MACHINE LEARNING

EEL4930 Machine Learning
Spring 2020

UF Herbert Wertheim College of Engineering
UNIVERSITY of FLORIDA

INSTRUCTORS

Instructor: Dr. Catia S. Silva
Lecturer
Electrical & Computer Engineering
Office: NEB 467
Office Hours: Tuesdays 10:40 AM – 11:40 AM, or by appointment

Supervised Teacher: Matthew Cook
Ph.D. student
Machine Learning & Sensing Lab
Electrical & Computer Engineering
Office: NEB 401
Office Hours: TBD

ABOUT ME

Dr. Catia Silva (KA-tee-uh SIL-vuh)

Lecturer in Electrical & Computer Engineering Department

Joined UF July 15, 2019

Conducting research in Machine Learning & Signal Processing since 2009

- Conduct basic Machine Learning & Pattern Recognition Research
- Driven by Application

MATT COOK

2nd year Ph.D. student

- Research Assistant in Dr. Alina Zare's research lab
  - Develop environmentally adaptive ATR

Previous school/work experience:

- University of Missouri (2009 to 2015): B.S. in ECE &M.S. in CE
- Naval Surface Warfare Center – Panama City Division (2016 to Present):
  - Developed Automatic Target Recognition Software for Navy Applications

Research Interests:

- Deep Learning
- Competency Aware machine learning

COURSE WEBSITE: CANVAS & GITHUB

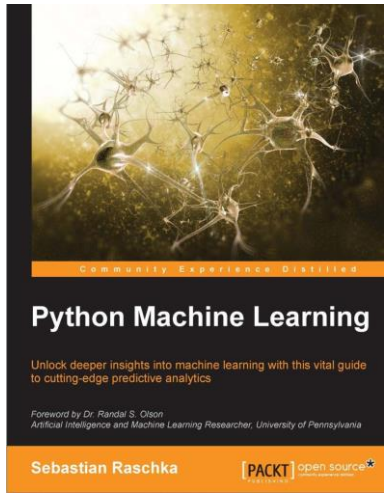
- Syllabus (including approximate course schedule) can be found posted on Canvas.

- Course Website
  1. Canvas: will be used as a communication channel and to post grades
     - https://ufl.instructure.com/courses/395133
  2. GitHub: will be used to access all course materials (lectures, assignments, labs & project groups) and submit assignments

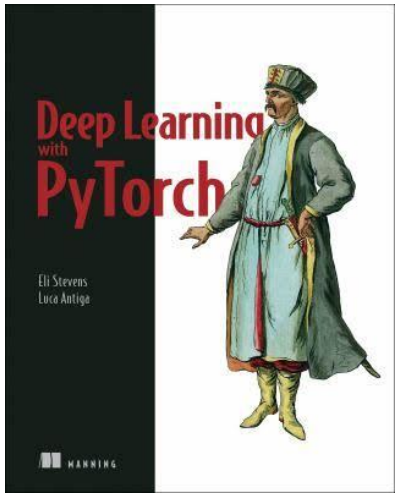
- Prerequisites
  - Programing experience
    - We will be programming in Python

TEXTBOOKS & SOFTWARE - REQUIRED

Title: Python Machine Learning
Author: Sebastian Raschka
Publisher: Packt Publishing
Year: 2016



Title: Deep Learning with Pytorch
Author: Eli Stevens & Luca Antiga
Publisher: Manning Publications
Year: 2006

