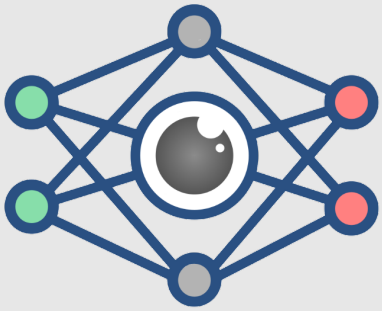

# Deep Learning for Computer Vision

CS3485

## Instructor Info


Jeová Farias S. R. Neto

**Office Hours:** Mon. and Wed. 4:30-5:30pm

**Hours Location:** Seales 121

j.farias@bowdoin.edu


## Course Info

**Class Days:** Mon & Wed

**Class Times:** 11:45a-1:15p

**Location:** Seales 126

## Overview

Computer Vision has become ubiquitous in our society, image searches to self-driving cars. On the other hand, Deep learning has shaken the world of artificial intelligence in recent years. Most of these developments greatly advanced the performance of state-of-the-art visual recognition systems, which put Computer Vision at the epicenter of most technological progress from the past decade. In this context, this course aims at providing a consistent exploration of how deep learning started to its most recent achievements, always using Computer Vision tasks as their main application, historically or practically. During the course, we'll also understand many of the main computer vision problems and use them as cases for the introduction of various deep learning related problems. Finally, this course hopes to give students working knowledge of PyTorch, one of the main deep learning frameworks, and prepare them for future industrial and academic careers in the field.

## Learning Objectives

By the end of the course, the students are expected to:

- Understand what Computer Vision is and how it's been broadly applied in the industry and academia.
- Know what neural networks are and how that led to the development of Deep Learning.
- Have a concise knowledge of how Deep Learning was developed and what problems it brought solutions to.
- Have enough working skills on PyTorch to developer Deep Learning applications for, and more broadly than, Computer Vision.
- Be able to read and understand the recent literature in Deep Leaning and Computer Vision and present their content to a wider audience.

## Prerequisite

Basics of Multivariate Calculus, Linear Algebra and Machine Learning.

## Textbook

Ayyadevara, V. Kishore, and Yeshwanth Reddy. *Modern Computer Vision with PyTorch: Explore deep learning concepts and implement over 50 real-world image applications.* Packt Publishing Ltd, 2020.

## Grading Scheme

| | |
|---|---|
| 10% | **Attendance/Participation** |
| 30% | **Labs** |
| 30% | **Midterm Exams, 15% each** |
| 30% | **Final Project** |

*Extra participation points may be given along the course.*

Final grades will follow the scale:

**4** : $95-100\%$, **3.7** : $90-95\%$, **3.3** : $85-90\%$, **3** : $80-85\%$,
**2.7** : $75-80\%$, **2.3** : $70-75\%$, **2** : $60-70\%$, **1** : $50-60\%$, **0** : $< 50\%$

*Curving is at the discretion of the professor.*

## Make-up Policy and Extensions

Each individual will be given **4 late days for the semester**. A late day is a 24 hour extension from the original deadline. This will encompass any reason - illness, interviews, many midterms in the same week, etc. Past these days, late assignments will not be accepted. You should budget your days to account for future illnesses or assignment deadlines for other courses. Even if you do not fully complete a lab assignment you should submit what you have done to receive partial credit. Late days count against both partners in a group lab.

For extensions beyond these 4 late days (in the case of an emergency or ongoing personal issue), please contact your Class Dean. The three of us will work together to arrange an appropriate accommodation.

## Accommodations for Students with Disabilities

I am committed to partnering with you on your academic and intellectual journey. I also recognize that your ability to thrive academically can be impacted by your personal well-being and that stressors may impact you over the course of the semester. If the stressors are academic, I welcome the opportunity to discuss and address those stressors with you in order to find solutions together. If you are experiencing challenges or questions related to emotional health, finances, physical health, relationships, learning strategies or differences, or other potential stressors, I hope you will consider reaching out to the many resources available on campus.

Students who have already been approved to receive academic accommodations and want to use their accommodations in this course should share their accommodation letter and make arrangements to meet with me as soon as possible to discuss how their accommodations will be implemented in this course. Please note that accommodations are not retroactive and require advance notice in order to successfully implement.

