EECS 598 – Special Topics: The Ecological Approach

University of Michigan, Electrical Engineering and Computer Science

Syllabus for Winter 2020

Administrivia

Instructor: David Fouhey (`fouhey` at `umich.edu`)

Class: Tuesday/Thursday 3:00PM – 4:30PM , 1003 EECS

Course Information: This course will use Piazza for announcements, updates, and discussions and gradescope for turning in assignments. Email David if you have personal questions; use piazza otherwise.

Description

The only known examples of actually intelligent agents that perceive their world are biological agents that are born, exist, move, interact with, and survive in the real world. Being a real agent has its challenges you are not fed the steady diet of human-labeled images and experiences that has fueled recent computer vision growth. However, it does come with the opportunity to explore and change the world as well as experience time-locked signals from a multiple modalities. In vision, this emphasis on the interdependence between a real agent and its environment is often referred to as the Ecological Approach to Visual Perception, as coined by JJ Gibson in his 1979 book with the same title. The goal of this course is to concretely explore this general perspective of an agent in its environment.

Specifically, we will explore (in no particular order): the perception of affordances and spatial layout; perception of and for manipulation; visual navigation; learning from demonstration and natural supervision (e.g., time-locked modalities); learning of physical models and dynamics; and learning of agency and intentionality. While the primary focus (and assumed background knowledge) is learning-based visual perception, readings will come from a wide variety of fields.

This is a graduate-level course incorporating two components. The first is weekly group-driven reading and active discussion and debating of related work in robotics, computer vision, machine learning, and psychology. The second are projects that put ideas from the first component to the test. These are semester-long projects, ideally interdisciplinary, that: find a particular problem; make a concrete hypothesis and experiments to test it; and execute them computationally using realistic data.

Textbooks

There is no textbook.

Format

Each class will be 75 minutes and consist of one of the following formats:

1. When we start a new topic:
   (a) Introduction (15 minutes – David);
   (b) Paper 1 (30 minutes – Student);
   (c) Paper 2 (30 minutes – Student).
2. When we are in the middle of a topic:
   (a) Paper 1 (30 minutes – Student);

(b) Paper 2 (30 minutes – Student);

(c) 15 minutes for more paper-specific discussion, everyone all together.

3. When we're done with a topic:

   (a) Paper 1 (30 minutes – Student);

   (b) Long-form Synthesis Discussion (45 minutes). This will be first in small groups (done by random number generator) and then together.

Work and Evaluation

This is a graduate-level highly participatory class and it is assumed that if you put in a strong effort and come prepared, you will do well. There are grades as an accountability mechanism, but the point is not the grades themselves. Your project will be graded on a normal 0-100 basis. Some fraction of grading will be done on a ✓+/✓/✓–/0 basis to avoid arguing worrying about the nuances of grading a two paragraph paper review. These mean (along with their corresponding numerical scores):

- ✓+: Exceptional work (97%) – in the top 10-20% of the work. It is normal to not get this.
- ✓: Normal work (94%) – this work is fine and well done, but not exceptional. This does not mean that you did poorly. This also will not be given for poor work.
- ✓–: Poor work (85%) – this work does not engage with the material in enough detail, is sloppy, or otherwise bad. I'll provide feedback for grades that are a ✓– to help you understand why they are a ✓–.
- 0: No work (0%) – this is work that does not exist, or is in the instructor's view a clear lack of good-fath effort (e.g., just a series of meows).

Your grade will be based on: (20%) Presentation and Discussion Leading; (20%) Paper reviews; (10%) Participation; (50%) Project .

