

TARGET MODEL ACQUISITION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present disclosure claims benefit of priority to Chinese Application No. 202010852192.4, filed on August 21, 2020 titled “METHOD AND DEVICE FOR ACQUIRING TARGET MODEL, ELECTRONIC EQUIPMENT, AND STORAGE MEDIUM”. Content of the Chinese Application is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to the field of information technology, and more particularly, to a method and device for acquiring a target model, electronic equipment, and a storage medium.

BACKGROUND

[0003] Transfer Learning aims at acquiring a target model by subjecting a raw model configured for executing a task to relevant processing, so as to apply the target model to a target task. With rapid development of technology such as deep learning, computer vision, etc., transfer learning has been applied to many scenes. Therefore, it has become a highly valued research topic as to how to improve performance of a target model.

SUMMARY

[0004] The present disclosure provides a method and device for acquiring a target model, electronic equipment, and a storage medium.

[0005] A first aspect of the present disclosure provides a method for acquiring a target model. The method includes: adjusting a network parameter of a raw model by pre-training the raw model using a first training sample set, the raw model including a

first sub-network configured for feature extraction; acquiring the target model using a second sub-network and at least one partial structure of the first sub-network pre-trained, the second sub-network being configured to perform a target task based on a feature extracted by the first sub-network; and adjusting a network parameter of the target model by training the target model using a second training sample set corresponding to the target task.

[0006] In some embodiments, the first sub-network includes multiple network stages. Each network stage may include at least one feature extracting block connected sequentially and configured for feature extraction.

[0007] In some embodiments, the first sub-network may include at least one branch network, and each branch network may include at least one network stage of the multiple network stages connected sequentially.

[0008] In some embodiments, acquiring the target model using the second sub-network and the at least one partial structure of the first sub-network pre-trained may include: acquiring at least one candidate sub-network using different partial structures of the first sub-network, and selecting a candidate sub-network meeting a preset condition as a selected sub-network; and acquiring the target model using the selected sub-network and the second sub-network.

[0009] In some embodiments, the preset condition may include that a preset performance condition is met with a candidate model acquired using the candidate sub-network and the second sub-network.

[0010] In some embodiments, the preset condition may further include that a number of feature extracting blocks in the candidate sub-network reaches a preset number.

[0011] In some embodiments, the at least one candidate sub-network may include at least one feature extracting block in each network stage in one branch network, and feature extracting blocks in different candidate sub-networks may be at least partially different.

[0012] In some embodiments, acquiring the at least one candidate sub-network using the different partial structures of the first sub-network, and selecting the candidate

sub-network meeting the preset condition as the selected sub-network may include: acquiring an initial pending sub-network by selecting a first feature extracting block in the each network stage in the one branch network; acquiring a candidate sub-network by adding at least one feature extracting block to a pending sub-network, an added feature extracting block being located after a selected feature extracting block in a network stage; forming candidate models using the second sub-network and respective candidate sub-networks, and selecting, as the pending sub-network, a candidate sub-network corresponding to a candidate model of best performance of multiple candidate models; in response to a number of feature extracting blocks in the pending sub-network being less than a preset number, acquiring a new candidate sub-network based on the pending sub-network, and selecting, as a new pending sub-network, a candidate sub-network corresponding to a candidate model of best performance of candidate models formed using multiple new candidate sub-networks and the second sub-network; and in response to the number of feature extracting blocks in the pending sub-network being no less than the preset number, taking the pending sub-network as the selected sub-network.

[0013] In some embodiments, acquiring the candidate sub-network by adding the at least one feature extracting block to the pending sub-network may include: taking the each network stage as a target stage, and acquiring a candidate sub-network corresponding to the target stage by increasing a number of selected feature extracting blocks in the target stage by an integer while keeping a number of selected feature extracting blocks in a network stage other than the target stage unchanged.

[0014] In some embodiments, acquiring the new candidate sub-network based on the pending sub-network may include: acquiring the new candidate sub-network by adding at least one feature extracting block to the pending sub-network, the added feature extracting block being located after the selected feature extracting block in the network stage.

[0015] In some embodiments, the preset performance condition being met with the candidate model acquired using the candidate sub-network and the second sub-network may include: acquiring, by verifying the candidate model acquired using the candidate sub-network and the second sub-network using a verification sample corresponding to the target task, a performance score of the candidate model in performing the target task; and determining whether the candidate model meets the preset performance condition

based on the performance score.

[0016] In some embodiments, the first sub-network includes a first number of feature extracting blocks, and the first sub-network includes a second number of network stages, the preset number being less than the first number, and greater than or equal to the second number.

[0017] In some embodiments, the first sub-network may include a branch network. The branch network may include multiple network stages connected sequentially. Each network stage may include at least one feature extracting block connected sequentially. Adjusting the network parameter of the raw model by pre-training the raw model using the first training sample set may include: prior to each training, selecting, using a preset selection strategy, a feature extracting block in the each network stage; and adjusting, by training a portion of the each network stage located before the selected feature extracting block using the first training sample set, a network parameter of the portion of the each network stage located before the selected feature extracting block.

[0018] In some embodiments, the first sub-network may include multiple branch networks. Each branch network may include at least one network stage connected sequentially. Each network stage may include at least one feature extracting block connected sequentially. Adjusting the network parameter of the raw model by pre-training the raw model using the first training sample set may include: prior to each training, selecting, using a preset selection strategy, a branch network in the first sub-network, and selecting a feature extracting block in each network stage in the selected branch network; and adjusting, by training a portion of the each network stage located before the selected feature extracting block using the first training sample set, a network parameter of the portion of the each network stage located before the selected feature extracting block.

[0019] In some embodiments, prior to the each training, selecting, using the preset selection strategy, the branch network in the first sub-network, and selecting the feature extracting block in the each network stage in the selected branch network, may include: randomly selecting the branch network in the first sub-network, and selecting the feature extracting block in the each network stage in the selected branch network.

[0020] In some embodiments, prior to the each training, selecting, using the preset

selection strategy, the branch network in the first sub-network, and selecting the feature extracting block in the each network stage in the selected branch network, may include: selecting a branch network containing a greatest number of feature extracting blocks in the first sub-network, and selecting the feature extracting block in the each network stage in the selected branch network.

[0021] In some embodiments, the first sub-network may further include a down-sampling layer between adjacent network stages.

[0022] In some embodiments, the at least one feature extracting block may include a convolution layer, an activation layer, and a Batch Normalization (BN) layer connected sequentially.

[0023] In some embodiments, the method may further include: after adjusting the network parameter of the raw model by pre-training the raw model using the first training sample set, and before acquiring the target model using the second sub-network and the at least one partial structure of the first sub-network pre-trained, adjusting the network parameter of the raw model by training the raw model using the second training sample set.

[0024] In some embodiments, the method may further include: after acquiring the target model using the second sub-network and the at least one partial structure of the first sub-network pre-trained, and before adjusting the network parameter of the target model by training the target model using the second training sample set corresponding to the target task, adjusting the network parameter of the target model by training the target model using the first training sample set.

[0025] In some embodiments, the raw model may further include a third sub-network configured to perform a preset task based on an extracted feature. The preset task may be the same as the target task or different from the target task.

[0026] In some embodiments, a number of first training samples in the first training sample set may be greater than a number of second training samples in the second training sample set.

[0027] A second aspect of the present disclosure provides a device for acquiring a

target model, including a first training module, a model acquiring module, and a second training module. The first training module is configured to adjust a network parameter of a raw model by pre-training the raw model using a first training sample set. The raw model includes a first sub-network configured for feature extraction. The model acquiring module is configured to acquire the target model using a second sub-network and at least one partial structure of the first sub-network pre-trained. The second sub-network is configured to perform a target task based on a feature extracted by the first sub-network. The second training module is configured to adjust a network parameter of the target model by training the target model using a second training sample set corresponding to the target task.

