

100% مكتئب



عايز يتجوز: 20%

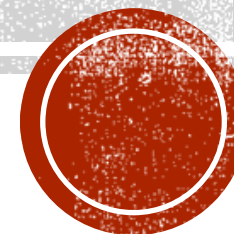
معوش فلوس: 30%

فوت صلاة الفجر: 50%



بسم الله الرحمن الرحيم

BACKPROPAGATION



$$f(a, b, c) = a * b + c$$

$$\frac{f(x + h) - f(x)}{h}$$

$$f(a+h, b, c) = (a+h) * b + c$$

$$(f(a+h, b, c) - f(a, b, c)) / h$$

$$((a+h) * b + c - (a*b + c)) / h$$

$$(\cancel{a*b} + h*b + c - \cancel{a*b} - c) / h$$

$$df/da = h*b / h = b$$

Differentiating f with respect to a

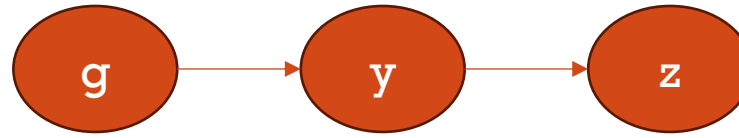


$$g = -2 * w1$$

$$y = w2 + g$$

$$z = y * w3$$

$$z = \overbrace{(w2 - \underbrace{2 * w1}_g)}^y * w3$$



Target = 10

$$w1 = 3$$

$$w2 = 4$$

$$w3 = 5$$

$$\text{Predicted} = Z = (4 - 2 * 3) * 5 = -10$$

$$\text{Loss} = 10 - (-10) = 20$$

Backpropagation STARTS...

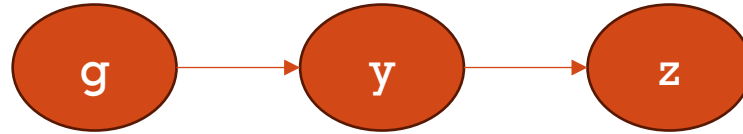


$$g = -2 * w1$$

$$y = w2 + g$$

$$z = y * w3$$

$$z = (w2 + -2 * w1) * w3$$



Target = 10

Predicted = -10

Loss = 20

$w1 = 3$

$w2 = 4$

$w3 = 5$

GOAL!!!

$dz / dw1$ Differentiate z with respect to $w1$

$dz / dw2$ Differentiate z with respect to $w2$

$dz / dw3$ Differentiate z with respect to $w3$

Chain Rule STARTS...



Car is 4 times faster than bicycle, and bicycle is 2 times faster as a man

→ So, Car is $4 \times 2 = 8$ times faster than man

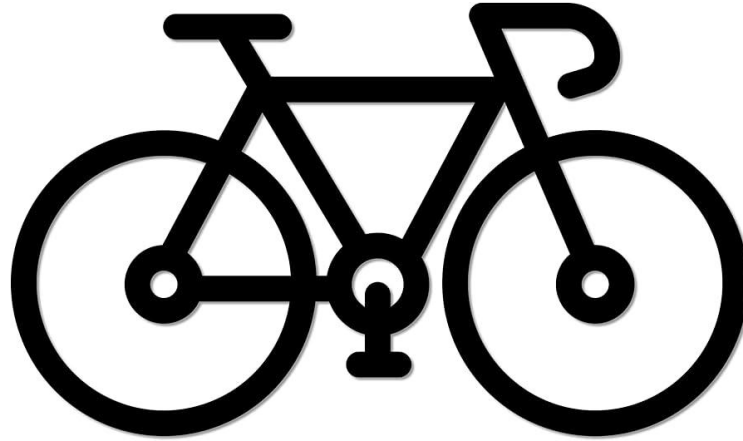
$d\text{Car}/d\text{Bicycle}=4$, $d\text{Bicycle}/d\text{Man}=2$

→ So, $d\text{Car}/d\text{Man} = d\text{Car}/d\text{Bicycle} * d\text{Bicycle}/d\text{Man} = 4 \times 2 = 8$

