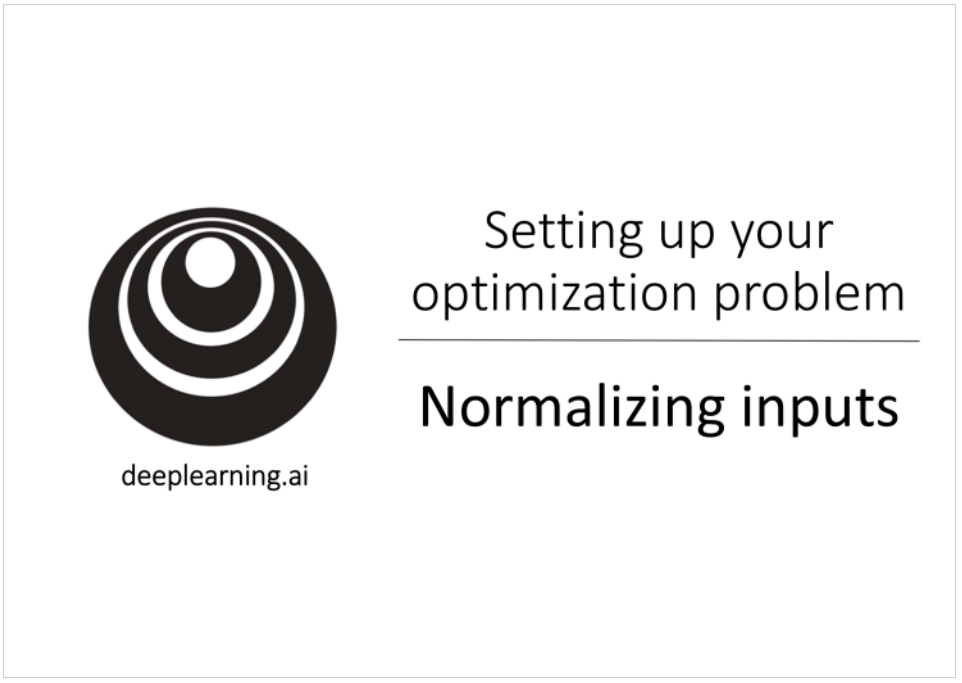
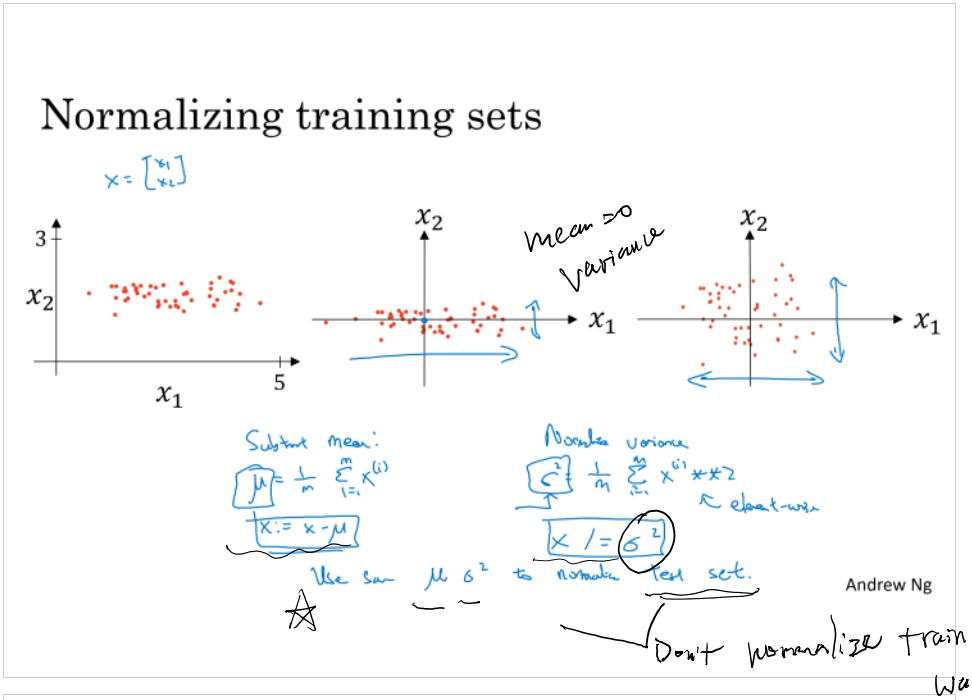
Normalizing input

