RESOURCE RECOMMENDATION METHOD AND APPARATUS, RESOURCE RECOMMENDATION MODEL TRAINING METHOD AND APPARATUS, AND DEVICE

RELATED APPLICATION

[0001] This application claims priority to Chinese Patent Application No. 2024110976362, filed with the China National Intellectual Property Administration on August 9, 2024 and entitled "RESOURCE RECOMMENDATION METHOD, METHOD AND APPARATUS FOR TRAINING RESOURCE RECOMMENDATION MODEL, AND DEVICE", which is incorporated herein by reference in its entirety.

FIELD OF THE TECHNOLOGY

[0002] Embodiments of this disclosure relate to the technical field of computers, and in particular, to a resource recommendation method, a method and apparatus for training a resource recommendation model, and a device.

BACKGROUND OF THE DISCLOSURE

[0003] With the rapid development of computer technology, the application of artificial intelligence technology in the recommendation field is becoming increasingly widespread. For example, resources such as items, videos, or music may be recommended to a user. The user will provide feedback on the received resources, and feedback data may serve as a basis for recommendation by a recommendation system to the user.

[0004] In the related art, for a recommendation task in a given field, which resources in that field to recommend to the user is usually inferred according to feedback data generated by the user in the field. However, if the user generates a small amount of feedback data in this field, the volume of data available for resource recommendation is insufficient, leading to low accuracy of resource recommendation.

SUMMARY

[0005] Embodiments of this disclosure provide a resource recommendation method, a method and apparatus for training a resource recommendation model, and a device, to improve accuracy of resource recommendation. The technical solutions are described as follows:

[0006] According to one aspect, this disclosure provides a resource recommendation

method. The method includes:

[0007] acquiring object data of an object and resource data of a target resource, the target resource belonging to a target domain, and the target domain being any domain;

[0008] acquiring first source domain interaction data of the object and target domain interaction data of the object, the first source domain interaction data including a plurality of source domain interaction items, each source domain interaction item referring to an interaction item between the object and a resource in a source domain, the target domain interaction data including a plurality of target domain interaction items, each target domain interaction item referring to an interaction item between the object and a resource in the target domain, and the source domain and the target domain belonging to different domains;

[0009] determining, in the first source domain interaction data, at least one source domain interaction item associated with the target domain, to form second source domain interaction data; and

[0010] determining a recommendation prediction result of the target resource based on the object data, the resource data, the second source domain interaction data, and the target domain interaction data, the recommendation prediction result being configured to represent an interaction status between the object and the target resource in a case that the target resource is recommended to the object.

[0011] In some embodiments, the determining that the source domain interaction item is associated with the target domain if a similarity between an entity to which a resource in the source domain interaction item belongs and any target entity is greater than a similarity threshold includes:

[0012] acquiring a target entity feature of each target entity;

[0013] performing feature extraction on the entity to which the resource in the source domain interaction item belongs, to obtain a source domain entity feature; and

[0014] determining that the source domain interaction item is associated with the target domain if the similarity between the source domain entity feature and any target entity feature is greater than the similarity threshold.

[0015] In some embodiments, the feature extraction submodel further includes a second attention network, and the second attention network includes a second mapping matrix. The determining a source domain interaction feature based on a second fused interaction feature includes:

[0016] splitting the second fused interaction feature to obtain an intermediate source domain interaction feature;

[0017] multiplying, by the second attention network, the resource feature by the second mapping matrix, to obtain a second query feature, and multiplying the intermediate source domain interaction feature by the second mapping matrix, to obtain a second key feature and a second value feature; and

[0018] fusing, by the second attention network, the second query feature, the second key feature, and the second value feature, to obtain the source domain interaction feature.

[0019] In some embodiments, the feature extraction submodel further includes a third attention network, and the third attention network includes a third mapping matrix. The determining a target domain interaction feature based on the second fused interaction feature includes:

[0020] splitting the second fused interaction feature to obtain an intermediate target domain interaction feature;

[0021] multiplying, by the third attention network, the resource feature by the third mapping matrix, to obtain a third query feature, and multiplying the intermediate target domain interaction feature by the third mapping matrix, to obtain a third key feature and a third value feature; and

[0022] fusing, by the third attention network, the third query feature, the third key feature, and the third value feature, to obtain the target domain interaction feature.

[0023] In some embodiments, after the determining a recommendation prediction result of the target resource based on the object data, the resource data, the second source domain interaction data, and the target domain interaction data, the method further includes:

[0024] recommending the target resource to the object if the recommendation prediction result satisfies a recommendation condition.

[0025] According to another aspect, this disclosure provides a method for training a resource recommendation model. The method includes:

[0026] acquiring sample object data of a sample object, sample resource data of a sample resource, and a sample tag, the sample resource belonging to a target domain, the sample tag being configured to indicate a real interaction status between the sample object and the sample resource after the sample resource is recommended to the sample object, and the target domain being any domain;

[0027] acquiring first sample source domain interaction data of the sample object and

sample target domain interaction data of the sample object, the first sample source domain interaction data including a plurality of sample source domain interaction items, each sample source domain interaction item referring to an interaction item between the sample object and a resource in a source domain, the sample target domain interaction data including a plurality of sample target domain interaction items, each sample target domain interaction item referring to an interaction item between the sample object and a resource in the target domain, and the source domain and the target domain belonging to different domains;

[0028] determining, in the first sample source domain interaction data, at least one sample source domain interaction item associated with the target domain, to form second sample source domain interaction data;

[0029] determining, by the resource recommendation model, a recommendation prediction result of the sample resource based on the sample object data, the sample resource data, the second sample source domain interaction data, and the sample target domain interaction data, the recommendation prediction result being configured to represent a predicted interaction status between the sample object and the sample resource in a case that the sample resource is recommended to the sample object; and

[0030] training the resource recommendation model based on the recommendation prediction result and the sample tag.

[0031] In some embodiments, the feature extraction submodel includes a feature extraction network, a feature fusion network, and a first attention network, and the first attention network includes a first mapping matrix. The performing feature extraction on the second sample source domain interaction data and the sample target domain interaction data through the feature extraction submodel, to obtain a sample source domain interaction feature and a sample target domain interaction feature includes:

[0032] performing, by the feature extraction network, feature extraction on the second sample source domain interaction data to obtain an initial sample source domain interaction feature, and performing feature extraction on the sample target domain interaction data to obtain an initial sample target domain interaction feature;

[0033] fusing the initial sample source domain interaction feature and the initial sample target domain interaction feature through the feature fusion network, to obtain a first sample fused interaction feature;

[0034] multiplying the first sample fused interaction feature by the first mapping matrix

through the first attention network, to obtain a first sample query feature, a first sample key feature, and a first sample value feature, and fusing the first sample query feature, the first sample key feature, and the first sample value feature, to obtain a second sample fused interaction feature; and

[0035] determining the sample source domain interaction feature and the sample target domain interaction feature based on the second sample fused interaction feature.

[0036] In some embodiments, the feature extraction submodel further includes a second attention network, and the second attention network includes a second mapping matrix. The determining the sample source domain interaction feature and the sample target domain interaction feature based on the second sample fused interaction feature includes:

[0037] splitting the second sample fused interaction feature to obtain an intermediate sample source domain interaction feature;

[0038] multiplying, by the second attention network, the sample resource feature by the second mapping matrix, to obtain a second sample query feature, and multiplying the intermediate sample source domain interaction feature by the second mapping matrix, to obtain a second sample key feature and a second sample value feature; and

[0039] fusing, by the second attention network, the second sample query feature, the second sample key feature, and the second sample value feature, to obtain the sample source domain interaction feature.

[0040] In some embodiments, the feature extraction submodel further includes a third attention network, and the third attention network includes a third mapping matrix. The determining the sample source domain interaction feature and the sample target domain interaction feature based on the second sample fused interaction feature includes:

[0041] splitting the second sample fused interaction feature to obtain an intermediate sample target domain interaction feature;

[0042] multiplying, by the third attention network, the sample resource feature by the third mapping matrix, to obtain a third sample query feature, and multiplying the intermediate sample target domain interaction feature by the third mapping matrix, to obtain a third sample key feature and a third sample value feature; and

[0043] fusing, by the third attention network, the third sample query feature, the third sample key feature, and the third sample value feature, to obtain the sample target domain interaction feature.

[0044] In some embodiments, the determining, in the first sample source domain interaction data, at least one sample source domain interaction item associated with the target domain includes:

[0045] determining a plurality of target entities, each target entity referring to an entity to which the resource in the target domain belongs, and each entity referring to an object providing a resource; and

[0046] determining, for any sample source domain interaction item in the first sample source domain interaction data, that the sample source domain interaction item is associated with the target domain if an entity to which a resource in the sample source domain interaction item belongs is any target entity.

[0047] In some embodiments, the determining, in the first sample source domain interaction data, at least one sample source domain interaction item associated with the target domain includes:

[0048] determining a plurality of target entities, each target entity referring to an entity to which the resource in the target domain belongs, and each entity referring to an object providing a resource; and

[0049] determining, for any sample source domain interaction item in the first sample source domain interaction data, that the sample source domain interaction item is associated with the target domain if a similarity between the entity to which the resource in the sample source domain interaction item belongs and any target entity is greater than a similarity threshold.

[0050] In some embodiments, the determining that the sample source domain interaction item is associated with the target domain if a similarity between the entity to which the resource in the sample source domain interaction item belongs and any target entity is greater than a similarity threshold includes:

[0051] acquiring a target entity feature of each target entity;

[0052] performing feature extraction on the entity to which the resource in the sample source domain interaction item belongs, to obtain a sample source domain entity feature; and

[0053] determining that the sample source domain interaction item is associated with the target domain if the similarity between the sample source domain entity feature and any target entity feature is greater than the similarity threshold.

[0054] According to another aspect, this disclosure provides a resource recommendation apparatus. The apparatus includes:

[0055] a first acquiring module, configured to acquire object data of an object and resource

data of a target resource, the target resource belonging to a target domain, and the target domain being any domain;

[0056] a second acquiring module, configured to acquire first source domain interaction data of the object and target domain interaction data of the object, the first source domain interaction data including a plurality of source domain interaction items, each source domain interaction item referring to an interaction item between the object and a resource in a source domain, the target domain interaction data including a plurality of target domain interaction items, each target domain interaction item referring to an interaction item between the object and a resource in the target domain, and the source domain and the target domain belonging to different domains;

[0057] a screening module, configured to determine, in the first source domain interaction data, at least one source domain interaction item associated with the target domain, to form second source domain interaction data; and

[0058] a prediction module, configured to determine a recommendation prediction result of the target resource based on the object data, the resource data, the second source domain interaction data, and the target domain interaction data, the recommendation prediction result being configured to represent an interaction status between the object and the target resource in a case that the target resource is recommended to the object.

[0059] In some embodiments, the screening module is configured to:

[0060] determine a plurality of target entities, each target entity referring to an entity to which the resource in the target domain belongs, and each entity referring to an object providing a resource; and

[0061] determine, for any source domain interaction item in the first source domain interaction data, that the source domain interaction item is associated with the target domain if the entity to which the resource in the source domain interaction item belongs is any target entity.

[0062] In some embodiments, the screening module is configured to:

[0063] determine a plurality of target entities, each target entity referring to an entity to which the resource in the target domain belongs, and each entity referring to an object providing a resource; and

[0064] determine, for any source domain interaction item in the first source domain interaction data, that the source domain interaction item is associated with the target domain if the similarity between the entity to which the resource in the source domain interaction item belongs

and any target entity is greater than the similarity threshold.

[0065] In some embodiments, the screening module is configured to:

[0066] acquire a target entity feature of each target entity;

[0067] perform feature extraction on the entity to which the resource in the source domain interaction item belongs, to obtain a source domain entity feature; and

[0068] determine that the source domain interaction item is associated with the target domain if a similarity between the source domain entity feature and any target entity feature is greater than the similarity threshold.

[0069] In some embodiments, the prediction module is configured to:

[0070] perform feature extraction on the object data to obtain an object feature;

[0071] perform feature extraction on the resource data to obtain a resource feature;

[0072] perform feature extraction on the second source domain interaction data and the target domain interaction data, to obtain a source domain interaction feature and a target domain interaction feature; and

[0073] determine the recommendation prediction result of the target resource based on the object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature.

[0074] In some embodiments, the prediction module is configured to:

[0075] perform feature extraction on the second source domain interaction data to obtain an initial source domain interaction feature, and perform feature extraction on the target domain interaction data to obtain an initial target domain interaction feature;

[0076] fuse the initial source domain interaction feature and the initial target domain interaction feature, to obtain a first fused interaction feature;

[0077] multiply the first fused interaction feature by a first mapping matrix, to obtain a first query feature, a first key feature, and a first value feature;

[0078] fuse the first query feature, the first key feature, and the first value feature, to obtain a second fused interaction feature; and

[0079] determine the source domain interaction feature and the target domain interaction feature based on the second fused interaction feature.

[0080] In some embodiments, the prediction module is configured to:

[0081] split the second fused interaction feature to obtain an intermediate source domain interaction feature;

[0082] multiply the resource feature by a second mapping matrix, to obtain a second query feature;

[0083] multiply the intermediate source domain interaction feature by the second mapping matrix, to obtain a second key feature and a second value feature; and

[0084] fuse the second query feature, the second key feature, and the second value feature, to obtain the source domain interaction feature.

[0085] In some embodiments, the prediction module is configured to:

[0086] split the second fused interaction feature to obtain an intermediate target domain interaction feature;

[0087] multiply the resource feature by a third mapping matrix, to obtain a third query feature;

[0088] multiply the intermediate target domain interaction feature by the third mapping matrix, to obtain a third key feature and a third value feature; and

[0089] fuse the third query feature, the third key feature, and the third value feature, to obtain the target domain interaction feature.

[0090] In some embodiments, the resource recommendation model includes a feature extraction submodel and a recommendation prediction submodel, and the prediction module is configured to:

[0091] perform feature extraction on the object data through the feature extraction submodel, to obtain an object feature;

[0092] perform feature extraction on the resource data through the feature extraction submodel, to obtain a resource feature;

[0093] perform feature extraction on the second source domain interaction data and the target domain interaction data through the feature extraction submodel, to obtain a source domain interaction feature and a target domain interaction feature; and

[0094] determine, by the recommendation prediction submodel, the recommendation prediction result of the target resource based on the object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature.

[0095] In some embodiments, the feature extraction submodel includes a feature extraction network, a feature fusion network, and a first attention network, and the first attention network includes the first mapping matrix. The prediction module is configured to:

[0096] perform, by the feature extraction network, feature extraction on the second source domain interaction data, to obtain the initial source domain interaction feature, and perform feature extraction on the target domain interaction data, to obtain the initial target domain interaction feature;

[0097] fuse the initial source domain interaction feature and the initial target domain interaction feature through the feature fusion network, to obtain the first fused interaction feature;

[0098] multiply the first fused interaction feature by the first mapping matrix through the first attention network, to obtain the first query feature, the first key feature, and the first value feature, and fuse the first query feature, the first key feature, and the first value feature, to obtain the second fused interaction feature; and

[0099] determine the source domain interaction feature and the target domain interaction feature based on the second fused interaction feature.

[00100] In some embodiments, the feature extraction submodel further includes a second attention network, and the second attention network includes the second mapping matrix. The prediction module is configured to:

[00101] split the second fused interaction feature to obtain the intermediate source domain interaction feature;

[00102] multiply, by the second attention network, the resource feature by the second mapping matrix, to obtain the second query feature, and multiply the intermediate source domain interaction feature by the second mapping matrix, to obtain the second key feature and the second value feature; and

[00103] fuse, by the second attention network, the second query feature, the second key feature, and the second value feature, to obtain the source domain interaction feature.

[00104] In some embodiments, the feature extraction submodel further includes a third attention network, and the third attention network includes the third mapping matrix. The prediction module is configured to:

[00105] split the second fused interaction feature to obtain the intermediate target domain interaction feature;

[00106] multiply, by the third attention network, the resource feature by the third mapping matrix, to obtain the third query feature, and multiply the intermediate target domain interaction feature by the third mapping matrix, to obtain the third key feature and the third value feature; and

[00107] fuse, by the third attention network, the third query feature, the third key feature, and the third value feature, to obtain the target domain interaction feature.

[00108] In some embodiments, the apparatus further includes:

[00109] a recommendation module, configured to recommend the target resource to the object if the recommendation prediction result satisfies a recommendation condition.

[00110] According to another aspect, this disclosure provides a resource recommendation apparatus. The apparatus includes:

[00111] a first acquiring module, configured to acquire sample object data of a sample object, sample resource data of a sample resource, and a sample tag, the sample resource belonging to a target domain, the sample tag being configured to indicate a real interaction status between the sample object and the sample resource after the sample resource is recommended to the sample object, and the target domain being any domain;

[00112] a second acquiring module, configured to acquire first sample source domain interaction data of the sample object and sample target domain interaction data of the sample object, the first sample source domain interaction data including a plurality of sample source domain interaction items, each sample source domain interaction item referring to an interaction item between the sample object and a resource in a source domain, the sample target domain interaction data including a plurality of sample target domain interaction items, each sample target domain interaction item referring to an interaction item between the sample object and a resource in the target domain, and the source domain and the target domain belonging to different domains;

[00113] a screening module, configured to determine, in the first sample source domain interaction data, at least one sample source domain interaction item associated with the target domain, to form second sample source domain interaction data;

[00114] a prediction module, configured to determine, by a resource recommendation model, a recommendation prediction result of the sample resource based on the sample object data, the sample resource data, the second sample source domain interaction data, and the sample target domain interaction data, the recommendation prediction result being configured to represent a predicted interaction status between the sample object and the sample resource in a case that the sample resource is recommended to the sample object; and

[00115] a training module, configured to train the resource recommendation model based on the recommendation prediction result and the sample tag.

[00116] In some embodiments, the resource recommendation model includes a feature extraction submodel and a recommendation prediction submodel. The prediction module is configured to:

[00117] perform feature extraction on the sample object data through the feature extraction submodel, to obtain a sample object feature;

[00118] perform feature extraction on the sample resource data through the feature extraction submodel, to obtain a sample resource feature;

[00119] perform feature extraction on the second sample source domain interaction data and the sample target domain interaction data through the feature extraction submodel, to obtain a sample source domain interaction feature and a sample target domain interaction feature; and

[00120] determine, by the recommendation prediction submodel, the recommendation prediction result based on the sample object feature, the sample resource feature, the sample source domain interaction feature, and the sample target domain interaction feature.

[00121] In some embodiments, the sample source domain interaction item includes a source domain resource and an interaction time point of the source domain resource, the sample target domain interaction item includes a target domain resource and an interaction time point of the target domain resource, the sample source domain interaction feature includes a source domain resource feature of a source domain resource in each sample source domain interaction item, and the sample target domain interaction feature includes a target domain resource feature of a target domain resource in each sample target domain interaction item. The apparatus further includes:

[00122] a first determination module, configured to determine, for any source domain resource in the second sample source domain interaction data, a first target domain resource in the sample target domain interaction data, and determine a source domain resource feature of the source domain resource and a target domain resource feature of the first target domain resource as a first positive sample pair, an interaction time point of the first target domain resource being the closest to the interaction time point of the source domain resource; and determine a similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair.

[00123] The training module is configured to:

[00124] train the resource recommendation model based on the recommendation prediction

result, the sample tag, and the similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair.

