CSE 163
ML and Images

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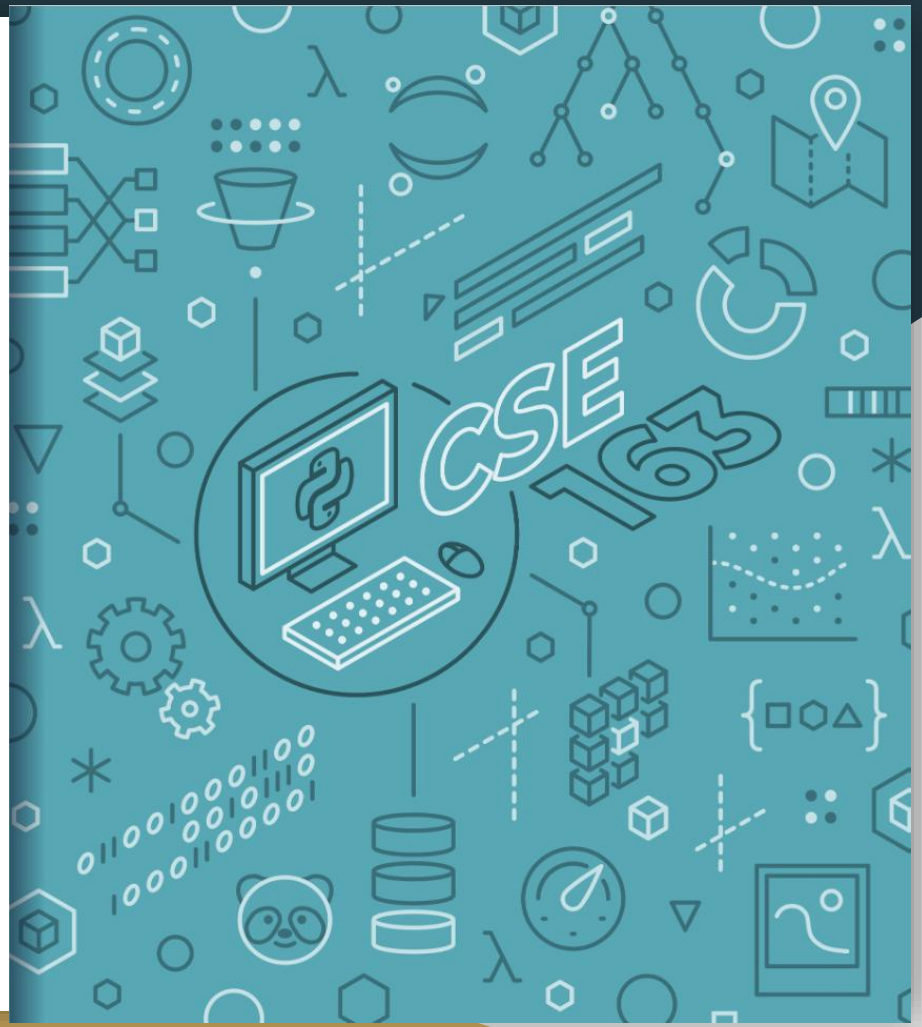
Spring 2026

💭 Icebreaker (discuss with neighbors):
Favorite band or musical artist?
Add to our Slido!

slido.com
#cse163



Announcements

- **Take Home Assessment 5: Mapping** due Tuesday May 26th at 11:59pm
- **Lesson 20 Canvas Quiz** due tonight at 11:59pm!
- **Checkpoint 4** due tonight at 11:59pm!
- **Project Part 3** now available, due June 1st at 11:59pm on Gradescope!

Revisiting ML Terms

- Features / Labels
- Learning algorithm
- Model
- Model class
- Training set / Test set
- Parameters / Hyperparameters

ML on Images

- How do we do machine learning on images?

