ACM AI

Intro to Machine Learning

Advanced Track Workshop #1: Neural Networks

Slides: https://tinyurl.com/aiadvanced1

ACM AI

Sign in Here!

ACM AI

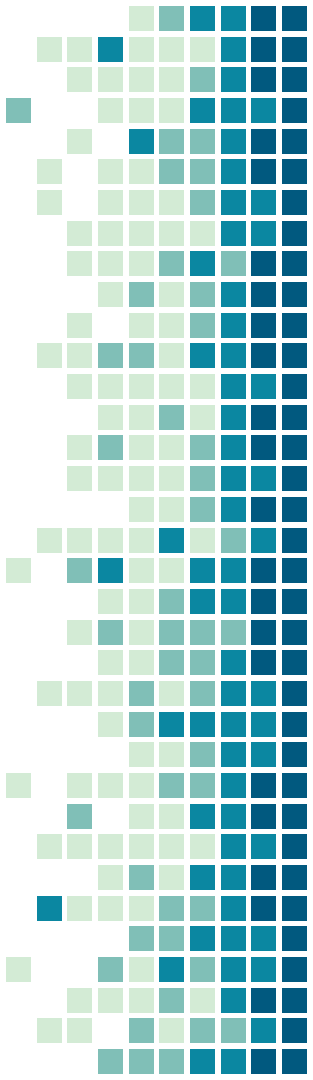
Resources

Slides: https://tinyurl.com/aiadvanced1

Github: github.com/uclaacmai/advanced-track-spring18

Colab: colab.research.google.com

Membership Portal Code: aiadvanced1



ACM AI

1. Overview and Logistics

Overview of ACM AI

Revamped Workshops

- Changing things up after feedback
- Two workshop tracks: Beginner and Advanced

New Events

- Inviting speakers, hosting social events
- New “Implications of AI” Series

Projects

- Working in collaboration with Creative Labs
- ML team led by Henry Yang
- More information to follow

Beginner vs. Advanced Workshops

Beginner

Introduction to basic machine learning methods, such as linear and logistic regression

Explains mathematical concepts and motivations

No prior knowledge expected

Advanced

Focused on Deep Learning

Expected prior knowledge of working with data in Python and basic machine learning skills

Introduces neural networks

Advanced Track Tentative Schedule

- Week 3: Introduction to Neural Networks
- Week 4: Application of Neural Networks
- Week 5: Multilayer Neural Networks
- Week 6: Intro to Convolutional Neural Networks
- Week 7: Application of CNNs
- Week 8: Intro to Recurrent Neural Networks
- Week 9: Application of RNNs

Every Friday 5:30 - 7:00 PM in Eng VI Rm 289

ACM AI

Officers Helping w/ Advanced Track

Adit Deshpande (President)

Lawrence Chen

Henry Yang

Sriram Duraisamy

ACM AI

“

Questions?

ACM AI

2. Review and “Prerequisites”

ACM AI

Expected Prior Knowledge

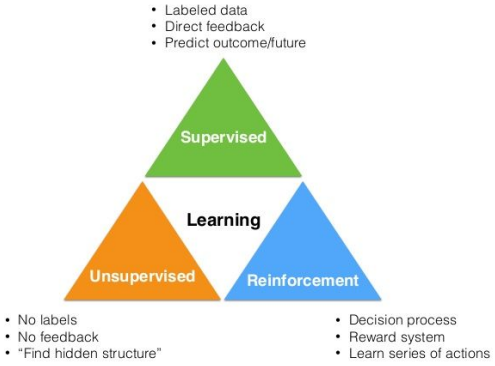
- Comfortable with coding in Python
- Basic machine learning knowledge
- Basic knowledge of working with data, i.e. Numpy arrays

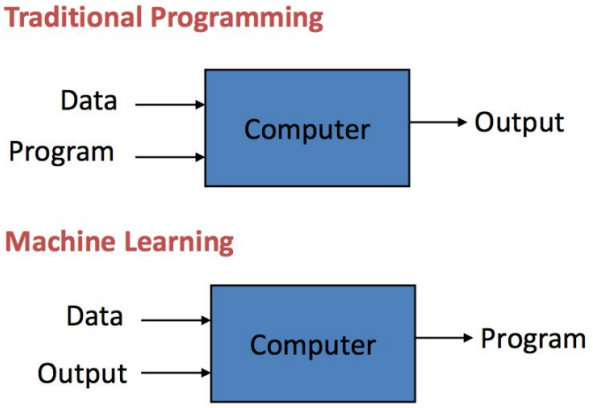
Today's Contents

- Review on machine learning
- Basics of Tensorflow (using Logistic regression)
- Introduction to neural networks

