US 20250265466A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2025/0265466 A1**

EZRIELEV et al. (43) **Pub. Date: Aug. 21, 2025**

(54) **ADAPTIVE MANAGEMENT OF DATA SOURCE UNAVAILABILITY FOR AN INFERENCE MODEL**

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(21) Appl. No.: **18/443,771**

(22) Filed: **Feb. 16, 2024**

Publication Classification

(51) **Int. Cl.**

G06N 3/082 (2023.01)

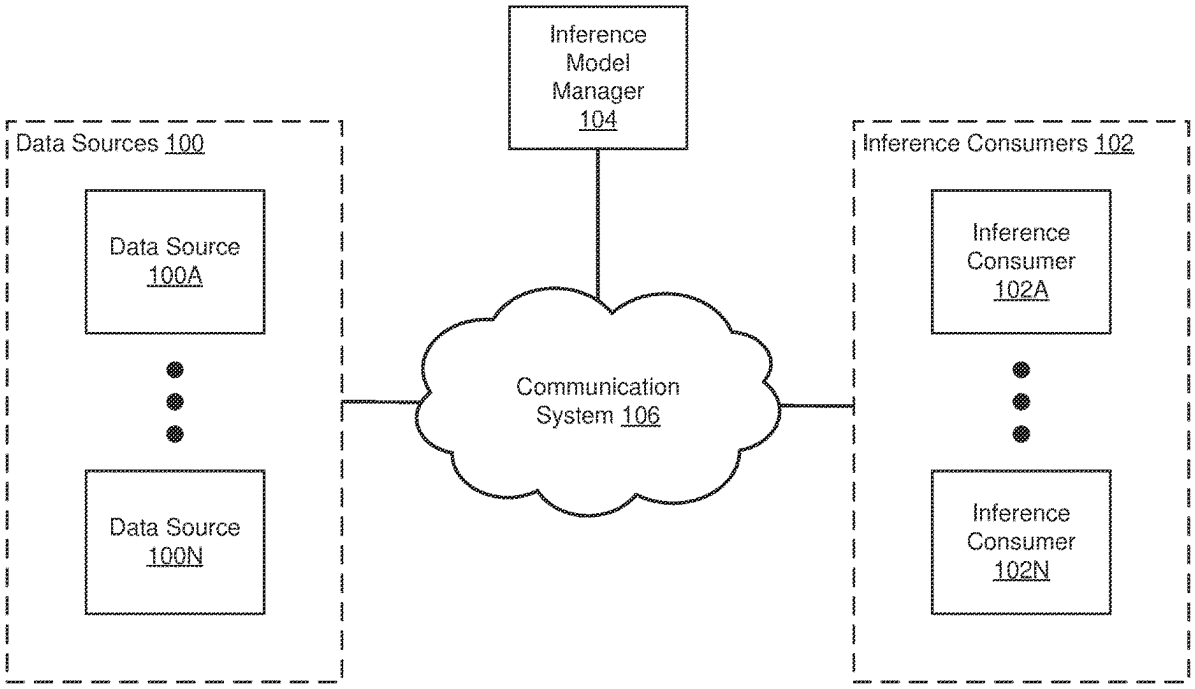
G06N 3/04 (2023.01)

(52) **U.S. Cl.**

CPC ***G06N 3/082*** (2013.01); ***G06N 3/04*** (2013.01)

(57) **ABSTRACT**

Methods and systems for managing inference models are disclosed. Input data from one or more data sources associated with the inference model may become unavailable, which may impede inference generation by an inference model. The inference model may be made up of modular sub-network units and each data source may be associated with a sub-network unit. A second inference model may generate inferences to predict data source unavailability. If one or more data sources are predicted to become unavailable, the sub-network unit associated with the unavailable data source may be substituted with another sub-network unit. The replacement sub-network unit may duplicate operation of the sub-network unit within a threshold and may be previously trained so that the replacement sub-network unit is substituted into the inference model without re-training the inference model. By doing so, an updated inference model may be obtained, and inference generation may resume.



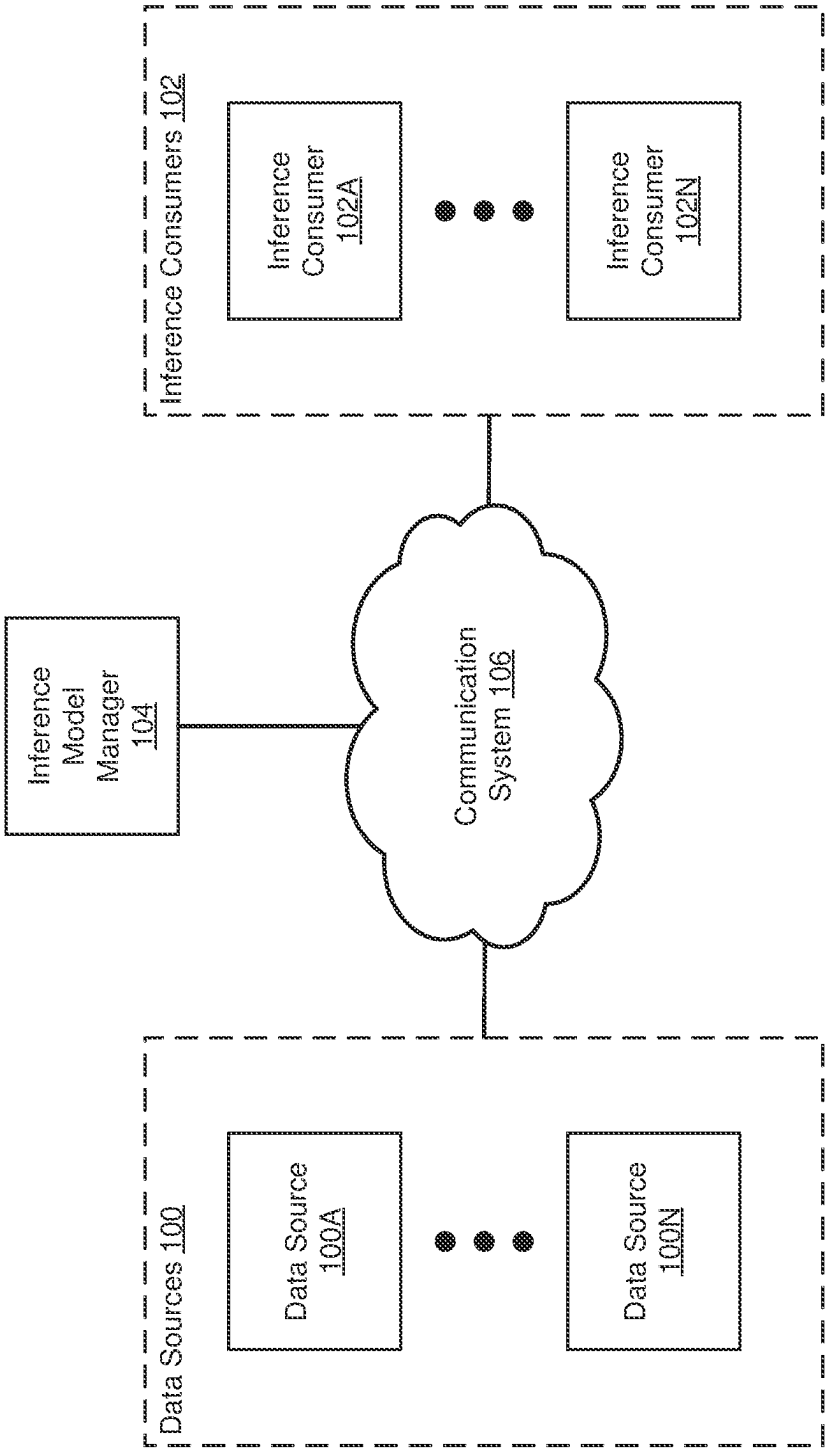

Inference Consumers 102
Inference Consumer 102A
Inference Consumer 102N
Inference Model Manager 104
Communication System 106
Data Sources 100
Data Source 100A
Data Source 100N

FIG. 1

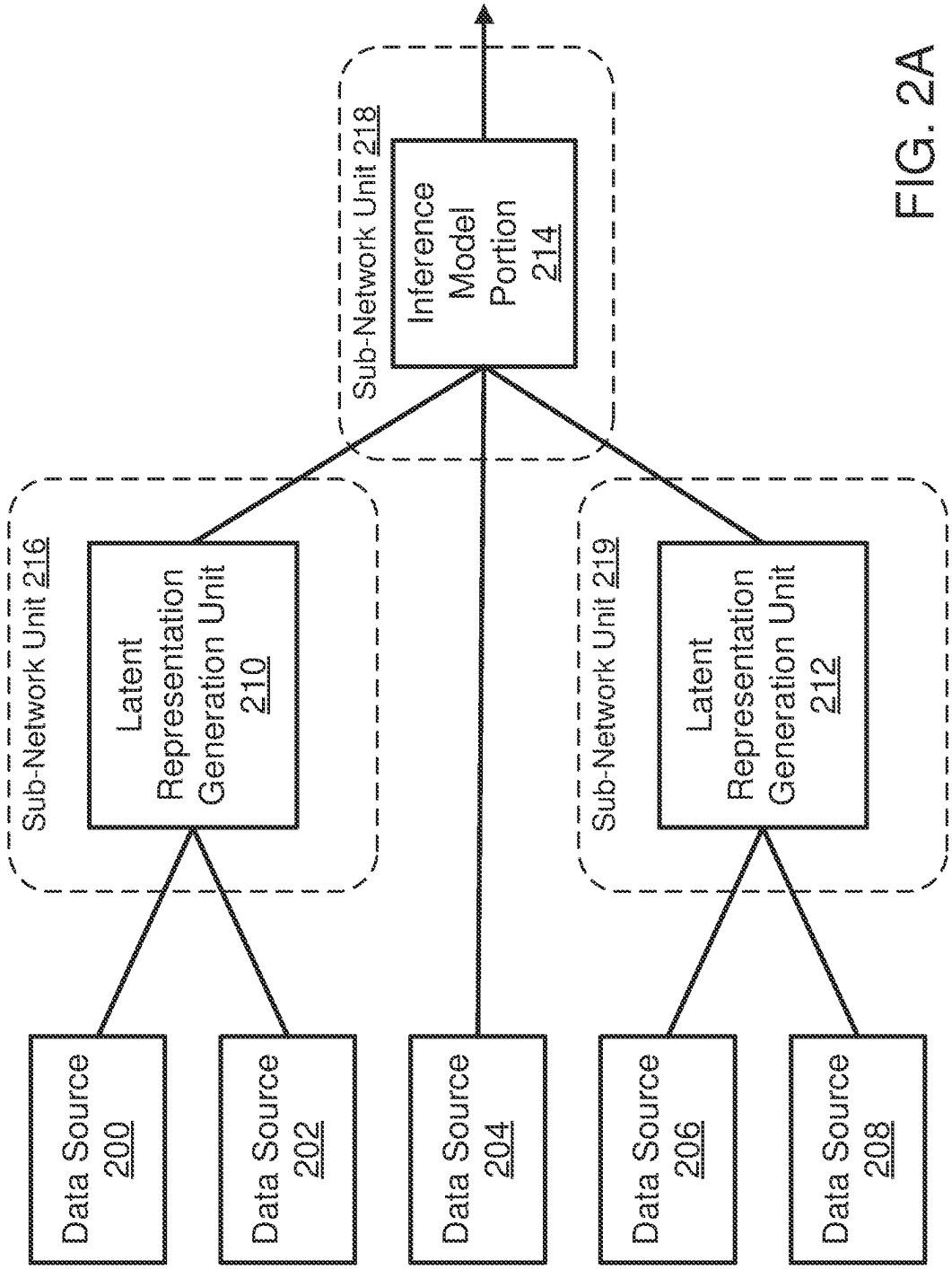

Data Source 200
Data Source 202
Data Source 204
Data Source 206
Data Source 208
Latent Representation Generation Unit 210
Latent Representation Generation Unit 212
Inference Model Portion 214
Sub-Network Unit 216
Sub-Network Unit 218
Sub-Network Unit 219

FIG. 2A

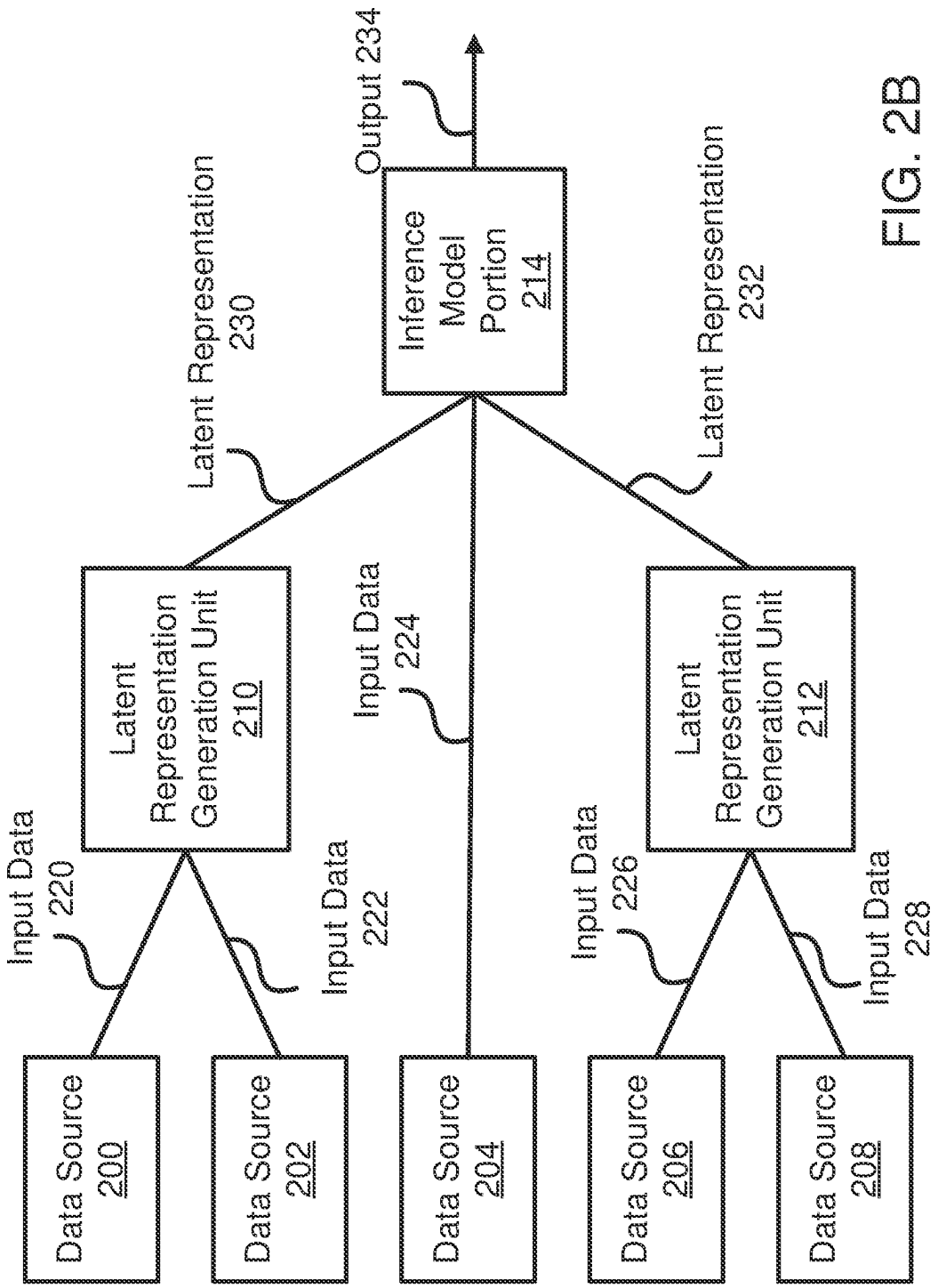

Data Source 200
Data Source 202
Data Source 204
Data Source 206
Data Source 208
Input Data 220
Input Data 222
Input Data 224
Input Data 226
Input Data 228
Latent Representation Generation Unit 210
Latent Representation Generation Unit 212
Inference Model Portion 214
Latent Representation 230
Latent Representation 232
Output 234

