

[Citation List]

[Patent Document]

[0007]

[Patent Document 1] Japanese Patent Application Laid-Open Publication No. 2021-103344

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0008]

According to the learning support device disclosed in Patent Document 1, efficient learning is enabled. According to a general learning method, it is generally known that learning effects may be enhanced by performing an incrementation processing of incrementing the teacher data according to a predetermined method. Therefore, according to the learning support device disclosed in Patent Document 1, it is expected that the learning effects may be enhanced by incrementing the teacher data.

[0009]

However, by performing incrementation processing to the selected teacher data in the learning support device disclosed in Patent Document 1, it has been discovered that there were cases where conditions for completing learning may not be satisfied even when a maximum number of epochs has been reached, or there were cases where the learning time become excessive.

[0010]

In consideration of the problems mentioned above, embodiments of the present invention aims at providing a learning device, a learning method, and a learning program, which may perform learning of models appropriately.

[Means of Solving the Problems]

[0011]

According to a first aspect of the present invention, there is provided a learning device implementing a computer comprising at least a processor and a storage device. The learning device is configured to calculate an evaluation value based on an image data of a product as a target data, and to cause learning to be performed by a model that performs learning using a teacher data to compare the evaluation value with a predetermined threshold value and classify the target data as at least one of labels of a first label which is a good product and a second label which is a defective product, the learning device including a data acquisition unit configured to acquire a teacher candidate data classified as at least either the first label or the second label, an incrementation processing unit configured to modify a portion of a content of the teacher candidate data and generate one or a plurality of modified teacher candidate data, an extraction unit configured to perform an extraction processing of calculating, by adopting the teacher candidate data and the modified teacher candidate data as a population, an evaluation value using the model regarding the population, and extracting data the evaluation value of which is within a predetermined extraction range including the threshold value, a learning unit configured to cause the model to perform a learning processing by a predetermined learning rate, and a control unit configured to control the extraction unit and the learning unit, wherein, in a

state where a number of extraction data having been extracted as a result of performing the extraction processing by the extraction unit exceeds a predetermined stop number, the control unit is configured to add the extraction data to the teacher data to perform the learning processing,

perform the extraction processing, and execute the learning processing and the extraction processing until a new number of extraction data reaches the stop number.

[0012]

The learning device according to embodiments of the present invention is equipped with an incrementation processing unit of modifying a portion of a content of the teacher candidate data and generating one or a plurality of modified teacher candidate data, wherein not only the teacher candidate data but also the modified teacher candidate data are adopted as a population for extracting the teacher candidate data. The incrementation of data by the incrementation processing unit is performed before executing the learning processing and the extraction processing, such that by repeating the learning processing and the extraction processing, finally the number of extraction data reaches a predetermined stop number, and the learning is completed. Therefore, according to the learning device of the present invention, a large population may be used to cause a model to learn more efficiently compared to a conventional learning device.

[0013]

According to embodiments of the learning device of the present invention, in a state where the extraction processing is performed using an already learned model, the control unit may create a new population having extruded the extraction data from the population, and cause the extraction unit to perform the extraction processing to the new population. According to this configuration, the number of data of the population data reduces as the learning processing and the extraction processing are performed repeatedly, such that the load of the processing performed by the control unit may be reduced.

[0014]

The learning device according to embodiments of the present invention may be configured such that, in the extraction processing, if there are a plurality of the modified teacher candidate data having a common teacher candidate data that serves as a basis of modification, a limitation processing of extracting only a predetermined limited extraction number of the teacher candidate data or the modified teacher candidate data may be performed in the extraction processing performed once. According to this configuration, the number of teacher candidate data or the modified teacher candidate data when performing the learning processing may be suppressed, such that the learning processing may be performed promptly.

[0015]

The learning device according to embodiments of the present invention may further include a display unit of displaying the extraction data, and a label modification unit capable of modifying the label of the extraction data displayed on the display unit, wherein modification of the label by the label modification unit may be enabled before adding the extraction data to the teacher data. According to this configuration, the user may confirm the determination result of the label by the extraction unit through the label modification unit and the input unit, and if there is an error in the determination result, the user may modify the result through the label modification unit, such that the determination accuracy of the extraction unit may be improved.

[0016]

According to embodiments of the learning device of the present invention, in a state where a number of the extraction data has exceeded the stop number and is less than a predetermined reference number of data, the control unit may perform the extraction processing by performing an expansion processing of expanding a width of the extraction range, and in a case where the number of the extraction data has become equal to or greater than the reference number of data, the control unit may perform the learning processing.

[0017]

If the user modifies the label through the label modification unit in a state where the extraction data is smaller than the reference number of data, the frequency of modification of the label will be increased and much load is applied on the user. In the present invention, the learning processing and the extraction processing are performed after the number of extraction data has become equal to or greater than the reference number of data, such that the frequency of the user selecting a label through the selecting unit may be reduced.

