

CS 3570 多媒體技術概論

Introduction to Multimedia Technology

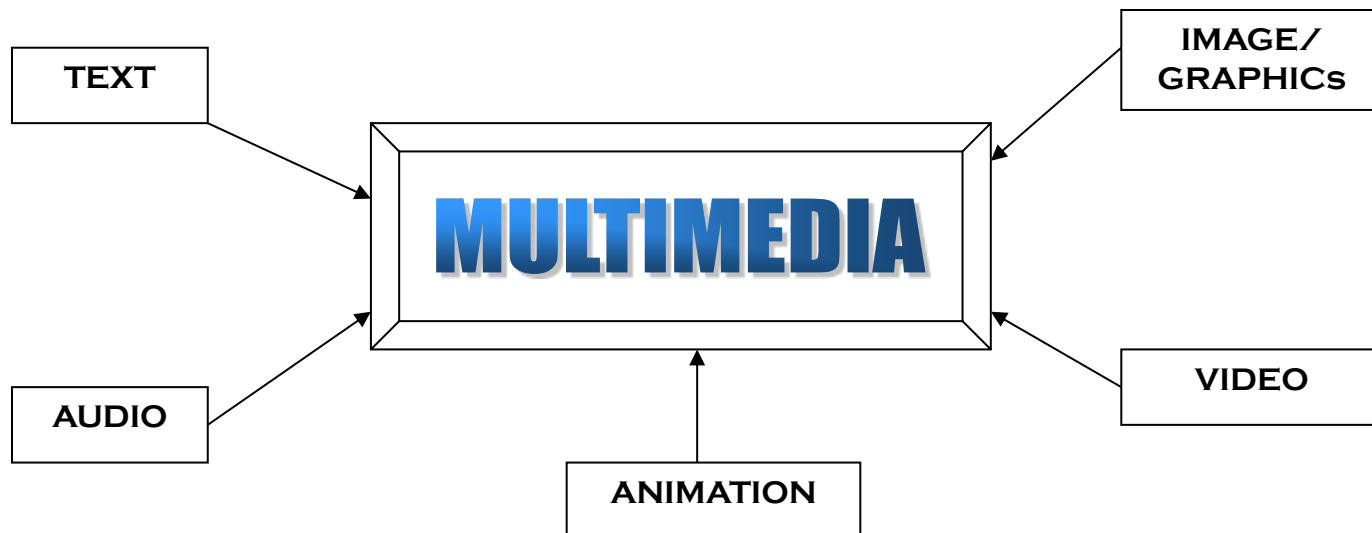
- **Class Meeting:** T5F5F6 台達館 103
- **Instructor:** 賴尚宏
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Course Objective

- This course will introduce fundamental techniques for digital image/audio/video/graphics representation, compression, processing, and analysis.
- Students will learn the basic knowledge of the multimedia signal processing techniques, and practical implementations of various multimedia applications.

Definition of Multimedia

- Multimedia is a combination of text, image, graphic, sound, animation, and video that is delivered interactively to the user by electronic or digitally manipulated means.



Course Contents

- Digital Data Representation and Communication
- Digital Image Representation & Processing
- Digital Audio Representation & Processing
- Digital Video Representation and Processing
- Computer Graphics
- AI for Multimedia
- AR & VR