FIG. 2B

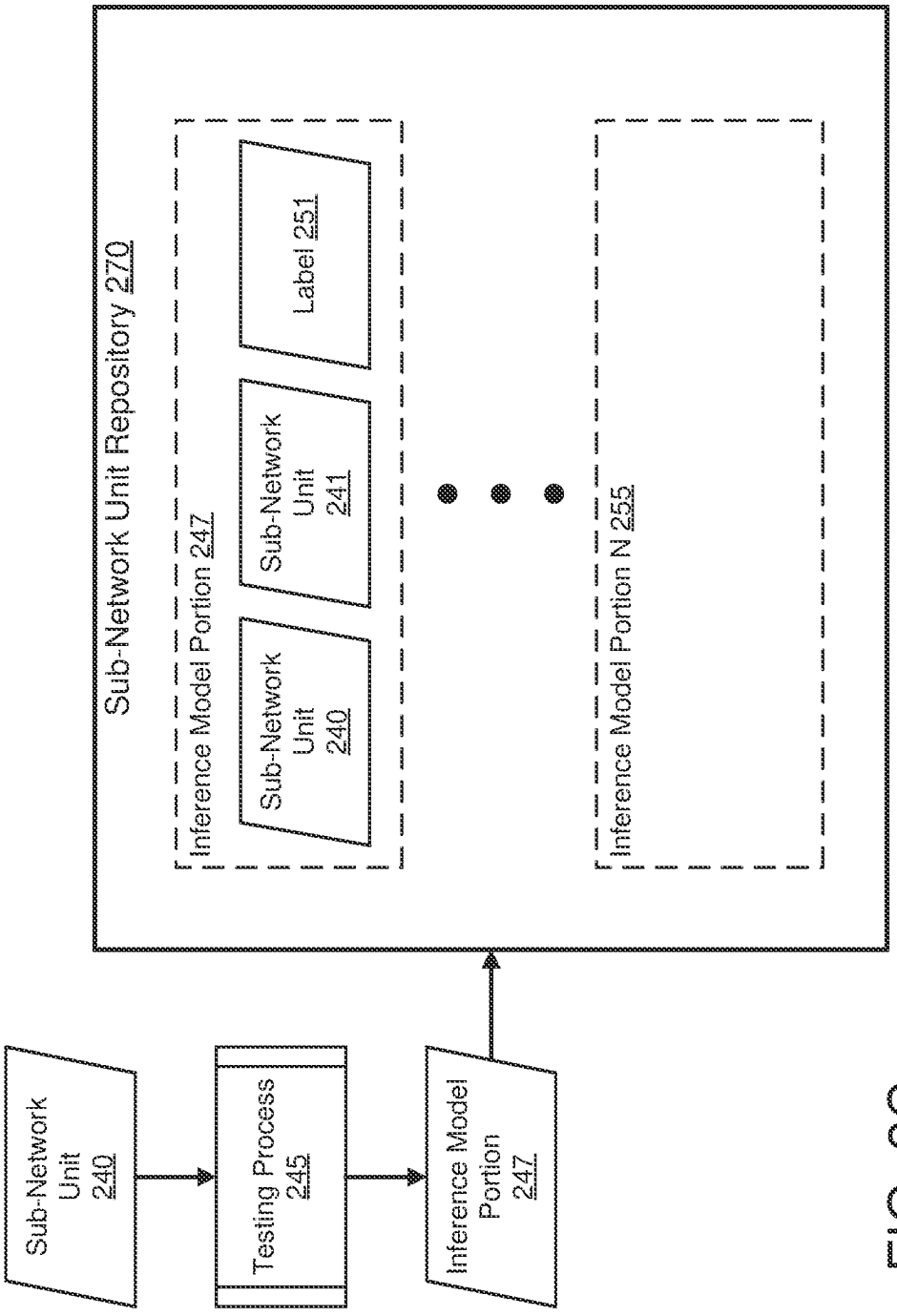

Sub-Network Unit Repository 270
Inference Model Portion 247
Sub-Network Unit 240
Sub-Network Unit 241
Label 251
Inference Model Portion N 255
Sub-Network Unit 240
Testing Process 245
Inference Model Portion 247

FIG. 2C

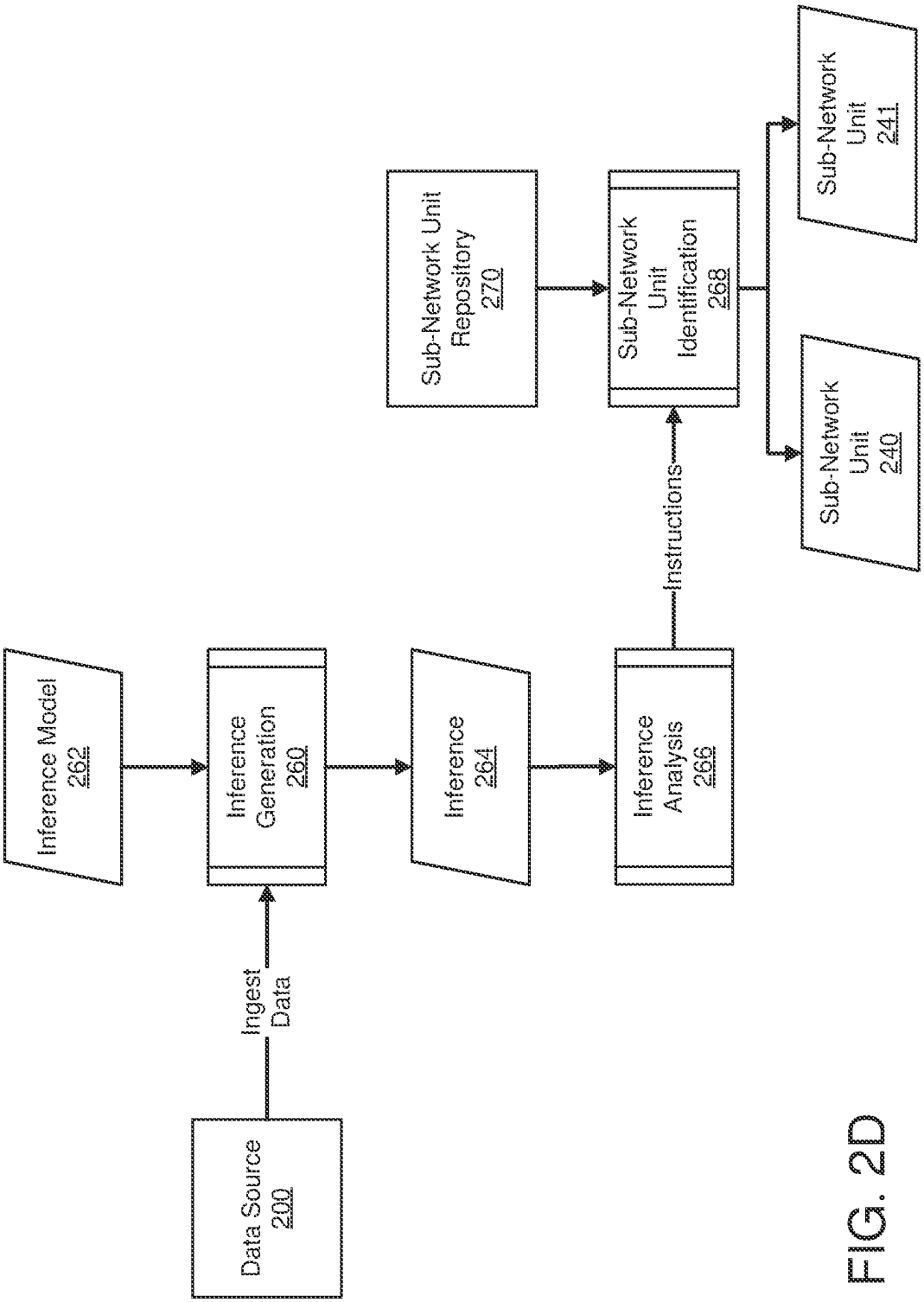

Data Source
200
Ingest
Data
Inference Model
262
Inference
Generation
260
Inference
264
Inference
Analysis
266
Instructions
Sub-Network Unit
Repository
270
Sub-Network
Unit
Identification
268
Sub-Network
Unit
240
Sub-Network
Unit
241

FIG. 2D

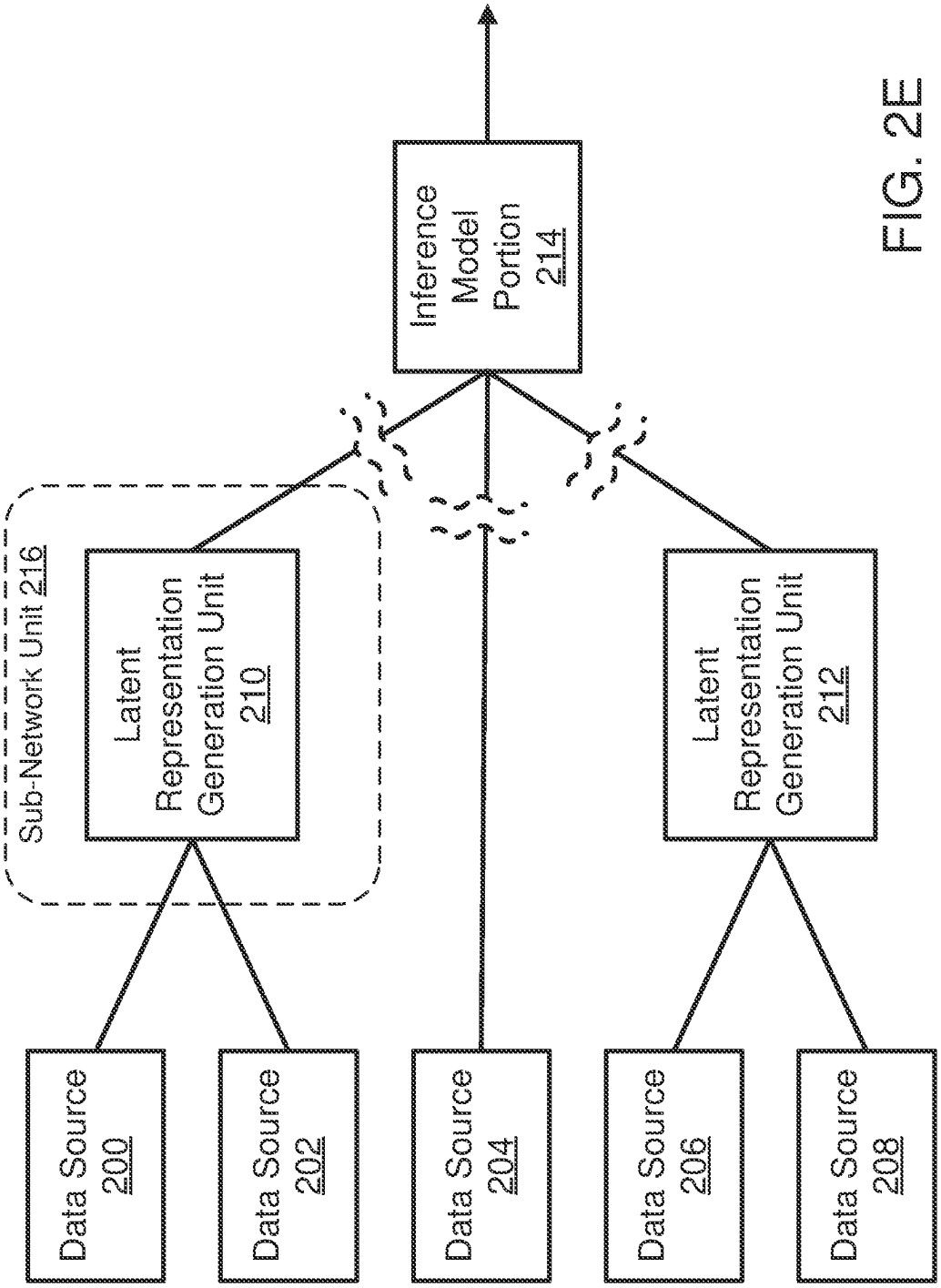

Inference Model Portion 214
Sub-Network Unit 216
Latent Representation Generation Unit 210
Latent Representation Generation Unit 212
Data Source 200
Data Source 202
Data Source 204
Data Source 206
Data Source 208