[00125] In some embodiments, the apparatus further includes:

[00126] a second determination module, configured to determine, for any source domain resource in the second sample source domain interaction data, a second target domain resource in sample target domain interaction data of any object except the sample object, and determine a source domain resource feature of the source domain resource and a target domain resource feature of the second target domain resource as a first negative sample pair, the second target domain resource being any target domain resource in the sample target domain interaction data of any object; and determine a similarity between the source domain resource feature and the target domain resource feature in the first negative sample pair.

[00127] The training module is configured to:

[00128] train the resource recommendation model based on the recommendation prediction result, the sample tag, the similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair, and the similarity between the source domain resource feature and the target domain resource feature in the first negative sample pair.

[00129] In some embodiments, the sample source domain interaction item includes a source domain resource and an entity to which the source domain resource belongs, the sample target domain interaction item includes a target domain resource and an entity to which the target domain resource belongs, the sample source domain interaction feature includes a source domain resource feature of a source domain resource in each sample source domain interaction item, and the sample target domain interaction feature includes a target domain resource feature of a target domain resource in each sample target domain interaction item. The apparatus further includes:

[00130] a third determination module, configured to determine, for any source domain resource in the second sample source domain interaction data, a third target domain resource in the sample target domain interaction data, and determine a source domain resource feature of the source domain resource and a target domain resource feature of the third target domain resource as a second positive sample pair, an entity to which the third target domain resource belongs being the same as an entity to which the source domain resource belongs; and determine a similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair.

[00131] The training module is configured to:

[00132] train the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair.

[00133] In some embodiments, the apparatus further includes:

[00134] a fourth determination module, configured to determine, for any source domain resource in the second sample source domain interaction data, a fourth target domain resource, and determine a source domain resource feature of the source domain resource and a target domain resource feature of the fourth target domain resource as a second negative sample pair, the fourth target domain resource referring to any target domain resource belonging to an entity different from that of the source domain resource; and determine a similarity between the source domain resource feature and the target domain resource feature in the second negative sample pair.

[00135] The training module is configured to:

[00136] train the resource recommendation model based on the recommendation prediction result, the sample tag, the similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair, and the similarity between the source domain resource feature and the target domain resource feature in the second negative sample pair.

[00137] In some embodiments, the feature extraction submodel includes a feature extraction network, a feature fusion network, and a first attention network, and the first attention network includes a first mapping matrix. The prediction module is configured to:

[00138] perform, by the feature extraction network, feature extraction on the second sample source domain interaction data to obtain an initial sample source domain interaction feature, and perform feature extraction on the sample target domain interaction data to obtain an initial sample target domain interaction feature;

[00139] fuse the initial sample source domain interaction feature and the initial sample target domain interaction feature through the feature fusion network, to obtain a first sample fused interaction feature;

[00140] multiply the first sample fused interaction feature by the first mapping matrix through the first attention network, to obtain a first sample query feature, a first sample key feature, and a first sample value feature, and fuse the first sample query feature, the first sample key feature, and the first sample value feature, to obtain a second sample fused interaction feature; and

[00141] determine the sample source domain interaction feature and the sample target domain interaction feature based on the second sample fused interaction feature.

[00142] In some embodiments, the feature extraction submodel further includes a second attention network, and the second attention network includes a second mapping matrix. The prediction module is configured to:

[00143] split the second sample fused interaction feature to obtain an intermediate sample source domain interaction feature;

[00144] multiply, by the second attention network, the sample resource feature by the second mapping matrix, to obtain a second sample query feature, and multiply the intermediate sample source domain interaction feature by the second mapping matrix, to obtain a second sample key feature and a second sample value feature; and

[00145] fuse, by the second attention network, the second sample query feature, the second sample key feature, and the second sample value feature, to obtain the sample source domain interaction feature.

[00146] In some embodiments, the feature extraction submodel further includes a third attention network, and the third attention network includes a third mapping matrix. The prediction module is configured to:

[00147] split the second sample fused interaction feature to obtain an intermediate sample target domain interaction feature;

[00148] multiply, by the third attention network, the sample resource feature by the third mapping matrix, to obtain a third sample query feature, and multiply the intermediate sample target domain interaction feature by the third mapping matrix, to obtain a third sample key feature and a third sample value feature; and

[00149] fuse, by the third attention network, the third sample query feature, the third sample key feature, and the third sample value feature, to obtain the sample target domain interaction feature.

[00150] In some embodiments, the screening module is configured to:

[00151] determine a plurality of target entities, each target entity referring to an entity to which the resource in the target domain belongs, and each entity referring to an object providing a resource; and

[00152] determine, for any sample source domain interaction item in the first sample source domain interaction data, that the sample source domain interaction item is associated with the target domain if an entity to which a resource in the sample source domain interaction item belongs is any

target entity.

[00153] In some embodiments, the screening module is configured to:

[00154] determine a plurality of target entities, each target entity referring to an entity to which the resource in the target domain belongs, and each entity referring to an object providing a resource; and

[00155] determine, for any sample source domain interaction item in the first sample source domain interaction data, that the sample source domain interaction item is associated with the target domain if a similarity between the entity to which the resource in the sample source domain interaction item belongs and any target entity is greater than a similarity threshold.

[00156] In some embodiments, the screening module is configured to:

[00157] acquire a target entity feature of each target entity;

[00158] perform feature extraction on the entity to which the resource in the sample source domain interaction item belongs, to obtain a sample source domain entity feature; and

[00159] determine that the sample source domain interaction item is associated with the target domain if the similarity between the sample source domain entity feature and any target entity feature is greater than the similarity threshold.

[00160] According to another aspect, this disclosure provides a computer device. The computer device includes a processor and a memory, the memory has at least one computer program stored therein, and the at least one computer program is loaded and executed by the processor to implement the operations performed in the resource recommendation method described in the foregoing aspect, or implement the operations performed in the method for training a resource recommendation model described in the foregoing aspect.

[00161] According to another aspect, this disclosure provides a computer-readable storage medium. The computer-readable storage medium has at least one computer program stored therein, and the at least one computer program is loaded and executed by a processor, to implement the operations performed in the resource recommendation method described in the foregoing aspect, or implement the operations performed in the method for training a resource recommendation model described in the foregoing aspect.

[00162] According to another aspect, this disclosure provides a computer program product, including a computer program, and the computer program is loaded and executed by a processor, to implement the operations performed in the resource recommendation method described in the

foregoing aspect, or implement the operations performed in the method for training a resource recommendation model described in the foregoing aspect.

[00163] In the solutions according to the embodiments of this disclosure, during the determination of whether to recommend the target resource in the target domain to the object, reference needs to be made to a historical interaction status between the object and other resources, to infer an interaction tendency of the object for the target resource. Therefore, the target domain interaction data of the object in the target domain is acquired. Considering a case that a data volume of the target domain interaction data may be insufficient, the source domain interaction data of the object in the source domain is additionally acquired, a part associated with the target domain is screened out from the source domain interaction data, and then the target domain interaction data and the screened-out source domain interaction data are used as a reference to predict the interaction status between the object and the target resource if the target resource is recommended to the object. On the one hand, because the source domain interaction data is introduced, a defect of insufficient target domain interaction data may be compensated for, and the impact caused by sparsity of the target domain interaction data is relieved. On the other hand, because only the source domain interaction data associated with the target domain is considered, and the source domain interaction data unrelated to the target domain is discarded, interference with the prediction result caused by the source domain interaction data unrelated to the target domain may be reduced, thereby improving the overall accuracy of resource recommendation.

BRIEF DESCRIPTION OF THE DRAWINGS

[00164] To describe technical solutions of embodiments of this disclosure more clearly, the following briefly introduces the accompanying drawings required for describing the embodiments. Apparently, the accompanying drawings in the following descriptions show only some of embodiments of this disclosure, and a person of ordinary skill in the art may further derive other accompanying drawings from these accompanying drawings without creative efforts.

[00165] FIG. 1 is a schematic diagram of an implementation environment according to an embodiment of this disclosure.

[00166] FIG. 2 is a flowchart of a resource recommendation method according to an embodiment of this disclosure.

[00167] FIG. 3 is a flowchart of another resource recommendation method according to an embodiment of this disclosure.

[00168] FIG. 4 is a comparison chart of data volumes according to an embodiment of this

disclosure.

[00169] FIG. 5 is a schematic diagram of a resource recommendation method according to an embodiment of this disclosure.

[00170] FIG. 6 is a flowchart of another resource recommendation method according to an embodiment of this disclosure.

[00171] FIG. 7 is a flowchart of a method for training a resource recommendation model according to an embodiment of this disclosure.

[00172] FIG. 8 is a flowchart of another method for training a resource recommendation model according to an embodiment of this disclosure.

[00173] FIG. 9 is a schematic diagram of a method for training a resource recommendation model according to an embodiment of this disclosure.

[00174] FIG. 10 is an overall architecture diagram of a resource recommendation method according to an embodiment of this disclosure.

[00175] FIG. 11 is a flowchart of another resource recommendation method according to an embodiment of this disclosure.

[00176] FIG. 12 is a schematic diagram of a service interface according to an embodiment of this disclosure.

[00177] FIG. 13 is a schematic diagram of a recharging interface according to an embodiment of this disclosure.

[00178] FIG. 14 is a schematic diagram of another service interface according to an embodiment of this disclosure.

[00179] FIG. 15 is a schematic structural diagram of a resource recommendation apparatus according to an embodiment of this disclosure.

[00180] FIG. 16 is a schematic structural diagram of another resource recommendation apparatus according to an embodiment of this disclosure.

[00181] FIG. 17 is a schematic structural diagram of an apparatus for training a resource recommendation model according to an embodiment of this disclosure.

[00182] FIG. 18 is a schematic structural diagram of another apparatus for training a resource recommendation model according to an embodiment of this disclosure.

[00183] FIG. 19 is a schematic structural diagram of a terminal according to an embodiment

of this disclosure.

[00184] FIG. 20 is a schematic structural diagram of a server according to an embodiment of this disclosure.

DESCRIPTION OF EMBODIMENTS

[00185] To make objectives, technical solutions, and advantages of embodiments of this disclosure clearer, the following further describes in detail implementations of this disclosure with reference to the accompanying drawings.

[00186] The terms "first", "second", and the like used in this disclosure may be used herein to describe various concepts. However, the concepts are not limited by the terms unless otherwise specified. These terms are merely used to distinguish one concept from another. For example, without departing from the scope of this disclosure, first source domain interaction data may be referred to as second source domain interaction data, and similarly, the second source domain interaction data may be referred to as the first source domain interaction data.

[00187] "At least one" refers to one or more. For example, at least one source domain interaction item may be any integer number of source domain interaction items that is greater than or equal to one, such as one source domain interaction item, two source domain interaction items, or three source domain interaction items. "A plurality of" refers to two or more. For example, a plurality of source domain interaction items may be any integer number of source domain interaction items that is greater than or equal to two, such as two source domain interaction items, or three source domain interaction items. "Each" refers to each of at least one. For example, each source domain interaction item refers to each of the plurality of source domain interaction items. If the plurality of source domain interaction items are three source domain interaction items, each source domain interaction item refers to each of the three source domain interaction items.

[00188] Information (including but not limited to user equipment information, personal information of a user, and the like), data (including but not limited to data configured for analysis, stored data, displayed data, and the like), and signals (including but not limited to signals transmitted between a user terminal and another device, and the like) involved in this disclosure are used under full authorization by the user or relevant parties, and collection, use, and processing of relevant data need to conform to related laws, regulations, and standards of related countries and regions.

[00189] For example, object data, resource data, source domain interaction data, target domain interaction data, and the like involved in this disclosure are all fully authorized by the user

or relevant parties, and collection, use, and processing of the relevant data need to conform to related laws, regulations, and standards of related countries and regions.

[00190] A resource recommendation method provided in the embodiments of this disclosure can be used in a computer device. In some embodiments, the computer device may be a terminal or a server. In some embodiments, the server is an independent physical server, a server cluster or a distributed system composed of a plurality of physical servers, or a cloud server that provides basic cloud computing services such as a cloud service, a cloud database, cloud computing, a cloud function, cloud storage, a network service, cloud communication, a middleware service, a domain name service, a security service, a content delivery network (CDN), a big data platform, and an artificial intelligence platform. In some embodiments, the terminal may be a smart phone, a tablet computer, a notebook computer, a desktop computer, a smart speaker, a smartwatch, a smart voice interaction device, a smart household appliance, an on-board terminal, an aerial vehicle, and the like, but is not limited thereto. The embodiments of this disclosure may be applied to various scenarios, including but not limited to, cloud technology, artificial intelligence, intelligent transportation, assisted driving, and the like.

[00191] In a possible implementation, computer programs as referred to in the embodiments of this disclosure may be deployed on one computer device for execution, or may be executed on a plurality of computer devices at one location, or may be executed on a plurality of computer devices distributed at a plurality of locations and connected by a communication network. The plurality of computer devices distributed at the plurality of locations and connected by the communication network can form a blockchain system.

[00192] In a possible implementation, the computer device in the embodiments of this disclosure is a node in the blockchain system. The node can store the object data, the resource data, the source domain interaction data, the target domain interaction data, and the like in a blockchain. Then, the node or a node corresponding to another device in the blockchain may query, by accessing the blockchain, data stored in the blockchain.

[00193] FIG. 1 is a schematic diagram of an implementation environment according to an embodiment of this disclosure. Referring to FIG. 1, the implementation environment includes a terminal 101 and a server 102. The terminal 101 and the server 102 are connected to each other by a wireless or wired network.

[00194] A client 111 is installed and runs on the terminal 101. The client 111 may be of a type such as a social application client, an online payment client, an online shopping client, a game client, a medical service client, or a video client. When the client 111 runs on the terminal 101, a

user interface of the client 111 is displayed on a screen of the terminal 101. The terminal 101 is a terminal used by a user 121.

[00195] In some embodiments, the terminal 101 may generally refer to one of a plurality of terminals, and the terminal 101 includes a smartphone, a tablet computer, a notebook computer, a desktop computer, a smart voice interaction device, a smart home appliance, an on-board terminal, an aerial vehicle, a virtual reality (VR) apparatus, an augmented reality (AR) apparatus, or the like, but is not limited thereto.

[00196] A person skilled in the art may understand that the number of the foregoing terminals may be more or fewer. For example, only one terminal may exist, or six, eight, or even more terminals may exist. The embodiments of this disclosure do not limit the number and device type of the terminals.

[00197] FIG. 1 shows only one terminal, but a plurality of other terminals 103 may access the server 102 in different embodiments. In some embodiments, one or more terminals 103 are terminals corresponding to a developer. A development and editing platform for the client is installed on the terminal 103. The developer may edit and update the client on the terminal 103 and transmit an updated client installation package to the server 102 through a wired network or a wireless network. The terminal 101 may download the client installation package from the server 102 to update the client.

[00198] The terminal 101 and the other terminals 103 are connected to the server 102 through the wired network or the wireless network.

[00199] The server 102 includes at least one of a server, a plurality of servers, a cloud computing platform, or a virtualization center. The server 102 is configured to provide a back-end service for the client. In some embodiments, the server 102 performs primary computing work, and the terminal 101 performs secondary computing work. Alternatively, the server 102 performs secondary computing work, and the terminal 101 performs primary computing work. Alternatively, a distributed computing architecture is used between the server 102 and the terminal 101 for collaborative computing.

[00200] In the embodiments of this disclosure, the terminal 101 sends a recommendation task for an object to the server 102. After receiving the recommendation task, the server 102 acquires object data of the object and resource data of a to-be-recommended target resource, and acquires source domain interaction data and target domain interaction data of the object. The target resource belongs to a resource of a target domain. The server 102 determines a recommendation prediction

result according to the object data of the object, the resource data of the target resource, the source domain interaction data, and the target domain interaction data. If the recommendation prediction result indicates a high possibility that the object interacts with the target resource if the target resource is recommended to the object, the server 102 returns the target resource to the terminal 101. The terminal 101 receives the target resource, and recommends the target resource to the object.

[00201] The foregoing implementation environment is merely an example. The method according to this embodiment of this disclosure may alternatively be independently performed by the terminal 101 or the server 102, or performed by another computer device, which is not limited in this embodiment of this disclosure.

[00202] FIG. 2 is a flowchart of a resource recommendation method according to an embodiment of this disclosure. This embodiment of this disclosure is performed by a computer device. The computer device is a device such as the terminal 101 or the server 102 shown in FIG. 1. Referring to FIG. 2, the method includes:

[00203] 201: The computer device acquires object data of an object and resource data of a target resource, the target resource belonging to a target domain.

[00204] The computer device acquires the object data of the object. The object is an object to which a resource is to be recommended. For example, the object may be an account or the like. The object data includes a nickname of the object, an age of the object, a label of the object, preference information of the object, and the like.

[00205] The computer device acquires the target resource, and the target resource is a resource to be recommended to the object. In this embodiment of this disclosure, the resource may include a virtual resource, an item resource, an image resource, a video resource, an image and text resource, or the like. For example, the virtual resource may be an exchange coupon or the like configured to exchange for an item.

[00206] In this embodiment of this disclosure, the target resource belongs to the target domain, and the target domain may be any domain. For example, the target domain may be an advertisement placement domain, a video recommendation domain, an item recommendation domain, or the like, which is not limited in this embodiment of this disclosure.

[00207] 202: The computer device acquires first source domain interaction data of the object and target domain interaction data of the object, the first source domain interaction data including a plurality of source domain interaction items, each source domain interaction

item referring to an interaction item between the object and a resource in a source domain, **the target domain interaction data including a plurality of target domain interaction items, each target domain interaction item referring to an interaction item between the object and a resource in the target domain, and the source domain and the target domain belonging to different domains.**

[00208] In this embodiment of this disclosure, the source domain may be any domain different from the target domain. For example, the source domain may be a shopping domain, a video playback domain, or the like.

[00209] The computer device acquires the first source domain interaction data of the object, and the first source domain interaction data is acquired according to a historical interaction status between the object and at least one resource in the source domain. The first source domain interaction data includes a plurality of source domain interaction items. One source domain interaction item refers to an item that the object interacts with the resource in the source domain once. That is, the source domain interaction item records the resource in the source domain with which the object has previously interacted.

[00210] The computer device acquires the target domain interaction data of the object, and the target domain interaction data is acquired according to a historical interaction status between the object and at least one resource in the target domain. The target domain interaction data includes the plurality of target domain interaction items, and one target domain interaction item refers to an item that the object interacts with the resource in the target domain once. That is, the target domain interaction item records the resource in the target domain with which the object has previously interacted.

[00211] In some embodiments, there are a plurality of methods in which the object interacts with the resource. For example, the resource is an item, and an interaction between the object and the resource means that the object purchases the item. For another example, the resource is a virtual resource (an exchange coupon or the like), and an interaction between the object and the resource means that the object collects the virtual resource. For another example, the resource is a video, and an interaction between the object and the resource means that the object plays the video. For another example, the resource is an e-book, and an interaction between the object and the resource means that the object reads the e-book.

[00212] **203: The computer device determines, in the first source domain interaction data, at least one source domain interaction item associated with the target domain to form second source domain interaction data.**

[00213] The first source domain interaction data includes the plurality of source domain interaction items. Some source domain interaction items are associated with the target domain, and some source domain interaction items are unrelated to the target domain. In this embodiment of this disclosure, whether to recommend the target resource in the target domain to the object needs to be predicted with reference to the source domain interaction items. If the referenced source domain interaction items are unrelated to the target domain, a prediction result may be interfered with, and a processing load is also increased.