[0028] A third aspect of the present disclosure provides electronic equipment, including a memory and a processor coupled to each other. The processor is configured to execute program instructions stored in the memory to implement the method for acquiring a target model of the first aspect.

[0029] A fourth aspect of the present disclosure provides a computer-readable storage medium, having stored thereon program instructions which, when executed by a processor, implement the method for acquiring a target model of the first aspect.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

[0030] FIG. 1 is a flowchart of a method for acquiring a target model according to embodiments of the present disclosure.

[0031] FIG. 2 is a block diagram of a first sub-network according to embodiments of the present disclosure.

[0032] FIG. 3 is a block diagram of a first sub-network according to embodiments of the present disclosure.

[0033] FIG. 4 is a flowchart of S12 in FIG. 1 according to embodiments of the present disclosure.

[0034] FIG. 5 is a block diagram of a pending sub-network according to embodiments

of the present disclosure.

[0035] FIG. 6 is a flowchart of a method for acquiring a target model according to embodiments of the present disclosure.

[0036] FIG. 7 is a block diagram of a device for acquiring a target model according to embodiments of the present disclosure.

[0037] FIG. 8 is a block diagram of electronic equipment according to embodiments of the present disclosure.

[0038] FIG. 9 is a block diagram of a computer-readable storage medium according to embodiments of the present disclosure.

DETAILED DESCRIPTION

[0039] Embodiments of the present disclosure are elaborated below with reference to the accompanying drawings.

[0040] In description as follows, for purpose of illustration rather than limiting, specifics such as a specific system structure, interface, technology, etc., are proposed for thorough understanding of the present disclosure.

[0041] Terms "system" and network" in the present disclosure are often interchangeable in usage. A term "and / or" in the present disclosure describes just an association between associated objects, including three possible relationships. For example, by A and / or B, it may mean that there may be three cases, namely, existence of but A, existence of both A and B, or existence of but B. A slash mark "/" in the present disclosure generally denotes an "or" relationship between two associated objects that come respectively before and after the mark per se. in addition, in the present disclosure, by "multiple", it means two or more than two.

[0042] Refer to FIG. 1. FIG. 1 is a flowchart of a method for acquiring a target model according to embodiments of the present disclosure. Specifically, steps S11 to S13 may be included.

[0043] In S11, a network parameter of a raw model is adjusted by pre-training the raw model using a first training sample set. The raw model includes a first sub-network configured for feature extraction.

[0044] In an implementation, the first sub-network includes multiple network stages. Each network stage may include at least one feature extracting block connected sequentially. Specifically, a feature extracting block is configured for feature extraction. A feature extracting block may include a convolution layer, an activation layer, and a Batch Normalization (BN) layer connected sequentially. A convolution layer may include a number of convolution kernels for feature extraction. An activation layer may include an activation function such as sigmoid, tanh, ReLu, etc., for introducing a non-linear factor. A BN layer may be configured for normalization. With the convolution layer, the activation layer, and the BN layer connected sequentially, a learning effect of a feature extracting block during training can be improved. In addition, in a feature extracting block, a convolution layer may be followed by connection to a pooling layer configured to perform down-sampling on a feature extracted by the convolution layer. In addition, the first sub-network may further include a down-sampling layer between adjacent network stages, facilitating feature dimensionality reduction, compressing a data and parameter amount, reducing overfitting, improving fault tolerance. The number of feature extracting blocks included in each network stage may be the same. For example, each network stage includes 3, 4, or 5 feature extracting blocks. The number of feature extracting blocks included in each network stage may be completely different. For example, the first network stage includes 3 feature extracting blocks, the second network stage includes 4 feature extracting blocks, and the third network stage includes 5 feature extracting blocks. The number of feature extracting blocks included in each network stage may not be identical. For example, the first network stage includes 3 feature extracting blocks, the second network stage includes 3 feature extracting blocks, too, and the third network stage includes 5 feature extracting blocks. That is, it may be provided as needed, and is not limited here.

[0045] In a specific implementation, a number of the multiple network stages may have the same input node, in which case the first sub-network may have multiple branch networks. Each branch network may include at least one network stage connected sequentially.

[0046] Refer to FIG. 2. FIG. 2 is a block diagram of a first sub-network according to embodiments of the present disclosure. As shown in FIG. 2, a dotted rectangle represents a network stage. Each network stage may include 4 feature extracting blocks. The first sub-network may include 3 branch networks connected in parallel. The first branch network may be a first row of network stages (where for simplicity, just one network stage is schematically illustrated in the first branch network). The second branch network may be a second row of network stages. The third branch network may be a third row of network stages (where for simplicity, just one network stage is schematically illustrated in the third branch network). The three branch networks may have the same input node. In other scenes, a first sub-network including another number of branch networks may also be provided as needed. For example, the first sub-network may be provided to include 2 branch networks, 4 branch networks, etc., which is not limited here.

[0047] In another specific implementation, multiple network stages may also be connected in series. In this case, the first sub-network may include just one branch network. The branch network may include multiple network stages connected sequentially.

[0048] Refer to FIG. 3. FIG. 3 is a block diagram of a first sub-network according to embodiments of the present disclosure. As shown in FIG. 3 a dotted rectangle represents a network stage. Each network stage may include 4 feature extracting blocks. The first sub-network may include 2 network stages connected in series. In this case, the first sub-network may include just one branch network.

[0049] In yet another specific implementation, the raw model may include, in addition to the first sub-network, another sub-network, such as a third sub-network. The another sub-network may be configured to perform a preset task based on an extracted feature. The preset task may be a target detection task, an image classification task, a scene segmentation task, etc., which is not limited here. With a target detection task, a target object in an image is to be detected. For example, a vehicle, a pedestrian, etc., in an image is to be detected. With an image classification task, an image is to be classified into a certain class. For example, an image is to be classified into a cat, a dog, a turtle, etc. With a scene segmentation task, a class of a pixel in an image is to be detected. For example, pixels belonging respectively to a lane, a vehicle, a greenbelt, sky, etc., in an image are to be detected. Such an example of the preset task may indicate just a possible

use in actual application, and does not limit a use range of the preset task. The specific structure of another sub-network may be set as needed, and is not limited here. For example, in case the preset task is a target detection task or an image classification task, another sub-network may include a number of (e.g., 2, 3, etc.) layers, such as a fully connected layer, a softmax layer, etc., connected sequentially, which is not limited here. As another example, in case the preset task is scene segmentation, another sub-network may include a fully connected layer and a softmax layer, which is not limited here.

[0050] In an implementation, to improve accuracy in pre-training, the first training sample set may be a large-scale data set. That is, the number of first training samples in the first training sample set may be greater than a preset value (e.g., 1,000, 5,000, 10,000, etc.). Therefore, the raw model may be fully pre-trained using the first training sample set, improving accuracy of the target model acquired subsequently. In an implementation, to improve efficiency in pre-training, the first sub-network may include just one branch network. The branch network may include multiple network stages connected sequentially. In this case, prior to each training, a feature extracting block may be selected from each network stage using a preset selection strategy. Thus, a network parameter of a portion of each network stage located before the selected feature extracting block may be adjusted by training the portion (including the selected feature extracting block) of the network stage located before the selected feature extracting block using the first training sample set. In this way, efficiency in pre-training can be improved. Specifically, the preset selection strategy may include that a feature extracting block within each network stage may be selected randomly.

