# Syllabus

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# Department of Mathematical and Statistical Sciences
# Marquette University

Syllabus
Summer 2024

**Course:** MATH 4770/MSSC 5770: Statistical Machine Vision

**Time:** MoTuWeTh 11:30 am - 1:00 pm
Synchronous Distance Learning via MS Teams
Recorded for Asynchronous Learners

**Office Hours:** TuTh 1:00 pm – 2:00 pm via MS Teams

**Instructor:** Daniel B. Rowe, Ph.D. daniel.rowe@marquette.edu

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Course Description From The University Bulletin

**MATH 4770/MSSC 5770.** Statistical Machine Vision. 3 cr. hrs.

Object recognition and tracking for automatic machine vision systems. Topics include image representation, convolution, filter design, statistical deconvolution, discrete Fourier transform, automated object identification, text analysis, video object tracking and line tracing. Real-world applications such as object tracking within sequence of images, identification of item placement location in industrial settings, and autonomous lane departure identification. Additional topics may include object feature representations and statistical classification of objects. Computational implementation and examples utilize high-level programming language.

**Prereq:** COSC 1010, MATH 1451, and MATH 4720 or the equivalents.

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**Course Grading**
**Homeworks:** 60% (Submitted when due.)
**Final Project:** 40% (Present last class.)

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| | | |
|---|---|---|
| **MATH 4770 SCALE**: | 93% - 100% (A) | 90% - 93% (A-) |
| 87% - 90% (B+) | 83% - 87% (B) | 80% - 83% (B-) |
| 77% - 80% (C+) | 73% - 77% (C) | 70% - 73% (C-) |
| 65% - 70% (D+) | 60% - 65% (D) | 0% - 60% (F) |

**MSSC 5770**: Students in MSSC 5770 will be expected to demonstrate mastery of additional theoretical and numerical strategies on homework assignments.

| | | |
|---|---|---|
| **MSSC 5770 SCALE**: | 93% - 100% (A) | 90% - 93% (A-) |
| 87% - 90% (B+) | 83% - 87% (B) | 80% - 83% (B-) |
| 77% - 80% (C+) | 73% - 77% (C) | 0% - 70% (F) |

# Syllabus

**Topics:**

- Discrete image representation.
- Image enhancement via local pixel weighting
- (spatial kernel filter and image space convolution).
- Pixel noise reduction via local averaging (smoothing filters).
- Edge enhancement via local differencing (gradient filters).
- Statistical properties of local averaging or differencing (change in pixel mean, variance, and correlation).
- Image text recognition, letter or word identification (letter A, word MATH) or image object detection (car, face) via statistical correlation (template matching).

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**Topics:**

- Line tracing (road lane lines) within an image via discrete derivatives, gradients, and Hessians.
- Weighted time averaging (temporal recursive filters) for pixel noise reduction in image sequences.
- Identifying and tracking of objects including orientation through a sequence of images (car moving across a scene in a sequence of images).
- Image object segmentation (outlining image objects of interest).
- Connected component analysis object identification (determining the pixels that make up objects within an image).
- Image object representations (perimeter, area, elongation, etc.), feature extraction.

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**Topics:**

- Statistical classification of image objects using features (square, circle, and rectangle).
- Throughout computational implementation and examples will be given with Matlab.
- Additional topics will include the DFT to perform convolutions faster in frequency space.

Second time course being taught in MSSC.
Lecture length timings and course flow may vary.

Throughout the course you will implement techniques in Matlab.
I will provide a lot of sample code for you to mimic and draw from.

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# Questions?