If, at any point in the semester, a disability or personal circumstances affect your learning in this course or if there are ways in which the overall structure of the course and general classroom interactions could be adapted to facilitate full participation, please do not hesitate to reach out to me.

## Final Project

The Final Project is an opportunity for you to apply what you have learned in class to a problem of your interest! Here's some logistics:

**Theme:** The project can be on anything that can use deep learning as a helper/solver (**Project Type 1**). If you're coming to the class with a specific background and interests (e.g. biology, engineering, physics), we'd love to see you apply deep learning techniques to problems related to them! Note that this does not need to directly involve computer vision in any way. Additionally, the students can also choose to do a mini-literature review of a computer vision task that was or wasn't covered in class (**Project Type 2**). In this case, the students will choose at least two papers on that task, run their available codes and compare their performance. They will also a mini-introduction what that task is and how people have approached it besides deep learning, if ever. In the case that you don't have any project idea for either type, the professor can also suggest project ideas. He will also be available to quick routine meetings if with team finds it appropriate.

**Team Formation:** The teams should be of 2-4 people and they are formed at the discretion of each student. In case you are having trouble finding project partners, consult the professor.

**Project Proposal:** The teams should be formed by **Nov 10th**, when they should submit a 1-2 page project proposal. It should contain the problem statement, motivation, the main tasks and how each student will contribute to it.

**Project Presentation:** The final presentations will take place on **the week before the finals period** and each presentation should last for at least 10 min, such that each student member presents for at least 4 min. In the presentation, the team should introduce and motivate the problem, describe your solutions and the difficulties found and present some results along with the summary.

**Deliverables:** Each team should send two main deliverables: (1) your project code in a .zip file and (2) your slides. Your code will be mostly graded based on its organization, where documentation will play a big role. Your presentation will also be graded on its organization (from both the slides and speech perspective) and whether it covered the topics described above.

**Grade breakdown:** The final grading will be as follows:

**Proposal** : 10%, **Code** : 40%, **Slides** : 10%, **Presentation** : 40%,

## Diversity and Inclusivity Statement

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability - and other visible and non-visible differences.

## Academic Integrity

The College Honor Code is central to the ideals of this course. Students are expected to be independently familiar with the Code and to recognize that their work in the course is to be their own original work that truthfully represents the time and effort applied. Violations of the Code are most serious and will be handled in a manner that fully represents the extent of the Code and that befits the seriousness of its violation.

## Tentative Class Schedule

A tentative class

# Tentative Class Schedule

## MODULE 1: Deep Learning

| | |
|---|---|
| Week 1 | *Aug/30th*: Intro to Computer Vision |
| Week 2 | *Sep/4th*: ***LABOR DAY***<br>*Sep/6th*: Linear Classifiers and Perceptron |
| Week 3 | *Sep/11th*: Multilayer Perceptron and Intro to Deep Learning<br>*Sep/13th*: Optimization and Regularization |
| Week 4 | *Sep/18th*: Pytorch<br>*Sep/20th*: Convolutional Neural Networks |
| Week 5 | *Sep/25th*:Data Augmentation and Deep CNNs<br>*Sep/27th*: Transfer Learning and Residual Nets |
| Week 6 | *Oct/2nd*: Review<br>*Oct/4th*: **Midterm 1** |
| Week 7 | *Oct/9th*: ***FALL BREAK***<br>*Oct/11th*: Inception Net and what CNNs learn |
| Week 8 | *Oct/16th*: Adversarial Examples and Self-supervision |

## MODULE 2: Computer Vision

| | |
|---|---|
| Week 8 | *Oct/18th*: Intro to Object Detection |
| Week 9 | *Oct/23th*: Fast Object Detection<br>*Oct/25th*: Intro to Image Segmentation |
| Week 10 | *Oct/30th*: Applications of Detection and Segmentation<br>*Nov/1st*: Autoencoders |
| Week 11 | *Nov/6th*: Image Generation with GANs<br>*Nov/8th*: Advanced GANs |
| Week 12 | *Nov/13th*: Transformers and ChatGPT<br>*Nov/15th*: Image Generation by Prompt Review |
| Week 13 | *Nov/20nd*: **Midterm 2**<br>*Nov/22th*: ***THANKSGIVING!*** |

## MODULE 3: Final Projects

| | |
|---|---|
| Week 14 | Work on Final Projects |
| Week 15 | **FINAL PROJECTS WEEK** |