Machine Learning Refresher

- Machine Learning is teaching computers how to act based on data





Key elements of Machine Learning

- **Representation:** Represent knowledge. Eg: decision trees, neural networks
- **Evaluation:** Evaluate candidate programs (hypotheses). Eg: Cost, margin, entropy, squared error
- **Optimization:** Candidate programs are generated (search process) Eg: combinatorial optimization, gradient descent

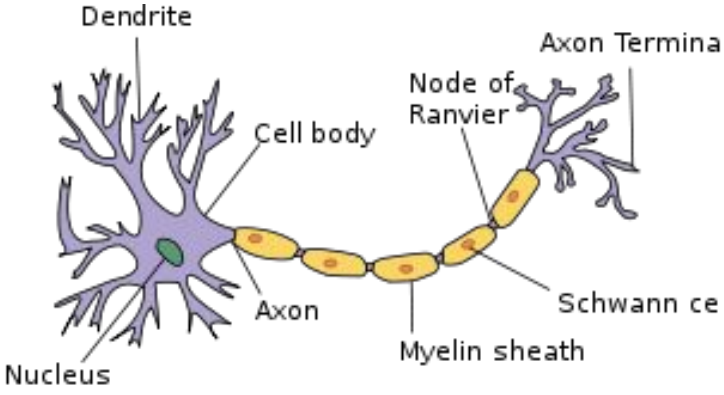
Machine Learning vs. Deep Learning

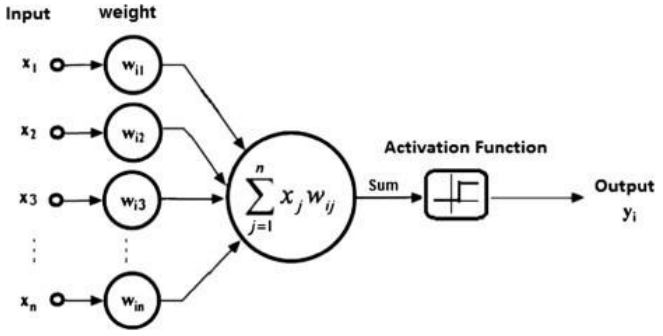
- AKA DL is just a subset of ML
- Uses a certain type of layered algorithm: Artificial Neural Networks (ANNs)
- Inspired by the human brain (neurons)
- Eg: Google's AlphaGo

ACM AI

Motivations of Deep Learning

- Imitating real life biology
- Neurons vs. Perceptrons

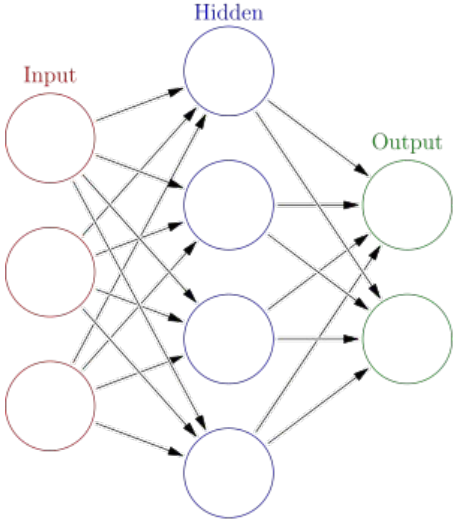




ACM AI

Motivations of Deep Learning

- Layer the ‘neurons’ to imitate a full brain
- Basically like repeated logistic regressions



Logistic Regression

- Machine learning model used primarily for problem spaces where a selection from a group of categories/classes is needed.
- Example Problem Spaces
  - Cancer Detection (Binary 0/1)
  - Digit Classification (10 Classes)
  - Object Classification (Multiple Classes)

Logistic Regression

- Very similar to linear regression
  - $Y = xw + b$
- Logistic Regression Equation
  - $Y = \sigma(xw + b)$