- **Simplest**: Unroll the image into a vector
- **Complex**: Use other tools to extract features from the images

Raw Image

10	20	30
40	50	60
70	80	90

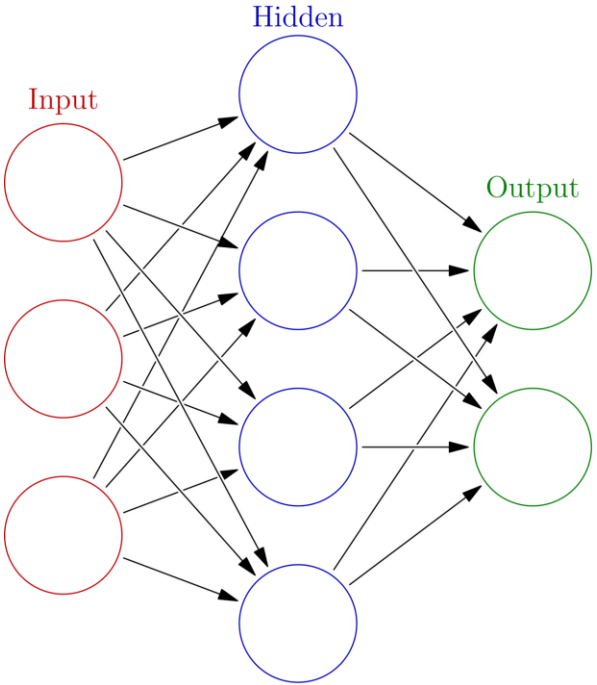
“Unrolled” Image

10
20
30
40
50
60
70
80
90

ML on Images

- ***Pros***: Simple transformation (call to reshape!)
- ***Cons***: Loss of idea of “neighboring” pixels (up/down)
  - Most machine learning models don’t take position of features into account
  - More complex models (e.g. convolutional neural networks) come in to encode the local information as features

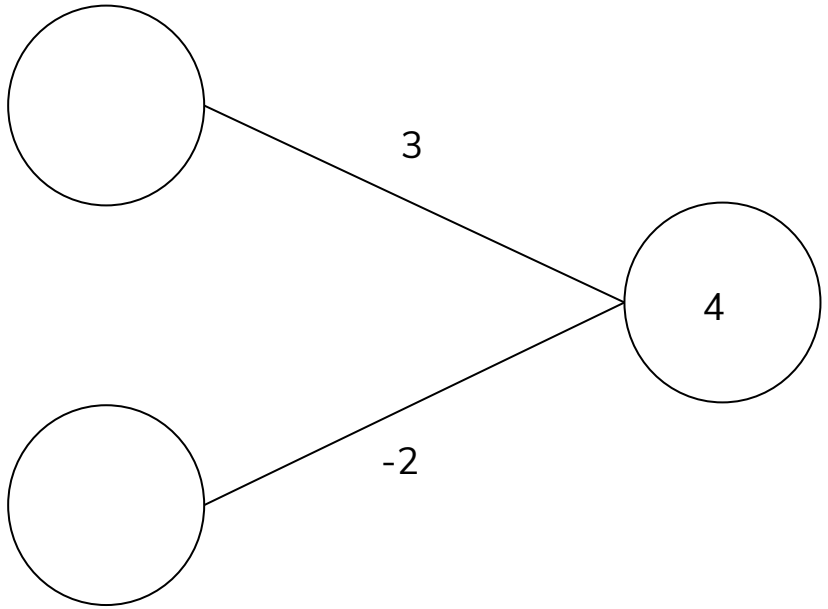
Neural Networks - based on our brains



Neural Networks - Example

What is the output for this neuron if the inputs are 0 for the first input and 1 for the second?

- The ***activation function*** is the step function (0 if negative, 1 otherwise)
- The ***bias*** should be subtracted from the weighted sum before applying the activation function



