EE6132 Deep Learning for Imaging (Aug.-Dec. 2021)

Programming Assignment 0

August 21, 2021

This assignment consists of a set of warm-up programming exercises intended to help you prepare for this course and help you acquire necessary knowledge of Python and other useful libraries such as Numpy, Pytorch and Image Processing tasks. This assignment is **not** evaluated and intended only for practice purpose.

Instructions

1. Jupyter/iPython notebooks with questions are available on Moodle.
2. Use Python 3.x to run this notebook
3. Write your code only in between the lines `"YOUR CODE STARTS HERE"` and `"YOUR CODE ENDS HERE"`.
4. You can look up the documentation for each of the Python/Numpy/Pytorch function used.
5. This Assignment will help you understand several commonly used library functions.

How to run the code:

1. **[Recommended]** You can use Google Colab[1] with your personal Google account. The links below can help you in getting started with Google Colab: [Source-1][2] [Source-2[3]]
2. Alternatively, you can setup Jupyter/iPython notebooks on your local PC. You can use Anaconda for this. [Source][4]

1 Python Basics

Python is a general-purpose high-level programming language that is widely used in deep learning algorithms. You are expected to have prior experience with Python programming.

- **Tutorial:** This tutorial[5] will help you refresh your Python programming knowledge.
- **Programming Tasks:** Implement the exercises in the `"EE6132_Lab0_Q1_Python.ipynb"` file.

[1] https://colab.research.google.com/
[2] https://www.analyticsvidhya.com/blog/2020/03/google-colab-machine-learning-deep-learning/
[3] https://colab.research.google.com/notebooks/intro.ipynb
[4] https://www.geeksforgeeks.org/set-up-virtual-environment-for-python-using-anaconda/
[5] https://cs231n.github.io/python-numpy-tutorial/#python

2 Numpy Basics

NumPy (Numerical Python) is a library consisting of multi-dimensional array objects and a collection of routines for processing those arrays. In this exercise, you will implement various array functions, types of indexing, etc.

- **Tutorial:** This Tutorial[6] is a brief introduction to NumPy. You can refer to the documentation[7] for more information.
- **Programming Tasks:** Implement the exercises in the `"EE6132_Lab0_Q2_NumPy.ipynb"` file.

3 Pytorch Basics

PyTorch is an open-source machine learning library for Python designed to run code efficiently. Pytorch could be thought of as a replacement for NumPy to use the power of GPUs. Though we are not going to use any of the GPU functionalities in this assignment, we will be using it extensively in future assignments.

A major feature of Pytorch (or other libraries such as TensorFlow etc) is that it comes with an automatic differentiation package, autograd, which simplifies computing derivatives. The following tutorials will help you get started with the basics of Pytorch:

- **Tutorial:** Pytorch Tensors Introduction - [Source-1][8] [Source-2][9]
  Pytorch Differentiation - [Source-1][10] [Source-2][11]
- **Programming Tasks:** Implement the exercises in the `"EE6132_Lab0_Q3_Pytorch.ipynb"` file.

4 Linear Regression using Pytorch

In this part, you will use all the concepts from previous sections (part-1,2,3) to implement a very simple one-variable linear regression task to fit a straight line to noisy data.

- **Tutorial:** [Source-1][12] [Source-2][13]
- **Programming Tasks:** Implement one-variable Linear Regression using the starters code provided in the `"EE6132_Lab0_Q4_Lin_Reg.ipynb"` file.

5 Image Processing Basics

Throughout this course, we will work with images. In this section, you will load images and process them to familiarize yourself with basic image processing concepts.

- **Programming Tasks:** Perform Image filtering, Geometric transformation etc using the starters code provided in the `"EE6132_Lab0_Q5_Image_Processing.ipynb"` file.

–end–

[6] https://cs231n.github.io/python-numpy-tutorial/#numpy
[7] https://numpy.org/doc/
[8] https://pytorch.org/tutorials/beginner/basics/tensorqs_tutorial.html
[9] https://jhui.github.io/2018/02/09/PyTorch-Basic-operations/
[10] https://pytorch.org/tutorials/beginner/basics/autogradqs_tutorial.html
[11] https://jhui.github.io/2018/02/09/PyTorch-Variables-functionals-and-Autograd/
[12] http://cs229.stanford.edu/notes2020spring/cs229-notes1.pdf
[13] https://www.youtube.com/watch?v=4b4MUYve_U8