FIG. 2E

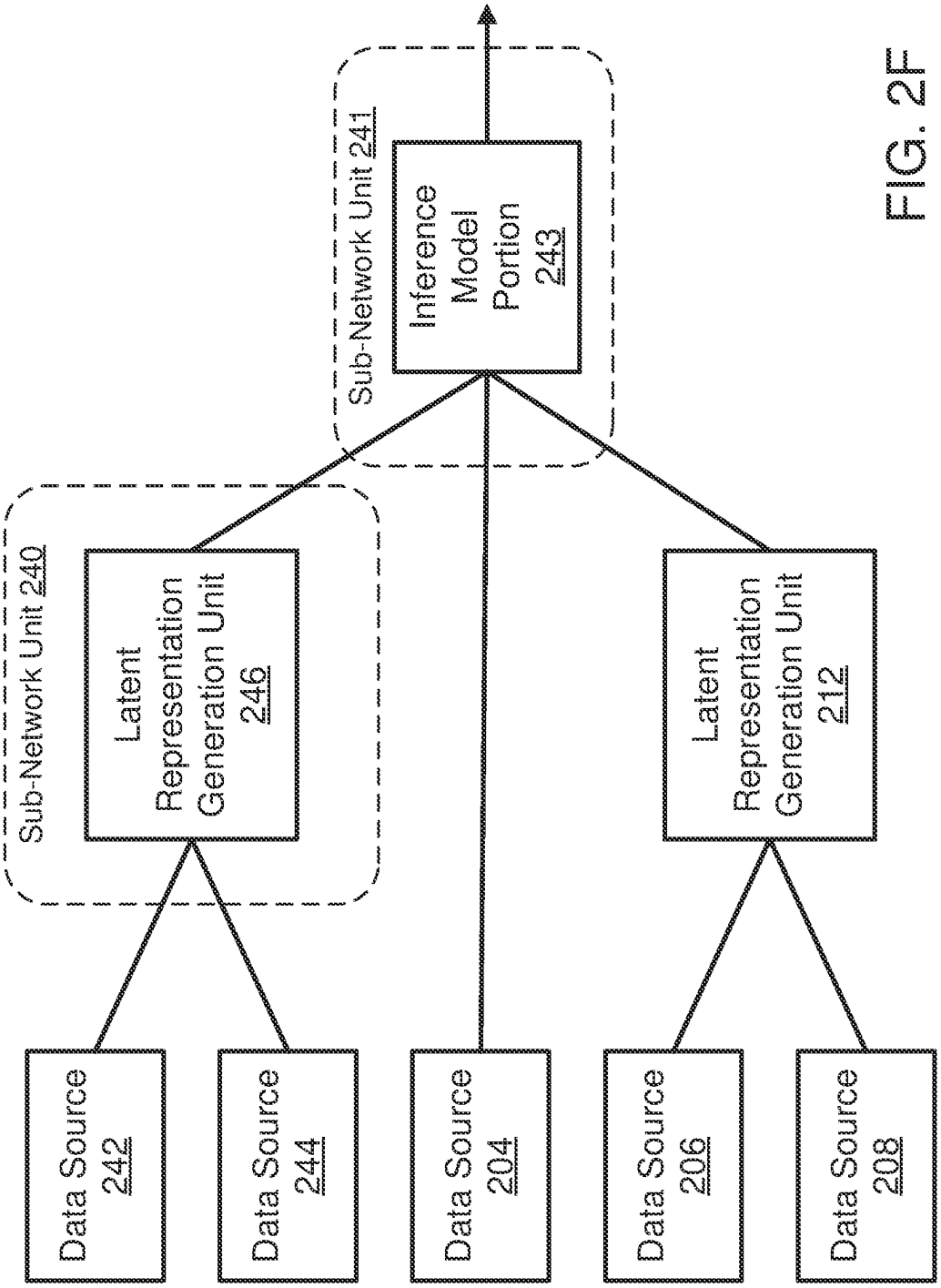

Sub-Network Unit 241
Inference Model Portion 243
Sub-Network Unit 240
Latent Representation Generation Unit 246
Latent Representation Generation Unit 212
Data Source 242
Data Source 244
Data Source 204
Data Source 206
Data Source 208

FIG. 2F

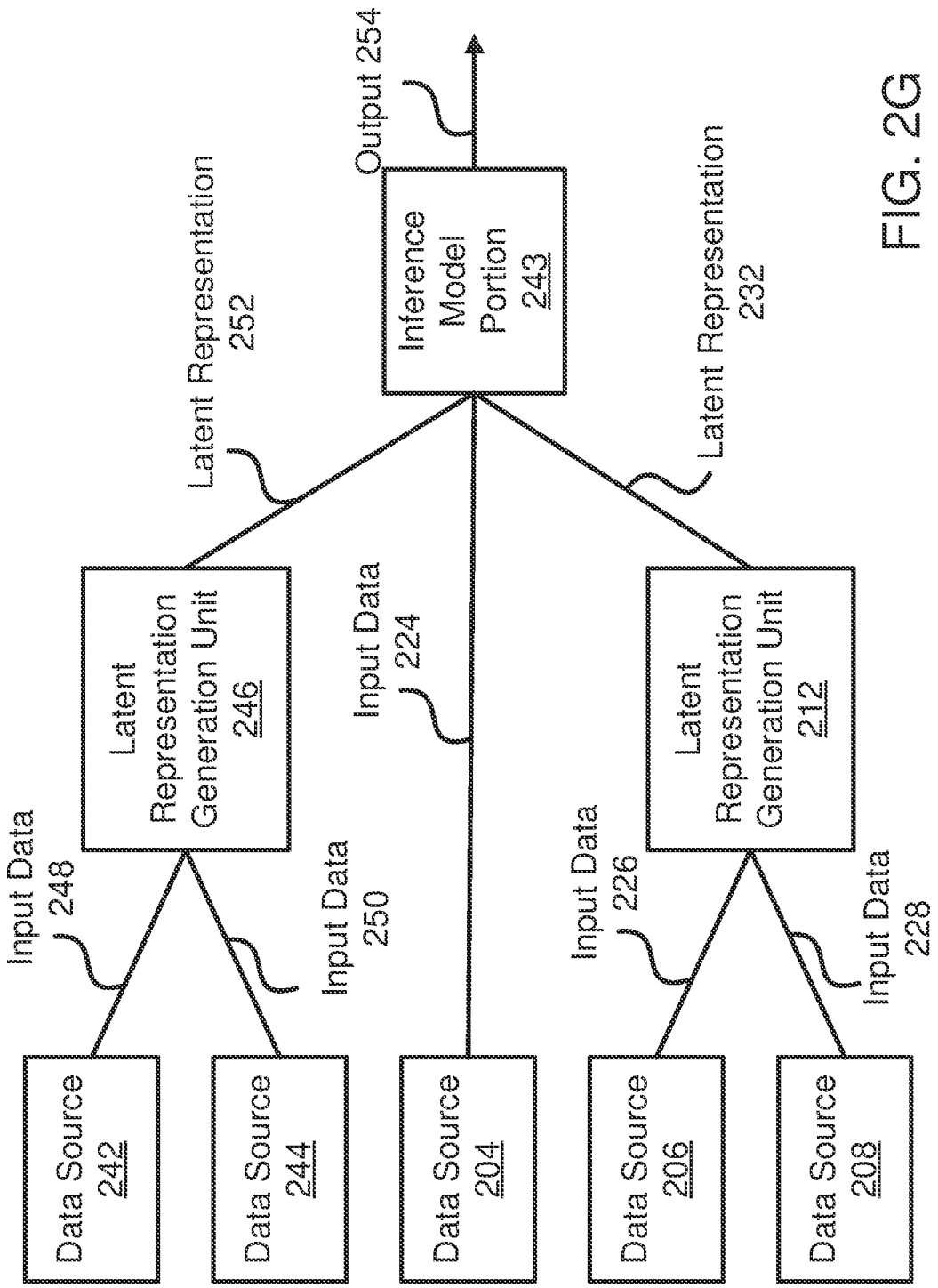

Data Source 242
Data Source 244
Data Source 204
Data Source 206
Data Source 208
Input Data 248
Input Data 250
Input Data 224
Input Data 226
Input Data 228
Latent Representation Generation Unit 246
Latent Representation Generation Unit 212
Latent Representation 252
Latent Representation 232
Inference Model Portion 243
Output 254

FIG. 2G

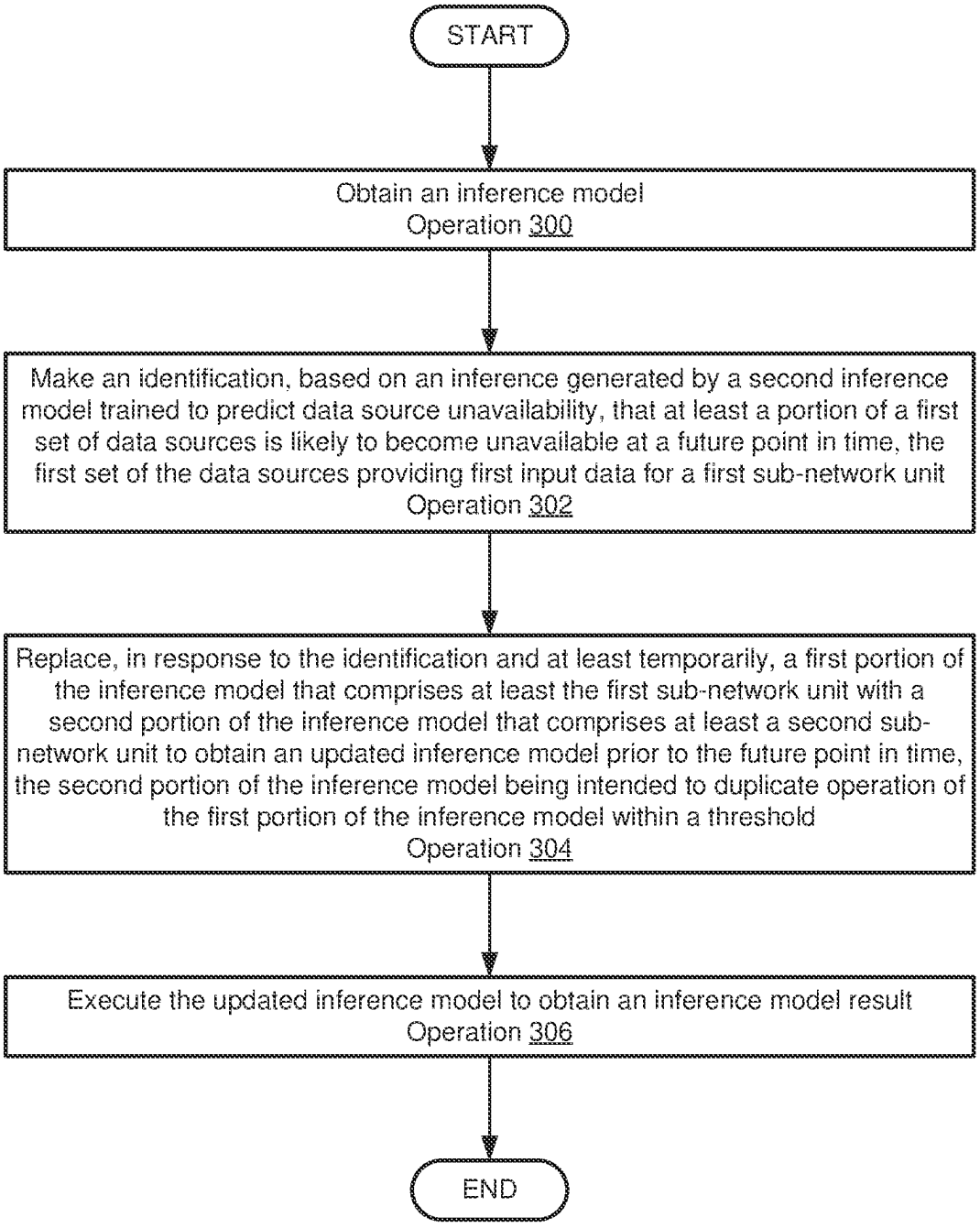

START
Obtain an inference model
Operation 300
Make an identification, based on an inference generated by a second inference model trained to predict data source unavailability, that at least a portion of a first set of data sources is likely to become unavailable at a future point in time, the first set of the data sources providing first input data for a first sub-network unit
Operation 302
Replace, in response to the identification and at least temporarily, a first portion of the inference model that comprises at least the first sub-network unit with a second portion of the inference model that comprises at least a second sub-network unit to obtain an updated inference model prior to the future point in time, the second portion of the inference model being intended to duplicate operation of the first portion of the inference model within a threshold
Operation 304
Execute the updated inference model to obtain an inference model result
Operation 306
END

FIG. 3A

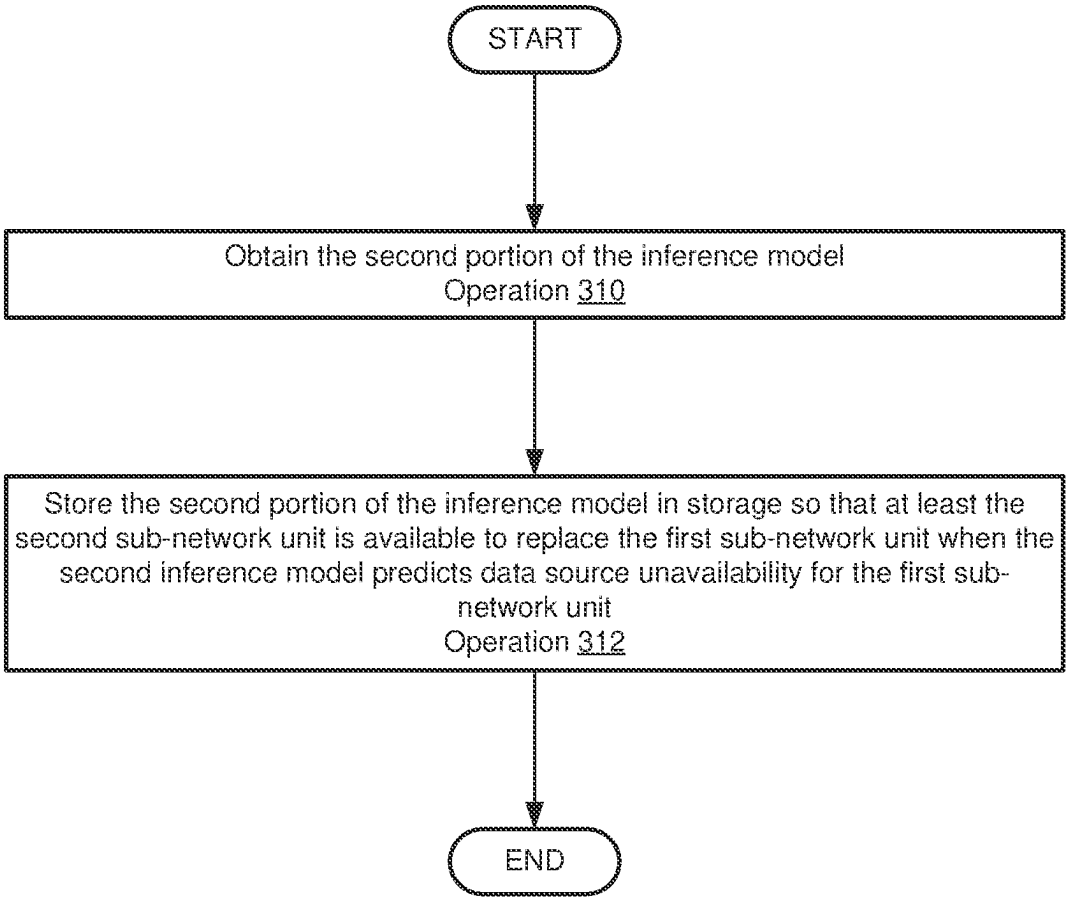

START
Obtain the second portion of the inference model
Operation 310
Store the second portion of the inference model in storage so that at least the second sub-network unit is available to replace the first sub-network unit when the second inference model predicts data source unavailability for the first sub-network unit
Operation 312
END