[0051] In a specific implementation, the preset selection strategy may include that an integer may be selected randomly within a preset value range corresponding to a respective network stage. The upper limit of the preset value range may be the number of feature extracting blocks included in the corresponding network stage, which may be denoted as N_i for convenience of description, representing the number of feature extracting blocks included in the i th network stage. The lower limit of the preset value range may be 1. Then, an integer may be randomly selected within the preset value range of 1 to N_i . The randomly selected integer may be denoted as S_i for convenience of description, representing the integer randomly selected in the i th network stage. Then, a

network parameter of a portion of each network stage located before the S_i th feature extracting block (i.e., the first feature extracting block to the S_i th feature extracting block) may be adjusted by training the portion of each network stage located before the S_i th feature extracting block (i.e., the first feature extracting block to the S_i th feature extracting block).

[0052] As shown by a dotted arrow in FIG. 3, when training the portion of each network stage located before the selected feature extracting block using the first training sample set, the result output by the selected feature extracting block in each network stage may be taken as input data for the next network stage. Referring to FIG. 3, for example, when the selected feature extracting block in the first network stage is the 2nd feature extracting block, the result output by the 2nd feature extracting block may be taken as input data to the next network stage. As another example, when the selected feature extracting block in the first network stage is the 3rd feature extracting block, the result output by the 3rd feature extracting block may be taken as input data to the next network stage, so on and so forth, which is not listed one by one here.

[0053] In an implementation, in case the first sub-network includes multiple branch networks, prior to each training, a branch network in the first sub-network may be selected using a preset selection strategy. A feature extracting block in each network stage in the selected branch network may be selected. Thus, a network parameter of a portion of each network stage included in the selected branch network located before the selected feature extracting block may be adjusted by training the portion of each network stage included in the selected branch network located before the selected feature extracting block. Refer to foregoing related description for a specific mode of selecting a feature extracting block in a network stage, which is not repeated here.

[0054] In a specific implementation, a mode of selecting a feature extracting block in a network stage may be referred to for a mode of selecting a branch network in the first sub-network. Specifically, an integer may be selected randomly within a preset value range. The upper limit of the preset value range may be the number of branch networks included in the first sub-network, which may be denoted as N for convenience of description, representing that the first sub-network includes a total of N branch networks. The lower limit of the preset value range may be 1. Then, an integer may be

randomly selected within the preset value range of 1 to N . The randomly selected integer may be denoted as S for convenience of description, representing that the S th branch network in the first sub-network is selected. Refer to FIG. 2. The first sub-network shown in FIG. 2 includes a total of 3 branch networks. Then, an integer such as 2 may be randomly selected from 1 to 3. Then, the 2nd branch network S2 may be taken as the selected branch network. Then, a feature extracting block is selected from each network stage included in the 2nd branch network S2. Refer to foregoing description for a detail, which is not repeated here.

[0055] In another specific implementation, a branch network containing a greatest number of feature extracting blocks in the first sub-network may be selected. Then, a feature extracting block may be selected from each network stage included in the branch network. Refer to foregoing description for a detail, which is not repeated here.

[0056] In an implementation, pre-training of the raw model may be ended when a preset end condition is met. Specifically, the preset end condition may include that the number of times each first training sample taking part in training has reached a preset number-of-times threshold. The preset number-of-times threshold may be set as needed, such as to 100, 120, 150, etc., which is not limited here.

[0057] In S12, a target model is acquired using a second sub-network and at least one partial structure of the first sub-network pre-trained.

[0058] In embodiments of the present disclosure, the second sub-network is configured to perform a target task based on a feature extracted by the first sub-network. In an implementation, a target task may be any one of a target detection task, an image classification task, a scene segmentation task, etc. Refer to foregoing description for specific meanings of a target detection task, an image classification task, and a scene segmentation task, which is not repeated here. Further, as previously described, the raw model may further include a third sub-network. The third sub-network may be configured to perform a preset task based on an extracted feature. The preset task may be the same as the target task, or different from the target task. For example, both the preset task and the target task may be image classification tasks. As another example, both the preset task and the target task may be target detection tasks. As another example, the preset task may be a target detection task, and the target task may be an image

classification task, which is not limited here. Further, the third sub-network may be the same as the second sub-network, or different from the second sub-network. For example, the third sub-network may include a fully connected layer and a softmax layer. The second sub-network may include two fully connected layers connected sequentially, and a softmax layer connected following the two fully connected layers. As another example, like the third sub-network, the second sub-network may also include a fully connected layer and a softmax layer, which is not limited here.

[0059] In an implementation, at least one candidate sub-network may be acquired using different partial structures of the first sub-network. A candidate sub-network meeting a preset condition may be selected as a selected sub-network. Thus, the target model may be acquired using the selected sub-network and the second sub-network.

[0060] In a specific implementation, a candidate sub-network may include at least one feature extracting block in each network stage in one branch network. Feature extracting blocks in different candidate sub-networks may be at least partially different. Then, each time a partial structure of the first sub-network is selected, a branch network may be selected. A feature extracting block may be selected from each network stage of the selected branch network. Thus, a combination of portions in each network stage that are located before the selected feature extracting block may be taken as a partial structure of the first sub-network, acquiring different partial structures of the first sub-network. For example, the first sub-network includes just one branch network. Referring to FIG. 3, when a partial structure of the first sub-network is selected for the first time, the third feature extracting block in the first network stage may be randomly selected, and the second feature extracting block in the second network stage may be randomly selected. Then, the combination of the portion in the first network stage that is located before the third feature extracting block and the portion in the second network stage that is located before the second feature extracting block may be taken as a partial structure of the first sub-network. When a partial structure of the first sub-network is selected for the second time, the second feature extracting block in the first network stage may be randomly selected, and the third feature extracting block in the second network stage may be randomly selected. Then, the combination of the portion in the first network stage located before the second feature extracting block and the portion in the second network stage located before the third feature extracting block may be taken as a partial structure

of the first sub-network, so on and so forth, which is not listed one by one here. Specifically, the number of selections made may be set as needed. For example, the number of selections may be set as 10, 15, 20, etc., according to complexity of computation, which is not limited here.

[0061] In another specific implementation, the preset condition includes that a preset performance condition is met with a candidate model acquired using the candidate sub-network and the second sub-network. Specifically, a performance score of the candidate model in performing the target task is acquired by verifying the candidate model acquired using the candidate sub-network and the second sub-network using a verification sample corresponding to the target task. Then, it may be determined whether the candidate model meets the preset performance condition based on the performance score. For example, when a performance score is the highest of performance scores of all candidate models, the candidate model corresponding to the highest performance score may be deemed as meeting the preset performance condition.

[0062] In yet another specific implementation, the preset condition further includes that a number of feature extracting blocks in the candidate sub-network is no less than a preset number. The preset number may be set as needed, such as to 4, 5, 6, etc., which is not limited here. The preset number may constrain the complexity of the target model.

[0063] In yet another specific implementation, the selected sub-network and the second sub-network may be connected sequentially to acquire the target model.

[0064] In another implementation, the at least one candidate sub-network includes at least one feature extracting block in each network stage in one branch network. Feature extracting blocks in different candidate sub-networks may be at least partially different. In order to acquire a global optimal solution, all different partial structures in the first sub-network may be enumerated. Each partial structure may be taken as a corresponding candidate sub-network. A candidate sub-network meeting a preset condition may be selected as a selected sub-network, acquiring the target model using the selected sub-network and the second sub-network. Specifically, Refer to foregoing description for a mode of setting the preset condition, which is not repeated here.

