<p style="text-align:center">Course Syllabus</p>

PHOT533 BIOMEDICAL IMAGING AND IMAGE PROCESSING
2024 Spring

Instructor

Dr. Michaël Barbier

e-mail: michaelbarbier@iyte.edu.tr

Office: door on the right of Z5

Hours: 9:00 – 17:00 (via appointment)

Course Schedule

TBA

Course Fundamentals

Course Description

This course in biomedical imaging technologies will cover the following topics: Image reconstruction and noise reduction techniques. Segmentation and mathematical morphology. Bioimaging in histopathology. Digitized histological slides: sectioning of tissue samples, immunohistochemical staining, image acquisition. Preprocessing of histology image data. Tissue segmentation. Region segmentation. Segmentation and morphological characterization of cell nuclei. Abnormality detection via pattern classification.

Course Objectives (Learning Outcomes)

At the end of the course, you should be able to:

1. Understand the characteristics of digital images of different modalities. Assess the required image properties to quantitatively study cells and tissues.
2. Discuss image processing pipelines for quantitative image analysis.
3. Perform different types of image processing: spot detection, regional segmentation, pixel & object classification, etc.
4. Extract and classify morphological features of cells.
5. Perform texture classification for cell and tissue image data.
6. Apply machine-learning techniques for image segmentation and object classification.

Prerequisites

There are currently no official prerequisites for this course. However, basic knowledge of numerical methods and previous experience with Python would be beneficial.

<u>Textbooks</u>

<u>Course Textbook</u>:

R.C. Gonzalez, R.E. Woods, **Digital Image Processing**, 4th ed., Prentice-Hall, 2022

<u>Supplementary Materials</u>:

William K. Pratt, **Introduction to Digital Image Processing**, CRC Press, 2013

F. Merchant (editor), **Microscopy Image Processing**, 2nd ed., Academic Press, 2022

<u>Course website and announcements</u>

You will find all announcements relevant to the course (homework, grades, etc.) on MS-Teams. Syllabus and course schedule may be subject to change during the semester.

<u>Class structure</u>

Course material will be presented on the whiteboard and on the screen. All lecture notes and class materials can be reached from Teams.

<u>Course schedule (tentative)</u>

Week 1	Microscopy and image acquisition characteristics: fluorescence, wide field, bright field, confocal, super-resolution, and holography.
Week 2	Definition of an image: pixels, spatial & temporal resolution, color, brightness/contrast, dynamic range, Nyquist sampling and aliasing effect
Week 3	Pointwise image operations
Week 4	Local filters and convolution
Week 5	Fourier spectrum and filters
Week 6	Denoising and deconvolution
Week 7	Image and video compression methods
Week 8	Image segmentation and pixel classification
Week 9	Object identification and tracking
Week 10	Object features and data analysis

Week 11	Quantitative comparison of image analysis procedures, analysis bias, interobserver error.
Week 12	Pixel and object classification with machine learning
Week 13	Convolutional neural networks
Week 14	Advanced neural networks for image processing

Course Policies

Attendance and class behavior

Students who attend the lecture are expected to actively participate (in listening, taking notes, understanding, problem solving sessions, etc.).

Homework assignments

Individual projects will be assigned during the term. These can be performed with help from others (fellow students, course instructors, etc.), but the solutions should have unique reports and are to be defended during the exams. Homework solutions/reports can be uploaded to Teams on the indicated due date until 23.59. Late homework may be turned in, but 25 points will be deducted from the full score (100 points) for each day that it is late.

Quizzes

Non-graded quizzes can be given during specific lectures (TBA), these do not influence your grades and scores will only be given to the individual students for him/her to understand what type of questions he/she might expect on the exam.

Examinations and Grading

To be announced according to Senate regulations.

Examination Dates

TBA

Disabilities

Students with certified disabilities requiring special accommodations are urged to contact the instructor at the beginning of the semester so that suitable arrangements may be made.

<u>Academic Integrity</u>

Students who violate University rules on academic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or suspension from the University. Forms of academic dishonesty include copying homework assignments (from a fellow student or internet), cheating on exams, use of unauthorized materials for exams, and changing solutions to returned assignments and exams.