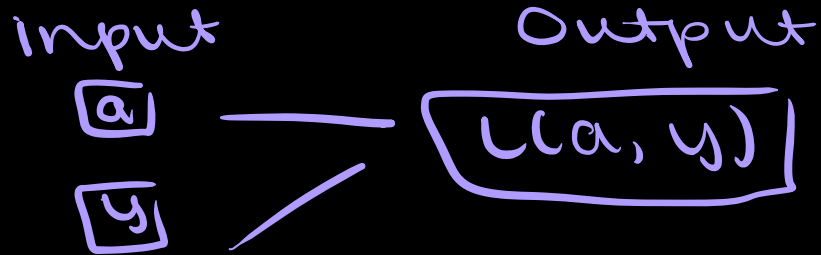# Statistics and Artificial Intelligence

Lecture 13: Fundamentals of Machine Learning I

Yixin Wang

JiTT

- Contrast the forward and backward passes in backpropagation.

Defined in computational graph

input   Output

$\boxed{a}$

$\boxed{y}$ $\boxed{L(a, y)}$

Forward pass: go from input to output

back pass: determine gradients

$$\frac{d \; L(a, y)}{da}$$

derivative of output w/ respect to input

Core technical innovation in deep learning is back propogation

JiTT

- True or ~~False~~: You can perform backpropagation without knowledge of a neural network's computational graph.

Can't even define forward/backward pass w/out the computational graph

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$$L(a,y) = -y \log(a) - (1-y) \log(1-a)$$

prediction ↑ ↑ label

wanna talk about initialization

– easy to optimize, function is convex
wrt to weight/bias parameters

- In which situation(s) will initializing weights to zero cause the relevant model(s) to fail to converge to a useful solution? Select the most complete answer.
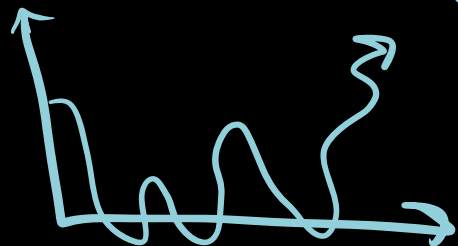
  - Logistic regression? ✗

    cross entropy loss: distance from y to $\hat{y}$

  - Deep neural networks? ✓
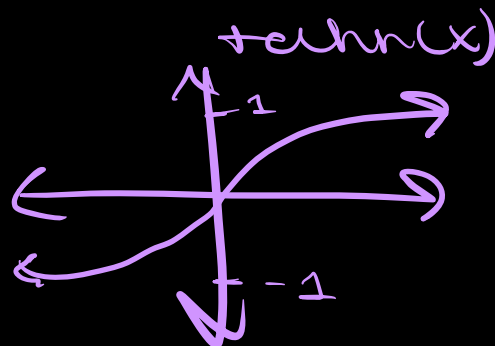
    neural network w/ hidden layers

Not convex:

can get to different points depending where we initialize gradient descent
– local minimums

Hidden unit = weighted sum of input + biases

$$a = \Theta(\Sigma \, wixi + b)$$

initialize to 0 → hidden layer does nothing

JiTT

$$\tanh(x)$$

Q6 tanh Function
1 Point

Which of the following are true of the tanh function? Select all that apply.

- ☑ $\lim_{x \to \infty} \tanh(x) = 1$

- ☐ $\lim_{x \to \infty} \tanh(x) = \infty$

- ☑ $\lim_{x \to -\infty} \tanh(x) = -1$

- ☐ $\lim_{x \to -\infty} \tanh(x) = -\infty$

- ☑ $\tanh(0) = 0$

Roadmap for Today

- Classification for Text Data

- Fundamentals of ML

- Boston Housing Example

Neural Network for Text

- IMDB

  - https://colab.research.google.com/drive/1MC4ngpTT5ulpyTunCWr3c-huaGdwqhqd?usp=sharing

Fundamentals of ML

- Fundamentals I: https://colab.research.google.com/drive/1I8vQTTPmnn4ukL-Od_OBoT1g_qH7op0W?usp=sharing

- Example: Boston Housing

  - https://colab.research.google.com/drive/1CW9gKd-wCEFy_PWVg8wr82ChL6U5QdCC?usp=sharing

The materials in this course are adapted from materials created by Alexander Amini, Alfredo Canziani, Justin Johnson, Andrew Ng, Bhiksha Raj, Grant Sanderson and the 3blue1brown channel, Rita Singh, Ava Soleimany, and Ambuj Tewari.