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(54) **COMPUTER-READABLE RECORDING MEDIUM HAVING STORED THEREIN MACHINE LEARNING PROGRAM, MACHINE LEARNING METHOD, AND INFORMATION PROCESSING APPARATUS**

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(57) **ABSTRACT**

A computer-readable recording medium has stored therein a machine learning program executable by one or more computers, the machine learning program including: an instruction for comparing a first plurality of relationship information pieces with a second plurality of relationship information pieces, the first plurality of relationship information pieces being determined in terms of an inputted configuration of a first Artificial Intelligence (AI) system and each including a plurality of attributes, the second plurality of relationship information pieces being determined in terms of a second AI system; an instruction for determining priorities of the first plurality of relationship information pieces, the priorities being based on a result of the comparing; and an instruction for outputting, as a checklist of the first AI system, one or more check items selected in accordance with the determined priorities from among a plurality of check items associated with the plurality of attributes.

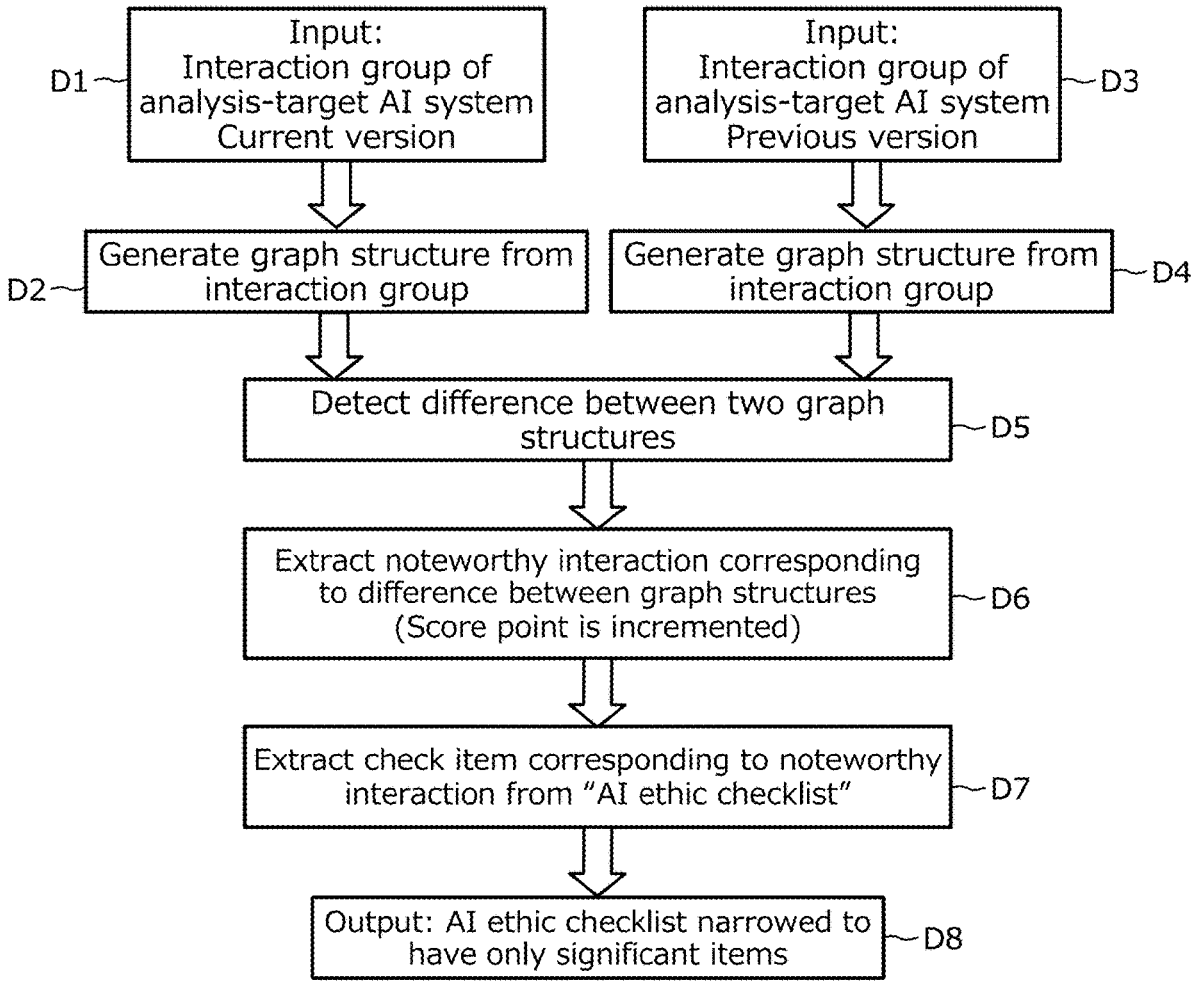


FIG.1
RELATED ART

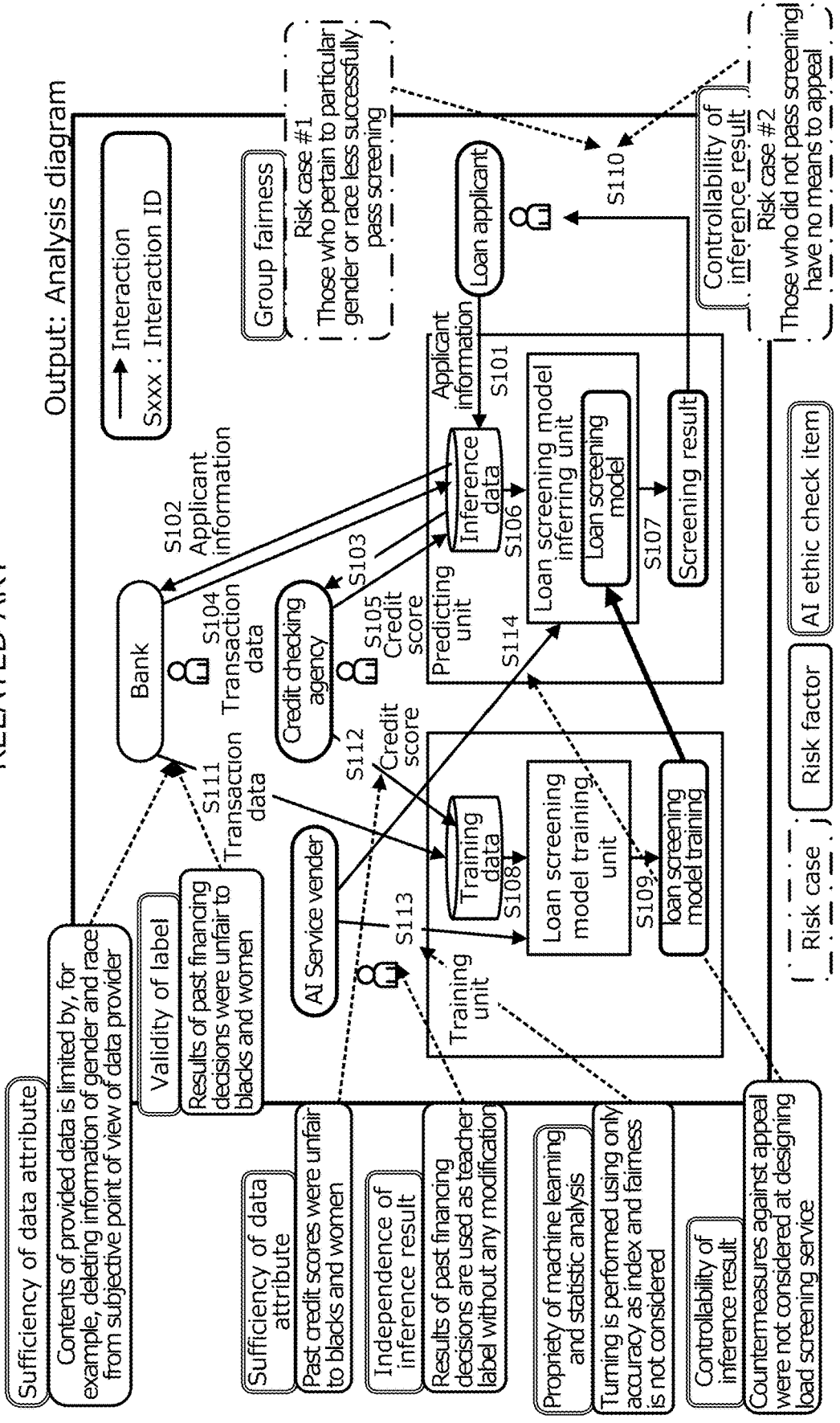


FIG.2
RELATED ART

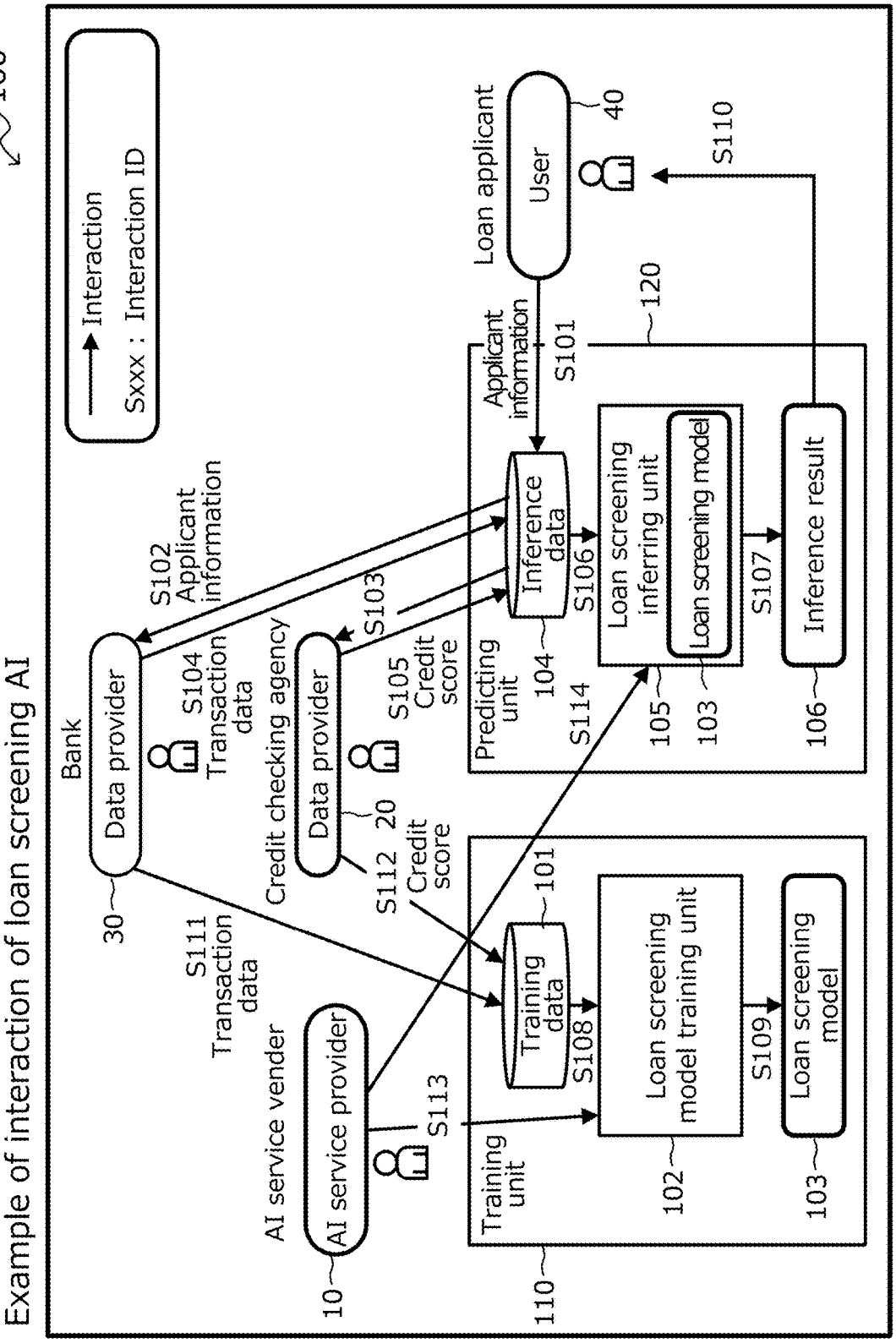


FIG.3
RELATED ART

AI ethic checklist (excerpt)

		Interaction type	
Check item	Outline	From	To
Maintain social credibility	Use of AI does not lose credibility from stakeholders	Inference result	User
Validity of evaluation of person or organization	Validity of deciding ability of person or organization on the basis of output of AI system is ensured	AI system user	User
Not interrupting decision making process of user	Output from AI system does not interrupt autonomous decision making process of user	Inference result	User
Sufficiency of examining validity of providing information indicative of use of AI	Validity of providing user of information indicative of use of AI technique in the system is well considered	AI system provider	User
Easiness of recognizing AI use	User of AI system can easily grasp that the system use AI technique	AI system provider	User
Controllability of inference result	If end user dissatisfies inference result, the user is allowed to appeal	User	AI system provider

FIG.4
RELATED ART

Output: Analysis sheet (excerpt)