FIG. 3B

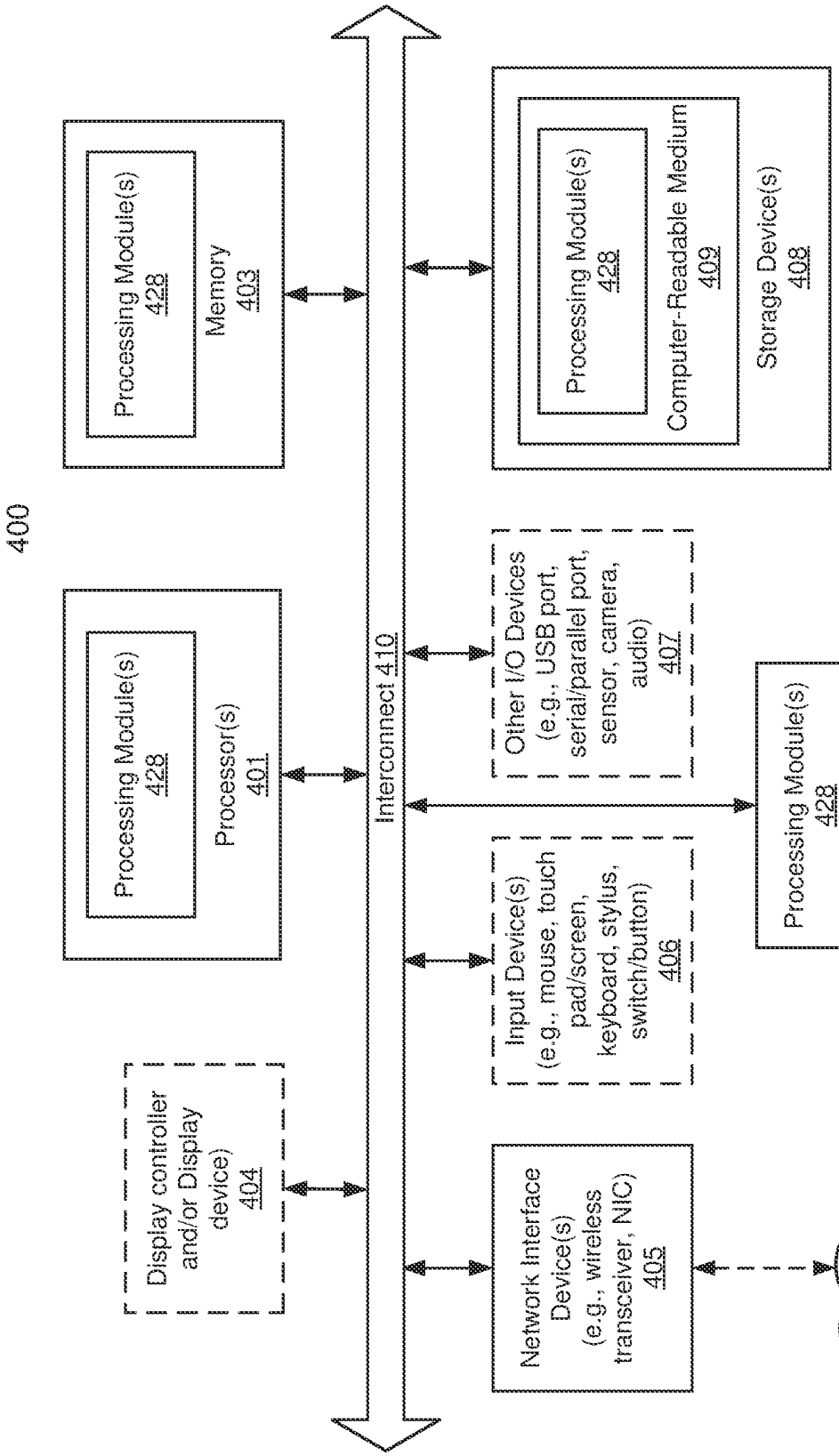

400
Processing Module(s) 428
Memory 403
Processing Module(s) 428
Processor(s) 401
Processing Module(s) 428
Computer-Readable Medium 409
Storage Device(s) 408
Interconnect 410
Other I/O Devices (e.g., USB port, serial/parallel port, sensor, camera, audio) 407
Input Device(s) (e.g., mouse, touch pad/screen, keyboard, stylus, switch/button) 406
Processing Module(s) 428
Display controller and/or Display device) 404
Network Interface Device(s) (e.g., wireless transceiver, NIC) 405
Network

FIG. 4

ADAPTIVE MANAGEMENT OF DATA SOURCE UNAVAILABILITY FOR AN INFERENCE MODEL

FIELD

[0001] Embodiments disclosed herein relate generally to inference models. More particularly, embodiments disclosed herein relate to systems and methods to adaptively manage impact of unavailability of data sources on inference generation by inference models.

BACKGROUND

[0002] Computing devices may provide computer-implemented services. The computer-implemented services may be used by users of the computing devices and/or devices operably connected to the computing devices. The computer-implemented services may be performed with hardware components such as processors, memory modules, storage devices, and communication devices. The operation of these components and the components of other devices may impact the performance of the computer-implemented services.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Embodiments disclosed herein are illustrated by way of example and not limitation in the figures of the accompanying drawings in which like references indicate similar elements.

[0004] FIG. **1** shows a block diagram illustrating a system in accordance with an embodiment.

[0005] FIGS. **2**A-**2**B show an example inference model over time in accordance with an embodiment.

[0006] FIGS. **2**C-**2**D show data flow diagrams illustrating management of portions of an inference model in accordance with an embodiment.

[0007] FIGS. **2**E-**2**G show an example inference model modification process over time in accordance with an embodiment.

[0008] FIG. **3**A shows a flow diagram illustrating a method of managing an inference model in accordance with an embodiment.

[0009] FIG. **3**B shows a flow diagram illustrating a method of managing an inference model portion in accordance with an embodiment.

[0010] FIG. **4** shows a block diagram illustrating a data processing system in accordance with an embodiment.

DETAILED DESCRIPTION

[0011] Various embodiments will be described with reference to details discussed below, and the accompanying drawings will illustrate the various embodiments. The following description and drawings are illustrative and are not to be construed as limiting. Numerous specific details are described to provide a thorough understanding of various embodiments. However, in certain instances, well-known or conventional details are not described in order to provide a concise discussion of embodiments disclosed herein.

[0012] Reference in the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in conjunction with the embodiment can be included in at least one embodiment. The appearances of the phrases "in one embodiment" and "an embodiment" in various places in the specification do not necessarily all refer to the same embodiment.

[0013] References to an "operable connection" or "operably connected" means that a particular device is able to communicate with one or more other devices. The devices themselves may be directly connected to one another or may be indirectly connected to one another through any number of intermediary devices, such as in a network topology.

[0014] In general, embodiments disclosed herein relate to methods and systems for managing an inference model. The inference model may generate inference model results (e.g., inferences) by ingesting input data from any number of data sources and may provide the inference model results to any number of downstream consumers. Therefore, reliable provision of computer-implemented services (e.g., inference generation) for the downstream consumers may rely on availability of input data from the data sources.

[0015] However, one or more data sources may become unavailable over time, causing an interruption to a flow of input data from the one or more data sources to the inference model. The one or more data sources may become unavailable for any reason including, for example, network connection interruptions, depowering of a data processing system associated with the one or more data sources (e.g., a data aggregator, a data collector), compromise of a data processing system associated with the one or more data sources, etc. An interruption to the flow of input data to the inference model may result in interruptions to and/or cessation of inference generation by the inference model. Consequently, provision of the computer-implemented services (e.g., inference generation) may be interrupted, which may negatively impact the downstream consumers.

[0016] To reduce interruptions to inference generation by the inference model in the event of unavailability of input data (e.g., from the one or more unavailable data sources), the inference model may be composed of modular sub-network units. The sub-network units may include portions of the inference model (e.g., input layers, trained latent representation generation units, other data processing units, intermediate layers, output layers) and may be modular so that a first sub-network unit may be substituted with a second sub-network unit as needed. For example, if a data source that supplies input data to the first sub-network unit becomes unavailable, the inference model may be modified so that the second sub-network unit is substituted for the first sub-network unit. The second sub-network unit may source input data from a set of data sources that does not include the one or more unavailable data sources associated with the first sub-network unit. The second sub-network unit may also be chosen based on a likelihood that the substitution will impact inference generation. Specifically, the second sub-network unit may be chosen so that an output (e.g., data, reduced-size representations of data) supplied by the second sub-network unit is similar to an output of the first sub-network unit within a threshold.

[0017] To further reduce a likelihood of data source unavailability causing undesirable interruptions to inference generation by the inference model, the second sub-network unit may be obtained, tested, and stored in advance so that the second sub-network unit is available to replace the first sub-network unit as needed.

[0018] A second inference model may be trained to predict instances of data source unavailability. If the second inference model generates an inference indicating that the data

source that supplies input data to the first sub-network unit is likely to become unavailable at a future point in time, the first sub-network unit (and/or other sub-network units) may be proactively replaced (e.g., with the second sub-network unit) to prevent delays in provision of the computer-implemented services.

[0019] Thus, embodiments disclosed herein may provide an improved system for managing inference models so that interruptions to inference generation by the inference models are reduced in the event of at least a portion of input data becoming unavailable. Re-training at least a portion of the inference model in response to input data unavailability may consume an undesirable quantity of computing resources, may delay the provision of the computer-implemented services based on the inferences, and/or may otherwise negatively impact downstream consumers of the inferences. The disclosed embodiments may address this technical problem by substituting pre-trained modular (e.g., interchangeable) sub-network units of the inference model proactively prior to predicted input data unavailability and/or otherwise loss of functionality of portions of the inference model.

[0020] In an embodiment, a method for managing an inference model that comprises sub-network units is provided. The method may include: making an identification, based on an inference generated by a second inference model trained to predict data source unavailability, that at least a portion of a first set of data sources is likely to become unavailable at a future point in time, the first set of the data sources providing first input data for a first sub-network unit of the sub-network units and the inference model being unable to generate an inference model result when at least a portion of the first set of the data sources is unavailable; replacing, in response to the identification and at least temporarily, a first portion of the inference model that comprises at least the first sub-network unit with a second portion of the inference model that comprises at least a second sub-network unit to obtain an updated inference model prior to the future point in time, the second portion of the inference model being intended to duplicate operation of the first portion of the inference model within a threshold; and executing the updated inference model to obtain the inference model result.

[0021] Making the identification may include: obtaining the inference using the second inference model and ingest data, the ingest data indicating a status of the first set of the data sources.

[0022] The inference may indicate a likelihood that the at least the portion of the first set of the data sources will become unavailable at the future point in time.

[0023] The method may also include: prior to making the identification: obtaining the second portion of the inference model; and storing the second portion of the inference model in storage so that at least the second sub-network unit is available to replace the first sub-network unit when the second inference model predicts data source unavailability for the first sub-network unit.

[0024] Obtaining the second portion of the inference model may include: obtaining the second sub-network unit from a sub-network unit repository, the second sub-network unit sourcing input data from a second set of the data sources and the second set of the data sources being different from the first set of the data sources; obtaining, using the second sub-network unit and second input data obtained from the second set of the data sources, a first reduced-size representation of the second input data; comparing the first reduced-size representation of the second input data to an expected reduced-size representation of the first input data, the expected reduced-size representation of the first input data being generated by the first sub-network unit using the first input data obtained from the first set of the data sources; and in an instance of the comparing in which the first reduced-size representation of the second input data matches the expected reduced-size representation of the first input data within the threshold: concluding that the second sub-network unit duplicates the operation of the first sub-network unit within the threshold; and adding the second sub-network unit to the second portion of the inference model.

[0025] Obtaining the second portion of the inference model may also include: in a second instance of the comparing in which the first reduced-size representation of the second input data does not match the expected reduced-size representation of the first input data within the threshold: adding the second sub-network unit to the second portion of the inference model; and obtaining a fourth sub-network unit from the sub-network unit repository, the fourth sub-network unit being trained to ingest an output of the second sub-network unit and the fourth sub-network being intended to duplicate operation of a third sub-network unit of the inference model within a second threshold, the third sub-network unit being part of the first portion of the inference model; and adding the fourth sub-network unit to the second portion of the inference model.

[0026] Replacing the first portion of the inference model with the second portion of the inference model may include: replacing the first sub-network unit with the second sub-network unit; and replacing the third sub-network unit with the fourth sub-network unit.

[0027] When a first data source of the first set of the data sources becomes unavailable, a second data source of the first set of the data sources may have an increased likelihood of becoming unavailable.

[0028] The first sub-network unit may include a first set of latent representation generation units and the second sub-network unit may include a second set of latent representation generation units.

[0029] Each latent representation generation unit of the first set of the latent representation generation units may be trained to generate a reduced-size representation of the first input data obtained from the first set of the data sources.

[0030] The method may also include: prior to making the identification: obtaining the inference model.

[0031] Obtaining the inference model may include: obtaining a plurality of data sources; for each data source of the plurality of the data sources: making a second determination, based on an intended use of the data source and a quantity of data supplied by the data source, regarding whether a latent representation of the data supplied by the data source is to be used; in a first instance of the second determination in which the latent representation of the data supplied by the data source is to be used: obtaining a latent representation generation unit; and obtaining a third sub-network unit that comprises the latent representation generation unit.

[0032] Obtaining the inference model may also include: in a second instance of the second determination in which the latent representation of the data supplied by the data source is not to be used: treating the input data supplied by the data source as ingest for a fourth sub-network unit of the infer-

ence model, the input data supplied by the data source not being fed into a latent representation generation unit prior to being used by the fourth sub-network unit.

[0033] Obtaining the inference model may also include: grouping data sources based on likelihoods of multiple of the data sources becoming unavailable at same points in time to obtain sets of data sources that comprise portions of the data sources that are likely to become unavailable at the same points in time, and the first set of data sources being one of the sets of the data sources; training, for the first set of sources, and autoencoder; and using a portion of the autoencoder as the first sub-network unit.

[0034] In an embodiment, a non-transitory media is provided. The non-transitory media may include instructions that when executed by a processor cause the computer-implemented method to be performed.

[0035] In an embodiment, a data processing system is provided. The data processing system may include the non-transitory media and a processor, and may perform the method when the computer instructions are executed by the processor.

[0036] Turning to FIG. **1**, a block diagram illustrating a system in accordance with an embodiment is shown. The system shown in FIG. **1** may provide computer-implemented services that may utilize inference models as part of the provided computer-implemented services.

[0037] The inference models may be artificial intelligence (AI) models and may include, for example, linear regression models, deep neural network models, and/or other types of inference generation models. The inference models may be used for various purposes. For example, the inference models may be trained to recognize patterns, automate tasks, and/or make decisions.

[0038] The computer-implemented services may include any type and quantity of computer-implemented services. The computer-implemented services may be provided by, for example, data sources **100**, inference model manager **104**, inference consumers **102**, and/or any other type of devices (not shown in FIG. **1**). Any of the computer-implemented services may be performed, at least in part, using inference models and/or inferences obtained with the inference models.

[0039] Data sources **100** may include any number of data sources (**100**A-**100**N) that may obtain (i) training data usable to train inference models, and/or (ii) ingest data that is ingestible into trained inference models to obtain corresponding inferences. The inferences generated by the inference models may be provided to inference consumers **102** for downstream use.