5km



10km



40km



Chain Rule

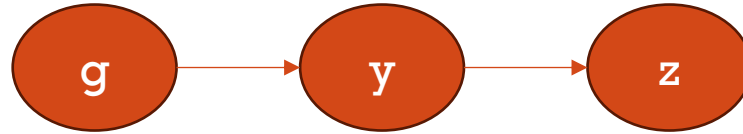


$$g = -2 * w1$$

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$$z = (w2 + -2 * w1) * w3$$



Target = 10

Predicted = -10

Loss = 20

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$w3 = 5$

$$dz / dw1 = dz/dy * dy/dg * dg/dw1$$

$$dz / dw2 = dz/dy * dy/dw2$$

$$dz / dw3 = y$$

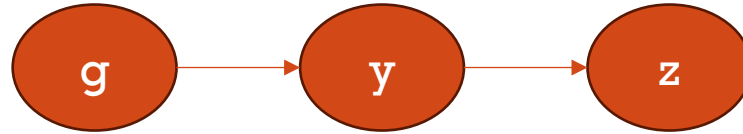


$$g = -2 * w1$$

$$y = w2 + g$$

$$z = y * w3$$

$$z = (w2 + -2 * w1) * w3$$



Target = 10

Predicted = -10

Loss = 20

$w1 = 3$

$w2 = 4$

$w3 = 5$

➔ $dz/dw1 = dz/dy * dy/dg * dg/dw1$

$$dg/dw1 = -2$$



$$\begin{aligned}
 & (f(x+h) - f(x)) / h \\
 & (g(w1+h) - g(w1)) / h \\
 & (-2*(w1+h) + 2*w1) / h \\
 & (-2*w1 - 2*h + 2*w1) / h \\
 & -2*h / h = -2
 \end{aligned}$$

$$\frac{f(x+h) - f(x)}{h}$$

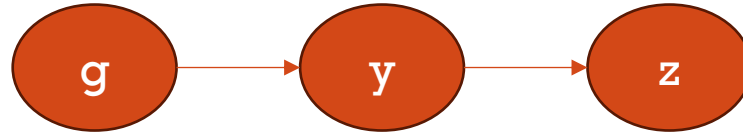


$$g = -2 * w1$$

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$$z = y * w3$$

$$z = (w2 + -2 * w1) * w3$$



Target = 10

Predicted = -10

Loss = 20

$w1 = 3$

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$w3 = 5$

$$\Rightarrow \frac{dz}{dw1} = \frac{dz}{dy} * \frac{dy}{dg} * \frac{dg}{dw1}$$

$$\frac{dg}{dw1} = -2$$

$$\frac{dy}{dg} = 1$$

$$\frac{f(x+h) - f(x)}{h}$$

$$\frac{y(g+h) - y(g)}{h}$$

$$\frac{(w2 + (g+h) - (w2+g))}{h}$$

$$\frac{(w2 + g + h - w2 - g)}{h}$$

$$h / h = 1$$

$$\frac{f(x+h) - f(x)}{h}$$

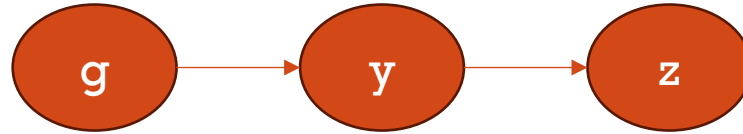


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Loss = 20

$$w1 = 3$$

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$$\Rightarrow \frac{dz}{dw1} = \frac{dz}{dy} * \frac{dy}{dg} * \frac{dg}{dw1}$$

$$\frac{dg}{dw1} = -2$$

$$\frac{dy}{dg} = 1$$

$$\frac{dz}{dy} = w3$$

$$\begin{aligned}
 & \frac{(f(x+h) - f(x))}{h} \\
 & \frac{(z(y+h) - z(y))}{h} \\
 & \frac{((y+h)*w3 - y*w3)}{h} \\
 & \frac{(y*w3 + h*w3 - y*w3)}{h} \\
 & \frac{h*w3}{h} = w3
 \end{aligned}$$

$$\frac{f(x+h) - f(x)}{h}$$



$$g = -2 * w1$$

$$y = w2 + g$$

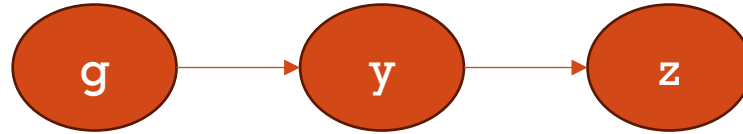
$$z = y * w3$$

$$z = (w2 + -2 * w1) * w3$$

$$dg/dw1 = -2$$

$$dy/dg = 1$$

$$dz/dy = w3 = 5$$



Target = 10

Predicted = -10

Loss = 20

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➔ $dz/dw1 = dz/dy * dy/dg * dg/dw1 = -2 * 1 * 5 = -10$

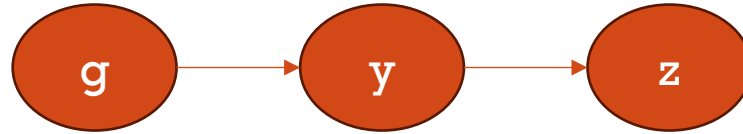


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$$dz / dw1 = dz/dy * dy/dg * dg/dw1 = -10$$

$$dz / dw2 = dz/dy * dy/dw2 = w3 * 1 = w3 = 5$$

$$dz / dw3 = y = w2 + g = w2 - 2 * w1 = 4 - 2 * 3 = -2$$



NEXT... Gradient Descent

