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(54) **WEATHER FORECAST METHOD AND APPARATUS, AND RELATED DEVICE**

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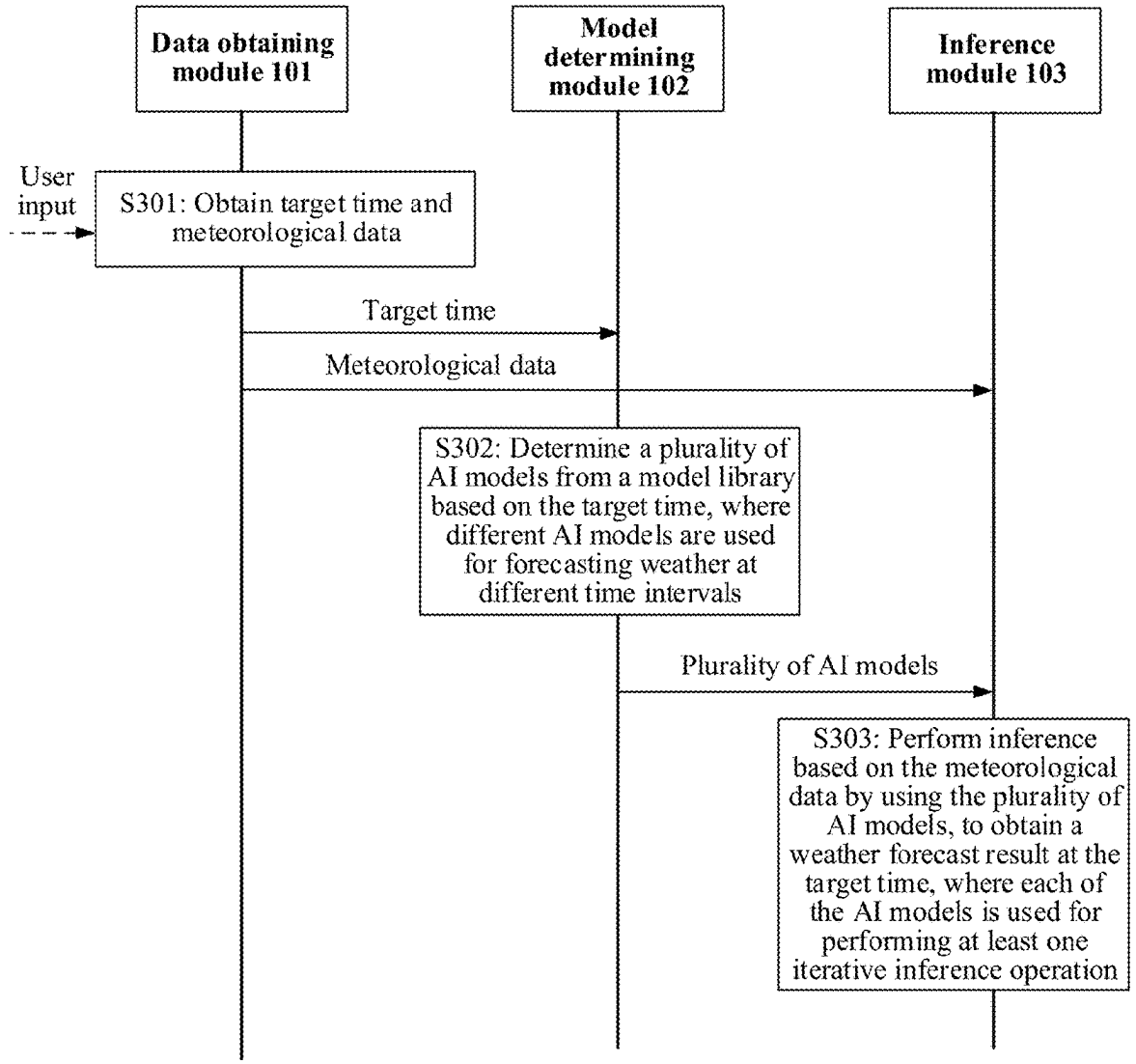
(57) **ABSTRACT**

This application provides a weather forecast method, including: obtaining meteorological data and target time; determining a plurality of first AI models from a model library based on the target time, where different first AI models are used for forecasting weather at different time intervals; and performing inference based on the obtained meteorological data by using the plurality of first AI models, to obtain a first weather forecast result at the target time.



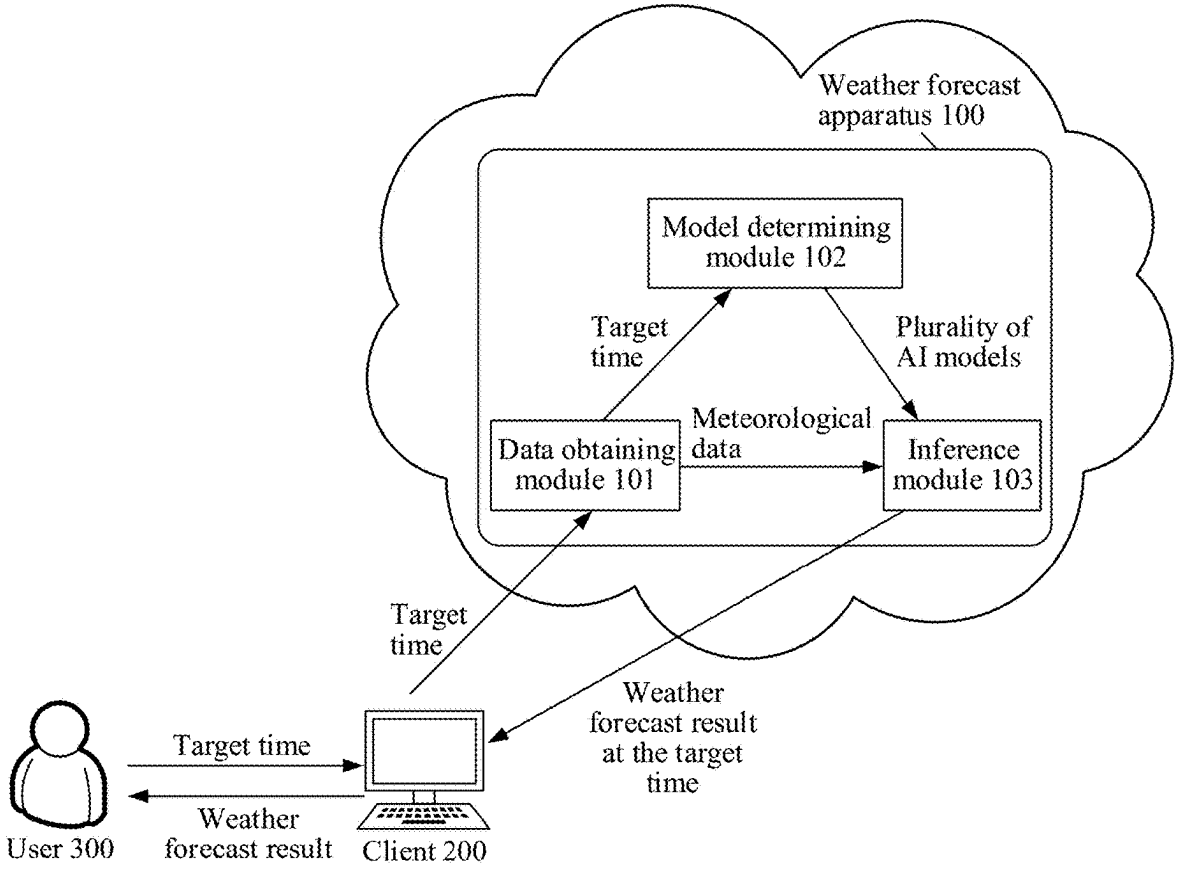

Weather forecast apparatus 100
Model determining module 102
Target time
Plurality of AI models
Data obtaining module 101
Meteorological data
Inference module 103
Target time
Weather forecast result at the target time
Target time
Weather forecast result
User 300
Client 200