[0018]

According further to embodiments of the learning device of the present invention, the control unit may expand the width of the extraction range and lower the learning rate as the expansion processing. As described, by expanding the extraction range, the number of extraction data may be incremented. Further, the learning rate is an adjustment value of the amount of updating weight and bias within a neural network by learning processing performed once. In the present invention, the learning rate is lowered when the extraction range is widened in the expansion processing, by which fine-tuning of the number of extraction data may be performed.

[0019]

Further, according to a second aspect of the present invention, there is provided a learning device implementing a computer comprising at least a processor and a storage device. The learning device is configured to calculate an evaluation value based on an image data of a product as a target data, and to cause learning to be performed by a model that performs learning using a teacher data to compare the evaluation value with a predetermined threshold value and classify the target data as at least one of labels of a first label which is a good product and a second label which is a defective product, the learning device including a data acquisition unit configured to acquire a teacher candidate data classified as at least either the first label or the second label, an extraction unit configured to perform an extraction processing of calculating, by adopting the teacher candidate data as a population, an evaluation value using the model regarding the population, and extracting data the evaluation value of which is within a predetermined extraction range including the threshold value, a learning unit configured to cause the model to perform a learning processing by a predetermined learning rate, and a control unit configured to control the extraction unit and the learning unit, wherein the control unit is configured to, in a state where a number of extraction data extracted by the extraction unit exceeds a predetermined stop number and is less than a predetermined reference number of data, perform an expansion processing of expanding a width of the extraction range to execute the extraction processing, and in a state where the number of the extraction data has become equal to or greater than the reference number of data, perform the learning processing

by adding the extraction data to the teacher data, and perform the extraction processing, to thereby execute the learning processing and the extraction processing until a new number of extraction data reaches the stop number.

[0020]

According to the learning device configured as above, if the number of extraction by the extraction unit is smaller than the predetermined reference number of data, the width of the extraction range is widened to increase the number of extraction, such that the number of extraction is increased, and the learning processing may be performed efficiently.

[0021]

According to a third aspect of the present invention, there is provided a learning method causing learning to be performed by a learning device implementing a computer comprising at least a processor and a storage device. The learning method is a method of calculating an evaluation value based on an image data of a product as a target data, and causing learning to be performed by a model that performs learning using a teacher data to compare the evaluation value with a predetermined threshold value and classify the target data as at least one of labels of a first label which is a good product and a second label which is a defective product, the learning method including a data acquisition step of acquiring a teacher candidate data classified as at least either the first label or the second label, an incrementation processing step of modifying a portion of a content of the teacher candidate data and generating one or a plurality of modified teacher candidate data, an extraction step of calculating, by adopting the teacher candidate data and the modified teacher candidate data as a population, an evaluation value using the model regarding the population, and extracting data whose evaluation value is within a predetermined extraction range including the threshold value, and a learning step of causing the model to perform a learning processing by a predetermined learning rate, wherein, in a state where a number of extraction data having been extracted by the extraction step exceeds a predetermined stop number, the extraction data is added to the teacher data to execute the learning step, a new population having removed the extraction data from the population is created, the extraction step is executed to the new population, and the learning step and the extraction step are executed until a new number of extraction data reaches the stop number.

[0022]

A learning program according to embodiments of the present invention is a program that causes a computer to function as the learning devices described above.

[Brief Description of the Drawings]

[0023]

FIG. 1 is an explanatory view illustrating a functional configuration of a learning device according to one example of an embodiment of the present invention.

FIG. 2 is a flowchart illustrating a learning method of the learning device according to the present embodiment.

FIG. 3 is an explanatory view illustrating an image of an extraction processing by an extraction unit of the learning device according to the present embodiment.

FIG. 4 is an explanatory view illustrating a display screen displayed by a display unit of the learning device according to the present embodiment, wherein (A) illustrates a case of a good product, and (B) illustrates a case of a defective product.

FIG. 5 is an explanatory view illustrating an incrementation processing by an incrementation processing unit of the learning device according to the present embodiment, wherein (A) illustrates a flip processing, (B) illustrates a shift processing, (C) illustrates a minute rotation processing, and (D) illustrates a filter processing.