	Stakeholder #1				Stakeholder #2				System component #1			System component #2			Data type						
ID	Type	Name	Role description	Start point (0) · End point (1)	Type	Name	Role description	Start point (0) · End point (1)	Type	Name	Start point (0) · End point (1)	Type	Name	Start point (0) · End point (1)	Type	Name	Start point (0) · End point (1)	Risk (Case)	Risk (Factor)	AI ethic check item (=AI ethic characteristic)	Policy
S110	User	Loan applicant	Receive screening result	1	–	–	–	–	–	–	–	–	–	–	Inference result	Screening result	0	Women and blacks and less successfully pass screening		Group Fairness	financing among groups of genders or races fall within tolerance range
S111	Data Provider	Bank	Provide transaction data	0	–	–	–	–	–	–	–	–	–	–	Training data	Transaction data	1	–	Results of past financing decisions were unfair to blacks and women	Group Fairness	Rationalize teacher label (result of financing decision), considering fairness
S111	Data Provider	Bank	Provide transaction data	0	–	–	–	–	–	–	–	–	–	–	Training data	Transaction data	1	–	Original data includes data of those who passed screening but does not include data of those who did not pass screening	Equality of training data set	AI service development company and bank deeply investigate risk assumed to be caused by content of original data in advance and determine whether service development is valid
S111	Data Provider	Bank	Provide transaction data	0	–	–	–	–	–	–	–	–	–	–	Training data	Transaction data	1	–	Data does not include attribute of gender and race to verify fairness	Sufficiency of data attribute	AI service development company and bank reach agreement in the point of including of attribute such as gender and race in data and purpose of use of the data
S111	Data Provider	Bank	Provide transaction data	0	–	–	–	–	–	–	–	–	–	–	Training data	Transaction data	1	–	Content of provided data is limited by, for example, deleting information of gender and race from subjective point of view of data provider	Fairness of procedure	AI service development company and bank collectively clarify data requirement and perform test each time data is provided
S112	Data provider	Credit checking agency	Provide score data	0	–	–	–	–	–	–	–	–	–	–	Training data	Score data	1	–	Past credit scores were unfair to blacks and women	Independence from protected attribute	Fairness of past credit score is verified and if unfairness is found, the unfairness is corrected by AI algorithm and pre- and post-processing

FIG.5
RELATED ART

A1

Interaction ID	Stakeholder #1				Stakeholder #2				System component #1				System component #2				Data type			
	Type	Name	Role description	Start point (0) · End point (1)	Type	Name	Role description	Start point (0) · End point (1)	Type	Name	Start point (0) · End point (1)	Type	Name	Start point (0) · End point (1)	Type	Name	Start point (0) · End point (1)
S101	User	Loan applicant	Provide applicant information	0	—	—	—	-	—	—	-	—	—	-	Inference data	Applicant Information / Transaction data / Credit score	1
S102	Data Provider	Bank	Receive applicant information	1	—	—	—	-	—	—	-	—	—	-	Inference data	Applicant Information / Transaction data / Credit score	0
S103	Data provider	Credit checking agency	Receive applicant information	1	—	—	—	-	—	—	-	—	—	-	Inference data	Applicant Information / Transaction data / Credit score	0
S104	Data Provider	Bank	Provide transaction data of applicant	0	—	—	—	-	—	—	-	—	—	-	Inference data	Applicant Information / Transaction data / Credit score	1
S105	Data provider	Credit checking agency	Provide credit score of applicant	0	—	—	—	-	—	—	-	—	—	-	Inference data	Applicant Information / Transaction data / Credit score	1
S106	—	—	—	-	—	—	—	-	AI model	Loan screening inferring unit	1	—	—	-	Inference data	Applicant Information / Transaction data / Credit score	0
S107	—	—	—	-	—	—	—	-	AI model	Loan screening inferring unit	0	—	—	-	Inference result	Screening result	1

A11

Role

A21

Role: user

A2

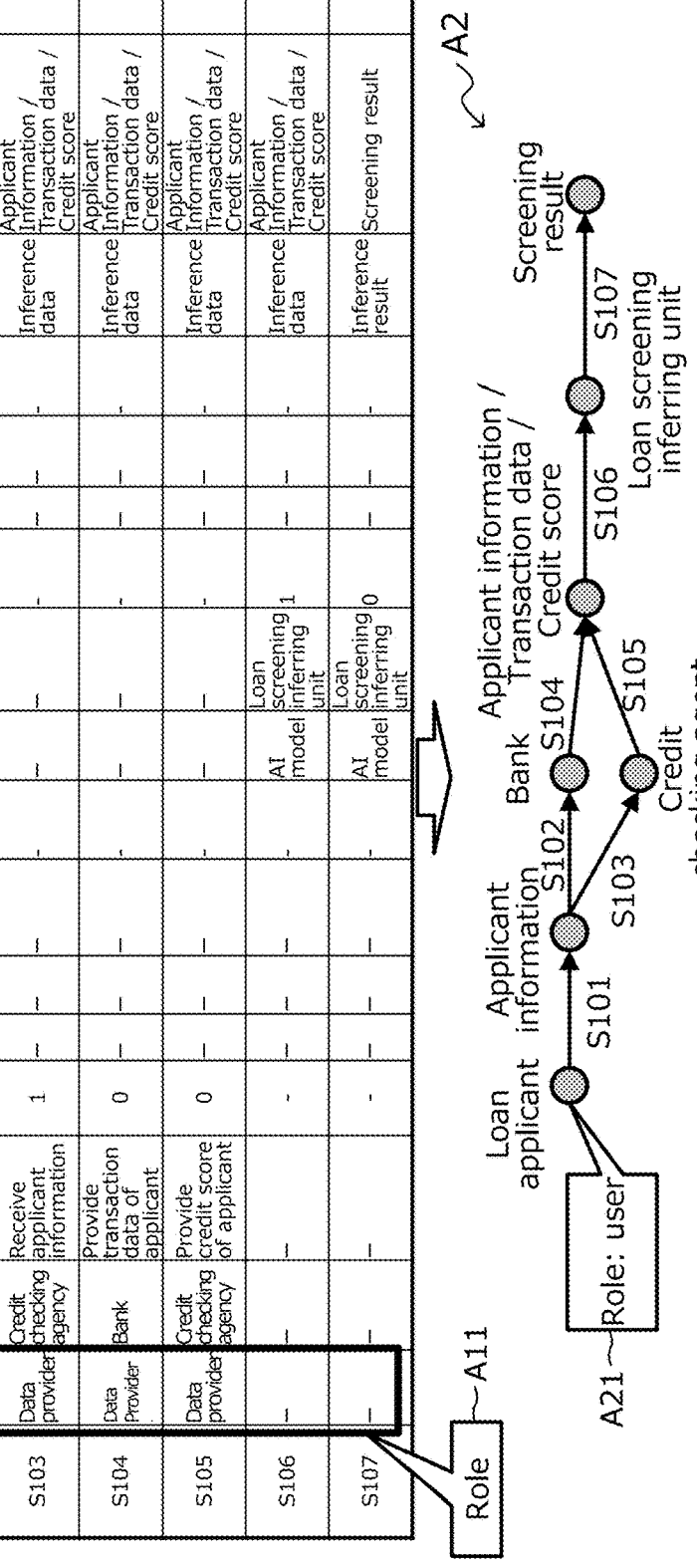


FIG.6
RELATED ART

Check item	Interaction (from)	Interaction (to)
Maintain social credibility	Inference result	User
Validity of evaluation of person or organization	AI system user	User
Not interrupting decision making process of user	Inference result	User
Controllability of inference result	Inference result	User
Propriety of target accuracy	AI system provider	Inference result
Validity of quality of training data	Data provider (training data)	Training data
Validity of condition for generating training data	Data provider (training data)	Training data
Validity of inclusion of personal information in data	Data provider (training data)	Data provider (training data)
Propriety of manner of obtaining data	Data provider (training data)	Data provider (training data)
Propriety of use of method for strengthening privacy protection	Data provider (training data)	Training data
...	...	...

B1

B2

Check item	Interaction (from)	Interaction (to)
Maintain social credibility	Inference result	User
Validity of evaluation of person or organization	AI system user	User
Controllability of inference result	Inference result	User
Validity of quality of training data	Data provider (training data)	Training data