FIG. 1

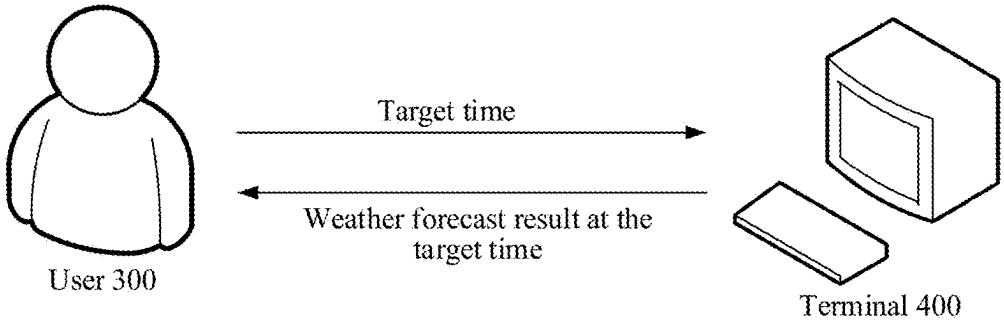

Target time
Weather forecast result at the target time
User 300
Terminal 400

FIG. 2

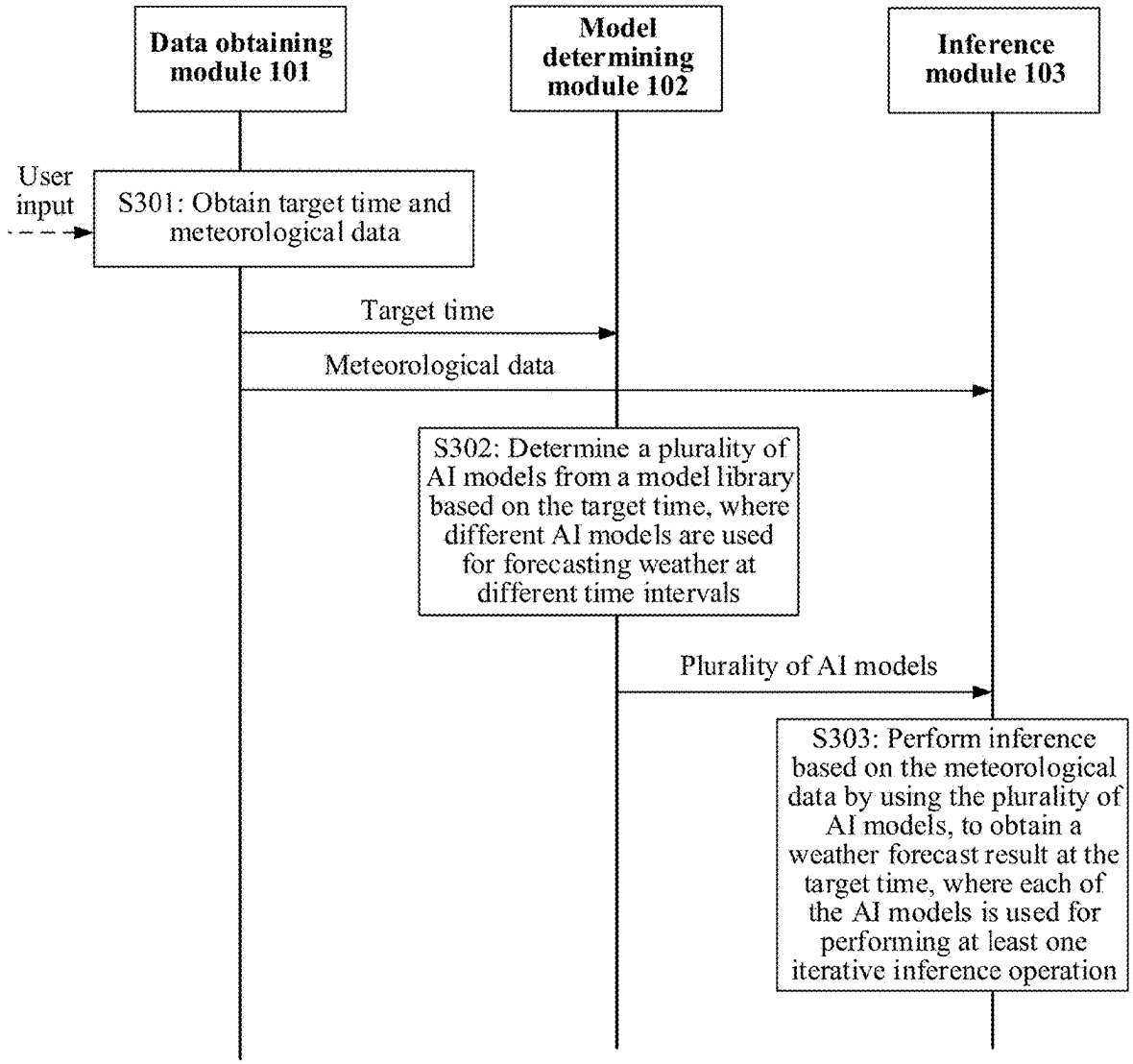

Data obtaining module 101
Model determining module 102
Inference module 103
User input
S301: Obtain target time and meteorological data
Target time
Meteorological data
S302: Determine a plurality of AI models from a model library based on the target time, where different AI models are used for forecasting weather at different time intervals
Plurality of AI models
S303: Perform inference based on the meteorological data by using the plurality of AI models, to obtain a weather forecast result at the target time, where each of the AI models is used for performing at least one iterative inference operation

FIG. 3

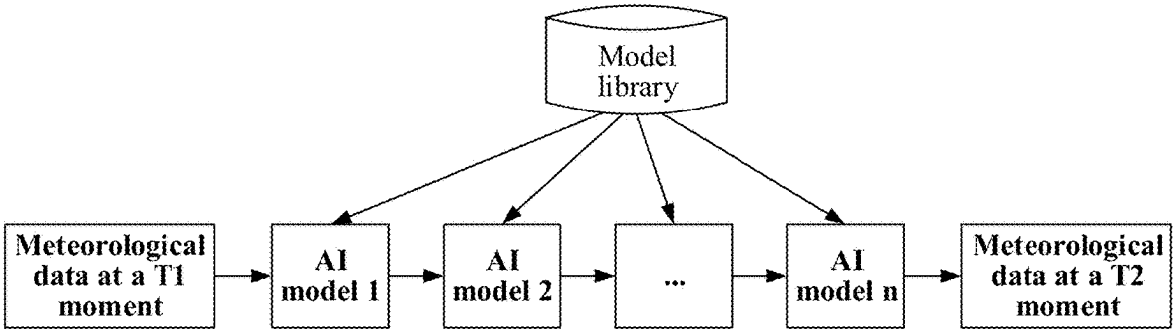

Model library
Meteorological data at a T1 moment
AI model 1
AI model 2
...
AI model n
Meteorological data at a T2 moment

FIG. 4

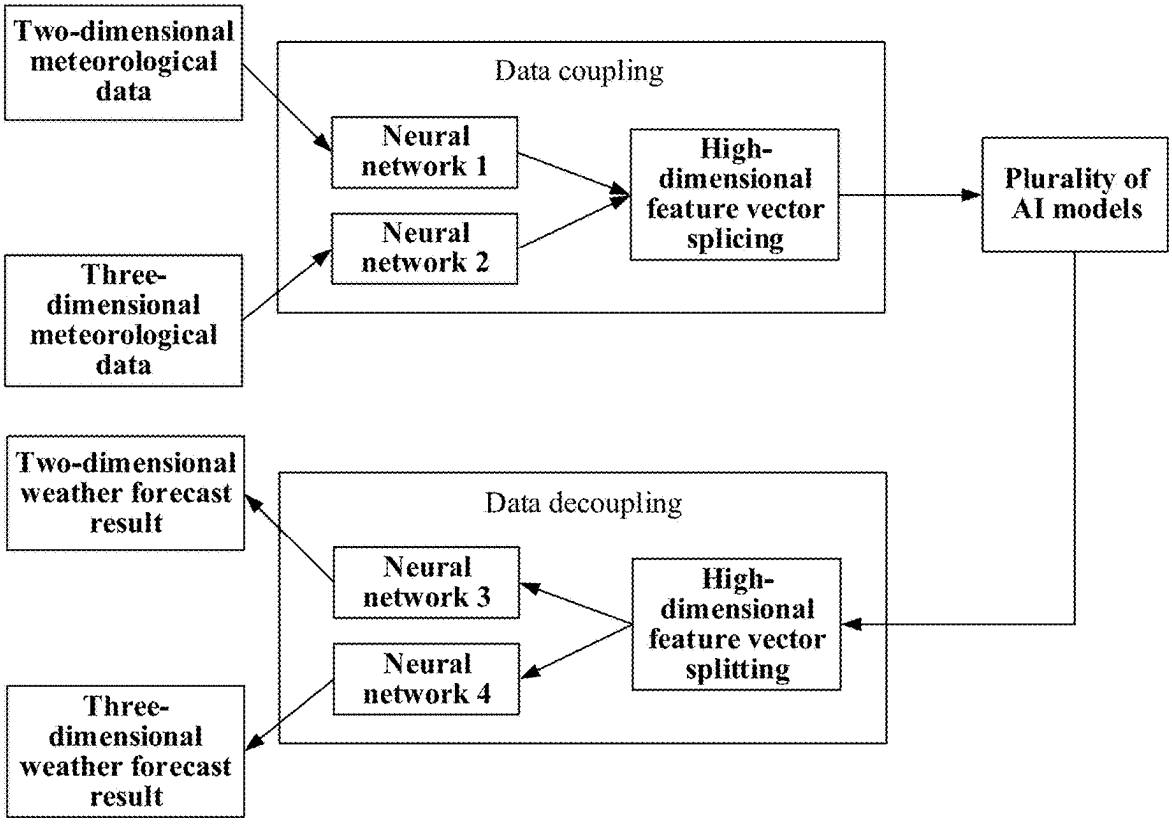

Two-dimensional meteorological data
Three-dimensional meteorological data
Data coupling
Neural network 1
Neural network 2
High-dimensional feature vector splicing
Plurality of AI models
Two-dimensional weather forecast result
Three-dimensional weather forecast result
Data decoupling
Neural network 3
Neural network 4
High-dimensional feature vector splitting

FIG. 5

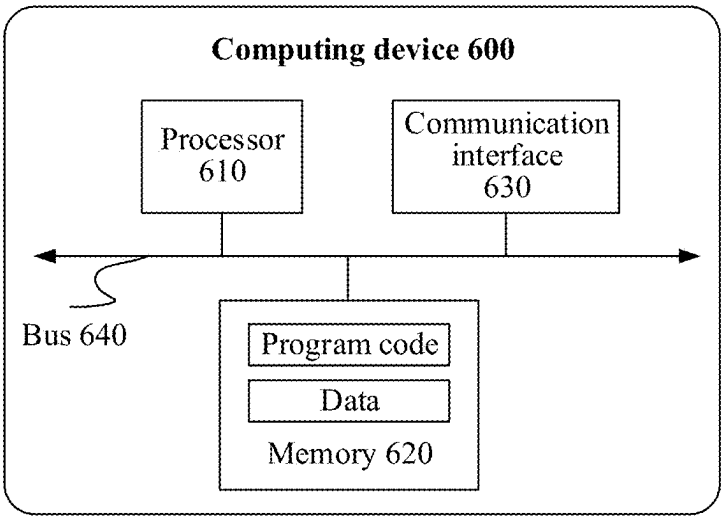

Computing device 600
Processor 610
Communication interface 630
Bus 640
Program code
Data
Memory 620