Image Enhancement Example



Adjusting the image histogram to improve image contrast

Image Super-Resolution



Image Compression

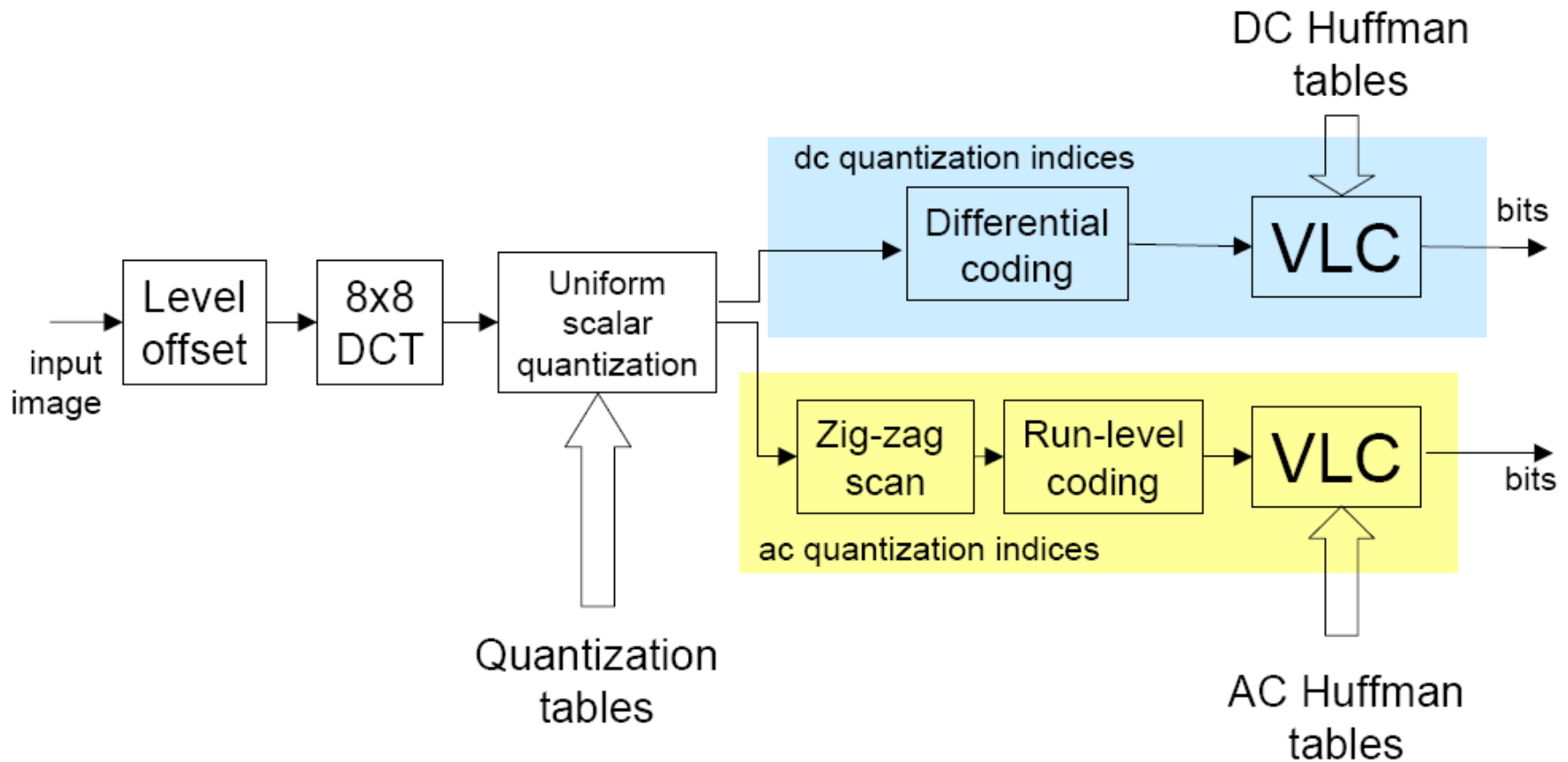


24k bytes with JPEG (Q=50)