FIG.7
RELATED ART

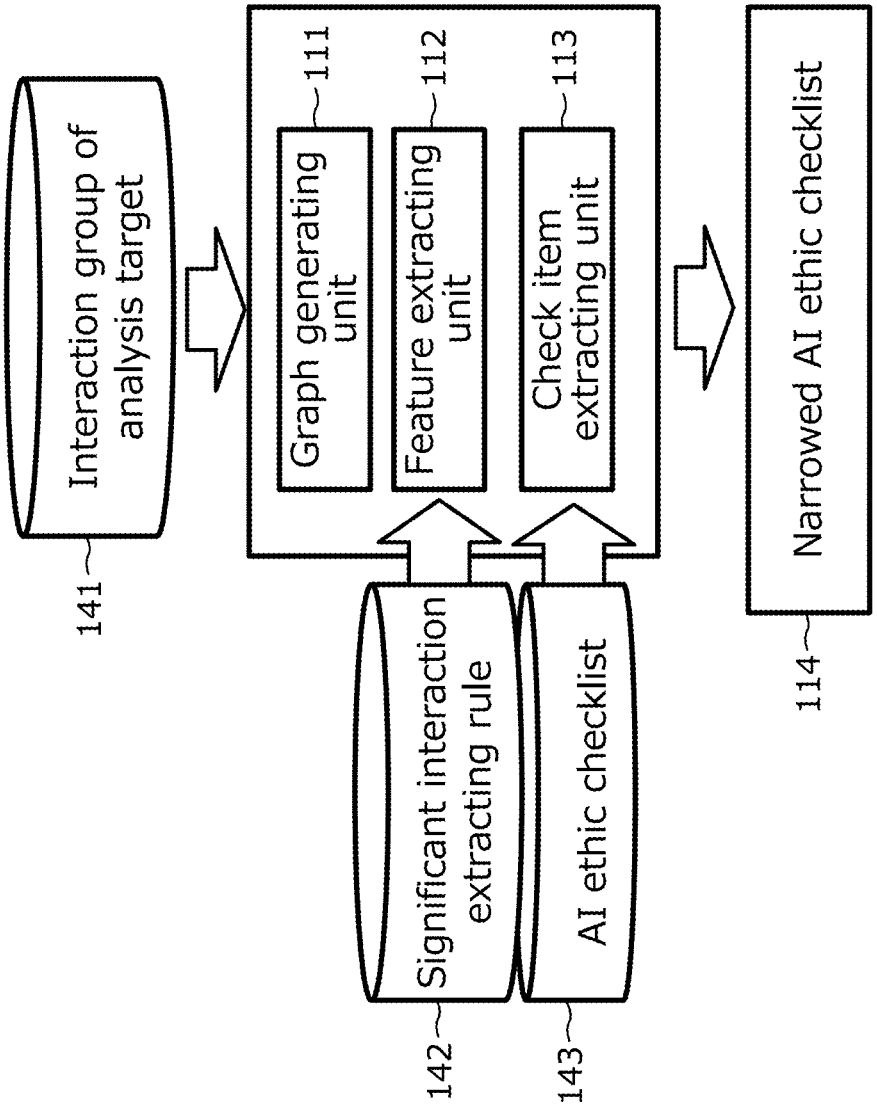


FIG.8
RELATED ART

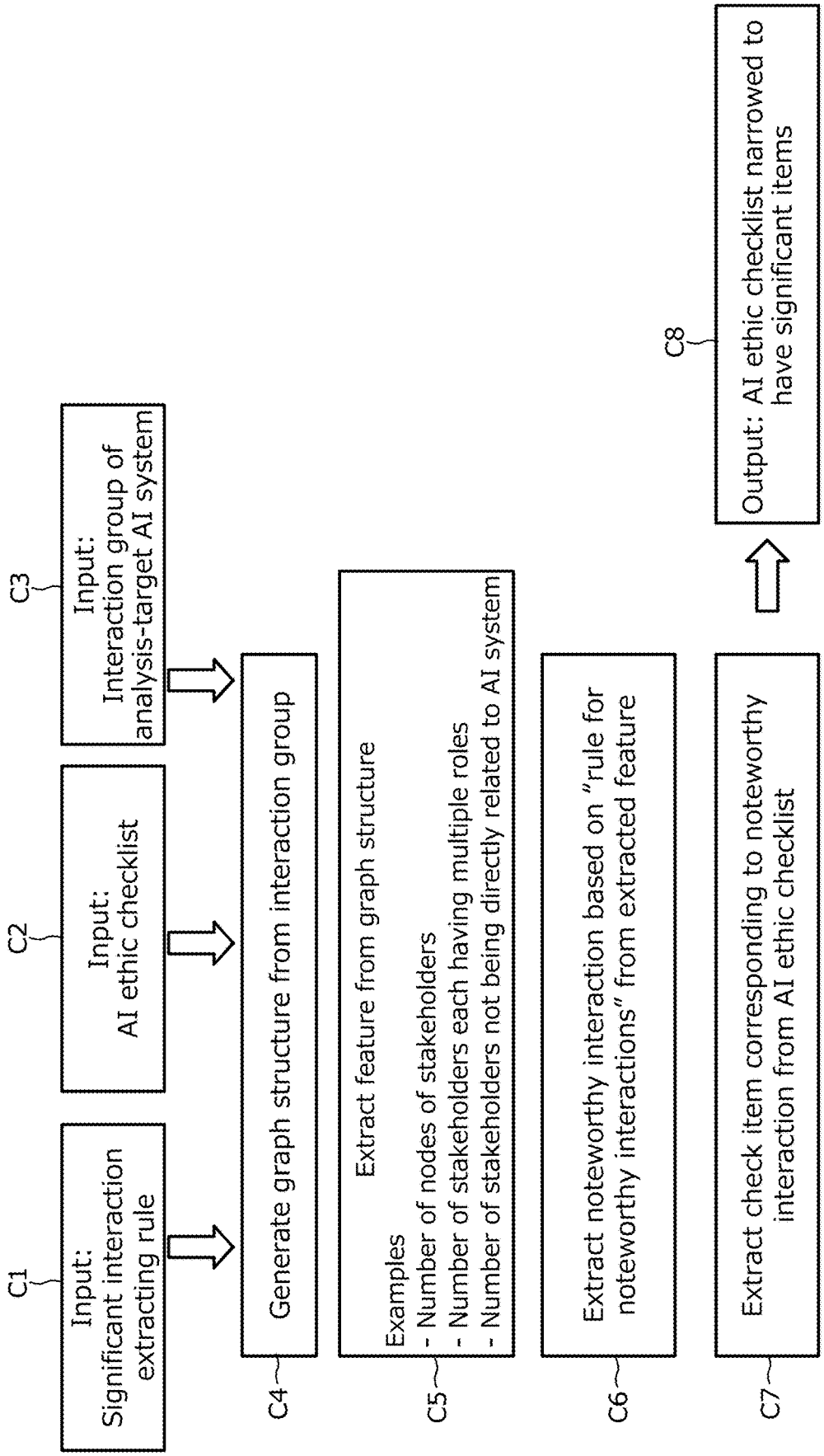


FIG.9

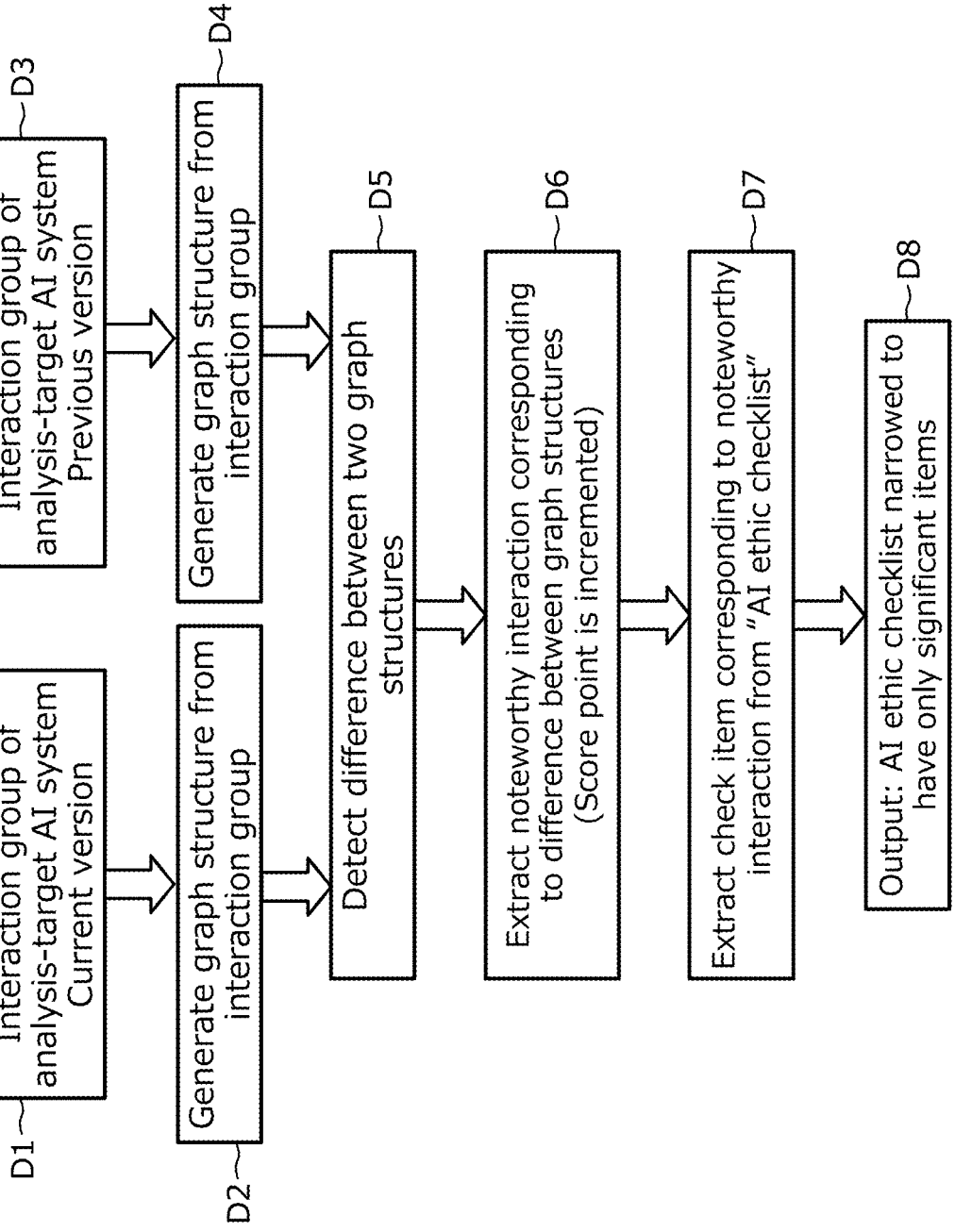

Input: Interaction group of analysis-target AI system Current version
D1
Input: Interaction group of analysis-target AI system Previous version
D3
Generate graph structure from interaction group
D2
Generate graph structure from interaction group
D4
Detect difference between two graph structures
D5
Extract noteworthy interaction corresponding to difference between graph structures (Score point is incremented)
D6
Extract check item corresponding to noteworthy interaction from "AI ethic checklist"
D7
Output: AI ethic checklist narrowed to have only significant items
D8

FIG.10

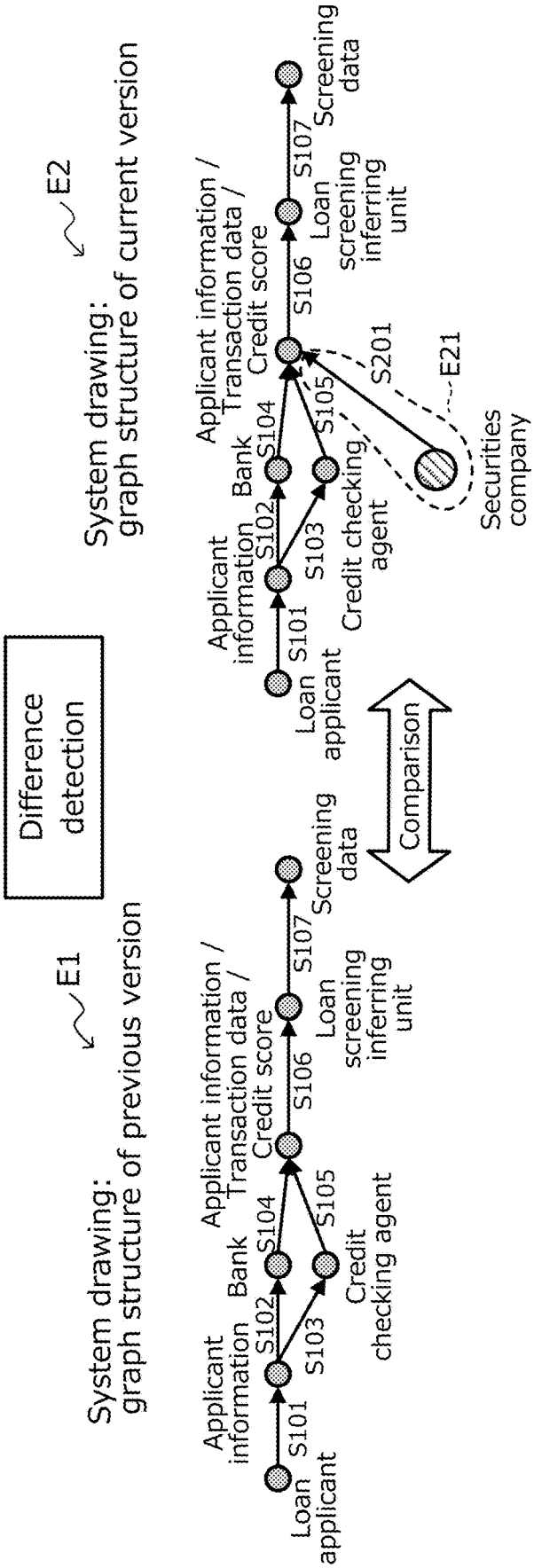

System drawing:
graph structure of previous version
E1
Difference detection
System drawing:
graph structure of current version
E2
Loan applicant
S101
Applicant information
S102
Bank
S103
Credit checking agent
S104
S105
Applicant information / Transaction data / Credit score
S106
Loan screening inferring unit
S107
Screening data
Comparison
S201
E21
Securities company

FIG.11

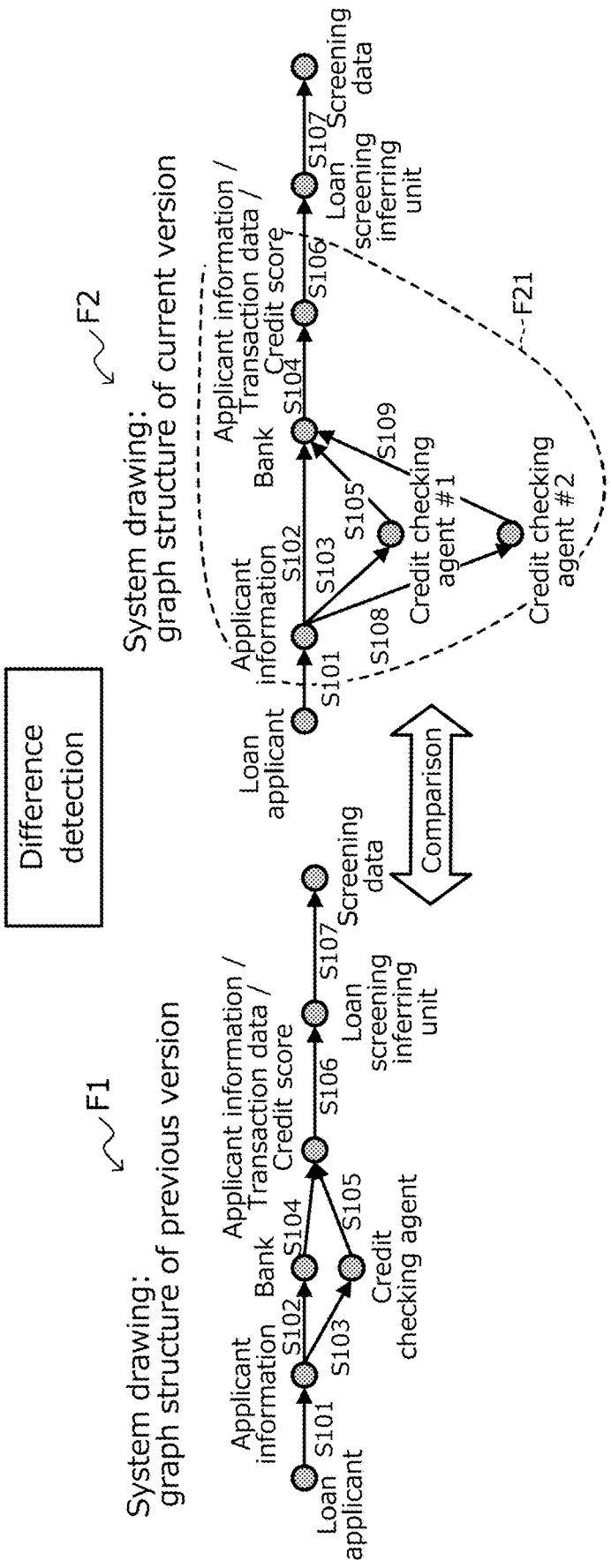

System drawing: graph structure of previous version
F1
Loan applicant
S101
Applicant information
S102
Bank
S103
Credit checking agent
S104
Applicant information / Transaction data / Credit score
S105
S106
Loan screening inferring unit
S107
Screening data
Difference detection
System drawing: graph structure of current version
F2
Loan applicant
S101
Applicant information
S102
Bank
S103
Credit checking agent #1
S104
Applicant information / Transaction data / Credit score
S105
S106
Loan screening inferring unit
S107
Screening data
S108
Credit checking agent #2
S109
F21
Comparison

FIG.12

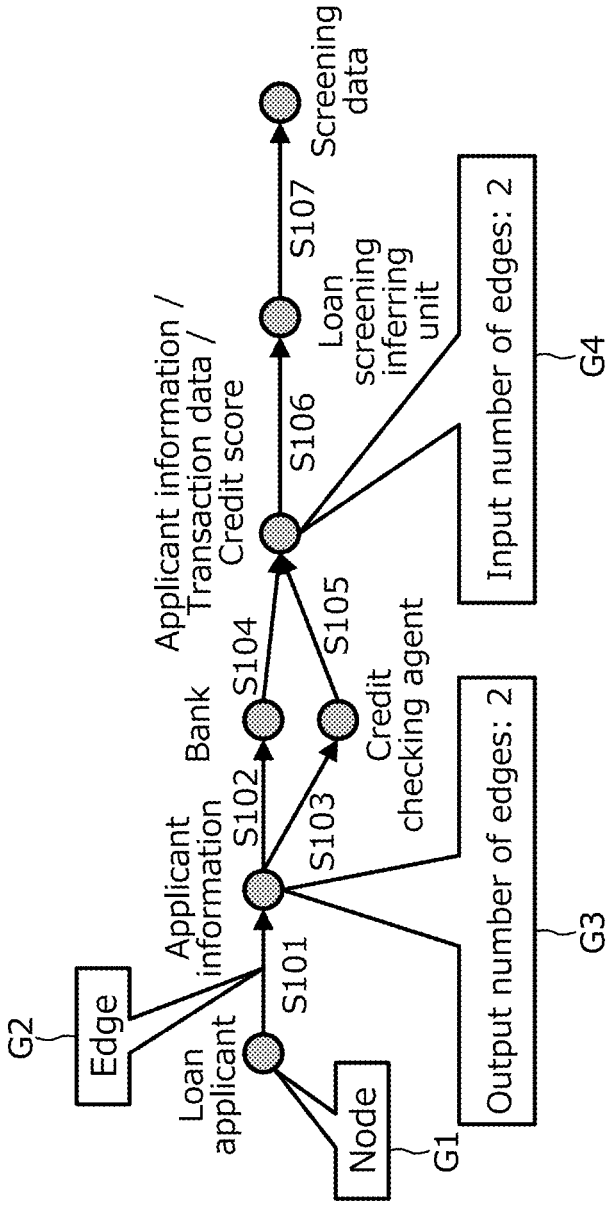

Loan applicant
Applicant information
Bank
Credit checking agent
Applicant information / Transaction data / Credit score
Loan screening inferring unit
Screening data
S101
S102
S103
S104
S105
S106
S107
Node
Edge
Output number of edges: 2
Input number of edges: 2
G1
G2
G3
G4