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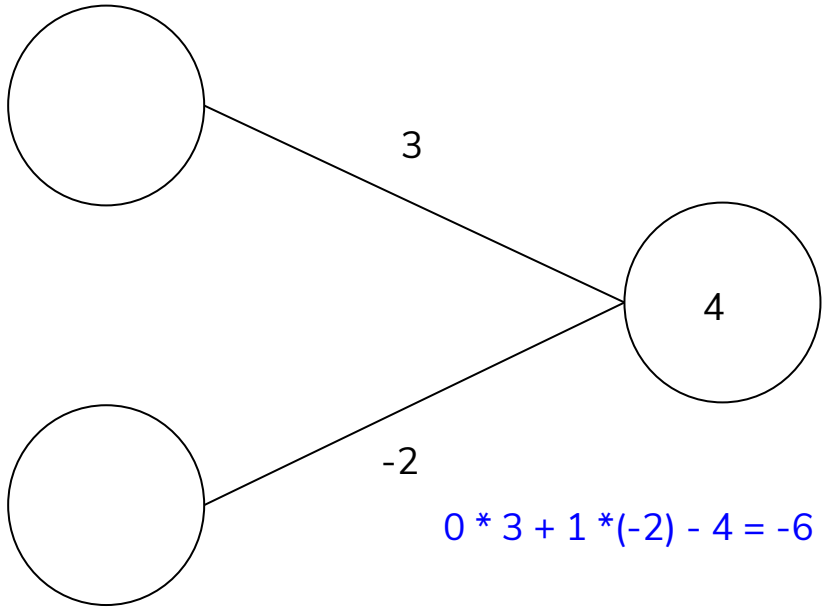

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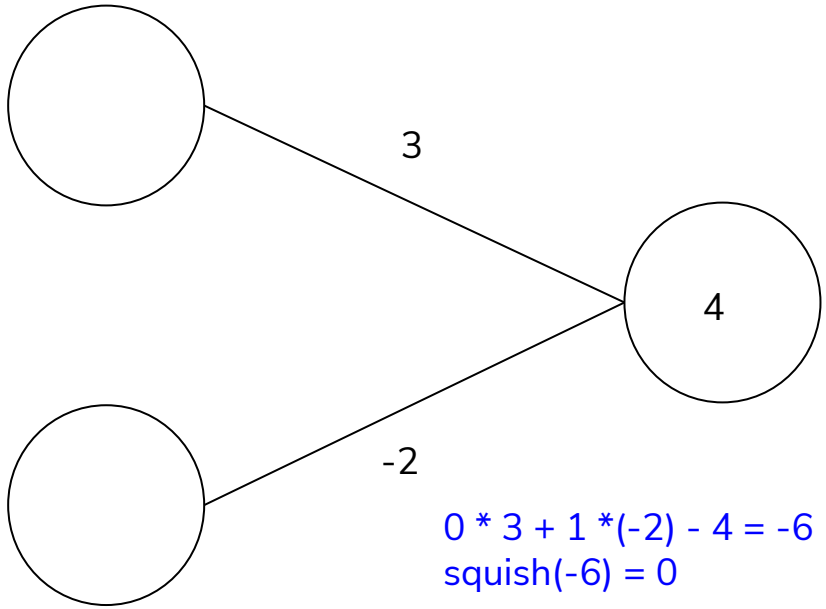
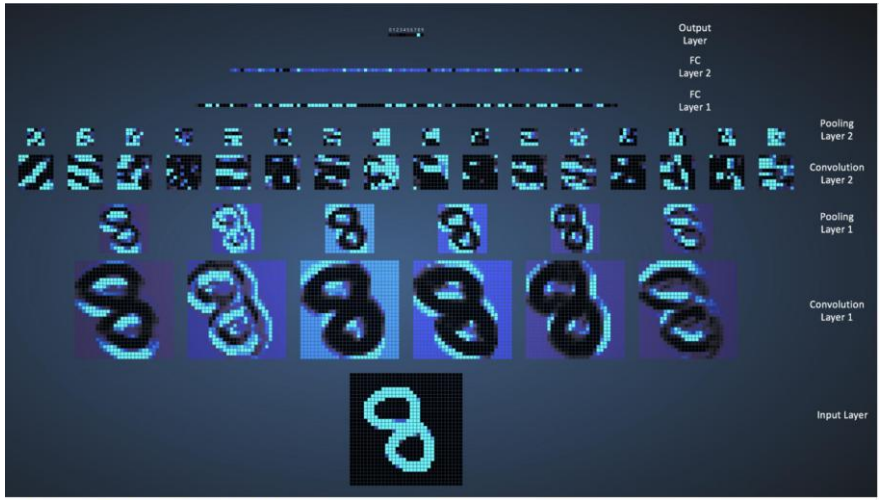
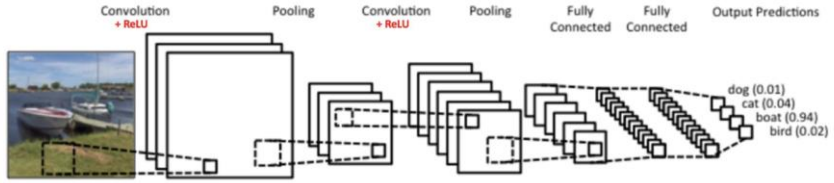