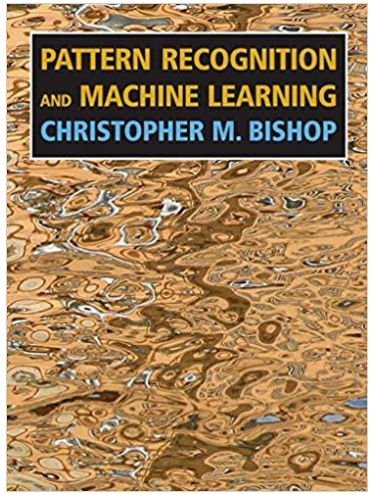


e-book available here

Software:
Python 3.4.3+
Git
Pytorch

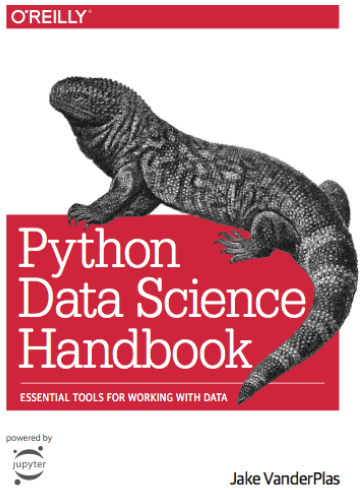
TEXTBOOKS - RECOMMENDED

Title: Pattern Recognition and Machine Learning
Author: Christopher Bishop
Publisher: Springer
Year: 2006



PDF available here

Title: Python Data Science Handbook
Author: Jake VanderPlas
Publisher: O'Reilly Media
Year: 2017



e-book available here

GRADING

- Grade will be based on:
  - Homework (30%)
  - Lab Assignments (20%)
  - Midterm Exam (20%)
  - Project (10%)
  - Final Exam (20%)
- During the semester, we will have:
  - ~ 8 Homework
  - 4 Lab Assignments
  - 1 semester-long project
  - We will provide assignment solutions
- Individual assignments will be normalized
- Final grades will be curved

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

EXPECTATIONS

- Do the reading in advance
- Stay on top of assignments
- Ask questions when you do not understand
- Participate in classroom discussions and activities
- You are expected to bring a laptop to class with git installed, the ability to code and compile in python 3.4.3+, and run jupyter notebooks

EXTRA CREDIT

If you find (meaningful) errors or typos in lecture notes, code, examples, etc. posted in the class materials, you can report these using HitHub's "pull request" to get some extra credit.

- See: https://help.github.com/articles/about-pull-requests/

For errors/typos in any PDF file, be sure to correct both the associated the .ipynb and .pdf file for my review.

WHAT IS MACHINE LEARNING?

Course Overview: Introduction to **machine learning** and its role in a variety of real-world problems in areas such as adaptive filtering and image processing.

- So, what is machine learning? www.wooclap.com/**SNDEMP**
- Can a machine or a computer learn?
- Can a machine or computer be intelligent?
- One definition of **Machine Learning**: Area of study to develop methods for computers to make (intelligent?) decisions without being explicitly programmed.

