SC4001 Learning Objectives

1. Interpret artificial neuron as an abstraction of biological neuron and explain how it can be used to build deep neural networks that are trained to perform various tasks such as regression and classification

2. Identify the underlying principles, architectures, and learning algorithms of various types of neural networks;

3. Select and design a suitable neural network for a given application;

4. Implement deep neural networks that can efficiently run on computing machines.

Pre-requisites: MH1810, SC1004, SC1003, SC1007

Comfortable with some Mathematics. Linear Algebra. Basic Calculus.

Need programming skills

Course Topics

First Half:

1. NN fundamentals
2. Regression and Classification
3. Neuron layers
4. Deep neural networks (DNN)
5. Model selection and overfitting
6. Convolution neural networks (CNN)

Second Half:

7. Convolution neural networks (CNN) architectures
8. Recurrent neural networks (RNN) and Gated RNN
9. Attention
10. Autoencoders
11. Generative adversarial networks (GAN)

Python and PyTorch

- **Python** >=**3.11** is the programming language
- **Pytorch** >=**2.0** Libraries:
  - PyTorch: https://pytorch.org/
  - Codes of lecture examples and tutorials will be provided.
- Codes are provided as **Jupyter Notebook** (.ipynb) files.

Assessment

- **Programming Assignment (25%):**

  Individual: handout Feb 16, deadline March 15

- **Project (35%):**

  Group of up to 3 students: handout March 15, deadline April 12

- **Final exam (40%):**

  Open book

For the Assignment and the Project, **codes** and **a report** are to be submitted to NTULearn by the deadline. Late submissions will be penalized!

Group project

Project (35%) – Group (up to three)

- Project ideas handout: March 15
- Deadline: April 12

The students are to propose the project and form project groups. The topic could also be selected from given project ideas.

The project includes potential research issue related to neural networks theory/application, literature survey, and design and implementation of a potential solution. Comparisons with existing solutions are to be performed.

A report, codes, and a video presentation are to be submitted to NTU Learn by the deadline by one of the group members. The project report should contain the names of all the project members. No need to inform prior to report submission.

Assignments and projects

- Python and Pytorch are recommended for assignments and projects
- **PC with at least 1 GPU** is recommended
- Access to **SCSE GPU Cluster** (GPU-TC) server for those who needs computational power. Students will have accounts after add-and-drop period is over. Email: scsegpu-tc@ntu.edu.sg
- Reports are to be submitted in pdf format and codes are to be submitted in a .zip file to NTU Learn before the deadline.
- Late submissions are penalized (each day at 5% up to 3 days)
- Assessment criteria are indicated in the handout.