FIG. 6

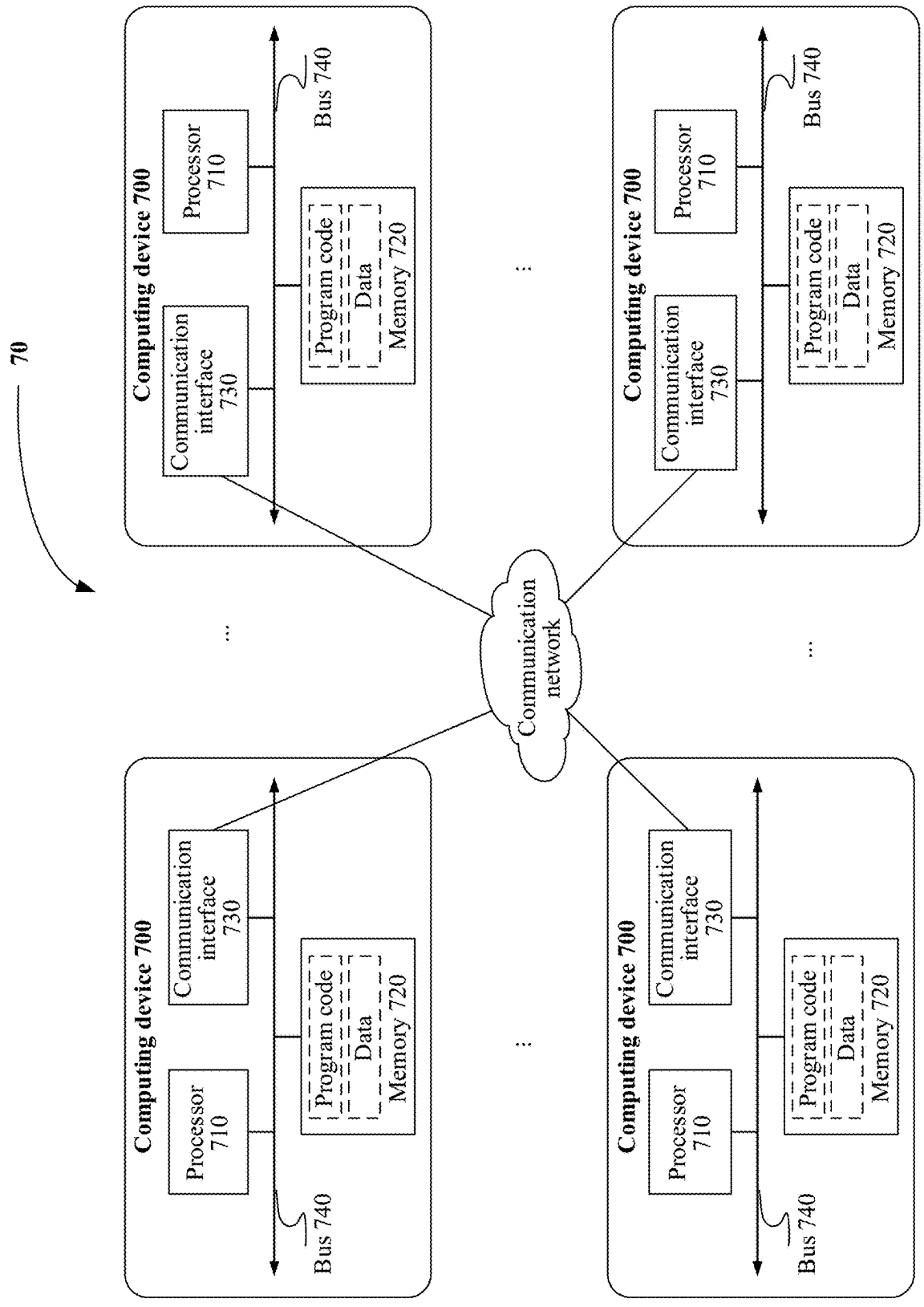

70
Computing device 700
Processor 710
Communication interface 730
Program code
Data
Memory 720
Bus 740
Communication network

FIG. 7

WEATHER FORECAST METHOD AND APPARATUS, AND RELATED DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of International Application No. PCT/CN2023/100686, filed on Jun. 16, 2023, which claims priority to Chinese Patent Application No. 202211351491.5, filed on Oct. 31, 2022. The disclosures of the aforementioned applications are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

[0002] This application relates to the field of artificial intelligence technologies, and in particular, to a weather forecast method and apparatus, and a related device.

BACKGROUND

[0003] Weather forecast (weather forecast, which may also be referred to as weather prediction) refers to a technology for forecasting a weather state of an atmosphere of the earth (or a place below the atmosphere of the earth) in the future by using a modern scientific means, and plays an important role in reasonable arrangement of work, early warning of bad weather, and the like.

[0004] Currently, mainly based on a numerical weather prediction (NWP) technology and based on an actual atmospheric condition, an atmospheric motion state and a weather phenomenon in a future time period is forecast by modeling mathematical and physical processes for the weather condition and by solving complex hydrodynamic and thermodynamic equations. However, in a complex equation solving process, not only high computing power needs to be consumed, but also a forecast delay is high.

SUMMARY

[0005] In view of this, embodiments of this application provide a weather forecast method, to reduce computing power required for weather forecast and reduce a forecast delay. This application further provides a corresponding apparatus, a computing device, a computing device cluster, a computer-readable storage medium, and a computer program product.

[0006] According to a first aspect, an embodiment of this application provides a weather forecast method. The method may be performed by a corresponding weather forecast apparatus. The weather forecast apparatus obtains meteorological data and target time. The obtained meteorological data may be, for example, meteorological data of a region at a current moment, or may be global meteorological data at the current moment. The target time may be a future moment, a future time period, or the like. Then, the weather forecast apparatus determines a plurality of first AI models from a model library based on the target time, where different first AI models in the plurality of first AI models are used for forecasting weather at different time intervals. Training of the plurality of AI models in the model library may be completed in advance based on sample data. In addition, the different AI models in the model library are respectively used for forecasting weather at different time intervals such as 1 hour, 2 hours, 3 hours, 1 day, and 3 days, and different AI models for forecasting weather at a same time interval have different training algorithms, model structures, iterative inference algorithms, or the like that are used. Therefore, the weather forecast apparatus performs inference based on the obtained meteorological data by using the plurality of first AI models, to obtain a first weather forecast result at the target time, where each of the first AI models is used for performing at least one iterative inference operation.

[0007] In this way, the weather forecast apparatus performs weather forecast by using the plurality of AI models, and does not need to perform a complex equation solving process. This can effectively reduce computing power consumed for weather forecast, and the AI model also can quickly output the weather forecast result at the target time, such that a weather forecast delay can be significantly reduced. In addition, in a weather forecast process, the weather forecast apparatus does not perform a large quantity of times of iterative inference by using a single AI model, but performs a small quantity of times of inference by using the plurality of AI models for forecasting the weather at the different time intervals. This not only can effectively reduce an iterative error, but also can reduce resource consumption required for iterative inference.

[0008] In a possible implementation, when determining the plurality of first AI models, the weather forecast apparatus may determine, from the model library based on the target time, the plurality of first AI models and a quantity of iterative inference operations performed by using each of the plurality of first AI models. For example, a part of the first AI models is used for performing iterative inference for three times, and other first AI models are used for performing iterative inference for 10 times. Therefore, when performing inference by using the plurality of first AI models, the weather forecast apparatus may sequentially perform, based on the meteorological data and the quantity of iterative inference operations performed by using each of the first AI models, the iterative inference operations by using the plurality of first AI models. In this way, the weather forecast apparatus may obtain the weather forecast result at the target time by using the plurality of first AI models to separately perform the at least one iterative inference operation. This reduces an iterative error, and reduces resource consumption required for iterative inference.

[0009] In a possible implementation, the meteorological data obtained by the weather forecast apparatus may include three-dimensional meteorological data. Further, the obtained meteorological data may further include two-dimensional meteorological data. The weather forecast apparatus may perform weather forecast based on the three-dimensional meteorological data and the two-dimensional meteorological data. In this way, precision of the weather forecast result obtained through performing inference based on the complete three-dimensional meteorological data can reach a high level, for example, may exceed precision of a weather forecast result obtained based on a conventional numerical weather prediction technology.

[0010] In actual application, the meteorological data obtained by the weather forecast apparatus may alternatively be the two-dimensional meteorological data.

[0011] In a possible implementation, the meteorological data obtained by the weather forecast apparatus is the three-dimensional meteorological data and the two-dimensional meteorological data. When performing weather forecast, the weather forecast apparatus may couple the three-dimensional meteorological data with the two-dimensional

meteorological data, to obtain fused meteorological data, and perform inference based on the fused meteorological data by using the plurality of first AI models, to obtain the first weather forecast result at the target time. When the two-dimensional meteorological data and the three-dimensional meteorological data are coupled, the two-dimensional meteorological data and the three-dimensional meteorological data may be separately projected to a high-dimensional vector space, and vector splicing is performed in the high-dimensional vector space, to obtain the fused meteorological data. In this way, precision of the weather forecast result obtained through performing inference based on the complete three-dimensional meteorological data can reach a high level.

[0012] In a possible implementation, when performing weather forecast, the weather forecast apparatus may add, in a process of performing inference on the meteorological data by using the plurality of first AI models, biases to computation results of intermediate variables in the plurality of first AI models or computation results of attention mechanisms in the plurality of first AI models, where the bias is determined based on altitude information or latitude information in the meteorological data. In this way, the computation result of the intermediate variable in the AI models can be compensated by using the bias, such that impact of uneven distribution of the meteorological data on precision of the weather forecast result can be overcome, and accuracy of inference performed by using the AI models can be improved.

[0013] In a possible implementation, the weather forecast apparatus may further determine a plurality of second AI models from the model library based on the target time, where different second AI models in the plurality of second AI models are used for forecasting weather at different time intervals. The plurality of second AI models and the plurality of first AI models may have different data input and model structures, and use different iterative inference algorithms; or the second AI models and the first AI models are used for forecasting weather at different time intervals, or the like. Then, the weather forecast apparatus performs inference based on the meteorological data by using the plurality of second AI models, to obtain a second weather forecast result at the target time, where each of the second AI models is used for performing at least one iterative inference operation. In this way, the weather forecast apparatus may perform inference by using another group of AI models, and can obtain another weather forecast result. Therefore, the weather forecast apparatus may present a plurality of pieces of possible forecast weather by presenting the second weather forecast result, to improve user experience. Alternatively, the weather forecast apparatus may comprehensively determine a finally output weather forecast result based on a plurality of weather forecast results such as the first weather forecast result and the second weather forecast result, to further improve accuracy of weather forecast.

[0014] In a possible implementation, the weather forecast apparatus may determine a target weather forecast result based on the first weather forecast result and the second weather forecast result, for example, determine the target weather forecast result through voting or computing an average value, and output the target weather forecast result. In this way, the weather forecast apparatus may comprehensively determine and output a unique weather forecast result by integrating weather inference results obtained through inference separately performed by a plurality of groups of AI models, such that accuracy of weather forecast can be improved.

[0015] In a possible implementation, the weather forecast apparatus may further obtain location information, where the location information indicates a region, for example, indicates a city A, or indicates a global scope. In addition, the first weather forecast result obtained through inference by using the plurality of first AI models indicates weather corresponding to the location information. Therefore, when determining the plurality of first AI models, the weather forecast apparatus may determine, from the model library based on the location information and time information, the plurality of first AI models used for performing inference for the weather of the region indicated by the location information. In this way, independent forecast can be performed for weather in a region.

[0016] In a possible implementation, when obtaining the target time, the weather forecast apparatus may output an interaction interface first, for example, present the interaction interface by using an externally presented client, and obtain, in response to an operation by a user on the interaction interface, the target time input by the user. In this way, the user may specify a future moment or a future time period in which forecast is performed for weather, such that the weather forecast result obtained through inference can satisfy a user requirement, and user experience is improved.

[0017] According to a second aspect, an embodiment of this application further provides a weather forecast apparatus, including: a data obtaining module, configured to obtain meteorological data and target time; a model determining module, configured to determine a plurality of first artificial intelligence AI models from a model library based on the target time, where different first AI models in the plurality of first AI models are used for forecasting weather at different time intervals; and an inference module, configured to perform inference based on the meteorological data by using the plurality of first AI models, to obtain a first weather forecast result at the target time, where each of the first AI models is used for performing at least one iterative inference operation.

[0018] In a possible implementation, the model determining module is configured to determine, from the model library based on the target time, the plurality of first artificial intelligence AI models and a quantity of iterative inference operations performed by using each of the plurality of first AI models; and the inference module is configured to sequentially perform, based on the meteorological data and the quantity of iterative inference operations performed by using each of the first AI models, the iterative inference operations by using the plurality of first AI models.