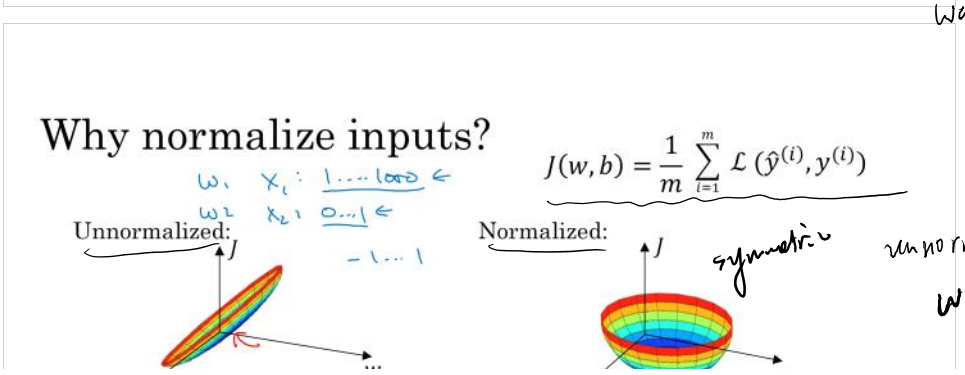
Friday, June 1, 2018 2:35 PM

normalize input



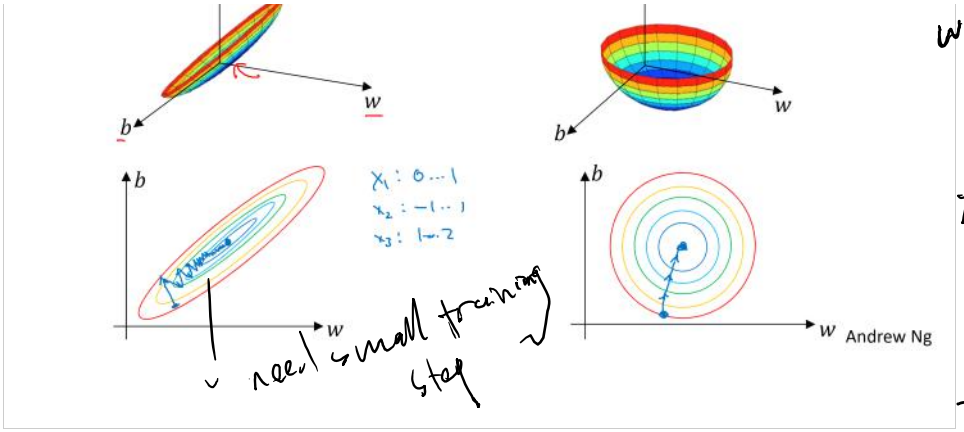


Don't normalize training & test set differently
Want same transformation



symmetric

unnormalize + feature of different scales
w_1, w_2 different value
elongated bowl



