Class Notes: DL

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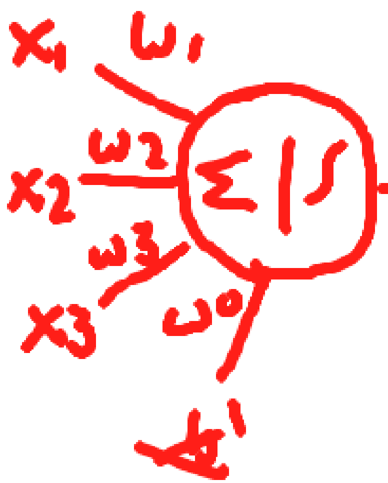
Data

- Data sufficiency
- Data Quality
- Some examples of evaluating information inside data

Basics of Deep Learning

- Deep learning emulation of human brain
- Deep Learning – layered architecture, hierarchical extraction of features
- Deep learning – every unit is capable of linear and non linear processing.

Training a neuron



$\hat{y} = NL(\sum w_i x_i + b) = NL(\sum w_i x_i)$

SP $= w_0 + w_1 x_1 + w_2 x_2 + w_3 x_3$

$= \sum w_i x_i$

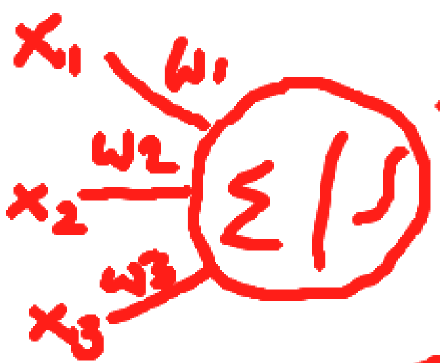
$\hat{y} = NL(\sum w_i x_i) = Sig(\sum w_i x_i)$

↑ Model's Pred

$E = \sum (y - \hat{y})^2$ ← SSE

↑ Minimize this Error

Minimizing the Error



$$\hat{y} = Sig(\sum w_i x_i) \qquad g = Sig$$

$$E = \sum (y - \hat{y})^2 = \sum (y - \underline{Sig(\sum w_i x_i)})^2$$

$$= \sum (y - g(\sum w_i x_i))^2$$

Minimize this Error

$$E \to 0$$

Car at a vel v, apply brake (multiple)

$$\boxed{-\frac{dv}{dt}} \qquad E \to 0 \qquad \boxed{-\eta \frac{\partial E}{\partial w_i} = \Delta w_i}$$

Scaling

Training and Gradient Descent

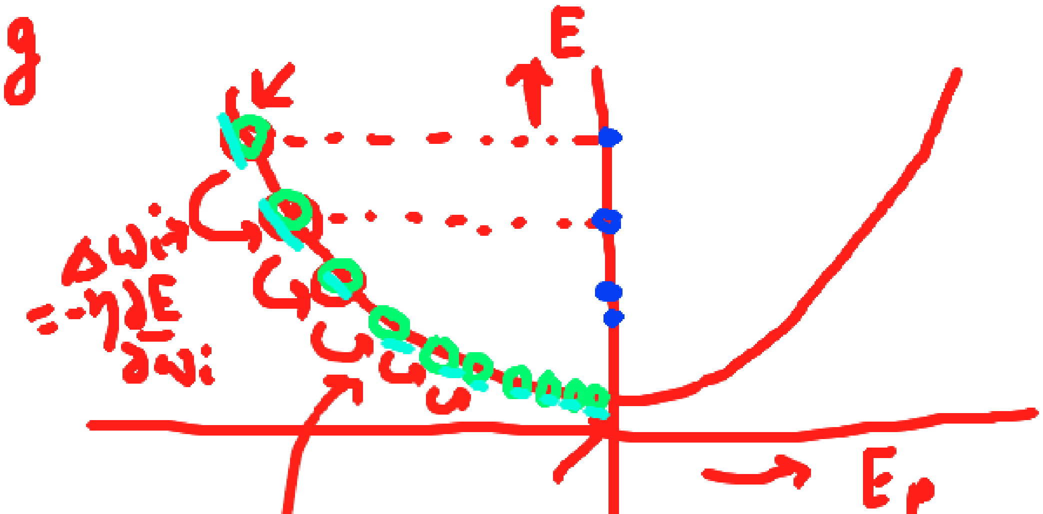
$$\boxed{\Delta w_i = -\eta \frac{\partial E}{\partial w_i}}$$