[00214] Therefore, after the first source domain interaction data is determined, at least one source domain interaction item associated with the target domain is screened out, to form the second source domain interaction data. Subsequently, whether to recommend the target resource in the target domain to the object is predicted through the second source domain interaction data associated with the target domain.

[00215] 204: The computer device determines a recommendation prediction result of the target resource based on the object data, the resource data, the second source domain interaction data, and the target domain interaction data, the recommendation prediction result being configured to represent an interaction status between the object and the target resource in a case that the target resource is recommended to the object.

[00216] Because the object data can reflect characteristics of the object, the resource data can reflect characteristics of the target resource, the second source domain interaction data can reflect an interest tendency of the object for the resource in the source domain, and the target domain interaction data can reflect an interest tendency of the object for the resource in the target domain, the interest tendency of the object for the target resource can be inferred through the object data, the resource data, the second source domain interaction data, and the target domain interaction data, to further determine the recommendation prediction result of the target resource. The recommendation prediction result is configured to represent an interaction tendency of the object for the target resource, that is, a possibility that the object interacts with the target resource if the target resource is recommended to the object. If the possibility that the object interacts with the target resource is high, the target resource may be recommended to the object subsequently. If the possibility that the object interacts with the target resource is low, the target resource may not be recommended to the object subsequently.

[00217] In the method according to this embodiment of this disclosure, during the determination of whether to recommend the target resource in the target domain to the object, reference needs to be made to a historical interaction status between the object and other resources,

to infer the interaction tendency of the object for the target resource. Therefore, the target domain interaction data of the object in the target domain is acquired. Considering a case that a data volume of the target domain interaction data may be insufficient, the source domain interaction data of the object in the source domain is additionally acquired, a part associated with the target domain is screened out from the source domain interaction data, and then the target domain interaction data and the screened-out source domain interaction data are used as a reference to predict the interaction status between the object and the target resource if the target resource is recommended to the object. On the one hand, because the source domain interaction data is introduced, a defect of insufficient target domain interaction data may be compensated for, and the impact caused by sparsity of the target domain interaction data is relieved. On the other hand, because only the source domain interaction data associated with the target domain is considered, and the source domain interaction data unrelated to the target domain is discarded, interference with the prediction result caused by the source domain interaction data unrelated to the target domain may be reduced, thereby improving the overall accuracy of resource recommendation.

[00218] Based on the foregoing embodiments, FIG. 3 is a flowchart of another resource recommendation method according to an embodiment of this disclosure. This embodiment of this disclosure is performed by a computer device. The computer device is a device such as the terminal 101 or the server 102 shown in FIG. 1. Referring to FIG. 3, the method includes:

[00219] **301: The computer device acquires object data of an object and resource data of a target resource, the target resource belonging to a target domain.**

[00220] In a possible implementation, the computer device acquires registration data of the object, data of resources with which the object has previously interacted, and the like, as the object data of the object. The registration data refers to data provided when registering the object and may include an object nickname, an object age, and the like.

[00221] In a possible implementation, the computer device acquires data such as a resource name, a resource type, and an entity to which the resource belongs of the target resource, as the resource data of the target resource.

[00222] **302: The computer device acquires first source domain interaction data of the object and target domain interaction data of the object, the first source domain interaction data including a plurality of source domain interaction items, each source domain interaction item referring to an interaction item between the object and a resource in a source domain, the target domain interaction data including a plurality of target domain interaction items, each target domain interaction item referring to an interaction item between the object and a**

resource in the target domain, and the source domain and the target domain belonging to different domains.

[00223] In a possible implementation, the computer device acquires a plurality of source domain interaction items that occurred for the object within a preset duration before a current time point and uses the plurality of source domain interaction items within the preset duration as the first source domain interaction data.

[00224] In some embodiments, the preset duration is preconfigured, such as 6 months or 3 months.

[00225] In some embodiments, each source domain interaction item includes a source domain resource with which the object interacts, an entity to which the source domain resource belongs, and an interaction time point. The entity to which the source domain resource belongs refers to an object providing the source domain resource. For example, the entity may be a company, a manufacturer, or the like.

[00226] Exemplarily, in a case that the source domain is a shopping scenario, the source domain resource is a purchased item, the source domain interaction item is a shopping item, the computer device is associated with a target client, the target client provides a payment function, and the computer device stores a payment bill generated by a payment operation performed by the object in the target client. The computer device acquires a plurality of payment bills of the object that are generated within a preset duration before a current time point. For each payment bill, the computer device generates one source domain interaction item based on the payment bill. The source domain interaction item includes an item purchased in the payment bill, an entity to which the item belongs, and a payment time point. The purchased item is the foregoing source domain resource, and the payment time point is the foregoing interaction time point.

[00227] In a possible implementation, the computer device acquires a plurality of target domain interaction items that occurred for the object within a preset duration before a current time point and uses the plurality of target domain interaction items within the preset duration as first target domain interaction data.

[00228] In some embodiments, each target domain interaction item includes a target domain resource with which the object interacts, an entity to which the target domain resource belongs, and an interaction time point. The entity to which the target domain resource belongs refers to an object providing the target domain resource. For example, the entity may be a company, a manufacturer, or the like.

[00229] Exemplarily, in a case that the target domain is an advertisement placement scenario, the target domain resource is a virtual resource included in a placed advertisement, and the virtual resource is configured for exchanging an item in the source domain. The target domain interaction item refers to a virtual resource collection item. The computer device is associated with a target client. The target client provides an advertisement placement function, and the advertisement including the virtual resource may be placed in the target client. The computer device stores a collection record generated by a virtual resource collection operation performed by the object in the target client. The computer device acquires a plurality of collection records of the object that are generated within a preset duration before the current time point. For each collection record, the computer device generates one target domain interaction item based on the collection record. The target domain interaction item includes a virtual resource collected in the collection record, an entity to which the virtual resource belongs, and a collection time point. The collected virtual resource is the foregoing target domain resource, and the collection time point is the foregoing interaction time point.

[00230] **303: The computer device determines, in the first source domain interaction data, at least one source domain interaction item associated with the target domain to form second source domain interaction data.**

[00231] The computer device stores interaction data of a plurality of objects. Each object corresponds to a source domain interaction item and a target domain interaction item, where a data volume of the source domain interaction item of each object is huge. As shown in FIG. 4, statistics on the total quantity of the source domain interaction items and the target domain interaction items of the plurality of objects show that a maximum total quantity of the source domain interaction items reaches approximately 5000, a median total quantity of the source domain interaction items reaches approximately 1000, and a maximum total quantity of the target domain interaction items is far less than 1000.

[00232] Therefore, the quantity of the plurality of source domain interaction items in the first source domain interaction data acquired by the computer device is also large. However, among the plurality of source domain interaction items, some source domain interaction items are associated with the target domain, while some source domain interaction items are unrelated to the target domain. In this embodiment of this disclosure, whether to recommend the target resource in the target domain to the object needs to be predicted with reference to the source domain interaction items. If the referenced source domain interaction items are unrelated to the target domain, a prediction result may be interfered with, and due to a large data volume, a processing load may also

be increased.

[00233] Based on this, in this embodiment of this disclosure, after the first source domain interaction data is determined, the at least one source domain interaction item associated with the target domain is screened out from the first source domain interaction data, to form the second source domain interaction data, thereby ensuring that all the source domain interaction items in the second source domain interaction data are related to the target domain. Subsequently, whether to recommend the target resource in the target domain to the object is predicted through the second source domain interaction data. On the one hand, it can be ensured that the referenced source domain interaction data is strongly correlated to the target domain, and on the other hand, the data volume that needs to be processed can be effectively reduced, thereby reducing the processing load.

[00234] In a possible implementation, the computer device determines a plurality of target entities, each target entity refers to an entity to which the resource in the target domain belongs, and each entity refers to an object providing a resource. For any source domain interaction item in the first source domain interaction data, if the entity to which the resource in the source domain interaction item belongs is any target entity, it is determined that the source domain interaction item is associated with the target domain.

[00235] Each resource in the target domain belongs to a specific entity, and the entities to which the resources in the target domain belong are determined as target entities. Each resource in the source domain belongs to a specific entity. For any source domain interaction item, if an entity to which a resource for interaction in the source domain interaction item belongs is the same as any target entity, the source domain interaction item is associated with the target domain.

[00236] In this embodiment of this disclosure, considering that the user may have similar interaction tendencies for different resources provided by the same entity, if the entity to which the resource in the source domain interaction item belongs is the same as the entity to which the resource in the target domain belongs, the source domain interaction item is associated with the target domain, and the source domain interaction item may be used as a reference to predict an interaction tendency of the user for resources provided by the same entity in the target domain, thereby helping ensure the accuracy of cross-domain mining of user interests, and further improving the accuracy of resource recommendation.

[00237] In addition, the same entity is used as a condition to search for the source domain interaction item associated with the target domain, thereby ensuring that the found source domain interaction item has a strong correlation with the target domain, and facilitating the improvement in the accuracy of searching for the source domain interaction item associated with the target domain.

[00238] In another possible implementation, the computer device determines a plurality of target entities, each target entity refers to an entity to which the resource in the target domain belongs, and each entity refers to an object providing a resource. For any source domain interaction item in the first source domain interaction data, if a similarity between the entity to which the resource in the source domain interaction item belongs and any target entity is greater than a similarity threshold, it is determined that the source domain interaction item is associated with the target domain.

[00239] For any source domain interaction item, if a similarity between an entity to which a source domain resource for interaction in the source domain interaction item belongs and any target entity is greater than the similarity threshold, the source domain interaction item is associated with the target domain.

[00240] In some embodiments, the computer device may determine the similarity between the entity to which the resource in the source domain interaction item belongs and any target entity through a large language model.

[00241] In some embodiments, the computer device acquires a target entity feature of each target entity; feature extraction is performed on the entity to which the resource in the source domain interaction item belongs, to obtain a source domain entity feature; and if a similarity between the source domain entity feature and any target entity feature is greater than the similarity threshold, it is determined that the source domain interaction item is associated with the target domain.

[00242] Exemplarily, the computer device acquires an entity name of the target entity, and inputs the entity name of the target entity into a text semantic extraction model, to obtain the target entity feature outputted by the text semantic extraction model. The computer device acquires a name of an entity to which the source domain resource belongs, and inputs the name of the entity to which the source domain resource belongs into the text semantic extraction model, to obtain the source domain entity feature outputted by the text semantic extraction model.

[00243] The text semantic extraction model is configured to extract semantic features. The text semantic extraction model may be a deep learning model, a machine learning model, a large language model, or the like. For example, the text semantic extraction model may be a BAAI general embedding (BGE) model.

[00244] Exemplarily, the computer device determines a similarity between the source domain entity feature and each target entity feature, and acquires a maximum similarity among the plurality

of determined similarities, and if the maximum similarity is greater than the similarity threshold, it is determined that the source domain interaction item is associated with the target domain.

[00245] The similarity may be a cosine similarity, or the like. The similarity threshold may be a preset threshold. For example, the similarity threshold may be equal to 0.8, 0.85, or the like.

[00246] In this embodiment of this disclosure, considering that the user may have similar interaction tendencies for different resources provided by similar entities, if the entity to which the resource in the source domain interaction item belongs is similar to the entity to which the resource in the target domain belongs, the source domain interaction item is associated with the target domain, and the source domain interaction item may be used as a reference to predict an interaction tendency of the user for resources provided by the similar entities in the target domain, thereby helping ensure the accuracy of cross-domain mining of user interests, and further improving the accuracy of resource recommendation.

[00247] In addition, using the similar entities as a condition to search for the source domain interaction item associated with the target domain can cover more source domain interaction items related to the target domain, thereby helping ensure a data volume of the found source domain interaction item, and avoiding problems of sparse data and insufficient mining.

[00248] In addition, determining the similarity between the entities according to the similarity between the features of the entities helps ensure the accuracy of the determined similarity, and further ensure the accuracy of the found source domain interaction item associated with the target domain.

[00249] In a possible implementation, if a length of the second source domain interaction data is less than a preset length, the second source domain interaction data is padded, so that the length of the padded second source domain interaction data is equal to the preset length. In some embodiments, a padding value may be 0. If the length of the second source domain interaction data is greater than the preset length, the second source domain interaction data is truncated, so that the length of the second source domain interaction data obtained after the truncation is equal to the preset length. In some embodiments, truncating the second source domain interaction data refers to deleting, according to a sequence of the interaction time point from early to late, the source domain interaction item having an earlier interaction time point.

[00250] The length of the second source domain interaction data is the quantity of source domain interaction items in the second source domain interaction data.

[00251] In a possible implementation, if a length of the target domain interaction data is less

than the preset length, the target domain interaction data is padded, so that the length of the padded target domain interaction data is equal to the preset length. In some embodiments, the padding value may be 0. If the length of the target domain interaction data is greater than the preset length, the target domain interaction data is truncated, so that the length of the target domain interaction data obtained after the truncation is equal to the preset length. In some embodiments, truncating the target domain interaction data refers to deleting, according to a sequence of the interaction time point from early to late, the target domain interaction item having an earlier interaction time point.

[00252] The length of the target domain interaction data is the quantity of target domain interaction items in the target domain interaction data.

[00253] 304: The computer device performs feature extraction on the object data, to obtain an object feature.

[00254] After acquiring the object data, the computer device performs feature extraction on the object data, to obtain the object feature.

[00255] In some embodiments, the computer device may perform the feature extraction operation through a feature extraction submodel. The computer device inputs the object data into the feature extraction submodel, and the feature extraction submodel performs feature extraction on the object data, to output the object feature.

[00256] In some embodiments, the object feature may be a feature vector, a feature matrix, or the like.

[00257] 305: The computer device performs feature extraction on the resource data to obtain a resource feature.

[00258] After acquiring the resource data, the computer device performs feature extraction on the resource data, to obtain the resource feature.

[00259] In some embodiments, the computer device may perform the feature extraction operation through the feature extraction submodel. The computer device inputs the resource data into the feature extraction submodel, and the feature extraction submodel performs feature extraction on the resource data, to output the resource feature.

[00260] In some embodiments, the resource feature may be a feature vector, a feature matrix, or the like.

[00261] 306: The computer device performs feature extraction on the second source domain interaction data and the target domain interaction data, to obtain a source domain

interaction feature and a target domain interaction feature.

[00262] After acquiring the second source domain interaction data and the target domain interaction data, the computer device performs feature extraction on the second source domain interaction data and the target domain interaction data, to obtain the source domain interaction feature of the second source domain interaction data and the target domain interaction feature of the target domain interaction data.

[00263] In a possible implementation, the second source domain interaction data includes a plurality of source domain interaction items, and each source domain interaction item includes a source domain resource, an entity to which the source domain resource belongs, and an interaction time point. The source domain interaction feature includes features of the plurality of source domain interaction items, and the features of each source domain interaction item include a source domain resource feature, a source domain entity feature, and a source domain interaction time feature.

[00264] In a possible implementation, the target domain interaction data includes a plurality of target domain interaction items, and each target domain interaction item includes a target domain resource, an entity to which the target domain resource belongs, and an interaction time point. The target domain interaction feature includes features of a plurality of target domain interaction items, and the features of each target domain interaction item include a target domain resource feature, a target domain entity feature, and a target domain interaction time feature.

[00265] In a possible implementation, if the computer device processes the second source domain interaction data and the target domain interaction data through an attention mechanism, to obtain the source domain interaction feature and the target domain interaction feature, operation 306 includes the following operation 3061 to operation 3065.

[00266] 3061: Perform feature extraction on the second source domain interaction data to obtain an initial source domain interaction feature, and perform feature extraction on the target domain interaction data to obtain an initial target domain interaction feature.

[00267] The computer device separately performs feature extraction on the second source domain interaction data and the target domain interaction data, to separately obtain the initial source domain interaction feature and the initial target domain interaction feature. The initial source domain interaction feature indicates an intrinsic feature of the second source domain interaction data and is independent of the target domain interaction data. The initial target domain interaction feature indicates an intrinsic feature of the target domain interaction data and is independent of the second source domain interaction data.

[00268] However, although all source domain interaction items in the second source domain interaction data are associated with the target domain, degrees of association between the source domain interaction items and the target domain are different. To improve the accuracy, the impact of the source domain interaction feature having a higher degree of association with the target domain on the recommendation prediction result is enhanced, and the impact of the source domain interaction feature having a lower degree of association with the target domain on the recommendation prediction result is reduced. In addition, noise may also exist in the target domain interaction data. For example, when a target domain interaction item is completely unrelated to the source domain, the target domain interaction item may be generated due to an accidental touch of the user. Therefore, the impact of the target domain interaction feature of the target domain interaction item on the recommendation prediction result is reduced. Based on this, in the following operation 3062 to operation 3064 according to this embodiment of this disclosure, the initial source domain interaction feature and the initial target domain interaction feature are processed through the attention mechanism, to mine the importance of each part in the initial source domain interaction feature and the initial target domain interaction feature, thereby enhancing more important parts in the initial source domain interaction feature and the initial target domain interaction feature.

[00269] 3062: Fuse the initial source domain interaction feature and the initial target domain interaction feature, to obtain a first fused interaction feature.

[00270] In some embodiments, the computer device concatenates the initial source domain interaction feature and the initial target domain interaction feature, to obtain the first fused interaction feature.

[00271] Exemplarily, the computer device determines the first fused interaction feature using the following formula:

$$HC = [HS^{gs}||HT]$$

[00272] HC represents the first fused interaction feature, HS^{gs} represents the initial source domain interaction feature, HT represents the initial target domain interaction feature, and $||$ represents a concatenation operation.

[00273] In some embodiments, the computer device performs weighted summation on the initial source domain interaction feature and the initial target domain interaction feature, to obtain the first fused interaction feature.

[00274] 3063: Multiply the first fused interaction feature by a first mapping matrix, to obtain a first query feature, a first key feature, and a first value feature.

[00275] The key feature (key), the value feature (value), and the query feature (query) in this embodiment of this disclosure respectively belong to different feature spaces. The value feature represents an intrinsic feature of the first fused interaction feature, and the query feature and the key feature are configured for determining the importance of a feature corresponding to each interaction item in the first fused interaction feature.

[00276] The first mapping matrix is a preset parameter matrix, and the first mapping matrix is configured for performing space transformation on the first fused interaction feature.

[00277] In some embodiments, the first mapping matrix refers to mapping matrices in three dimensions, including a mapping matrix for a query dimension, a mapping matrix for a key dimension, and a mapping matrix for a value dimension. The computer device separately multiplies the mapping matrices in the three dimensions by the first fused interaction feature, to separately obtain the first query feature, the first key feature, and the first value feature.

[00278] In some embodiments, the computer device determines the first query feature, the first key feature, and the first value feature using the following formulas:

$$Q1 = W_Q^{sa} \cdot HC$$

$$K1 = W_K^{sa} \cdot HC$$

$$V1 = W_V^{sa} \cdot HC$$

[00279] $Q1$ represents the first query feature, $K1$ represents the first key feature, and $V1$ represents the first value feature. HC represents the first fused interaction feature, W_Q^{sa} represents the mapping matrix for the query dimension, W_K^{sa} represents the mapping matrix for the key dimension, and W_V^{sa} represents the mapping matrix for the value dimension.

