HOMEWORK #0

ECBM E6040, Professor Aurel A. Lazar

Deadline: Noon 12:00PM, Jan 25, 2016

INSTRUCTIONS: It is recommended that you solve this homework using a GPU instance on Amazon EC2. Instructions on how to use Amazon EC2 and Jupyter notebooks are available in this webpage. Information on how to use Amazon EC2 will also be covered in Lecture #1.

If you have access to a fast GPU that supports CUDA, then you can also use your own computer. You can find information on installing Theano here. Make sure you install CUDA and cuDNN and enable GPU for Theano. If you are not able to install GPU enabled Theano in a timely fashion, consider using Amazon EC2 service with the provided machine image.

The submission for this homework should be a single Jupyter notebook file called `E6040_HW0.ipynb`.

PROBLEM #1: In the notebook, execute the following examples in the Deep Learning Tutorials with GPU support:

- code/logistic_sgd.py
- code/convolutional_mlp.py

Repeat the same using only CPU.

See this link for how to switch between using GPU and CPU. A suggested way is to use command

```
%env THEANO_FLAGS=device=cpu
```

to configure the device right in the notebook. Notice that you need to restart notebook kernel to load Theano with the new configuration (menu bar Kernel → Restart).

Save generated outputs using GPU and document any differences in execution time when CPU is used. (If you do not want to wait until the end, you can stop execution by using the menu bar Kernel → Interrupt. How many training iterations has each example finished?)

PROBLEM #2: Read this tutorial (`http://deeplearning.net/software/theano/tutorial/examples.html`) on how Theano defines functions, shared variables and random numbers.

Perform the following operations in the notebook:

1. Create a Theano single precision floating point matrix $\mathbf{X}$.
2. Create a RandomStream, and define a random stream of 10×10 matrices $\mathbf{A}$ and a random stream of 10×1 vectors $\mathbf{b}$, both from a normal distribution.
3. Create a Theano function that performs $(\mathbf{X} + \mathbf{A})\mathbf{b}$, use a shared variable in this function to record the randomly generated value of $\mathbf{A}$ and another to record the value of $\mathbf{b}$.
4. Evaluate the above function one time using a 10×10 numpy.ndarray of your choice as input, and show that you can use the shared variables to verify that the output of the function is correct.

Please save your code and the generated output in each step in the Jupyter notebook.

SUBMISSION:

1. Create a free BitBucket account (https://bitbucket.org) if you do not already have one. Add your details and Bitbucket username in google document "Bitbucket Usernames" found under Collaborations tab in Courseworks by Jan 22, noon 12PM. After that you will be given write access to a repository.

2. Upload `E6040_HW0.ipynb` to the repository above.

NEED HELP:

If you have any questions you are advised to use Piazza forum which is accessible through courseworks. Announcements related to the course will also be posted there. For anything else email to TA Konstantinos Psychas (kp2547@columbia.edu)

GOOD LUCK!