Minimize the Error

Multiple Times

Scaling Learning Rate

$$E = \sum (y - \hat{y})^2 = \sum (y - g(\sum w_i x_i))^2$$



Gradient Descent

↓ Grad ↓

Derivative of sigmoid

$$g(x) = Sig(x) = \frac{1}{1+e^{-x}} \qquad \frac{\partial}{\partial x}\left(Sig(x)\right) = \frac{\partial}{\partial x}\left(\frac{1}{1+e^{-x}}\right)$$

$$= \frac{\partial}{\partial x}\underbrace{(1+e^{-x})}_{u}{}^{-1} \qquad \frac{\partial}{\partial x} u^{-1} = -1 \cdot u^{-1-1} \cdot \frac{\partial u}{\partial x}$$

$$= -1 \cdot (1+e^{-x})^{-2} \frac{\partial}{\partial x}(1+e^{-x}) = \frac{-1}{(1+e^{-x})^2} \cdot (0+e^{-x} \cdot -1)$$

$$= \frac{e^{-x}}{(1+e^{-x})^2} = \frac{1}{(1+e^{-x})} \cdot \frac{e^{-x}}{(1+e^{-x})} = g(x) \cdot \frac{e^{-x}+1-1}{1+e^{-x}}$$

$$= g(x) \cdot \left(1 - \frac{1}{1+e^{-x}}\right) = g(x) \cdot (1 - g(x))$$

Derivative of Error

$$\boxed{\Delta w_i = -\eta \frac{\partial E}{\partial w_i}}$$

Multiple times (Epochs)

$$\frac{\partial E}{\partial w_i} = \frac{\partial}{\partial w_i}\left(\sum \Big(y - \overbrace{g\big(\textstyle\sum w_i x_i\big)}^{\hat{y}}\Big)^2\right)$$

$$= \frac{\partial}{\partial w_i}\left(\sum \big(\underbrace{y - g(\textstyle\sum w_i x_i)}_{u}\big)^2\right)$$

$$\frac{\partial}{\partial w_i} u^2 = 2 \cdot u^{2-1} \cdot \frac{\partial u}{\partial w_i}$$

$$= \sum 2 \cdot \big(y - g(\textstyle\sum w_i x_i)\big) \cdot \frac{\partial}{\partial w_i}\big(y - g(\textstyle\sum w_i x_i)\big)$$

$$= 2 \sum \big(y - g(\textstyle\sum w_i x_i)\big) \cdot \left(0 - \frac{\partial}{\partial w_i} g(\textstyle\sum w_i x_i)\right)$$

Derivative of Error, dependencies

$$\frac{\partial E}{\partial w_i} = 2 \sum \left(y - g\left(\sum w_i x_i\right)\right) \cdot \left(0 - \frac{\partial}{\partial w_i} g\left(\sum w_i x_i\right)\right)$$

$$= 2 \sum \left(y - g\left(\sum w_i x_i\right)\right) \cdot \left(- g(w_i x_i) \cdot \left(1 - g\left(\sum w_i x_i\right)\right)\right) \cdot \frac{\partial}{\partial w_i}\left(\sum w_i x_i\right)$$

$$= -2 \sum \left(y - g\left(\sum w_i x_i\right)\right) \cdot g\left(\sum w_i x_i\right)\left(1 - g\left(\sum w_i x_i\right)\right) \cdot x_i$$

$$\boxed{\frac{\partial E}{\partial w_i} = -2 \sum \underbrace{\left(y - g\left(\sum w_i x_i\right)\right)}_{\text{Dev from True Val}} \cdot \underbrace{g\left(\sum w_i x_i\right) \cdot \left(1 - g\left(\sum w_i x_i\right)\right)}_{\text{Der (Act Fn)}} \cdot \underbrace{x_i}_{\text{Input}}}$$

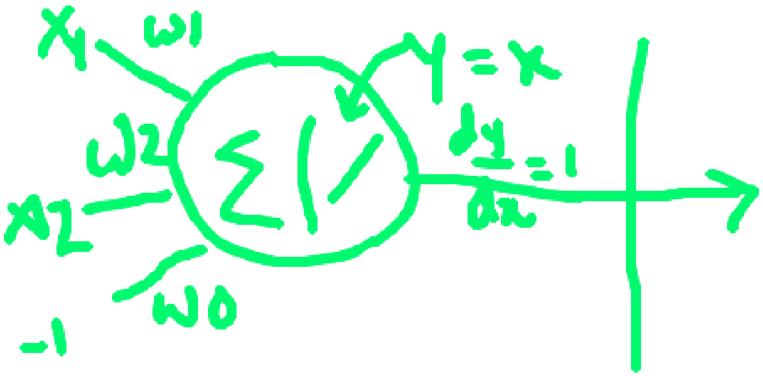
→ Dev from True Val

→ Der (Act Fn)

