National Tsing Hua University
Fall 2023
11210IPT 553000
Deep Learning in Biomedical Optical Imaging

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Course Overview

In this course, you will learn: (1) the foundational knowledge of deep learning algorithms, build neural networks from scratch via Python, and furthermore get familiar with different frameworks such as Pytorch, Tensorflow, and Keras. (2) The principle of different biomedical optical imaging technologies will be introduced as well. Finally, (3) a final project on medical imaging is required. We also offer (4) the opportunities of earning free official certificates from Nvidia Deep Learning Institute and DeepLearning.AI from Coursera as well, which might be helpful for your future career development.

Tentative Calendar: Monday, 16:30 – 19:20 | R205 – General building II

Week	Date	Topic		
1	09/11	Course Overview		
2	09/18	*Neural Network Basics (Part I)*	*Warm-up & GitHub*	*HW1 out*
3	09/25	*Neural Network Basics (Part II)*	*Build an ANN*	
4	10/02	*Improving Deep Neural Networks*	*Data Augmentation, hyper-parameter tuning*	*HW2 out*
5	10/09	*Holiday - Double Tenth Day (no class)*		
6	10/16	*Deep Learning Strategy*	*Build a CNN*	*HW3 out*
7	10/23	*CNN (Part I)*	*Transfer Learning*	*HW4 out*
8	10/30	*CNN (Part II)*	*Unsupervised Learning*	
9	11/06	*Transformer*	*Self-attention*	*Report out*
10	11/13	*AI for Medical Diagnosis + Nvidia Workshop*		*HW5 out*
11	11/20	*Mid-term Review + Introduction to Final Presentation*		
12	11/27	*Mid-term Exam*		
13	12/04	*Guest Lecture*		
14	12/11	*Guest Lecture*		
15	12/18	*Student Projects Presentation*		
16	12/25	*Student Projects Presentation*		

17	01/01	*Holiday - New Year's Day (no class)*
18	01/08	*Student Projects Presentation*

Grading

- **Homework (35 %):** Assignments to get familiar with basic deep learning programming.
- **Midterm (30 %):** Basic concepts of deep learning and related mathematical derivation.
- **Final Project Presentation (20 %):** A project presentation of a research paper related to the deep learning application in medical imaging and the code implementation of the
- **Creativity Report (15 %):** A Provide a detailed analysis of your model implementation on a given image dataset.

References

- Goodfellow, Y. Bengio, and A. Courville, "Deep Learning," 2016.
- Francois Chollet (creator of Keras), "Deep Learning with Python," 2017.
- J. Schmidhube, "Deep Learning in Neural Networks: An Overview," Neural Networks 61: 85-117, 2015.
- Y. Bengio, Y. LeCun, and G. Hinton, "Deep Learning," Nature 521: 436-44, 2015.

Online Resources

- Goodfellow, Y. Bengio, and A. Courville, "Deep Learning," 2016.
  http://www.deeplearningbook.org
- Deep Learning Specialization by Andrew Ng
  https://www.youtube.com/c/Deeplearningai/playlists
- Stanford CS231n: Deep Learning for Computer Vision
  http://cs231n.stanford.edu/schedule.html
- Google: Machine Learning Crash Course with TensorFlow APIs
  https://developers.google.com/machine-learning/crash-course
- AI for Medicine Specialization.
  https://www.coursera.org/specializations/ai-for-medicine
- NVIDIA Deep Learning Institute
  https://www.nvidia.com/en-us/training/
- NVIDIA NGC
  https://www.nvidia.com/zh-tw/gpu-cloud/containers/
- TensorFlow 2 quickstart for beginners.
  https://www.tensorflow.org/tutorials/quickstart/beginner
- Python Numpy Tutorial (with Jupyter and Colab)
  https://cs231n.github.io/python-numpy-tutorial/
- Python Basics for Data Science
  https://www.edx.org/course/python-basics-for-data-science

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- Python Tutorial
  https://www.w3schools.com/python/
- 莫烦 Python
  https://mofanpy.com/