

Extended Syllabus

Course Title	Intro to Visual Media Programming	Semester	2022-2
Credit	3	Course Number	MAS2011
Class Time	화,목 12:00 ~ 13:15	Enrollment Eligibility	

Instructor's Photo	Name: 서용덕 (SEO Yongduek)	Homepage:
	E-mail: yndk@sogang.ac.kr	Telephone: 02 705 8896
	Office: GA215 Office Hours: check saint.sogang.ac.kr	

I. Course Overview

1. Description

The course will be talking about:

- 2D drawing and related mathematics
- Image/video data visualization & manipulation
- Image/video data processing

2. Prerequisites

- Python programming language (e.g., COR1009)

3. Course Format (%)

Lecture	Discussion	Experiment /Practicum	Field study	Presentations	Other
50%	10%	10%	%	30%	%

4. Evaluation (%)

Grading will be based on a simple sum of points obtained through assignments, mid-term exam, final exam, projects and presentations. The percentage will be changed accordingly.

Mid-term Exam	Final exam	Quizzes	Presentations	Projects	Assignments	Participation	Other
20%	20%	%	20%	20%	20%		%

II. Course Objectives

Knowledge:

Computational thinking, image/video data manipulation & processing, basic game programming architecture

Skill: python programming, algorithm development

Attitude:

III. Course Format

(* In detail)

- The course is mostly self-contained. Details of mathematics will be introduced by student requests or by necessity of describing the related topics.
- programming experiments are performed by students and their details will be shared through in-class presentations and Q&As.

IV. Course Requirements and Grading Criteria

- Student projects and assignments will be presented during the course and evaluated.
- Progress of the projects, assignments, and source codes will be shared.

Examples of curriculum-based writing homeworks/activity: all writing exercises requested by classes, including reports, discussion and presentations

V. Course Policies

VI. Materials and References

- Computer Graphics Using OpenGL (2nd Ed.), Francis S. Hill
- Digital Image Processing, Rafael Gonzalez and Richard Woods.
- Computer Vision: Algorithms and Applications, 2nd ed., Richard Szeliski, <https://szeliski.org/Book/>
- Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, <https://mml-book.github.io/>
- www.opencv.org
- www.pygame.org

VII. Course Schedule

* Subject to change:

- This schedule is a rough plan. The order of sequence may change.
- The schedule and topic may be changed mainly by the progress of coding projects.

Week 1 (dd/mm)	Learning Objectives	Introduction to image/video data
	Topics	1. Course logistics, Q&A 2. Image video data structure, creation, indexing, visualization 3. 2D drawing by cv2 functions
	Class Work (Methods)	
	Materials (Required Readings)	- Numpy - Pip install opencv-python - Vscode environment
	Assignments	
Week 2 (dd/mm)	Learning Objectives	Algorithmic drawing and visualization
	Topics	- Various 2D drawings with points and lines - Intro to random sample functions & random dot scatter plot - Iterated Function System: - Drawing: Sierpinski gasket, The gingerbread man

	Class Work (Methods)	
	Materials (Required Readings)	
	Assignments	
Week 3 (dd/ mm)	Learning Objectives	Transformation from virtual plane to pixel plane
	Topics	<ul style="list-style-type: none"> - Window to viewport transformation to fit the plots into the rectangle of pixels. - Drawing multiple dinosaurs - Turtle graphics: polyspirals - Regular polygons
	Class Work (Methods)	
	Materials (Required Readings)	
	Assignments	
Week 4 (dd/ mm)	Learning Objectives	Using parametric form for a curve
	Topics	Drawing curves parametrized mathematically by explicit functions. <ul style="list-style-type: none"> - Conic sections: Parabola, hyperbola, ellipse, superellipse - Polar coordinate shapes - Helix, Toroidal spiral
	Class Work (Methods)	
	Materials (Required Readings)	
	Assignments	Case study 3.7 & 3.8 of Hill's book.
Week 5 (dd/ mm)	Learning Objectives	DIY Line drawing / rasterization
	Topics	1. Line equation, sampling, and drawing pixels. 2. The Bresenham algorithm 3. Triangles and filled triangles
	Class Work (Methods)	
	Materials (Required Readings)	
	Assignments	
Week	Learning Objectives	2D geometric transformations

6 (dd/ mm)	Topics	<ul style="list-style-type: none"> - Rotation & translation of an image - Linear/bi-linear interpolation - Forward/backward transformation - Intensity clipping for overflow and underflow (8bit precision)
	Class Work (Methods)	
	Materials (Required Readings)	
	Assignments	
Week 7 (dd/ mm)	Learning Objectives	2D geometric transformations
	Topics	<ul style="list-style-type: none"> - 2D transformations & linear algebra revised. - Composition of affine transformations - Homogeneous coordinate representation - Triangle filling with a part of image
	Class Work (Methods)	
	Materials (Required Readings)	
	Assignments	
Week 8 (dd/ mm)	Learning Objectives	Mid-term Exam
	Topics	
	Class Work (Methods)	
	Materials (Required Readings)	
Week 9 (dd/ mm)	Learning Objectives	Pixel-based Image processing
	Topics	<ul style="list-style-type: none"> - Binary image - Bit planes of a gray scale image - Color representation: RGB & HIS - Color negation - Pixel-swap: random swap, brightness sorting in column. - Chroma-Keying application (student project)
	Class Work (Methods)	

	Materials (Required Readings)	
	Assignments	
Week 10 (dd/ mm)	Learning Objectives	Histogram analysis
	Topics	<ul style="list-style-type: none"> - Histogram computation - Brightness vs contrast - Gamma correction - Histogram equalization algorithm
	Class Work (Methods)	
	Materials (Required Readings)	
	Assignments	
Week 11 (dd/ mm)	Learning Objectives	Mask operations
	Topics	<ul style="list-style-type: none"> - Inner product (linear algebra revised) - Smoothing of 1D signals with box kernel, gaussian kernel, DOG, LOG - Convolution vs correlation - Masking for blurring an image - Spatial gradient: Sobel, mag & direction, edge detection - Canny edge detector - Gabor filter and Factalius visual effect generation
	Class Work (Methods)	
	Materials (Required Readings)	
	Assignments	
Week 12 (dd/ mm)	Learning Objectives	Morphological operation
	Topics	<ul style="list-style-type: none"> - Structuring elements, min/max operation - Dilation & erosion - Closing & Opening - Intro to pygame architecture
	Class Work (Methods)	
	Materials (Required Readings)	

	Assignments	A filtered video.
Week 13 (dd/mm)	Learning Objectives	
	Topics	2D Projective Transformation
	Class Work (Methods)	<ul style="list-style-type: none"> - 2D perspective transformation for pin-hole camera effect - Homography matrix - Planar transformation in a 3D perspective view Stitching two images of a common plane
	Materials (Required Readings)	
	Assignments	
Week 14 (dd/mm)	Learning Objectives	Coding, Compression, and Harmonic (Fourier) Analysis
	Topics	1. Linear algebra revisited: orthogonal basis & basis change 2. Principal component analysis 3. SVD 4. DFT
	Class Work (Methods)	
	Materials (Required Readings)	
	Assignments	
Week 15 (dd/mm)	Learning Objectives	Projects
	Topics	Project presentation
	Class Work (Methods)	
	Materials (Required Readings)	
	Assignments	
Week 16 (dd/mm)	Learning Objectives	Final Exam
	Topics	
	Class Work (Methods)	

	Materials (Required Readings)	
	Assignments	

VIII. Special Accommodations

IX. Aid for the Challenged Students