

Deep Learning

Lecture 0

What this course is about

- Deep learning:
 - Theory
 - Practice
- By
 - Doing homeworks (part 1 of most assignments)
 - Implementing networks (part 2 of most assignments)
 - First two assignments: logistic regression and back prop from scratch
 - Next two assignments: convnets and recurrent nets using PyTorch
 - Final assignment: a project of your choice (usually in a team of 4-6 people)

Goals

- You should be able to implement your own networks using PyTorch
 - To solve decently-sized problems
- You should be able to understand some reasonably-sized fraction of a NeurIPS paper before you get lost. ;-)
- You will have some practice writing a NeurIPS-style paper (all project reports are in NeurIPS format!)

Logistics

- Go through the syllabus...

Notation (I will try to be consistent!)

w_i : weight from input i

w_{ij} : weight from i to j

i : input index

j : hidden unit index

k : output unit index (not always!)

a_j : weighted sum of inputs
to unit j

$g()$: activation function

d : number of inputs

c : number of outputs

C_k : k^{th} output category

N : number of patterns

n : pattern label

t : target label or time step
(in context should be clear)

x : input data

y : output activation

z : hidden unit activation

Why Deep Learning?

- Deep learning has revolutionized AI since about 2012.
- The 2019 Turing award was for Deep Learning.
- You probably already interact with deep networks in your everyday life (text transcription, google translate, google image search, etc.)
- You should understand how they work!
- Especially if you want that high-paying job at Google.

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 - Images from textual descriptions
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- Take an image of a person and change the gender, expression, whether they are wearing glasses, add a beard, make them old...
- Generate the next few frames of a video
- Et cetera

What *can't* deep learning do (yet)?

- Think
- Understand humans
- Solve problems
- Hold a conversation
- Walk, talk, and crawl on their bellies like a reptile
- Pass the Turing test
- I.e., *General intelligence*

Types of machine learning

- Unsupervised (learn a model of the data)
- Supervised (learn a *mapping* from input to a target)
- Reinforcement (learn from your mistakes)
- Imitation learning (not usually covered in textbooks...but considered a type of reinforcement learning)

Supervised Learning

- Supervised learning (learn a *mapping* from input to a target) comes in two forms:
 - Classification (learn a mapping to a category label)
 - Regression (learn a real-valued function)
- This is the textbook story, but in fact, it is hard to categorize all supervised learning into just these two – for example, transforming English sentences to French ones.

Resources

- Readings
 - New textbook (interactive!) *Dive into Deep Learning*
 - But uses MXNet instead of PyTorch.
 - [Read the first chapter!](#)
 - http://d2l.ai/chapter_introduction/index.html#a-motivating-example
 - Bishop 1995: *Neural Networks for Pattern Recognition*
 - I use his notation (See resources on piazza)
 - He has clear (but formal) explanations
- Human help:
 - Office hours every weekday
 - Problem solving sessions
 - Ask and answer questions on Piazza

Questions?