[0040] However, one or more of data sources **100** may become unavailable over time for any reason (e.g., compromise by a malicious entity, depowering of hardware resources, software component malfunction, network connectivity issues) and, therefore, input data may not be provided to the inference model as expected. An unexpected lack of input data for the inference model may interrupt inference generation and subsequent provision of the inferences to inference consumers **102**. Such interruptions may negatively impact computer-implemented services obtained by and/or provided by inference consumers **102**.

[0041] In general, embodiments disclosed herein may provide methods, systems, and/or devices for managing inference models so that interruptions to inference generation are reduced in the event of input data unavailability from one or more data sources of the inference model.

[0042] By doing so, the system may be more likely to provide desired computer-implemented services due to increased uptime of the inference model.

[0043] To reduce interruptions to inference generation and, therefore, reduce interruptions to the computer-implemented services, the inference model may be made up of any number of sub-network units. Each sub-network unit may include a portion of the inference model (e.g., a portion of an autoencoder, a data processing unit, any number of layers of a neural network inference model). The sub-network units may be modular (e.g., may be substituted for other sub-network units) without requiring re-training processes for the sub-network units and/or the inference model.

[0044] To manage the inference model, the system may include inference model manager **104**. Inference model manager **104** may manage any number of inference models. To do so, inference model manager **104** may: (i) oversee training processes to obtain trained inference models, (ii) manage inference model repositories, (iii) oversee inference generation by the inference models, (iv) perform remedial actions when one or more inference models does not perform as expected, and/or (v) perform other actions. For example, inference model manager **104** may perform actions to remediate unavailability of data sources **100**.

[0045] To obtain a trained inference model, inference model manager **104** may obtain any number of previously trained sub-network units (and/or may train any number of sub-network units) and may compile the sub-network units to generate the trained inference model. Refer to FIG. **2**A for additional details regarding obtaining the trained inference model.

[0046] To manage the trained inference model, inference model manager **104** may also manage a sub-network unit repository. The sub-network unit repository may include any number of previously trained sub-network units. Sub-network units stored in the sub-network unit repository may be available for substitution into the inference model. The sub-network units may be grouped so that sub-network units in a grouping are likely to be substituted together into the inference model.

[0047] To manage the sub-network unit repository, inference model manager **104** may: (i) train sub-network units, (ii) test sub-network units to determine appropriate substitutions (e.g., the second sub-network unit duplicates operation of the first sub-network unit within a threshold and, therefore, may be an appropriate substitution for the first sub-network unit), (iii) group sub-network units, (iv) retrieve sub-network units from the sub-network unit repository as needed, and/or (v) perform other tasks. Refer to FIG. **2**C for additional details regarding the sub-network unit repository.

[0048] To remediate the unavailability of data sources **100**, inference model manager **104** may: (i) identify, based on an inference generated by a second inference model that at least a portion of a first set of data sources **100** is likely to become unavailable at a future point in time, the first set of data sources **100** providing input data for the first sub-network unit of the inference model, (ii) replace, at least temporarily, a first portion of the inference model that includes the first sub-network unit with a second portion of the inference model that includes a second sub-network unit to obtain an updated inference model, (iii) execute the

updated inference model to obtain an inference model result, and/or (iv) perform other actions.

[0049] Refer to FIG. **2**D for additional details regarding the second inference model.

[0050] The second portion of the inference model include a grouping of sub-network units previously obtained, tested, and approved as a potential replacement for the first portion of the inference model. Therefore, the second portion of the inference model may be available (in the sub-network unit repository) for replacement as needed.

[0051] As a result, the first portion of the inference model may be replaced with the second portion of the inference model prior to the point in time when the data source unavailability was predicted to occur thereby proactively avoiding potential delays associated with the data source unavailability.

[0052] While described herein with respect to substituting one sub-network unit (e.g., the first sub-network unit) to remediate data source unavailability, it may be appreciated that any number of additional sub-network units of the inference model may be replaced to adapt to changes in availability of the input data. Refer to FIGS. **2**A-**2**G for additional details regarding substituting modular sub-network units of the inference model.

[0053] To perform the above-mentioned functionality, the system of FIG. **1** may include data sources **100**, inference model manager **104**, inference consumers **102**, and/or other entities. Data sources **100**, inference consumers **102**, inference model manager **104**, and/or any other type of devices not shown in FIG. **1** may perform all, or a portion of the computer-implemented services independently and/or cooperatively.

[0054] Data sources **100** may include any number and/or type of data sources. Data sources **100** may include, for example, data collectors, data aggregators, data repositories, and/or any other entity responsible for providing input data to inference models. Data sources **100** may be grouped (e.g., by inference model manager **104** prior to obtaining the inference model and/or by another entity at another time) into any number of groupings. Groupings of data sources **100** may include any number of data sources **100**. For example, a first grouping of data sources **100** may include two data sources of data sources **100** and a second grouping of data sources **100** may include five data sources of data sources **100**.

[0055] Groupings of data sources **100** may be assigned so that members of a grouping are likely to become unavailable at same points in time. The groupings of data sources **100** may be assigned based on other criteria including, for example, logical similarities in the input data sourced from data sources within the grouping so that data processing requirements for the input data may be reduced, etc. Refer to FIG. **2**A for additional details regarding groupings of data sources **100**.

[0056] Inference consumers **102** may provide, all or a portion, of the computer-implemented services. When doing so, inference consumers **102** may consume inferences obtained by inference model manager **104** (and/or other entities using inference models managed by inference model manager **104**). However, if inferences from inference models are unavailable, then inference consumers **102** may be unable to provide, at least in part, the computer-implemented services, may provide less desirable computer-implemented services, and/or may otherwise be impacted in an undesirable manner.

[0057] When performing its functionality, one or more of inference model manager **104**, data sources **100**, and inference consumers **102** may perform all, or a portion, of the methods and/or actions shown in FIGS. **2**A-**3**B.

[0058] Any of inference model manager **104**, data sources **100**, and inference consumers **102** may be implemented using a computing device (e.g., a data processing system) such as a host or a server, a personal computer (e.g., desktops, laptops, and tablets), a "thin" client, a personal digital assistant (PDA), a Web enabled appliance, a mobile phone (e.g., Smartphone), an embedded system, local controllers, an edge node, and/or any other type of data processing device or system. For additional details regarding computing devices, refer to FIG. **4**.

[0059] Any of the components illustrated in FIG. **1** may be operably connected to each other (and/or components not illustrated) with communication system **106**.

[0060] Communication system **106** may include one or more networks that facilitate communication between any number of components. The networks may include wired networks and/or wireless networks (e.g., and/or the Internet). The networks may operate in accordance with any number and types of communication protocols (e.g., such as the internet protocol).

[0061] Communication system **106** may be implemented with one or more local communications links (e.g., a bus interconnecting a processor of inference model manager **104** and any of the data sources **100**, and inference consumers **102**).

[0062] While illustrated in FIG. **1** as included a limited number of specific components, a system in accordance with an embodiment may include fewer, additional, and/or different components than those illustrated therein.

[0063] The system described in FIG. **1** may be used to reduce the computational cost for mitigating the impact of (input) data unavailability for inference models on inference consumers. The following processes described in FIGS. **2**A-**2**G may be performed by the system in FIG. **1** when providing this functionality.

[0064] Turning to FIG. **2**A, an example architecture of an inference model that includes sub-network units is shown. The inference model in FIG. **2**A is shown as sourcing input data from five data sources (e.g., **200**, **202**, **204**, **206**, and **208**). However, it may be appreciated that an inference model may source input data from any number of data sources without departing from embodiments disclosed herein. Each of the five data sources shown may represent any entity from which input data is obtained for the inference model. For example, data source **200** may be a data collector, a data aggregator, a data repository, a device storing any amount of data in storage, and/or any other entity.

[0065] To obtain the inference model architecture shown in FIG. **2**A, data sources **200**-**208** may be divided into three groupings. For example, a first grouping may include data source **200** and data source **202**, a second grouping may include data source **204**, and a third grouping may include data source **206** and **208**. The groupings may be formed based on any criteria including, for example, a likelihood that each data source will become unavailable at a same point in time, logical similarities between data sourced from

each data source, etc. Specifically, data source **200** and data source **202** may have a highest likelihood (when compared to data sources **204**, **206** and **208**) of becoming unavailable at a first point in time and data sources **204-208** may be less likely to become unavailable at the first point in time.

[0066] Data source **200** and data source **202** may have the highest likelihood of becoming unavailable at the first point in time due to any criteria. For example, data source **200** and data source **202** may be data collectors including sensors positioned in a first ambient environment. A weather event (e.g., a storm) may occur in the first ambient environment and data source **200** and data source **202** may be equally impacted by the weather event. However, data source **204** may be a data collector located in a second ambient environment that is not proximate to the first ambient environment. Therefore, data source **204** may be unlikely to be impacted by the weather event and may not be included in the first grouping.

[0067] Following grouping data sources **200-208**, it may be determined (e.g., by a user, by inference model manager **104** via any set of rules, by another entity) whether reduced-size representations of input data sourced from each grouping of data sources **200-208** are to be used.

[0068] For example, data source **200** and data source **202** together may generate a large quantity of input data and, therefore, a reduced-size representation of the large quantity of the input data may be favored for use in inference generation. Similarly, a network connection between data sources **200-202** and an entity hosting the inference model may have limited bandwidth available for transmission of the large quantity of the input data. Therefore, a reduced-size representation of the large quantity of the input data may be more easily transmitted to the entity hosting the inference model to use for inference generation.

[0069] It may be determined, therefore, that a reduced-size representation of input data from the first grouping (e.g., including data source **200** and data source **202**) is to be generated prior to inference generation. To do so, latent representation generation unit **210** may be obtained.

[0070] To obtain latent representation generation unit **210**, a first autoencoder may be trained using a first set of training data (e.g., from data source **200** and/or data source **202**). Training the first autoencoder may include performing any training process using the first set of the training data so that a first set of weights for the first autoencoder are obtained. The first set of the weights may be iteratively modified until a latent representation (e.g., the reduced-size representation) of the first set of the training data may be generated and subsequently used to faithfully re-create the first set of the training data within a threshold.

[0071] A portion of the first autoencoder (e.g., including the weights usable to generate the latent representation) may be treated as latent representation generation unit **210**. Therefore, input data sourced from data source **200** and data source **202** may be fed into latent representation generation unit **210** to obtain a latent representation of the input data, which may then be provided to inference model portion **214**.

[0072] Latent representation generation unit **210** may be obtained via other methods and may generate reduced-size representations of data via other means (e.g., other than a portion of an autoencoder) without departing from embodiments disclosed herein.

[0073] Inference model portion **214** may include: (i) any number of sub-network units, (ii) any number of layers of a neural network inference model, and/or (iii) other data processing units usable to facilitate inference generation. Refer to FIG. **2**B for an example inference generation process for the inference model.

[0074] It may also be determined that a reduced-size representation of input data from a second grouping (e.g., including data source **206** and data source **208**) is to be generated prior to inference generation. To do so, latent representation generation unit **212** may be obtained using methods similar to those described with respect to latent representation generation unit **210**.

[0075] Therefore, input data sourced from data source **206** and data source **208** may be fed into latent representation generation unit **212** to obtain a latent representation of the input data, which may then be provided to inference model portion **214** for further processing.

[0076] Lastly, it may be determined that a reduced-size representation of input data from a third grouping (e.g., including data source **204**) is not to be generated prior to inference generation. Therefore, input data sourced from data source **204** may be fed directly into inference model portion **214** to be used for inference generation.

[0077] As previously mentioned, the inference model may include any number of sub-network units. The inference model described in FIG. **2**A may include three sub-network units (e.g., sub-network unit **216**, sub-network unit **218**, and sub-network unit **219**). Each sub-network unit may include at least a portion of the inference model. Specifically, sub-network unit **216** may include at least latent representation generation unit **210**, sub-network unit **218** may include at least inference model portion **214**, and sub-network unit **219** may include at least latent representation generation unit **212**. While the inference model described in FIG. **2**A is shown as including three sub-network units, it may be appreciated that inference models may include any number of sub-network units without departing from embodiments disclosed herein.

[0078] Turning to FIG. **2**B, an example data flow during inference generation by the inference model described in FIG. **2**A is shown.

[0079] Data source **200** may provide input data **220** to latent representation generation unit **210** and data source **202** may provide input data **222** to latent representation generation unit **210**. Input data **220** and input data **222** may include any quantity and/or type of data usable by the inference model for inference generation. Although not shown in FIG. **2**B, the inference model may include other elements such as, for example, any number of input layers of a neural network. Latent representation generation unit **210** may use input data **220** and input data **222** to generate latent representation **230**.

[0080] To do so, latent representation generation unit **210** may include a portion of an autoencoder and may be trained to generate reduced-size representations of input data. Latent representation **230**, therefore, may include a reduced-size representation of input data **220** and/or input data **222**. The reduced-size representation may include, for example, attributes of input data **220** and input data **222**. Refer to FIG. **2**A for additional details regarding groupings of data sources for particular latent representation generation units. Latent representation **230** may be provided to inference model portion **214**.

[0081] Data source **204** may provide input data **224** directly to inference model portion **214** without traversing a latent representation generation unit. This may occur due to,

for example, a quantity and/or type of data included in input data **224**. Specifically, data source **204** may generate less data than data source **200** and/or data source **202** and/or a type of data that is provided by data source **204** may be preferred to not be in the form of a latent representation (for any reason). While not shown in FIG. **2**B, input data **224** may pass through additional inference model portions (e.g., including any number of input layers, any number of intermediate layers) prior to being fed into inference model portion **214**.

[0082] Data source **206** may provide input data **226** to latent representation generation unit **212** and data source **208** may provide input data **228** to latent representation generation unit **212**. Data sources **206** and **208** may be similar to any of data sources **200**, **202**, and/or **204**. Latent representation generation unit **212** may be similar to latent representation generation unit **210**. Latent representation generation unit **212** may generate, based on input data **226** and input data **228**, latent representation **232** which may be provided to inference model portion **214**.

[0083] Latent representation **230** may be fed into inference model portion **214** and may be used (along with input data **224** from data source **204** and latent representation **232** from latent representation generation unit **212**) by inference model portion **214** to generate output **234**. Inference model portion **214** may include any portion of the inference model including any number of sub-network units, any number of intermediate layers of a neural network, additional data processing units, etc. Output **234** may include at least partially processed data based on input data and latent representations of input data. Specifically, output **234** may be partially processed due to output **234** being fed into another sub-network unit (not shown in FIGS. **2**A-**2**F) and/or other portions of the inference model to facilitate inference generation by the inference model.