[00280] 3064: Fuse the first query feature, the first key feature, and the first value feature, to obtain a second fused interaction feature.

[00281] In some embodiments, the computer device normalizes a product of the first query feature, a transpose of the first key feature, and a scaling factor, to obtain a first normalized feature, and determines a product of the first normalized feature and the first value feature as the second fused interaction feature.

[00282] Exemplarily, the computer device fuses the first query feature, the first key feature, and the first value feature using the following formula.

$$Attention\ (Q1, K1, V1) = Softmax\left(\frac{Q1K1^T}{\sqrt{D_e}}\right)\mathrm{V1}$$

[00283] $Attention\ (Q1, K1, V1)$ represents the second fused interaction feature, $Q1$ represents the first query feature, $K1$ represents the first key feature, and $V1$ represents the first value feature.T represents a transpose operation of the matrix, $\frac{1}{\sqrt{D_e}}$ represents a scaling factor, and $Softmax(\cdot)$ represents a normalization operation.

[00284] 3065: Determine a source domain interaction feature and a target domain interaction feature based on the second fused interaction feature.

[00285] After determining the second fused interaction feature, the computer device splits the second fused interaction feature into the source domain interaction feature and the target domain interaction feature. In some embodiments, the first fused interaction feature is obtained by concatenating the initial source domain interaction feature and the initial target domain interaction feature. Then, the second fused interaction feature is split again according to the concatenation method, and the two interaction features obtained through splitting are used as the source domain interaction feature and the target domain interaction feature for final use.

[00286] For example, the first fused interaction feature is obtained by concatenating the initial source domain interaction feature and the initial target domain interaction feature, a length of the initial source domain interaction feature is m, a length of the initial target domain interaction feature is n, and both the first fused interaction feature and the second fused interaction feature have a length of m + n. The computer device uses the first item to an mth item in the second fused interaction feature as the source domain interaction feature, and uses an $(m+1)^{th}$ item to an $(m + n)^{th}$ item as the target domain interaction feature.

[00287] In some embodiments, the process of determining the source domain interaction feature in operation 3065 includes: splitting the second fused interaction feature to obtain an intermediate source domain interaction feature; multiplying the resource feature by a second mapping matrix, to obtain a second query feature; multiplying the intermediate source domain interaction feature by the second mapping matrix, to obtain a second key feature and a second value feature; and fusing the second query feature, the second key feature, and the second value feature, to obtain the source domain interaction feature.

[00288] In this embodiment of this disclosure, the computer device uses the interaction feature split from the second fused interaction feature and belonging to the source domain as the intermediate source domain interaction feature, and processes the intermediate source domain interaction feature and the resource feature through the attention mechanism, to obtain the source domain interaction feature for final use.

[00289] The second mapping matrix is a preset parameter matrix, and the second mapping matrix is configured for performing space transformation on the resource feature and the intermediate source domain interaction feature.

[00290] Exemplarily, the second mapping matrix refers to mapping matrices in three dimensions, including a mapping matrix for a query dimension, a mapping matrix for a key dimension, and a mapping matrix for a value dimension. The computer device multiplies the mapping matrix for the query dimension by the resource feature, to obtain the second query feature, and separately multiplies the mapping matrix for the key dimension and the mapping matrix for the value dimension by the intermediate source domain interaction feature, to separately obtain the second key feature and the second value feature.

[00291] For example, the computer device determines the second query feature, the second key feature, and the second value feature using the following formula.

$$Q2 = W_Q^{qa} \cdot q_t$$

$$K2 = W_K^{qa} \cdot HS^{sa}$$

$$V2 = W_V^{qa} \cdot HS^{sa}$$

[00292] $Q2$ represents the second query feature, $K2$ represents the second key feature, and $V2$ represents the second value feature.q_t represents the resource feature, and HS^{sa} represents the intermediate source domain interaction feature.W_Q^{qa} represents the mapping matrix for the query dimension, W_K^{qa} represents the mapping matrix for the key dimension, and W_V^{qa}represents the mapping matrix for the value dimension.

[00293] Exemplarily, the computer device normalizes a product of the second query feature, a transpose of the second key feature, and a scaling factor, to obtain a second normalized feature, and determines a product of the second normalized feature and the second value feature as the source domain interaction feature.

[00294] For example, the computer device fuses the second query feature, the second key feature, and the second value feature using the following formula.

$$Attention\ (Q2, K2, V2) = Softmax\left(\frac{Q2K2^T}{\sqrt{D_e}}\right)\mathrm{V2}$$

[00295] $Attention\ (Q2, K2, V2)$ represents the source domain interaction feature, $Q2$ represents the second query feature, $K2$ represents the second key feature, and $V2$ represents the

second value feature. T represents a transpose operation of the matrix, $\frac{1}{\sqrt{D_e}}$ represents a scaling factor, and $Softmax(\cdot)$ represents a normalization operation.

[00296] In some embodiments, the process of determining the target domain interaction feature in operation 3065 includes: splitting the second fused interaction feature to obtain an intermediate target domain interaction feature; multiplying the resource feature by a third mapping matrix, to obtain a third query feature; multiplying the intermediate target domain interaction feature by the third mapping matrix, to obtain a third key feature and a third value feature; and fusing the third query feature, the third key feature, and the third value feature, to obtain the target domain interaction feature.

[00297] In this embodiment of this disclosure, the computer device uses the interaction feature that belongs to the target domain and that is split from the third fused interaction feature as the intermediate target domain interaction feature, and processes the intermediate target domain interaction feature and the resource feature through the attention mechanism, to obtain the target domain interaction feature for final use.

[00298] The third mapping matrix is a preset parameter matrix, and the third mapping matrix is configured for performing space transformation on the resource feature and the intermediate target domain interaction feature.

[00299] Exemplarily, the third mapping matrix refers to mapping matrices in three dimensions, including a mapping matrix for a query dimension, a mapping matrix for a key dimension, and a mapping matrix for a value dimension. The computer device multiplies the mapping matrix for the query dimension by the resource feature, to obtain the third query feature, and separately multiplies the mapping matrix for the key dimension and the mapping matrix for the value dimension by the intermediate target domain interaction feature, to separately obtain the third key feature and the third value feature.

[00300] For example, the computer device determines the third query feature, the third key feature, and the third value feature using the following formulas.

$$Q3 = W_Q^{ta} \cdot q_t$$

$$K3 = W_K^{ta} \cdot HT^{sa}$$

$$V3 = W_V^{ta} \cdot HT^{sa}$$

[00301] $Q3$ represents the third query feature, $K3$ represents the third key feature, and $V3$ represents the third value feature. q_t represents the resource feature, and HT^{sa} represents the

intermediate target domain interaction feature.W_Q^{ta} represents the mapping matrix for the query dimension, W_K^{ta}represents the mapping matrix for the key dimension, and W_V^{ta}represents the mapping matrix for the value dimension.

[00302] Exemplarily, the computer device normalizes a product of the third query feature, a transpose of the third key feature, and a scaling factor, to obtain a third normalized feature, and determines a product of the third normalized feature and the third value feature as the target domain interaction feature.

[00303] For example, the computer device fuses the third query feature, the third key feature, and the third value feature using the following formula.

$$Attention\ (Q3, K3, V3) = Softmax\left(\frac{Q3K3^T}{\sqrt{D_e}}\right)\mathrm{V3}$$

[00304] $Attention\ (Q3, K3, V3)$ represents the target domain interaction feature, $Q3$ represents the third query feature, $K3$ represents the third key feature, and $V3$ represents the third value feature. T represents a transpose operation of the matrix, $\frac{1}{\sqrt{D_e}}$ represents a scaling factor, and $Softmax(\cdot)$ represents a normalization operation.

[00305] In this embodiment of this disclosure, the source domain interaction feature and the target domain interaction feature are processed through the attention mechanism. On the one hand, the source domain interaction feature may be weighted using the correlation between the source domain interaction feature and the target domain interaction feature, to help enhance the source domain interaction feature having a higher correlation with the target domain, and weaken the source domain interaction feature having a lower correlation with the target domain. On the other hand, the target domain interaction feature may be weighted using the correlation between the target domain interaction feature and the source domain interaction feature, thereby adjusting the target domain interaction feature through the source domain interaction feature, to help weaken features of sparse interaction behaviors in the target domain and, to a certain extent, reduce interference from accidental interaction behaviors in the target domain.

[00306] In addition, by processing the source domain interaction feature and the resource feature of the target resource through the attention mechanism, the source domain interaction feature may be weighted using the correlation between the source domain interaction feature and the resource feature, to help enhance the source domain interaction feature having a higher correlation with the target resource, thereby mining the source domain interaction feature strongly correlated to the target resource, so that the source domain interaction feature referred to during

target resource recommendation concentrates on the source domain interaction feature related to the to-be-recommended target resource, to reduce interference from unrelated source domain interaction features, and further improve the accuracy of the recommendation prediction result of the target resource.

[00307] In addition, by processing the target domain interaction feature and the resource feature of the target resource through the attention mechanism, the target domain interaction feature may be weighted using the correlation between the target domain interaction feature and the resource feature, to help enhance the target domain interaction feature having a higher correlation with the target resource, thereby mining the target domain interaction feature strongly correlated to the target resource, so that the target domain interaction feature referred to during target resource recommendation concentrates on the target domain interaction feature related to the to-be-recommended target resource, to reduce interference from unrelated target domain interaction features, and further improve the accuracy of the recommendation prediction result of the target resource.

[00308] **307: The computer device determines a recommendation prediction result of the target resource based on the object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature, the recommendation prediction result being configured to represent an interaction status between the object and the target resource in a case that the target resource is recommended to the object.**

[00309] After determining the object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature, the computer device can infer an interest tendency of the object for the target resource through the object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature, to further determine the recommendation prediction result of the target resource. The recommendation prediction result is configured to represent the interaction tendency of the object for the target resource.

[00310] In a possible implementation, the recommendation prediction result is configured to represent an interaction probability of the interaction between the object and the target resource in a case that the target resource is recommended to the object. For example, the recommendation prediction result may be a click-through-rate (CTR).

[00311] In this embodiment of this disclosure, the interaction status between the object and the target resource is predicted according to a feature of the object data, a feature of the resource data, a feature of the source domain interaction data, and a feature of the target domain interaction

data. The interest tendency of the object and a matching degree between the interest tendency of the object and the target resource can be fully mined through potential features of the data, so as to infer the interaction tendency of the object for the target resource, thereby helping ensure the accuracy of the recommendation prediction result.

[00312] 308: The computer device recommends the target resource to the object if the recommendation prediction result satisfies a recommendation condition.

[00313] After determining the recommendation prediction result, the computer device determines whether the recommendation prediction result satisfies the recommendation condition, and if the recommendation condition is satisfied, the target resource is recommended to the object. If the recommendation condition is not satisfied, the target resource does not need to be recommended to the object.

[00314] In a possible implementation, the recommendation prediction result is configured to represent a probability that the object interacts with the target resource if the target resource is recommended to the object. The recommendation condition is that the interaction probability of the target resource is greater than a probability threshold, or the recommendation condition is that among interaction probabilities of a plurality of candidate recommended resources, the interaction probability of the target resource is ranked in the top preset quantity in descending order.

[00315] FIG. 5 is a schematic diagram of a resource recommendation method according to an embodiment of this disclosure. As shown in FIG. 5, the user views a product interface, and requests a resource recommendation service on the product interface. A server acquires object data, resource data, source domain interaction data, and target domain interaction data from online storage. A resource recommendation model is used to determine a recommendation prediction result of a target resource according to the acquired data, and if a recommendation condition is satisfied, the target resource is recommended to the user. In addition, after the user interacts with the target resource, a log is generated, and the server stores the log in a log system. Subsequently, a target domain interaction item of the object may be extracted from the log for a next recommendation task.

[00316] In the method according to this embodiment of this disclosure, during the determination of whether to recommend the target resource in a target domain to the object, reference needs to be made to a historical interaction status between the object and other resources, to infer an interaction tendency of the object for the target resource. Therefore, the target domain interaction data of the object in the target domain is acquired. Considering a case that a data volume of the target domain interaction data may be insufficient, the source domain interaction data of the object in a source domain is additionally acquired, a part associated with the target domain is

screened out from the source domain interaction data, and then the target domain interaction data and the screened-out source domain interaction data are used as a reference to predict the interaction status between the object and the target resource if the target resource is recommended to the object. On the one hand, because the source domain interaction data is introduced, a defect of insufficient target domain interaction data may be compensated for, and the impact caused by sparsity of the target domain interaction data is relieved. On the other hand, because only the source domain interaction data associated with the target domain is considered, and the source domain interaction data unrelated to the target domain is discarded, interference with the prediction result caused by the source domain interaction data unrelated to the target domain may be reduced, thereby improving the overall accuracy of resource recommendation.

[00317] In addition, when the recommendation prediction result satisfies the recommendation condition, the object has a high probability of interacting with the target resource. Therefore, the target resource is recommended to the object, thereby achieving personalized resource recommendation for the object, which helps increase a conversion rate of resource recommendation and improve a recommendation effect.

[00318] Based on the foregoing embodiment, operation 304 to operation 307 may be implemented using the resource recommendation model. The resource recommendation model includes a feature extraction submodel and a recommendation prediction submodel. For a detailed process, refer to the following embodiment in FIG. 6.

[00319] FIG. 6 is a flowchart of another resource recommendation method according to an embodiment of this disclosure. This embodiment of this disclosure is performed by a computer device. The computer device is a device such as the terminal 101 or the server 102 shown in FIG. 1. Referring to FIG. 6, the method includes:

[00320] 601: The computer device acquires object data of an object and resource data of a target resource, the target resource belonging to a target domain.

[00321] 602: The computer device acquires first source domain interaction data of the object and target domain interaction data of the object, the first source domain interaction data including a plurality of source domain interaction items, each source domain interaction item referring to an interaction item between the object and a resource in a source domain, the target domain interaction data including a plurality of target domain interaction items, each target domain interaction item referring to an interaction item between the object and a resource in the target domain, and the source domain and the target domain belonging to different domains.

[00322] 603: The computer device determines, in the first source domain interaction data, at least one source domain interaction item associated with the target domain to form second source domain interaction data.

[00323] Operation 601 to operation 603 described above are similar to operation 301 to operation 303 described above. Details are not described herein again.

[00324] 604: The computer device performs feature extraction on the object data through a feature extraction submodel in a resource recommendation model, to obtain an object feature.

[00325] The feature extraction submodel in the resource recommendation model is configured for feature extraction. The computer device inputs the object data into the feature extraction submodel, and the feature extraction submodel performs feature extraction on the object data, to output the object feature.

[00326] The process of performing, by the feature extraction submodel, feature extraction on the object data is similar to operation 304 described above. Details are not described herein again.

[00327] 605: The computer device performs feature extraction on the resource data through the feature extraction submodel, to obtain a resource feature.

[00328] The computer device inputs the resource data into the feature extraction submodel, and the feature extraction submodel performs feature extraction on the resource data, to output the resource feature.

[00329] The process of performing, by the feature extraction submodel, feature extraction on the resource data is similar to operation 305 described above. Details are not described herein again.

[00330] 606: The computer device performs feature extraction on the second source domain interaction data and the target domain interaction data through the feature extraction submodel, to obtain a source domain interaction feature and a target domain interaction feature.

[00331] The computer device inputs the second source domain interaction data and the target domain interaction data into the feature extraction submodel, and the feature extraction submodel performs feature extraction on the second source domain interaction data and the target domain interaction data, to output the source domain interaction feature and the target domain interaction feature.

[00332] In a possible implementation, the feature extraction submodel includes a feature

extraction network, a feature fusion network, and a first attention network, and the first attention network includes a first mapping matrix. Operation 606 includes the following operation 6061 to operation 6065.

[00333] 6061: Perform feature extraction on the second source domain interaction data through the feature extraction network, to obtain an initial source domain interaction feature.

[00334] 6062: Perform feature extraction on the target domain interaction data through the feature extraction network, to obtain an initial target domain interaction feature.

[00335] 6063: Fuse the initial source domain interaction feature and the initial target domain interaction feature through the feature fusion network, to obtain a first fused interaction feature.

[00336] 6064: Multiply the first fused interaction feature by the first mapping matrix through the first attention network, to obtain a first query feature, a first key feature, and a first value feature, and fuse the first query feature, the first key feature, and the first value feature, to obtain a second fused interaction feature.

[00337] 6065: Determine a source domain interaction feature and a target domain interaction feature based on the second fused interaction feature.

[00338] In some embodiments, the feature extraction submodel further includes a second attention network, and the second attention network includes a second mapping matrix.

[00339] The process of determining the source domain interaction feature in operation 6065 includes: splitting the second fused interaction feature to obtain an intermediate source domain interaction feature; multiplying, by the second attention network, the resource feature by the second mapping matrix, to obtain a second query feature, and multiplying the intermediate source domain interaction feature by the second mapping matrix, to obtain a second key feature and a second value feature; and fusing, by the second attention network, the second query feature, the second key feature, and the second value feature, to obtain the source domain interaction feature.

[00340] In some embodiments, the feature extraction submodel further includes a third attention network, and the third attention network includes a third mapping matrix.

[00341] The process of determining the target domain interaction feature in operation 6065 includes: splitting the second fused interaction feature to obtain an intermediate target domain interaction feature; multiplying, by the third attention network, the resource feature by the third mapping matrix, to obtain a third query feature, and multiplying the intermediate target domain interaction feature by the third mapping matrix, to obtain a third key feature and a third value feature; and fusing, by the third attention network, the third query feature, the third key feature, and

the third value feature, to obtain the target domain interaction feature.

[00342] In this embodiment of this disclosure, the source domain interaction feature and the target domain interaction feature are processed using an attention network. On the one hand, the source domain interaction feature may be weighted using the correlation between the source domain interaction feature and the target domain interaction feature, to help enhance the source domain interaction feature having a higher correlation with the target domain, and weaken the source domain interaction feature having a lower correlation with the target domain. On the other hand, the target domain interaction feature may be weighted using the correlation between the target domain interaction feature and the source domain interaction feature, thereby adjusting the target domain interaction feature through the source domain interaction feature, to help weaken features of sparse interaction behaviors in the target domain and, to a certain extent, reduce interference from accidental interaction behaviors in the target domain.

[00343] In addition, by processing the source domain interaction feature and the resource feature of the target resource using an attention network, the source domain interaction feature may be weighted using the correlation between the source domain interaction feature and the resource feature, to help enhance the source domain interaction feature having a higher correlation with the target resource, thereby mining the source domain interaction feature strongly correlated to the target resource, so that the source domain interaction feature referred to during target resource recommendation concentrates on the source domain interaction feature related to the to-be-recommended target resource, to reduce interference from unrelated source domain interaction features, and further improve the accuracy of a recommendation prediction result of the target resource.

[00344] In addition, by processing the target domain interaction feature and the resource feature of the target resource using an attention network, the target domain interaction feature may be weighted using the correlation between the target domain interaction feature and the resource feature, to help enhance the target domain interaction feature having a higher correlation with the target resource, thereby mining the target domain interaction feature strongly correlated to the target resource, so that the target domain interaction feature referred to during target resource recommendation concentrates on the target domain interaction feature related to the to-be-recommended target resource, to reduce interference from unrelated target domain interaction features, and further improve the accuracy of the recommendation prediction result of the target resource.