FIG.13

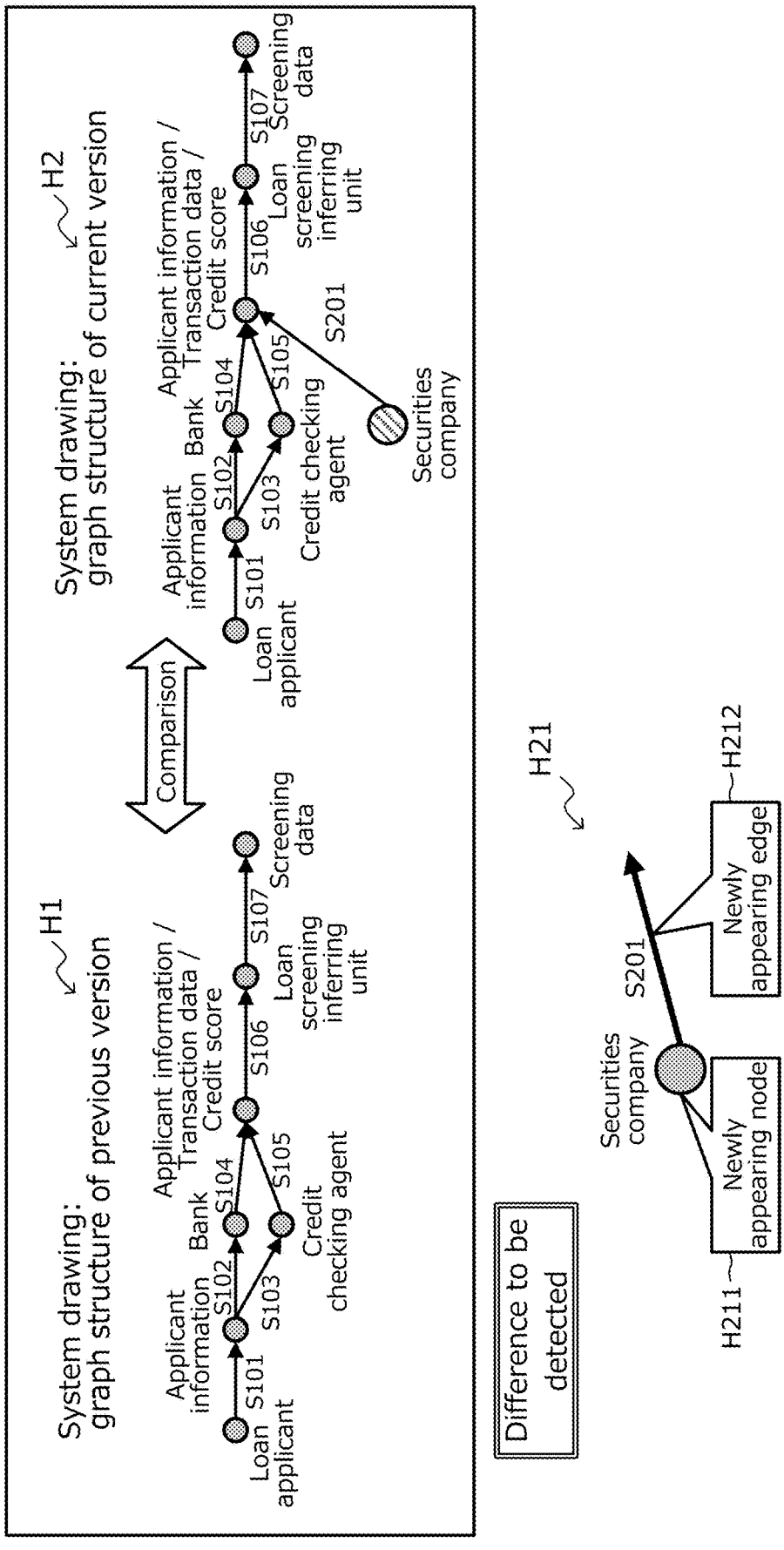

System drawing: graph structure of previous version
H1
Loan applicant
S101
Applicant information
S102
Bank
S103
Credit checking agent
S104
S105
Applicant information / Transaction data / Credit score
S106
Loan screening inferring unit
S107
Screening data
Comparison
System drawing: graph structure of current version
H2
Loan applicant
S101
Applicant information
S102
Bank
S103
Credit checking agent
S104
S105
Applicant information / Transaction data / Credit score
S106
Loan screening inferring unit
S107
Screening data
S201
Securities company
Difference to be detected
H21
Securities company
S201
Newly appearing node
H211
Newly appearing edge
H212

FIG.14

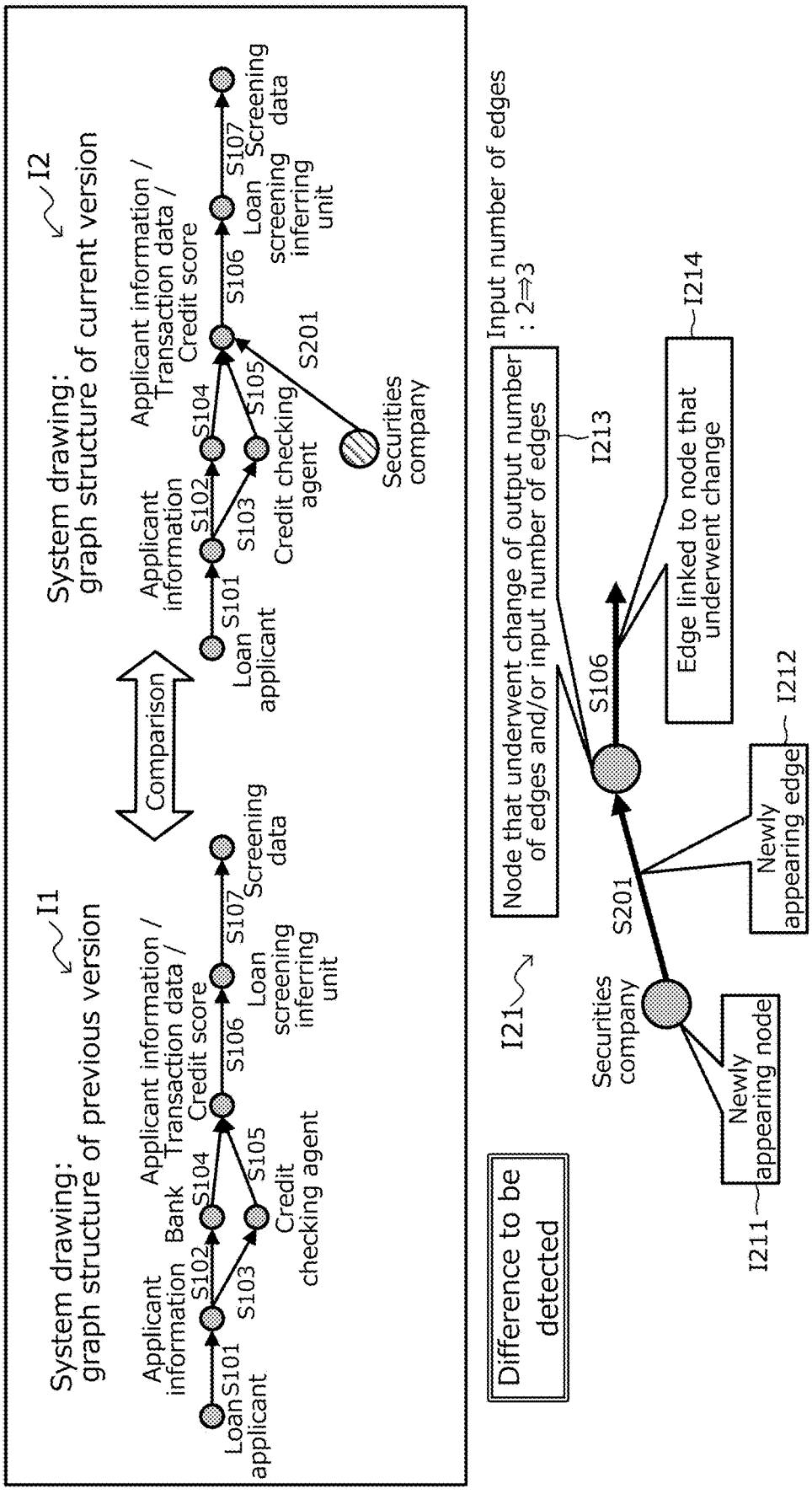

System drawing: graph structure of previous version
I1
Loan applicant
S101
Applicant information
S102
Bank
S103
S104
Credit checking agent
S105
Applicant information / Transaction data / Credit score
S106
Loan screening inferring unit
S107
Screening data
Comparison
System drawing: graph structure of current version
I2
Loan applicant
S101
Applicant information
S102
S103
Credit checking agent
S104
S105
Applicant information / Transaction data / Credit score
S106
Loan screening inferring unit
S107
Screening data
S201
Securities company
Difference to be detected
I21
Securities company
Newly appearing node
I211
S201
Newly appearing edge
I212
S106
Node that underwent change of output number of edges and/or input number of edges
I213
Input number of edges : 2⇒3
Edge linked to node that underwent change
I214

FIG.15

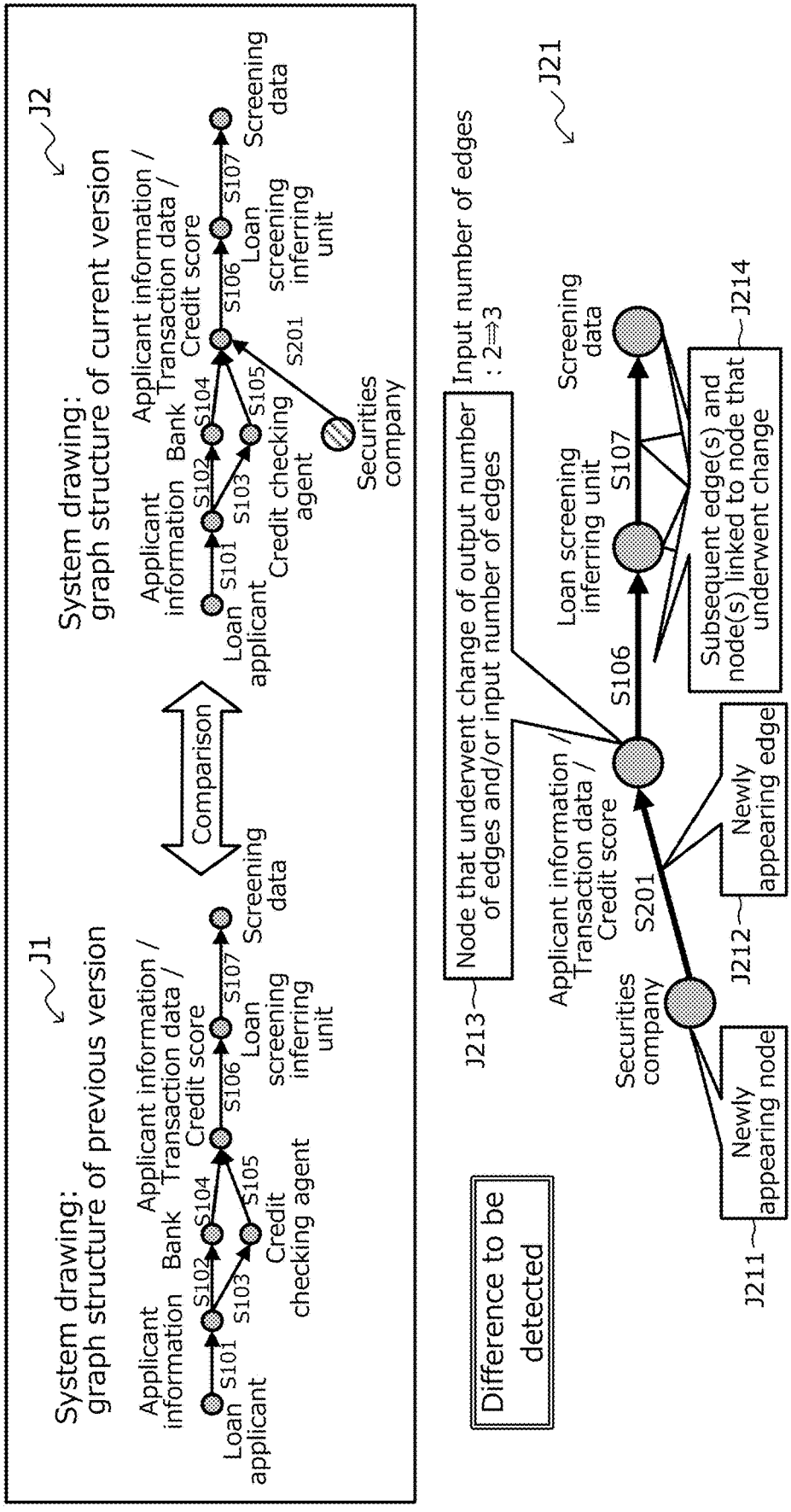

J1
System drawing:
graph structure of previous version
Loan applicant
Applicant information
S101
S102
Bank
S103
Credit checking agent
S104
Applicant information / Transaction data / Credit score
S105
S106
Loan screening inferring unit
S107
Screening data
Comparison
J2
System drawing:
graph structure of current version
Loan applicant
Applicant information
S101
S102
Bank
S103
Credit checking agent
S104
Applicant information / Transaction data / Credit score
S105
S106
Loan screening inferring unit
S107
Screening data
S201
Securities company
Difference to be detected
J213
Node that underwent change of output number of edges and/or input number of edges
Input number of edges : 2⇒3
J21
Securities company
Applicant information / Transaction data / Credit score
S201
S106
Loan screening inferring unit
S107
Screening data
J211
Newly appearing node
J212
Newly appearing edge
Subsequent edge(s) and node(s) linked to node that underwent change
J214