[0084] Thus, the inference model depicted in FIG. **2**B process data as a portion of an inference generation process using input data from any number of data sources and using some number of latent representation generation units to modify at least a size of input data from a portion of the data sources. By associating data sources with trained latent representation generation units, portions of the inference model (e.g., sub-network units) may be modular. In other words, if a data source associated with the inference model becomes unavailable, a latent representation generation unit associated with the unavailable data source may be replaced with a similar latent representation generation unit. However, to do so, the inference model may be divided into any number of modular sub-network units including previously trained latent representation generation units. Refer to FIG. **2**A for a visual depiction of the inference model divided into sub-network units.

[0085] To further clarify embodiments disclosed herein, data flow diagrams in accordance with an embodiment are shown in FIGS. **2**C-**2**D. In these diagrams, flows of data and processing of data are illustrated using different sets of shapes. A first set of shapes (e.g., **240**, **247**, etc.) is used to represent data structures, a second set of shapes (e.g., **245**, **260**, etc.) is used to represent processes performed using and/or that generate data, and a third set of shapes (e.g., **270**, **200**, etc.) is used to represent large scale data structures such as databases.

[0086] The inference model described in FIGS. **2**A-**2**B may experience instances of data source unavailability. In the event of data source unavailability, one or more sub-network units associated with the unavailable data source may be replaced. To reduce delays associated with identifying, training, and testing replacement sub-network units, any number of potential replacement sub-network units may be previously trained, labeled according to potential replacements in the inference model, and stored in storage for retrieval as needed.

[0087] Turning to FIG. **2**C, a data flow diagram depicting management of a sub-network unit repository in accordance with an embodiment is shown. Sub-network unit repository **270** may be hosted and managed by any entity (e.g., inference model manager **104**) and may store any number of trained sub-network units (e.g., **240**, **241**). Sub-network units stored in sub-network unit repository **270** may be grouped with other sub-network units likely to be substituted together in an instance of data source unavailability. The groupings of sub-network units may be referred to as inference model portions (e.g., **247**, **255**).

[0088] Each inference model portion may include a label (e.g., label **251** for inference model portion **247**). Label **251** may include information related to which sub-network units of the inference model that inference model portion **247** is intended to replace.

[0089] To manage sub-network unit repository **270**, sub-network units may be trained and tested. For example, sub-network unit **240** may be a sub-network unit not currently used by the inference model and sub-network unit **240** may be used for testing process **245**.

[0090] Testing process **245** may include determining whether sub-network unit **240** may be used as a replacement for a particular sub-network unit currently used by the inference model. For example, sub-network unit **240** may be intended to replace sub-network unit **216** shown in FIG. **2**A.

[0091] To determine whether sub-network unit **240** may be used as a replacement for sub-network unit **216**, testing process **245** may include determining whether sub-network unit **240** duplicates operation of sub-network unit **216** within a threshold.

[0092] Sub-network unit **240** may have two corresponding data sources from which to source input data from (not shown). Sub-network unit **240** may include a latent representation generation unit. The latent representation generation unit may include a portion of a previously trained autoencoder trained to generate latent representations of input data sourced from data sources.

[0093] Sub-network unit **240** may be eligible to replace sub-network unit **216** in the inference model architecture if sub-network unit **240** duplicates operation of sub-network unit **216** within the threshold. The threshold may be any threshold, may be based on needs of one or more inference consumers, and may be determined by any entity (e.g., a manufacturer, a user, a downstream consumer, a third-party service). Sub-network unit **240** may also be eligible to replace sub-network unit **216** based on other criteria including, for example, a type and/or quantity of data supplied by the two corresponding data sources of sub-network unit **240** being similar (e.g., based on another threshold) to a type and/or quantity of data expected to be supplied by data sources **200** and **202**, etc.

[0094] To determine whether sub-network unit **240** duplicates the operation of sub-network unit **216** within the threshold, input data sourced from the two corresponding data sources of sub-network unit **240** may be used to

generate a first reduced-size representation of data. The first reduced-size representation of the data may be compared to an expected reduced-size representation of the data (not shown). The expected reduced-size representation of the data may be previously generated and stored in storage, may be generated using historic input data sourced from data sources **200** and/or **202** and latent representation generation unit **210**, and/or may be generated via another method. The expected reduced-size representation of the data may be intended to represent the operation of sub-network unit **216**.

[0095] A difference may be obtained between the first reduced-size representation of the data and the expected reduced-size representation of the data, and the difference may be compared to the threshold (not shown). If the difference falls below the threshold, sub-network unit **240** may be added to inference model portion **247**, labeled as approved for replacement, and stored in sub-network unit repository **270**.

[0096] If the difference does not fall below the threshold, sub-network unit **240** may not be considered an adequate substitute for sub-network unit **216**. In the event that sub-network unit **240** is not considered an adequate substitute for sub-network unit **216**, additional portions of the inference model may be considered for substitution (e.g., at least a portion of inference model portion **214** and/or other portions not shown in FIGS. **2**A-**2**B) in order to duplicate the operation of sub-network unit **216** within the threshold.

[0097] Specifically, sub-network unit **241** may be tested and approved as a potential substitute sub-network unit **218**. Therefore, sub-network unit **240** and sub-network unit **241** may be added to inference model portion **247** and inference model portion **247** may be stored in sub-network unit repository **270** as shown in FIG. **2**C. Label **251** may, therefore, indicate that inference model portion **247** is to be used as a replacement for a portion of the inference model including sub-network unit **216** and sub-network unit **218** in the event that data source **200** and/or data source **202** becomes unavailable.

[0098] By replacing sub-network unit **216** with sub-network unit **240** and sub-network unit **218** with sub-network unit **241**, the output of sub-network unit **241** may duplicate (within the threshold) the expected output of sub-network unit **218**.

[0099] Turning to FIG. **2**D, a data flow diagram in accordance with an embodiment is shown. Consider a scenario in which a second inference model (e.g., inference model **262**) is trained to predict instances of data source unavailability. An instance of data source unavailability may include, for example, an interruption to the flow of input data (e.g., **220**, **222**, **226**, and **228** shown in FIG. **2**B) from any of data sources **200**-**208** shown in FIG. **2**B. Specifically, data source **200** and data source **202** may become unavailable due to a weather event impacting an environment in which data source **200** and data source **202** are positioned.

[0100] Inference model **262** may be any AI model (e.g., a neural network inference model) and may be hosted and operated by any entity (e.g., inference model manager **104**). To generate inferences, ingest data may be obtained from any number of data sources (e.g., data source **200**). While shown in FIG. **2**D as obtaining ingest data from one data source, it may be appreciated that ingest data may be obtained from any number of data sources without departing from embodiments disclosed herein. The ingest data may be obtained continuously, according to a previously determined schedule, on demand in response to a request for ingest data, and/or via other methods.

[0101] The ingest data may indicate a status of data source **200**. For example, the ingest data may include any amount of telemetry data associated with a data processing system of data source **200**, may include any amount of data related to an environment in which data source **200** is positioned, and/or any other type of data.

[0102] The ingest data may be obtained (e.g., by any entity) and may be used along with inference model **262** to perform inference generation **260** process. Inference generation **260** process may include feeding at least a portion of the ingest data into inference model **262** and obtaining, as an output from inference model **262**, inference **264**.

[0103] Inference **264** may indicate a likelihood that data source **200** (and/or any other data sources grouped with data source **200**) may become unavailable at a future point in time. Inference **264** may indicate, for example: (i) likely upcoming events that have a likelihood of causing data unavailability, (ii) an overall risk profile for data source **200**, and/or (iii) may predict data source unavailability via other means without departing from embodiments disclosed herein.

[0104] Specifically, inference **264** may include a risk profile for data source **200** along with an accompanying time series relationship indicating a quantification of risk of unavailability over a duration of time. Inference **264** may be used, therefore, to determine whether an action should be performed to preempt a loss of input data for the inference model (e.g., the inference model data source **200** provides input data for).

[0105] Inference **264** may be used to perform inference analysis **266** process. Inference analysis **266** process may include any type of data analysis process to determine if replacement a first portion of the inference model (including at least sub-network unit **216** shown in FIGS. **2**A-**2**B) is warranted based on the risk profile indicated by inference **264**. In addition, inference analysis **266** process may include identifying an appropriate replacement sub-network unit(s) if the first portion of the inference model is to be replaced.

[0106] For example, inference **264** may include any type of quantification of risk for data source **200**. Specifically, inference **264** may indicate that data source **200** has a 75% likelihood of becoming unavailable in the next 24 hours. Inference analysis **266** process may include comparing the percent likelihood to a risk threshold. The risk threshold may indicate, for example, that a sub-network unit is to be replaced if at least one data source associated with the sub-network unit has over a 60% chance of becoming unavailable in the next 24 hours. Thresholds may be based on other metrics, other durations of time, and/or other evaluations of risk without departing from embodiments disclosed herein. Inference analysis **266** process may include other methods of analyzing inferences.

[0107] The result of inference analysis **266** process may be a set of instructions based on one or more conclusions drawn during inference analysis **266** process. For example, the instructions may indicate: (i) a first portion of the inference model (including at least sub-network unit **216**) is not to be replaced, (ii) the first portion of the inference model is to be replaced, (iii) additional monitoring is required for the first portion of the inference model, and/or (iv) other instructions.

[0108] In FIG. **2**D, the instructions may indicate that the first portion of the inference model is to be replaced. The instructions may be provided to any entity responsible for managing inference models and/or sub-network units for the inference models (e.g., inference model manager **104**). The entity may perform, responsive to the instructions, sub-network unit identification **268** process. Sub-network unit identification **268** process may include: (i) reading the instructions, (ii) utilizing information indicated in the instructions to access sub-network unit repository **270**: (iii) obtaining sub-network unit **240** and sub-network unit **241** from sub-network unit repository **270**, and/or (iv) other processes.

[0109] Sub-network unit repository **270** may include any number of sub-network units (and/or groupings of sub-network units) that are previously trained and labeled as potential replacements for sub-network units currently utilized by the inference model.

[0110] For example, sub-network unit **240** and sub-network unit **241** may make up a second portion of the inference model that is intended as a potential replacement for the first portion of the inference model. The second portion of the inference model may have been previously obtained and stored in sub-network unit repository **270**. Refer to FIG. **3**B for additional details regarding obtaining the second portion of the inference model.

[0111] Thus, sub-network unit **240** and sub-network unit **241** may be retrieved from storage (e.g., sub-network unit repository **270**) in response to a predicted loss of input data from data source **200** at a future point in time. While shown in FIG. **2**D as identifying two potential replacement sub-network units, additional replacement sub-network units (other than sub-network unit **240** and sub-network unit **241**) may be identified and may be available to test as potential replacements for the first portion of the inference model without departing from embodiments disclosed herein.

[0112] Turning to FIG. **2**E, sub-network unit **216** (and corresponding data sources **200** and **202**) may be removed from the inference model prior to predicted input data unavailability from data source **200**. Sub-network unit **216** may be removed permanently and/or temporarily. As sub-network unit **216** provided latent representation **230** (shown in FIG. **2**B) to inference model portion **214**, inference model portion **214** may also be removed permanently and/or temporarily in response to the predicted data source unavailability.

[0113] Turning to FIG. **2**F, sub-network unit **216** may be replaced in the inference model architecture with sub-network unit **240**. Sub-network unit **240** may not have been used by the inference model at the time that data source **200** and data source **202** became unavailable. In addition, sub-network unit **240** may be retrieved from storage in a sub-network unit repository.

[0114] Sub-network unit **240** may have two corresponding data sources from which to source input data from (e.g., data source **242** and data source **244**). Data source **242** and data source **244** may be available and, therefore, may be able to provide input data to sub-network unit **240**. Sub-network unit **240** may include latent representation generation unit **246**. Latent representation generation unit **246** may be a portion of a previously trained autoencoder trained to generate latent representations of input data sourced from data sources.

[0115] Inference model portion **214** may not be able to ingest a latent representation of data generated by sub-network unit **240**. Therefore, sub-network unit **218** (shown in FIG. **2**A) may be replaced with sub-network unit **241**. Sub-network unit **241** may include inference model portion **243**. Inference model portion **243** may include any previously trained data processing portion of the inference model (e.g., including any number of intermediate layers of a neural network, any number of additional sub-network units) trained to ingest input data from sub-network unit **240**, data source **204**, and sub-network unit **219**.

[0116] While described with respect to replacing two sub-network units of the inference model, additional sub-network units other than those shown and described in FIGS. **2**A-**2**G may be substituted as needed to manage data source unavailability without departing from embodiments disclosed herein.

[0117] Turning to FIG. **2**G, an example updated inference model is shown. The updated inference model may be updated based on sub-network unit **240** being considered an adequate substitute for sub-network unit **216** and sub-network unit **241** being considered an adequate substitute for sub-network unit **218**. To continue inference generation, data source **242** may provide input data **248** to latent representation generation unit **246** and data source **244** may provide input data **250** to latent representation generation unit **246**. Input data **248** and input data **250** may include any quantity and type of data usable by the inference model for inference generation. Latent representation generation unit **246** may use input data **248** and input data **250** to generate latent representation **252**.

[0118] To do so, latent representation generation unit **246** may include a portion of an autoencoder and may be trained to generate reduced-size representations of input data. Latent representation **252**, therefore, may include a reduced-size representation of input data **248** and/or input data **250**. The reduced-size representation may include, for example, attributes of input data **248** and input data **250**. Latent representation **252** may be provided to inference model portion **243**.

[0119] Data source **204** may provide input data **224** directly to inference model portion **243** without traversing a latent representation generation unit as described in FIG. **2**B.

[0120] Data source **206** may provide input data **226** to latent representation generation unit **212** and data source **208** may provide input data **228** to latent representation generation unit **212** as described in FIG. **2**B.

[0121] Latent representation **252** may be fed into inference model portion **243** and may be used (along with input data **224** from data source **204** and latent representation **232** from latent representation generation unit **212**) by inference model portion **243** to generate output **254**. Output **254** may include any amount of partially processed data that may be used by additional (not shown) sub-network units of the inference model to as a part of inference generation by the inference model.

[0122] In an embodiment, the one or more entities performing the operations shown in FIGS. **2**A-**2**G are implemented using a processor adapted to execute computing code stored on a persistent storage that when executed by the processor performs the functionality of the system of FIG. **1** discussed throughout this application. The processor may be a hardware processor including circuitry such as, for example, a central processing unit, a processing core, or a

microcontroller. The processor may be other types of hardware devices for processing information without departing from embodiments disclosed herein.

[0123] As discussed above, the components of FIG. **1** may perform various methods to manage inference models. FIGS. **3**A-**3**B illustrate methods that may be performed by the components of FIG. **1**. In the diagrams discussed below and shown in FIGS. **3**A-**3**B, any of the operations may be repeated, performed in different orders, and/or performed in parallel with or in a partially overlapping in time manner with other operations.

[0124] Turning to FIG. **3**A, a flow diagram illustrating a method of managing an inference model in accordance with an embodiment is shown. The method may be performed by a data processing system, inference model manager, data source, inference consumer, and/or another device.

[0125] At operation **300**, an inference model may be obtained. Obtaining the inference model may include obtaining a plurality of data sources and for each data source of the plurality of the data sources: determining, based on an intended use of input data supplied by the data source and a quantity of the input data supplied by the data source, whether a latent representation of the input data supplied by the data source is to be used.

