Statistical Learning Theory,
Assignment 3 – Convolutional Neural Networks

Due: 11:55PM, December 7, 2018
Issued: November 19, 2018

Instructions:
·   First, go over the attached "Assignment3_codes.ipynb" which implement convolutaional neural networks with image dataset. Please make sure to fully understand the codes between "### START KEY CODE HERE ###" and "### END KEY CODE HERE ###."
·   An ipynb file is a notebook document used by Jupyter Notebook (http://jupyter.org/install), an interactive computational environment designed to help scientists work with the Python language and their data.

Grading:
·   We will review and comment on your submission regarding the style of your python code. You must attempt every question in order to receive credit.

Submission:
·   Write the following items in a pdf document and submit the pdf file to the Cyber.ewha.ac.kr assignment dropbox by the deadline (a single submission per team).

1. Add the second hidden layer (Layer 2) between the first hidden layer and the fully connected layer so that the final structure of the model is constructed as shown below:

Layer 1
·   Conv2D: stride 1, padding is "SAME"
·   ReLU
·   Max pool: Use an 8 by 8 filter size and an 8 by 8 stride, padding is "SAME"
Layer 2
·   Conv2D: stride 1, padding is "SAME"
·   ReLU
·   Max pool: Use a 4 by 4 filter size and a 4 by 4 stride, padding is "SAME"
FC layer
·   Flatten the previous output.
·   FULLYCONNECTED (FC) layer

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1) Briefly describe how you added the layer.

2) Report your train and test accuracy (%) by running the following commend. Write the average accuracy of the total of 5 runs (e.g., 80% = (79+80+81+78+82)/5). Each run has 150 epochs (iteration).

_, _, parameters = model(X_train, Y_train, X_test, Y_test)

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2. As this model clearly has a high variance (i.e., overfitting), you can actually improve its accuracy by using regularization. Implement the compute cost function with regularization terms. You may find the link below useful.
https://www.ritchieng.com/machine-learning/deep-learning/tensorflow/regularization/

   1) Briefly describe how you implemented the regularization term.

   2) Report your train and test accuracy (%) by running the following commend. Write the average accuracy of the total of 5 runs. Each run has 150 epochs (iteration).

3. Spend more time to improve your model's test accuracy. <mark>(The top 5 teams [1st-5th] and the top 10 teams [6th-10th] will receive an additional 20 and 10 points, respectively.)</mark>
   1) Describe how you improved its "test" accuracy (e.g., tuning the hyperparameters, changing the structure of layers). You may find the link below useful.
   https://machinelearningmastery.com/improve-deep-learning-performance/

   2) Report your test accuracy (%) by running the following commend. Write the average accuracy of the total of 5 runs. You may choose the number of epochs in your discretion, but it should not exceed 1000 epochs per run.

· Zip your source codes (Assignment3_codes.ipynb) with the pdf, and submit a single zip file. Please upload only the sources related to the task, except for the unnecessary ones.

Note:
· If you submit the assignment late, we will deduct the assignment score by 20% per day and will not accept submissions after the solution has been distributed. The solution will be uploaded 2 days after the deadline.