[0019] In a possible implementation, the meteorological data includes three-dimensional meteorological data.

[0020] In a possible implementation, the meteorological data includes the three-dimensional meteorological data and two-dimensional meteorological data; and the inference module is configured to: couple the three-dimensional meteorological data with the two-dimensional meteorological data, to obtain fused meteorological data; and perform inference based on the fused meteorological data by using the plurality of first AI models.

[0021] In a possible implementation, the inference module is configured to: in a process of performing inference on the meteorological data by using the plurality of first AI models,

add biases to computation results of intermediate variables in the plurality of first AI models or computation results of attention mechanisms in the plurality of first AI models, where the bias is determined based on altitude information or latitude information in the meteorological data.

[0022] In a possible implementation, the model determining module is further configured to determine a plurality of second AI models from the model library based on the target time, where different second AI models in the plurality of second AI models are used for forecasting weather at different time intervals; and the inference module is further configured to perform inference based on the meteorological data by using the plurality of second AI models, to obtain a second weather forecast result at the target time, where each of the second AI models is used for performing at least one iterative inference operation.

[0023] In a possible implementation, the inference module is further configured to: determine a target weather forecast result based on the first weather forecast result and the second weather forecast result; and output the target weather forecast result.

[0024] In a possible implementation, the data obtaining module is further configured to obtain location information, where the first weather forecast result indicates weather corresponding to the location information; and the model determining module is configured to determine the plurality of first artificial intelligence AI models from the model library based on the location information and the target time.

[0025] In a possible implementation, the data obtaining module is configured to: output an interaction interface; and in response to an operation by a user on the interaction interface, obtain the target time input by the user.

[0026] It should be noted that, the weather forecast apparatus provided in the second aspect corresponds to the weather forecast method provided in the first aspect. Therefore, for technical effects of the second aspect and any one of implementations of the second aspect, refer to technical effects of the first aspect or corresponding implementations of the first aspect.

[0027] According to a third aspect, this application provides a computing device, where the computing device includes a processor and a memory; and the memory is configured to store instructions, and the processor executes the instructions stored in the memory, to cause the computing device to perform the weather forecast method in the first aspect or any one of possible implementations of the first aspect. It should be noted that, the memory may be integrated into the processor, or may be independent of the processor. The computing device may further include a bus. The processor is connected to the memory through the bus. The memory may include a readable memory and a random access memory.

[0028] According to a fourth aspect, this application provides a computing device cluster, where the computing device cluster includes at least one computing device, and the at least one computing device includes at least one processor and at least one memory; and the at least one memory is configured to store instructions, and the at least one processor executes the instructions stored in the at least one memory, to cause the computing device cluster to perform the weather forecast method in the first aspect or any one of possible implementations of the first aspect. It should be noted that, the memory may be integrated into the processor, or may be independent of the processor. The at least one computing device may further include a bus. The processor is connected to the memory through the bus. The memory may include a readable memory and a random access memory.

[0029] According to a fifth aspect, this application provides a computer-readable storage medium, where the computer-readable storage medium stores instructions. When the instructions are run on at least one computing device, the at least one computing device is caused to perform the method according to the first aspect or any one of implementations of the first aspect.

[0030] According to a sixth aspect, this application provides a computer program product including instructions. When the computer program product runs on at least one computing device, the at least one computing device is caused to perform the method according to the first aspect or any one of implementations of the first aspect.

[0031] In this application, based on implementations according to the foregoing aspects, the implementations may be further combined to provide more implementations.

BRIEF DESCRIPTION OF DRAWINGS

[0032] To describe technical solutions in embodiments of this application more clearly, the following briefly describes accompanying drawings used for describing embodiments. It is clear that the accompanying drawings in the following descriptions are merely some embodiments recorded in this application, and for a person of ordinary skill in the art, other drawings may also be derived from the accompanying drawings.

[0033] FIG. **1** is a diagram of an example application scenario according to this application;

[0034] FIG. **2** is a diagram of another example application scenario according to this application;

[0035] FIG. **3** is a schematic flowchart of a weather forecast method according to this application;

[0036] FIG. **4** is a diagram in which a plurality of AI models serially perform an inference process according to this application;

[0037] FIG. **5** is a diagram of performing weather forecast based on two-dimensional meteorological data and three-dimensional meteorological data according to this application;

[0038] FIG. **6** is a diagram of a structure of a computing device according to this application; and

[0039] FIG. **7** is a diagram of a structure of a computing device cluster according to this application.

DESCRIPTION OF EMBODIMENTS

[0040] The following describes solutions in embodiments provided in this application with reference to accompanying drawings in this application.

[0041] In the specification, claims, and accompanying drawings of this application, terms such as "first", "second", and the like are used for distinguishing similar objects, but are not necessarily used for describing a order or sequence. It should be understood that, the terms used in such a way are interchangeable in proper circumstances, and this is merely a distinguishing manner used when objects with a same attribute are described in embodiments of this application.

[0042] When weather forecast is performed for a region or the world, weather of the region or the world at a future

moment is forecast usually based on an NWP technology and based on data that reflects an actual atmospheric situation by modeling mathematical and physical processes and by solving complex hydrodynamic and thermodynamic equations. However, solving a complex equation needs to consume high computing power, and a forecast delay is usually high.

[0043] Based on this, an embodiment of this application provides a weather forecast method. The weather forecast method may be performed by a corresponding weather forecast apparatus, to reduce computing power required for weather forecast and shorten a forecast delay. During implementation, the weather forecast apparatus obtains meteorological data and target time, and determines a plurality of artificial intelligence (AI) models from a model library based on the target time. Different AI models are used for forecasting weather at different time intervals. For example, an AI model a, an AI model b, and an AI model c are determined. In addition, the AI model a is used for forecasting weather after 1 hour, the AI model b is used for forecasting weather after 12 hours, the AI model c is used for forecasting weather after 3 days, or the like. In this way, the weather forecast apparatus performs inference based on the meteorological data by using the plurality of AI models, such that a weather forecast result at the target time can be obtained. Each of the AI models is used for performing at least one iterative inference operation.

[0044] The weather forecast apparatus performs weather forecast by using the plurality of AI models, and does not need to perform a complex equation solving process. This can effectively reduce computing power consumed for weather forecast, and the AI model also can quickly output the weather forecast result at the target time, such that a weather forecast delay can be significantly reduced.

[0045] In addition, in a weather forecast process, the weather forecast apparatus does not perform a large quantity of times of iterative inference by using a single AI model, but performs a small quantity of times of inference by using the plurality of AI models for forecasting the weather at the different time intervals. This not only can effectively reduce an iterative error, but also can reduce resource consumption required for iterative inference.

[0046] For example, it is assumed that global weather after 3 days and 14 hours needs to be forecast currently. In this case, if iterative inference is performed by using the foregoing single AI model a, the weather forecast apparatus needs to perform iterative inference for 86 times (that is, 3×24+14) by using the AI model a, to obtain a weather forecast result after the 3 days and 14 hours through inference. However, when inference is performed by using the AI model a, the AI model b, and the AI model c, because the AI model c can forecast the weather after 3 days, the AI model b can forecast the weather after 12 hours, and the AI model a can forecast the weather after 1 hour, the weather forecast apparatus may perform inference once by using the AI model c, then perform inference once by using the AI model b, and finally perform inference twice by using the AI model c, to obtain a weather forecast result after the 3 days and 14 hours (that is, 3 days+12 hours+1 hour×2).

[0047] In an example, the weather forecast apparatus may be deployed in a cloud, to provide a cloud service of weather forecast for a user. For example, in an application scenario shown in FIG. **1**, a weather forecast apparatus **100** may be deployed in a cloud, for example, may be implemented by a computing device in the cloud or a computing device cluster in the cloud. In addition, the weather forecast apparatus **100** may externally provide a client **200**, configured to implement interaction with a user **300**, for example, receive the foregoing target time input by the user **300**, or feed back a target weather forecast result to the user **300**. In actual application, for example, the client **200** may be an application running on a user-side device, or may be a web browser externally provided by the weather forecast apparatus **100**. The weather forecast apparatus **100** may include a data obtaining module **101**, a model determining module **102**, and an inference module **103**. The data obtaining module **101** is configured to obtain the target time input by the user **300** via the client **200**, provide the target time for the model determining module **102**, obtain the meteorological data from the cloud, and provide the meteorological data for the inference module **103**. The model determining module **102** is configured to: determine a plurality of AI models from a model library based on the target time (where the model library is deployed in the cloud with the weather forecast apparatus **100**), and provide the plurality of AI models for the inference module **103**. The inference module **103** is configured to perform inference based on the meteorological data by using the plurality of AI models, to obtain a weather forecast result at the target time. Further, the inference module **103** may further send the weather forecast result at the target time to the client **200**, such that the client **200** presents the weather forecast result to the user **300**.

[0048] In another example, the weather forecast apparatus may be deployed locally, to provide a local weather forecast service for a user. For example, in an application scenario shown in FIG. **2**, the weather forecast apparatus may be a local terminal **400**, such that a user **300** may input target time and meteorological data to the terminal **400**. The terminal **400** determines, by using the target time, a plurality of AI models from a locally deployed model library, performs inference based on the meteorological data by using the plurality of AI models, to obtain a weather forecast result at the target time, and presents the weather forecast result to the user **300**.

[0049] In actual application, the weather forecast apparatus may be implemented by software, or may be implemented by hardware.

[0050] The weather forecast apparatus is used as an example of a software functional unit, and may include code that is run on a computing instance. The computing instance may include at least one of a host, a virtual machine, and a container. Further, there may be one or more computing instances. For example, the weather forecast apparatus may include code that is run on a plurality of hosts/virtual machines/containers. It should be noted that, the plurality of hosts/virtual machines/containers configured to run the code may be distributed in a same region, or may be distributed in different regions. Further, the plurality of hosts/virtual machines/containers configured to run the code may be distributed in a same availability zone (AZ), or may be distributed in different AZs. Each of the AZs includes one data center or a plurality of data centers that are geographically close to each other. Usually, one region may include a plurality of AZs.

[0051] Similarly, the plurality of hosts/virtual machines/containers configured to run the code may be distributed in a same virtual private cloud (VPC), or may be distributed in a plurality of VPCs. Usually, one VPC is arranged in one

region. For cross-region communication between two VPCs in a same region and between VPCs in different regions, a communication gateway needs to be arranged in each of the VPCs, and interconnection between the VPCs is implemented through the communication gateway.

