

DHLO 2021: Contents

Digital Health Lab Open Lecture Series — Spring 2021

Instructor: Dr. Teng Zhang, Dr. Nan Meng, Mr. Xihe Kuang, Ms. Moxin Zhao



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Date	February 24, 2021 — April 28, 2021
Term	Spring 2021
Duration	2 months
Host	Digital Health Lab from Dept. Orthopedics and Traumatology && AIMed-DOT
Zoom	https://hku.zoom.us/j/3989937358?pwd=TW94Z2pQZHFKMUG1Uk1CbE1nMGdPUT09
Meeting ID	398 993 7358
Password	7PTNnf
Registration	piazza.com/hku.hk/spring2021/dhlo2021

1 Introduction to Digital Health

- **Instructor** : Dr. Teng Zhang (Grace)
- **Date** : February 24, 2021
- **Time** : HKT PM 5 :15 — 6 :00
- **Introduction** : The main aim of this session is to introduce the seminar serious orientation and timelines. Digital technologies have been significantly impacting multiple aspects of our modern life. For medical practice digital tools are giving more controls to the doctors and patients over the health management. Recent new applications of digital health technologies can empower doctors for better decision making, early/auto-diagnosis, continuous/out of hospital management of chronic diseases. Main objectives of the current digital health efforts are to reduce inefficiencies, to improve access, to control costs, to increase quality, and to enable personalised medicine.
- **Contents** :
 - History of digital health.
 - Current applications.
 - Main industries in digital health.
 - Future potentials.
 - Course structure and deliverables.
- **Outcomes** :
 - Understand of what digital health is.
 - Understand the contents of the seminar serous.
 - Contact the instructors for proposed topics.

2 Big Data in Health Care

- **Instructor** : Dr. Teng Zhang (Grace)
- **Date** : March 3, 2021
- **Time** : HKT PM 5 :15 — 6 :00
- **Introduction** : With the explosion of healthcare information, there has been a tremendous amount of heterogeneous medical knowledge, which plays an essential role in healthcare information systems. Existing works for integrating and utilising the medical knowledge mainly focus on straightforward connections establishment and pay less attention to make computers interpret and retrieve knowledge correctly as well as inconsideration of the connections of different data dimensions.
- **Contents** :
 - **VOLUME** : The amount of data from myriad sources.
 - **VARIETY** : Different types of data.
 1. Multidomain : structural V.S. unstructural
 2. Recurrent
 3. Identify clinical questions
 - **VELOCITY** : the speed at which big data is generated.
 - **VERACITY** : the degree to which big data can be trusted.
 - **VALUE** : the business value of the data collected.
 - **VARIABILITY** : the ways in which the big data can be used and formatted.
- **Outcomes** :
 - Understand the framework of heterogeneous medical data.
 - Basic capabilities of organizing and integrating in consideration of both human and machine interpretable.

3 Python Foundation 1

- **Instructor** : Dr. Nan Meng (Naen)
- **Date** : March 10, 2021
- **Time** : HKT PM 5 :15 — 6 :00
- **Introduction** : In this course, we will introduce a popular programming language — [Python](#), which is widely used in various fields such as medical image processing, optimization, data analysis and visualization, etc. This course consists of two parts. In the first part, we start by introducing the **merits and benefits** of this language for medical data processing and analysis. After that, we will recommend some popular integrated development environments (IDEs) for python, such as Anaconda (distribution), Pycharm, etc.

Start from the second part, we will get our hands dirty. We will demonstrate how to install the Python environment and set out to work on some simple projects to figure out how the python works and master some basic rules of coding.

- **Contents** :
 - Introduction of Python.
 - Introduction of commonly used packages in Python : Numpy, Matplotlib, Scipy, etc.
 - Coding tools : Anaconda & Pycharm & Notebook.
 - Operators and data type in Python.
 - Coding rules in Python.
 - Output formats in Python.
 - Practise with Python.
- **Outcomes** :
 - Be able to successfully install Python environment.
 - Know about the function of different python packages.
 - Master the basic coding rules when using Python, and can do some simple calculations using Python language.
 - Understand different printing formats and can control the formats of printing results.