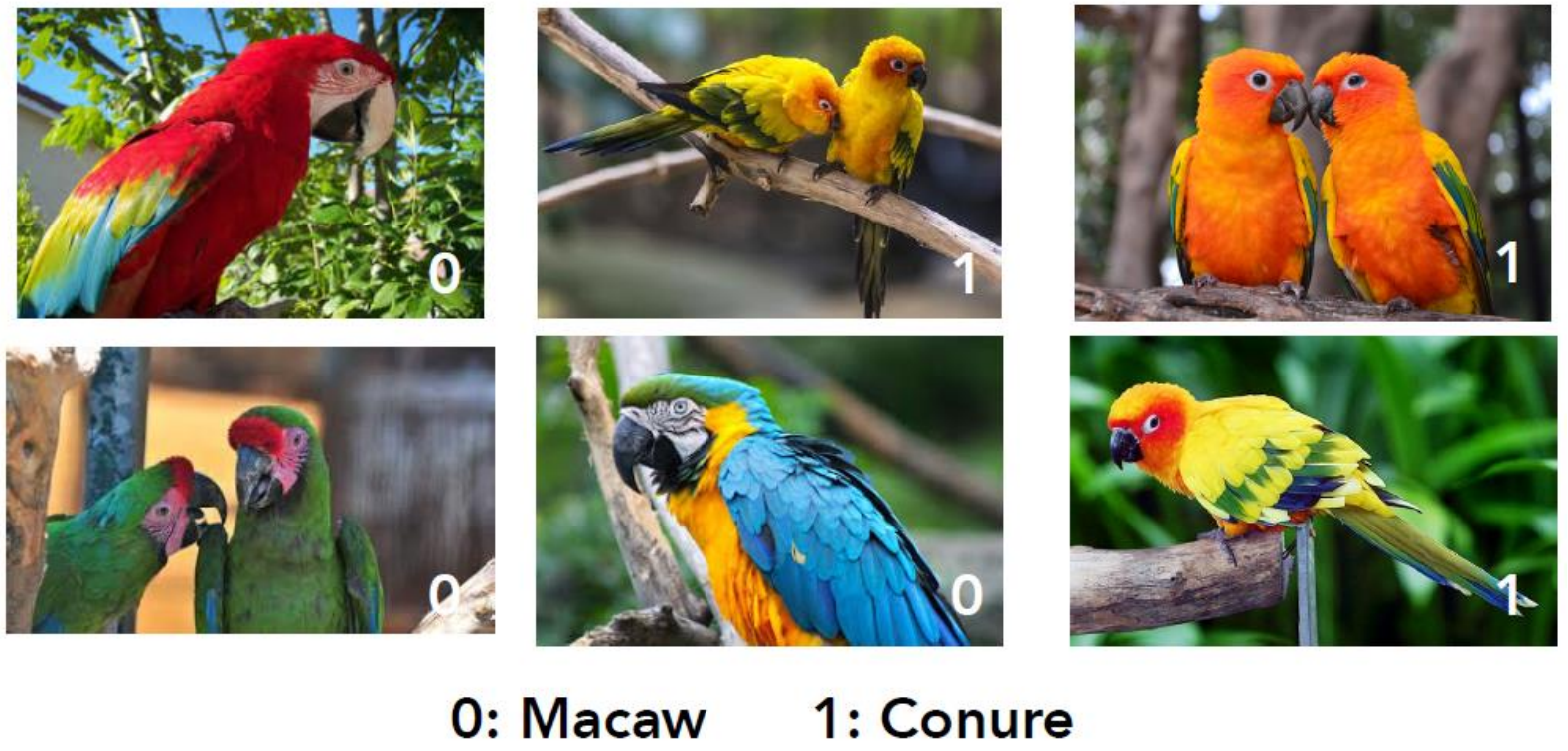
SUB-AREAS OF ML

- Supervised Learning
- Unsupervised Learning
- Neural Networks & Deep Learning
- Semi-supervised Learning
- Reinforcement Learning
- Active Learning
- Transfer Learning
- Structured Learning
- Associative Learning
- …

We will study these sub-areas of ML

SUPERVISED LEARNING

Learning mapping from input data to desired output values given labeled training data.



SUPERVISED LEARNING

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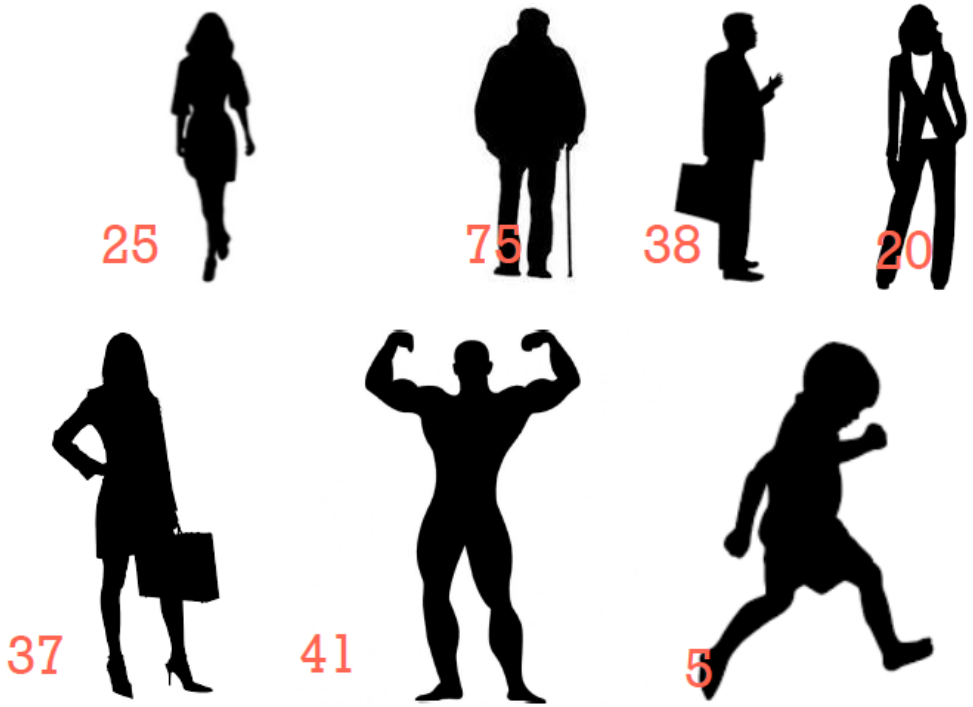