[TITLE OF THE DOCUMENT] CLAIMS

[Claim 1] A learning device implementing a computer comprising at least a processor and a storage device,

the learning device being a device configured to calculate an evaluation value based on an image data of a product as a target data, and to cause learning to be performed by a model that performs learning using a teacher data to compare the evaluation value with a predetermined threshold value and classify the target data as at least one of labels of a first label which is a good product and a second label which is a defective product, the learning device comprising:

a data acquisition unit configured to acquire a teacher candidate data classified as at least either the first label or the second label;

an incrementation processing unit configured to modify a portion of a content of the teacher candidate data and generate one or a plurality of modified teacher candidate data;

an extraction unit configured to perform an extraction processing of calculating, by adopting the teacher candidate data and the modified teacher candidate data as a population, an evaluation value using the model regarding the population, and extracting data the evaluation value of which is within a predetermined extraction range including the threshold value;

a learning unit configured to cause the model to perform a learning processing by a predetermined learning rate; and

a control unit configured to control the extraction unit and the learning unit,

wherein, in a state where a number of extraction data having been extracted as a result of performing the extraction processing by the extraction unit exceeds a predetermined stop number, the control unit is configured to add the extraction data to the teacher data to perform the learning processing, perform the extraction processing, and execute the learning processing and the extraction processing until a new number of extraction data reaches the stop number.

[Claim 2] The learning device according to claim 1,

wherein, in a state where the extraction processing is performed using an already learned model, the control unit creates a new population having extruded the extraction data from the population, and causes the extraction unit to perform the extraction processing to the new population.

[Claim 3] The learning device according to claim 1,

wherein, in the extraction processing, if there are a plurality of the modified teacher candidate data having a common teacher candidate data that serves as a basis of modification, a limitation processing of extracting only a predetermined limited extraction number of the teacher candidate data or the modified teacher candidate data is performed in the extraction processing performed once.

[Claim 4] The learning device according to claim 1, further comprising:

a display unit of displaying the extraction data, and a label modification unit capable of modifying the label of the extraction data displayed on the display unit,
 wherein modification of the label by the label modification unit is enabled before adding the extraction data to the teacher data.

[Claim 5] The learning device according to claim 4,

wherein, in a state where a number of the extraction data has exceeded the stop number and is less than a predetermined reference number of data, the control unit is configured to perform the extraction processing by performing an expansion processing of expanding a width of the extraction range, and

in a state where the number of the extraction data has become equal to or greater than the reference number of data, the learning processing is performed.

[Claim 6] The learning device according to claim 5,

wherein the control unit is configured to expand the width of the extraction range and to lower the learning rate as the expansion processing.

[Claim 7] A learning device implementing a computer comprising at least a processor and a storage device,

the learning device being a device configured to calculate an evaluation value based on an imaging data of a product as a target data, and to cause learning to be performed by a model that performs learning using a teacher data to compare the evaluation value with a predetermined threshold value and classify the target data as at least one of labels of a first label which is a good product and a second label which is a defective product, the learning device comprising:

a data acquisition unit configured to acquire a teacher candidate data classified as at least either the first label or the second label;

an extraction unit configured to perform an extraction processing of calculating, by adopting the teacher candidate data as a population, an evaluation value using the model regarding the population, and extracting data the evaluation value of which is within a predetermined extraction range including the threshold value;

a learning unit configured to cause the model to perform a learning processing by a predetermined learning rate; and

a control unit configured to control the extraction unit and the learning unit,

wherein the control unit is configured to

in a state where a number of extraction data extracted by the extraction unit exceeds a predetermined stop number and is less than a predetermined reference number of data, perform an expansion processing of expanding a width of the extraction range to execute the extraction processing, and

in a state where the number of the extraction data has become equal to or greater than the reference number of data, perform the learning processing by adding the extraction data to the

teacher data, and perform the extraction processing, to thereby execute the learning processing and the extraction processing until a new number of extraction data reaches the stop number.

[Claim 8] A learning method causing learning to be performed by a learning device implementing a computer comprising at least a processor and a storage device,

the learning method being a method of calculating an evaluation value based on an image data of a product as a target data, and causing learning to be performed by a model that performs learning using a teacher data to compare the evaluation value with a predetermined threshold value and classify the target data as at least one of labels of a first label which is a good product and a second label which is a defective product, the learning method comprising:

a data acquisition step of acquiring a teacher candidate data classified as at least either the first label or the second label;

an incrementation processing step of modifying a portion of a content of the teacher candidate data and generating one or a plurality of modified teacher candidate data;

an extraction step of calculating, by adopting the teacher candidate data and the modified teacher candidate data as a population, an evaluation value using the model regarding the population, and extracting data whose evaluation value is within a predetermined extraction range including the threshold value, and a learning step of causing the model to perform a learning processing by a predetermined learning rate,

wherein, in a state where a number of extraction data having been extracted by the extraction step exceeds a predetermined stop number, the extraction data is added to the teacher data to execute the learning step, a new population having removed the extraction data from the population is created, the extraction step is executed to the new population, and the learning step and the extraction step are executed until a new number of extraction data reaches the stop number.