[0052] The weather forecast apparatus is used as an example of a hardware functional unit, and the weather forecast apparatus may include at least one computing device, for example, a server. Alternatively, the weather forecast apparatus may be a device implemented by using an application-specific integrated circuit (ASIC), a programmable logic device (PLD), or the like. The PLD may be a complex programmable logic device (CPLD), a field-programmable gate array (FPGA), a generic array logic (GAL), a data processing unit (DPU), or any combination thereof.

[0053] A plurality of computing devices included in the weather forecast apparatus may be distributed in a same region, or may be distributed in different regions. The plurality of computing devices included in the weather forecast apparatus may be distributed in a same AZ, or may be distributed in different AZs. Similarly, the plurality of computing devices included in the weather forecast apparatus may be distributed in a same VPC, or may be distributed in a plurality of VPCs. The plurality of computing devices may be any combination of computing devices such as a server, an ASIC, a PLD, a CPLD, an FPGA, and a GAL.

[0054] Next, various non-limiting implementations of the weather forecast process are described in detail.

[0055] FIG. **3** is a schematic flowchart of a weather forecast method according to an embodiment of this application. The method may be applied to the application scenario shown in FIG. **1** or FIG. **2**, or may be applied to another applicable application scenario. The following uses an example in which the method is applied to the application scenario shown in FIG. **1** for description. In the application scenario shown in FIG. **1**, for functions of a data obtaining module **101**, a model determining module **102**, and an inference module **103** in a weather forecast apparatus **100**, refer to related descriptions in the following embodiments.

[0056] The weather forecast method shown in FIG. **3** may include the following steps.

[0057] S**301**: The data obtaining module **101** obtains target time and meteorological data.

[0058] Usually, when weather forecast is performed, time corresponding to weather to be forecast, which is referred to as the target time hereinafter, may be first determined, for example, weather after 24 hours is to be forecast.

[0059] In an example of obtaining the target time, the weather forecast apparatus **100** may externally provide a client **200**, and the client **200** may present an interaction interface to a user **300**, such that the user **300** may input the target time of the to-be-forecast weather on the interaction interface. Correspondingly, the weather forecast apparatus **100** obtains, in response to an operation by the user **300** on the interaction interface, the target time input by the user. The target time input by the user **300** may be a moment. For example, if a current moment may be 8:00:00, the target time may be a future moment 18:00:00 that is 10 hours away from the current moment. Therefore, the weather forecast apparatus **100** may subsequently feed back a weather forecast result corresponding to the moment 18:00:00 to the user **300**. Alternatively, the target time input by the user **300** may be a time period, for example, may be a time period between 8:00:00 and 18:00:00. Therefore, the weather forecast apparatus **100** may subsequently feed back weather forecast results respectively corresponding to a plurality of moments in the time period to the user **300**, for example, feed back a weather forecast result corresponding to 9:00:00, a weather forecast result corresponding to 10:00:00, a weather forecast result corresponding to 13:00:00, and a weather forecast result corresponding to 18:00:00. Alternatively, the weather forecast apparatus **100** may perform periodic weather forecast by default, and a moment corresponding to the periodicity may be the target time or the like.

[0060] In addition, the data obtaining module **101** further obtains the meteorological data. The meteorological data may be two-dimensional meteorological data, or may be three-dimensional meteorological data, or may include both the two-dimensional meteorological data and the three-dimensional meteorological data. The two-dimensional meteorological data may be, for example, information such as a temperature, humidity, a wind speed, total rainfall, and total illumination. The three-dimensional meteorological data may be, for example, information such as an isobaric surface, an altitude, a temperature, and humidity.

[0061] In some examples of obtaining the meteorological data, the user **300** may import the meteorological data to the weather forecast apparatus **100** via the client **200**, such that the data obtaining module **101** may receive the meteorological data sent by the client **200**. Alternatively, the weather forecast apparatus **100** may obtain the meteorological data from a network, for example, may obtain current meteorological data in real time by remotely accessing a meteorological detection device.

[0062] It should be noted that, an implementation in which the data obtaining module **101** obtains the target time and the meteorological data is merely used as an example for description. In actual application, the data obtaining module **101** may alternatively obtain the target time and the meteorological data in another manner. This is not limited in this embodiment.

[0063] After obtaining the target time and the meteorological data, the data obtaining module **101** may provide the target time for the model determining module **102**, and provide the meteorological data for the inference module **103**.

[0064] S**302**: The model determining module **102** determines a plurality of AI models from a model library based on the target time, where different AI models in the plurality of AI models are used for forecasting weather at different time intervals.

[0065] The model library may be deployed in the weather forecast apparatus **100**. The model library includes a plurality of different AI models, and the different AI models are used for forecasting the weather at the different time intervals. For example, the model library may include 10 AI models, and the 10 AI models are respectively used for forecasting weather after 1 hour, 2 hours, 3 hours, 5 hours, 7 hours, 12 hours, 24 hours (namely, 1 day), 72 hours (namely, 3 days), 168 hours (namely, 7 days), and 360 hours (namely, 15 days). Further, the model library may further include a plurality of AI models used for forecasting weather at a same time interval. The plurality of AI models have different model input, model structures, iterative inference algorithms used for model inference, model training algorithms, and the like. For example, the model library may further include an AI model m, an AI model n, and an AI model w. In addition, the three AI models are all used for

forecasting weather after one hour. Training of the AI model m and the AI model n is completed by using different training algorithms, the AI model m and the AI model w have different neural network architectures, and the like.

[0066] For example, the AI model in the model library may be constructed based on a neural network of a transformer structure, for example, constructed based on a vision transformer, or may be constructed based on another type of neural network. This is not limited in this embodiment.

[0067] In this embodiment, the weather forecast apparatus **100** may select the plurality of AI models from the model library, to forecast weather at the target time. During implementation, the model determining module **102** may first select, from the model library based on the target time, the plurality of AI models for performing weather forecast this time, and total duration of time intervals of the weather forecast by using the plurality of AI models matches the target time.

[0068] For example, it is assumed that the target time is 3 days and 15 hours. For example, weather after the 3 days and 15 hours from the current moment is forecast. In this case, the model determining module **102** may select, from the model library based on the target time, an AI model x used for forecasting weather after 3 hours, an AI model y used for forecasting weather after 12 hours, and an AI model z used for forecasting weather after 72 hours. Interval duration of the weather that can be forecast by using the three AI models may be 87 hours (that is, 3 hours+12 hours+72 hours), namely, the 3 days and 15 hours.

[0069] After determining the plurality of AI models, the model determining module **102** may provide the plurality of AI models for the inference module **103**.

[0070] S**303**: The inference module **103** performs inference based on the obtained meteorological data by using the plurality of AI models, to obtain a weather forecast result at the target time, where each of the AI models is used for performing at least one iterative inference operation.

[0071] During implementation, the inference module **103** may input the meteorological data into one AI model of the AI models, the AI model is used for performing inference based on the meteorological data, and an obtained inference result **1** may be used as input of a 2^{nd} AI model. In addition, the 2^{nd} AI model is used for performing inference based on the inference result **1**, and an obtained inference result **2** continues to be input into a next AI model. In other words, after the inference module **103** inputs meteorological data at a moment T**1** into a 1^{st} AI model, input of another AI model is an inference result output by a previous AI model, as shown in FIG. **4**. In this way, the inference module **103** sequentially performs inference operations by using the plurality of AI models, such that a weather forecast result output by a last AI model can be obtained, that is, a weather forecast result at a moment T**2** shown in FIG. **4** can be obtained.

[0072] A sequence in which the plurality of AI models are used for sequentially performing inference may be determined by the inference module **103** according to a preset rule. For example, the sequence in which the plurality of AI models are used for sequentially performing the inference operations may be an ascending sequence of the time intervals of the weather that can be forecast by using the plurality of AI models. An example in which the target time is 3 days and 15 hours is still used. The 1^{st} AI model that is used for performing the inference operation may be the AI model x used for forecasting the weather after 3 hours, and an inference result **1** obtained through performing inference by using the AI model x based on the meteorological data may be used as input of the AI model y used for forecasting the weather after 12 hours. After the inference operation is performed, the AI model y outputs an inference result **2**, and the inference result **2** is used as input of the AI model z used for forecasting the weather after 72 hours. In this way, after the inference operation is performed, the AI model z outputs a final inference result, that is, outputs the weather forecast result at the target time. Alternatively, the sequence in which the plurality of AI models are sequentially used for performing inference may be randomly determined by the inference module **103**. For example, the inference module **103** may determine, based on a random algorithm, that a sequence in which the AI model x, the AI model y, and the AI model z are used for performing inference is the AI model z->the AI model x->the AI model y. In this embodiment, the sequence in which the plurality of AI models are used for performing the inference operations is not limited.

[0073] In actual application, when there are many AI models that are used for forecasting the weather at the different time intervals and that are in the model library, for example, the model library may include 10 AI models respectively used for forecasting weather of 1 hour, 2 hours, 3 hours, 5 hours, 7 hours, 12 hours, 24 hours, 72 hours, 168 hours, and 360 hours, for any target time, the inference module **103** may obtain the weather forecast result at the target time through separately performing an inference process by using each of the determined AI models. For example, it is assumed that the target time is 3 days and 15 hours. In this case, the inference module **103** may obtain a weather forecast result of the 3 days and 15 hours through separately performing an inference process by sequentially using the AI model x, the AI model y, and the AI model z.

[0074] However, when there are few AI models that are used for forecasting the weather at the different time intervals and that are in the model library, for example, the model library includes four AI models respectively used for forecasting weather after 1 hour, 12 hours, 72 hours, and 168 hours, for any target time, the model determining module **102** may determine, from the model library based on the target time, the plurality of AI models and a quantity of iterative inference operations performed by using each of the AI models, and provide the determined plurality of AI models and the determined quantity of iterative inference operations performed by using each of the AI models for the inference module **103**. The inference module **103** may iteratively perform an inference process for a plurality of times on a part or all of the AI models based on the quantity of iterative inference operations performed by using each of the AI models, to obtain the weather forecast result at the target time. Still in an example in which the target time is 3 days and 15 hours, the model determining module **102** may determine, from the model library based on the target time, an AI model o used for forecasting weather after 1 hour, an AI model p used for forecasting weather after 12 hours, and an AI model q used for forecasting weather after 72 hours. A quantity of iterative inference operations that need to be performed by using the AI model o is 3, a quantity of iterative inference operations that need to be performed by using the AI model p is 1, and a quantity of iterative inference operations that need to be performed by using the AI model q is 1. Correspondingly, total duration of time

intervals of the weather that can be forecast by using the plurality of AI models is 87 hours (that is, 1 hour×3+12 hours×1+72 hours×1). In this way, based on a quantity of times of iteration corresponding to each of the AI models, the inference module **103** may iteratively perform three inference operations by using the AI model o, and provide a result obtained through the three times of iterative inference for the AI model p. Then, the inference module **103** performs one inference operation by using the AI model p, and provides a result obtained through performing the inference operation for the AI model q. In this way, after one inference operation is performed, the AI model q may output and obtain the weather forecast result at the target time. For example, the plurality of AI models that are determined by the model determining module **102** and the quantity that is determined by the model determining module **102** and that is of inference operations performed by using each of the AI models may satisfy the following formula (1):

$$i \cdot T = f_1 * N_1 + f_2 * N_2 + \ldots + f_n * N_n \quad (1)$$

[0075] Tis the target time; f_1 to f_n respectively refer to n AI models determined by the model determining module **102**; and N_1 to N_n respectively refer to the quantity of inference operations that need to be performed by using the AI models f_1 to f_n. For example, N_1 refers to a quantity of inference operations that need to be performed by using the AI model f_1, and N_n refers to a quantity of inference operations that need to be performed by using the AI model f_n.