[0065] In a specific implementation, for example, the first sub-network includes just one network branch. In enumerating all different partial structures in the first

sub-network, to avoid repeated selection, a count $count_i$ may be assigned to each network stage in the first sub-network to represent the count of the i -th network stage. Whenever a partial structure is to be selected, a combination of feature extracting blocks located before the count $count_i$ in each network stage may be taken as the present selected partial structure. The number of network stages included in the first sub-network may be denoted as N_s . The initial value of the count $count_i$ may be set to 1. Whenever a partial structure is selected, the count is increased by 1, until all different partial structures in the first sub-network are exhausted. For example, the first sub-network includes 4 network stages. Each network stage may also include 4 feature extracting blocks. When a partial structure is selected for the first time, the counts of the 4 network stages may be denoted as 1, 1, 1, and 1, respectively. In this case, the first feature extracting block in each network stage may be combined as the selected partial structure. When partial structure selection is performed for the second time, the counts of the 4 network stages may be denoted as 1, 1, 1, and 2, respectively. In this case, the first feature extracting blocks of the first 3 network stages and the first two feature extracting blocks of the last network stage may be combined as the selected partial structure. When partial structure selection is performed for the third time, the counts of the 4 network stages may be denoted as 1, 1, 1, and 3, respectively. In this case, the first feature extracting blocks of the first 3 network stages and the first 3 feature extracting blocks of the last network stage may be combined as the selected partial structure. When partial structure selection is performed for the fourth time, the counts of the 4 network stages may be denoted as 1, 1, 1, and 4, respectively. In this case, the first feature extracting blocks of the first 3 network stages and all feature extracting blocks of the last network stage may be taken as the selected partial structure. When partial structure selection is performed for the fifth time, the counts of the 4 network stages may be denoted as 1, 1, 2, and 1, respectively. In this case, the first feature extracting blocks of the first 2 network stages, the first 2 feature extracting blocks of the third network stage, and the first feature extracting block of the last network stage may be combined as the selected partial structure. When partial structure selection is performed for the sixth time, the counts of the 4 network stages may be denoted as 1, 1, 2, and 2, respectively. In this case, the first feature extracting blocks of the first 2 network stages and the first 2 feature extracting blocks of each of the last 2 network stages may be combined as the selected partial structure, so on and so forth, which is not repeated here.

[0066] In an implementation, to improve accuracy in adjusting a network structure dimension, before acquiring the target model using the second sub-network and the at least one partial structure of the first sub-network pre-trained, the network parameter of the raw model may be adjusted by training the raw model using the second training sample set. As a result, the network parameter of the raw model can be adjusted first based on the target task, improving accuracy in adjusting a network structure dimension. In this case, at least a partial structure of the first sub-network may include the adjusted network parameter trained by the second training sample set. That is, both the network parameter and the network structure are adjusted during transfer learning.

[0067] In a specific implementation, a number of first training samples in the first training sample set is greater than a number of second training samples in the second training sample set. Thus, with embodiment of the present disclosure, a target model applicable to a target task can be acquired based on a large-scale data sample (i.e., the first training sample set) and a small-scale data sample (i.e., the second training sample set) corresponding to the target task, lowering difficulty in collecting the small-scale data sample, as well as the amount of work in labeling the second training sample set, further improving efficiency in acquiring the target model. Specifically, the number of first training samples in the first training sample set may be 5000, 10000, 15000, etc. The number of second training samples in the second training sample set may be 100, 200, 300, etc. The numbers may be set as needed, which is not limited here.

[0068] In S13, a network parameter of the target model is adjusted by training the target model using a second training sample set corresponding to the target task.

[0069] In an implementation, a network parameter of the target model is adjusted by training the target model using just a second training sample set corresponding to the target task. Specifically, a number of second training samples in the second training sample set may be less than a number of first training samples in the first training sample set. For example, the second training sample set is of small-scale data samples, and the first training sample set is of large-scale data samples. Refer to foregoing description for a detail, which is not repeated here.

[0070] In another implementation, to improve accuracy of the target model, the network parameter of the target model may be adjusted by training the target model first

using the first training sample set. Then, the network parameter of the target model may again be adjusted by training the target model using the second training sample set corresponding to the target task.

[0071] In the embodiment, the network parameter of the target model may be adjusted by training the target model first using the first training sample set. The raw model includes the first sub-network configured for feature extraction. Then, the target model is acquired using the second sub-network and at least one partial structure of the first sub-network pre-trained. The second sub-network is configured to perform the target task based on the feature extracted by the first sub-network. Finally, the network parameter of the target model is adjusted by training the target model using the second training sample set corresponding to the target task. Therefore, not just the second training sample set corresponding to the target task can be used for adjustment in a network parameter dimension, but also the raw model can be adjusted in a network structure dimension, greatly increasing a degree of freedom in network adjustment, fully exploiting the potential of the pre-trained raw model in the network parameter dimension and the network structure dimension, improving performance of the target model.

[0072] Refer to FIG. 4. FIG. 4 is a flowchart of S12 in FIG. 1 according to embodiments of the present disclosure. Specifically, in embodiments of the present disclosure, the raw model is of a single-branch network structure. That is, the first sub-network may include a branch network. The branch network may include multiple network stages connected sequentially. Each network stage may include at least one feature extracting block connected sequentially. A candidate sub-network may include at least one feature extracting block in each network stage. Feature extracting blocks in different candidate sub-networks may be at least partially different. The step S12 may include steps S41 to S46.

[0073] In S41, an initial pending sub-network may be acquired by selecting a first feature extracting block in each network stage.

[0074] An initial pending sub-network may be acquired by selecting a first feature extracting block in each network stage and connecting each first feature extracting block to each other. Refer to FIG. 3. As shown by a dotted arrow in FIG. 3, the result output by the first feature extracting block in the first network stage may be taken as the input data

to the second network stage. The initial pending sub-network may be denoted as [1, 1].

[0075] In S42, a candidate sub-network may be acquired by adding at least one feature extracting block to a pending sub-network. An added feature extracting block may be located after a selected feature extracting block in at least one network stage.

[0076] In embodiments of the present disclosure, the at least one feature extracting block may be one feature extracting block, two feature extracting blocks, etc., which is not limited here. For example, in case a requirement on accuracy in network structure adjustment is low, the at least one feature extracting block may be multiple feature extracting blocks such as two or three feature extracting blocks. However, in case of a high requirement on accuracy in network structure adjustment, there may be one feature extracting block, which may be provided specifically as needed, and is not limited here.

[0077] Each network stage may be taken as a target stage. A candidate sub-network corresponding to the target stage may be acquired by increasing a numbering of the feature extracting block selected in the last step in the target stage by 1, i.e., adding one feature extracting block, while keeping a number of feature extracting blocks selected in the last step in a network stage other than the target stage in the first sub-network unchanged. Referring to FIG. 3, the first network stage and the second network stage may be taken as the target stage, respectively. The candidate sub-network corresponding to the first target stage may be acquired using the first two feature extracting blocks in the first target stage (in S41, the first feature extracting block in the first network stage is selected, thus it becomes the first two feature extracting blocks in this step) and the first feature extracting block in the second network stage. Specifically, as indicated by a dotted arrow in FIG. 3, the result output by the second feature extracting block in the first target stage may be taken as the input data to the second network stage. The candidate sub-network corresponding to the second target stage may be acquired using the first two feature extracting blocks in the second target stage and the first extracting block in the first network stage. Specifically, as shown by a dotted arrow in FIG. 3, the result output by the first feature extracting block in the first network stage may be taken as the input data to the second target stage. Again refer to FIG. 3. For ease of description, the candidate sub-network corresponding to the first target stage may be denoted as [2, 1], indicating that the candidate sub-network corresponding to the first target stage is composed of the first two feature extracting blocks of the first network stage and the first

feature extracting block of the second network stage. The initial candidate sub-network corresponding to the second target stage is denoted as [1, 2], indicating that the candidate sub-network corresponding to the second target stage is composed of the first feature extracting block of the first network stage and the first two feature extracting blocks of the second network stage, so on and so forth, which is not listed one by one here.