[0126] Obtaining the plurality of the data sources may include: (i) reading a list of identifiers for available data sources from storage, (ii) receiving a list of available data sources from another entity (e.g., a data source management system, the data sources), (iii) receiving contact information for the plurality of the data sources (e.g., a media access control (MAC) address usable to address communications to each of the plurality of the data sources) from another entity, and/or (iv) other methods.

[0127] Determining whether the latent representation of the input data supplied by the data source is to be used may include: (i) obtaining metadata associated with the input data supplied by the data source, and/or (ii) comparing attributes of the metadata to any criteria to determine whether the latent representation is to be used. For example, the metadata may indicate that a certain quantity of input data is received from the data source on average each day and the quantity of the input data may exceed a criterion for a desired rate of input data acquisition. In addition, the metadata may indicate a quantity of communication system bandwidth consumed during transmission of the input data. The quantity of the communication system bandwidth consumed may be compared to a bandwidth threshold to indicate whether sufficient communication system bandwidth is available to transmit the input data supplied by the data source, etc.

[0128] If a latent representation of the input data is to be used, obtaining the inference model may also include: (i) obtaining a latent representation generation unit and (ii) obtaining a third sub-network unit that includes the latent representation generation unit.

[0129] Obtaining the latent representation generation unit may include: (i) training an autoencoder using the input data from the data source to obtain a trained autoencoder, (ii) obtaining a portion of the autoencoder (e.g., a portion that obtains a latent representation) and/or (iii) treating the portion of the autoencoder as the latent representation generation unit.

[0130] Obtaining the latent representation generation unit may also include: (i) reading an algorithm (e.g., the portion of the autoencoder, another algorithm) capable of generating reduced-size representations of data from storage, (ii) receiving the algorithm from another entity, and/or (iii) other methods.

[0131] Obtaining the third sub-network unit may include: (i) encapsulating the latent representation generation unit in a data structure, (ii) treating the encapsulated latent representation generation unit (along with metadata including indicators for the associated data sources, etc.) as the third sub-network unit, and/or (iii) storing the third sub-network unit in a sub-network unit repository. If the third sub-network unit is used for inference generation, the third sub-network unit may: (i) request input data from the data source, (ii) generate, using the portion of the autoencoder, a reduced-size representation of the input data, and/or (iii) provide the reduced-size representation of the input data to another sub-network unit of the inference model.

[0132] If the latent representation of the input data is not to be used, obtaining the inference model may also include treating the input data supplied by the data source as ingest for a fourth sub-network unit of the inference model, the input data supplied by the data source not being fed into a latent representation generation unit prior to being used by the fourth sub-network unit. Treating the input data as ingest for a fourth sub-network unit may include: (i) obtaining input data from the data source, (ii) providing, without feeding the input data into a portion of an autoencoder, the input data to a fourth sub-network unit, the fourth sub-network unit including a portion of the inference model. The portion of the inference model may include, for example, any number of layers of a neural network inference model.

[0133] Treating the input data as ingest for the fourth sub-network unit may also include modifying instructions associated with execution of the inference model, the instructions indicating that input data from the data source is to be provided directly to the fourth sub-network unit, etc.

[0134] Obtaining the inference model may also include: (i) grouping data sources of the plurality of the data sources based on likelihoods of multiple of the data sources becoming unavailable at same points in time to obtain sets of data sources that include portions of the data sources that are likely to become unavailable at same points in time, and the first set of the data sources being one of the sets of the data sources, (ii) training, for the first set of the data sources, an autoencoder, and/or (iii) using a portion of the autoencoder as the first sub-network unit.

[0135] Grouping the data sources may include: (i) identifying characteristics of each data source of the data sources, and/or (ii) performing an analysis process using the identified characteristics to obtain any number of sets of the data sources, each set of the sets of the data sources including data sources with similar characteristics. For example, a first grouping of the data sources may include data sources located in a similar geographic area.

[0136] Training the autoencoder may include performing any training process using an autoencoder and input data from the first set of the data sources to obtain a set of optimized weights for the autoencoder, the set of the optimized weights being chosen so that the autoencoder faithfully (e.g., within a threshold) re-creates the input data from the first set of the data sources after generating a latent representation of the input data.

[0137] Using the portion of the autoencoder as the first sub-network unit may include: (i) obtaining the portion of

the autoencoder, the portion of the autoencoder including the weights usable to generate the latent representation, and/or (ii) storing the portion of the autoencoder in a sub-network unit repository. Storing the portion of the autoencoder in the sub-network unit repository may include generating metadata for the portion of the autoencoder, the metadata indicating at least which data sources are associated with the first sub-network unit and storing the metadata along with the portion of the autoencoder.

[0138] At operation **302**, an identification may be made, based on an inference generated by a second inference model trained to predict data source unavailability, that at least a portion of a first set of the data sources is likely to become unavailable at a future point in time, the first set of the data sources providing first input data for a first sub-network unit of the inference model.

[0139] Making the identification may include: (i) obtaining the inference using the second inference model and ingest data, the ingest data indicating a status of the first set of the data sources, and/or (ii) determining, based on the inference, that at least the portion of the first set of the data sources is likely to become unavailable at the future point in time.

[0140] Obtaining the inference may include: (i) obtaining the ingest data from at least the first set of the data sources, (ii) feeding the ingest data into the second inference model, and/or (iii) obtaining, as output from the second inference model, the inference.

[0141] Determining that at least the portion of the first set of the data sources is likely to become unavailable at the future point in time may include: (i) obtaining a quantification of the likelihood that at least the portion of the first set of the data sources may become unavailable at the future point in time (e.g., from the inference), (ii) comparing the quantification of the likelihood to a quantification threshold, and/or (iii) identifying that the quantification exceeds the threshold and thereby indicates that the likelihood exceeds an acceptable degree of risk indicated by the quantification threshold.

[0142] Making the identification may include other quantifications and/or indicators of risk compared to other thresholds and/or criteria without departing from embodiments disclosed herein.

[0143] At operation **304**, a first portion of the inference model that includes at least the first sub-network unit may be replaced, in response to the identification and at least temporarily, with a second portion of the inference model that includes at least a second sub-network unit to obtain an updated inference model prior to the future point in time. The second portion of the inference model may be intended to duplicate the first portion of the inference model within a threshold. Refer to FIG. **3**B for details regarding the second portion of the inference model.

[0144] Replacing the first portion of the inference model with the second portion of the inference model may include: (i) storing at least the first sub-network unit in the sub-network unit repository, (ii) adding at least the second sub-network unit to the inference model, (iii) modifying instructions for execution of the inference model so that the second sub-network unit begins requesting input data from the second set of the data sources and provides latent representations of the requested input data to another portion of the inference model, and/or (iv) other methods.

[0145] The second portion of the inference model may include additional sub-network units (other than the second sub-network unit). For example, the second sub-network unit may include a fourth sub-network unit intended to replace a third sub-network unit of the inference model, the third sub-network unit also being included in the first portion of the inference model.

[0146] Therefore, replacing the first portion of the inference model may also include replacing the third sub-network unit with the fourth sub-network unit. Replacing the third sub-network unit with the fourth sub-network unit may include: (i) storing at least the third sub-network unit in the sub-network unit repository, (ii) adding at least the fourth sub-network unit to the inference model, (iii) modifying instructions for execution of the inference model so that the fourth sub-network unit begins requesting ingest data from the second sub-network unit and provides at least partially processed data to another portion of the inference model, and/or (iv) other methods.

[0147] At operation **306**, the updated inference model may be executed to obtain an inference model result. Executing the updated inference model may include: (i) obtaining input data from any number of data sources, (ii) executing instructions (e.g., to generate latent representations of the input data) to generate an inference, and/or (iii) providing the inference to an inference consumer.

[0148] The method may end following operation **306**.

[0149] Turning to FIG. **3**B, a flow diagram illustrating a method of managing an inference model portion in accordance with an embodiment is shown. The method may be performed by a data processing system, inference model manager, data source, inference consumer, and/or another device.

[0150] At operation **310**, the second portion of the inference model may be obtained. Obtaining the second portion of the inference model may include: (i) obtaining the second sub-network unit from a sub-network unit repository, (ii) obtaining, using the second sub-network unit and second input data obtained from the second set of the data sources, a first reduced-size representation of the second input data, and/or (iii) comparing the first reduced-size representation of the second input data to an expected reduced-size representation of the first input data, the expected reduced-size representation of the first input data being generated by the first sub-network unit using the first input data obtained from the first set of the data sources. If the first reduced-size representation of the second input data matches the expected reduced-size representation of the first input data within the threshold, obtaining the second portion of the inference model may also include: (i) concluding that the second sub-network unit duplicates the operation of the first sub-network unit within the threshold, and/or (ii) adding the second sub-network unit to the second portion of the inference model.

[0151] Obtaining the second sub-network unit from the sub-network repository may include: (i) searching the sub-network unit repository using search criteria to obtain search results, the search criteria including characteristics of data sources and/or latent representation generation units similar to those associated with the first sub-network unit, and/or (ii) selecting the second sub-network unit from the search results, the search results including any number of sub-network units. Obtaining the second sub-network unit may

also include querying another entity responsible for searching the sub-network unit repository for potential replacement sub-network units.

[0152] Obtaining the first reduced-size representation of the second input data may include: (i) obtaining a test data set, the test data set including any amount of input data sourced from the second set of the data sources, (ii) feeding the test data set into a latent representation generation unit associated with the second sub-network unit, and/or (iii) reading the first reduced-size representation of the second input data from an output of the latent representation generation unit.

[0153] Comparing the first reduced-size representation of the second input data to the expected reduced-size representation of the first input data may include: (i) obtaining the expected reduced-size representation of the first input data, (ii) obtaining a difference between the first reduced-size representation of the second input data and the expected reduced-size representation of the first input data, (iii) obtaining the threshold, and/or (iv) comparing the difference to the threshold.

[0154] Obtaining the expected reduced-size representation of the first input data may include: (i) obtaining the first input data from the first set of the data sources, (ii) feeding the first input data from the first set of the data sources into the first sub-network unit, and/or (iii) treating an output of a latent representation generation unit associated with the first sub-network unit as the expected reduced-size representation of the first input data.

[0155] Concluding that the second sub-network unit duplicates the operation of the first sub-network unit within the threshold may include not considering additional sub-network units of the inference model for replacement and/or other actions.

[0156] Adding the second sub-network unit to the second portion of the inference model may include: (i) encapsulating the second sub-network unit in a data structure labeled as the second portion of the inference model, (ii) storing the second portion of the inference model in the sub-network unit repository, (iii) providing the second sub-network unit to another entity responsible for adding the second sub-network unit to the second portion of the inference model, and/or (iv) other methods.

[0157] If the first reduced-size representation of the second input data does not match the expected reduced-size representation of the first input data within the threshold, obtaining the second portion of the inference model may also include: (i) adding the second sub-network unit to the second portion of the inference model, (ii) obtaining a fourth sub-network unit from the sub-network unit repository, the fourth sub-network unit being trained to ingest an output of the second sub-network unit and the fourth sub-network unit being intended to duplicate operation of a third sub-network unit of the inference model within a second threshold, the third sub-network unit being part of the first portion of the inference model, and/or (iii) adding the fourth sub-network unit to the second portion of the inference model.

[0158] Adding the second sub-network unit to the second portion of the inference model may include methods similar to those described above.

[0159] As the second sub-network unit was not determined as an adequate substitute for the first sub-network unit (in this scenario), the latent representation of the second input data generated by the second sub-network unit may not be ingestible by the third sub-network unit to produce an output similar (e.g., within the second threshold) to an output based on the latent representation of the first input data previously generated by the first sub-network unit.

[0160] The fourth sub-network unit may be intended to source input data from the second sub-network unit and may be intended to duplicate operation of the third sub-network unit within the second threshold.

[0161] The fourth sub-network unit may be obtained by (i) searching the sub-network unit repository using search criteria to obtain search results, the search criteria including characteristics of data sources and/or latent representation generation units similar to those associated with the third sub-network unit, and/or (ii) selecting the fourth sub-network unit from the search results, the search results including any number of sub-network units. Obtaining the fourth sub-network unit may also include querying another entity responsible for searching the sub-network unit repository for potential replacement sub-network units.

[0162] Obtaining the fourth sub-network unit may also include determining whether the fourth sub-network unit duplicates the operation of the third sub-network unit within the second threshold. This may be performed via methods similar to those described with respect to determining whether the second sub-network unit duplicates the operation of the first sub-network unit within the threshold.

[0163] Adding the fourth sub-network unit to the second portion of the inference model may include methods similar to those described above with respect to adding the second sub-network unit to the second portion of the inference model.

[0164] At operation **312**, the second portion of the inference model may be stored in storage so that at least the second sub-network unit is available to replace the first sub-network unit when the second inference model predicts data source unavailability for the first sub-network unit. Storing the second portion of the inference model may include: (i) performing a storing process to add the second portion of the inference model to storage locally or off-site (e.g., the sub-network unit repository and/or any other storage architecture), (ii) providing the second portion of the inference model to another entity responsible for hosting and managing storage for portions of the inference model, and/or (iii) other methods.

[0165] The method may end following operation **312**.

[0166] Any of the components illustrated in FIGS. **1-2**G may be implemented with one or more computing devices. Turning to FIG. **4**, a block diagram illustrating an example of a data processing system (e.g., a computing device) in accordance with an embodiment is shown. For example, system **400** may represent any of data processing systems described above performing any of the processes or methods described above. System **400** can include many different components. These components can be implemented as integrated circuits (ICs), portions thereof, discrete electronic devices, or other modules adapted to a circuit board such as a motherboard or add-in card of the computer system, or as components otherwise incorporated within a chassis of the computer system. Note also that system **400** is intended to show a high-level view of many components of the computer system. However, it is to be understood that additional components may be present in certain implementations and furthermore, different arrangement of the components shown may occur in other implementations. System **400**

may represent a desktop, a laptop, a tablet, a server, a mobile phone, a media player, a personal digital assistant (PDA), a personal communicator, a gaming device, a network router or hub, a wireless access point (AP) or repeater, a set-top box, or a combination thereof. Further, while only a single machine or system is illustrated, the term "machine" or "system" shall also be taken to include any collection of machines or systems that individually or jointly execute a set (or multiple sets) of instructions to perform any one or more of the methodologies discussed herein.

[0167] In one embodiment, system **400** includes processor **401**, memory **403**, and devices **405-407** via a bus or an interconnect **410**. Processor **401** may represent a single processor or multiple processors with a single processor core or multiple processor cores included therein. Processor **401** may represent one or more general-purpose processors such as a microprocessor, a central processing unit (CPU), or the like. More particularly, processor **401** may be a complex instruction set computing (CISC) microprocessor, reduced instruction set computing (RISC) microprocessor, very long instruction word (VLIW) microprocessor, or processor implementing other instruction sets, or processors implementing a combination of instruction sets. Processor **401** may also be one or more special-purpose processors such as an application specific integrated circuit (ASIC), a cellular or baseband processor, a field programmable gate array (FPGA), a digital signal processor (DSP), a network processor, a graphics processor, a network processor, a communications processor, a cryptographic processor, a co-processor, an embedded processor, or any other type of logic capable of processing instructions.