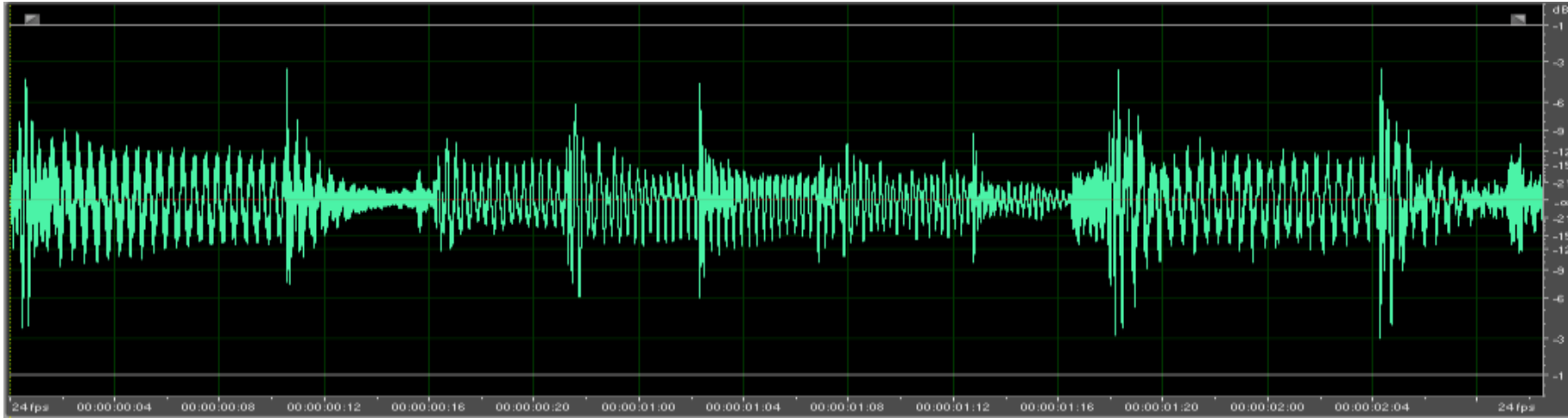


6M bytes with raw image format
(without compression)

JPEG Image Compression



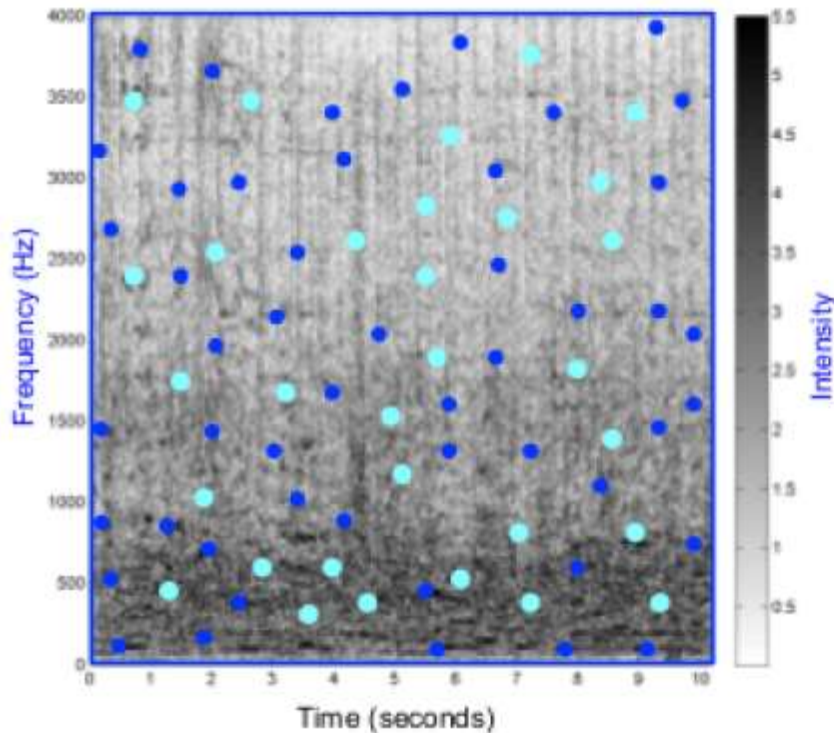
Audio Signal Processing



- Audio compression
- Noise reduction
- Frequency-domain processing

Audio Recognition/Matching

Shazam audio fingerprints:



Steps:

