

CLAIMS

What is claimed is:

1. A computer-implemented recommendation method based on automatic feature grouping, the method being performed by one or more processors and comprising:

5 obtaining a plurality of candidate recommended objects and a plurality of association features of each of the plurality of candidate recommended objects;

performing multi-order automatic feature grouping on the plurality of association features of each of the plurality of candidate recommended objects using the one or more processors, to obtain a multi-order feature interaction set of each candidate recommended object, wherein each-order
10 feature interaction set in the multi-order feature interaction set of each of the plurality of candidate recommended objects comprises one or more feature interaction groups, each of the one or more feature interaction groups comprises at least one of the plurality of association features of the candidate recommended object, in each feature interaction group in a k^{th} -order feature interaction set in the multi-order feature interaction set, a quantity of association features used in a non-linear
15 mathematical operation is k , and k is an integer greater than 0, the non-linear mathematical operation being a vector inner product or matrix multiplication;

obtaining an interaction feature contribution value of each candidate recommended object through calculation based on the plurality of association features in the multi-order feature interaction set of each of the plurality of candidate recommended objects;

20 obtaining a prediction score of each candidate recommended object through calculation based on the interaction feature contribution value of each of the plurality of candidate recommended objects; and

determining one or more corresponding candidate recommended objects as one or more target recommended objects, each of the one or more corresponding candidate recommended objects
25 having a prediction score higher than at least some of the other candidate recommended objects in the plurality of candidate recommended objects;

wherein the performing multi-order automatic feature grouping on the plurality of association features of each of the plurality of candidate recommended objects, to obtain a multi-order feature interaction set of each candidate recommended object comprises:

30 for k^{th} -order feature interaction of each candidate recommended object, obtaining an

allocation probability of each of the plurality of association features of the candidate recommended object; and

obtaining the k^{th} -order feature interaction set of the candidate recommended object based on the allocation probability of each of the plurality of association features of the candidate recommended object;

wherein the automatic feature grouping reduces a computational complexity from enumeration of all possible feature combinations to selective processing of allocated feature groups, thereby reducing processing requirements of the one or more processors.

2. The method according to claim 1, wherein the obtaining an interaction feature contribution value of each candidate recommended object through calculation based on the plurality of association features in the multi-order feature interaction set of each of the plurality of candidate recommended objects comprises:

for the multi-order feature interaction set of each candidate recommended object,

obtaining a k^{th} -order interaction result of each feature interaction group through calculation based on a plurality of association features of each feature interaction group in the k^{th} -order feature interaction set; and

obtaining the interaction feature contribution value of the candidate recommended object through calculation based on a corresponding-order interaction result of a feature interaction group in the multi-order feature interaction set of the candidate recommended object.

3. The method according to claim 2, wherein the obtaining a k^{th} -order interaction result of each feature interaction group through calculation based on a plurality of association features of each feature interaction group in the k^{th} -order feature interaction set comprises:

inputting the plurality of association features of each feature interaction group in the k^{th} -order feature interaction set to a feature interaction model for calculation, to obtain the k^{th} -order interaction result of each feature interaction group.

4. The method according to claim 3, wherein the inputting the plurality of association features of each feature interaction group in the k^{th} -order feature interaction set to a feature interaction model for calculation, to obtain the k^{th} -order interaction result of the feature interaction group comprises:

performing the following steps on each feature interaction group in the k^{th} -order feature interaction set:

obtaining a feature vector of each association feature of the interaction group and a weight corresponding to the feature vector;

performing weighted summation on the feature vector of each association feature of the feature interaction group and the weight corresponding to the feature vector, to obtain a feature value of the feature interaction group; and

determining the k^{th} -order interaction result of the feature interaction group based on the feature vector of each association feature of the feature interaction group, the weight corresponding to the feature vector, and the feature value of the feature interaction group.

5. The method according to any one of claims 2 to 4, wherein the obtaining the interaction feature contribution value of the candidate recommended object through calculation based on a corresponding-order interaction result of a feature interaction group in the multi-order feature interaction set of the candidate recommended object comprises:

obtaining an interaction feature vector based on the corresponding-order interaction result of the feature interaction group in the multi-order feature interaction set of the candidate recommended object; and

inputting the interaction feature vector to a neural network model for calculation, to obtain the interaction feature contribution value of the candidate recommended object, wherein the neural network model is obtained based on a fully connected neural network.

6. The method according to any one of claims 1 to 5, wherein the performing multi-order automatic feature grouping on the plurality of association features of each of the plurality of candidate recommended objects, to obtain a multi-order feature interaction set of each candidate recommended object comprises:

inputting the plurality of association features of each of the plurality of candidate recommended objects to an automatic feature grouping model for processing, to obtain the multi-order feature interaction set of each candidate recommended object.

7. The method according to claim 6, wherein the allocation probability of each of the plurality of association features of the candidate recommended object is a probability that each association feature is allocated to a j^{th} feature interaction group in the k^{th} -order feature interaction set, and the j^{th} feature interaction group is any feature interaction group in the k^{th} -order feature interaction set.