[00345] In a case that the feature extraction submodel includes the feature extraction

network, the feature fusion network, and the first attention network, in the foregoing operation 604 and operation 605, only the object feature and the resource feature need to be extracted through the feature extraction network.

[00346] 607: The computer device determines, through a recommendation prediction submodel in the resource recommendation model, a recommendation prediction result of the target resource based on the object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature, the recommendation prediction result being configured to represent an interaction status between the object and the target resource in a case that the target resource is recommended to the object.

[00347] The recommendation prediction submodel in the resource recommendation model is configured for determining the recommendation prediction result. The computer device inputs the object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature into the recommendation prediction submodel, and the recommendation prediction submodel outputs the recommendation prediction result. Exemplarily, the recommendation prediction submodel may be a multilayer perceptron (MLP).

[00348] In a possible implementation, the computer device pools the source domain interaction feature and the target domain interaction feature, to obtain a pooled source domain interaction feature and a pooled target domain interaction feature. The object feature, the resource feature, the pooled source domain interaction feature, and the pooled target domain interaction feature are concatenated to obtain a concatenated feature, the concatenated feature is inputted into the recommendation prediction submodel, and the recommendation prediction submodel outputs the recommendation prediction result.

[00349] In some embodiments, the source domain interaction feature includes source domain interaction item features of a plurality of source domain interaction items, and the target domain interaction feature includes target domain interaction item features of a plurality of target domain interaction items. The computer device performs average pooling on the plurality of source domain interaction item features, to obtain the pooled source domain interaction feature. The computer device performs average pooling on the plurality of target domain interaction item features, to obtain the pooled target domain interaction feature.

[00350] Exemplarily, the computer device pools the source domain interaction feature and the target domain interaction feature using the following formulas.

$$rs = \frac{1}{m} \sum_{hs \epsilon HS^{es}} hs$$

$$rt = \frac{1}{n} \sum_{ht \epsilon HT^{es}} ht$$

[00351] rs represents the pooled source domain interaction feature, hs represents one source domain interaction item feature in the source domain interaction features, and m represents a length of the source domain interaction feature, namely the quantity of the source domain interaction item features.rt represents the pooled target domain interaction feature, htrepresents one target domain interaction item feature in the target domain interaction features, and n represents a length of the target domain interaction feature, namely the quantity of the target domain interaction item features.

[00352] Exemplarily, the computer device determines the recommendation prediction result using the following formula.

$$\hat{y} = Model([x||q_t||rt||rs])$$

[00353] $\hat{y}$ represents the recommendation prediction result, x represents the object feature, q_t represents the resource feature, rs represents the pooled source domain interaction feature, rt represents the pooled target domain interaction feature, $||$ represents a concatenation operation, and $Model(\cdot)$ represents the recommendation prediction submodel.

[00354] 608: The computer device recommends the target resource to the object if the recommendation prediction result satisfies a recommendation condition.

[00355] In the method according to this embodiment of this disclosure, during the determination of whether to recommend the target resource in the target domain to the object, reference needs to be made to a historical interaction status between the object and other resources, to infer an interaction tendency of the object for the target resource. Therefore, the target domain interaction data of the object in the target domain is acquired. Considering a case that a data volume of the target domain interaction data may be insufficient, the source domain interaction data of the object in the source domain is additionally acquired, a part associated with the target domain is screened out from the source domain interaction data, and then the target domain interaction data and the screened-out source domain interaction data are used as a reference to predict the interaction status between the object and the target resource if the target resource is recommended to the object. On the one hand, because the source domain interaction data is introduced, a defect of insufficient target domain interaction data may be compensated for, and the impact caused by

sparsity of the target domain interaction data is relieved. On the other hand, because only the source domain interaction data associated with the target domain is considered, and the source domain interaction data unrelated to the target domain is discarded, interference with the prediction result caused by the source domain interaction data unrelated to the target domain may be reduced, thereby improving the overall accuracy of resource recommendation.

[00356] In addition, using the resource recommendation model to perform the process of determining the recommendation prediction result based on the object data, the resource data, the source domain interaction data, and the target domain interaction data helps improve processing efficiency.

[00357] An embodiment of this disclosure further provides a method for training a resource recommendation model. FIG. 7 is a flowchart of a method for training a resource recommendation model according to an embodiment of this disclosure. This embodiment of this disclosure is performed by a computer device, and the computer device is a device such as the terminal 101 or the server 102 shown in FIG. 1. Referring to FIG. 7, the method includes:

[00358] **701: The computer device acquires sample object data of a sample object, sample resource data of a sample resource, and a sample tag, the sample resource belonging to a target domain, and the sample tag being configured to indicate a real interaction status between the sample object and the sample resource after the sample resource is recommended to the sample object.**

[00359] The sample resource is a resource already recommended to the sample object, the sample object data is similar to the foregoing object data, and the sample resource data is similar to the foregoing resource data. Details are not described herein again.

[00360] The sample tag may indicate a real interaction probability between the sample object and the sample resource after the sample resource is recommended to the sample object. For example, if the sample object interacts with the sample resource, the sample tag may be set to 1, and if the sample object does not interact with the sample resource, the sample tag may be set to 0.

[00361] **702: The computer device acquires first sample source domain interaction data of the sample object and sample target domain interaction data of the sample object, the first sample source domain interaction data including a plurality of sample source domain interaction items, each sample source domain interaction item referring to an interaction item between the sample object and a resource in a source domain, the sample target domain interaction data including a plurality of sample target domain interaction items, each sample**

target domain interaction item referring to an interaction item between the sample object and a resource in the target domain, and the source domain and the target domain belonging to different domains.

[00362] 703: The computer device determines, in the first sample source domain interaction data, at least one sample source domain interaction item associated with the target domain, to form second sample source domain interaction data.

[00363] 704: The computer device determines, by the resource recommendation model, a recommendation prediction result of the sample resource based on the sample object data, the sample resource data, the second sample source domain interaction data, and the sample target domain interaction data, the recommendation prediction result being configured to represent a predicted interaction status between the sample object and the sample resource in a case that the sample resource is recommended to the sample object.

[00364] The process of operation 702 to operation 704 is similar to the process of operation 602 to operation 607. Details are not described again herein.

[00365] 705: The computer device trains the resource recommendation model based on the recommendation prediction result and the sample tag.

[00366] The sample tag can reflect the real interaction status between the sample object and the sample resource. The recommendation prediction result is a prediction result obtained based on the resource recommendation model, and can reflect a predicted interaction status between the sample object and the sample resource. In this case, a smaller difference between the recommendation prediction result and the sample tag indicates a more accurate recommendation prediction result, that is, the resource recommendation model is more accurate. Therefore, the computer device trains the resource recommendation model based on the recommendation prediction result and the sample tag. A training objective is to reduce the difference between the recommendation prediction result and the sample tag, thereby improving the accuracy of the resource recommendation model.

[00367] In the method according to this embodiment of this disclosure, when the resource recommendation model is trained, for a recommendation task of the target domain, the sample target domain interaction data of the sample object in the target domain is acquired. Considering a case that a data volume of the sample target domain interaction data may be insufficient, the sample source domain interaction data of the sample object in the source domain is additionally acquired, a part associated with the target domain is screened out from the sample source domain interaction

data, then the sample target domain interaction data and the screened-out sample source domain interaction data are used as a reference to predict the recommendation prediction result using the resource recommendation model if the sample resource is recommended to the sample object, and then, the resource recommendation model is trained using the recommendation prediction result and the sample tag. On the one hand, because the sample source domain interaction data is introduced, a defect of insufficient sample target domain interaction data may be compensated for, and the impact caused by sparsity of the sample target domain interaction data is relieved, which helps improve the accuracy of the resource recommendation model. On the other hand, because only the sample source domain interaction data associated with the target domain is considered, and the sample source domain interaction data unrelated to the target domain is discarded, interference with the prediction result caused by the sample source domain interaction data unrelated to the target domain may be reduced, thereby further improving the accuracy of the resource recommendation model. In addition, the sample source domain interaction data unrelated to the target domain is filtered out, so that a volume of data that needs to be stored and processed can be effectively controlled, thereby helping save storage resources and processing resources.

[00368] Based on the foregoing embodiments, the resource recommendation model includes the feature extraction submodel and the recommendation prediction submodel. FIG. 8 is a flowchart of another method for training a resource recommendation model according to an embodiment of this disclosure. This embodiment of this disclosure is performed by a computer device, and the computer device is a device such as the terminal 101 or the server 102 shown in FIG. 1. Referring to FIG. 8, the method includes:

[00369] **801: The computer device acquires sample object data of a sample object, sample resource data of a sample resource, and a sample tag, the sample resource belonging to a target domain, and the sample tag being configured to indicate a real interaction status between the sample object and the sample resource after the sample resource is recommended to the sample object.**

[00370] **802: The computer device acquires first sample source domain interaction data of the sample object and sample target domain interaction data of the sample object, the first sample source domain interaction data including a plurality of sample source domain interaction items, each sample source domain interaction item referring to an interaction item between the sample object and a resource in a source domain, the sample target domain interaction data including a plurality of sample target domain interaction items, each sample target domain interaction item referring to an interaction item between the sample object and**

a resource in the target domain, and the source domain and the target domain belonging to different domains.

[00371] 803: The computer device determines, in the first sample source domain interaction data, at least one sample source domain interaction item associated with the target domain, to form second sample source domain interaction data.

[00372] In a possible implementation, a plurality of target entities are determined, each target entity refers to an entity to which the resource in the target domain belongs, and each entity refers to an object providing a resource. For any sample source domain interaction item in the first sample source domain interaction data, if the entity to which the resource in the sample source domain interaction item belongs is any target entity, it is determined that the sample source domain interaction item is associated with the target domain.

[00373] In another possible implementation, a plurality of target entities are determined, each target entity refers to an entity to which the resource in the target domain belongs, and each entity refers to an object providing a resource. For any sample source domain interaction item in the first sample source domain interaction data, if a similarity between the entity to which the resource in the sample source domain interaction item belongs and any target entity is greater than a similarity threshold, it is determined that the sample source domain interaction item is associated with the target domain.

[00374] In some embodiments, a target entity feature of each target entity is acquired; feature extraction is performed on the entity to which the resource in the sample source domain interaction item belongs, to obtain a sample source domain entity feature; and if a similarity between the sample source domain entity feature and any target entity feature is greater than the similarity threshold, it is determined that the sample source domain interaction item is associated with the target domain.

[00375] 804: The computer device performs feature extraction on the sample object data through a feature extraction submodel in the resource recommendation model, to obtain a sample object feature.

[00376] 805: The computer device performs feature extraction on the sample resource data through the feature extraction submodel, to obtain a sample resource feature.

[00377] 806: The computer device performs feature extraction on the second sample source domain interaction data and the sample target domain interaction data through the feature extraction submodel, to obtain a sample source domain interaction feature and a

sample target domain interaction feature.

[00378] In a possible implementation, the feature extraction submodel includes a feature extraction network, a feature fusion network, and a first attention network, and the first attention network includes a first mapping matrix. Operation 806 includes the following operation 8061 to operation 8065.

[00379] 8061: Perform feature extraction on the second sample source domain interaction data through the feature extraction network, to obtain an initial sample source domain interaction feature.

[00380] 8062: Perform feature extraction on the sample target domain interaction data through the feature extraction network, to obtain an initial sample target domain interaction feature.

[00381] 8063: Fuse the initial sample source domain interaction feature and the initial sample target domain interaction feature through the feature fusion network, to obtain a first sample fused interaction feature.

[00382] 8064: Multiply the first sample fused interaction feature by the first mapping matrix through the first attention network, to obtain a first sample query feature, a first sample key feature, and a first sample value feature, and fuse the first sample query feature, the first sample key feature, and the first sample value feature, to obtain a second sample fused interaction feature.

[00383] 8065: Determine a sample source domain interaction feature and a sample target domain interaction feature based on the second sample fused interaction feature.

[00384] In some embodiments, the feature extraction submodel further includes a second attention network, and the second attention network includes a second mapping matrix.

[00385] The process of determining the sample source domain interaction feature in operation 8065 includes: splitting the second sample fused interaction feature to obtain an intermediate sample source domain interaction feature; multiplying, by the second attention network, the sample resource feature by the second mapping matrix, to obtain a second sample query feature, and multiplying the intermediate sample source domain interaction feature by the second mapping matrix, to obtain a second sample key feature and a second sample value feature; and fusing, by the second attention network, the second sample query feature, the second sample key feature, and the second sample value feature, to obtain the sample source domain interaction feature.

[00386] In some embodiments, the feature extraction submodel further includes a third attention network, and the third attention network includes a third mapping matrix.

[00387] The process of determining the sample target domain interaction feature in operation 8065 includes: splitting the second sample fused interaction feature to obtain an intermediate sample target domain interaction feature; multiplying, by the third attention network, the sample resource feature by the third mapping matrix, to obtain a third sample query feature, and multiplying the intermediate sample target domain interaction feature by the third mapping matrix, to obtain a third sample key feature and a third sample value feature; and fusing, by the third attention network, the third sample query feature, the third sample key feature, and the third sample value feature, to obtain the sample target domain interaction feature.

[00388] **807: The computer device determines, through a recommendation prediction submodel in the resource recommendation model, a recommendation prediction result based on the sample object feature, the sample resource feature, the sample source domain interaction feature, and the sample target domain interaction feature.**

[00389] In this embodiment of this disclosure, the interaction status between the sample object and the sample resource is predicted according to a feature of the sample object data, a feature of the sample resource data, a feature of the sample source domain interaction data, and a feature of the sample target domain interaction data. An interest tendency of the sample object and a matching degree between the interest tendency of the sample object and the sample resource can be fully mined through potential features of the sample data, so as to infer the interaction tendency of the sample object for the sample resource, thereby helping ensure the accuracy of the recommendation prediction result, and accelerating the training process of the resource recommendation model.

[00390] **808: The computer device trains the resource recommendation model based on the recommendation prediction result and the sample tag.**

[00391] In a possible implementation, the computer device determines a first loss parameter based on the recommendation prediction result and the sample tag, and trains the resource recommendation model based on the first loss parameter, so that the first loss parameter obtained based on the trained resource recommendation model is reduced.

[00392] In some embodiments, the computer device determines the first loss parameter using the following formula:

$$\mathcal{L}_{ctr} = -\sum_{y \in Y} [y log\ \hat{y} + (1-y) log\ (1-\hat{y})]$$

[00393] $\mathcal{L}_{ctr}$ represents the first loss parameter, $\hat{y}$ represents the recommendation

prediction result, and y represents the sample tag.

[00394] In a possible implementation, due to a cross-domain problem and the fact that the resource recommendation model is trained using a recommendation task of the target domain as a sample, the representational learning for the resources in the source domain is insufficient, resulting in a significant difference between the source domain resource feature and the target domain resource feature. To overcome the foregoing challenge, an additional supervised learning process may be applied to the source domain resource feature and the target domain resource feature that are extracted by the resource recommendation model, to train the resource recommendation model by aligning the resource feature in the source domain with the resource feature in the target domain as a training objective. Two training methods are provided below.

[00395] **First method:** The sample source domain interaction item includes a source domain resource and an interaction time point of the source domain resource, the sample target domain interaction item includes a target domain resource and an interaction time point of the target domain resource, the sample source domain interaction feature includes a source domain resource feature of a source domain resource in each sample source domain interaction item, and the sample target domain interaction feature includes a target domain resource feature of a target domain resource in each sample target domain interaction item.

[00396] For any source domain resource in the second sample source domain interaction data, the computer device determines a first target domain resource in the sample target domain interaction data, and determines a source domain resource feature of the source domain resource and a target domain resource feature of the first target domain resource as a first positive sample pair. An interaction time point of the first target domain resource is closest to the interaction time point of the source domain resource.

[00397] Operation 808 includes: training the resource recommendation model based on the recommendation prediction result, the sample tag, and a similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair.

[00398] In interaction items of the same object in the same domain, interaction resources present similar features. Further, because the interest of the object may be kept stable in different domains within a short term, in interaction items of the same object in different domains within a similar time period, interaction resources also present similar features. Therefore, the source domain resource feature and the target domain resource feature that are close in interaction time points in the source domain and the target domain may be used as the positive sample pair, and shortening a distance between two resource features in the positive sample pair is a training objective.

[00399] Accordingly, in operation 808, the training objective is to reduce a difference between the recommendation prediction result and the sample tag, and improve the similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair.

[00400] In some embodiments, the computer device determines, for any source domain resource in the second sample source domain interaction data, a second target domain resource in sample target domain interaction data of any object except the sample object, and determines a source domain resource feature of the source domain resource and a target domain resource feature of the second target domain resource as a first negative sample pair, and the second target domain resource is any target domain resource in the sample target domain interaction data of any object. In addition, a similarity between the source domain resource feature and the target domain resource feature in the first negative sample pair is determined.

[00401] Operation 808 includes: training the resource recommendation model based on the recommendation prediction result, the sample tag, the similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair, and the similarity between the source domain resource feature and the target domain resource feature in the first negative sample pair.

[00402] Correspondingly, in interaction items of different objects in different domains, interaction resources present dissimilar features. Therefore, the source domain resource feature of the object in the source domain and a target domain resource feature of another object in the target domain may be used as a negative sample pair, and increasing a distance between two resource features in the negative sample pair is a training objective.

[00403] Exemplarily, the computer device determines the first loss parameter based on the recommendation prediction result and the sample tag, determines a second loss parameter based on the similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair, and the similarity between the source domain resource feature and the target domain resource feature in the first negative sample pair, and trains the resource recommendation model based on the first loss parameter and the second loss parameter, so that the first loss parameter and the second loss parameter obtained based on the trained resource recommendation model are reduced.

[00404] For example, the computer device determines the second loss parameter using the following formula.

$$\mathcal{L}_{uc} = -\frac{1}{m}\sum_{es^{uc}\in HS_{uc}^{gs}} log\frac{exp\,(sim(es^{uc}, et^{uc})/\tau)}{\sum_{uo\in B_u, uo\neq uc}\, exp\,(\frac{sim(es^{uc}, et^{uo})}{\tau})}$$

[00405] $\mathcal{L}_{uc}$ represents the second loss parameter, es^{uc} represents the source domain resource feature in the first positive sample pair, et^{uc}represents the target domain resource feature in the first positive sample pair, es^{uc} represents the source domain resource feature in the first negative sample pair, et^{uo} represents the target domain resource feature in the first negative sample pair, and $m$represents a length of the source domain interaction feature, which may also be understood as the quantity of source domain resource features. $\tau$is a hyperparameter, and HS_{uc}^{gs} represents the source domain interaction feature. $sim(\cdot)$ represents a cosine similarity. uc represents the sample object, B_u represents all objects except a current training batch, and uo represents any object other than the sample object.

[00406] In this embodiment of this disclosure, the resource recommendation model extracts the source domain resource feature of the source domain resource and the target domain resource feature of the target domain resource. Considering that resources for interaction by the same object in different domains within close time are similar, features of two resources with close interaction time points in the source domain and the target domain are used as the positive sample pair, and shortening the distance between the source domain resource feature and the target domain resource feature in the positive sample pair is used as the objective, to train the resource recommendation model, thereby effectively aligning resource features of different domains extracted by the resource recommendation model, and improving a feature extraction capability of the resource recommendation model, which helps ensure the accuracy of a cross-domain processing.