For binary classification: σ = Sigmoid Function

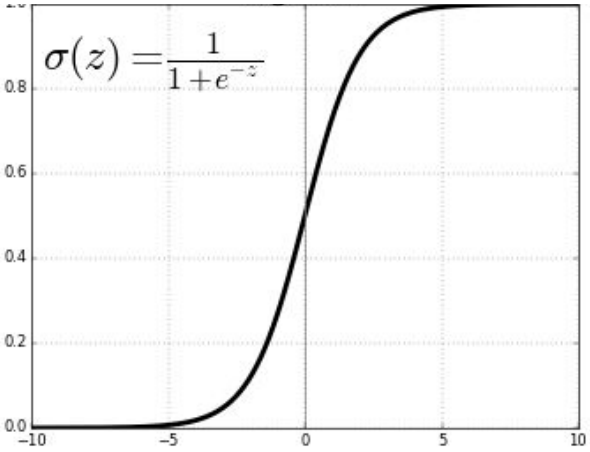
For Multi-class classification: σ = Softmax Function

Activation function

- Logistic Regression is just linear regression, with an activation function
- The activation function is used to take the continuous output of the linear regression, and separate the result into classes in a non-linear fashion, whether it be two classes (sigmoid function) or multiclass (softmax function)

ACM AI

Sigmoid Function

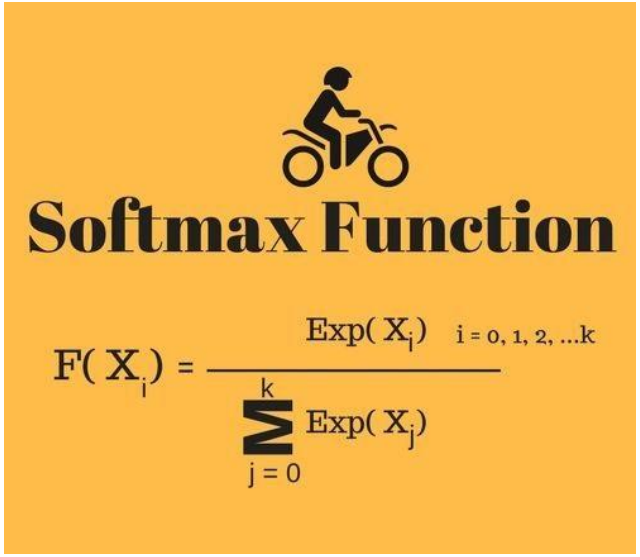


- Sigmoid takes any range real number and returns the output value which falls in the range of 0 to 1
- output value in the range of -1 to 1

- Can be interchangeable with Tanh and Arctan functions
- Have slightly different maps (Tanh from -1 to 1 ; Arctan from -π/2 to π/2)

ACM AI

Softmax Function



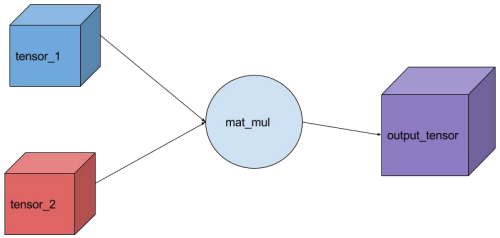
- Softmax takes multiple outputs and converts them into probabilities
- output value in the range of -1 to 1

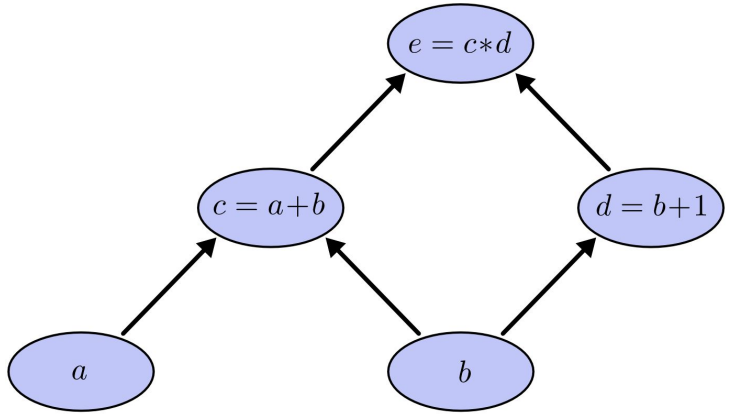
Tensorflow

- Tensorflow is an open source software library for high performance numerical computation
- Used in:
  - voice/sound recognition
  - Text based application
  - Time series data analysis (recommendations)

Tensorflow Overview

- Based on Computational Graphs
- Tensors (n-dimensional array or list)
- Typically run together





ACM AI

“

Questions?