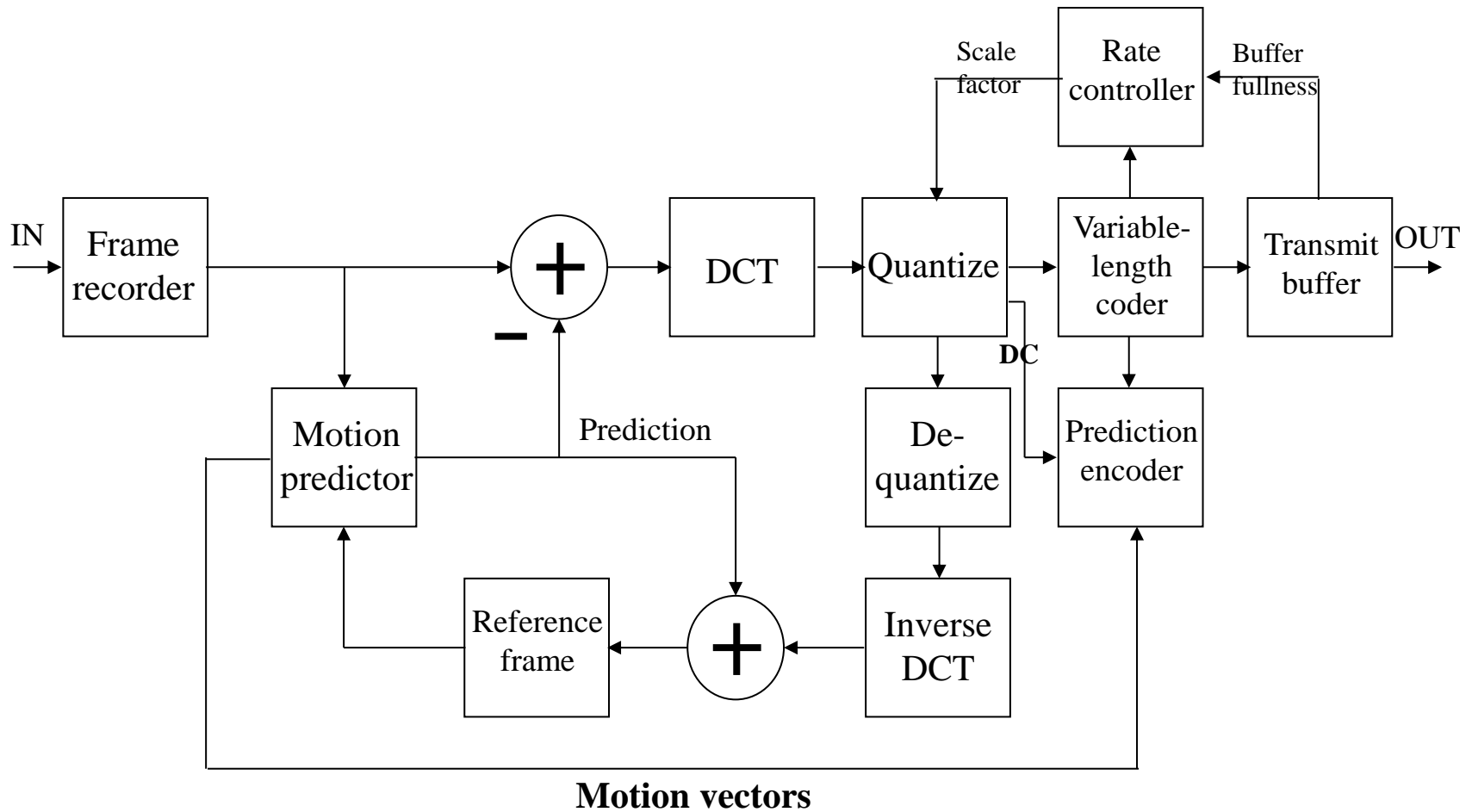
1. Spectrogram
2. Peaks / differing peaks

Robustness:

- Noise, reverb, room acoustics, equalization
- Audio codec
- Superposition of other audio sources