[0078] In an implementation, each network stage may be taken as a target stage. A candidate sub-network corresponding to the target stage may be acquired by increasing a numbering of the feature extracting block selected in the last step in the target stage by an integer such as 2, 3, etc., i.e., adding two feature extracting blocks, three feature extracting blocks, etc., while keeping a number of feature extracting blocks selected in the last step in a network stage other than the target stage in the first sub-network unchanged. The number of feature extracting blocks added may be set as needed, and is not limited here.

[0079] In S43, candidate models may be formed using the second sub-network and respective candidate sub-networks. A candidate sub-network corresponding to a candidate model of best performance of multiple candidate models may be selected as the pending sub-network.

[0080] Performance scores of multiple candidate models in performing the target task may be acquired by respectively verifying the multiple candidate models acquired using multiple candidate sub-networks and the second sub-network using a verification sample corresponding to the target task. The candidate model of best performance may be determined based on the performance scores. The verification sample may be the same as the second training sample set, or may be a portion of the second training sample set. Refer to related descriptions in a disclosed embodiment for a detail, which is not repeated here. Assume that the candidate sub-network [2, 1] may be taken as the pending sub-network, as verified using the verification sample.

[0081] In S44, it may be determined whether a number of feature extracting blocks in the pending sub-network is less than a preset number. If the number is less than the preset number, S42 may be performed. Otherwise if the number is no less than the preset number, S45 may be performed.

[0082] In embodiments of the present disclosure, the preset number may be preset as

needed, specifically according to a desired complexity of the target model, such as to 4, 5, 6, etc., which is not limited here. For example, when the preset number is 4, since there are 3 feature extracting blocks in the pending sub-network [2, 1], which number is less than the preset number, S42 may be performed. As another example, when the preset number is 3, since there are 3 feature extracting blocks in the pending sub-network [2, 1], which number is no less than the preset number, S45 may be performed. That is, the pending sub-network [2, 1] may be directly taken as the selected sub-network, so on and so forth, which is not listed one by one here.

[0083] In an implementation, the first sub-network includes a first number of feature extracting blocks. The first sub-network may include a second number of network stages. The preset number may be set to be less than the first number, and greater than the second number.

[0084] In an implementation, the preset number may be set based on computational complexity of the target model for completing the target task.

[0085] As an example, the candidate sub-network [2, 1] may be taken as the pending sub-network as verified by the verification sample. When it is determined in S44 that the number of feature extracting blocks in the pending sub-network [2, 1] is less than the preset number, the flow may again go to S42. In this case, a new candidate sub-network may be acquired based on the pending sub-network [2, 1].

[0086] In an implementation, the first feature extracting block located after the selected feature extracting block in the target stage is added to feature extracting blocks selected in the target stage, acquiring a new candidate sub-network. Again refer to FIG. 3. Taking the pending sub-network [2, 1] as an example, first the first network stage may be taken as a target stage, and the first feature extracting block (the third feature extracting block) located after the selected feature extracting block (the second feature extracting block) may be added after the selected feature extracting block (the second feature extracting block) of the target stage, acquiring a new candidate sub-network, denoted by [3, 1] for convenience of description. That is, the new candidate sub-network is composed of the first three feature extracting blocks in the first network stage and the first feature extracting block of the second network stage. Similarly, the second network stage may further be taken as a target stage, and the first feature extracting block (the

second feature extracting block) located after the selected feature extracting block (the first feature extracting block) in the target stage may be added after the selected feature extracting block (the first feature extracting block) of the target stage, acquiring another new candidate sub-network, denoted by [2, 2] for convenience of description, so on and so forth, which is not listed one by one here.

[0087] As may be seen from the step, a sub-network of best performance may be selected from the present candidate sub-networks based on a certain number of feature extracting blocks, and taken as the pending sub-network. A new candidate sub-network may be computed based on the previous pending sub-network by adding at least one feature extracting block to the previous number of feature extracting blocks. A sub-network of best performance may again be selected from the new candidate sub-network and taken as the new pending sub-network. Still considering the above example, a pending sub-network may be selected from the candidate sub-networks [2, 1] and [1, 2]. Assume that [2, 1] is of better performance. Then, [2, 1] may be the pending sub-network. Then subsequently, based on [2, 1], a pending sub-network may be selected from [3, 1] and [2, 2]. In this case, [1, 3] will not be taken as a candidate sub-network for a second round of performance evaluation, saving a candidate sub-network for computing performance scores in S43. In the case there are a lot of network stages, with the method, a significant amount of computation is saved.

[0088] Refer to FIG. 5. FIG. 5 is a block diagram of a pending sub-network according to embodiments of the present disclosure. As shown in FIG. 5, a feature extracting block of a solid rectangular frame indicates a selected feature extracting block, and a feature extracting block of a dotted rectangular frame indicates a feature extracting block not selected. A pending sub-network as shown in FIG. 5 is [2, 2]. For example, the pending sub-network is [2, 2], and the preset number is 5. As there are 4 feature extracting blocks in the pending sub-network, S45 as follows may be performed, and then the pending sub-network [2, 2] may be taken as a selected sub-network.

[0089] In S45, the pending sub-network may be selected as the selected sub-network.

[0090] Specifically, the pending sub-network may be selected as the selected sub-network in case the number of feature extracting blocks in the pending sub-network is no less than the preset number. In this way, a sub-network selected at a performance

level may be acquired under model complexity constrained by a preset number.

[0091] In S46, the target model may be acquired using the selected sub-network and the second sub-network.

[0092] Specifically, the target model may be acquired by connecting the selected sub-network and the second sub-network sequentially.

[0093] In embodiments of the present disclosure, with the method, the target model can be constrained in terms of model complexity and model performance, while improving efficiency in acquiring the target model.

[0094] In an implementation, in case the first sub-network includes multiple branch networks, one branch network may first be selected from the first sub-network, and then S41 to S46 may be performed for the branch network.

[0095] Refer to FIG. 6. FIG. 6 is a flowchart of a method for acquiring a target model according to embodiments of the present disclosure. Specifically, in embodiments of the present disclosure, the raw model includes a first sub-network configured for feature extraction. The first sub-network may include one branch network. The branch network may include multiple network stages connected sequentially. Each network stage may include at least one feature extracting block connected sequentially. Steps S601 to S612 may be included.

[0096] In S601, prior to each training of a raw model, a feature extracting block may be selected from each network stage using a preset selection strategy.

[0097] Refer to related description in a disclosed embodiment for a detail.

[0098] In S602, a network parameter of a portion of each network stage located before the selected feature extracting block may be adjusted by training the portion of the each network stage located before the selected feature extracting block using a first training sample set.

[0099] Refer to related description in a disclosed embodiment for a detail.

[00100] In S603, a network parameter of the raw model may be adjusted by training the raw model using a second training sample set corresponding to a target task.

- [00101] Refer to related description in a disclosed embodiment for a detail.
- [00102] In S604, an initial pending sub-network may be acquired by selecting a first feature extracting block in each network stage.
- [00103] Refer to related description in a disclosed embodiment for a detail.
- [00104] In S605, a candidate sub-network may be acquired by adding at least one feature extracting block to a pending sub-network.
- [00105] An added feature extracting block may be located after a selected feature extracting block in at least one network stage.
- [00106] Refer to related description in a disclosed embodiment for a detail.
- [00107] In S606, candidate models may be formed using the second sub-network and respective candidate sub-networks. A candidate sub-network corresponding to a candidate model of best performance of multiple candidate models may be selected as the pending sub-network.
- [00108] In embodiments of the present disclosure, the second sub-network is configured to perform a target task based on a feature extracted by the first sub-network. Refer to related description in a disclosed embodiment for a detail.
- [00109] In S607, it may be determined whether a number of feature extracting blocks in the pending sub-network is less than a preset number. If the number of feature extracting blocks in the pending sub-network is less than the preset number, S605 may be performed. Otherwise if the number of feature extracting blocks in the pending sub-network is no less than the preset number, S608 may be performed.
- [00110] Refer to related description in a disclosed embodiment for a detail.
- [00111] In S608, a new candidate sub-network be acquired based on the pending sub-network.
- [00112] Refer to related description in a disclosed embodiment for a detail.
- [00113] In S609, the pending sub-network may be taken as the selected sub-network.