8. The method according to claim 7, wherein the obtaining the k^{th} -order feature interaction set of the candidate recommended object based on the allocation probability of each of the plurality

of association features of the candidate recommended object comprises:

determining an allocation value of the association feature based on the allocation probability of each of the plurality of association features of the candidate recommended object, wherein the allocation value is a probability that each association feature is allocated to the j^{th} feature

5 interaction group in the k^{th} -order feature interaction set; and

if the allocation value of the association feature is greater than a preset threshold, allocating the association feature to the j^{th} feature interaction group in the k^{th} -order feature interaction set; or

if the allocation value of the association feature is not greater than a preset threshold, skipping allocating the association feature to the j^{th} feature interaction group in the k^{th} -order feature
10 interaction set.

9. A recommendation apparatus based on automatic feature grouping, comprising:

a memory, configured to store instructions; and

a processor, coupled to the memory, wherein

when executing the instructions, the processor performs the method:

15 obtaining a plurality of candidate recommended objects and a plurality of association features of each of the plurality of candidate recommended objects;

performing multi-order automatic feature grouping on the plurality of association features of each of the plurality of candidate recommended objects, to obtain a multi-order feature interaction set of each candidate recommended object, wherein each-order feature interaction set in the multi-

20 order feature interaction set of each of the plurality of candidate recommended objects comprises one or more feature interaction groups, each of the one or more feature interaction groups comprises at least one of the plurality of association features of the candidate recommended object, in each feature interaction group in a k^{th} -order feature interaction set in the multi-order feature interaction set, a quantity of association features used in a non-linear mathematical operation is k ,
25 and k is an integer greater than 0, the non-linear mathematical operation being a vector inner product or matrix multiplication;

obtaining an interaction feature contribution value of each candidate recommended object through calculation based on the plurality of association features in the multi-order feature interaction set of each of the plurality of candidate recommended objects;

30 obtaining a prediction score of each candidate recommended object through calculation based on the interaction feature contribution value of each of the plurality of candidate recommended

objects; and

determining one or more corresponding candidate recommended objects as one or more target recommended objects, each of the one or more corresponding candidate recommended objects having a prediction score higher than at least some of the other candidate recommended objects in the plurality of candidate recommended objects;

wherein the performing multi-order automatic feature grouping on the plurality of association features of each of the plurality of candidate recommended objects, to obtain a multi-order feature interaction set of each candidate recommended object comprises:

for k^{th} -order feature interaction of each candidate recommended object, obtaining an allocation probability of each of the plurality of association features of the candidate recommended object; and

obtaining the k^{th} -order feature interaction set of the candidate recommended object based on the allocation probability of each of the plurality of association features of the candidate recommended object

wherein the automatic feature grouping reduces a computational complexity from enumeration of all possible feature combinations to selective processing of allocated feature groups, thereby reducing processing requirements of the one or more processors.

10. The apparatus according to claim 9, wherein the obtaining an interaction feature contribution value of each candidate recommended object through calculation based on the plurality of association features in the multi-order feature interaction set of each of the plurality of candidate recommended objects comprises:

for the multi-order feature interaction set of each candidate recommended object,

obtaining a k^{th} -order interaction result of each feature interaction group through calculation based on a plurality of association features of each feature interaction group in the k^{th} -order feature interaction set; and

obtaining the interaction feature contribution value of the candidate recommended object through calculation based on a corresponding-order interaction result of a feature interaction group in the multi-order feature interaction set of the candidate recommended object.

11. The apparatus according to claim 10, wherein the obtaining a k^{th} -order interaction result of each feature interaction group through calculation based on a plurality of association features of each feature interaction group in the k^{th} -order feature interaction set comprises:

inputting the plurality of association features of each feature interaction group in the k^{th} -order feature interaction set to a feature interaction model for calculation, to obtain the k^{th} -order interaction result of each feature interaction group.

12. The apparatus according to claim 11, wherein the inputting the plurality of association features of each feature interaction group in the k^{th} -order feature interaction set to a feature interaction model for calculation, to obtain the k^{th} -order interaction result of the feature interaction group comprises:

performing the following steps on each feature interaction group in the k^{th} -order feature interaction set:

obtaining a feature vector of each association feature of the interaction group and a weight corresponding to the feature vector;

performing weighted summation on the feature vector of each association feature of the feature interaction group and the weight corresponding to the feature vector, to obtain a feature value of the feature interaction group; and

determining the k^{th} -order interaction result of the feature interaction group based on the feature vector of each association feature of the feature interaction group, the weight corresponding to the feature vector, and the feature value of the feature interaction group.

13. The apparatus according to any one of claims 10 to 12, wherein the obtaining the interaction feature contribution value of the candidate recommended object through calculation based on a corresponding-order interaction result of a feature interaction group in the multi-order feature interaction set of the candidate recommended object comprises:

obtaining an interaction feature vector based on the corresponding-order interaction result of the feature interaction group in the multi-order feature interaction set of the candidate recommended object; and

inputting the interaction feature vector to a neural network model for calculation, to obtain the interaction feature contribution value of the candidate recommended object, wherein the neural network model is obtained based on a fully connected neural network.

