

# Syllabus

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Intro to Computer Vision and Machine Learning ARTTECH 3039

## Semester, Year

Spring, 2020

## Meeting Times

Thursday 9am-4pm

## Meeting Location

MacLean 401

## Instructor

Doug Rosman

[dougrosman.com](http://dougrosman.com)

[drosman@saic.edu](mailto:drosman@saic.edu)

## TA

Sal Moreno

[smoreno4@saic.edu](mailto:smoreno4@saic.edu)

## Course website

<https://dougrosman.github.io/cvml-saic>

**All course material including assignments, weekly code exercises, in class resources, etc. will be posted on the class website, NOT on Canvas**

## Canvas

<https://saic.instructure.com/courses/2645666>

**Please make sure you are able to receive Canvas notifications. I will be posting announcements through Canvas to reach the entire class**

## Slack channel

[cvmlsp20.slack.com](https://cvmlsp20.slack.com)

**The Slack channel exists as a class community resource. Post code/general questions, resources, or whatever cool stuff you find**

## Course Description

Computer vision allows machines to see and understand their environment. This course will equip students with the practical skills and critical theory needed to both employ and critically engage these techniques. Real-time

body tracking, object and facial recognition, and gesture analysis. Artificial Intelligence and machine learning will be emphasized. Machine learning applications related to text and sound and reinforcement learning will also be discussed, although in-class exercises will not focus on them.

Students will explore and critique contemporary applications ranging from automated mass surveillance to interactive installations. A final project will build on in-class workshops, technical exercises, critical readings and discussions.

## Course Goals

- Working and applied knowledge of creative coding practices
- Working and applied knowledge of “classical” computer vision techniques.
- Working and applied knowledge of "modern" computer vision techniques that leverage machine learning.

## Course Values

- Sharing / Open
  - Documentation
  - [DIWO \(Do It With Others\)](#)
  - Publish
  - [Cult of Done Manifesto](#)

## Methodology

Students will engage in individual in-lab and home assignments, class presentations, lectures, discussions, assigned readings, group and individual projects and desk critiques. Visiting artists / faculty may enhance the experience and offer additional perspectives.

## Class Structure (Typical)

9:00 - 9:30 : Look at new artists, catch up on the week's CV/ML headlines.

9:30 - 10:15 : Lecture Part 1.

10:15 - 10:30 : Break

10:30 - 12:00 : Lecture Part 2.

12:00 - 01:00 : Lunch

01:00 - 02:30 : Hands-on Workshop.

02:30 - 02:45 : Break

02:45 - 04:00 : Open Studio (Homework, Projects, Discussion, etc).

## Assignments

The first 10 weeks of the course will be built on well-constrained code-based assignments. These assignments have clear goals and are intended to build confidence and code competency:

- Weeks 1-4 weeks emphasize code and "classic" computer vision techniques.
- Weeks 5-10 emphasize machine learning approaches and data acquisition/curation.
- Weeks 11-15 week of the course are focused on integrating these techniques, technologies and critical discussions with your existing creative / research practice.

## Creative Coding Tools

We will be doing most of our work with **P5.js** on the web, with potential for some Processing and C++/openFrameworks. While many modern computer vision and machine learning tools are built with C++ at their core, many powerful creative tools have become available that allow web-based applications to utilize computer vision and machine learning techniques.

- [P5.js](#)
- [ml5.js](#)
- [Processing](#)
- [openFrameworks](#)
- [Wekinator](#)
- [RunwayML](#)
- [Teachable Machine](#)

Open source tools available online use a variety of coding languages and frameworks. Students are encouraged to find tools outside of what is introduced in class when composing final projects.

## Class Text(s)

There is no single class text, though there are online books, guides and articles we'll reference throughout the semester.

### Computer Vision

- [ofBook: Image Processing and Computer Vision](#)
- [Learning OpenCV : computer vision with the OpenCV](#)

### Machine Learning

- [ML4A \(Machine Learning for Artists\)](#)
- [Deep Learning \(Ian Goodfellow, Yoshua Bengio, Aaron Courville\)](#)
- [Neural Networks and Deep Learning](#)

## End of semester exhibition (tentative)

Depending on availability, final projects will be included in an exhibition at the end of the semester.