- [00114] Refer to related description in a disclosed embodiment for a detail.
- [00115] In S610, the target model may be acquired using the selected sub-network and the second sub-network.
- [00116] Referring to FIG. 5, when the pending sub-network is the sub-network [2, 2] shown in FIG. 5, and the preset number is 4, the pending sub-network [2, 2] may be taken as the selected sub-network, and the target model may be acquired using the selected sub-network and the second sub-network. Specifically, the target model may be acquired by connecting the selected sub-network and the second sub-network sequentially.
- [00117] Refer to related description in a disclosed embodiment for a detail.
- [00118] In S611, the network parameter of the target model may be adjusted by training the target model using the first training sample set.
- [00119] Again referring to FIG. 5, when the selected sub-network is the pending sub-network [2, 2] shown in FIG. 5, the network parameter of the target model may be adjusted by training, using the first training sample set, the target model composed of the pending sub-network [2, 2] and the second sub-network.
- [00120] Refer to related description in a disclosed embodiment for a detail.
- [00121] In S612, the network parameter of the target model is adjusted by training the target model using the second training sample set corresponding to the target task.
- [00122] Again referring to FIG. 5, when the selected sub-network is the pending sub-network [2, 2] shown in FIG. 5, the network parameter of the target model may be adjusted further by training, using the second training sample set, the target model composed of the pending sub-network [2, 2] and the second sub-network.
- [00123] Refer to related description in a disclosed embodiment for a detail.
- [00124] In embodiments of the present disclosure, with the method, efficiency in acquiring the selected sub-network is improved in terms of network structure adjustment. The raw model is adjusted in terms of both network structure adjustment and network parameter adjustment, greatly increasing a degree of freedom in network adjustment,

fully exploiting the potential of the pre-trained raw model in the network parameter dimension and the network structure dimension, improving performance of the target model.

[00125] In an implementation, in case the first sub-network includes multiple branch networks, a branch network may first be selected from the first sub-network, and then S601 to S612 may be performed for the branch network.

[00126] Refer to FIG. 7. FIG. 7 is a block diagram of a device 70 for acquiring a target model according to embodiments of the present disclosure. The device 70 for acquiring a target model may include a first training module 71, a model acquiring module 72, and a second training module 73. The first training module 71 is configured to adjust a network parameter of a raw model by pre-training the raw model using a first training sample set. The raw model may include a first sub-network configured for feature extraction. The model acquiring module 72 is configured to acquire the target model using a second sub-network and at least one partial structure of the first sub-network pre-trained. The second sub-network is configured to perform a target task based on a feature extracted by the first sub-network. The second training module 73 is configured to adjust a network parameter of the target model by training the target model using a second training sample set corresponding to the target task.

[00127] In some embodiments of the present disclosure, the first sub-network includes multiple network stages. Each network stage may include at least one feature extracting block connected sequentially. Therefore, the first sub-network may be set as a single-chain one-branch network, or a multi-chain multi-branch network, allowing to acquire the target model from both a multi-branch network and a one-branch network, extending a range of use.

[00128] In some embodiments of the present disclosure, the model acquiring module 72 may include a structure searching sub-module, configured to acquire at least one candidate sub-network using different partial structures of the first sub-network, and select a candidate sub-network meeting a preset condition as a selected sub-network. The model acquiring module 72 may include a model constructing module, configured to acquire the target model using the selected sub-network and the second sub-network.

[00129] At least one candidate sub-network may be acquired using different partial

structures of the first sub-network. A candidate sub-network meeting a preset condition may be selected as a selected sub-network. Thus, the target model may be acquired using the selected sub-network and the second sub-network, expanding space of adjustment in a network structure dimension, improving performance of the target model.

[00130] In some embodiments of the present disclosure, the preset condition includes that a preset performance condition is met with a candidate model acquired using the candidate sub-network and the second sub-network.

[00131] In some embodiments of the present disclosure, the preset condition further includes that a number of feature extracting blocks in the candidate sub-network reaches a preset number.

[00132] Because the number of feature extracting blocks can reflect the complexity of the target model to some extent, and the preset performance condition can reflect performance of the target model to some extent, the target model can be constrained in terms of model complexity and model performance.

[00133] In some embodiments of the present disclosure, a candidate sub-network may include at least one feature extracting block in each network stage in one branch network. Feature extracting blocks in different candidate sub-networks may be at least partially different.

[00134] In some embodiments of the present disclosure, the structure searching sub-module may include an initialization unit, configured to acquire an initial pending sub-network by selecting a first feature extracting block in the each network stage in the one branch network. The initialization unit may be further configured to acquire a candidate sub-network by adding at least one feature extracting block to a pending sub-network. An added feature extracting block may be located after a selected feature extracting block in the network stage. The structure searching sub-module may include a performance evaluating unit configured to form candidate models using the second sub-network and respective candidate sub-networks, and select, as the pending sub-network, a candidate sub-network corresponding to a candidate model of best performance of multiple candidate models. The structure searching sub-module may include a search repeating unit configured to, in response to a number of feature extracting blocks in the pending sub-network being less than a preset number, acquire a

new candidate sub-network based on the pending sub-network, and select, as a new pending sub-network, a candidate sub-network corresponding to a candidate model of best performance of candidate models formed using multiple new candidate sub-networks and the second sub-network. The structure searching sub-module may include a selection acquiring unit, configured to, in response to the number of feature extracting blocks in the pending sub-network being no less than the preset number, take the pending sub-network as the selected sub-network.

[00135] In some embodiments of the present disclosure, the initialization unit may be configured to take the each network stage as a target stage, and acquire a candidate sub-network corresponding to the target stage by increasing a number of selected feature extracting blocks in the target stage by an integer while keeping a number of selected feature extracting blocks in a network stage other than the target stage unchanged. The search repeating unit may be configured to acquire the new candidate sub-network by adding at least one feature extracting block to the selected sub-network. An added feature extracting block may be located after the selected feature extracting block in the network stage.

[00136] Each network stage may be taken respectively as a target stage. An initial pending sub-network may be acquired using the first feature extracting block in each network stage, allowing to start network structure adjustment from the beginning of each network stage of the first sub-network. A candidate sub-network corresponding to the target stage may be acquired by increasing a number of selected feature extracting blocks in the target stage by an integer while keeping a number of selected feature extracting blocks in a network stage other than the target stage unchanged. Therefore, during subsequent adjustment, feature extracting blocks of different network stages can be adjusted one by one, increasing accuracy in network adjustment.

[00137] In some embodiments of the present disclosure, the performance evaluating unit may be configured to acquire, by verifying the candidate model acquired using the candidate sub-network and the second sub-network using a verification sample corresponding to the target task, a performance score of the candidate model in performing the target task.

[00138] In some embodiments of the present disclosure, the first sub-network includes

a first number of feature extracting blocks. The first sub-network may include a second number of network stages. The preset number may be less than the first number, and greater than or equal to the second number.

[00139] A performance score of the candidate model in performing the target task may be acquired by verifying, using a verification sample corresponding to the target task, the candidate model acquired using the candidate sub-network and the second sub-network. It may be determined whether the candidate model meets the preset performance condition based on the performance score, increasing accuracy in selecting a selected sub-network. In addition, the first sub-network may include a first number of feature extracting blocks. The first sub-network may include a second number of network stages. The preset number may be less than the first number, and greater than or equal to the second number, reducing the complexity of the target model.