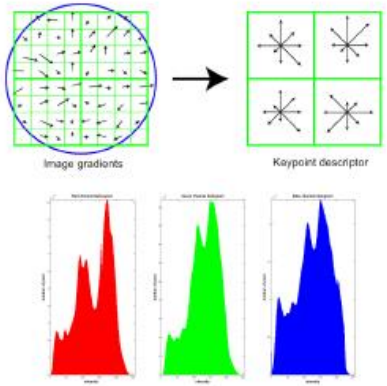
SUPERVISED LEARNING

The Usual Flow (but not always)

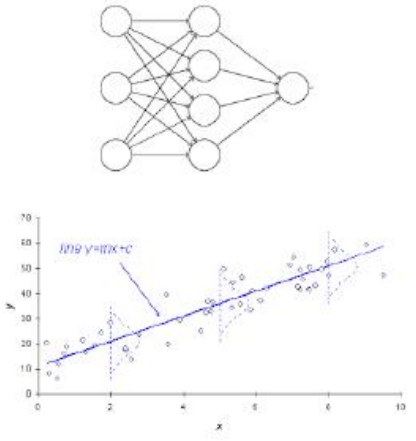
Training

Collect Labeled Training Data

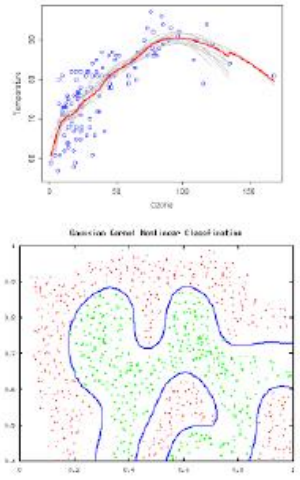
Extract Features



Select a Model



Fit the Model



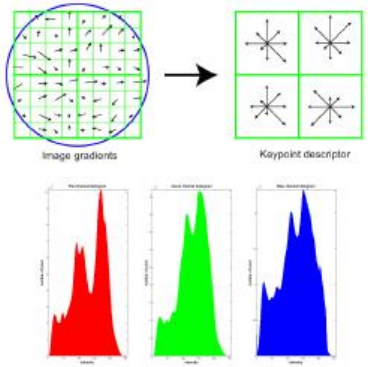
SUPERVISED LEARNING

The Usual Flow (but not always)

