

# CSCI 5561: Computer Vision

Spring 2021, 3 credits

## Instructor

Prof. Hyun Soo Park ([hspark@umn.edu](mailto:hspark@umn.edu))

- Office hour: Tue 2-3pm @ Zoom

## Teaching Assistant

Praneet Bala ([balax007@umn.edu](mailto:balax007@umn.edu)), Zhixuan Yu ([yu000064@umn.edu](mailto:yu000064@umn.edu))

- Office hour: Mon/Wed/Thr 2-3pm @ Zoom

## Teaching Mode

Completely online. Lecture videos will be uploaded every week in Canvas.

## Suggested Textbook (not mandatory)

"Computer Vision: Algorithms and Applications", Richard Szeliski

"Computer Vision: A Modern Approach", David A. Forsyth and Jean Ponce

## Program Language for Homework

In this course we will use Python to write programs.

## Prerequisites

CSCI 5511: Artificial Intelligence I

Note: **I will assume that all students are fluent on the following subjects** (we don't have time to cover in the lectures):

- + Python usage for image handling, matrix operation, numpy
- + Linear algebra
- + Calculus
- + Machine learning

## Evaluation

Your overall grade in the course will be determined by the following:

- 5 programming assignment (15% each)

- Late submission: 20% off from each extra late day
- Final project (25%)
  - Project proposal presentation 5%
  - Project proposal 5%
  - Project final presentation 10%
  - Project final report 5%

Note: no make-up assignment

Note on collaboration: in general, you are welcome to discuss the assignment problems in general with others, but **you must work out and write your own solutions: any in-person or online discussion should stop before you start discussing or designing a solution.** Note this means not only writing the final program, but also key preliminary and intermediate steps such as problem analysis, solution design, debugging, etc. Copying others' solutions or letting another person copy your solutions is a serious situation, which will result in course failure and we will report to University according to the plagiarism policy (<https://communitystandards.umn.edu/content/plagiarism>). If you have any questions about what is and is not allowable in this class, please ask the professor.

## Course Project

A team (three students) will find a challenging computer vision problem and propose a novel solution. The requirements are:

- Project proposal (3 pages)
  - Introduction/motivation
  - Related work
  - Baseline method
  - Proposed method
- Final report (6 pages)
  - Introduction/motivation
  - Related work
  - Baseline method
  - Proposed method
  - Result
    - Quantitative comparison
    - Qualitative result
  - Conclusion
- Rubric:
  - Clarity (20%)
    - Is presentation clear and well-delivered through visual representation?
    - Is the report well-written?
  - Introduction (10%)

- Is problem definition clear?
  - Why is the problem challenging?
  - What is the insight of the proposed work?
  - Does it summarize the report well?
- Related work (10%)
  - Does it include an exhaustive list of relevant work (+30 citations)?
  - Does it identify the position of the proposed work in the context of the related work?
- Baseline (10%)
  - Is the baseline reasonable (published in the last 3 years)?
  - Is training/testing data reasonable (state-of-the-art)?
- Proposed method (20%)
  - Is it new?
  - Is it understandable?
- Quantitative result (10%)
  - Does it include evaluation metric and training/testing data?
  - Comparison with the baselines?
  - Is comparison fair?
- Qualitative result (10%)
  - Is the result visually compelling?
- Conclusion (10%)
  - Does it summarize the proposed work?
  - Why does the proposed work work and what is evidence?

Submission format: CVPR submission format will be used (**cvpr2019AuthorKit.zip**).  
[http://cvpr2019.thecvf.com/submission/main\\_conference/author\\_guidelines](http://cvpr2019.thecvf.com/submission/main_conference/author_guidelines)

## Incompletes

An incomplete grade will be given only in very rare instances when an unforeseeable event causes a student who has completed all the coursework to date to be unable to complete a small portion of the work (typically the final assignment or exam). Incompletes will not be awarded for foreseeable events including a heavy course load or a poorer-than-expected performance. Verifiable documentations must be provided for the incomplete to be granted, and arrangements for the incomplete should be made as soon as such the unforeseeable event is apparent.

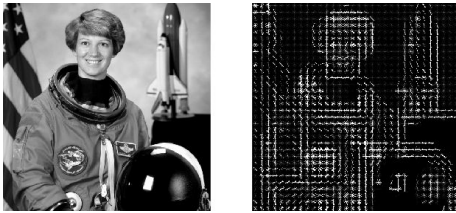
## Withdrawals

You are free to withdraw from the class up to the end of the tenth week of classes. Withdrawing thereafter is up to the college, and is not automatic. If you are not doing as well as you had hoped and are considering withdrawing, please do so by that date.

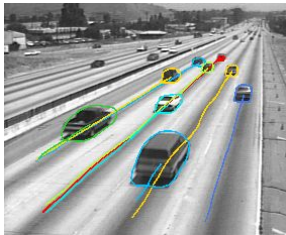
## Content

This course will walk through the fundamentals of computer vision from low level vision to 4Rs (registration, recognition, reorganization, and reconstruction).

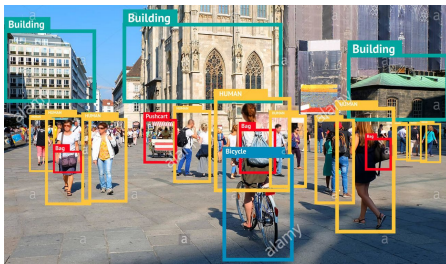
- + Low level computer vision: image formation, image convolution/filtering, feature representation



- + Registration: optical flow, image alignment, tracking



- + Recognition: bag of feature, template matching, object proposal, convolutional neural network



- + Reorganization: graph cuts, superpixel, semantic segmentation



- + Reconstruction: camera geometry, epipolar geometry, stereo



## **Tentative Schedule**

Week 1-3: Low level computer vision

Week 4-5: Registration

Week 6-8: Recognition

Week 9-10: Reorganization

Week 11-12: Reconstruction

## **Important Dates**

HW #1 due: Feb 5 midnight

HW #2 due: Feb 26 midnight

HW #3 due: Mar 19 midnight

HW #4 due: Apr 9 midnight

HW #5 due: Apr 23 midnight

Project proposal presentation: Mar 10

Project proposal report: Mar 12 midnight

Project final presentation: Apr 28

Project final report: Apr 30

## **Additional Information**

Standard University of Minnesota policies apply to this course on matters of

- the student conduct code,
- use of personal electronic devices in the classroom,
- scholastic dishonesty,
- makeup work for legitimate absences,
- appropriate student use of class notes and course materials,
- grading and transcripts,
- sexual harassment,
- equity, diversity, equal opportunity, and affirmative action,
- disability accommodations,
- mental health and stress management, and
- academic freedom and responsibility.

For detailed information about these policies, please see  
<https://policy.umn.edu/education/syllabusrequirements-appa>.