[00140] In some embodiments of the present disclosure, the first sub-network includes a branch network. The branch network may include multiple network stages connected sequentially. Each network stage may include at least one feature extracting block connected sequentially. The first training module 71 may include a block selecting sub-module configured to, prior to each training, select, using a preset selection strategy, a feature extracting block in each network stage. The first training module 71 may include a sample training sub-module configured to adjust, by training a portion of the each network stage located before the selected feature extracting block using the first training sample set, a network parameter of the portion of the each network stage located before the selected feature extracting block.

[00141] In some embodiments of the present disclosure, the first sub-network includes multiple branch networks. Each branch network may include at least one network stage connected sequentially. Each network stage may include at least one feature extracting block connected sequentially. The block selecting sub-module is further configured to, prior to each training, select, using a preset selection strategy, a branch network in the first sub-network, and select a feature extracting block in each network stage in the selected branch network. The sample training sub-module may be configured to adjust, by training a portion of the each network stage located before the selected feature extracting block using the first training sample set, a network parameter of the portion of the each network stage located before the selected feature extracting block.

[00142] With the configuration, portions of the first sub-network are fully trained after multiple times of training, improving efficiency in pre-training.

[00143] In some embodiments of the present disclosure, the branch network is randomly selected from the first sub-network. A feature extracting block may be selected from each network stage included in the selected branch network.

[00144] In some embodiments of the present disclosure, a branch network containing a greatest number of feature extracting blocks in the first sub-network may be selected. A feature extracting block may be selected from each network stage in the selected branch network.

[00145] In some embodiments of the present disclosure, the first sub-network further includes a down-sampling layer between adjacent network stages.

[00146] In some embodiments of the present disclosure, a feature extracting block includes a convolution layer, an activation layer, and a Batch Normalization (BN) layer connected sequentially.

[00147] A feature extracting block is set to include a convolution layer, an activation layer, and a BN layer connected sequentially, improving a learning effect of the feature extracting block during training. The first sub-network is provided with a down-sampling layer between adjacent network stages, facilitating feature dimensionality reduction, compressing a data and parameter amount, reducing overfitting, improving fault tolerance.

[00148] In some embodiments of the present disclosure, the device 70 for acquiring a target model may further include a third training module configured to adjust the network parameter of the raw model by training the raw model using the second training sample set.

[00149] After pre-training, the network parameter of the raw model is first adjusted by training the raw model using the second training sample set corresponding to the target task, improving accuracy in subsequent adjustment in the network structure dimension.

[00150] In some embodiments of the present disclosure, the device 70 for acquiring a target model may further include a fourth training module configured to adjust the

network parameter of the target model by training the target model using the first training sample set.

[00151] After completing adjustment in the network structure dimension, the target model is first trained using the first training sample set, and then re-trained using the second training sample set corresponding to the target task, improving performance of the target model.

[00152] In some embodiments of the present disclosure, the raw model further includes a third sub-network. The third sub-network may be configured to perform a preset task based on an extracted feature. The preset task may be the same as the target task or different from the target task.

[00153] The raw model is set to further include a third sub-network. The third sub-network may be configured to perform a preset task based on an extracted feature. The preset task may be the same as the target task or different from the target task, further expanding the range suitable for acquiring the target model.

[00154] In some embodiments of the present disclosure, a number of first training samples in the first training sample set is greater than a number of second training samples in the second training sample set.

[00155] A number of first training samples in the first training sample set is set to be greater than a number of second training samples in the second training sample set, reducing the amount of work in labeling samples on the target task.

[00156] Refer to FIG. 8. FIG. 8 is a block diagram of electronic equipment 80 according to embodiments of the present disclosure. The electronic equipment 80 includes a memory 81 and a processor 82 coupled to each other. The processor 82 is configured to execute program instructions stored in the memory 81 to implement steps of any foregoing embodiment of the method for acquiring a target model. In a specific implementation, the electronic equipment 80 may include but is not limited to: a microcomputer, a server, etc. In addition, the electronic equipment 80 may also include mobile equipment such as a notebook computer, a tablet computer, etc., which is not limited here.

[00157] Specifically, the processor 82 is configured to control the processor per se and the memory 81 to implement steps of any foregoing embodiment of the method for acquiring a target model. The processor 82 may also be referred to as a Central Processing Unit (CPU). The processor 82 may be an integrated circuit chip capable of signal processing. The processor 82 may also be a general purpose processor, a Digital Signal Processor (DSP), an Application Specific Integrated Circuit (ASIC), a Field-Programmable Gate Array (FPGA) or another programmable logic device, a discrete gate or transistor logic device, a discrete hardware component. The general purpose processor may be a microprocessor or the processor may be any conventional processor, etc. In addition, the processor 82 may be jointly implemented by an integrated circuit chip.

[00158] In embodiments of the present disclosure, not just the second training sample set corresponding to the target task can be used for adjustment in a network parameter dimension, but also the raw model can be adjusted in a network structure dimension, greatly increasing a degree of freedom in network adjustment, fully exploiting the potential of the pre-trained raw model in the network parameter dimension and the network structure dimension, improving performance of the target model.

[00159] Refer to FIG. 9. FIG. 9 is a block diagram of a computer-readable storage medium 90 according to embodiments of the present disclosure. The computer-readable storage medium 90 has stored thereon program instructions 901 executable by a processor. The program instructions 901 are configured to implement steps of any foregoing embodiment of the method for acquiring a target model.

[00160] In embodiments of the present disclosure, not just the second training sample set corresponding to the target task can be used for adjustment in a network parameter dimension, but also the raw model can be adjusted in a network structure dimension, greatly increasing a degree of freedom in network adjustment, fully exploiting the potential of the pre-trained raw model in the network parameter dimension and the network structure dimension, improving performance of the target model.

[00161] In some embodiments, a function or a module of a device provided in embodiments of the present disclosure may be configured to implement a method described in a method embodiment here. Refer to description of a method embodiment

here for specific implementation of the device, which is not repeated here for brevity.

[00162] The above description of the various embodiments tends to emphasize differences in the various embodiments. Refer to one another for identical or similar parts among the embodiments, which are not repeated for conciseness.

[00163] Note that in several embodiments provided in the present disclosure, the disclosed equipment and method may be implemented in other ways. For example, the described equipment embodiments are merely illustrative. For example, the module or unit division is merely logic function division and can be other division in actual implementation. For example, units or components may be combined, or integrated into another system, or some features/characteristics can be omitted or skipped. Furthermore, the inter-coupling, or direct coupling or communicational connection illustrated or discussed may be communicational connection or indirect coupling through some communication interfaces, devices, or units, and may be electrical, mechanical, or of another form.

[00164] Units described as separate components may or may not be physically separated. Components shown as units may be or may not be physical units. They may be located in one place, or distributed on network units. Some or all of the units may be selected to achieve the purpose of a solution of the present embodiments as needed.

[00165] In addition, various functional modules in the embodiments may be integrated in one processing unit, or exist as separate physical units respectively. Alternatively, two or more such units may be integrated in one unit. The integrated unit may be implemented in form of hardware or software functional module(s).

[00166] When implemented in form of a software functional module and sold or used as an independent product, an integrated unit may be stored in a computer-readable storage medium. Based on such an understanding, the essential part of the technical solution of the embodiments or a part contributing to prior art or all or part of the technical solution may appear in form of a software product, which software product is stored in storage media, and includes a number of instructions for allowing computer equipment (such as a personal computer, a server, network equipment, and/or the like) or a processor to execute all or part of the steps of the methods of embodiments of the present disclosure. The storage media include various media that can store program

codes, such as a U disk, a mobile hard disk, Read-Only Memory (ROM), Random Access Memory (RAM), a magnetic disk, a CD, etc.

