Syllabus

Course Description

This course is an introduction to computer vision, especially learning-based computer vision. Topics include camera models, low-level image processing, high-level vision, as well as latest research directions.

Here is a rough outline of topics:

- Image formation and processing
- Machine learning and neural networks
- Fundamental computer vision tasks
- Latest computer vision research topics
- Computer vision for autonomous driving

Grading Policy

Your grade will be based on:

1. **Homework Assignments (64%)**: There will be **six assignments** over the semester. The first one is very easy, worthing 4%. Each of the other five is worth 12%. In some assignments, you might get extra credits for solving more problems.

2. **Course Project (36%)**: You will work together in groups of 2-3 students to produce a substantial project over the second half of the semester. The team-up report is worth 4%; the proposal is worth 4%; the progress report is worth 4%; the presentation is worth 10% and the final report is worth 14%.

3. **Extra credits (at most 4%)**: Extra points can be awarded to someone who makes significant contributions to the course, such as asking insightful questions, or speaking up to promote better course designs.

Homework Assignment

- **Assignment l: Quick Survey**

- **Assignment 2: Python Programming**

- **Assignment 3: Image Processing**

- **Assignment 4: Machine Learning**

- **Assignment 5: Deep Learning for Computer Vision**

- **Assignment 6: Mini Project**

Course Project

This is an opportunity to explore a topic in depth and should involve substantial work. We consider two tracks: the competition-oriented track and the research-oriented track.

- **Competition-Oriented Project**

This track emphasizes engineering skills and is designed for future computer vision engineers. We expect that you develop a computer vision system that can reach the top performance in an existing benchmark. You can use any method, any trick to improve the performance. No novelty is required. The evaluation will lean to empirical performances. Here are some recommendations for the benchmarks.

  - 3D object detection: https://www.argoverse.org/tasks.html

  - 3D camera-only detection: https://waymo.com/open/challenges/2022/3d-camera-only-detection/

  - Object tracking: https://www.bdd100k.com/challenges/cvpr2022/

- **Research-Oriented Project**

This track emphasizes novelty and critical thinking. We expect that you are working on critical problems and novel techniques in computer vision. You have to explain why your problem is significant to the computer vision research community and how your solution is novel and intuitive. Great empirical performance is NOT necessary. The evaluation will lean to the task motivations and the technical novelties.

No matter which track you pick, we expect that all written works should be in CVPR format. **Please remember that we do not see your hard work, we only see the products you deliver.**

Concretely, the course project has the following deliverables:

Individual team-up report (at most 1 page): The individual team-up report should aim to introduce your team, why you choose the other team members. This report reminds you that good partners are always critical.

Proposal (at most 3 pages): The proposal should aim to explain what the problem is, why you want to do this, and how you plan to achieve it. The grade will be based on:

- *Quality of writing*. We expect very clear logical flow and nice illustrative figures.

- *Motivation*. We expect that you can well explain why this task is important or interesting in computer vision. This pushes your team to take time to do sufficient research and determine what specific problem are you trying to solve.

- *Tentative solution*. How are you going to solve the problem? You don't need to have everything already planned out, but you should propose some ideas.

- *Expected outcome*. What do you expect as an outcome and how will you identify and quantify success?

- *Timeline*. We expect you to make a detailed plan (weekly or bi- weekly).

- *Feasibility*. What are the potential reasons this project might fail? Can you access all data and code you need?

- *Division of work*. What is the role of each member?

Progress report (at most 5 pages): The progress report should aim to explain what the problem is, why it is significant, and how you plan to achieve it. The grade will be based on:

- *Quality of writing*. We expect very clear logical flow and nice illustrative figures.

- *Motivation*. For the competition track, we expect that you can explain why this benchmark is worth your efforts. For the research track, we expect that you can explain why your task is critical to the computer vision community.

- *Solution*. For the competition track, we expect that you list all the methods you have tried and you are going to try. For the research track, we expect that you propose novel technical ideas and can well justify your solution.

- *Division of work*. What is the contribution of each member? Who is the team leader?

Presentation (15-minute talk and 5- minute Q&A): The presentation should aim to well demonstrate the work of your team.

Final Project Report (at most 8 pages): Please write up your project in the style of a CVPR paper. Your final report should explain:

- *Quality of writing*. Again, clear logical flow, nice illustrative figures and concrete description.

- *Motivation*. For the competition track, we expect that you can explain why this benchmark is worth your efforts. For the research track, we expect that you can explain why your task is critical to the computer vision community.

- *Solution*. For the competition track, we expect that you list all the methods you have tried. For the research track, we expect that you propose novel technical ideas and can well justify your solution.

- *Outcome*. For the competition track, we expect that you report all the meaningful results you have. Leading positions in the benchmark would be highly appreciated. For the research track, we do not expect great results; instead, we expect the intention to achieve complete results.

- *Division of work*. What is the contribution of each member? Overall, who is the team leader?