National Cheng Kung University
Modular Course 2021 Summer Program

數位影像處理導論
Introduction to Digital Image Processing

Instructor	Affiliation	Graduation (Ph.d.)
朱書賢	Intel Corporation, Hillsboro, OR	College of Science and Engineering, University of Minnesota-Twin Cities, Minneapolis, MN

Course Type	Course Credit	Student Size (Maximum)	
Lecture + Recitation	1.5	25	因 COVID-19 疫情嚴峻，本課程將延至 2022 暑假(111-1)。

Student Background

College of Science、College of Engineering、College of Bioscience and Biotechnology、College of Electrical Engineering & Computer Science、College of Management、College of Medicine、College of Planning & Design、College of Social Science

Difficulty

☐ Challenging ☐ Medium Well ■ Medium ☐ Entry Level (Basic)

Format of The Course

Lecture 70%，Practice 30%

Note:

Lectures will be provided in the morning and lab sessions are in the afternoon. Knowledge of python is not required and understanding of basic programming logic will help. During the first part of lab sessions, we will go over examples and python homework questions. Source code will be provided so that students can follow the code in the class and practice after class. The second part of lab sessions are offered as TA hour for questions from homework and project. Students can work on them during this period of time as well.

Grading Policy

Quiz 28%、Homework 50%、Project 22%

Note:

- **Quiz 28%:**

Quizzes will be given at the beginning (9:00-9:30) of lectures from day 2 to day 5. Quiz questions cover the previous lecture.

- **Homework 50%:**

Homework will be posted before each lecture and due midnight the next day.

- **Project 22%:**

Each group can have at most 4 members who shall work on an assigned DIP problem, explore possible solutions, and hand in a project report in 2 days after the end of this course. The report should include title, author, abstract, introduction, problem statement, method, result, discussion, conclusion, individual contribution, and references. The report can be written in either English or Chinese.

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Code of Conduct for The Course

按時上課、按時交作業(報告)

Course Description

Digital imaging processing (in shot, DIP) has a wide range of applications in our daily life not only for entertainment but also in medical, industrial, artificial intelligence, and science applications such as manufacturing inspection, robot navigation, car assembly, computer tomography, aerial image, biology, astronomy, chemistry, traffic control, physics. In the course, we will introduce fundamental techniques and algorithms used for acquiring, processing, and extracting useful information from digital images. Particular emphasis will be on image sampling, quantization, transformation, enhancement, and information extraction. Frequency-based analysis and operation won't be covered. In addition to lectures, this course also includes computer recitations designed to exercise manipulations of real-world data.

Timetable and Syllabus

Peroid	Timetable	Syllabus
	9:00-15:30	**9:00-12:00** **(a) Course Introduction** **We first cover course specifics and logistics. Then, an overview of image processing and its applications will be presented. We will introduce the fundamentals of DIP including visual perception, image acquisition, representation, contrast, intensity, and resolution.** **(b) Mathematical Tools for DIP** **13:00-15:30** **(c) Lab: Python introduction and installation; Practice on image creation, matrix/array representation and basic manipulations**
	9:00-15:30	**9:00-12:00** **(a) Intensity transformation** **Histogram operations: equalization, matching…etc.** **(b) Color image processing** **Models, pseudocolor, and transformations** **13:00-15:30** **(c) Lab: Intensity transformation and color image manipulations**
	9:00-15:30	**9:00-12:00** **(a) Spatial filtering** **Correlation, convolution, smoothing, sharpening…etc** **13:00-15:30** **(b) Lab: Spatial filtering on morphological images and color images**
	9:00-15:30	**9:00-12:00** **(a) Morphological image processing**

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		13:00-15:30 **(b) Lab: Morphological image processing practice**
	9:00-15:30	**9:00-12:00** **(a) Image Segmentation** **Line and edge detection, thresholding, region-based segmentation** **(b) Hough Transformation** **13:00-15:30** **(c) Lab: Component detection and image segmentation practice**

Goal of the Course

1. Understand the formation of digital images (Morphological, gray-scale, and color images)

2. Familiar with spatial domain image enhancement techniques

3. Capable of extracting information: component detection and segmentation

4. Develop insight in applying digital image processing tools to real-world problems

The Importance, Cross-Over Disciplinary and Contemporary of The Curriculum

The role of image processing has become critical with the advance in computing technology and machine learning development. Successful interdisciplinary applications can be found everywhere, such as medical imaging, machine/robot vision, pattern recognition (handwriting, traffic objects, computer-aided diagnosis), and cellphone cameras. After the class, students will be able to know how digital image processing is utilized. Furthermore, they will be able to apply digital image processing in their life, study, research, and work.

Remarks

References：

R.C. Gonzales and R.E Woods, Digital Image Processing 3rd or 4th ed.