FIG.16

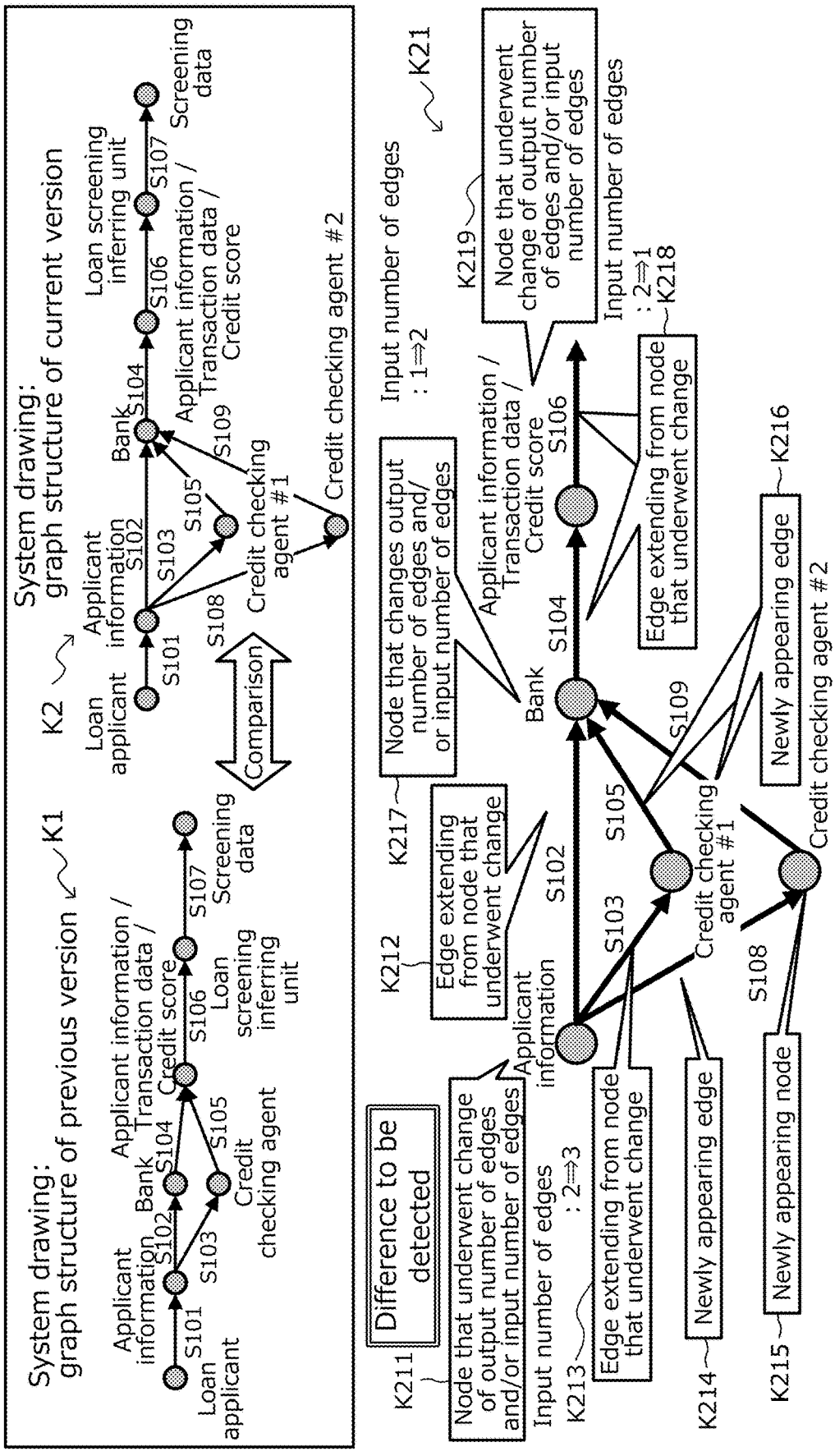

System drawing: graph structure of previous version
K1
Loan applicant
S101
Applicant information
S102
Bank
S104
Applicant information / Transaction data / Credit score
S106
S103
Credit checking agent
S105
Loan screening inferring unit
S107
Screening data
System drawing: graph structure of current version
K2
Loan applicant
S101
Applicant information
S102
S103
Bank
S104
S105
Credit checking agent #1
S106
Loan screening inferring unit
S107
Screening data
Applicant information / Transaction data / Credit score
S109
Credit checking agent #2
S108
Comparison
Difference to be detected
K211
Node that underwent change of output number of edges and/or input number of edges
Input number of edges : 2⇒3
K213
Edge extending from node that underwent change
K212
Edge extending from node that underwent change
K217
Node that changes output number of edges and/or input number of edges
Input number of edges : 1⇒2
K21
K214
Newly appearing edge
K215
Newly appearing node
K216
Newly appearing edge
K219
Node that underwent change of output number of edges and/or input number of edges
Input number of edges : 2⇒1
K218

FIG.17

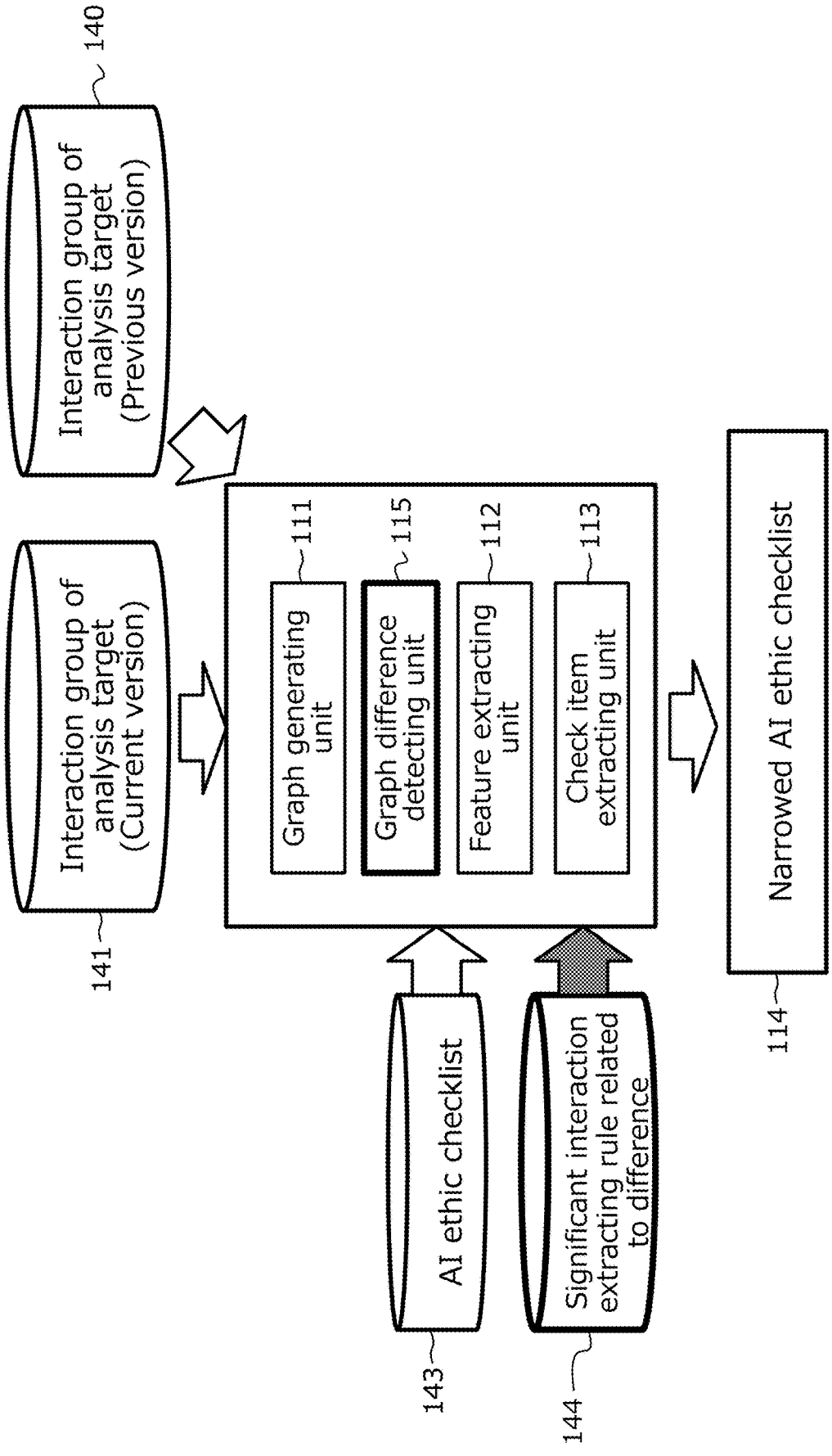
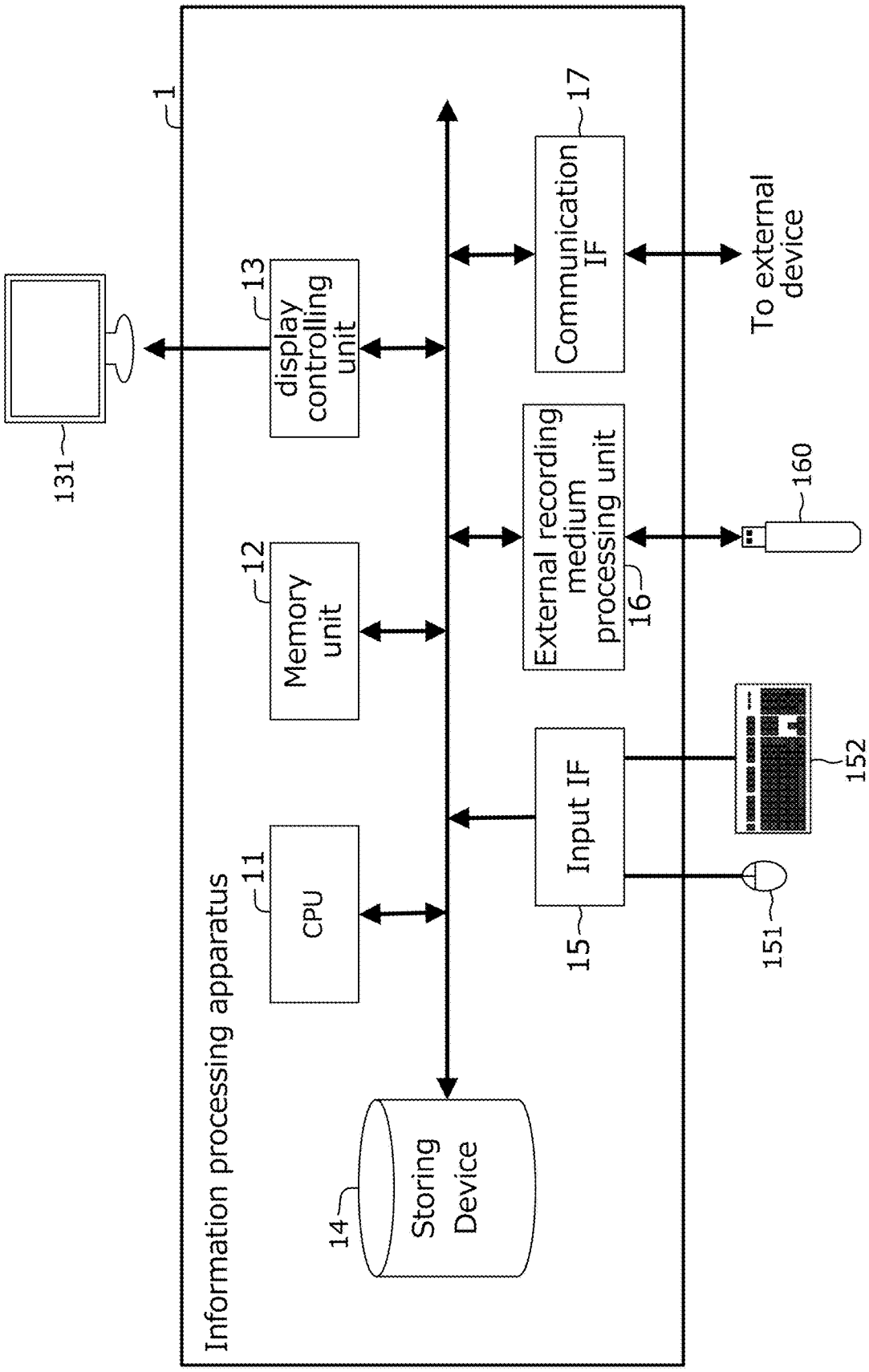

140
Interaction group of analysis target (Previous version)
Interaction group of analysis target (Current version)
141
111
Graph generating unit
115
Graph difference detecting unit
112
Feature extracting unit
113
Check item extracting unit
Narrowed AI ethic checklist
114
AI ethic checklist
143
Significant interaction extracting rule related to difference
144

FIG.18


1
Information processing apparatus
CPU
11
Memory unit
12
display controlling unit
13
131
Storing Device
14
Input IF
15
151
152
External recording medium processing unit
16
160
Communication IF
17
To external device

COMPUTER-READABLE RECORDING MEDIUM HAVING STORED THEREIN MACHINE LEARNING PROGRAM, MACHINE LEARNING METHOD, AND INFORMATION PROCESSING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based upon and claims the benefit of priority of the prior Japanese Patent application No. 2022-161752, filed on Oct. 6, 2022, the entire contents of which are incorporated herein by reference.

FIELD

[0002] The embodiment discussed herein relates to a computer-readable recording medium having stored therein a machine learning program, a machine learning method, and an information processing apparatus.

BACKGROUND

[0003] An Artificial Intelligence (AI) system sometimes involves an ethical risk assessment.

[0004] The use of AI systems in various industries and tasks may cause ethical problems. If such a problem arises, not only the company and the organization that provided the AI systems but also the users of the AI system and the community ahead thereof would be largely affected.

[0005] For the above, in the social implementation of AI, efforts are being made to recognize and deal with ethical risks.

[0006] However, if an AI system involves multiple stakeholders and the social circumference around the stakeholders changes, it may be not easy to detect what ethical problems are caused by use of the AI system.

[0007] As a solution to the above, a checklist indicated by the principles and the guidelines related to AI ethics is sometimes applied to an AI system and the stakeholders thereof and analyzed.

[0008] Examples of the principles and the guidelines related to AI ethics are "Ethics Guidelines for Trustworthy AI" of "European High-Level Expert Group on AI (AI HLEG)", "AI Use Guidelines of the Ministry of Internal Affairs and Communications", ""Human-Centered AI social principles" of the Integrated Innovation Strategy Promotion Council", and OECD "Recommendation of the Council on Artificial Intelligence".

[0009] In addition, a "Risk Chain Model (RC Model) has been proposed as a model contributing to risk control examination on the own AI service by an AI service provider, considering the presence of various manners of providing AI services.

[0010] In a risk chain model, the risk components are organized and structured according to the following components (1) to (3).

[0011] (1) Technical components of an AI system;

[0012] (2) Components pertaining to the Code of Conduct of a service provider (including communication with users); and

[0013] (3) Components pertaining to understanding, behavior, and usage environment of users.

[0014] In the risk chain model, risk scenarios are identified, components to be risk factors are specified, a risk chain is visualized, and a risk control is examined. In the visualization of a risk chain and the examination of risk control, an AI service provider visualizes the relationship (risk chain) of the components related to the risk scenarios, and thereby enables the examination of the stepwise risk reduction.