CLAIMS

WHAT IS CLAIMED IS:

1. A method for acquiring a target model, comprising:

adjusting a network parameter of a raw model by pre-training the raw model using a first training sample set, the raw model comprising a first sub-network configured for feature extraction;

acquiring the target model using a second sub-network and at least one partial structure of the first sub-network pre-trained, the second sub-network being configured to perform a target task based on a feature extracted by the first sub-network; and

adjusting a network parameter of the target model by training the target model using a second training sample set corresponding to the target task.

2. The method of claim 1, wherein the first sub-network comprises multiple network stages, each network stage of the multiple network stages comprising at least one feature extracting block connected sequentially and configured for feature extraction.

3. The method of claim 2, wherein the first sub-network comprises at least one branch network, and each branch network of the at least one branch network comprises at least one network stage of the multiple network stages connected sequentially.

4. The method of any one of claims 1 to 3, wherein acquiring the target model using the second sub-network and the at least one partial structure of the first sub-network pre-trained comprises:

acquiring at least one candidate sub-network using different partial structures of the first sub-network, and selecting a candidate sub-network meeting a preset condition as a selected sub-network; and

acquiring the target model using the selected sub-network and the second sub-network.

5. The method of claim 4, wherein the preset condition comprises that a preset performance condition is met with a candidate model acquired using the candidate sub-network and the second sub-network.

6. The method of claim 5, wherein the preset condition further comprises that a number of feature extracting blocks in the candidate sub-network reaches a preset number.

7. The method of any one of claims 4 to 6, wherein the at least one candidate sub-network comprises at least one feature extracting block in each network stage in one branch network, and feature extracting blocks in different candidate sub-networks are at least partially different.

8. The method of claim 7, wherein acquiring the at least one candidate sub-network using the different partial structures of the first sub-network, and selecting the candidate sub-network meeting the preset condition as the selected sub-network comprises:

acquiring an initial pending sub-network by selecting a first feature extracting block in the each network stage in the one branch network;

acquiring a candidate sub-network by adding at least one feature extracting block to a pending sub-network, an added feature extracting block being located after a selected feature extracting block in a network stage;

forming candidate models using the second sub-network and respective candidate sub-networks, and selecting, as the pending sub-network, a candidate sub-network corresponding to a candidate model of best performance of multiple candidate models;

in response to a number of feature extracting blocks in the pending sub-network being

less than a preset number, acquiring a new candidate sub-network based on the pending sub-network, and selecting, as a new pending sub-network, a candidate sub-network corresponding to a candidate model of best performance of candidate models formed using multiple new candidate sub-networks and the second sub-network; and

in response to the number of feature extracting blocks in the pending sub-network being no less than the preset number, taking the pending sub-network as the selected sub-network.

9. The method of claim 8, wherein acquiring the candidate sub-network by adding the at least one feature extracting block to the pending sub-network comprises:

taking the each network stage as a target stage, and acquiring a candidate sub-network corresponding to the target stage by increasing a number of selected feature extracting blocks in the target stage by an integer while keeping a number of selected feature extracting blocks in a network stage other than the target stage unchanged.

10. The method of claim 8 or 9, wherein acquiring the new candidate sub-network based on the pending sub-network comprises:

acquiring the new candidate sub-network by adding at least one feature extracting block to the pending sub-network, the added feature extracting block being located after the selected feature extracting block in the network stage.

11. The method of any one of claims 5 to 10, wherein the preset performance condition being met with the candidate model acquired using the candidate sub-network and the second sub-network comprises:

acquiring, by verifying the candidate model acquired using the candidate sub-network and the second sub-network using a verification sample corresponding to the target task, a performance score of the candidate model in performing the target task; and

determining whether the candidate model meets the preset performance condition based on the performance score.

12. The method of any one of claims 6 to 11, wherein the first sub-network comprises a first number of feature extracting blocks, and the first sub-network comprises a second number of network stages, the preset number being less than the first number, and greater than or equal to the second number.

13. The method of any one of claims 1 to 12, wherein the first sub-network comprises a branch network comprising multiple network stages connected sequentially, each network stage of the multiple network stages comprising at least one feature extracting block connected sequentially, wherein adjusting the network parameter of the raw model by pre-training the raw model using the first training sample set comprises:

prior to each training, selecting, using a preset selection strategy, a feature extracting block in the each network stage; and

adjusting, by training a portion of the each network stage located before the selected feature extracting block using the first training sample set, a network parameter of the portion of the each network stage located before the selected feature extracting block.

14. The method of any one of claims 1 to 12, wherein the first sub-network comprises multiple branch networks, each branch network of the multiple branch networks comprising at least one network stage connected sequentially, each network stage of the at least one network stage comprising at least one feature extracting block connected sequentially, wherein adjusting the network parameter of the raw model by pre-training the raw model using the first training sample set comprises:

prior to each training, selecting, using a preset selection strategy, a branch network in the first sub-network, and selecting a feature extracting block in each network stage in the selected branch network; and

adjusting, by training a portion of the each network stage located before the selected feature extracting block using the first training sample set, a network parameter of the portion of the each network stage located before the selected feature extracting block.

15. The method of claim 14, wherein prior to the each training, selecting, using the preset selection strategy, the branch network in the first sub-network, and selecting the feature extracting block in the each network stage in the selected branch network, comprises:

randomly selecting the branch network in the first sub-network, and selecting the feature extracting block in the each network stage in the selected branch network.

16. The method of claim 14, wherein prior to the each training, selecting, using the preset selection strategy, the branch network in the first sub-network, and selecting the feature extracting block in the each network stage in the selected branch network, comprises:

selecting a branch network containing a greatest number of feature extracting blocks in the first sub-network, and selecting the feature extracting block in the each network stage in the selected branch network.

17. The method of any one of claims 2 to 16, wherein the first sub-network further comprises a down-sampling layer between adjacent network stages.

18. The method of any one of claims 2 to 17, wherein the at least one feature extracting block comprises a convolution layer, an activation layer, and a Batch Normalization (BN) layer connected sequentially.

19. The method of any one of claims 1 to 18, further comprising: after adjusting the network parameter of the raw model by pre-training the raw model using the first training sample set, and before acquiring the target model using the second sub-network and the at least one

partial structure of the first sub-network pre-trained,

adjusting the network parameter of the raw model by training the raw model using the second training sample set.

20. The method of any one of claims 1 to 19, further comprising: after acquiring the target model using the second sub-network and the at least one partial structure of the first sub-network pre-trained, and before adjusting the network parameter of the target model by training the target model using the second training sample set corresponding to the target task,

adjusting the network parameter of the target model by training the target model using the first training sample set.

21. The method of any one of claims 1 to 20, wherein the raw model further comprises a third sub-network configured to perform a preset task based on an extracted feature, the preset task being the same as the target task or different from the target task.

22. The method of any one of claims 1 to 21, wherein a number of first training samples in the first training sample set is greater than a number of second training samples in the second training sample set.

23. A device for acquiring a target model, comprising a first training module, a model acquiring module, and a second training module,

wherein the first training module is configured to adjust a network parameter of a raw model by pre-training the raw model using a first training sample set, the raw model comprising a first sub-network configured for feature extraction,

wherein the model acquiring module is configured to acquire the target model using a second sub-network and at least one partial structure of the first sub-network pre-trained, the

second sub-network being configured to perform a target task based on a feature extracted by the first sub-network,

wherein the second training module is configured to adjust a network parameter of the target model by training the target model using a second training sample set corresponding to the target task.

24. Electronic equipment, comprising a memory and a processor coupled to each other, the processor being configured to execute program instructions stored in the memory to implement the method of any one of claims 1 to 22.

25. A computer-readable storage medium, having stored thereon program instructions which, when executed by a processor, implement the method of any one of claims 1 to 22.