[00407] In addition, considering that resources for interaction by the same object in different domains within dissimilar time differ significantly, features of two resources with interaction time points that are not close in the source domain and the target domain are used as the negative sample pair, and increasing the distance between the source domain resource feature and the target domain resource feature in the negative sample pair is used as the objective, to train the resource recommendation model, thereby further aligning resource features of different domains extracted by the resource recommendation model.

[00408] **Second method:** The sample source domain interaction item includes a source domain resource and an entity to which the source domain resource belongs, the sample target domain interaction item includes a target domain resource and an entity to which the target domain resource belongs, the sample source domain interaction feature includes a source domain resource

feature of a source domain resource in each sample source domain interaction item, and the sample target domain interaction feature includes a target domain resource feature of a target domain resource in each sample target domain interaction item.

[00409] The computer device determines, for any source domain resource in the second sample source domain interaction data, a third target domain resource in the sample target domain interaction data, and determines a source domain resource feature of the source domain resource and a target domain resource feature of the third target domain resource as a second positive sample pair, and an entity to which the third target domain resource belongs is the same as the entity to which the source domain resource belongs. In addition, a similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair is determined.

[00410] Operation 808 includes: training the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair.

[00411] Different resources having the same entity in the same domain present similar features. The same applies to different cross-domain resources, that is, different resources having the same entity in different domains also present similar features. Therefore, the source domain resource feature and the target domain resource feature that belong to the same entity and that are in the source domain and the target domain may be used as a positive sample pair, and shortening a distance between two resource features in the positive sample pair is a training objective.

[00412] Accordingly, in operation 808, the training objective is to reduce a difference between the recommendation prediction result and the sample tag, and improve the similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair.

[00413] In some embodiments, the computer device determines, for any source domain resource in the second sample source domain interaction data, a fourth target domain resource, and determines a source domain resource feature of the source domain resource and a target domain resource feature of the fourth target domain resource as a second negative sample pair, and the fourth target domain resource refers to any target domain resource belonging to an entity different from that of the source domain resource. In addition, a similarity between the source domain resource feature and the target domain resource feature in the second negative sample pair is determined.

[00414] Operation 808 includes: training the resource recommendation model based on the recommendation prediction result, the sample tag, the similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair, and the similarity between the source domain resource feature and the target domain resource feature in the second negative sample pair.

[00415] Correspondingly, different resources having different entities in different domains present dissimilar features. Therefore, the source domain resource feature and the target domain resource feature of the object that belong to different entities may be used as a negative sample pair, and increasing a distance between two resource features in the negative sample pair is a training objective.

[00416] Exemplarily, the computer device determines the first loss parameter based on the recommendation prediction result and the sample tag, determines a third loss parameter based on the similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair, and the similarity between the source domain resource feature and the target domain resource feature in the second negative sample pair, and trains the resource recommendation model based on the first loss parameter and the third loss parameter, so that the first loss parameter and the third loss parameter obtained based on the trained resource recommendation model are reduced.

[00417] For example, the computer device determines the third loss parameter using the following formula.

$$\mathcal{L}_{lc} = -\frac{1}{m}\sum_{es^{lc}\in HS_{uc}^{gs}} log\frac{exp\ (sim(es^{lc}, et^{lc})/\tau)}{\sum_{k,lo\neq lc}\ exp\ (\frac{sim(es^{lc}, et^{lo})}{\tau})}$$

[00418] $\mathcal{L}_{lc}$ represents the third loss parameter, es^{lc} represents the source domain resource feature in the second positive sample pair, et^{lc}represents the target domain resource feature in the second positive sample pair, es^{lc} represents the source domain resource feature in the second negative sample pair, et^{lo} represents the target domain resource feature in the second negative sample pair, and m represents a length of the source domain interaction feature, which may also be understood as the quantity of source domain resource features. $\tau$is a hyperparameter, and HS_{uc}^{gs} represents the source domain interaction feature. $sim(\cdot)$ represents a cosine similarity.

[00419] In this embodiment of this disclosure, the resource recommendation model extracts the source domain resource feature of the source domain resource and the target domain resource feature of the target domain resource. Considering that resources belonging to the same entity in

different domains are similar, features of two resources belonging to the same entity in the source domain and the target domain are used as the positive sample pair, and shortening the distance between the source domain resource feature and the target domain resource feature in the positive sample pair is used as the objective, to train the resource recommendation model, thereby effectively aligning resource features of different domains extracted by the resource recommendation model, and improving the feature extraction capability of the resource recommendation model, which helps ensure the accuracy of the cross-domain processing.

[00420] In addition, considering that resources belonging to different entities in different domains differ significantly, features of two resources belonging to different entities in the source domain and the target domain are used as the negative sample pair, and increasing the distance between the source domain resource feature and the target domain resource feature in the negative sample pair is used as the objective, to train the resource recommendation model, thereby further aligning resource features of different domains extracted by the resource recommendation model.

[00421] In a possible implementation, the computer device determines a target loss parameter based on the first loss parameter, the second loss parameter, and the third loss parameter described above, and trains the resource recommendation model based on the target loss parameter, so that the target loss parameter obtained based on the trained resource recommendation model is reduced.

[00422] In some embodiments, the computer device determines the target loss parameter using the following formulas.

$$\mathcal{L}_{ca} = \lambda_{uc}\mathcal{L}_{uc} + \lambda_{lc}\mathcal{L}_{lc}$$

$$\mathcal{L} = \mathcal{L}_{ctr} + \lambda_{ca}\mathcal{L}_{ca}$$

[00423] $\mathcal{L}_{uc}$ represents the first loss parameter, $\mathcal{L}_{lc}$ represents the second loss parameter, $\mathcal{L}_{ctr}$ represents the third loss parameter, $\mathcal{L}$ represents the target loss parameter, and λ_{uc}, λ_{lc}, and λ_{ca} are hyperparameters.

[00424] In a possible implementation, only an example in which the resource features of the source domain and the target domain are aligned as the training objective is used for description above. In addition, aligning the resource features of the same domain may also be used as the training objective to train the resource recommendation model. Therefore, the following provides a plurality of training methods.

[00425] In some embodiments, the computer device determines a first source domain resource and a second source domain resource in the second sample source domain interaction data of the sample object, and determines a source domain resource feature of the first source domain

resource and a source domain resource feature of the second source domain resource as a third positive sample pair, the first source domain resource is any source domain resource, and an interaction time point of the second source domain resource is the closest to an interaction time point of the first source domain resource. The computer device trains the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the two source domain resource features in the third positive sample pair. The training objective is to reduce the difference between the recommendation prediction result and the sample tag, and improve the similarity between the two source domain resource features in the third positive sample pair.

[00426] In some embodiments, the computer device determines, for the first source domain resource in the second sample source domain interaction data, a third source domain resource in sample source domain interaction data of any object except the sample object, and determines the source domain resource feature of the first source domain resource and a source domain resource feature of the third source domain resource as a third negative sample pair, and the third source domain resource is any source domain resource in the sample source domain interaction data of any object. The computer device trains the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the two source domain resource features in the third negative sample pair. The training objective is to reduce the difference between the recommendation prediction result and the sample tag, and reduce the similarity between the two source domain resource features in the third negative sample pair.

[00427] In some embodiments, the computer device determines the first source domain resource and a fourth source domain resource in the second sample source domain interaction data of the sample object, and determines the source domain resource feature of the first source domain resource and a source domain resource feature of the fourth source domain resource as a fourth positive sample pair, the first source domain resource is any source domain resource, and an entity to which the fourth source domain resource belongs is the same as an entity to which the first source domain resource belongs. The computer device trains the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the two source domain resource features in the fourth positive sample pair. The training objective is to reduce the difference between the recommendation prediction result and the sample tag, and improve the similarity between the two source domain resource features in the fourth positive sample pair.

[00428] In some embodiments, the computer device determines, for the first source domain resource in the second sample source domain interaction data, a fifth source domain resource, and

determines the source domain resource feature of the first source domain resource and a source domain resource feature of the fifth source domain resource as a fourth negative sample pair, and the fifth source domain resource refers to any source domain resource belonging to an entity different from that of the first source domain resource. The computer device trains the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the two source domain resource features in the fourth negative sample pair. The training objective is to reduce the difference between the recommendation prediction result and the sample tag, and reduce the similarity between the two source domain resource features in the fourth negative sample pair.

[00429] Only an example in which the resource features of the source domain are aligned is used for description above. The process of aligning the resource features of the target domain is similar to the process of aligning the resource features of the source domain. Details are not described herein again.

[00430] In the method according to this embodiment of this disclosure, because the sample source domain interaction data is introduced, a defect of insufficient sample target domain interaction data may be compensated for, and the impact caused by sparsity of the sample target domain interaction data is relieved, which helps improve the accuracy of the resource recommendation model. On the other hand, because only the sample source domain interaction data associated with the target domain is considered, and the sample source domain interaction data unrelated to the target domain is discarded, interference with the prediction result caused by the sample source domain interaction data unrelated to the target domain may be reduced, thereby further improving the accuracy of the resource recommendation model. In addition, the sample source domain interaction data unrelated to the target domain is filtered out, so that a volume of data that needs to be stored and processed can be effectively controlled, thereby helping save storage resources and processing resources.

[00431] FIG. 9 is a schematic diagram of a method for training a resource recommendation model according to an embodiment of this disclosure. As shown in FIG. 9, an initial sample is obtained from a user log, and the initial sample is processed to obtain a training sample. Source domain interaction data is acquired from a source domain, target domain interaction data is acquired from a target domain, cross-domain screening is performed on the source domain interaction data, to obtain source domain interaction data associated with the target domain, and the screened-out source domain interaction data and the target domain interaction data are subjected to feature extraction, and stored in a feature library. The resource recommendation model is trained using the

training sample and the data in the feature library. The data stored in the feature library may further be configured for online resource recommendation.

[00432] FIG. 10 is an overall architecture diagram of a resource recommendation method according to an embodiment of this disclosure. As shown in FIG. 10, an overall architecture includes a cross-domain retrieval module, a cross-domain feature alignment module, a feature enhancement module, and a recommendation prediction module.

[00433] The cross-domain retrieval module is configured to screen source domain interaction data associated with a target domain. For example, a target entity includes an entity A, an entity B, and an entity F. By means of cross-domain retrieval, it may be determined that source domain interaction items corresponding to the entity A, the entity B, and the entity D in the source domain are associated with the target domain.

[00434] The cross-domain feature alignment module is configured to align resource features of the source domain and the target domain. For the same object, a distance between a source domain resource feature and a target domain resource feature that are close in interaction time points of the same object in the source domain and the target domain needs to be shortened. For the same entity, a distance between a source domain resource feature and a target domain resource feature that belong to the same entity in the source domain and the target domain needs to be shortened.

[00435] The feature enhancement module is configured to enhance a source domain interaction feature associated with the target domain, and enhance a source domain interaction feature associated with a target resource. The source domain interaction feature and the target domain interaction feature are processed through an attention mechanism, the source domain interaction feature and the resource feature are processed through the attention mechanism, and the target domain interaction feature and the resource feature are processed through the attention mechanism.

[00436] The recommendation prediction module is configured to determine a recommendation prediction result according to an object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature. For example, the recommendation prediction module includes a recommendation prediction submodel, and the recommendation prediction submodel includes a concatenation network and a prediction network. The object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature are inputted into the concatenation network for concatenating, to obtain a concatenated feature, and the concatenated feature is inputted into the prediction network, to obtain

the recommendation prediction result.

[00437] To verify the effectiveness of the resource recommendation method according to this embodiment of this disclosure, the resource recommendation method in this embodiment of this disclosure and a resource recommendation method provided in the related art are tested through experimental data. A test result is shown in Table 1 below.

Table 1

Model name	AUC	CTR
Related art 1	0.8304	base
Related art 2	0.8371	+2.04%
This disclosure	0.8463	+4.69%

[00438] An offline evaluation index uses an area under the curve (AUC, a model performance metric index), and an online evaluation index uses CTR. It can be seen from Table 1 that, the solution of this embodiment of this disclosure achieves better effects than the related art in both offline and online.

[00439] An embodiment of this disclosure provides a cross-domain ultra-long interaction data modeling method based on retrieval and alignment, to achieve the application of abundant interaction data in the source domain to a resource recommendation task of the target domain, thereby improving resource recommendation accuracy and diversity. The method in this embodiment of this disclosure may be applied to any scenario requiring resource recommendations.

[00440] For example, the source domain is a shopping domain, the target domain is an advertisement placement domain, a resource in the source domain is an item in the shopping domain, a resource in the target domain is a virtual resource placed in the advertisement placement domain, and the virtual resource is configured to exchange an item in the source domain. For example, the virtual resource is a coupon, an exchange coupon, or the like.

[00441] In some embodiments, the virtual resource in the target domain and the item in the source domain may be provided by the same entity, or may be provided by different entities. In some embodiments, the virtual resource provided by each entity in the target domain is configured to exchange an item respectively provided in the source domain. For example, a virtual resource provided by the entity A in the target domain is configured to exchange an item provided by the entity A in the source domain, but the virtual resource provided by the entity A in the target domain cannot be configured to exchange an item provided by another entity other than the entity A in the

source domain, and the item provided by the entity A in the source domain cannot be exchanged through a virtual resource provided by another entity other than the entity A in the target domain.

[00442] The process of the resource recommendation method according to this embodiment of this disclosure is described below through an example in which the source domain is the shopping domain and the target domain is the advertisement placement domain. FIG. 11 is a flowchart of another resource recommendation method according to an embodiment of this disclosure. Referring to FIG. 11, the method includes:

[00443] 1101: A terminal sends a resource recommendation task for an object to a server when the object satisfies an advertisement placement condition.

[00444] 1102: The server acquires, in response to the resource recommendation task for the object, object data of the object and virtual resource data of a target virtual resource, the target virtual resource being configured for exchanging an item.

[00445] 1103: The server acquires first item interaction data of the object and virtual resource interaction data of the object.

[00446] The first item interaction data includes a plurality of item interaction items, and each item interaction item refers to the object interacting with the item in the shopping domain. For example, an interaction behavior between the object and the item is a behavior of purchasing the item.

[00447] The virtual resource interaction data includes a plurality of virtual resource interaction items, and each virtual resource interaction item refers to the object interacting with the virtual resource placed in the advertisement placement domain. For example, the virtual resource is a coupon placed in the advertisement placement domain, and the interaction behavior between the object and the virtual resource is a behavior of collecting the coupon.

[00448] 1104: The server determines, in the first item interaction data, at least one item interaction item associated with the advertisement placement domain, the at least one item interaction item associated with the advertisement placement domain forming second item interaction data.

[00449] 1105: The server determines a recommendation prediction result of the target virtual resource based on the object data, the virtual resource data, the second item interaction data, and the virtual resource interaction data, the recommendation prediction result being configured to represent an interaction status between the object and the target virtual resource if the target virtual resource is recommended to the object.

[00450] 1106: The server returns the target virtual resource to the terminal if the recommendation prediction result satisfies a recommendation condition.

[00451] 1107: The terminal recommends the target virtual resource to the object.

[00452] In a possible implementation, a target client runs on the terminal, and the target client provides a plurality of services, for example, including a payment service and an advertisement placement service. For example, after the user completes a payment operation on the target client, an advertisement resource is recommended to the user. The advertisement resource includes a virtual resource for exchanging an item.

[00453] FIG. 12 is a schematic diagram of a service interface according to an embodiment of this disclosure. As shown in FIG. 12, the service interface provides a recharging entry 1201. After clicking the recharging entry 1201, the user is redirected to a recharging interface. The recharging interface is configured for phone recharging. In addition, the recharging interface further includes a welfare collection entry 1202.

[00454] In some embodiments, after phone recharging is completed, the recharging interface shown in FIG. 12 is redirected to a recharging interface shown in FIG. 13. As shown in FIG. 13, the recharging interface displays a message notification of successful recharging. In addition, the recharging interface further includes an advertisement resource 1301 recommended to the user. The advertisement resource 1301 carries a virtual resource for exchanging an item. For example, the virtual resource is a coupon or the like.

[00455] In some embodiments, if the user clicks the welfare collection entry 1202 on the recharging interface shown in FIG. 12, the user is redirected to a service interface shown in FIG. 14. A plurality of advertisement resources recommended to the user are displayed on the service interface shown in FIG. 14. Each advertisement resource carries a virtual resource for exchanging an item. For example, the virtual resource is a coupon, a red packet, a voucher, a discount coupon, or the like.

[00456] Only the shopping domain and the advertisement placement domain are used as examples for description above. In addition, the method in this embodiment of this disclosure may also be applied to another resource recommendation scenario. For example, an e-book is used as the source domain, and a movie is used as the target domain. Alternatively, a self-selected stock is used as the source domain, and stock information is used as the target domain.

[00457] FIG. 15 is a schematic structural diagram of a resource recommendation apparatus according to an embodiment of this disclosure. Referring to FIG. 15, the apparatus includes:

[00458] a first acquiring module 1501, configured to acquire object data of an object and resource data of a target resource, the target resource belonging to a target domain, and the target domain being any domain;

[00459] a second acquiring module 1502, configured to acquire first source domain interaction data of the object and target domain interaction data of the object, the first source domain interaction data including a plurality of source domain interaction items, each source domain interaction item referring to an interaction item between the object and a resource in a source domain, the target domain interaction data including a plurality of target domain interaction items, each target domain interaction item referring to an interaction item between the object and a resource in the target domain, and the source domain and the target domain belonging to different domains;

[00460] a screening module 1503, configured to determine, in the first source domain interaction data, at least one source domain interaction item associated with the target domain, to form second source domain interaction data; and

[00461] a prediction module 1504, configured to determine a recommendation prediction result of the target resource based on the object data, the resource data, the second source domain interaction data, and the target domain interaction data, the recommendation prediction result being configured to represent an interaction status between the object and the target resource in a case that the target resource is recommended to the object.

[00462] In the resource recommendation apparatus according to this embodiment of this disclosure, during the determination of whether to recommend the target resource in the target domain to the object, reference needs to be made to a historical interaction status between the object and other resources, to infer an interaction tendency of the object for the target resource. Therefore, the target domain interaction data of the object in the target domain is acquired. Considering a case that a data volume of the target domain interaction data may be insufficient, the source domain interaction data of the object in the source domain is additionally acquired, a part associated with the target domain is screened out from the source domain interaction data, and then the target domain interaction data and the screened-out source domain interaction data are used as a reference to predict the interaction status between the object and the target resource if the target resource is recommended to the object. On the one hand, because the source domain interaction data is introduced, a defect of insufficient target domain interaction data may be compensated for, and the impact caused by sparsity of the target domain interaction data is relieved. On the other hand, because only the source domain interaction data associated with the target domain is considered,

and the source domain interaction data unrelated to the target domain is discarded, interference with the prediction result caused by the source domain interaction data unrelated to the target domain may be reduced, thereby improving the overall accuracy of resource recommendation.

[00463] In some embodiments, referring to FIG. 16, the screening module 1503 is configured to:

[00464] determine a plurality of target entities, each target entity refers to an entity to which the resource in the target domain belongs, and each entity refers to an object providing a resource; and

[00465] determine, for any source domain interaction item in the first source domain interaction data, that the source domain interaction item is associated with the target domain if the entity to which the resource in the source domain interaction item belongs is any target entity.