[0015] For example, related arts are disclosed in International Publication Pamphlet NO. WO2020/240981, International Publication Pamphlet NO. WO2021/084810, US Patent Application Publication No. 2020/0372374, US Patent Application Publication No. 2021/0271885, and Takashi MATSUMOTO, Arisa EMA, "RCModel, a Risk Chain Model for Risk Reduction in AI Services", Jul. 6, 2020, Internet <URL: ifi.u-tokyo.ac.jp/en/news/4815/>.

SUMMARY

[0016] According to an aspect of the embodiment, a computer-readable recording medium has stored therein a machine learning program executable by one or more computers, the machine learning program including: an instruction for comparing a first plurality of relationship information pieces with a second plurality of relationship information pieces, the first plurality of relationship information pieces being determined in terms of an inputted configuration of a first Artificial Intelligence (AI) system and each including a plurality of attributes, the second plurality of relationship information pieces being determined in terms of a second AI system; an instruction for determining priorities of the first plurality of relationship information pieces, the priorities being based on a result of the comparing; and an instruction for outputting, as a checklist of the first AI system, one or more check items selected in accordance with the determined priorities from among a plurality of check items associated with the plurality of attributes.

[0017] The object and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the claims.

[0018] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF DRAWINGS

[0019] FIG. **1** is a block diagram illustrating an analysis diagram serving an output data according to a related example;

[0020] FIG. **2** is a block diagram illustrating an analysis target system diagram of the related example;

[0021] FIG. **3** is a table illustrating an excerpt part of an AI ethic checklist of the related example;

[0022] FIG. **4** is a table illustrating an excerpt part of an analysis sheet of the related example;

[0023] FIG. **5** is a block diagram illustrating an example of generating a graph structure from the analysis sheet of the related example;

[0024] FIG. **6** is a block diagram illustrating an example of extracting an AI ethic check item of the related example;

[0025] FIG. **7** is a block diagram schematically illustrating an example of a software configuration of an information processing apparatus of the related example;

[0026] FIG. **8** is a flow diagram illustrating a process of generating an AI ethic checklist of the related example;

[0027] FIG. **9** is a flow diagram illustrating a process of generating an AI ethic checklist of an embodiment;

[0028] FIG. **10** is a diagram illustrating a first example of difference detecting process and a significance addition process of the embodiment;

[0029] FIG. **11** is a diagram illustrating a second example of the difference detecting process and the significance addition process of the embodiment;

[0030] FIG. **12** is a diagram illustrating a graph structure;

[0031] FIG. **13** is a diagram illustrating a first specific example of the difference detecting process of the embodiment;

[0032] FIG. **14** is a diagram illustrating a second specific example of the difference detecting process of the embodiment;

[0033] FIG. **15** is a diagram illustrating a third specific example of the difference detecting process of the embodiment;

[0034] FIG. **16** is a diagram illustrating a fourth specific example of the difference detecting process of the embodiment;

[0035] FIG. **17** is a diagram schematically illustrating an example of a software configuration of an information processing apparatus of the embodiment; and

[0036] FIG. **18** is a diagram schematically illustrating an example of a hardware configuration of the information processing apparatus of the embodiment.

DESCRIPTION OF EMBODIMENT (S)

[0037] However, a checklist indicated by the principles and the guidelines does not specifically indicate what part of an AI system needs to be, and AI system developers and providers have to embody this need. This embodying work has a high degree of difficulty and needs large load to accomplish the process.

[0038] Risk components of a risk chain mode is organized, but AI system providers and developers need to adapt these components into components that the AI system and each individual stakeholder need to implement.

[0039] Furthermore, if the configuration of an AI system is updated, the ethical risks that may arise in the course of the operation of the AI system need to be reexamined, so that there is a possibility that the ethical risks are not recognized efficiently.

(A) Related Example

[0040] The related example generates a checklist of ethic features that an AI system **100** (to be described below with reference to FIG. **2**) needs to possess in association with the relationships between the AI system **100** and stakeholders, and analyzes ethical risks of the AI system **100**, using the AI ethic checklist. This eliminates the need for an AI service provider **10** (to be described below with reference to FIG. **2**) and developers to adapt these components into components that the AI system **100** and each individual stakeholder need to implement.

[0041] In addition, the relationship between the components of the AI system **100** and the stakeholders are made into a graph structure, and an AI ethic checklist prioritized for AI ethic check items based on the features of the graph structure is automatically generated. This makes it possible to more efficient generate the AI ethic checklist by preferentially analyzing the significant AI ethic check items.

[0042] FIG. **1** is a block diagram illustrating an analysis diagram serving an output data according to the related example.

[0043] The ethical risks surrounding AI are extracted and visualized in association with the relationships (interactions) between AI system components and stakeholders.

[0044] In the analysis diagram illustrated in FIG. **1**, if the corresponding AI ethic check items (to be described in FIG. **3**) to the respective interaction IDs (S**101** to S**114**) displayed in the system diagram including a training unit **110** and a predicting unit **120** (to be described below with reference to FIG. **2**) are present, the interactions and the AI ethic check items are displayed in association with each other. In addition, in each AI ethic check item and either one of a risk event (see the dashed-dotted line frame in FIG. **1**) and a risk factor (see the dotted line frame in FIG. **1**) are displayed in association with each other.

[0045] In Example of FIG. **1**, S**110** is displayed in association with a risk event "Those who pertain to particular gender or race less successfully pass screening" of an AI ethic check Item "group fairness". In addition, S**100** is displayed in association with a risk event "Those who did not pass screening have no means to appeal" of an AI ethic check Item "controllability of inference result". S**111** is displayed in association with AI ethic check items "sufficiency of data attribute" and "validity of label". S**112** is displayed in association with an AI ethic check Item "sufficiency of data attribute", and S**113** is displayed in association with AI ethic check Items "independence of inference result" and "propriety of machine learning and statistic analysis". S**114** is displayed in association with an AI ethic check Item "controllability of inference result".

[0046] FIG. **2** is a block diagram illustrating an analysis target system diagram of the related example.

[0047] An AI system **100** illustrated in FIG. **2** illustrates an example of interactions of the loan screening AI. The arrows in FIG. **2** indicate interactions. The both ends (start and end points) of each interaction are any elements of a stakeholder, data and a component of an AI system. The type of an interaction is determined in terms of the roles (e.g., data providers **20**, **30**, a user **40**, training data **101**, loan screening model **103**) of elements corresponding to the start and end points of an interaction. The reference sign "Sxxx" attached to each interaction indicates an interaction ID.

[0048] The AI system **100** is used by an AI service provider **10** such as an AI service vendor, a data provider **20** such as a credit checking agent, a data provider **30** such as a bank, and a user **40** such as a loan applicant.

[0049] The training unit **110** includes a loan screening model training unit **102** (in other words, a machine learning unit) that trains a loan screening model **103** (in other words, an AI model) by machine-learning the training data **101**. The training data **101** may be generated by inputting a credit score from the data provider **20** and/or inputting transaction data from the data provider **30**.

[0050] The predicting unit **120** includes an inferring unit **105** that outputs a screening result **106** (in other words, inference result) by inferring inference data **104** using the loan screening model **103**. The inference data **104** may be generated by inputting and outputting a credit score from the data provider **20**, inputting and outputting application information and transaction data from the data provider **30**, and inputting the applicant information from the user **40**.

[0051] FIG. **3** is a table illustrating an excerpt part of an AI ethic checklist of the related example.

[0052] The AI ethic checklist is generated on the basis of the AI ethic model. The AI ethic model is configured as a list containing check items that the AI system **100** needs to satisfy by organizing the principles and guidelines related to the AI ethic.

[0053] The AI ethic checklist associates each type of interaction in FIG. **2** with an AI ethic check item to be satisfied according. One check item in the AI ethic checklist corresponds to one type of interaction.

[0054] An excerpt part of an AI ethic check list illustrated in FIG. **3** is based on an AI ethic model derived from" "Ethics Guidelines for Trustworthy AI" of "European High-Level Expert Group on AI (AI HLEG)".

[0055] In the excerpt part of an AI ethic checklist of FIG. **3**, a check item, an outline, and an interaction type (From, To) are associated with one other. For example, the check item "Maintenance of social credibility" is registered in association with the outline "Use of AI does not lose credibility from stakeholders" and the interaction type (From) "inference result" and the interaction type (To) "user".

[0056] FIG. **4** is a table illustrating an excerpt part of an analysis sheet of the related example.

[0057] In an analysis sheet, a stakeholder, a data type, a risk, an AI ethic check item (AI ethic characteristic), and a policy are associated with one another. For example, a stakeholder type "user", a name "loan applicant", and discrimination of start/end point "1 (end point)" are associated with one another for an interaction ID "S**110**". In addition, a data type "inference result", a data name "screening result", and discrimination of start/end point "0 (start point)" are associated with one another for an interaction ID "S**110**". Furthermore, for the Interaction ID "S**110**", a risk (case) "women and blacks less successfully pass screening" and an AI check item "group fairness", and a policy "improve AI algorithm such that differences of ratio of passing financing among groups of genders or races fall within tolerance range" are associated with each other.

[0058] Here, description will now be made in relation to an analyzing process of an AI ethical risk.

[0059] A risk analysis is performed by the user in the procedural Steps (1) to (4) as follows.

[0060] (1) The relationship among the components, the data, and the stakeholders of the AI system **100** are plotted into a system diagram (see FIG. **2**) and the interactions are extracted.

[0061] (2) The contents of each interaction are described in the analysis sheet (see FIG. **4**).

[0062] (3) For each item of the AI ethic checklist (see FIG. **3**), a risk (risk event, risk factor) assumed from a state where the corresponding interaction does not satisfy the check item thereof is extracted and described in the analysis sheet.

[0063] (4) By referring to the risks in the analysis sheet, the same contents are organized, and the relationship between a case and a factor is described. When the risk analysis is to be visualized, an analysis drawing (see FIG. **1**) additionally includes a risk event and factor to the system diagram are generated.

[0064] This means that the system diagram, the analysis sheet, and the analysis diagram are output as output data.

[0065] In Step (3) of the above risk analysis, since the AI ethic checklist has many items, the load of a process to verify all the items in the checklist is large. Therefore, in the procedural Step (3) in the above risk analysis, a generating process of a prioritized AI ethic checklist is executed.

[0066] In the generating process of a prioritized AI ethic checklist, the relationship (interaction) between the AI system **100** serving as an analysis target and a stakeholder is expressed in a graph structure. Then, from the features of the graph structure, highly significant relationship (interaction) being ethically noteworthy is extracted on a rule basis, and a check item for extracting an ethical risk associated with highly significant relationship (interaction) is presented as a prioritized checklist.

[0067] The information processing apparatus (not illustrated) in the related Example narrows the contents of the AI ethic checklist. In narrowing the contents of the AI ethic checklist, the features that "the relationship between the configuration of the AI system and the stakeholder" has are expressed as the features of a graph structure composed of a group of interactions.

[0068] The table data of the analysis sheet is in data format of "interaction group", which can automatically generate a graph structure. For example, the following items can be automatically extracted as the feature of the graph structure:

[0069] the number of nodes of stakeholders

[0070] the number of stakeholders each having multiple roles

[0071] the number of stakeholders not being directly related to AI system

[0072] A feature of a graph structure that is likely to cause an ethical risk and an item of AI ethic checklist that needs caution are registered in advance as rules. For example, if one or more stakeholders not directly related to the AI system **100** are present, the priorities of interactions that stakeholders relate to are raised. This is to grasp the impacts on indirect stakeholders that tend to be missed in designing and developing the AI system **100**.

[0073] On the basis of the rules registered from the feature of the graph structure, the AI ethic check items are narrowed to highly significant AI ethic check items, which are generated into the prioritized AI ethic checklist.

[0074] FIG. **5** is a block diagram illustrating an example of generating a graph structure from the analysis sheet of the related example.

[0075] The analysis sheet indicated by the reference sign **A1** has the same table structure as that of the analysis sheet of FIG. **4**. From the analysis sheet illustrated in the reference sign **A1**, a graph structure as indicated by the reference sign **A2** may be generated.

[0076] In the graph structure indicate by the reference sign **A2**, arrows between the nodes indicated by circles represent interactions.

[0077] In the example of FIG. **5**, the output of applicant information from a loan applicant is represented by S**101**, the input of the applicant information into a bank is represented by S**102**, and the input of the applicant information into a credit checking agency is represented by S**103**. In addition, the output of the applicant information, transaction data, and a credit score from the bank is represented by S**104**, and the output of the applicant information, the transaction data, and the credit score from the credit checking agency is represented by S**105**. Furthermore, the input from the applicant information, the transaction data, and a

credit score into the loan screening inferring unit is represented by S106, and the output of screening data from the loan screening inferring unit is represented by S107.

[0078] As indicated by the reference sign A11, roles (types of stakeholders) are registered to the respective stakeholders, and as indicated by the reference sign A21, each node, such as the loan applicant, has a role.

[0079] Here, the highly significant noteworthy interactions are extracted in the following order of (1) to (3).

[0080] (1) The score point of significance of every interaction is set to one.

[0081] (2) The score point of significance of an interaction having a particular feature is incremented (by one point may be added per feature).

[0082] (3) Interactions are ranked by significance.

[0083] The particular feature in the above (2) may include features of the nodes (components of the AI system **100**, data, stakeholders) at both ends of each interaction and a feature of the connection. The features of the nodes at both ends of each interaction may include a stakeholder with multiple roles (the AI system provider and also the data provider), a stakeholder with a role of a user, and a stakeholder with the role of a training data provider. The feature of a connection may include an interaction of a stakeholder that is not connected to an output of the AI system **100**, and an interaction in which the FIG. **6** is a block diagram illustrating an example of extracting an AI ethic checking item of the related example.

[0084] In the order of interactions having higher score points of significance, the corresponding AI ethic check items are aligned.

[0085] In Example illustrated in FIG. **6**, from among AI ethic check items indicated by the reference sign B1, four AI ethic check items having the higher score points of significance are extracted and aligned as indicated by the reference sign B2.

[0086] FIG. **7** is a block diagram schematically illustrating an example of a software configuration of an information processing apparatus of the related example.