<http://www.ee.columbia.edu/~dpwe/papers/Wang03-shazam.pdf>

Video Compression



MPEG Video Encoder

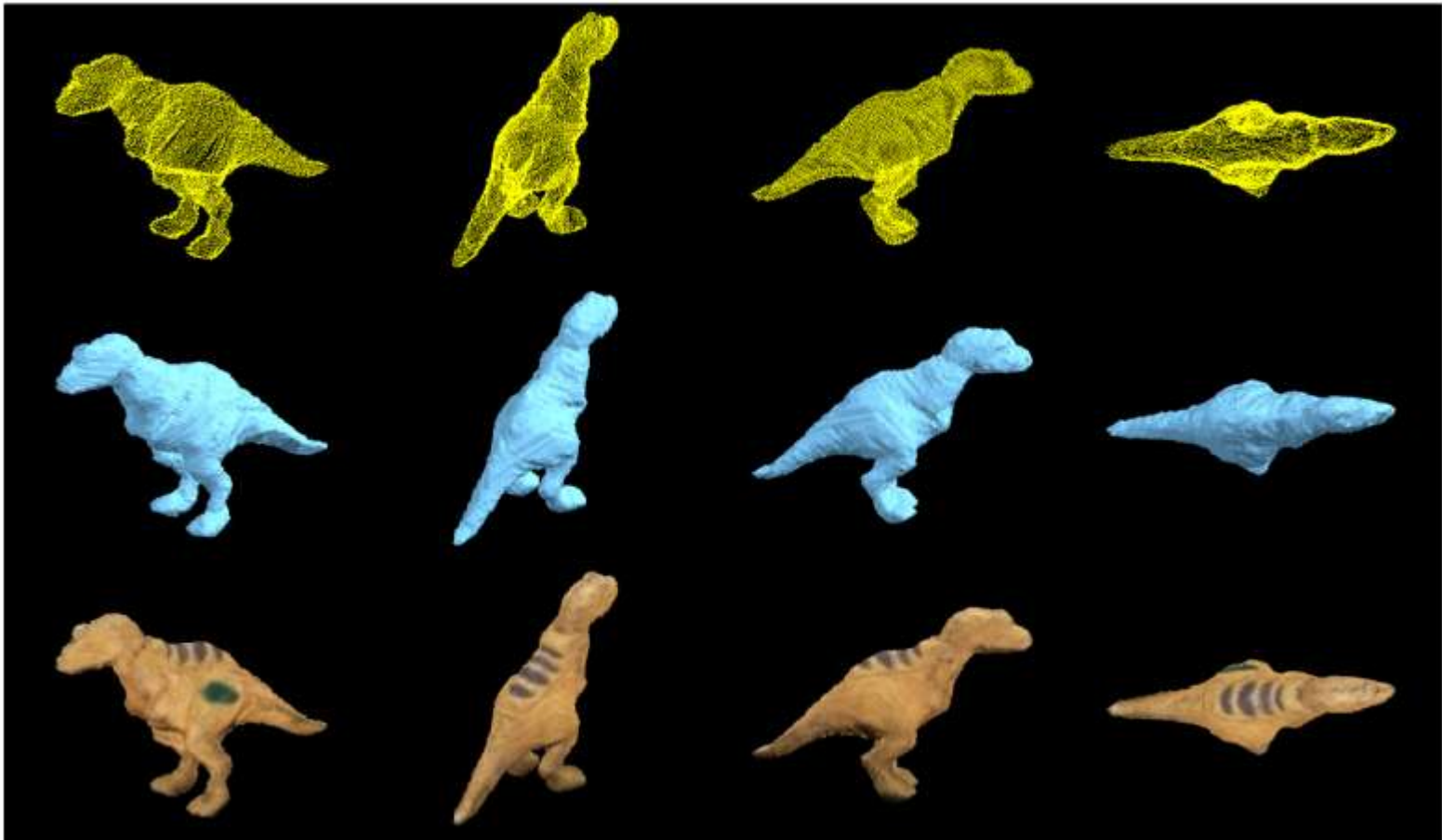
Video Stabilization



Adopted from:
<http://public.hronopik.de/vidstab/features.php?lang=en>

3D Computer Graphics

- 3D Modeling
- Image Rendering



Augmented Reality (AR)

- A combination of
 - a real scene viewed by a user and
 - a virtual scene/object generated by a computer that augments the scene with additional information.
- Usually require 3D models for the virtual object as well as precise 3D pose estimation of the real scene.



Virtual Reality (VR)

- Inducing targeted behavior in an organism by using artificial sensory stimulation, while the organism has little or no awareness of the interference.



The user, wearing a VR headset, flaps his wings while flying over virtual San Francisco, while a motion platform and fan provide additional sensory stimulation. The figure on the right shows the stimulus presented to each eye.