[00466] In some embodiments, referring to FIG. 16, the screening module 1503 is configured to:

[00467] determine a plurality of target entities, each target entity refers to an entity to which the resource in the target domain belongs, and each entity refers to an object providing a resource; and

[00468] determine, for any source domain interaction item in the first source domain interaction data, that the source domain interaction item is associated with the target domain if a similarity between the entity to which the resource in the source domain interaction item belongs and any target entity is greater than a similarity threshold.

[00469] In some embodiments, referring to FIG. 16, the screening module 1503 is configured to:

[00470] acquire a target entity feature of each target entity;

[00471] perform feature extraction on the entity to which the resource in the source domain interaction item belongs, to obtain a source domain entity feature; and

[00472] determine that the source domain interaction item is associated with the target domain if a similarity between the source domain entity feature and any target entity feature is greater than the similarity threshold.

[00473] In some embodiments, referring to FIG. 16, the prediction module 1504 is configured to:

[00474] perform feature extraction on the object data to obtain an object feature;

[00475] perform feature extraction on the resource data to obtain a resource feature;

[00476] perform feature extraction on the second source domain interaction data and the target domain interaction data, to obtain a source domain interaction feature and a target domain interaction feature; and

[00477] determine the recommendation prediction result of the target resource based on the object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature.

[00478] In some embodiments, referring to FIG. 16, the prediction module 1504 is configured to:

[00479] perform feature extraction on the second source domain interaction data to obtain an initial source domain interaction feature, and perform feature extraction on the target domain interaction data to obtain an initial target domain interaction feature;

[00480] fuse the initial source domain interaction feature and the initial target domain interaction feature, to obtain a first fused interaction feature;

[00481] multiply the first fused interaction feature by a first mapping matrix, to obtain a first query feature, a first key feature, and a first value feature;

[00482] fuse the first query feature, the first key feature, and the first value feature, to obtain a second fused interaction feature; and

[00483] determine the source domain interaction feature and the target domain interaction feature based on the second fused interaction feature.

[00484] In some embodiments, referring to FIG. 16, the prediction module 1504 is configured to:

[00485] split the second fused interaction feature to obtain an intermediate source domain interaction feature;

[00486] multiply the resource feature by a second mapping matrix, to obtain a second query feature;

[00487] multiply the intermediate source domain interaction feature by the second mapping matrix, to obtain a second key feature and a second value feature; and

[00488] fuse the second query feature, the second key feature, and the second value feature, to obtain the source domain interaction feature.

[00489] In some embodiments, referring to FIG. 16, the prediction module 1504 is configured to:

[00490] split the second fused interaction feature to obtain an intermediate target domain interaction feature;

[00491] multiply the resource feature by a third mapping matrix, to obtain a third query feature;

[00492] multiply the intermediate target domain interaction feature by the third mapping matrix, to obtain a third key feature and a third value feature; and

[00493] fuse the third query feature, the third key feature, and the third value feature, to obtain the target domain interaction feature.

[00494] In some embodiments, referring to FIG. 16, the resource recommendation model includes a feature extraction submodel and a recommendation prediction submodel, and the prediction module 1504 is configured to:

[00495] perform feature extraction on the object data through the feature extraction submodel, to obtain an object feature;

[00496] perform feature extraction on the resource data through the feature extraction submodel, to obtain a resource feature;

[00497] perform feature extraction on the second source domain interaction data and the target domain interaction data through the feature extraction submodel, to obtain a source domain interaction feature and a target domain interaction feature; and

[00498] determine, by the recommendation prediction submodel, the recommendation prediction result of the target resource based on the object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature.

[00499] In some embodiments, referring to FIG. 16, the feature extraction submodel includes a feature extraction network, a feature fusion network, and a first attention network, and the first attention network includes the first mapping matrix. The prediction module 1504 is configured to:

[00500] perform, by the feature extraction network, feature extraction on the second source domain interaction data to obtain the initial source domain interaction feature, and perform feature extraction on the target domain interaction data to obtain the initial target domain interaction feature;

[00501] fuse the initial source domain interaction feature and the initial target domain

interaction feature through the feature fusion network, to obtain the first fused interaction feature;

[00502] multiply the first fused interaction feature by the first mapping matrix through the first attention network, to obtain the first query feature, the first key feature, and the first value feature, and fuse the first query feature, the first key feature, and the first value feature, to obtain the second fused interaction feature; and

[00503] determine the source domain interaction feature and the target domain interaction feature based on the second fused interaction feature.

[00504] In some embodiments, referring to FIG. 16, the feature extraction submodel further includes a second attention network, and the second attention network includes the second mapping matrix. The prediction module 1504 is configured to:

[00505] split the second fused interaction feature to obtain an intermediate source domain interaction feature;

[00506] multiply, by the second attention network, the resource feature by the second mapping matrix, to obtain the second query feature, and multiply the intermediate source domain interaction feature by the second mapping matrix, to obtain the second key feature and the second value feature; and

[00507] fuse, by the second attention network, the second query feature, the second key feature, and the second value feature, to obtain the source domain interaction feature.

[00508] In some embodiments, referring to FIG. 16, the feature extraction submodel further includes a third attention network, and the third attention network includes the third mapping matrix. The prediction module 1504 is configured to:

[00509] split the second fused interaction feature to obtain the intermediate target domain interaction feature;

[00510] multiply, by the third attention network, the resource feature by the third mapping matrix, to obtain the third query feature, and multiply the intermediate target domain interaction feature by the third mapping matrix, to obtain the third key feature and the third value feature; and

[00511] fuse, by the third attention network, the third query feature, the third key feature, and the third value feature, to obtain the target domain interaction feature.

[00512] In some embodiments, referring to FIG. 16, the apparatus further includes:

[00513] a recommendation module 1505, configured to recommend the target resource to the object if the recommendation prediction result satisfies a recommendation condition.

[00514] The resource recommendation apparatus according to the foregoing embodiment is illustrated only with an example of division of the foregoing function modules. In practical applications, the foregoing functions may be allocated to and completed by different function modules according to requirements. That is, an internal structure of the computer device is divided into different function modules to complete all or some of the functions described above. In addition, the resource recommendation apparatus according to the foregoing embodiment and the resource recommendation method embodiments belong to the same concept. For the specific implementation process, refer to the method embodiments. Details are not described herein again.

[00515] FIG. 17 is a schematic structural diagram of an apparatus for training a resource recommendation model according to an embodiment of this disclosure. Referring to FIG. 17, the apparatus includes:

[00516] a first acquiring module 1701, configured to acquire sample object data of a sample object, sample resource data of a sample resource, and a sample tag, the sample resource belonging to a target domain, the sample tag being configured to indicate a real interaction status between the sample object and the sample resource after the sample resource is recommended to the sample object, and the target domain being any domain;

[00517] a second acquiring module 1702, configured to acquire first sample source domain interaction data of the sample object and sample target domain interaction data of the sample object, the first sample source domain interaction data including a plurality of sample source domain interaction items, each sample source domain interaction item referring to an interaction item between the sample object and a resource in a source domain, the sample target domain interaction data including a plurality of sample target domain interaction items, each sample target domain interaction item referring to an interaction item between the sample object and a resource in the target domain, and the source domain and the target domain belonging to different domains;

[00518] a screening module 1703, configured to determine, in the first sample source domain interaction data, at least one sample source domain interaction item associated with the target domain, to form second sample source domain interaction data;

[00519] a prediction module 1704, configured to determine, by the resource recommendation model, a recommendation prediction result of the sample resource based on the sample object data, the sample resource data, the second sample source domain interaction data, and the sample target domain interaction data, the recommendation prediction result being configured to represent a predicted interaction status between the sample object and the sample resource in a case that the sample resource is recommended to the sample object; and

[00520] a training module 1705, configured to train the resource recommendation model based on the recommendation prediction result and the sample tag.

[00521] In the apparatus for training the resource recommendation model according to this embodiment of this disclosure, when the resource recommendation model is trained, for a recommendation task of the target domain, the sample target domain interaction data of the sample object in the target domain is acquired. Considering a case that a data volume of the sample target domain interaction data may be insufficient, the sample source domain interaction data of the sample object in the source domain is additionally acquired, a part associated with the target domain is screened out from the sample source domain interaction data, then the sample target domain interaction data and the screened-out sample source domain interaction data are used as a reference to predict the recommendation prediction result using the resource recommendation model if the sample resource is recommended to the sample object, and then, the resource recommendation model is trained using the recommendation prediction result and the sample tag. On the one hand, because the sample source domain interaction data is introduced, a defect of insufficient sample target domain interaction data may be compensated for, and the impact caused by sparsity of the sample target domain interaction data is relieved, which helps improve the accuracy of the resource recommendation model. On the other hand, because only the sample source domain interaction data associated with the target domain is considered, and the sample source domain interaction data unrelated to the target domain is discarded, interference with the prediction result caused by the sample source domain interaction data unrelated to the target domain may be reduced, thereby further improving the accuracy of the resource recommendation model. In addition, the sample source domain interaction data unrelated to the target domain is filtered out, so that a volume of data that needs to be stored and processed can be effectively controlled, thereby helping save storage resources and processing resources.

[00522] In some embodiments, referring to FIG. 18, the resource recommendation model includes a feature extraction submodel and a recommendation prediction submodel. The prediction module 1704 is configured to:

[00523] perform feature extraction on the sample object data through the feature extraction submodel, to obtain a sample object feature;

[00524] perform feature extraction on the sample resource data through the feature extraction submodel, to obtain a sample resource feature;

[00525] perform feature extraction on the second sample source domain interaction data and the sample target domain interaction data through the feature extraction submodel, to obtain a

sample source domain interaction feature and a sample target domain interaction feature; and

[00526] determine, by the recommendation prediction submodel, the recommendation prediction result based on the sample object feature, the sample resource feature, the sample source domain interaction feature, and the sample target domain interaction feature.

[00527] In some embodiments, referring to FIG. 18, the sample source domain interaction item includes a source domain resource and an interaction time point of the source domain resource, the sample target domain interaction item includes a target domain resource and an interaction time point of the target domain resource, the sample source domain interaction feature includes a source domain resource feature of a source domain resource in each sample source domain interaction item, and the sample target domain interaction feature includes a target domain resource feature of a target domain resource in each sample target domain interaction item. The apparatus further includes:

[00528] a first determination module 1706, configured to: determine, for any source domain resource in the second sample source domain interaction data, a first target domain resource in the sample target domain interaction data, and determine a source domain resource feature of the source domain resource and a target domain resource feature of the first target domain resource as a first positive sample pair, an interaction time point of the first target domain resource being the closest to the interaction time point of the source domain resource.

[00529] The training module 1705 is configured to:

[00530] train the resource recommendation model based on the recommendation prediction result, the sample tag, and a similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair.

[00531] In some embodiments, referring to FIG. 18, the apparatus further includes:

[00532] a second determination module 1707, configured to determine, for any source domain resource in the second sample source domain interaction data, a second target domain resource in sample target domain interaction data of any object except the sample object, and determine a source domain resource feature of the source domain resource and a target domain resource feature of the second target domain resource as a first negative sample pair, the second target domain resource being any target domain resource in the sample target domain interaction data of any object; and determine a similarity between the source domain resource feature and the target domain resource feature in the first negative sample pair.

[00533] The training module 1705 is configured to:

[00534] train the resource recommendation model based on the recommendation prediction result, the sample tag, the similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair, and the similarity between the source domain resource feature and the target domain resource feature in the first negative sample pair.

[00535] In some embodiments, referring to FIG. 18, the sample source domain interaction item includes a source domain resource and an entity to which the source domain resource belongs, the sample target domain interaction item includes a target domain resource and an entity to which the target domain resource belongs, the sample source domain interaction feature includes a source domain resource feature of a source domain resource in each sample source domain interaction item, and the sample target domain interaction feature includes a target domain resource feature of a target domain resource in each sample target domain interaction item. The apparatus further includes:

[00536] a third determination module 1708, configured to determine, for any source domain resource in the second sample source domain interaction data, a third target domain resource in the sample target domain interaction data, and determine a source domain resource feature of the source domain resource and a target domain resource feature of the third target domain resource as a second positive sample pair, an entity to which the third target domain resource belongs being the same as the entity to which the source domain resource belongs; and determine a similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair.

[00537] The training module 1705 is configured to:

[00538] train the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair.

[00539] In some embodiments, referring to FIG. 18, the apparatus further includes:

[00540] a fourth determination module 1709, configured to determine, for any source domain resource in the second sample source domain interaction data, a fourth target domain resource, and determine a source domain resource feature of the source domain resource and a target domain resource feature of the fourth target domain resource as a second negative sample pair, the fourth target domain resource referring to any target domain resource belonging to an entity different from that of the source domain resource; and determine a similarity between the source domain resource feature and the target domain resource feature in the second negative sample pair.

[00541] The training module 1705 is configured to:

[00542] train the resource recommendation model based on the recommendation prediction result, the sample tag, the similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair, and the similarity between the source domain resource feature and the target domain resource feature in the second negative sample pair.

[00543] In some embodiments, referring to FIG. 18, the feature extraction submodel includes a feature extraction network, a feature fusion network, and a first attention network, and the first attention network includes a first mapping matrix. The prediction module 1704 is configured to:

[00544] perform, by the feature extraction network, feature extraction on the second sample source domain interaction data to obtain an initial sample source domain interaction feature, and perform feature extraction on the sample target domain interaction data to obtain an initial sample target domain interaction feature;

[00545] fuse the initial sample source domain interaction feature and the initial sample target domain interaction feature through the feature fusion network, to obtain a first sample fused interaction feature;

[00546] multiply the first sample fused interaction feature by the first mapping matrix through the first attention network, to obtain a first sample query feature, a first sample key feature, and a first sample value feature, and fuse the first sample query feature, the first sample key feature, and the first sample value feature, to obtain a second sample fused interaction feature; and

[00547] determine the sample source domain interaction feature and the sample target domain interaction feature based on the second sample fused interaction feature.

[00548] In some embodiments, referring to FIG. 18, the feature extraction submodel further includes a second attention network, and the second attention network includes a second mapping matrix. The prediction module 1704 is configured to:

[00549] split the second sample fused interaction feature to obtain an intermediate sample source domain interaction feature;

[00550] multiply, by the second attention network, the sample resource feature by the second mapping matrix, to obtain a second sample query feature, and multiply the intermediate sample source domain interaction feature by the second mapping matrix, to obtain a second sample key feature and a second sample value feature; and

[00551] fuse, by the second attention network, the second sample query feature, the second

sample key feature, and the second sample value feature, to obtain the sample source domain interaction feature.

[00552] In some embodiments, referring to FIG. 18, the feature extraction submodel further includes a third attention network, and the third attention network includes a third mapping matrix. The prediction module 1704 is configured to:

[00553] split the second sample fused interaction feature to obtain an intermediate sample target domain interaction feature;

[00554] multiply, by the third attention network, the sample resource feature by the third mapping matrix, to obtain a third sample query feature, and multiply the intermediate sample target domain interaction feature by the third mapping matrix, to obtain a third sample key feature and a third sample value feature; and

[00555] fuse, by the third attention network, the third sample query feature, the third sample key feature, and the third sample value feature, to obtain the sample target domain interaction feature.

[00556] In some embodiments, referring to FIG. 18, the screening module 1703 is configured to:

[00557] determine a plurality of target entities, each target entity referring to an entity to which the resource in the target domain belongs, and each entity referring to an object providing a resource; and

[00558] determine, for any sample source domain interaction item in the first sample source domain interaction data, that the sample source domain interaction item is associated with the target domain if an entity to which a resource in the sample source domain interaction item belongs is any target entity.

[00559] In some embodiments, referring to FIG. 18, the screening module 1703 is configured to:

[00560] determine a plurality of target entities, each target entity referring to an entity to which the resource in the target domain belongs, and each entity referring to an object providing a resource; and

[00561] determine, for any sample source domain interaction item in the first sample source domain interaction data, that the sample source domain interaction item is associated with the target domain if a similarity between the entity to which the resource in the sample source domain

interaction item belongs and any target entity is greater than a similarity threshold.

[00562] In some embodiments, referring to FIG. 18, the screening module 1703 is configured to:

[00563] acquire a target entity feature of each target entity;

[00564] perform feature extraction on the entity to which the resource in the sample source domain interaction item belongs, to obtain a sample source domain entity feature; and

[00565] determine that the sample source domain interaction item is associated with the target domain if a similarity between the sample source domain entity feature and any target entity feature is greater than the similarity threshold.

[00566] The resource recommendation apparatus according to the foregoing embodiment is illustrated only with an example of division of the foregoing function modules. In practical applications, the foregoing functions may be allocated to and completed by different function modules according to requirements. That is, an internal structure of the computer device is divided into different function modules to complete all or some of the functions described above. In addition, the apparatus for training the resource recommendation model according to the foregoing embodiment and the method embodiments for training the resource recommendation model belong to the same concept. For details of a specific implementation process, refer to the method embodiments. Details are not described herein again.

[00567] An embodiment of this disclosure further provides a computer device. The computer device includes a processor and a memory. The memory has at least one computer program stored therein, and the at least one computer program is loaded and executed by the processor, to implement the operations performed in the resource recommendation method in the foregoing embodiments.

[00568] In some embodiments, the computer device is provided as a terminal. FIG. 19 is a schematic structural diagram of a terminal 1900 according to an exemplary embodiment of this disclosure.

[00569] The terminal 1900 includes: a processor 1901 and a memory 1902.

[00570] The processor 1901 may include one or more processing cores, such as a 4-core processor or an 8-core processor. The processor 1901 may be implemented in at least one hardware form of digital signal processing (DSP), a field programmable gate array (FPGA), and a programmable logic array (PLA). The processor 1901 may also include a main processor and a coprocessor. The main processor is configured to process data in an awake state, also referred to as

a central processing unit (CPU). The coprocessor is a low-power processor configured to process data in a standby state. In some embodiments, the processor 1901 may have a graphics processing unit (GPU, an interactor for image processing) integrated therein. The GPU is configured to render and draw content that needs to be displayed on a display screen. In some embodiments, the processor 1901 may also include an artificial intelligence (AI) processor. The AI processor is configured to process a computing operation related to machine learning.

[00571] The memory 1902 may include one or more computer-readable storage media which may be non-transitory. The memory 1902 may alternatively include a high-speed random access memory and a non-volatile memory such as one or more magnetic disk storage devices and flash storage devices. In some embodiments, the non-transitory computer-readable storage medium in the memory 1902 is configured to store at least one computer program. The at least one computer program is used by the processor 1901 to implement the resource recommendation method or the method for training a resource recommendation model in the method embodiments of this disclosure.

[00572] In some embodiments, the terminal 1900 may alternatively include: a peripheral device interface 1903 and at least one peripheral device. The processor 1901, the memory 1902, and the peripheral device interface 1903 may be connected through a bus or a signal line. Each peripheral device may be connected to the peripheral device interface 1903 through a bus, a signal line, or a circuit board. In some embodiments, the peripheral device includes: at least one of a radio frequency circuit 1904, a display screen 1905, a camera component 1906, an audio circuit 1907, or a power supply 1908.

[00573] The peripheral device interface 1903 may be configured to connect at least one input/output (I/O)-related peripheral device to the processor 1901 and the memory 1902. In some embodiments, the processor 1901, the memory 1902, and the peripheral device interface 1903 are integrated on the same chip or the same circuit board. In some other embodiments, any one or two of the processor 1901, the memory 1902, and the peripheral device interface 1903 may be implemented on an independent chip or circuit board, which is not limited in this embodiment.