[0087] The information processing apparatus (not illustrated) in the related example functions as a graph generating unit **111**, a feature extracting unit **112**, and a check item extracting unit **113**.

[0088] The graph generating unit **111** obtains multiple relationship information pieces (in other words, interactions) including at least two attributes among the attribute of the type of a target person, the attribute of the type of a process, and the attribute of the type of data determined on the basis of the configuration of the AI system **100**. The graph generating unit **111** may obtain relationship information on the basis of an interaction group **141** of an analysis target. The graph generating unit **111** may generate the graph structure illustrated in FIG. **5** on the basis the obtained relationship information.

[0089] The feature extracting unit **112** determines priorities of the multiple relationship information based on the attribute of the type of the target person. The feature extracting unit **112** may determine the priorities based on a significant interaction extracting rule **142**. The feature extracting unit **112** may heighten the priority of a particular target person associated with each of the multiple pieces of the relationship information. The feature extracting unit **112** may heighten the priority of a particular piece among the multiple pieces of the relationship information.

[0090] The check item extracting unit **113** outputs, as a narrowed AI ethic checklist **114** of the AI system **100**, one or more check items selected on the basis of the determined priorities from among the multiple check items associated with the respective attributes.

[0091] Next, detailed description will now be made in relation to a generating process of an AI ethic checklist in the related example with reference to a flow diagram (Steps C1 to C8) of FIG. **8**.

[0092] The graph generating unit **111** receives a significant interaction extracting rule **142**, an AI ethic checklist **143**, and an interaction group **141** of an analysis target as the input data (Steps C1 to C3).

[0093] The graph generating unit **111** generates a graph structure from the interaction group **141** (Step C4).

[0094] The feature extracting unit **112** extracts a feature from the graph structure (Step C5). A feature may be extracted based on, for example, the number of nodes of stakeholders, the number of stakeholders each having multiple roles, and the number of stakeholders not being directly related to the AI system **100**.

[0095] The feature extracting unit **112** extracts a noteworthy interaction based on the significant interaction extracting rule **142** from the extracted feature (Step C6).

[0096] The check item extracting unit **113** extracts the check item of the AI ethic checklist **143** corresponding to the noteworthy interaction (Step C7).

[0097] The check item extracting unit **113** outputs an AI ethic checklist **143** narrowed to have only significant items (Step C8). Then, the generating process of the AI ethic checklist **143** ends.

(B) Embodiment

[0098] Hereinafter, one embodiment will now be described with reference to the accompanying drawings. However, the following embodiment is merely illustrative and there is no intention to exclude the application of various modifications and techniques not explicitly described in the embodiment. Namely, the present embodiment can be variously modified and implemented without departing from the scope thereof. Further, each of the drawings can include additional functions not illustrated therein to the elements illustrated in the drawing.

[0099] In the generating process of the AI ethic checklist in the related example described above, the AI ethic checklist is narrowed by providing priorities to the interactions according to the rules of the features of the graph structure (for example, the features related to the roles of stakeholders) of significant interactions which are likely to generate an ethical risk. In contrast, the present embodiment provides the priorities to the interactions according to the difference between the graph structure of the current system diagram and the graph structure of the system diagram of the previous version in addition to or in place of the features of the graph structure being regarded as significant interactions which are likely to generate an ethical risk. If an AI system that has executed an ethical risk analysis in the past undergoes a change in partial configuration and detailing, the AI system would have two analysis target system diagrams before and after the change. The system diagram before the change and the system diagram after the change are regarded as the previous version and the current version, respectively. In the execution of the ethical risk analysis again in response to a change of the AI system, an interaction changed

between the previous version and the current version is regarded as a noteworthy significant interaction for the forthcoming re-analysis.

[0100] A process of generating an AI ethic checklist of an embodiment will now be described with reference to a flow diagram (Steps D**1** to D**8**) of FIG. **9**.

[0101] The system diagram of the current version of the AI system **100** (see FIG. **2**) describes interactions between AI system components and stakeholders. A data format of the analysis sheet (see FIG. **4**), i.e., a data format of "interaction group", obtained by extracting all the interactions from the system diagram of the current version is inputted into the information processing apparatus **1** (to be detailed below with reference to FIG. **18**) of the present embodiment (Step D**1**).

[0102] A graph structure is generated from the interaction group of the current version (Step D**2**).

[0103] On the other hand, an interaction group of the system diagram of the previous version is also inputted into the information processing apparatus **1** (Step D**3**).

[0104] A graph structure is generated from the interaction group of the previous version (Step D**4**).

[0105] The two graph structures of the current version and the previous version are compared and the difference (change) is detected (Step D**5**). As a method of the difference detection, a rule registered in advance is used. Examples of the difference detection using a rule will be described below with reference to FIG. **13** to FIG. **16**.

[0106] An interaction detected to be the difference is regarded and a score point of significance of the interaction is incremented (Step D**6**).

[0107] The check item corresponding to a noteworthy (highly significant) interaction is extracted from the AI ethic checklist (Step D**7**).

[0108] Then, an AI ethic checklist narrowed to have only significant items is outputted (Step D**8**).

[0109] FIG. **10** is a diagram illustrating a first example of difference detecting process and a significance addition process of the embodiment.

[0110] The graph structure of the system diagram of the "previous version" indicated by the reference sign E**1** and the graph structure of the system diagram of the "current version" indicated by the reference sign E**2** are inputted into the information processing apparatus **1** and are compared.

[0111] In the system diagram of the "current version", the interaction S**201** from the node "securities company" indicated by the reference sign E**21** to the node "applicant information, transaction data, and credit score" is detected to be a different interaction.

[0112] Since the interaction ID may be renumbered in the course of updating of the diagram, the old ID in the previous version is not considered and a significant score is provided to an ID in a new diagram of the "current version". Since the graph structures are compared on the name basis of the nodes (e.g., "loan applicant"), the present embodiment assumes that node names match in the two system diagrams.

[0113] On the basis of the detected different interaction, a score point of significance of the interaction S**201** is incremented.

[0114] FIG. **11** is a diagram illustrating a second example of the difference detecting process and the significance addition process of the embodiment.

[0115] The graph structure of the system diagram of the "previous version" indicated by the reference sign F**1** and the graph structure of the system diagram of the "current version" indicated by the reference sign F**2** are inputted into the information processing apparatus **1** and are compared.

[0116] In the system diagram of the "current version", the interactions S**102**, S**103**, S**104**, S**105**, S**106**, S**108**, and S**109** from the node "applicant information" indicated by reference sign F**21** to the node "data collection, and preprocessing (applicant data)" are detected to be different interactions.

[0117] On the basis of the detection, score points of significance of the interactions S**102**, S**103**, S**104**, S**105**, S**106**, S**108**, and S**109** are increased.

[0118] That is, in the example of FIG. **11**, difference detection is conducted on not only newly added interactions S**108** and S**109** but also on a structure of a partial graph.

[0119] FIG. **12** is a diagram illustrating a graph structure.

[0120] The graph structure is illustrated by a relationship between nodes (see G**1**, see "white circles") and an edge (see G**2**, see "arrows") that connects nodes with each other. A node represents a stakeholder or an AI system component, and an edge represents an interaction. An edge has a direction (in other words, the direction of the arrow).

[0121] Each node is recorded with an output edge number representing the number of edges extending from the node and an input edge number representing the number of edges entering the node. The number of output edges of the node indicated by the reference sign G**3** is "two" of the interactions S**102** and S**103**, and the number of input edges of the node indicated by the reference sign G**4** is "two" of the interactions S**104** and S**105**.

[0122] FIG. **13** is a diagram illustrating a first specific example of the difference detecting process of the embodiment. An element condition (a preset difference extracting rule) to be detected as a difference may be appropriately set in view of the balance between the load required for analysis and completeness. Next, description will now be made in relation to an example of an element condition to be detected as a difference.

[0123] The graph structure of the system diagram of the "previous version" indicated by the reference sign H**1** and the graph structure of the system diagram of the "current version" indicated by the reference sign H**2** are inputted into the information processing apparatus **1** and are compared.

[0124] In the example of FIG. **13**, the element conditions to be detected as differences are assumed to be:

[0125] newly appearing node (in other words, a node with a new name)

[0126] newly appearing edge (in other words, an edge linked to nodes at least one of which is newly added or has a name different from that of the node previously linked).

[0127] In this case, the elements detected as the differences of the graph structures indicated by the reference signs H**1** and H**2** are a node (i.e., newly appearing node indicated by the reference sign H**211**) of the securities company indicated by the reference sign H**21** and an edge (i.e., newly appearing edge indicated by the reference sign H**212**) of S**201** extending from the node of the securities company.

[0128] As a result, S**201** is detected as a different interaction.

[0129] On the basis of the above, score points of significance of the significance of S**201** is incremented.

[0130] FIG. **14** is a diagram illustrating a second specific example of the difference detecting process of the embodiment. In this example, the graph structures to be compared

are the same as those illustrated in FIG. **12**, but the element conditions (difference extracting rule) to be detected as differences are different.

[0131] The graph structure of the system diagram of the "previous version" indicated by the reference sign I**1** and the graph structure of the system diagram of the "current version" indicated by the reference sign I**2** are inputted into the information processing apparatus **1** and are compared.

[0132] In the example of FIG. **14**, the element conditions to be detected as differences are as follows:

[0133] newly appearing node (in other words, a node with a new name)

[0134] newly appearing edge (in other words, an edge linked to nodes at least one of which is newly added or has a name different from that of the node previously linked),

[0135] node that underwent a change of the number of output edges and/or the number of input edges

[0136] edge linked to node that underwent a change.

[0137] In this case, the elements detected as the differences of the graph structures indicated by the reference signs I**1** and I**2** are node (i.e., newly appearing node indicated by the reference sign I**211**) of the securities company indicated by the reference sign I**21** and an edge (i.e., newly appearing edge indicated by the reference sign I**212**) of S**201**, the node (node that underwent a change of output edge number and/or input edge number indicated by the reference sign I**213**) of the applicant information, the transaction data, and the credit score, and the edge (the edge linked to node that underwent change indicated by the reference sign I**214**) of S**106**.

[0138] As a result, S**201** and S**106** are detected as the different interactions.

[0139] On the basis of the above, score points of significance of the significance of S**201** and S**106** are incremented.

[0140] Alternatively, the element condition to be detected as a difference may have a more detailed restriction. For example, as "an edge linked to node that underwent a change", an edge like the interaction S**106** linked to nodes at the start and end points one of which undergoes a change is detected in the example of FIG. **13**, but alternatively, "an edge linked to the nodes on the both ends that underwent changes" may be detected.

[0141] Further, "an edge linked to node that underwent a change" may be "an edge extending from a node that underwent a change".

[0142] FIG. **15** is a diagram illustrating a third specific example of the difference detecting process of the embodiment. In this example, the graph structures to be compared are the same as those illustrated in FIGS. **13** and **14**, but the element conditions (the difference extracting rule) to be detected as differences are further different. The graph structure of the system diagram of the "previous version" indicated by the reference sign J**1** and the graph structure of the system diagram of the "current version" indicated by the reference sign J**2** are inputted into the information processing apparatus **1** and are compared.

[0143] In the example of FIG. **15**, the element conditions to be detected as differences are assumed to be:

[0144] newly appearing node (in other words, a node with a new name)

[0145] newly appearing edge (in other words, an edge linked to nodes at least one of which is newly added or has a name different from that of the node previously linked)

[0146] node that underwent a change of the number of output edges and/or the number of input edges

[0147] subsequent edge(s) and node(s) linked to a node that underwent a change

[0148] In this case, the elements detected as the differences of the graph structures indicated by the reference signs J**1** and I**2** are a node (i.e., newly appearing node indicated by the reference sign J**211**) of the securities company indicated by the reference sign J**21**, an edge (i.e., newly appearing edge indicated by the reference sign J**212**) of S**201**, the node (node that underwent a change of output edge number and/or input edge number indicated by the reference sign J**213**) of the applicant information, the transaction data, and the credit score, the edge of S**106**, the node of the loan screening inferring unit, the edge of S**107**, and the node (subsequent edge(s) and node(s) linked to node that underwent change indicted by the reference sign J**214**) of the screening data.

[0149] As a result, S**201**, S**106** and S**107** are detected as the interactions of the differences.

[0150] Based on this, the importance of S**201**, S**106** and S**107** is added.

[0151] A detection priority may be assigned to a node and an edge to be detected. Specifically, a higher priority may be set to a node or an edge having a smaller hop number (which means a less edge number on the route) from the most downstream node "applicant information, transaction data, and credit score" that underwent a change.

[0152] Alternatively, a high priority may be provided to an upstream node or edge of the most downstream node "applicant information, transaction data, and credit score" that underwent a change. In the example illustrated in FIG. **15**, the priorities of the edge S**201** and the nodes "securities company" and the "applicant information, transaction data, and credit score" are set to be high.

[0153] Further, the priorities of a node and an edge each having a hop number "one" from the "applicant information, transaction data, and credit score" that underwent a change are set to be middle. In Example illustrated in FIG. **15**, the priorities of the edge S**106** and the node "loan screening inferring unit" are set to be middle.

[0154] Further, the priorities of a node and an edge each having a hop number two or more from the "applicant information, transaction data, and credit score" node that underwent a change are set to be low. In the example illustrated in FIG. **15**, the priorities of the edge S**107** and the node "screening data" are set to be low.

[0155] Then, according to the set detection priorities, the score points of an interaction significance to be incremented may be changed, e.g., three points for a high priority, two points for a middle priority, and one point to a low priority.

[0156] FIG. **16** is a diagram illustrating a fourth specific example of the difference detecting process of the embodiment. The fourth specific example to be described here is an example when the two graph structures to be compared are different from those described in FIGS. **13**-**15**.

[0157] The graph structure of the system diagram of the "previous version" indicated by the reference sign K**1** and the graph structure of the system diagram of the "current version" indicated by the reference sign K**2** are inputted into the information processing apparatus **1** and are compared.

[0158] In the example of FIG. **16**, the element conditions to be detected as differences are the same as those of FIG. **14** as follows:

[0159] newly appearing node (in other words, a node with a new name)

[0160] newly appearing edge (in other words, an edge linked to nodes at least one of which is newly added or has a name different from that of the node previously linked)

[0161] node that underwent a change of the number of output edges and/or the number of input edges

[0162] edge extending from node that underwent a change.