Image Classification



Real example network: LeNet



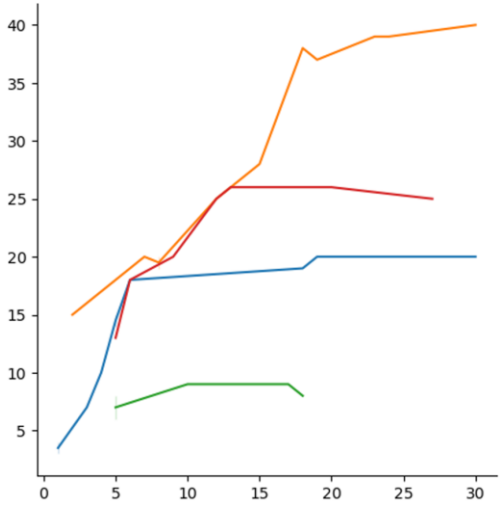
Unsupervised Learning

- So far, we have seen ***supervised*** machine learning. We explicitly show the algorithm the labels.

- ***Unsupervised*** machine learning lets the algorithm try to lean the trends on its own without providing explicit labels.
  - Clustering
  - Outlier detection
  - Dimensionality reduction

Project Deliverables

Graphs



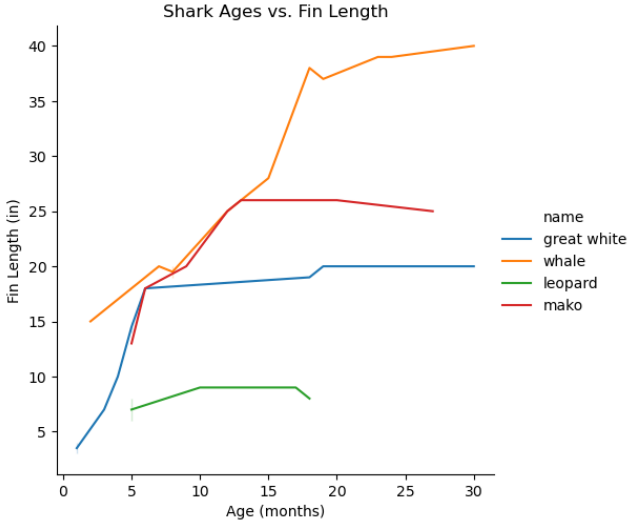


Fig 1. A line plot showing the relationship between shark ages in months and caudal fin lengths in inches.

Don’t let numbers float!

- ***Accuracy / MSE*** – what do these numbers mean for your ML model?
- ***Pearson’s R or R-squared values*** – what does this imply about the strength or direction of the relationship between variables?
- ***p-values*** – do you reject or fail to reject the null hypothesis? What does this imply about your results?
- ***Percentages, counts, averages, sums, etc.***
- ***Make sure your numbers have context attached to them!***

Length Requirements

- ***10 - 15 pages for the reports*** (excluding optional title page and appendix)
- ***3 minute presentation***
- Does a 16 page report count if the last page only has one word? ***– NO!***
- Does a 3:01 minute presentation count? – ***Try your best to keep it within 3 min***
  - If your presentation does exceed the time limit by a lot (e.g. 4-5 min presentation) you will be marked down
- ***These are strict maximum length requirements.***