[00574] The radio frequency circuit 1904 is configured to receive and transmit a radio frequency (RF) signal, which is also referred to as an electromagnetic signal. The radio frequency circuit 1904 communicates with a communication network and another communication device through the electromagnetic signal. The radio frequency circuit 1904 converts an electrical signal into an electromagnetic signal for sending, or converts a received electromagnetic signal into an electrical signal. In some embodiments, the radio frequency circuit 1904 includes: an antenna

system, an RF transceiver, one or more amplifiers, a tuner, an oscillator, a digital signal processor, a codec chip set, a subscriber identity module card, and the like. The radio frequency circuit 1904 may communicate with another device through at least one wireless communication protocol.

[00575] The display screen 1905 is configured to display a user interface (UI). The UI may include graphics, text, icons, videos, and any combination thereof. When the display screen 1905 is a touch display screen, the display screen 1905 further has a capability of acquiring a touch signal on or above a surface of the display screen 1905. The touch signal may be inputted, as a control signal, into the processor 1901 for processing. In this case, the display screen 1905 may be further configured to provide a virtual button and/or a virtual keyboard, which is also referred to as a soft button and/or a soft keyboard. In some embodiments, one display screen 1905 may be arranged on a front panel of the terminal 1900. In some other embodiments, at least two display screens 1905 may be respectively arranged on different surfaces of the terminal 1900 or may be folded. In still other embodiments, the display screen 1905 may be a flexible display screen arranged on a curved surface or a folded surface of the terminal 1900.

[00576] The camera component 1906 is configured to collect images or videos. In some embodiments, the camera component 1906 includes a front-facing camera and a rear-facing camera. The front-facing camera is arranged on the front panel of the terminal 1900, and the rear-facing camera is arranged on a back surface of the terminal 1900. In some embodiments, at least two rear-facing cameras are arranged, which are respectively any of a main camera, a depth-of-field camera, a wide-angle camera, or a telephoto camera, to achieve a background blur function through fusion of the main camera and the depth-of-field camera, a function of panoramic photographing and virtual reality (VR) photographing through fusion of the main camera and the wide-angle camera, or other fused photographing functions. In some embodiments, the camera component 1906 may further include a flash. The flash may be a single-color-temperature flash or a dual-color-temperature flash. The dual-color-temperature flash is a combination of a warm-light flash and a cold-light flash, and may be configured to perform light compensation at different color temperatures.

[00577] The audio circuit 1907 may include a microphone and a speaker. The microphone is configured to collect sound waves of a user and an environment, and convert the sound waves into electrical signals for input to the processor 1901 for processing, or for input to the radio frequency circuit 1904 for implementing voice communication. For the purpose of stereo collection or noise reduction, a plurality of microphones may be respectively arranged at different parts of the terminal 1900. The microphone may be further an array microphone or an omnidirectional pickup

microphone. The speaker is configured to convert the electrical signal from the processor 1901 or the radio frequency circuit 1904 into sound waves. The speaker may be a conventional thin-film speaker or a piezoelectric ceramic speaker. When the speaker is the piezoelectric ceramic speaker, the speaker can not only convert an electrical signal into sound waves audible to a human being, but also convert an electrical signal into sound waves inaudible to the human being for ranging and other purposes. In some embodiments, the audio circuit 1907 may further include an earphone jack.

[00578] The power supply 1908 is configured to supply power to components in the terminal 1900. The power supply 1908 may be an alternating current source, a direct current source, a primary battery, or a rechargeable battery. When the power supply 1908 includes the rechargeable battery, the rechargeable battery may support wired charging or wireless charging. The rechargeable battery may be further configured to support a fast-charging technology.

[00579] A person skilled in the art may understand that the structure shown in FIG. 19 does not constitute a limitation on the terminal 1900. The terminal may include more or fewer components than those shown in the figure, or some merged components, or different component arrangements.

[00580] In some embodiments, the computer device is provided as a server. FIG. 20 is a schematic structural diagram of a server according to an embodiment of this disclosure. The server 2000 may vary greatly due to differences in configuration or performance, and may include one or more central processing units (CPUs) 2001 and one or more memories 2002. The memory 2002 has at least one computer program stored therein, the at least one computer program being loaded and executed by the processor 2001 to implement the method according to the foregoing method embodiments. Certainly, the server may further include parts such as a wired or wireless network interface, a keyboard, and an input/output interface, to perform input and output. The server may further include another part configured to implement a device function. Details are not described herein again.

[00581] An embodiment of this disclosure further provides a computer-readable storage medium. The computer-readable storage medium has at least one computer program stored therein, and the at least one computer program is loaded and executed by a processor to implement the operations performed in the resource recommendation method in the foregoing embodiments, or implement the operations performed in the method for training a resource recommendation model in the foregoing embodiments.

[00582] An embodiment of this disclosure further provides a computer program product, including a computer program. The computer program is loaded and executed by a processor, to

implement the operations performed in the resource recommendation method in the foregoing embodiments, or implement the operations performed in the method for training a resource recommendation model in the foregoing embodiments.

[00583] A person of ordinary skill in the art may understand that all or part of the operations of the foregoing embodiments may be implemented by hardware, or may be implemented by a program instructing related hardware. The program may be stored in a computer-readable storage medium. The storage medium mentioned above may be a read-only memory, a magnetic disk, an optical disc, or the like.

[00584] The above descriptions are merely exemplary embodiments of the embodiments of this disclosure, and are not intended to limit the embodiments of this disclosure. Any modification, equivalent replacement, improvement, and the like made within the spirit and principle of the embodiments of this disclosure fall within the protection scope of this disclosure.

CLAIMS

What is claimed is:

1. A method for resource recommendation, comprising:

acquiring object data of an object and resource data of a target resource, the target resource belonging to a target domain, and the target domain being any domain;

acquiring first source domain interaction data of the object and target domain interaction data of the object, the first source domain interaction data comprising a plurality of source domain interaction items, each source domain interaction item referring to an interaction item between the object and a resource in a source domain, the target domain interaction data comprising a plurality of target domain interaction items, each target domain interaction item referring to an interaction item between the object and a resource in the target domain, and the source domain and the target domain belonging to different domains;

determining, in the first source domain interaction data, at least one source domain interaction item associated with the target domain, to form second source domain interaction data; and

determining a recommendation prediction result of the target resource based on the object data, the resource data, the second source domain interaction data, and the target domain interaction data, the recommendation prediction result being configured to represent an interaction status between the object and the target resource in a case that the target resource is recommended to the object.

2. The method according to claim 1, wherein determining, in the first source domain interaction data, the at least one source domain interaction item associated with the target domain comprises:

determining a plurality of target entities, each target entity referring to an entity to which a resource in the target domain belongs; and

determining, for any source domain interaction item in the first source domain interaction data, that the source domain interaction item is associated with the target domain if an entity to which a resource in the source domain interaction item belongs is any target entity.

3. The method according to claim 1, wherein determining, in the first source domain interaction data, the at least one source domain interaction item associated with the target domain comprises:

determining a plurality of target entities, each target entity referring to an entity to which a resource in the target domain belongs; and

determining, for any source domain interaction item in the first source domain interaction data, that the source domain interaction item is associated with the target domain if a similarity between an entity to which a resource in the source domain interaction item belongs and any target entity is greater than a similarity threshold.

4. The method according to any one of claims 1 to 3, wherein determining the recommendation prediction result of the target resource based on the object data, the resource data, the second source domain interaction data, and the target domain interaction data comprises:

performing feature extraction on the object data to obtain an object feature;

performing feature extraction on the resource data to obtain a resource feature;

performing feature extraction on the second source domain interaction data and the target domain interaction data, to obtain a source domain interaction feature and a target domain interaction feature; and

determining the recommendation prediction result of the target resource based on the object feature, the resource feature, the source domain interaction feature, and the target domain interaction feature.

5. The method according to claim 4, wherein performing the feature extraction on the second source domain interaction data and the target domain interaction data, to obtain the source domain interaction feature and the target domain interaction feature comprises:

performing feature extraction on the second source domain interaction data to obtain an initial source domain interaction feature, and performing feature extraction on the target domain interaction data to obtain an initial target domain interaction feature;

fusing the initial source domain interaction feature and the initial target domain interaction feature, to obtain a first fused interaction feature;

multiplying the first fused interaction feature by a first mapping matrix, to obtain a first query feature, a first key feature, and a first value feature;

fusing the first query feature, the first key feature, and the first value feature, to obtain a second fused interaction feature; and

determining the source domain interaction feature and the target domain interaction feature based on the second fused interaction feature.

6. The method according to claim 5, wherein determining the source domain interaction feature based on the second fused interaction feature comprises:

splitting the second fused interaction feature to obtain an intermediate source domain interaction feature;

multiplying the resource feature by a second mapping matrix, to obtain a second query feature;

multiplying the intermediate source domain interaction feature by the second mapping matrix, to obtain a second key feature and a second value feature; and

fusing the second query feature, the second key feature, and the second value feature, to obtain the source domain interaction feature.

7. The method according to claim 5 or 6, wherein determining the target domain interaction feature based on the second fused interaction feature comprises:

splitting the second fused interaction feature to obtain an intermediate target domain interaction feature;

multiplying the resource feature by a third mapping matrix, to obtain a third query feature;

multiplying the intermediate target domain interaction feature by the third mapping matrix, to obtain a third key feature and a third value feature; and

fusing the third query feature, the third key feature, and the third value feature, to obtain the target domain interaction feature.

8. The method according to any one of claims 1 to 7, wherein the resource recommendation model comprises a feature extraction submodel and a recommendation prediction submodel, and determining the recommendation prediction result of the target resource based on the object data, the resource data, the second source domain interaction data, and the target domain interaction data comprises:

performing feature extraction on the object data through the feature extraction submodel, to obtain an object feature;

performing feature extraction on the resource data through the feature extraction submodel, to obtain a resource feature;

performing feature extraction on the second source domain interaction data and the target domain interaction data through the feature extraction submodel, to obtain a source domain interaction feature and a target domain interaction feature; and

determining, by the recommendation prediction submodel, the recommendation prediction result of the target resource based on the object feature, the resource feature, the source domain

interaction feature, and the target domain interaction feature.

9. The method according to claim 8, wherein the feature extraction submodel comprises a feature extraction network, a feature fusion network, and a first attention network, and the first attention network comprises a first mapping matrix; and performing the feature extraction on the second source domain interaction data and the target domain interaction data through the feature extraction submodel, to obtain the source domain interaction feature and the target domain interaction feature comprises:

performing, by the feature extraction network, feature extraction on the second source domain interaction data, to obtain an initial source domain interaction feature, and performing feature extraction on the target domain interaction data, to obtain an initial target domain interaction feature;

fusing the initial source domain interaction feature and the initial target domain interaction feature through the feature fusion network, to obtain a first fused interaction feature;

multiplying the first fused interaction feature by the first mapping matrix through the first attention network, to obtain a first query feature, a first key feature, and a first value feature, and fusing the first query feature, the first key feature, and the first value feature, to obtain a second fused interaction feature; and

determining the source domain interaction feature and the target domain interaction feature based on the second fused interaction feature.

10. A method for training a resource recommendation model, comprising:

acquiring sample object data of a sample object, sample resource data of a sample resource, and a sample tag, the sample resource belonging to a target domain, the sample tag being configured to indicate a real interaction status between the sample object and the sample resource after the sample resource is recommended to the sample object, and the target domain being any domain;

acquiring first sample source domain interaction data of the sample object and sample target domain interaction data of the sample object, the first sample source domain interaction data comprising a plurality of sample source domain interaction items, each sample source domain interaction item referring to an interaction item between the sample object and a resource in a source domain, the sample target domain interaction data comprising a plurality of sample target domain interaction items, each sample target domain interaction item referring to an interaction item between the sample object and a resource in the target domain, and the source domain and the

target domain belonging to different domains;

determining, in the first sample source domain interaction data, at least one sample source domain interaction item associated with the target domain, to form second sample source domain interaction data;

determining, by the resource recommendation model, a recommendation prediction result of the sample resource based on the sample object data, the sample resource data, the second sample source domain interaction data, and the sample target domain interaction data, the recommendation prediction result being configured to represent a predicted interaction status between the sample object and the sample resource in a case that the sample resource is recommended to the sample object; and

training the resource recommendation model based on the recommendation prediction result and the sample tag.

11. The method according to claim 10, wherein the resource recommendation model comprises a feature extraction submodel and a recommendation prediction submodel; and determining, by the resource recommendation model, the recommendation prediction result of the sample resource based on the sample object data, the sample resource data, the second sample source domain interaction data, and the sample target domain interaction data comprises:

performing feature extraction on the sample object data through the feature extraction submodel, to obtain a sample object feature;

performing feature extraction on the sample resource data through the feature extraction submodel, to obtain a sample resource feature;

performing feature extraction on the second sample source domain interaction data and the sample target domain interaction data through the feature extraction submodel, to obtain a sample source domain interaction feature and a sample target domain interaction feature; and

determining, by the recommendation prediction submodel, the recommendation prediction result based on the sample object feature, the sample resource feature, the sample source domain interaction feature, and the sample target domain interaction feature.

12. The method according to claim 10 or 11, wherein the sample source domain interaction item comprises a source domain resource and an interaction time point of the source domain resource, the sample target domain interaction item comprises a target domain resource and an interaction time point of the target domain resource, the sample source domain interaction feature comprises a source domain resource feature of a source domain resource in each sample source

domain interaction item, and the sample target domain interaction feature comprises a target domain resource feature of a target domain resource in each sample target domain interaction item;

the method further comprises:

determining, for any source domain resource in the second sample source domain interaction data, a first target domain resource in the sample target domain interaction data, and determining a source domain resource feature of the source domain resource and a target domain resource feature of the first target domain resource as a first positive sample pair, an interaction time point of the first target domain resource being closest to the interaction time point of the source domain resource; and

determining a similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair; and

training the resource recommendation model based on the recommendation prediction result and the sample tag comprises:

training the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair.

13. The method according to claim 12, further comprising:

determining, for any source domain resource in the second sample source domain interaction data, a second target domain resource in sample target domain interaction data of any object except the sample object, and determining a source domain resource feature of the source domain resource and a target domain resource feature of the second target domain resource as a first negative sample pair, the second target domain resource being any target domain resource in the sample target domain interaction data of any object; and

determining a similarity between the source domain resource feature and the target domain resource feature in the first negative sample pair; and

training the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair comprises:

training the resource recommendation model based on the recommendation prediction result, the sample tag, the similarity between the source domain resource feature and the target domain resource feature in the first positive sample pair, and the similarity between the source domain

resource feature and the target domain resource feature in the first negative sample pair.

14. The method according to claim 10 or 11, wherein the sample source domain interaction item comprises a source domain resource and an entity to which the source domain resource belongs, the sample target domain interaction item comprises a target domain resource and an entity to which the target domain resource belongs, the sample source domain interaction feature comprises a source domain resource feature of a source domain resource in each sample source domain interaction item, and the sample target domain interaction feature comprises a target domain resource feature of a target domain resource in each sample target domain interaction item; the method further comprises:

determining, for any source domain resource in the second sample source domain interaction data, a third target domain resource in the sample target domain interaction data, and determining a source domain resource feature of the source domain resource and a target domain resource feature of the third target domain resource as a second positive sample pair, an entity to which the third target domain resource belongs being the same as an entity to which the source domain resource belongs; and

determining a similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair; and

training the resource recommendation model based on the recommendation prediction result and the sample tag comprises:

training the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair.

15. The method according to claim 14, further comprising:

determining, for any source domain resource in the second sample source domain interaction data, a fourth target domain resource, and determining a source domain resource feature of the source domain resource and a target domain resource feature of the fourth target domain resource as a second negative sample pair, the fourth target domain resource referring to any target domain resource belonging to an entity different from that of the source domain resource; and

determining a similarity between the source domain resource feature and the target domain resource feature in the second negative sample pair; and

training the resource recommendation model based on the recommendation prediction result, the sample tag, and the similarity between the source domain resource feature and the target domain

resource feature in the second positive sample pair comprises:

training the resource recommendation model based on the recommendation prediction result, the sample tag, the similarity between the source domain resource feature and the target domain resource feature in the second positive sample pair, and the similarity between the source domain resource feature and the target domain resource feature in the second negative sample pair.

16. A resource recommendation apparatus, comprising:

a first acquiring module, configured to acquire object data of an object and resource data of a target resource, the target resource belonging to a target domain, and the target domain being any domain;

a second acquiring module, configured to acquire first source domain interaction data of the object and target domain interaction data of the object, the first source domain interaction data comprising a plurality of source domain interaction items, each source domain interaction item referring to an interaction item between the object and a resource in a source domain, the target domain interaction data comprising a plurality of target domain interaction items, each target domain interaction item referring to an interaction item between the object and a resource in the target domain, and the source domain and the target domain belonging to different domains;

a screening module, configured to determine, in the first source domain interaction data, at least one source domain interaction item associated with the target domain, to form second source domain interaction data; and

a prediction module, configured to determine a recommendation prediction result of the target resource based on the object data, the resource data, the second source domain interaction data, and the target domain interaction data, the recommendation prediction result being configured to represent an interaction status between the object and the target resource in a case that the target resource is recommended to the object.

17. An apparatus for training a resource recommendation model, comprising:

a first acquiring module, configured to acquire sample object data of a sample object, sample resource data of a sample resource, and a sample tag, the sample resource belonging to a target domain, the sample tag being configured to indicate a real interaction status between the sample object and the sample resource after the sample resource is recommended to the sample object, and the target domain being any domain;

a second acquiring module, configured to acquire first sample source domain interaction data of the sample object and sample target domain interaction data of the sample object, the first sample

source domain interaction data comprising a plurality of sample source domain interaction items, each sample source domain interaction item referring to an interaction item between the sample object and a resource in a source domain, the sample target domain interaction data comprising a plurality of sample target domain interaction items, each sample target domain interaction item referring to an interaction item between the sample object and a resource in the target domain, and the source domain and the target domain belonging to different domains;

a screening module, configured to determine, in the first sample source domain interaction data, at least one sample source domain interaction item associated with the target domain, to form second sample source domain interaction data;

a prediction module, configured to determine, by the resource recommendation model, a recommendation prediction result of the sample resource based on the sample object data, the sample resource data, the second sample source domain interaction data, and the sample target domain interaction data, the recommendation prediction result being configured to represent a predicted interaction status between the sample object and the sample resource in a case that the sample resource is recommended to the sample object; and

a training module, configured to train the resource recommendation model based on the recommendation prediction result and the sample tag.

18. A computer device, comprising a processor and a memory, the memory having at least one computer program stored therein, and the at least one computer program being loaded and executed by the processor to implement the operations performed in the resource recommendation method according to any one of claims 1 to 9, or the operations performed in the method for training a resource recommendation model according to any one of claims 10 to 15.

19. A computer-readable storage medium, having at least one computer program stored therein, the at least one computer program being loaded and executed by a processor to implement the operations performed in the resource recommendation method according to any one of claims 1 to 9, or the operations performed in the method for training a resource recommendation model according to any one of claims 10 to 15.

20. A computer program product, comprising a computer program, the computer program being loaded and executed by a processor, to implement the operations performed in the resource recommendation method according to any one of claims 1 to 9, or the operations performed in the method for training a resource recommendation model according to any one of claims 10 to 15.