

CLAIMS

1. A normalization method for a deep neural network, comprising:

inputting an input data set into a deep neural network, the input data set comprising at least one piece of input data;

normalizing a feature map set output by means of a network layer in the deep neural network from at least one dimension to obtain at least one dimension variance and at least one dimension mean, the feature map set comprising at least one feature map, the feature map set corresponding to at least one channel, and each channel corresponding to at least one feature map; and

determining a normalized target feature map set based on the at least one dimension variance and the at least one dimension mean,

wherein the dimension comprises at least one of: a spatial dimension, a channel dimension, or a batch coordinate dimension, and

wherein normalizing the feature map set output by means of the network layer in the deep neural network from at least one dimension to obtain at least one dimension variance and at least one dimension mean comprises:

normalizing the feature map set based on the spatial dimension to obtain a spatial dimension variance and a spatial dimension mean;

obtaining a channel dimension variance and a channel dimension mean corresponding to the channel dimension based on the spatial dimension variance and the spatial dimension mean; and

obtaining a batch coordinate dimension variance and a batch coordinate dimension mean corresponding to the batch coordinate dimension based on the spatial dimension variance and the spatial dimension mean.

2. The method according to claim 1, wherein normalizing the feature map set based on the spatial dimension to obtain the spatial dimension variance and the spatial dimension mean comprises:

obtaining the spatial dimension mean based on the at least one feature map by using the height value and the width value of the at least one feature map in the feature map set as

variables; and

obtaining the spatial dimension variance based on the spatial dimension mean and the at least one feature map.

3. The method according to claim 1 or 2, wherein obtaining the channel dimension variance and the channel dimension mean corresponding to the channel dimension based on the spatial dimension variance and the spatial dimension mean comprises:

obtaining the channel dimension mean based on the spatial dimension mean by using the number of channels corresponding to the feature map set as a variable; and

obtaining the channel dimension variance based on the spatial dimension mean, the spatial dimension variance, and the channel dimension mean by using the number of channels corresponding to the feature map set as the variable.

4. The method according to any one of claims 1 to 3, wherein obtaining the batch coordinate dimension variance and the batch coordinate dimension mean corresponding to the batch coordinate dimension based on the spatial dimension variance and the spatial dimension mean comprises:

obtaining the batch coordinate dimension mean based on the spatial dimension mean by using the amount of input data corresponding to the input data set as a variable; and

obtaining the batch coordinate dimension variance based on the spatial dimension mean, the spatial dimension variance, and the batch coordinate dimension mean by using the amount of input data corresponding to the input data set as the variable.

5. The method according to any one of claims 1 to 4, wherein determining the normalized target feature map set based on the at least one dimension variance and the at least one dimension mean comprises:

weighted-averaging the at least one dimension variance to obtain a normalized variance, and weighted-averaging the at least one dimension mean to obtain a normalized mean; and

determining the target feature map set based on the normalized variance and the normalized mean.

6. The method according to claim 5, wherein determining the target feature map set based on the normalized variance and the normalized mean comprises:

processing the feature map set based on the normalized variance, the normalized mean, a scaling parameter, and a translation parameter to obtain the target feature map set.

7. The method according to any one of claims 1 to 6, further comprising:

determining at least one data result corresponding to the input data set based on the target feature map set.

8. The method according to any one of claims 1 to 7, wherein the input data is sample data having annotation information; and

the method further comprises:

training the deep neural network based on a sample data set, the sample data set comprising at least one piece of sample data.

9. The method according to claim 8, wherein the deep neural network comprises at least one network layer and at least one normalization layer; and

training the deep neural network based on the sample data set comprises:

inputting the sample data set into the deep neural network, and outputting a sample feature map set by means of the network layer, the sample feature map set comprising at least one sample feature map;

normalizing, by means of the normalization layer, the sample feature map set from at least one dimension to obtain at least one sample dimension variance and at least one sample dimension mean;

determining a normalized prediction feature map set based on the at least one sample dimension variance and the at least one sample dimension mean;

determining a prediction result corresponding to the sample data based on the prediction feature map set; and

adjusting parameters of the at least one network layer and parameters of the at least one normalization layer based on the prediction result and the annotation information.

10. The method according to claim 9, wherein the parameters of the normalization layer comprise at least one of: a weight value corresponding to the dimension, a scaling parameter, or a translation parameter; and

wherein the weight value comprises at least one of:

a spatial dimension weight value, a channel dimension weight value, or a batch coordinate dimension weight value.

11. The method according to any one of claims 9 to 10, wherein normalizing, by means of the normalization layer, the sample feature map set from at least one dimension to obtain at least one sample dimension variance and at least one sample dimension mean comprises:

normalizing the sample feature map set based on the spatial dimension to obtain a sample spatial dimension variance and a sample spatial dimension mean; and/or,

normalizing the sample feature map set based on the channel dimension to obtain a sample channel dimension variance and a sample channel dimension mean; and/or,

normalizing the sample feature map set based on the batch coordinate dimension to obtain a sample batch coordinate dimension variance and a sample batch coordinate dimension mean.