Course Schedule I

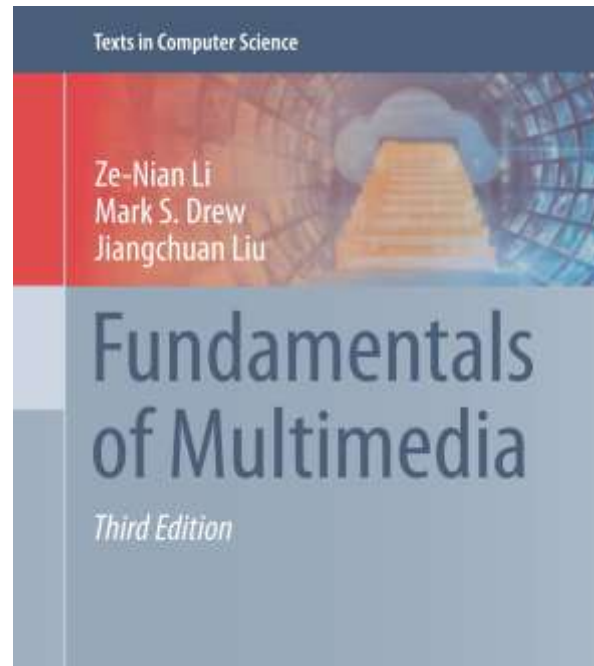
- 2/18: Course Introduction
- 2/21: Introduction to Digital Multimedia
- 2/25, 3/4: Image Data Representation
- 2/28: 和平紀念日(no class)
- 3/7: Image Color Model
- 3/11, 14: Image Compression
- 3/18, 21: Digital Audio
- 3/25, 28: Audio Compression
- 4/1, 8: Digital Video
- 4/4: 民族掃墓節(no class)
- 4/11, 15: Video Compression

Course Schedule II

- 4/18, 22: Graphics
- 4/25: Midterm Exam
- 4/29, 5/2: AI for Multimedia
- 5/6, 9: Generative AI for Image/Video
- 5/13, 20: Generative AI for 3D
- 5/16, 23: Invited Talks (TBD)
- 5/27: AR/VR
- 5/30: 端午節 (no class)
- 6/3, 6: Final Project Presentation

Textbook

**Ze-Nian Li, Mark S. Drew, and Jiangchuan Liu,
Fundamentals of Multimedia, 3rd Ed., Springer,
2021 (available online from NTHU Library)**



Prerequisites

- Linear Algebra
- Probability
- Basic programming skills

Grading

Midterm Exam. (April 25)	25%
Homeworks (4)	35%
Final Project	25%
Quizzes (2-3)	5%
Class Participation	10%

Homework Policy

- Homeworks will involve programming assignments (in Python).
- Discussion of homework is encouraged, but you have to write your own. Copying or submitting AI-generated document/code is **strictly** prohibited.
- Homework should be submitted before the announced due time. Scores of late homeworks will be reduced by 20% per day.

Final Project

- Each student is required to do a final project of a topic closely related to the course.
- You need to form a team of 3-4 students to do the final project.
- Each team needs to present the project outcome in the last week of the classes.
- All members in each team share the same score for the final project.

Digital Learning Platform

- Course information and lecture slides will be posted on NTHU eeclass.
- Questions and discussions for this course are encouraged to post on eeclass.

Class Participation

- Class attendance is required and treated as the basic requirement for class participation.
- Asking questions is highly encouraged.
- There will be a couple of quizzes in class during the semester.

CS 3570 Classroom Rule

- No eating is permitted.
- No sleeping during the class.
- Disturbance to others in class should be minimized.
- Cell phone should be turned off during the class.

Additional Enrollment (課程加簽)

- Several students have emailed me requesting to enroll in this course.
- Currently, we have reached the preset quota 75. I am willing to enroll more students (probably 10-15).
- To be considered for additional enrollment, you need to do the following:
 - 1. Apply for 加簽 from the NTHU online system
 - 2. Send an email to shlai@gapp.nthu.edu.tw with the subject line: Request to Enroll CS 3570 (Name: XXX Student ID: #####) and describe your **background** and **detailed reasons** why you need to take this course by this Wednesday (2/21).
- The students who applied for additional enrollment will be decided by the end of this week.