[0076] Correspondingly, training of the plurality of AI models in the model library may be completed in advance based on meteorological data in a past time period. For example, for an AI model that is used for forecasting weather after a time interval of 1 hour and that is in the model library, training of the AI model may be completed by using meteorological data at 5:00:00 in the past time period and meteorological data at 6:00:00. The meteorological data at 5:00:00 may be used as input of the AI model, and the AI model is used for performing inference based on the input, to obtain meteorological data at 6:00:00 forecast by using the AI model. Then, gradient adjustment is performed on a parameter in the AI model through comparing a difference between the meteorological data at 6:00:00 forecast by using the AI model and the actual meteorological data at 6:00:00, to perform iterative training on the AI model by using a plurality of groups of meteorological data, until a training termination condition of the AI model is satisfied, for example, a value of a loss function of the AI model is less than a preset value. In a similar manner, the plurality of AI models used for forecasting the weather at the different time intervals may be obtained through training. In actual application, the plurality of AI models in the model library may alternatively be obtained through training in another manner. This is not limited in this embodiment. After the plurality of AI models are obtained through training, a model library may be created based on the plurality of AI models, and the model library is deployed in the weather forecast apparatus **100**. Training of the plurality of AI models in the model library may be completed by the weather forecast apparatus **100**, or may be sent to the weather forecast apparatus **100** by another device after the another device completes training of the AI models, or the like. This is not limited in this embodiment.

[0077] In a process of forecasting the weather at the target time, the meteorological data input by the inference module **103** into one of the AI models may be two-dimensional meteorological data, or may be three-dimensional meteorological data, or may include both the two-dimensional meteorological data and the three-dimensional meteorological data. When the meteorological data includes both the two-dimensional meteorological data and the three-dimensional meteorological data, before inputting the meteorological data into the AI model, the inference module **103** may couple the two-dimensional meteorological data with the three-dimensional meteorological data in advance, to obtain fused meteorological data. In this way, the inference module **103** performs inference based on the fused meteorological data by using the plurality of AI models.

[0078] In a possible implementation, the inference module **103** may input the two-dimensional meteorological data into a neural network **1**, such that the neural network **1** projects the two-dimensional meteorological data into a high-dimensional (three-dimensional or more) space, to obtain a high-dimensional feature vector. In addition, the inference module **103** further inputs the three-dimensional meteorological data into a neural network **2**, such that the neural network **2** projects the three-dimensional meteorological data into a high-dimensional (three-dimensional or more) space, to obtain a high-dimensional feature vector, as shown in FIG. **5**. Then, the inference module **103** may splice the high-dimensional feature vector output by the neural network **1** and the high-dimensional feature vector output by the neural network **2**. Between the high-dimensional feature vectors output by the two neural networks, expect for a difference in a feature vector corresponding to a dimension of altitude in the three-dimensional meteorological data, feature vectors of remaining dimensions match each other, that is, a sum operation may be performed on values of the feature vectors of the remaining dimensions in a process of splicing the high-dimensional feature vectors. A new high-dimensional feature vector obtained through computation is the foregoing fused meteorological data. For example, the neural network **1** outputs feature vectors of five dimensions, and the neural network **2** outputs feature vectors of six dimensions. Feature vectors of five dimensions in the feature vectors of the six dimensions match the feature vectors that are of the five dimensions and that are output by the neural network **1**, and a feature vector of a sixth dimension in the feature vectors of the six dimensions is the feature vector corresponding to the dimension of altitude in the three-dimensional meteorological data. In this case, when the feature vectors that are of the five dimensions and that are output by the neural network **1** and the feature vectors that are of the six dimensions and that are output by the neural network **2** are spliced, a value of the feature vector of the sixth dimension in the feature vectors of the six dimensions remains unchanged, and values of the feature vectors of the remaining five dimensions in the feature vectors of the six dimensions may be correspondingly summed up with values of the feature vectors that are of the five dimensions and that are output by the neural network **1**. In this way, in comparison with a manner in which weather forecast is performed based only on the two-dimensional meteorological data, in modeling and weather forecast performed based on the complete

three-dimensional meteorological data, not only information in more dimensions can be integrated, but also a relationship feature between data in more dimensions is retained, such that precision of the weather forecast result can be effectively improved.

[0079] For example, the neural network **1** and the neural network **2** that are used for coupling the two-dimensional meteorological data with the three-dimensional meteorological data may be, for example, any one or more of a fully connected neural network (FCNN) and a convolutional neural network (CNN) whose convolution kernel is 1, or may be another applicable neural network. This is not limited in this embodiment.

[0080] After the weather forecast result is obtained through performing inference based on the fused meteorological data by using the plurality of AI models, the inference module **103** may further decouple the weather forecast result, to obtain a two-dimensional weather forecast result and a three-dimensional weather forecast result, as shown in FIG. **5**. A data decoupling process may be an inverse operation of the foregoing data coupling process. The weather forecast result output by the last AI model in the plurality of AI models may be a high-dimensional feature vector, such that the inference module **103** may split the high-dimensional feature vector, to obtain two different high-dimensional feature vectors. A process of splitting the high-dimensional feature vector is opposite to the foregoing process of splicing the high-dimensional feature vectors. Then, the two high-dimensional feature vectors obtained through splitting may be respectively input into a neural network **3** and a neural network **4** by the inference module **103**, such that the two neural networks output the two-dimensional weather forecast result and the three-dimensional weather forecast result, as shown in FIG. **5**.

[0081] Correspondingly, when the meteorological data includes both the two-dimensional meteorological data and the three-dimensional meteorological data, the plurality of AI models in the model library may be trained based on the two-dimensional meteorological data and the three-dimensional meteorological data that are in the past time period. The AI models may be trained by using the fused meteorological data obtained through coupling the two-dimensional meteorological data with the three-dimensional meteorological data. For a process of training the AI models by using the fused meteorological data, refer to the foregoing related descriptions of training the AI models. Details are not described herein again.

[0082] In an actual application scenario, the meteorological data is usually distributed unevenly and irregularly. For example, meteorological data near the equator (namely, a low latitude) is usually sparsely distributed, and meteorological data near the Antarctic or the Arctic (namely, a high latitude) is usually densely distributed. For another example, altitudes (a type of meteorological data) of isobaric surfaces in different regions are usually different. For example, atmospheric pressure at an altitude of 1 km in a region A is the same as atmospheric pressure at an altitude of 2 km in a region B. Therefore, in a process of performing weather forecast by using the plurality of AI models, the inference module **103** may compensate for an computation result of the intermediate variable in the AI models, to overcome impact of uneven distribution of the meteorological data on precision of the weather forecast result.

[0083] In an implementation example, in a process of performing inference by using each of the AI models, the inference module **103** may add biases to computation results of intermediate variables of computation units in the AI models, where the bias is determined based on altitude information or latitude information in the meteorological data. For computation results that are of intermediate variables and that are computed by the AI models based on meteorological data at different locations, if latitudes or altitudes are different, values of biases added to the computation results of the intermediate variables are also different. However, when the latitudes (and the altitudes) are the same, the values of the biases added to the computation results of the intermediate variables are the same.

[0084] In another implementation example, each of the AI models is used for performing inference by using an attention mechanism. In this case, in a process of performing inference by using each of the AI models, the inference module **103** may add a bias to a computation result of the attention mechanism in each of the AI models, where the bias is determined based on altitude information or latitude information in the meteorological data. For computation results that are of attention mechanisms and that are computed by the AI models based on meteorological data at different locations, if latitudes or altitudes are different, values of biases added to the computation results of the attention mechanisms are also different. However, when the latitudes (and the altitudes) are the same, the values of the biases added to the computation results of the attention mechanisms are the same. Further, the bias added to the computation result of the attention mechanism may alternatively satisfy translation symmetry in longitude. When the computation results that are of the attention mechanisms and that are computed based on the meteorological data at the different locations, because rotation of different geographical locations around the earth axis satisfies symmetry, for computation results of attention mechanisms corresponding to two geographical locations with a same longitude difference relative to the earth axis, biases of same values may be added (when consistency of altitude information and consistency of latitude information are both satisfied). In this way, the bias is added to the computation result of the intermediate variable in the AI model or the computation result of the attention mechanism in the AI model, such that impact caused by irregularity of the meteorological data on the weather forecast result can be overcome, and precision of the weather forecast result can be further improved.

[0085] In a further possible implementation, alternatively, the weather forecast apparatus **100** may separately predict the weather at the target time based on the meteorological data and a plurality of groups of AI models, to provide a plurality of forecast possibilities of the weather at the target time. The following uses an example in which two groups of AI models are determined to perform weather forecast for description. For ease of distinction and description, the AI models used for performing weather forecast are referred to as first AI models (namely, a first group of AI models) below, and the obtained weather forecast result at the target time is referred to as a second forecast result.

[0086] The model determining module **102** may not only determine the foregoing plurality of first AI models, but also determine a plurality of second AI models (namely, a second group of AI models). Different second AI models in the plurality of second AI models are used for forecasting the

weather at the different time intervals. In addition, total duration of the time intervals of the weather forecast by using the plurality of second AI models matches the target time, and each of the second AI models is used for performing at least one iterative inference operation. Compared with the first AI models, the determined second AI models may have a different combination of time intervals of the forecast weather. For example, it is assumed that the target time is 3 days and 15 hours. In this case, the plurality of first AI models determined by the model determining module **102** are respectively an AI model x used for forecasting weather after 3 hours, an AI model y used for forecasting weather after 12 hours, and an AI model z used for forecasting weather after 72 hours; and the determined plurality of second AI models are an AI model u used for forecasting weather after 1 hour, an AI model v used for forecasting weather after 6 hours, and an AI model w used for forecasting weather after 24 hours. Alternatively, there may be another possible combination. Then, the inference module **103** may perform inference based on the meteorological data by using the plurality of second AI models, to obtain a second weather forecast result at the target time. The inference module **103** may perform iterative inference by using the AI model u for three times, perform iterative inference by using the AI model v twice, and perform iterative inference by using the AI model w for three times. In this way, total duration of time intervals corresponding to the three AI models is 3 days and 15 hours (that is, 1 hour×3+6 hours×2+24 hours×3). For an implementation process in which the inference module **103** obtains the second weather forecast result at the target time through inference by using the plurality of second AI models, refer to related descriptions of obtaining the first weather forecast result at the target time through inference by using the plurality of first AI models in the foregoing embodiments. Details are not described herein again.