14. The apparatus according to any one of claims 9 to 13, wherein the performing multi-order automatic feature grouping on the plurality of association features of each of the plurality of candidate recommended objects, to obtain a multi-order feature interaction set of each candidate recommended object comprises:

inputting the plurality of association features of each of the plurality of candidate recommended objects to an automatic feature grouping model for processing, to obtain the multi-order feature interaction set of each candidate recommended object.

15 15. The apparatus according to claim 14, wherein the allocation probability of each of the plurality of association features of the candidate recommended object is a probability that each association feature is allocated to a j^{th} feature interaction group in the k^{th} -order feature interaction set, and the j^{th} feature interaction group is any feature interaction group in the k^{th} -order feature interaction set.

10 16. The apparatus according to claim 15, wherein the obtaining the k^{th} -order feature interaction set of the candidate recommended object based on the allocation probability of each of the plurality of association features of the candidate recommended object comprises:

15 determining an allocation value of the association feature based on the allocation probability of each of the plurality of association features of the candidate recommended object, wherein the allocation value is a probability that each association feature is allocated to the j^{th} feature interaction group in the k^{th} -order feature interaction set; and

if the allocation value of the association feature is greater than a preset threshold, allocating the association feature to the j^{th} feature interaction group in the k^{th} -order feature interaction set; or

20 if the allocation value of the association feature is not greater than a preset threshold, skipping allocating the association feature to the j^{th} feature interaction group in the k^{th} -order feature interaction set.

25 17. A chip system, wherein the chip system is applied to an electronic device, the chip system comprises one or more interface circuits and one or more processors, the interface circuit and the processor are interconnected by using a line, the interface circuit is configured to receive a signal from a memory of the electronic device, and send the signal to the processor, the signal comprises computer instructions stored in the memory, and when the processor executes the computer instructions, the electronic device performs the method:

obtaining a plurality of candidate recommended objects and a plurality of association features of each of the plurality of candidate recommended objects;

30 performing multi-order automatic feature grouping on the plurality of association features of each of the plurality of candidate recommended objects, to obtain a multi-order feature interaction

set of each candidate recommended object, wherein each-order feature interaction set in the multi-order feature interaction set of each of the plurality of candidate recommended objects comprises one or more feature interaction groups, each of the one or more feature interaction groups comprises at least one of the plurality of association features of the candidate recommended object, in each feature interaction group in a k^{th} -order feature interaction set in the multi-order feature interaction set, a quantity of association features used in a non-linear mathematical operation is k , and k is an integer greater than 0, the non-linear mathematical operation being a vector inner product or matrix multiplication;

obtaining an interaction feature contribution value of each candidate recommended object through calculation based on the plurality of association features in the multi-order feature interaction set of each of the plurality of candidate recommended objects;

obtaining a prediction score of each candidate recommended object through calculation based on the interaction feature contribution value of each of the plurality of candidate recommended objects; and

determining one or more corresponding candidate recommended objects as one or more target recommended objects, each of the one or more corresponding candidate recommended objects having a prediction score higher than at least some of the other candidate recommended objects in the plurality of candidate recommended objects;

wherein the performing multi-order automatic feature grouping on the plurality of association features of each of the plurality of candidate recommended objects, to obtain a multi-order feature interaction set of each candidate recommended object comprises:

for k^{th} -order feature interaction of each candidate recommended object, obtaining an allocation probability of each of the plurality of association features of the candidate recommended object; and

obtaining the k^{th} -order feature interaction set of the candidate recommended object based on the allocation probability of each of the plurality of association features of the candidate recommended object

wherein the automatic feature grouping reduces a computational complexity from enumeration of all possible feature combinations to selective processing of allocated feature groups, thereby reducing processing requirements of the one or more processors.

18. The chip system according to claim 17, wherein the obtaining an interaction feature

contribution value of each candidate recommended object through calculation based on the plurality of association features in the multi-order feature interaction set of each of the plurality of candidate recommended objects comprises:

for the multi-order feature interaction set of each candidate recommended object,

5 obtaining a k^{th} -order interaction result of each feature interaction group through calculation based on a plurality of association features of each feature interaction group in the k^{th} -order feature interaction set; and

obtaining the interaction feature contribution value of the candidate recommended object through calculation based on a corresponding-order interaction result of a feature interaction group
10 in the multi-order feature interaction set of the candidate recommended object.

19. A computer storage medium, wherein the computer storage medium stores a computer program, the computer program comprises program instructions, and when executing the program instructions, a processor performs the method according to any one of claims 1 to 8.

15 20. A computer program product, comprising computer instructions, wherein when the computer instructions are run on a recommendation apparatus, the recommendation apparatus is enabled to perform the method according to any one of claims 1 to 8.