

National Cheng Kung University

Modular Course 2024 Summer Program

領域：科際整合【自、生】

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

Student Background

College of Science、Institute of Technology、College of Biological Sciences and Technology、College of Electrical Engineering and Computer Science、Faculty of Management、College and Faculty of Medicine、College of Planning and Design、College of Social Science

Difficulty

Challenging Moderately Difficult Medium Entry Level (Basic)

Format of The Course

Lecture 70%、Practice 30%

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%

- 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.

Code of Conduct for The Course

Go to class on time and submit homework (reports) on time

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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.

Keywords : [Digital Image Processing](#), [Image Analysis](#), [Image Enhancement](#), [Information Extraction](#)

Timetable and Syllabus

Period	Timetable	Syllabus
8/12(MON)	9:00-12:00	on 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
8/13(TUE)	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
8/14(WED)	9:00-12:00	Spatial filtering Correlation, convolution, smoothing, sharpening...etc
	13:00-15:30	(b) Lab: Spatial filtering on morphological images and color images
8/15(THU)	09:00-12:00	Morphological image processing
	13:00-15:30	(b)Lab: Morphological image processing practice
8/16(FRI)	09:00-12:00	(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

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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

Prerequisites : No requirement. Basic knowledge on Linear Algebra and Python will be helpful.

Software and Tools:

1. Python: <https://www.python.org/downloads/>
2. Numpy: <https://numpy.org/>
3. Pillow: <https://python-pillow.org/>
4. Opencv-python: <https://pypi.org/project/opencv-python/>

Reference :

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

本課程若因天災等不可抗力之因素或中央、地方政府公告停課，授課教師需依情況依建議補課方式調整課程進度與補課；若需使用假日、國定假日補課，則需與所有修課學生達成共識方能用例假日補課。

建議補課方式：

1. 線上授課方式補課；
2. 當預期可能會因天災(颱風、超大豪雨...等)宣佈停課時，建議老師先行調整加快課程進度或預先增加可能天氣預警之前幾次課程時數；
3. 停課後隔天起延後下課，補足停課延誤的進度；若停課超過1天，則在開始上課後延後下課補課，或當週星期六、日補課；

更改課程授課方式，例如：DEMO 改以考試、報告、作業取代。