**Extended Syllabus**

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| **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** |  |

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

**Ⅰ. Course Overview**

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| 1. Description |
| The course will be talking about:   * 2D drawing and related mathematics * Image/video data visualization & manipulation * Image/video data processing |
| 1. Prerequisites |
| * Python programming language (e.g., COR1009) |
| 1. Course Format (%) |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Lecture | Discussion | Experiment  /Practicum | Field study | Presentations | Other | | 50% | 10% | 10% | % | 30% | % | |
| 1. 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**

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| Knowledge:  Computational thinking, image/video data manipulation & processing, basic game programming architecture  Skill: python programming, algorithm development  Attitude: |

**Ⅲ. Course Format**

(\* In detail)

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| - 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**

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| * 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**

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**Ⅵ. Materials and References**

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| * 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](http://www.opencv.org) * [www.pygame.org](http://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.

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| **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** | * Window to viewport transformation to fit the plots into the rectangle of pixels. * Drawing multiple dinosaurs * Turtle graphics: polysprials * 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.   * Conic sections: Parabola, hyperbola, ellipse, superellipse * Polar coordinate shapes * Hellix, Toroial 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**  **6**  **(dd/mm)** | **Learning Objectives** | 2D geometric transformations |
| **Topics** | * 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** | * 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)** |  |
| **Assignments** |  |
| **Week**  **9**  **(dd/mm)** | **Learning Objectives** | Pixel-based Image processing |
| **Topics** | * 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** | * 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** | * 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** | * 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)** | * 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**

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**Ⅸ. Aid for the Challenged Students**

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