4 Python Foundation 2

- **Instructor** : Dr. Nan Meng (Naen)
- **Date** : March 17, 2021
- **Time** : HKT PM 5 :15 — 6 :00
- **Introduction** : In this course, we will follow what we have learned in the last course and continue to learn the logic flow and functions in Python. This course is a laboratory course in which we will learn new concepts and coding simultaneously. We will demonstrate how to control the logic flow in python, how to define and execute functions, and display/visualize image data in this course.
- **Contents** :
 - Logic flow in Python.
 - Define and execute function in Python.
 - Plot some simple function, such as $\sin(\cdot)$, $\cos(\cdot)$, Gaussian, etc.
 - Visualize the image data.
- **Outcomes** :
 - Understand logic flow in Python.
 - Be able to define and execute function in Python.
 - Be able to plot some simple function, such as $\sin(\cdot)$, $\cos(\cdot)$, Gaussian, etc.

- Can visualize the image data.

5 Deep Learning Foundation and Practice

- **Instructor** : Dr. Nan Meng (Naen)
- **Date** : March 24, 2021
- **Time** : HKT PM 5 :15 — 6 :00
- **Introduction** : In this course, we will introduce the deep learning techniques, such as the famous **Convolutional Neural Network**. We will go inside the learning framework and to see how the network is constructed. This includes how many types of layers are there in the common learning framework, what is the function of each type of layer, how do the layers are connected, what do the features extracted by different layers look like, etc.
- **Contents** :
 - Construction of classical learning framework.
 - Functions of different types of layers.
 - What the learned representations (features) look like.
- **Outcomes** :
 - Understand the construction of classical learning framework.
 - Understand the functions of different types of layers.
 - Understand what the learned representations (features) look like.

6 Image Processing Foundation and Practice

- **Instructor** : Ms. Moxin Zhao
- **Date** : March 31, 2021
- **Time** : HKT PM 5 :15 — 6 :00
- **Introduction** : In this course, we will learn the basics of image processing, including different types of medical images, some classical processing algorithms, and practical implementation with Python. We start with introducing a number of medical images from different imaging techniques, such as X-ray, computed tomography (CT), magnetic resonance imaging, etc. Given that most of the medical images are gray-scale photographs with only one intensity channel, we subsequently introduce several processing techniques for gray-scale images, i.e., intensity transformation and histogram equalization.
- **Contents** :
 - A brief introduction of different modalities of medical images, including the projection X-ray image, computed tomography (CT) image, magnetic resonance imaging (MRI) image, ultrasound image, et al.
 - Gray-scale image intensity transformation and histogram processing.
 - Practice some spatial domain image processing methods using python.
- **Outcomes** :
 - Understand the characteristics of different types of medical images.
 - Understand gray-scale image intensity transformation and histogram equalization.
 - Be able to implement some basic image processing methods using python.

7 Medical Image Segmentation and Detection

- **Instructor** : Mr. Xihe Kuang (Tony)
- **Date** : April 7, 2021

- **Time** : HKT PM 5 :15 — 6 :00
- **Introduction** : In this course, we will first introduce some basic concepts of medical image classification and detection (C&D). We will discuss the major difference between the C&D tasks about medical image and common natural image. Then we will illustrate the basic process of deep learning based medical image C&D. Finally, we will introduce some commonly used deep learning models.
- **Contents** :
 - Brief introduction of medical image C&D task.
 - Basic deep learning process for C&D.
 - Commonly used deep learning model.
- **Outcomes** :
 - Understand the basic concepts and characteristics of medical image C&D task.
 - Be able to develop a deep learning based process for C&D task with developed model.
 - Understand the merit and demerit of different deep learning models.

8 Medical Image Classification and Reconstruction

- **Instructor** : Mr. Xihe Kuang (Tony), Dr. Teng Zhang (Grace)
- **Date** : April 14, 2021
- **Time** : HKT PM 5 :15 — 6 :00
- **Introduction** : In this course, we will first introduce what is the segmentation and what's the technical and clinical significance of it. Then we will introduce different kinds of segmentation methods for medical image and discuss their advantage and disadvantage. Next, we will show how to develop a deep learning based process for the medical image segmentation by simply modified the network architecture and training strategy for classification tasks. Finally, we will illustrate how to build a 3D reconstruction model based on the segmentation result.
- **Contents** :
 - Brief introduction of medical image segmentation.
 - Characteristics of different kinds of segmentation method.
 - Deep learning based segmentation process.
 - A basic method for segmentation based 3D reconstruction.
- **Outcomes** :
 - Understand the basic concept of medical image segmentation.
 - Learn the merit and demerit of different segmentation method.
 - Be able to develop a deep learning based segmentation process.
 - Learn how to build a 3D reconstruction based on segmentation.

9 Medical Simulation “FEA V.S. DEA”

— To be decided.

10 Machine Learning & Data Mining Foundation

— To be decided.