[0163] As illustrated in the reference sign K**21**, the element conditions detected as the difference are an "applicant information" node, a "bank" node, an "applicant information, transaction data, and credit score" node (node that underwent a change of the number of output edges and/or the number of input edges indicated by reference signs K**211**, K**217**, and K**219**), edges S**102**,S**103**,S**104**,S**106** (edges extending from a node underwent a change indicated by reference signs K**212**, K**213**, and K**218**), edges S**108**, S**105**, and S**109** (newly appearing edges indicated by the reference signs K**214** and K**216**), and a "credit checking agency **2**" node (a newly appearing node indicated by the reference sign K**215**).

[0164] As a result, S**102**, S**103**, S**104**, S**106**, S**108**, S**105**, and S**109** are detected as the different interactions.

[0165] On the basis of the above, score points of significance of the significance of S**102**, S**103**, S**104**, S**106**, S**108**, S**105**, and S**109** are incremented.

[0166] FIG. **17** is a diagram schematically illustrating an example of a software configuration of the information processing apparatus **1** of the embodiment.

[0167] The information processing apparatus **1** of the embodiment functions as a graph generating unit **111**, a feature extracting unit **112**, a check item extracting unit, and a graph difference detecting unit **115**.

[0168] The graph generating unit **111** obtains multiple relationship information pieces (in other words, interactions) including at least two attributes among the attribute of the type of the target person, the attribute of the type of the process determined on the basis of the configuration of the AI system **100**. The graph generating unit **111** may obtain the relationship information on the basis of the interaction group **141** of the current version (in other words, the first multiple relationship information information) of the analysis target and the interaction group **140** of the previous version (in other words, the second multiple relationship information information) of the analysis target. The graph generating unit **111** may generate the graph structure illustrated in FIGS. **10-16**, for example, based on the obtained relationship information.

[0169] The graph difference detecting unit **115** compares the graph structure generated by the system diagram of the current version with the graph structure generated by the system diagram of the previous version, and detects the difference of the system diagrams. The graph difference detecting unit **115** may detect the difference based on significant interaction extracting rule **144** related to a difference.

[0170] The feature extracting unit **112** determines priorities of multiple relationship information based on the differences in the graph structures detected by graph difference detecting unit **115**. The feature extracting unit **112** may determine the priorities based on the significant interaction extracting rule **144** related to a difference.

[0171] The check item extracting unit **113** outputs, as a narrowed AI ethic checklist **143** of the AI system **100**, one or more check items selected on the basis of the priorities determined by the feature extracting unit **112** from among the multiple AI ethic check items associated with the respective attributes.

[0172] FIG. **18** is a diagram schematically illustrating an example of a hardware configuration of the information processing apparatus **1** of the embodiment.

[0173] As illustrated in FIG. **18**, the information processing apparatus **1** includes a Central Processing Unit (CPU) **11**, a memory unit **12**, a display controlling unit **13**, a storing device **14**, an input IF **15**, an external recording medium processing unit **16**, and a communication IF **17**.

[0174] The memory unit **12** is an example of a storing device, and is exemplified by a Read Only Memory (ROM) and a Random Access Memory (RAM). In the ROM of the memory unit **12**, a program such as Basic Input/Output System (BIOS) may be written. The software program of the memory unit **12** may be appropriately read and executed by the CPU **11**. The RAM of the memory unit **12** may be used as a temporary recording memory or a working memory.

[0175] The display controlling unit **13** is connected to a displaying device **131**, and controls the displaying device **131**. Examples of the displaying device **131** are a liquid crystal display, a Light-Emitting Diode (OLED) display, a Cathode Ray Tube (CRT), an electronic paper display, which displays various types of information to the operator or the like. The displaying device **131** may be combined with an input device and is exemplified by a touch panel. The displaying device **131** displays various types of information to the user of the information processing apparatus **1**.

[0176] The storing device **14** is a high IO performance storing device and is exemplified by a Dynamic Random Access Memory (DRAM), a Solid State Drive (SSD), a Storage Class Memory (SCM), and a Hard Disk Drive (HDD).

[0177] The input IF **15** is connected to an input device such as a mouse **151** and a keyboard **152** and controls the input device such as the mouse **151** and the keyboard **152**. The mouse **151** and the keyboard **152** are examples of an input device through which the operator makes various inputting operations.

[0178] The external recording medium processing unit **16** is configured to be capable of mounting a recording medium **160** thereon. The external recording medium processing unit **16** is configured to be capable of reading, in a state where the recording medium **160** is mounted thereon, the information recorded in the recording medium **160**. In the present embodiment, the recording medium **160** is portable. Examples of the recording medium **160** is a flexible disc, an optical disc, a magnetic disc, a magneto-optical disc, and a semiconductor memory.

[0179] The communication IF **17** is an interface that makes the information processing apparatus **1** communicable with an external apparatus.

[0180] The CPU **11** is an example of a processor, and a processor device that carries out various controls and arithmetic operations. The CPU **11** achieves various functions by executing an Operating System (OS) and a program read in the memory unit **12**. The CPU **11** may be a multiprocessor including multiple CPUs, a multi-core processor including multiple CPU cores, or a configuration including multiple multi-core processors.

[0181] The apparatus that controls the entire operation of the information processing apparatus **1** is not limited to the CPU **11**, and may alternatively be any one of MPUs (Micro Processing Units), DSPs (Digital Signal Processors), ASICs (Application Specific Integrated Circuits), PLDs (Programmable Logic Devices), FPGAs (Field Programmable Gate Arrays), and may be a combination of two or more of the above.

(C) Effect

[0182] The machine learning program, the machine learning method, and the information processing apparatus **1** bring the following effects and advantages, for example.

[0183] The graph difference detecting unit **115** compares a first multiple relationship information with a second multiple relationship information pieces, the first multiple relationship information pieces being determined in terms of an inputted configuration of a first Artificial Intelligence (AI) system and each including multiple attributes, the second multiple relationship information pieces being determined in terms of a second AI system. The feature extracting unit **112** determines a priority of the first multiple relational information pieces on the basis of the result of the comparison. The check item extracting unit **113** outputs, as a narrowed AI ethic checklist **114** of the AI system, one or more check items selected according to the determined priorities from among multiple check items associated one with each of the multiple attributes.

[0184] This can help developers and providers of an AI system to appropriately recognize and deal with ethical risks that may arise from operation of the AI system. Specifically, the AI ethic check list can be prioritized and the efficiency for finding measures to deal with risks can be enhanced by preferentially analyzing an item having a higher priority in the checklist. In particular, when a risk analysis is to be executed again on an AI system that has undergone ethical risk analysis and also undergone change and detailing, the efficiency of the re-analysis can be largely enhanced.

[0185] The above case is exemplified by a case where omission of an interaction is found in the course of analysis of an AI ethical risk, and then the system diagram is corrected and the re-analysis is to be performed, and a case where a system diagram that was rough when introduction of an AI is to be examined comes to be detailed as the phase of the AI life cycle proceeds, which makes it possible to perform more detailed risk analysis. In the above cases, the present embodiment can preferentially recognize a risk to be newly extracted as a result of updating of the system diagram.

(D) Miscellaneous

[0186] The technique disclosed herein should by no means be limited to the foregoing embodiment. Various changes and modifications can be suggested without departing from the scope of the present embodiment. The configurations and the processes of the present embodiment may be appropriately selected, omitted, or combined according to the requirement.

[0187] In one aspect, the disclosed technique can help AI system developers and providers to appropriately recognize and deal with ethical risks that may arise from operation of the AI system

[0188] Throughout the descriptions, the indefinite article "a" or "an", or adjective "one" does not exclude a plurality.

[0189] All examples and conditional language recited herein are intended for the pedagogical purposes of aiding the reader in understanding the invention and the concepts contributed by the inventor to further the art, and are not to be construed limitations to such specifically recited examples and conditions, nor does the organization of such examples in the specification relate to a showing of the superiority and inferiority of the invention. Although one or more embodiments of the present inventions have been described in detail, it should be understood that the various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the invention.

What is claimed is:

1. A non-transitory computer-readable recording medium having stored therein a machine learning program executable by one or more computers, the machine learning program comprising:

an instruction for comparing a first plurality of relationship information pieces with a second plurality of relationship information pieces, the first plurality of relationship information pieces being determined in terms of an inputted configuration of a first Artificial Intelligence (AI) system and each including a plurality of attributes, the second plurality of relationship information pieces being determined in terms of a second AI system;

an instruction for determining priorities of the first plurality of relationship information pieces, the priorities being based on a result of the comparing; and

an instruction for outputting, as a checklist of the first AI system, one or more check items selected in accordance with the determined priorities from among a plurality of check items associated with the plurality of attributes.

2. The non-transitory computer-readable recording medium according to claim **1**, wherein

the comparing includes comparing a first graph structure of the first plurality of relationship information pieces with a second graph structure of the second plurality of relationship information pieces, and

the determining includes heightening a priority of a relationship information piece detected to have a difference from the second plurality of relationship information piece among the first plurality of relationship information.

3. The non-transitory computer-readable recording medium according to claim **2**, wherein the determining includes detecting, in the first graph structure of the first plurality of relationship information pieces, a node being included in the first AI system and not being included in the second AI system, and an edge being included in the first AI system and not being included in the second AI system and heightening priorities of the node and the edge.

4. The non-transitory computer-readable recording medium according to claim **3**, wherein the determining further includes detecting, as a difference from the second plurality of relationship information pieces, a node that undergoes a change of an output number or an input number and an edge linked to the node in the first graph structure of the first plurality of relationship information pieces, and heightening priorities of the node and the edge.

5. The non-transitory computer-readable recording medium according to claim 4, wherein the determining further includes detecting, as the difference from the second plurality of relationship information pieces, a subsequent node and a subsequent edge linked to the node that undergoes the change, and heightening priorities of the node and the edge.

6. The non-transitory computer-readable recording medium according to claim 5, wherein the determining includes heightening priorities of the node and the edge by setting higher priorities to a node and an edge each having a less hop number from the node that undergoes the change among subsequent nodes and subsequent edges linked to an edge linked to the node that undergoes the change.

7. A computer-implemented machine learning method comprising:

comparing a first plurality of relationship information pieces with a second plurality of relationship information pieces, the first plurality of relationship information pieces being determined in terms of an inputted configuration of a first Artificial Intelligence (AI) system and each including a plurality of attributes, the second plurality of relationship information pieces being determined in terms of a second AI system;

determining priorities of the first plurality of relationship information pieces, the priorities being based on a result of the comparing; and

outputting, as a checklist of the first AI system, one or more check items selected in accordance with the determined priorities from among a plurality of check items associated with the plurality of attributes.

8. The computer-implemented machine learning method according to claim 7, wherein

the comparing includes comparing a first graph structure of the first plurality of relationship information pieces with a second graph structure of the second plurality of relationship information pieces, and

the determining includes heightening a priority of a relationship information piece detected to have a difference from the second plurality of relationship information piece among the first plurality of relationship information.

9. The computer-implemented machine learning method according to claim 8, wherein the determining includes detecting, in the first graph structure of the first plurality of relationship information pieces, a node being included in the first AI system and not being included in the second AI system, and an edge being included in the first AI system and not being included in the second AI system and heightening priorities of the node and the edge.

10. The computer-implemented machine learning method according to claim 9, wherein the determining further includes detecting, as a difference from the second plurality of relationship information pieces, a node that undergoes a change of an output number or an input number and an edge linked to the node in the first graph structure of the first plurality of relationship information pieces, and heightening priorities of the node and the edge.

11. The computer-implemented machine learning method according to claim 10, wherein the determining further includes detecting, as a difference from the second plurality of relationship information pieces, a node that undergoes a change of an output number or an input number and an edge linked to the node in the first graph structure of the first plurality of relationship information pieces, and heightening priorities of the node and the edge.

12. The computer-implemented machine learning method according to claim 11, wherein the determining includes heightening priorities of the node and the edge by setting higher priorities to a node and an edge each having a less hop number from the node that undergoes the change among subsequent nodes and subsequent edges linked to an edge linked to the node that undergoes the change.

13. An information processing apparatus comprising:

a memory; and

a processor coupled to the memory, the processor being configured to

perform comparing a first plurality of relationship information pieces with a second plurality of relationship information pieces, the first plurality of relationship information pieces being determined in terms of an inputted configuration of a first Artificial Intelligence (AI) system and each including a plurality of attributes, the second plurality of relationship information pieces being determined in terms of a second AI system,

perform determining priorities of the first plurality of relationship information pieces, the priorities being based on a result of the comparing, and

perform outputting, as a checklist of the first AI system, one or more check items selected in accordance with the determined priorities from among a plurality of check items associated with the plurality of attributes.

14. The information processing apparatus according to claim 13, wherein

the comparing includes comparing a first graph structure of the first plurality of relationship information pieces with a second graph structure of the second plurality of relationship information pieces, and

the determining includes heightening a priority of a relationship information piece detected to have a difference from the second plurality of relationship information piece among the first plurality of relationship information.

15. The information processing apparatus according to claim 14, wherein the determining includes detecting, in the first graph structure of the first plurality of relationship information pieces, a node being included in the first AI system and not being included in the second AI system, and an edge being included in the first AI system and not being included in the second AI system and heightening priorities of the node and the edge.

16. The information processing apparatus according to claim 15, wherein the determining further includes detecting, as a difference from the second plurality of relationship information pieces, a node that undergoes a change of an output number or an input number and an edge linked to the node in the first graph structure of the first plurality of relationship information pieces, and heightening priorities of the node and the edge.

17. The information processing apparatus according to claim 16, wherein the determining further includes detecting, as a difference from the second plurality of relationship information pieces, a node that undergoes a change of an output number or an input number and an edge linked to the

node in the first graph structure of the first plurality of relationship information pieces, and heightening priorities of the node and the edge.

18. The information processing apparatus according to claim **17**, wherein the determining includes heightening priorities of the node and the edge by setting higher priorities to a node and an edge each having a less hop number from the node that undergoes the change among subsequent nodes and subsequent edges linked to an edge linked to the node that undergoes the change.

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