ACM AI

3. Coding Example

ACM AI

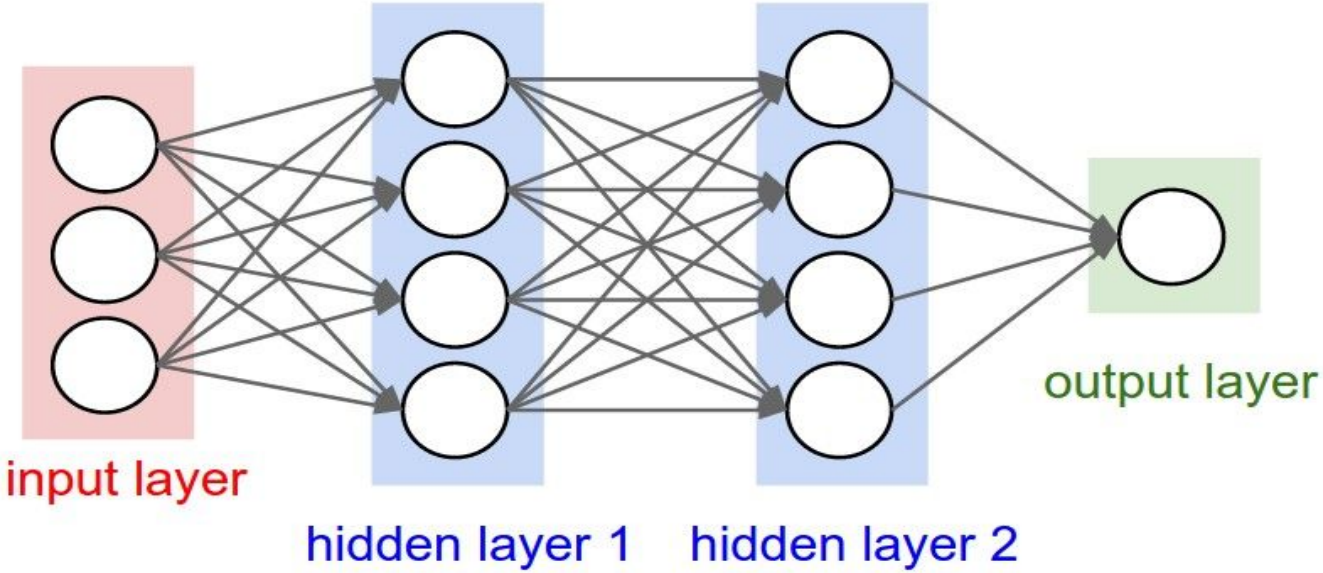
“

Questions?

ACM AI

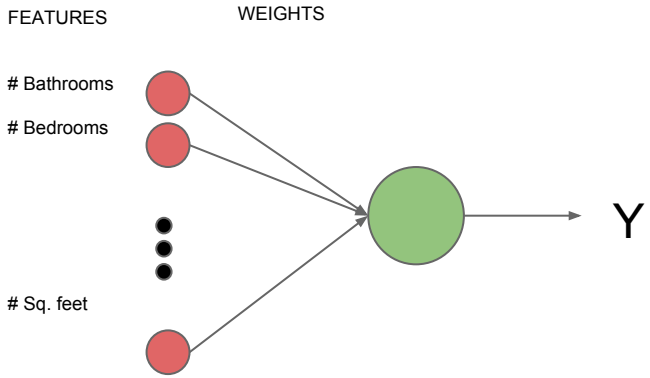
4. Introduction to Neural Networks

Neural Networks



Perceptron

- Represents a “Neuron”
- Logistic Regression
  - Weights Vector w
  - Activation Function σ
- Recall: Logistic Regression Equation
  - Y = σ(xw + b)