Class Presentation / Discussion Leading (20%)

- **Description:** You are expected to: (1) present on at least one paper during the course of the semester; and (2) either present a second paper or lead a discussion in a small group during one of the discussions. If you present twice, your lower grade will be dropped.
- **Expectations (Presentation):** You are expected to talk for 20-25 minutes with 5-10 minutes of discussion. A reasonable divide might of your 20 minutes might be (for a paper where the contribution is primarily in the method): 5 minutes introduction and context; 10 minutes method; 5 minutes results. You should *summarize* the most important parts of the paper, point out the strengths.
  Going over your allotted time is one of the worst sins of presentations. Be sure to practice your talk, including actually talking, even to an empty room.
- **Expectations (Discussion Leading):** You are expected to help organize the discussion and keep it on track.
- **Grading:** ✓+/✓/✓–/0 by instructor

Paper Reviews (20%)

- **Description:** You are expected to write 12 short paper reviews about the papers we read over the course of the semester – one a week. You can pick any paper that we are reading, but you must submit this review *before* the paper is covered in class. The purpose of these is to incentivize you to read carefully and critically.
- **Expectations:** You should write three short paragraphs (about half a page) covering:

  1. a brief summary in your own words;

2. the strengths of the paper;
3. the shortcomings of the paper.

Here are some possible things you should think about:

1. What might be the limitations of the approach and its assumptions: where might it fail, even if all of its components work as intended?
2. What might this paper have done that was previously impossible?
3. What are broader take-aways from the paper that can be applied elsewhere?
4. What's the most important part of the paper or the method?
5. Do the experiments justify the paper's argument?

Be sure to separate the paper *in retrospect* from the paper *when it was published*, and always remember that while criticizing (in hindsight) is often easy, it is equally important to learn to see the good in papers.

- **Grading:** ✓+/✓/✓–/0 by instructor.

Participation (10%)

- **Description:** This is a discussion based class and you are expected to actively and meaningfully participate in discussions.
- **Expectations:** You are expected to come to class and actively and meaningfully participate in discussion. Quality is more important than quantity.
- **Grading:** On five randomly selected (i.e., by `random.random`) days, I'll take attendance. These get graded as follows: (✓+: 5; ✓: 4; ✓–: 2,3; 0: 0, 1). I reserve the use of this grade to penalize for failure to do peer reviews or quality peer reviews.

Project (50%):

- **Description:** You will complete a project over the course of a semester in groups of 2-5 that put ideas from the course to the test. An ideal project is a publishable paper. The proposal is ungraded, but should be taken seriously.
- **Expectations:** A full credit project could be published and presented at a respectable vision or robotics conference in terms of project, writeup, and presentation:
  - *Project:* The project should aim to test a concrete hypothesis and have the experiments and data to do it properly. Of course, research does not always go the way you want, so if you do a well-designed experiment and get a negative result, this is fine – you should investigate it thoroughly and write it up properly and accurately.
  - *Writeup:* The writeup should teach the reader in 6-8 pages what the paper set out to do, how it tried to do it, and what experiments were done. A good writeup can be understood by a half-interested person who is eating a sandwich and who desperately wants to not be there. It should be written well and include good figures.
  - *Presentation:* The presentation should be understandable by itself and will be done in the last few classes.
  - *Midterm report:* Partially through the semester, you will submit an abbreviated format 3 page paper that your peers and the instructor will evaluate. You should describe what is left, and what you hope to deliver.
- **Grading:** Your grade will be decided in five parts.
  1. 20% Peer and instructor review of midterm report
  2. 20% Project quality, graded by the instructor. This takes into consideration the ambition, amount and quality of work done, and general thoughtfullness.

3. 20% Final report quality, graded by the instructor. This takes into consideration the writing, presentation, and figures.
4. 20% Final presentation quality, graded by the instructor.
5. 20% Final holistic project evaluation, graded by peers

Homework Policies

You are free to discuss as much as you want – that's the entire point of the class. But:

1. Your work must be your own, unless you cite it properly
2. Your reviews must be written individually.

Please be reasonable about this.

General Remarks

1. *Accommodation:* If you think that you need an accommodation for a learning disability, please let me know. We will work with the Office of Service for Students with Disabilities (https://ssd.umich.edu/ to make proper accommodations.
2. *Counseling Center:* The Counseling Center staff (https://caps.umich.edu/) are trained to help you deal with a wide range of issues, such as how to deal with exam-related stress and other academic and non-academic issues. Services are free and confidential and do not impact student records.

Academic Integrity

All students in the class are: (a) presumed to be decent and honorable; (b) bound by the College of Engineering Honor Code; and (c) expected to read, understand, and follow the honor code. Information about this can be found here: https://elc.engin.umich.edu/honor-council/.