[0087] Alternatively, the plurality of second AI models determined by the inference module **103** are different from the first AI models in terms of model input, model structures, iterative inference algorithms used for model inference, model training algorithms, and the like. This is not limited in this embodiment.

[0088] After obtaining a plurality of different weather forecast results through inference based on the plurality of groups of AI models, the inference module **103** may present the plurality of different weather forecast results to the user **300** via the client **200**, such that the user **300** evaluates the weather at the future target time based on the plurality of weather forecast results.

[0089] Alternatively, the inference module **103** may determine a unique weather forecast result based on the plurality of different weather forecast results. During implementation, the inference module **103** may compare a difference between the first weather forecast result and the second weather forecast result. In addition, if the difference between the first weather forecast result and the second weather forecast result falls within a preset error range, the inference module **103** may use the first weather forecast result or the second weather forecast result as a finally determined target weather forecast result, and output the target weather forecast result. However, if the difference between the first meteorological forecast result and the second meteorological forecast result exceeds the preset error range, the inference module **103** may re-forecast the weather at the target time based on the meteorological data. Alternatively, the inference module **103** may determine a third weather forecast result based on the meteorological data by using a third group of AI models, and determine, in a manner in which the minority is subordinate to the majority, a weather forecast result with a largest quantity of same or similar weather forecast results in the plurality of weather forecast results as the final and unique output target weather forecast result. Alternatively, the inference module **103** may determine the unique target weather forecast result through weighted computation or the like. This is not limited in this embodiment. In this way, the weather forecast apparatus **100** may forecast the plurality of weather results based on the plurality of groups of AI models, to implement a large amount of integrated weather forecast.

[0090] After determining the target weather forecast result, the inference module **103** may further output the target weather forecast result to the user **300**. For example, the inference module **103** may send the target weather forecast result to the client **200**, and the client **200** presents the target weather forecast result to the user **300**.

[0091] It should be noted that, in this embodiment, an example in which the weather forecast apparatus **100** forecasts weather in a region by default or forecasts global weather by default is used for description. In another embodiment, the weather forecast apparatus **100** may further perform weather forecast for a region specified by the user. During implementation, the data obtaining module **101** may further obtain location information, where the location information indicates a region in which weather forecast needs to be performed. For example, the data obtaining module **101** may obtain, via the client **200**, the location information input by the user, such that the model determining module **102** may determine, from the model library based on the location information and the target time, the plurality of AI models (for example, the first AI models or the second AI models) used for forecasting the weather of the region indicated by the location information. In this way, the weather of the region indicated by the location information is forecast by using the determined plurality of AI models. In this way, the user may specify a region in which weather needs to be forecast, to implement independent forecast for the weather in the region, such that selectivity in performing weather forecast for the user is improved, to improve user experience.

[0092] In this embodiment, the weather forecast apparatus **100** performs weather forecast by using the plurality of AI models, and does not need to perform a complex equation solving process. This can effectively reduce computing power consumed for weather forecast, and the AI model also can quickly output the weather forecast result at the target time, such that a weather forecast delay can be significantly reduced. In a weather forecast process, the weather forecast apparatus **100** does not perform a large quantity of times of iterative inference by using a single AI model, but performs a small quantity of times of inference by using the plurality of AI models for forecasting the weather at the different time intervals. This not only can effectively reduce an iterative error, but also can reduce resource consumption required for iterative inference.

[0093] In addition, when the meteorological data includes the three-dimensional meteorological data, in comparison with a manner in which weather forecast is performed based only on the two-dimensional meteorological data, in mod-

eling and weather forecast performed based on the complete three-dimensional meteorological data, not only information in more dimensions can be integrated, but also a relationship feature between data in more dimensions is retained, such that precision of weather forecast can be effectively improved. In addition, in the process of performing inference by using the AI model, the bias is added to the computation result of the intermediate variable or the computation result of the attention mechanism, such that impact caused by irregularity of the meteorological data on the weather forecast result can be overcome, and precision of the weather forecast result can be further improved. In an actual application scenario, precision of weather forecast performed in the foregoing manner can exceed precision of weather forecast performed based on an NWP technology.

[0094] In the embodiment shown in FIG. **3**, the weather forecast apparatus **100** (including the data obtaining module **101**, the model determining module **102**, and the inference module **103**) involved in the weather forecast process may be software configured on a computing device or a computing device cluster. In addition, by running the software on the computing device or the computing device cluster, the computing device or the computing device cluster may be caused to implement functions of the weather forecast apparatus **100**. The following describes in detail the weather forecast apparatus **100** involved in the weather forecast process from a perspective of hardware device implementation.

[0095] FIG. **6** is a diagram of a structure of a computing device. The foregoing weather forecast apparatus **100** may be deployed on the computing device. The computing device may be a computing device (for example, a server) in a cloud environment, a computing device in an edge environment, a terminal device, or the like, and may be configured to implement functions of the data obtaining module **101**, the model determining module **102**, and the inference module **103** in the embodiment shown in FIG. **3**.

[0096] As shown in FIG. **6**, the computing device **600** includes a processor **610**, a memory **620**, a communication interface **630**, and a bus **640**. The processor **610**, the memory **620**, and the communication interface **630** communicate with each other through the bus **640**. The bus **640** may be a peripheral component interconnect (PCI) bus, an extended industry standard architecture (EISA) bus, or the like. The bus may be classified into an address bus, a data bus, a control bus, or the like. For ease of representation, only one thick line is used for representing the bus in FIG. **6**, but this does not mean that there is only one bus or only one type of bus. The communication interface **630** is configured to communicate with the outside, for example, obtain meteorological data, target time, and location information, and output a weather forecast result.

[0097] The processor **610** may be a central processing unit (CPU), an application-specific integrated circuit (ASIC), a graphics processing unit (GPU), or one or more integrated circuits. The processor **610** may alternatively be an integrated circuit chip, and has a signal processing capability. In an implementation process, functions of the modules in the weather forecast apparatus **100** may be completed by using an integrated logic circuit of hardware in the processor **610** or by using instructions in a form of software. The processor **610** may alternatively be a general-purpose processor, a digital signal processor (DSP), a field programmable gate array (FPGA) or another programmable logic device, a discrete gate or a transistor logic device, or a discrete hardware component, and may implement or perform methods, steps, and logical block diagrams disclosed in embodiments of this application. The general-purpose processor may be a microprocessor, the processor may be any conventional processor, or the like. The method disclosed with reference to embodiments of this application may be directly performed and completed by a hardware decoding processor, or may be performed and completed by using a combination of hardware in the decoding processor and a software module. The software module may be located in a mature storage medium in the art, such as a random access memory, a flash memory, a read-only memory, a programmable read-only memory, an electrically erasable programmable memory, or a register. The storage medium is located in the memory **620**. The processor **610** reads information in the memory **620**, and completes a part or all of functions of the weather forecast apparatus **100** in combination with hardware in the processor **610**.

[0098] The memory **620** may include a volatile memory, for example, a random access memory (RAM). The memory **620** may further include a non-volatile memory, for example, a read-only memory (ROM), a flash memory, an HDD, or an SSD.

[0099] The memory **620** stores executable code, and the processor **610** executes the executable code to perform the method performed by the weather forecast apparatus **100**.

[0100] When the embodiment shown in FIG. **3** is implemented, and the data obtaining module **101**, the model determining module **102**, and the inference module **103** described in the embodiment shown in FIG. **3** are implemented by software, software or program code required for performing the functions of the data obtaining module **101**, the model determining module **102**, and the inference module **103** in FIG. **3** is stored in the memory **620**. Interaction between the data obtaining module **101** and another device is implemented through the communication interface **630**. The processor is configured to execute instructions in the memory **620**, to implement the method perform by the weather forecast apparatus **100**.

[0101] FIG. **7** is a diagram of a structure of a computing device cluster. The computing device cluster **70** shown in FIG. **7** includes a plurality of computing devices, and the foregoing weather forecast apparatus **100** may be deployed on the plurality of computing devices in the computing device cluster **70** in a distributed manner. As shown in FIG. **7**, the computing device cluster **70** includes a plurality of computing devices **700**, and each of the computing devices **700** includes a memory **720**, a processor **710**, a communication interface **730**, and a bus **740**. The memory **720**, the processor **710**, and the communication interface **730** implement a communication connection to each other through the bus **740**.

[0102] The processor **710** may be a CPU, a GPU, an ASIC, or one or more integrated circuits. The processor **710** may alternatively be an integrated circuit chip, and has a signal processing capability. In an implementation process, a part of functions of the weather forecast apparatus **100** may be completed by using an integrated logic circuit of hardware in the processor **710** or by using instructions in a form of software. The processor **710** may alternatively be a DSP, an FPGA, a general-purpose processor, another programmable logic device, a discrete gate or a transistor logic device, or a discrete hardware component, and may implement or

perform a part of methods, steps, and logical block diagrams disclosed in embodiments of this application. The general-purpose processor may be a microprocessor, the processor may be any conventional processor, or the like. Steps of the method disclosed with reference to embodiments of this application may be directly performed and completed by a hardware decoding processor, or may be performed and completed by using a combination of hardware in the decoding processor and a software module. The software module may be located in a mature storage medium in the art, such as a random access memory, a flash memory, a read-only memory, a programmable read-only memory, an electrically erasable programmable memory, or a register. The storage medium is located in the memory **720**. In each of the computing devices **700**, the processor **710** reads information in the memory **720**, and may complete a part of functions of the weather forecast apparatus **100** in combination with hardware in the processor **710**.

[0103] The memory **720** may include a ROM, a RAM, a static storage device, a dynamic storage device, a hard disk (for example, an SSD or an HDD), and the like. The memory **720** may store program code, for example, may store a part or all of program code used for implementing a data obtaining module **101**, a part or all of program code used for implementing a model determining module **102**, and a part or all of program code used for implementing an inference module **103**. For each of the computing devices **700**, when the program code stored in the memory **720** is executed by the processor **710**, the processor **710** performs, based on the communication interface **730**, a part of methods performed by the weather forecast apparatus **100**. For example, a part of the computing devices **700** may be configured to perform the method performed by the data obtaining module **101**, a part of the computing devices **700** may be configured to perform the method performed by the model determining module **102**, and a part of the computing devices **700** are configured to perform the method performed by the inference module **103**. The memory **720** may further store data, for example, store intermediate data or result data generated by the processor **710** in an execution process, such as the foregoing first weather forecast result, the second weather forecast result, or the target weather forecast result.