w_1, w_2 different value

elongated bowl

In pratice, w high dim

this two-dim plot shows the intuition

if feature similar scale, won't be important but this won't do any harm

vanish exploding gradient

one big problem

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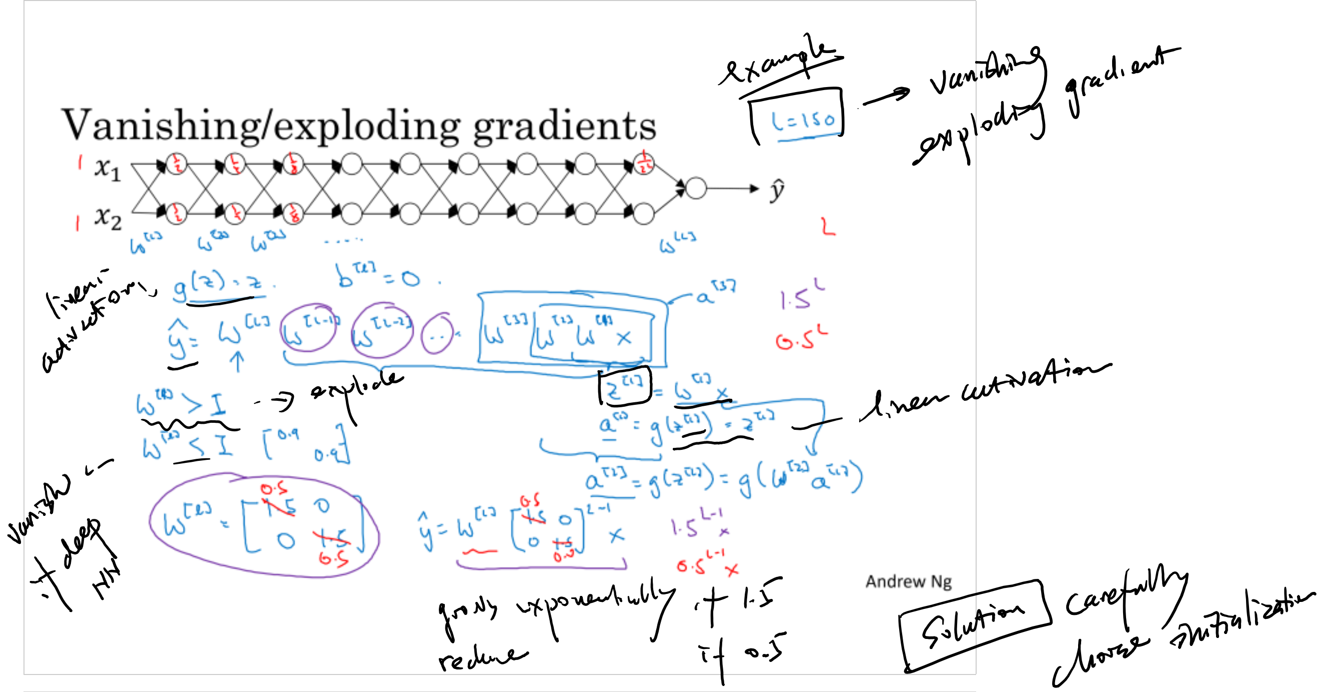
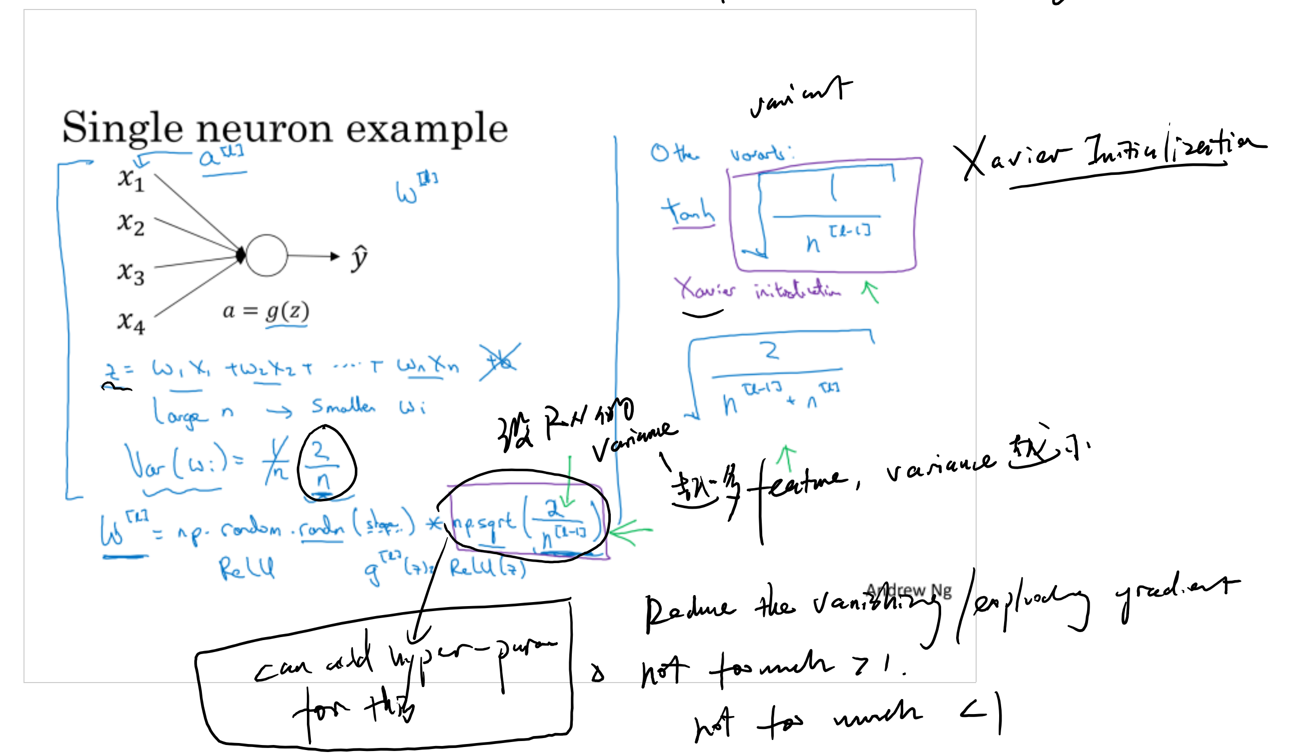
Setting up your optimization problem

Vanishing/exploding gradients





numerical approx

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Setting up your optimization problem

Numerical approximation of gradients

Checking your derivative computation

$f(\theta) = \theta^3$

$\theta \in \mathbb{R}$.