[0168] Processor **401**, which may be a low power multi-core processor socket such as an ultra-low voltage processor, may act as a main processing unit and central hub for communication with the various components of the system. Such processor can be implemented as a system on chip (SoC). Processor **401** is configured to execute instructions for performing the operations discussed herein. System **400** may further include a graphics interface that communicates with optional graphics subsystem **404**, which may include a display controller, a graphics processor, and/or a display device.

[0169] Processor **401** may communicate with memory **403**, which in one embodiment can be implemented via multiple memory devices to provide for a given amount of system memory. Memory **403** may include one or more volatile storage (or memory) devices such as random-access memory (RAM), dynamic RAM (DRAM), synchronous DRAM (SDRAM), static RAM (SRAM), or other types of storage devices. Memory **403** may store information including sequences of instructions that are executed by processor **401**, or any other device. For example, executable code and/or data of a variety of operating systems, device drivers, firmware (e.g., input output basic system or BIOS), and/or applications can be loaded in memory **403** and executed by processor **401**. An operating system can be any kind of operating systems, such as, for example, Windows® operating system from Microsoft®, Mac OS®/iOS® from Apple, Android® from Google®, Linux®, Unix®, or other real-time or embedded operating systems such as VxWorks.

[0170] System **400** may further include IO devices such as devices (e.g., **405**, **406**, **407**, **408**) including network interface device(s) **405**, optional input device(s) **406**, and other optional IO device(s) **407**. Network interface device(s) **405** may include a wireless transceiver and/or a network interface card (NIC). The wireless transceiver may be a Wi-Fi transceiver, an infrared transceiver, a Bluetooth transceiver, a WiMax transceiver, a wireless cellular telephony transceiver, a satellite transceiver (e.g., a global positioning system (GPS) transceiver), or other radio frequency (RF) transceivers, or a combination thereof. The NIC may be an Ethernet card.

[0171] Input device(s) **406** may include a mouse, a touch pad, a touch sensitive screen (which may be integrated with a display device of optional graphics subsystem **404**), a pointer device such as a stylus, and/or a keyboard (e.g., physical keyboard or a virtual keyboard displayed as part of a touch sensitive screen). For example, input device(s) **406** may include a touch screen controller coupled to a touch screen. The touch screen and touch screen controller can, for example, detect contact and movement or break thereof using any of a plurality of touch sensitivity technologies, including but not limited to capacitive, resistive, infrared, and surface acoustic wave technologies, as well as other proximity sensor arrays or other elements for determining one or more points of contact with the touch screen.

[0172] IO devices **407** may include an audio device. An audio device may include a speaker and/or a microphone to facilitate voice-enabled functions, such as voice recognition, voice replication, digital recording, and/or telephony functions. Other IO devices **407** may further include universal serial bus (USB) port(s), parallel port(s), serial port(s), a printer, a network interface, a bus bridge (e.g., a PCI-PCI bridge), sensor(s) (e.g., a motion sensor such as an accelerometer, gyroscope, a magnetometer, a light sensor, compass, a proximity sensor, etc.), or a combination thereof. IO device(s) **407** may further include an imaging processing subsystem (e.g., a camera), which may include an optical sensor, such as a charged coupled device (CCD) or a complementary metal-oxide semiconductor (CMOS) optical sensor, utilized to facilitate camera functions, such as recording photographs and video clips. Certain sensors may be coupled to interconnect **410** via a sensor hub (not shown), while other devices such as a keyboard or thermal sensor may be controlled by an embedded controller (not shown), dependent upon the specific configuration or design of system **400**.

[0173] To provide for persistent storage of information such as data, applications, one or more operating systems and so forth, a mass storage (not shown) may also couple to processor **401**. In various embodiments, to enable a thinner and lighter system design as well as to improve system responsiveness, this mass storage may be implemented via a solid state device (SSD). However, in other embodiments, the mass storage may primarily be implemented using a hard disk drive (HDD) with a smaller amount of SSD storage to act as an SSD cache to enable non-volatile storage of context state and other such information during power down events so that a fast power up can occur on re-initiation of system activities. Also, a flash device may be coupled to processor **401**, e.g., via a serial peripheral interface (SPI). This flash device may provide for non-volatile storage of system software, including a basic input/output software (BIOS) as well as other firmware of the system.

[0174] Storage device **408** may include computer-readable storage medium **409** (also known as a machine-readable storage medium or a computer-readable medium) on which is stored one or more sets of instructions or software (e.g.,

processing module, unit, and/or processing module/unit/logic **428**) embodying any one or more of the methodologies or functions described herein. Processing module/unit/logic **428** may represent any of the components described above. Processing module/unit/logic **428** may also reside, completely or at least partially, within memory **403** and/or within processor **401** during execution thereof by system **400**, memory **403** and processor **401** also constituting machine-accessible storage media. Processing module/unit/logic **428** may further be transmitted or received over a network via network interface device(s) **405**.

[0175] Computer-readable storage medium **409** may also be used to store some software functionalities described above persistently. While computer-readable storage medium **409** is shown in an exemplary embodiment to be a single medium, the term "computer-readable storage medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, and/or associated caches and servers) that store the one or more sets of instructions. The terms "computer-readable storage medium" shall also be taken to include any medium that is capable of storing or encoding a set of instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies of embodiments disclosed herein. The term "computer-readable storage medium" shall accordingly be taken to include, but not be limited to, solid-state memories, and optical and magnetic media, or any other non-transitory machine-readable medium.

[0176] Processing module/unit/logic **428**, components and other features described herein can be implemented as discrete hardware components or integrated in the functionality of hardware components such as ASICS, FPGAs, DSPs, or similar devices. In addition, processing module/unit/logic **428** can be implemented as firmware or functional circuitry within hardware devices. Further, processing module/unit/logic **428** can be implemented in any combination hardware devices and software components.

[0177] Note that while system **400** is illustrated with various components of a data processing system, it is not intended to represent any particular architecture or manner of interconnecting the components; as such details are not germane to embodiments disclosed herein. It will also be appreciated that network computers, handheld computers, mobile phones, servers, and/or other data processing systems which have fewer components or perhaps more components may also be used with embodiments disclosed herein.

[0178] Some portions of the preceding detailed descriptions have been presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the ways used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of operations leading to a desired result. The operations are those requiring physical manipulations of physical quantities.

[0179] It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the above discussion, it is appreciated that throughout the description, discussions utilizing terms such as those set forth in the claims below, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

[0180] Embodiments disclosed herein also relate to an apparatus for performing the operations herein. Such a computer program is stored in a non-transitory computer readable medium. A non-transitory machine-readable medium includes any mechanism for storing information in a form readable by a machine (e.g., a computer). For example, a machine-readable (e.g., computer-readable) medium includes a machine (e.g., a computer) readable storage medium (e.g., read only memory ("ROM"), random access memory ("RAM"), magnetic disk storage media, optical storage media, flash memory devices).

[0181] The processes or methods depicted in the preceding figures may be performed by processing logic that comprises hardware (e.g. circuitry, dedicated logic, etc.), software (e.g., embodied on a non-transitory computer readable medium), or a combination of both. Although the processes or methods are described above in terms of some sequential operations, it should be appreciated that some of the operations described may be performed in a different order. Moreover, some operations may be performed in parallel rather than sequentially.

[0182] Embodiments disclosed herein are not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of embodiments disclosed herein.

[0183] In the foregoing specification, embodiments have been described with reference to specific exemplary embodiments thereof. It will be evident that various modifications may be made thereto without departing from the broader spirit and scope of the embodiments disclosed herein as set forth in the following claims. The specification and drawings are, accordingly, to be regarded in an illustrative sense rather than a restrictive sense.

What is claimed is:

1. A method of managing an inference model that comprises sub-network units, the method comprising:

making an identification, based on an inference generated by a second inference model trained to predict data source unavailability, that at least a portion of a first set of data sources is likely to become unavailable at a future point in time, the first set of the data sources providing first input data for a first sub-network unit of the sub-network units and the inference model being unable to generate an inference model result when at least a portion of the first set of the data sources is unavailable;

replacing, in response to the identification and at least temporarily, a first portion of the inference model that comprises at least the first sub-network unit with a second portion of the inference model that comprises at least a second sub-network unit to obtain an updated inference model prior to the future point in time, the second portion of the inference model being intended to

duplicate operation of the first portion of the inference model within a threshold; and

executing the updated inference model to obtain the inference model result.

2. The method of claim **1**, wherein making the identification comprises:

obtaining the inference using the second inference model and ingest data, the ingest data indicating a status of the first set of the data sources.

3. The method of claim **2**, wherein the inference indicates a likelihood that the at least the portion of the first set of the data sources will become unavailable at the future point in time.

4. The method of claim **1**, further comprising:

prior to making the identification:

obtaining the second portion of the inference model; and

storing the second portion of the inference model in storage so that at least the second sub-network unit is available to replace the first sub-network unit when the second inference model predicts data source unavailability for the first sub-network unit.

5. The method of claim **4**, wherein obtaining the second portion of the inference model comprises:

obtaining the second sub-network unit from a sub-network unit repository, the second sub-network unit sourcing input data from a second set of the data sources and the second set of the data sources being different from the first set of the data sources;

obtaining, using the second sub-network unit and second input data obtained from the second set of the data sources, a first reduced-size representation of the second input data;

comparing the first reduced-size representation of the second input data to an expected reduced-size representation of the first input data, the expected reduced-size representation of the first input data being generated by the first sub-network unit using the first input data obtained from the first set of the data sources; and

in an instance of the comparing in which the first reduced-size representation of the second input data matches the expected reduced-size representation of the first input data within the threshold:

concluding that the second sub-network unit duplicates the operation of the first sub-network unit within the threshold; and

adding the second sub-network unit to the second portion of the inference model.

6. The method of claim **5**, wherein obtaining the second portion of the inference model further comprises:

in a second instance of the comparing in which the first reduced-size representation of the second input data does not match the expected reduced-size representation of the first input data within the threshold:

adding the second sub-network unit to the second portion of the inference model; and

obtaining a fourth sub-network unit from the sub-network unit repository, the fourth sub-network unit being trained to ingest an output of the second sub-network unit and the fourth sub-network being intended to duplicate operation of a third sub-network unit of the inference model within a second threshold, the third sub-network unit being part of the first portion of the inference model; and

adding the fourth sub-network unit to the second portion of the inference model.

7. The method of claim **6**, wherein replacing the first portion of the inference model with the second portion of the inference model comprises:

replacing the first sub-network unit with the second sub-network unit; and

replacing the third sub-network unit with the fourth sub-network unit.

8. The method of claim **1**, wherein when a first data source of the first set of the data sources becomes unavailable, a second data source of the first set of the data sources has an increased likelihood of becoming unavailable.

9. The method of claim **1**, wherein the first sub-network unit comprises a first set of latent representation generation units and the second sub-network unit comprises a second set of latent representation generation units.

10. The method of claim **9**, wherein each latent representation generation unit of the first set of the latent representation generation units is trained to generate a reduced-size representation of the first input data obtained from the first set of the data sources.

11. The method of claim **1**, further comprising:

prior to making the identification:

obtaining the inference model.

12. The method of claim **11**, wherein obtaining the inference model comprises:

obtaining a plurality of data sources;

for each data source of the plurality of the data sources:

making a second determination, based on an intended use of the data source and a quantity of data supplied by the data source, regarding whether a latent representation of the data supplied by the data source is to be used;

in a first instance of the second determination in which the latent representation of the data supplied by the data source is to be used:

obtaining a latent representation generation unit; and

obtaining a third sub-network unit that comprises the latent representation generation unit.

13. The method of claim **12**, wherein obtaining the inference model further comprises:

in a second instance of the second determination in which the latent representation of the data supplied by the data source is not to be used:

treating the input data supplied by the data source as ingest for a fourth sub-network unit of the inference model, the input data supplied by the data source not being fed into a latent representation generation unit prior to being used by the fourth sub-network unit.

14. The method of claim **11**, wherein obtaining the inference model further comprises:

grouping data sources based on likelihoods of multiple of the data sources becoming unavailable at same points in time to obtain sets of data sources that comprise portions of the data sources that are likely to become unavailable at the same points in time, and the first set of data sources being one of the sets of the data sources;

training, for the first set of sources, and autoencoder; and

using a portion of the autoencoder as the first sub-network unit.

15. A non-transitory machine-readable medium having instructions stored therein, which when executed by a pro-

cessor, cause the processor to perform operations for managing an inference model that comprises sub-network units, the operations comprising:

making an identification, based on an inference generated by a second inference model trained to predict data source unavailability, that at least a portion of a first set of data sources is likely to become unavailable at a future point in time, the first set of the data sources providing first input data for a first sub-network unit of the sub-network units and the inference model being unable to generate an inference model result when at least a portion of the first set of the data sources is unavailable;

replacing, in response to the identification and at least temporarily, a first portion of the inference model that comprises at least the first sub-network unit with a second portion of the inference model that comprises at least a second sub-network unit to obtain an updated inference model prior to the future point in time, the second portion of the inference model being intended to duplicate operation of the first portion of the inference model within a threshold; and

executing the updated inference model to obtain the inference model result.

16. The non-transitory machine-readable medium of claim **15**, wherein making the identification comprises:

obtaining the inference using the second inference model and ingest data, the ingest data indicating a status of the first set of the data sources.

17. The non-transitory machine-readable medium of claim **16**, wherein the inference indicates a likelihood that the at least the portion of the first set of the data sources will become unavailable at the future point in time.

18. A data processing system, comprising:

a processor; and

a memory coupled to the processor to store instructions, which when executed by the processor, cause the processor to perform operations for managing an inference model that comprises sub-network units, the operations comprising:

making an identification, based on an inference generated by a second inference model trained to predict data source unavailability, that at least a portion of a first set of data sources is likely to become unavailable at a future point in time, the first set of the data sources providing first input data for a first sub-network unit of the sub-network units and the inference model being unable to generate an inference model result when at least a portion of the first set of the data sources is unavailable;

replacing, in response to the identification and at least temporarily, a first portion of the inference model that comprises at least the first sub-network unit with a second portion of the inference model that comprises at least a second sub-network unit to obtain an updated inference model prior to the future point in time, the second portion of the inference model being intended to duplicate operation of the first portion of the inference model within a threshold; and

executing the updated inference model to obtain the inference model result.

19. The data processing system of claim **18**, wherein making the identification comprises:

obtaining the inference using the second inference model and ingest data, the ingest data indicating a status of the first set of the data sources.

20. The data processing system of claim **19**, wherein the inference indicates a likelihood that the at least the portion of the first set of the data sources will become unavailable at the future point in time.

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