

SYLLABUS  
Vision in Humans, Animals & Machines

Psychology 312, Spring 2018  
Lecture, TR 9:40–11:00 AM, TLC 201

INSTRUCTOR: Dr. Flip Phillips

OFFICE: TLC 155

PHONE: 580-5313

URL: <https://www.skidmore.edu/~flip>

OFFICE HOURS: <https://goo.gl/ozosaS>

EMAIL: [flip@skidmore.edu](mailto:flip@skidmore.edu)

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## Overview

*Vision in Humans, Animals & Machines* will focus on the notion of *experimental vision*. We address this by surveying ‘vision’ in its many forms — ranging from single-celled animals to so-called ‘artificial intelligence’ based computer vision systems. We will survey the biological and evolutionary processes that led to our own sense of sight as well as how both natural and artificial systems have influenced our understanding of vision. We will explore computational models of biological vision as well as state-of-the-art deep learning techniques for image and scene identification. Ultimately we will settle once-and-for-all whether vision — as practiced by machines — bears any resemblance at all to the behavior of vision in natural systems.

This semester is an extension of last semester’s course. Part of this course will be in conjunction with a similar class at MIT, offered by my colleague, Pawan Sinha.

*NOTE*— If you’re just joining the class this semester, you have a little bit of ‘catch up’ reading and other work to do. We’ll go over it at the beginning of the semester.

Last semester we learned about the human visual system and some foundational theories of its operation. We also learned and used *Mathematica* to explore machine vision based on so-called ‘deep learning’.

This semester, our guiding question will be —

Does the deep learning approach to computer vision help us understand  
*anything* useful about biological vision?

## Outcome Goal Objectives Buzzword Pedagogy Mandatory Section

Students who complete this class will have a broad understanding of the relationship between vision as practiced by machines, humans, animals, and other living systems.

Specifically —

- How computer vision takes inspiration from
  - Animals
  - Other life forms
  - Non living things
- How our understanding of human vision is *inspired* by
  - Animals
  - Other life forms
  - Non living things
- How our understanding of human vision is *hampered* by
  - Computers
  - Other life forms
  - Non living things

Assessment will be via —

- Four (4) to six (6) projects spread through the semester.
- Three (3) to five (5) will be common across all students in the class.
- One (1) or two (2) will be team projects.
- One (1) will be a self-determined, final project.
- Overall contribution to the class.

## Materials

There is no required book. There *is* required reading, which will be posted on the MSTeams site for the class.

For a good part of the class, we'll be using *Mathematica* (see <https://www.wolfram.com> if you're not familiar with it). If you happen to be familiar with some other programming languages / system I'm *happy* for you to use it, but can't offer much support. Most if not all of the class projects can be done with OpenCV <http://opencv.org>, Pillow <https://python-pillow.org>, using Java, node, Python, SciKit Learn <http://scikit-learn.org>, MATLAB &c.


Skidmore's *Mathematica* license includes student access for your own personal machine. I'd recommend getting your own copy, since the lab and public computers are usually a version or two behind. Instructions are here — <https://academics.skidmore.edu/blogs/flip/?p=925>.


There is a very nice (if a *bit* pedantic) book on learning *Mathematica* — <https://www.wolfram.com/language/elementary-introduction> — that you can use to learn a little more about scientific computing.


There are a bunch of different ways you can use the book. You can buy a print copy, use it directly in a web browser, with CloudMathematica™, &c. The way *I* prefer to use the book is by downloading the notebooks —




### OTHER VERSIONS:

 Online Training Series:  
[Register Now »](#)

 Cloud edition:  
[Included in Wolfram Programming Lab »](#)

 Notebook edition:  
[Download Directly »](#)

*Also included in*  
[Wolfram Programming Lab for Desktop »](#)

 Kindle edition:  
[Order on Amazon »](#)

## Some useful places

- [www.wolfram.com](http://www.wolfram.com) — Scientific computing environment
- [www.wolfram.com/language](https://www.wolfram.com/language) — The Wolfram™ Language