[0104] The communication interface **703** in each of the computing devices **700** is configured to communicate with the outside, for example, interact with another computing device **700**.

[0105] The bus **740** may be a peripheral component interconnect bus, an extended industry standard architecture bus, or the like. For ease of representation, only one thick line is used for representing the bus **740** in each of the computing devices **700** in FIG. **7**, but this does not mean that there is only one bus or only one type of bus.

[0106] A communication path is established between the plurality of computing devices **700** via a communication network, to implement functions of the weather forecast apparatus **100**. Any one of the computing devices may be a computing device (for example, a server) in a cloud environment, a computing device in an edge environment, or a terminal device.

[0107] In addition, an embodiment of this application further provides a computer-readable storage medium. The computer-readable storage medium stores instructions. When the instructions are run on one or more computing devices, the one or more computing devices are caused to perform the methods performed by the modules of the weather forecast apparatus **100** in the foregoing embodiments.

[0108] In addition, an embodiment of this application further provides a computer program product. When the computer program product is executed by one or more computing devices, the one or more computing devices perform any one of methods in the foregoing weather forecast method. The computer program product may be a software installation package. When any one of the methods in the weather forecast method needs to be applied, the computer program product may be downloaded and executed on a computer.

[0109] In addition, it should be noted that, the apparatus embodiments described above are merely examples. Units described as separate components may or may not be physically separate, and components displayed as units may or may not be physical units, may be located at one location, or may be distributed on a plurality of network units. A part or all of the modules may be selected based on an actual requirement, to achieve the objectives of the solutions of embodiments. In addition, in the accompanying drawings of the apparatus embodiments provided in this application, a connection relationship between the modules indicates that there is a communication connection between the modules, and may be implemented as one or more communication buses or signal cables.

[0110] Based on the descriptions of the foregoing implementations, a person skilled in the art may clearly understand that, this application may be implemented by software in addition to necessary universal hardware, or certainly may be implemented by dedicated hardware, including an application-specific integrated circuit, a dedicated CPU, a dedicated memory, a dedicated component, and the like. Generally, any functions completed by a computer program can be easily implemented by corresponding hardware. In addition, a hardware structure used for implementing a same function may also be various, such as an analog circuit, a digital circuit, or a dedicated circuit. However, for this application, software program implementation is a preferred implementation in most cases. Based on such an understanding, the technical solutions of this application essentially or the part contributing to a conventional technology may be embodied in a form of a software product. The computer software product is stored in a readable storage medium, such as a floppy disk, a USB flash drive, a removable hard disk, a ROM, a RAM, a magnetic disk, or an optical disc of a computer, and includes a plurality of instructions for instructing a computer device (which may be a personal computer, a training device, a network device, or the like) to perform the methods in embodiments of this application.

[0111] All or a part of the foregoing embodiments may be implemented by using software, hardware, firmware, or any combination thereof. When software is used for implementing embodiments, all or a part of embodiments may be implemented in a form of a computer program product.

[0112] The computer program product includes one or more computer instructions. When the computer program instructions are loaded and executed on a computer, all or a part of procedures or functions according to embodiments of this application are generated. The computer may be a general-purpose computer, a dedicated computer, a computer network, or another programmable apparatus. The computer instructions may be stored in a computer-readable

storage medium, or may be transmitted from a computer-readable storage medium to another computer-readable storage medium. For example, the computer instructions may be transmitted from a website, a computer, a training device, or a data center to another website, computer, training device, or data center in a wired (for example, a coaxial cable, an optical fiber, or a digital subscriber line (DSL)) or wireless (for example, infrared, radio, or microwave) manner. The computer-readable storage medium may be any usable medium that can be stored in a computer, or a data storage device, such as a training device or a data center, integrating one or more usable media. The usable medium may be a magnetic medium (for example, a floppy disk, a hard disk, or a magnetic tape), an optical medium (for example, a DVD), a semiconductor medium (for example, a solid state disk (SSD)), or the like.

1. A weather forecast method, wherein the method comprises:

obtaining meteorological data and target time;

determining a plurality of first artificial intelligence (AI) models from a model library based on the target time, wherein different first AI models in the plurality of first AI models are used for forecasting weather at different time intervals; and

performing inference based on the meteorological data by using the plurality of first AI models, to obtain a first weather forecast result at the target time, wherein each of the first AI models is used for performing at least one iterative inference operation.

2. The method according to claim **1**, wherein the determining a plurality of first AI models from a model library based on the target time comprises:

determining, from the model library based on the target time, the plurality of first artificial intelligence (AI) models and a quantity of iterative inference operations performed by using each of the plurality of first AI models; and

the performing inference based on the meteorological data by using the plurality of first AI models comprises:

sequentially performing, based on the meteorological data and the quantity of iterative inference operations performed by using each of the first AI models, the iterative inference operations by using the plurality of first AI models.

3. The method according to claim **1** wherein the meteorological data comprises three-dimensional meteorological data.

4. The method according to claim **3**, wherein the meteorological data comprises the three-dimensional meteorological data and two-dimensional meteorological data; and

the performing inference based on the meteorological data by using the plurality of first AI models comprises:

coupling the three-dimensional meteorological data with the two-dimensional meteorological data, to obtain fused meteorological data; and

performing inference based on the fused meteorological data by using the plurality of first AI models.

5. The method according to claim **1**, wherein the performing inference based on the meteorological data by using the plurality of first AI models comprises:

in a process of performing inference based on the meteorological data by using the plurality of first AI models, adding biases to computation results of intermediate variables in the plurality of first AI models or computation results of attention mechanisms in the plurality of first AI models, wherein the bias is determined based on altitude information or latitude information in the meteorological data.

6. The method according to claim **1**, wherein the method further comprises:

determining a plurality of second AI models from the model library based on the target time, wherein different second AI models in the plurality of second AI models are used for forecasting weather at different time intervals; and

performing inference based on the meteorological data by using the plurality of second AI models, to obtain a second weather forecast result at the target time, wherein each of the second AI models is used for performing at least one iterative inference operation.

7. The method according to claim **6**, wherein the method further comprises:

determining a target weather forecast result based on the first weather forecast result and the second weather forecast result; and

outputting the target weather forecast result.

8. The method according to claim **1**, wherein the method further comprises:

obtaining location information, wherein the first weather forecast result indicates weather corresponding to the location information; and

the determining a plurality of first AI models from a model library based on the target time comprises:

determining the plurality of first AI models from the model library based on the location information and the target time.

9. The method according to claim **1**, wherein the obtaining target time comprises:

outputting an interaction interface; and

in response to an operation by a user on the interaction interface, obtaining the target time input by the user.

10. A weather forecast apparatus, comprising:

at least one processor; and

one or more memories coupled to the at least one processor and storing programming instructions for execution by the at least one processor to cause the apparatus to:

obtain meteorological data and target time;

determine a plurality of first artificial intelligence (AI) models from a model library based on the target time, wherein different first AI models in the plurality of first AI models are used for forecasting weather at different time intervals; and

perform inference based on the meteorological data by using the plurality of first AI models, to obtain a first weather forecast result at the target time, wherein each of the first AI models is used for performing at least one iterative inference operation.

11. The apparatus according to claim **10**, wherein the programming instructions, when executed by the at least one processor, cause the apparatus to:

determine, from the model library based on the target time, the plurality of first AI models and a quantity of iterative inference operations performed by using each of the plurality of first AI models; and

sequentially perform, based on the meteorological data and the quantity of iterative inference operations per-

formed by using each of the first AI models, the iterative inference operations by using the plurality of first AI models.

12. The apparatus according to claim **10**, wherein the meteorological data comprises three-dimensional meteorological data.

13. The apparatus according to claim **12**, wherein the meteorological data comprises the three-dimensional meteorological data and two-dimensional meteorological data; and

wherein the programming instructions, when executed by the at least one processor, cause the apparatus to:

couple the three-dimensional meteorological data with the two-dimensional meteorological data, to obtain fused meteorological data; and

perform inference based on the fused meteorological data by using the plurality of first AI models.

14. The apparatus according to claim **10**, wherein the programming instructions, when executed by the at least one processor, cause the apparatus to: in a process of performing inference based on the meteorological data by using the plurality of first AI models, add biases to computation results of intermediate variables in the plurality of first AI models or computation results of attention mechanisms in the plurality of first AI models, wherein the bias is determined based on altitude information or latitude information in the meteorological data.

15. The apparatus according to claim **10**, wherein the programming instructions, when executed by the at least one processor, cause the apparatus to:

determine a plurality of second AI models from the model library based on the target time, wherein different second AI models in the plurality of second AI models are used for forecasting weather at different time intervals; and

perform inference based on the meteorological data by using the plurality of second AI models, to obtain a second weather forecast result at the target time, wherein each of the second AI models is used for performing at least one iterative inference operation.

16. The apparatus according to claim **15**, wherein the programming instructions, when executed by the at least one processor, cause the apparatus to:

determine a target weather forecast result based on the first weather forecast result and the second weather forecast result; and

output the target weather forecast result.

17. The apparatus according to claim **10**, wherein the programming instructions, when executed by the at least one processor, cause the apparatus to:

obtain location information, wherein the first weather forecast result indicates weather corresponding to the location information; and

determine the plurality of first AI models from the model library based on the location information and the target time.

18. The apparatus according to claim **10**, wherein the programming instructions, when executed by the at least one processor, cause the apparatus to:

output an interaction interface; and

in response to an operation by a user on the interaction interface, obtain the target time input by the user.

19. A non-transitory computer-readable storage medium, wherein the computer-readable storage medium stores instructions; and when the instructions are run on at least one computing device, the at least one computing device is caused to perform operations comprising:

obtaining meteorological data and target time;

determining a plurality of first artificial intelligence (AI) models from a model library based on the target time, wherein different first AI models in the plurality of first AI models are used for forecasting weather at different time intervals; and

performing inference based on the meteorological data by using the plurality of first AI models, to obtain a first weather forecast result at the target time, wherein each of the first AI models is used for performing at least one iterative inference operation.

20. (canceled)

21. The non-transitory computer-readable storage medium according to claim **19**, wherein the determining a plurality of first AI models from a model library based on the target time comprises:

determining, from the model library based on the target time, the plurality of first artificial intelligence (AI) models and a quantity of iterative inference operations performed by using each of the plurality of first AI models; and

the performing inference based on the meteorological data by using the plurality of first AI models comprises:

sequentially performing, based on the meteorological data and the quantity of iterative inference operations performed by using each of the first AI models, the iterative inference operations by using the plurality of first AI models.

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