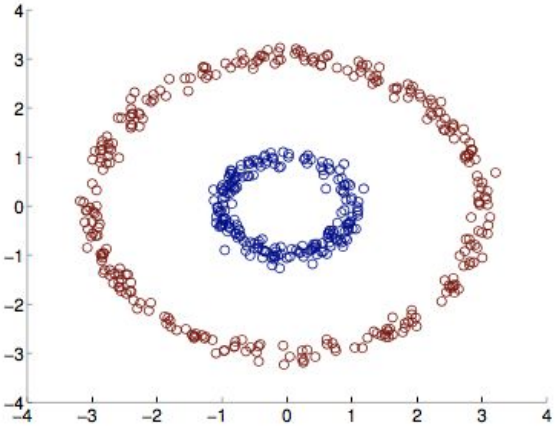


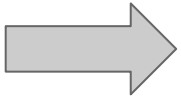
Universal Approximator

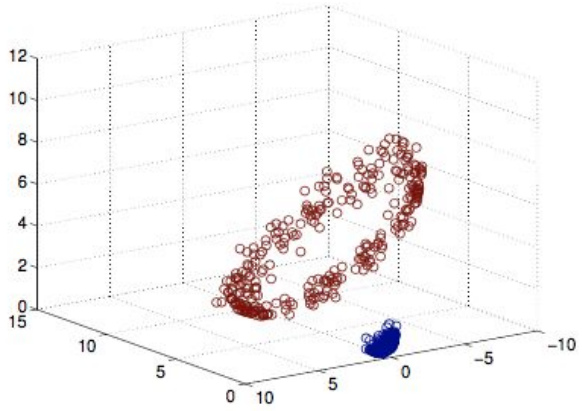
"With sufficient number of **nonlinear** hidden units, linear output unit can approximate any continuous function"

- why nonlinear?
- where is the nonlinearity coming from?

Why Nonlinear?



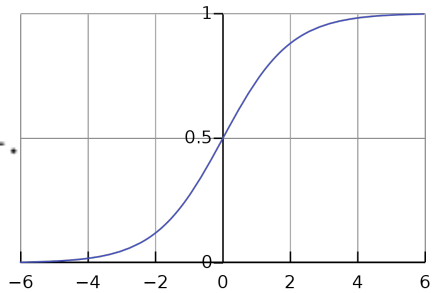




Where is the nonlinearity coming from?

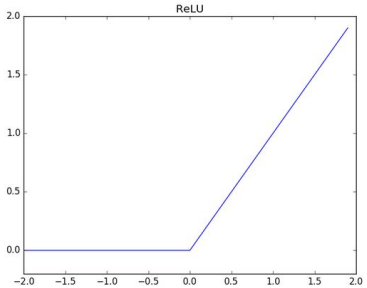
Sigmoid

$$S(x) = \frac{1}{1 + e^{-x}}.$$

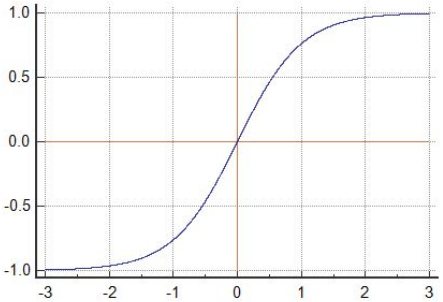


ReLu

$$f(x) = \max(0, x)$$



Tanh



Softmax

$$\sigma(z)_j = \frac{e^{z_j}}{\sum_{k=1}^{K} e^{z_k}}$$

$$\begin{bmatrix} 1.2 \\ 0.9 \\ 0.4 \end{bmatrix} \rightarrow \text{Softmax} \rightarrow \begin{bmatrix} 0.46 \\ 0.34 \\ 0.20 \end{bmatrix}$$

Generalized activation function to N classes

Neural Networks Pipeline

1. Define architecture
2. Pass inputs forward, get prediction
3. Compute loss
    a. function of prediction and actual label
4. Perform gradient descent to get weight adjustments
5. Propagate adjustments backwards
    a. backpropagation, chain rule for derivatives

ACM AI

“

Questions?

ACM AI

5. Upcoming Events

ACM AI

Advanced Track Meeting Next Week

When: Friday, May 4th from 5:30 - 7:00 PM

Where: Engineering VI - Room 289

- Next week, we'll be continuing with neural networks

ACM AI

Joining ACM AI

- If you're interested in teaching machine learning, creating content, and seeing what happens behind the scenes, **apply to become an officer**!
- We're looking for dedicated and enthusiastic applicants who have a passion for teaching and learning about ML/AI.
  - Hint: You don't need to be an expert in machine learning!
- **Deadline is TONIGHT at 11:59 PM**

Apply here: http://bit.ly/uclaacm-app-2018-2019

ACM AI

Beginner Track Meeting Next Week

When: Friday, May 4th from 4:00 - 5:30 PM

Where: Engineering VI - Room 289

- If you felt like today's lesson was too fast paced, check out our Beginner Track workshops!
- We're currently going over linear and regression

ACM AI

Please Fill Out Our Feedback Form!

ACM AI

Thank you all for coming!

Coming up next week:
Further Applications of Neural Networks

Join our Facebook group