- [mathematica.stackexchange.com](http://mathematica.stackexchange.com) — A great (if a little brusque) place to get your *Mathematica* questions answered.
- [community.wolfram.com/](http://community.wolfram.com/) — The Wolfram Community

## Schedule

Here's the plan —

- PART 0: Review — Scientific Computing, Computer Vision, Biological Vision  
A quick look at / review of *Mathematica* and friends. If you're not already into the computer thing this will be where you start your learning process via the Wolfram book, mentioned above. What computers can see, how they see it, what they are really bad at. What animals can see, how they see it, what they are really bad at.
- PART 1: Biologically Inspired Computer Vision Part II  
What we know about animal & biological vision and how it effects computer vision.
- PART 2: Computer Inspired Biological Vision  
How computational models of vision have helped and *especially* hindered our understanding of biological vision.

There will be a project due *roughly* at the end of each part. The requirements for each will be featured on MSTeams.

## Assessment & Grading

PROJECTS: ( $N = 3$  to  $5$ ) — 60%

FINAL PROJECT: ( $N = 1$ ) — 30%

'PRESENCE': ( $N = 1$ ) — 10%

### PROJECTS

Projects will include exercises in basic computer vision, visual psychophysics, as well as writing.

### PARTICIPATION & PRESENCE

Participation can take many forms. Feel free to do so as you feel comfortable, but do participate. Your grade for this section depends on *all* contributions to class, including but not limited to: class discussions, paper reviews, on-line contributions, & helping your fellow students.

## Office Hours & Appointments

I schedule my office hours using Outlook. There is a link with step-by-step directions on my web page, but, in brief:

- Go to the People section of Outlook (on-line or on your phone/pad/computer).
- Search for Flip Phillips.
- You'll see a little button that says Schedule a meeting —
- Do that.
- It will show you when I'm 'busy'.
- Schedule anything (rational, e.g., not before 8 AM or after 6 PM) and it will send me a request. If it's cool with the rest of my schedule, we're good!

## Details

**Honor Code:** The Skidmore Honor Code is the main governing policy of this class. Learn it. Know it. Live it.

See <http://www.skidmore.edu/advising/integrity/index.php> for details.

**Attendance:** Show up. Miss more than 3 classes and I *reserve the right* to fail you. Miss the first day and I *reserve the right* to drop you from the class and admit someone on the wait-list.

**Missing Exams or Labs:** To be excused from an exam, except for sudden extreme illness, you must arrange with me at least 24 hours before the exam is scheduled. Anyone missing an exam who has not been excused will receive a o. Make-up exams must be scheduled within the week following the exam.

**Lateness:** Work presented late without prior notice will receive a o. If something is going to be late get in touch with me. I reserve the right to give late work whatever penalty I feel is appropriate.

**Extra Credit:** I don't offer 'extra credit.'

**Plagiarism:** *Any* act of plagiarism will result in a failing grade for the course and whatever procedures / processes I am obligated to undertake on behalf of the department & college. I take this pretty seriously. If you're not sure if something is plagiarism, **ask**.

ADA: Services and accommodations are available to students covered under the Americans with Disabilities Act. If you have any visual, perceptual, or physical challenges that might result in the need for some form of accommodation I am more than willing to help you help yourself. Contact me and/or Student Academic Services

[http://www.skidmore.edu/academic\\_services](http://www.skidmore.edu/academic_services)

for assistance.

Slack: Generous swaths of slack shall be cut to those who exhibit respect for the learning process and the class in general.

CYA: This document subject to random changes at my discretion or via *vis major* — with proper notice in class / via email / BlackBoard / MS Teams / and/or carrier pigeon.

Warning:

In this class, you *could* be exposed, at any moment, *and without warning of its imminence* to: ideas, comments, imagery, sounds, feels, readings, people, and other things that you may find: shocking, offensive, absurd, annoying, racist, sexist, homophobic, discriminatory, or generally obnoxious.

Similarly, you *will* be exposed to: ideas, people, readings, sounds, comments, and other things that you will find: exhilarating, exciting, confusing, joyous, thought provoking, midnight-dorm-conversation worthy, and rewarding.

We call this ‘education.’

— ADAPTED FROM J RAUCH

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Last updated: January 23, 2018