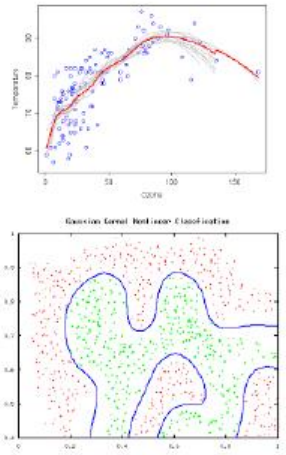
<u>Testing</u>

Given
Unlabeled Test
Data

Extract
(the same)
Features



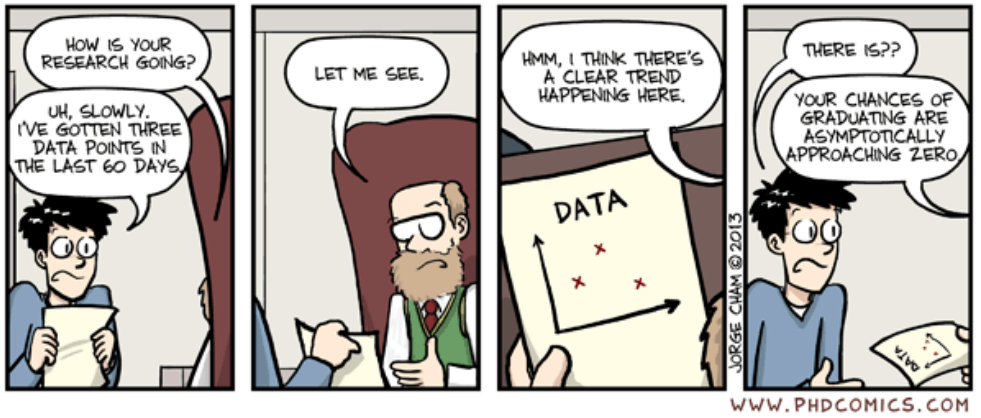
Run It Through
Your Trained
Model



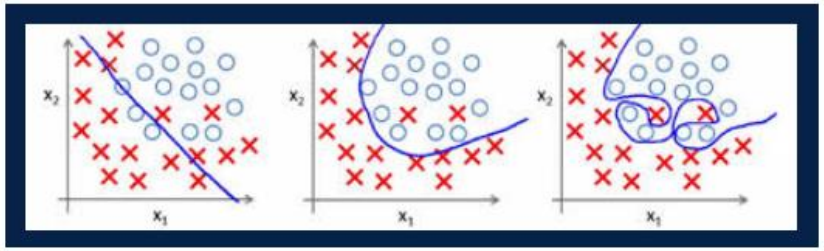
(SUBSET OF) CHALLENGES

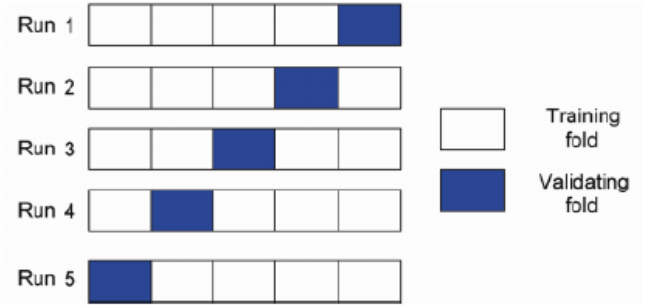
- How do you know if you have *representative* training data?
- How do you know if you extracted *good* features?
- How do you know if you selected the *right* model?
- How do you know if you trained the model *well*?

GET LOADS AND LOADS OF DATA

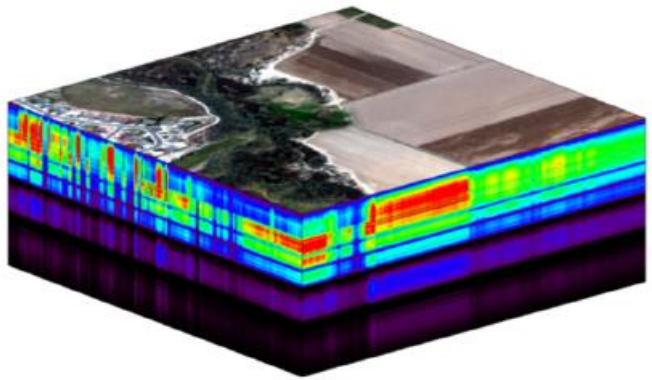


Partition (thoughtfully) into Training, Validation, & Testing Data
Conduct Cross-Validation
Carefully select Evaluation Metrics





Obtaining Labeled Training Data is often hard, expensive, and sometimes infeasible...



From NEON
neonscience.org

LET'S GET STARTED

- Homework 0 has been posted.