Code and Data
for "Training quantum machine learning model on cloud without uploading the data"

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Overview

All the output data of the experiments in the paper are in the */data* directory.
All the software code of the Python 3.8 programs for generating these data are located in the */code* directory.

About the programs

- *1_parameter_generator.py*:

Generating the initial values of the adjustable parameters of the variational quantum circuits (VQC).
The result is saved to the file *parameters.csv* under the */data* directory.

- *2_old_method.py* and *3_our_method.py*:

Computing the cost function of the MNIST dataset using the old method and our method, respectively.

They read the files:
/data/parameters.csv
and
mnist.pkl.gz (i.e., the MNIST dataset, available at:
https://github.com/mnielsen/neural-networks-and-deep-learning/archive/master.zip)

and output the file:
/data/results_of_old_method.csv
or
/data/results_of_our_method.csv

Running instructions:
(1) To run with different values of the adjustable parameters of the VQC, put the file */data/parameters.csv* under any of the subdirectories */trial_1*, */trial_2*, ..., */trial_10* to the directory */data* before running the program.
(2) These two programs will compute the data for Fig. 3(a) in the manuscript (i.e., the

ansatz of the VQC contains 1 repetition) by default.
To compute the data for Fig. 3(b) (i.e., the ansatz of the VQC contains 2 repetitions), change “repetitions = 1” to “repetitions = 2” in these programs manually.

- *4_average.py*:

Computing the average of the data generated by *2_old_method.py* and *3_our_method.py*, and checking whether the cost functions computed by the two methods are identical.

It reads the files:
results_of_old_method.csv
and
results_of_our_method.csv
under the subdirectories */trial_1*, */trial_2*, ..., */trial_10*

and outputs the files:
/data/average_of_old_method.csv
and
/data/average_of_our_method.csv

About the data files

- *parameters.csv*:
  The initial values of the adjustable parameters of the VQC.
  Generated by *1_parameter_generator.py*.
  The values are generated randomly, uniformly distributed over the interval $[0,\pi)$.
  The VQC with 1-repetition uses the first 20 data in the file only.
  The VQC with 2-repetition uses the first 30 data in the file only.

- *results_of_old_method.csv*:
  The runtime and cost function of the old method.
  Generated by *2_old_method.py*.

- *results_of_our_method.csv*:
  The runtime and cost function of our method.
  Generated by *3_our_method.py*.

- *average_of_old_method.csv* and *average_of_our_method.csv*:
  The average and relative standard deviation of the runtime of the old method and our method, respectively. Used for Fig.3.
  Generated by *4_average.py*.