$g(\theta) = \frac{d}{d\theta} f(\theta) = f'(\theta)$

$g(\theta) = 3\theta^2$.

$g(\theta) = 3 \cdot (1)^2 = 3$ when $\theta = 1$

$\frac{dJ}{db}$

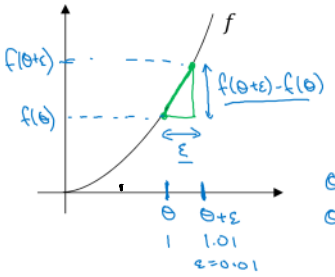
$\frac{f(\theta+\varepsilon) - f(\theta)}{\varepsilon} \approx g(\theta)$

$\frac{(1.01)^3 - 1^3}{0.01} = 3.0301 \approx 3$

0.0301

3.1

3.2



$\theta = 1$

$\theta + \varepsilon = 1.01$

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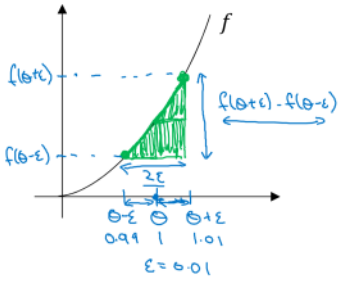
Checking your derivative computation



$f(\theta) = \theta^3$

numerical approximation

Just calculus.

$\frac{f(\theta+\varepsilon) - f(\theta-\varepsilon)}{2\varepsilon} \approx g(\theta)$

$\frac{(1.01)^3 - (0.99)^3}{2(0.01)} = 3.0001 \approx 3$

$g(\theta) = 3\theta^2 = 3$

Approx error: 0.0001

(previous slide: 3.0301. error: 0.03)

$f'(\theta) = \lim_{\varepsilon \to 0} \frac{f(\theta+\varepsilon) - f(\theta-\varepsilon)}{2\varepsilon}$ $O(\varepsilon^2)$ 0.01 0.0001

$\frac{f(\theta+\varepsilon) - f(\theta)}{\varepsilon}$ error: $O(\varepsilon)$ 0.01

Two sided.

for gradient checking

We would rather use the two-sided difference

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gradient check

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Setting up your optimization problem

Gradient Checking

Gradient check for a neural network

Take $W^{[1]}, b^{[1]}, \dots, W^{[L]}, b^{[L]}$ and reshape into a big vector θ.

concatenate

$J(W^{[1]}, b^{[1]}, \dots, W^{[L]}, b^{[L]}) = J(\theta)$

Take $dW^{[1]}, db^{[1]}, \dots, dW^{[L]}, db^{[L]}$ and reshape into a big vector $d\theta$.

concatenate

Is $d\theta$ the gradient of $J(\theta)$?

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Gradient checking (Grad check)

$J(\theta) = J(\theta_1, \theta_2, \theta_3, \dots)$

why ε

for each i:

$$\to d\theta_{approx}[i] = \frac{J(\theta_1, \theta_2, \dots, \theta_i + \varepsilon, \dots) - J(\theta_1, \theta_2, \dots, \theta_i - \varepsilon, \dots)}{2\varepsilon}$$

$$\approx d\theta[i] = \frac{\partial J}{\partial \theta_i}$$

Where to get? still the prog thing?

$d\theta_{approx} \overset{?}{\approx} d\theta$

How to define whether two vectors are close, Euclidean distance

Check

$$\frac{\| d\theta_{approx} - d\theta \|_2}{\| d\theta_{approx} \|_2 + \| d\theta \|_2} \approx 10^{-7} \text{ - great!} \leftarrow$$

10^{-5}

$\to 10^{-3}$ - worry. $\leftarrow$

$\varepsilon = 10^{-7}$

normalize it into a ratio.

$\to$ if big value need debug

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Gradient checking implementation notes

- Don't use in training – only to debug

- If algorithm fails grad check, look at components to try to identify bug.

- Remember regularization.

- Doesn't work with dropout.

- Run at random initialization; perhaps again after some training.

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