

CLAIMS

1. A computer-implemented method for testing image recognition models, comprising:

5 obtaining a sample image from a test sample set;

inputting the sample image into a plurality of image recognition models comprised in a model set that are to be tested, wherein the plurality of image recognition models comprise at least one neural network model;

10 obtaining a plurality of output results, comprising obtaining, from each model of the plurality of image recognition models, a respective output result;

determining, based on the plurality of output results, whether a test result satisfies a predetermined condition, wherein the test result comprises at least one of a first test result or a second test result, wherein the first test result comprises a plurality of output result accuracies, wherein each output result accuracy of the plurality of output result accuracies corresponds to a
15 respective model of the plurality of image recognition models, and wherein the second test result comprises at least one neuron coverage rate corresponding to the at least one neural network model;

in response to determining that the test result does not satisfy the predetermined condition:

20 generating, based on the sample image and a predetermined rule, a new sample image, comprising:

identifying a specified range corresponding to a feature of the sample image; and

25 generating a new sample image by adding, based on the specified range, a random error term to one or more values associated with the feature of the sample image; and

adding the new sample image to the test sample set; and

in response to determining that the test result satisfies the predetermined condition:

removing the plurality of image recognition models from the model set.

30 2. The computer-implemented method according to claim 1, wherein the test result

comprises the first test result, and wherein determining the test result comprises:

determining, through voting, a correct output result for an additional plurality of image recognition models that are of the same function and that are comprised in the plurality of image recognition models, wherein an output result having the most votes is the correct output result;

5 and

in response to determining that a particular output result of a particular model matches the correct output result, determining that the particular output result of the particular model is accurate.

10 3. The computer-implemented method according to claim 1, wherein the model set comprises a standard model, and wherein determining the test result comprises:

determining, based on an output result of the standard model, a correct output result for a particular model of the plurality of image recognition models, wherein the particular model has the same function as the standard model; and

15 in response to determining that a particular output result of the particular model matches the correct output result, determining that the particular output result of the particular model is accurate.

20 4. The computer-implemented method according to claim 1, wherein the test result comprises the second test result, wherein determining the test result comprises:

for each neural network model of the at least one neural network model:

determining, based on whether a respective output of each neuron in each neural network model satisfies an output condition, a quantity of covered neurons, wherein the quantity of covered neurons is a quantity of neurons that satisfy the output condition; and

25 determining, based on the quantity of covered neurons, a neuron coverage rate of the each neural network model, wherein the neuron coverage rate is positively correlated with a ratio of the quantity of covered neurons to a total quantity of neurons of the each neural network model among the at least one neural network model.

30 5. The computer-implemented method according to claim 4, wherein the predetermined condition comprises:

each neuron coverage rate of the at least one neuron coverage rate is greater than a predetermined coverage rate threshold.

5 6. The computer-implemented method according to claim 5, wherein the predetermined condition further comprises:

each output result accuracy of the plurality of output result accuracies is greater than a predetermined accuracy threshold.

10 7. A non-transitory, computer-readable medium storing one or more instructions executable by a computer system to perform operations comprising:

obtaining a sample image from a test sample set;

inputting the sample image into a plurality of image recognition models comprised in a model set that are to be tested, wherein the plurality of image recognition models comprise at least one neural network model;

15 obtaining a plurality of output results, comprising obtaining, from each model of the plurality of image recognition models, a respective output result;

determining, based on the plurality of output results, whether a test result satisfies a predetermined condition, wherein the test result comprises at least one of a first test result or a second test result, wherein the first test result comprises a plurality of output result accuracies, wherein each output result accuracy of the plurality of output result accuracies corresponds to a respective model of the plurality of image recognition models, and wherein the second test result comprises at least one neuron coverage rate corresponding to the at least one neural network model;

20 in response to determining that the test result does not satisfy the predetermined condition:

generating, based on the sample image and a predetermined rule, a new sample image, comprising:

identifying a specified range corresponding to a feature of the sample image; and

30 generating a new sample image by adding, based on the specified range, a random error term to one or more values associated with the feature of the sample image; and

adding the new sample image to the test sample set; and
 in response to determining that the test result satisfies the predetermined condition:
 removing the plurality of image recognition models from the model set.

5 8. The non-transitory, computer-readable medium according to claim 7, wherein the
 test result comprises the first test result, and wherein determining the test result comprises:
 determining, through voting, a correct output result for an additional plurality of image
 recognition models that are of the same function and that are comprised in the plurality of image
 recognition models, wherein an output result having the most votes is the correct output result;
 10 and
 in response to determining that a particular output result of a particular model matches
 the correct output result, determining that the particular output result of the particular model is
 accurate.