→ Input

$$\boxed{\Delta w_i = -\eta \frac{\partial E}{\partial w_i}}$$

$\frac{\partial E}{\partial w_i} \Rightarrow 0$ Trg will stop



$S > 0 \rightarrow +ve$ $\quad \hat{Y}$

$S < 0 \rightarrow -ve$

	$\hat{y}$	y	
$S<0$	-1	-1	Corr
$S>0$	1	$+1$	
$S<0$	-1	$+1$	opposing Error
$S>0$	$+1$	-1	

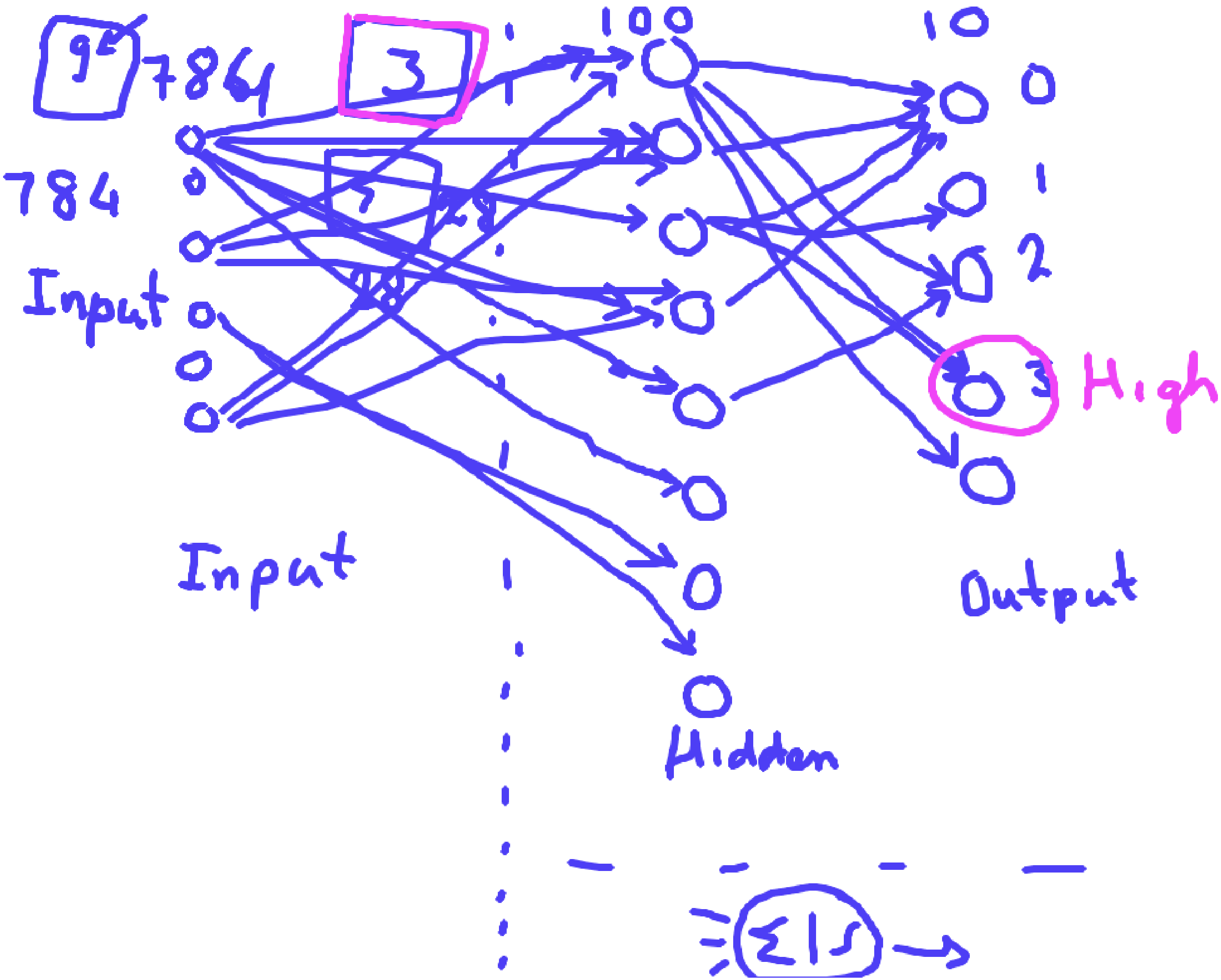
$S.y \leq 0 \leftarrow$ For E

$$\boxed{\Delta w_i = -\eta \frac{\partial E}{\partial w_i} = \eta . y_i . x_i}$$

$$\frac{\partial E}{\partial w_i} = -2\Sigma(\text{Der F Tr}) . \text{Der}(\text{Act}) . x_i$$

$$= -2 . 2y_i . 1 . x_i = \underline{-4 . y_i . x_i}$$

Building and connecting ANN



Tensorflow Intro