12. The method according to claim 11, wherein normalizing the sample feature map set based on the channel dimension to obtain the sample channel dimension variance and the sample channel dimension mean comprises:

obtaining the sample channel dimension mean based on at least one sample feature map by using a height value and a width value of the at least one sample feature map in the sample feature map set and the number of channels corresponding to the sample feature map set as variables; and

obtaining the sample channel dimension variance based on the sample channel dimension mean and the at least one sample feature map.

13. The method according to claim 11 or 12, wherein normalizing the sample feature map set based on the batch coordinate dimension to obtain the sample batch coordinate dimension variance and the sample batch coordinate dimension mean comprises:

obtaining the sample batch coordinate dimension mean based on the at least one sample feature map by using the height value and the width value of the at least one sample feature map in the sample feature map set and the amount of sample data corresponding to the sample data set as variables; and

obtaining the sample batch coordinate dimension variance based on the sample batch coordinate dimension mean and the at least one sample feature map.

14. The method according to any one of claims 9 to 10, wherein normalizing, by means of the normalization layer, the sample feature map set from at least one dimension to obtain at least one sample dimension variance and at least one sample dimension mean comprises:

normalizing the sample feature map set based on the spatial dimension to obtain a sample spatial dimension variance and a sample spatial dimension mean;

obtaining a sample channel dimension variance and a sample channel dimension mean corresponding to the channel dimension based on the sample spatial dimension variance and the sample spatial dimension mean; and

obtaining a sample batch coordinate dimension variance and a sample batch coordinate dimension mean corresponding to the batch coordinate dimension based on the sample spatial dimension variance and the sample spatial dimension mean.

15. The method according to any one of claims 11 to 14, wherein normalizing the sample feature map set based on the spatial dimension to obtain the sample spatial dimension variance and the sample spatial dimension mean comprises:

obtaining the sample spatial dimension mean based on at least one sample feature map by using the height value and the width value of the at least one sample feature map in the sample feature map set as variables; and

obtaining the sample spatial dimension variance based on the sample spatial dimension mean and the at least one sample feature map.

16. The method according to claim 14 or 15, wherein obtaining the sample channel dimension variance and the sample channel dimension mean corresponding to the channel dimension based on the sample spatial dimension variance and the sample spatial dimension

mean comprises:

obtaining the sample channel dimension mean based on the sample spatial dimension mean by using the number of channels corresponding to the sample feature map set as a variable; and

obtaining the sample channel dimension variance based on the sample spatial dimension mean, the sample spatial dimension variance, and the sample channel dimension mean by using the number of channels corresponding to the sample feature map set as the variable.

17. The method according to any one of claims 14 to 16, wherein obtaining the sample batch coordinate dimension variance and the sample batch coordinate dimension mean corresponding to the batch coordinate dimension based on the sample spatial dimension variance and the sample spatial dimension mean comprises:

obtaining the sample batch coordinate dimension mean based on the sample spatial dimension mean by using the amount of sample data corresponding to the sample data set as a variable; and

obtaining the sample batch coordinate dimension variance based on the sample spatial dimension mean, the sample spatial dimension variance, and the sample batch coordinate dimension mean by using the amount of sample data corresponding to the sample data set as the variable.

18. The method according to any one of claims 9 to 17, wherein determining the normalized prediction feature map set based on the at least one sample dimension variance and the at least one sample dimension mean comprises:

weighted-averaging the at least one sample dimension variance to obtain a sample normalized variance, and weighted-averaging the at least one sample dimension mean to obtain a sample normalized mean; and

processing the sample feature map set based on the sample normalized variance, the sample normalized mean, a scaling parameter, and a translation parameter to obtain the prediction feature map set.

19. A normalization apparatus for a deep neural network, comprising:

an input unit, configured to input an input data set into a deep neural network, the input data set comprising at least one piece of input data;

a dimension normalization unit, configured to normalize a feature map set output by means of a network layer in the deep neural network from at least one dimension to obtain at least one dimension variance and at least one dimension mean, the feature map set comprising at least one feature map, the feature map set corresponding to at least one channel, and each channel corresponding to at least one feature map; and

a batch normalization unit, configured to determine a normalized target feature map set based on the at least one dimension variance and the at least one dimension mean,

wherein the dimension comprises at least one of: a spatial dimension, a channel dimension, or a batch coordinate dimension; and

wherein the dimension normalization unit is configured to normalize the feature map set based on the spatial dimension to obtain a spatial dimension variance and a spatial dimension mean, obtain a channel dimension variance and a channel dimension mean corresponding to the channel dimension based on the spatial dimension variance and the spatial dimension mean, and obtain a batch coordinate dimension variance and a batch coordinate dimension mean corresponding to the batch coordinate dimension based on the spatial dimension variance and the spatial dimension mean.

20. An electronic device, comprising: a memory configured to store executable instructions; and

a processor configured to communicate with the memory to execute the executable instructions so as to complete operations of the normalization method for a deep neural network according to any one of claims 1 to 18.

21. A computer readable storage medium, configured to store computer readable instructions, wherein when the instructions are executed, operations of the normalization method for a deep neural network according to any one of claims 1 to 18 are implemented.