15 9. The non-transitory, computer-readable medium according to claim 7, wherein the
 model set comprises a standard model, and wherein determining the test result comprises:
 determining, based on an output result of the standard model, a correct output result for a
 particular model of the plurality of image recognition models, wherein the particular model has
 the same function as the standard model; and
 20 in response to determining that a particular output result of the particular model matches
 the correct output result, determining that the particular output result of the particular model is
 accurate.

 10. The non-transitory, computer-readable medium according to claim 7, wherein the
 25 test result comprises the second test result, wherein determining the test result comprises:
 for each neural network model of the at least one neural network model:
 determining, based on whether a respective output of each neuron in each neural
 network model satisfies an output condition, a quantity of covered neurons, wherein the quantity
 of covered neurons is a quantity of neurons that satisfy the output condition; and
 30 determining, based on the quantity of covered neurons, a neuron coverage rate of
 the each neural network model, wherein the neuron coverage rate is positively correlated with a

ratio of the quantity of covered neurons to a total quantity of neurons of the each neural network model among the at least one neural network model.

11. The non-transitory, computer-readable medium according to claim 10, wherein
5 the predetermined condition comprises:

each neuron coverage rate of the at least one neuron coverage rate is greater than a predetermined coverage rate threshold.

12. The non-transitory, computer-readable medium according to claim 11, wherein
10 the predetermined condition further comprises:

each output result accuracy of the plurality of output result accuracies is greater than a predetermined accuracy threshold.

13. A computer-implemented system, comprising:

one or more computers; and

one or more computer memory devices interoperably coupled with the one or more computers and having tangible, non-transitory, machine-readable media storing one or more instructions that, when executed by the one or more computers, perform one or more operations comprising:

15 obtaining a sample image from a test sample set;

inputting the sample image into a plurality of image recognition models comprised in a model set that are to be tested, wherein the plurality of image recognition models comprise at least one neural network model;

20 obtaining a plurality of output results, comprising obtaining, from each model of the plurality of image recognition models, a respective output result;

determining, based on the plurality of output results, whether a test result satisfies a predetermined condition, wherein the test result comprises at least one of a first test result or a second test result, wherein the first test result comprises a plurality of output result accuracies, wherein each output result accuracy of the plurality of output result accuracies corresponds to a
25 respective model of the plurality of image recognition models, and wherein the second test result comprises at least one neuron coverage rate corresponding to the at least one neural network

model;

in response to determining that the test result does not satisfy the predetermined condition:

generating, based on the sample image and a predetermined rule, a new

5 sample image, comprising:

identifying a specified range corresponding to a feature of the sample image; and

generating a new sample image by adding, based on the specified range, a random error term to one or more values associated with the feature of the sample image; and

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adding the new sample image to the test sample set; and

in response to determining that the test result satisfies the predetermined condition:

removing the plurality of image recognition models from the model set.

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14. The computer-implemented system according to claim 13, wherein the test result comprises the first test result, and wherein determining the test result comprises:

determining, through voting, a correct output result for an additional plurality of image recognition models that are of the same function and that are comprised in the plurality of image recognition models, wherein an output result having the most votes is the correct output result; and

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in response to determining that a particular output result of a particular model matches the correct output result, determining that the particular output result of the particular model is accurate.

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15. The computer-implemented system according to claim 13, wherein the model set comprises a standard model, and wherein determining the test result comprises:

determining, based on an output result of the standard model, a correct output result for a particular model of the plurality of image recognition models, wherein the particular model has the same function as the standard model; and

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in response to determining that a particular output result of the particular model matches

the correct output result, determining that the particular output result of the particular model is accurate.

16. The computer-implemented system according to claim 13, wherein the test result
5 comprises the second test result, wherein determining the test result comprises:

for each neural network model of the at least one neural network model:

determining, based on whether a respective output of each neuron in each neural
network model satisfies an output condition, a quantity of covered neurons, wherein the quantity
of covered neurons is a quantity of neurons that satisfy the output condition; and

10 determining, based on the quantity of covered neurons, a neuron coverage rate of
the each neural network model, wherein the neuron coverage rate is positively correlated with a
ratio of the quantity of covered neurons to a total quantity of neurons of the each neural network
model among the at least one neural network model.

15 17. The computer-implemented system according to claim 16, wherein the
predetermined condition comprises:

each neuron coverage rate of the at least one neuron coverage rate is greater than a
predetermined coverage rate threshold.

20 18. The computer-implemented system according to claim 17, wherein the
predetermined condition further comprises:

each output result accuracy of the plurality of output result accuracies is greater than a
predetermined accuracy threshold.