## Materials

Some machines are available in the classroom for deep learning projects, but students should bring their personal devices to complete their assignments. Peripheral devices (webcams, Kinects, etc.) are available to check out from the ATS tech room.

## Attendance

- Students are best served by attending all classes.
- Missing three classes will result in a class failure. This is strictly enforced.

- Six or more unexcused late arrivals or early departures will result in class failure. Class will begin promptly at 9am. Tip: If you are going to be absent, late to class, or need to depart early, please contact me BEFORE class starts.

## Wait Lists

Students wait-listed for classes will be admitted on a space available basis determined by instructors' discretion (in consultation with the department chair).

## Grading Procedure/Criteria

Grades are credit / no-credit for this course. Credit is based on several factors:

- 30% participation (discussions, critiques, etc)
- 70% projects / assignments. All assignments must be completed in order to receive credit for this class
- Incomplete grades will not be offered.

## Writing Assistance

[Writing Center](#)

## Disability and Learning Resource Center

[Disability and Learning Resource Center](#)

## Study Sessions/Tutor hours

Based on class availability, I plan to be available once a week for a couple hours to help reinforce in-class concepts. I will not be providing homework answers in these sessions. Please attempt the homework before attending these sessions. Students are encouraged to work together on homework assignments.

## Course Schedule

(subject to change based on incoming skills and experience)

### **Session 01 (01.28.2020) - Introduction**

- Introduction to Computer Vision / Machine Learning
- "What is computer vision?"
- "What is machine learning?"
- Introduction to Artists Using Computer Vision / Machine Learning
- Setting up our tools
- Creative Coding crash course: HTML/CSS/P5.js
- Pixel and webcam basics

### **Session 02 (02.04.2020) - Computer Vision/Creative Code Basics**

- Brightness Threshold Tracking
- Color Detection
- Brightest point

- Frame difference

### **Session 03 (02.11.2020) - Computer Vision/Creative Code Basics II**

- RGB+D
- Optical Flow

### **Session 04 (02.18.2020) - Graphics/3D basics/physics**

- Particle physics
- Box 2D
- Intro to three.js

### **Session 05 (02.25.2020) - Intro to machine learning**

- RunwayML
- Teachable Machine
- Create a neural network from scratch

### **Session 06 (03.03.2020) - Dimension Reduction and Visualization**

- PCA (principle component analysis)
- tSNE
- data sourcing techniques
- intro to web scraping and scripting

### **Session 07 (03.10.2020) - Recognition**

- Face Recognition
- Object recognition
- Pose/gesture recognition

### **Session 08 (03.17.2020) - Image synthesis I**

- Style Transfer
- GANs (BiGAN, StyleGAN)

### **Session 09 (03.24.2020) - Image synthesis II**

- pix2pix
- Final project proposal assigned

### **Session 10 (03.31.2020) - NO CLASS - CRITIQUE WEEK**

- Final project proposal due online

### **Session 11 (04.07.2020) - Open studio**

- Misc workshops

- Work on final projects

### Session 12 (04.14.2020) - Open studio

- Misc workshops
- Work on final projects

### Session 13 (04.21.2020) - Open studio

- Misc workshops
- Work on final projects

### Session 14 (04.28.2020) - Critique day

- Final Critiques

### Session 15 (05.05.2020) - Documentation day

- Exhibition install?

## Prerequisites

Knowledge of basic coding tools is strongly encouraged, but not required for this course. This includes the following:

### Familiarity with the Command Line

- Navigate the file system using
  - `cd` Change directory
    - using `cd ../../../../my_folder` relative paths names
    - `cd /Users/me/Desktop` absolute path names
  - `..` Specify the parent directory
  - `.` Specify the current directory
  - `pwd` Output the current working directory
- Modify the file system using
  - `mkdir new_directory` Make a new directory
  - `rmdir old_directory` Remove an old directory
  - `rm -rf old_directory` Recursively and forcefully remove an old directory (be careful!)
  - `mv old_name.txt new_name.txt` Rename files
  - `mv old_name.txt ../../` Move files
- Resources:
  - [Learn Enough Command Line](#)

### Familiarity with Git / Github

- Resources:
  - [GitHub for Poets](#)
  - [Up and Running with Git and GitHub Git Essential Training](#)