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# Basics of Neural Network Programming

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## Computation Graph

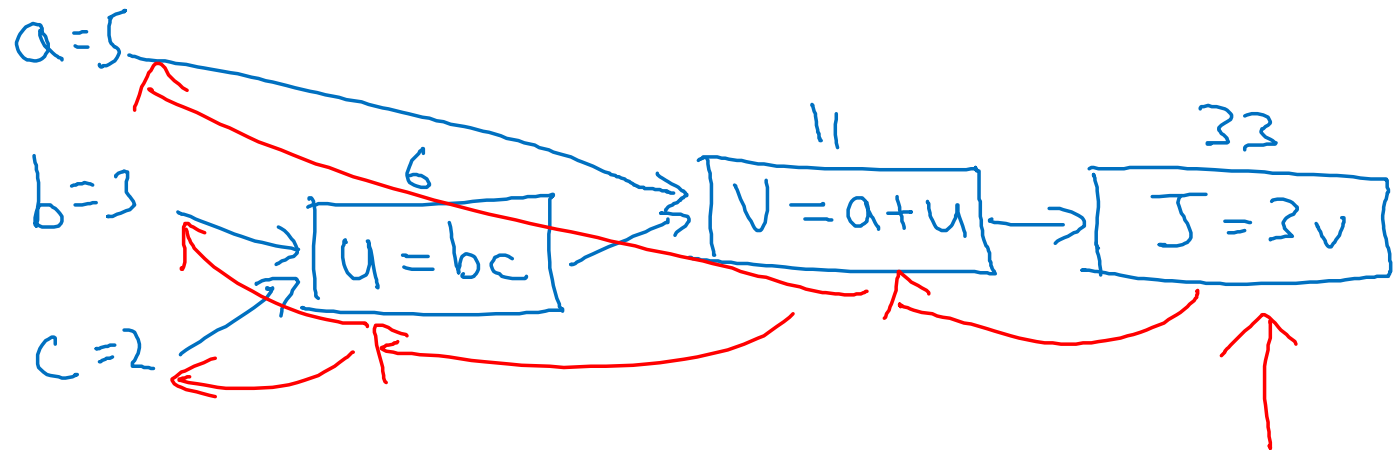
# Computation Graph

$$J(a, b, c) = 3(a + \underbrace{bc}_u) = 3(5 + \underbrace{3 \times 2}_v) = 33$$

$$u = bc$$

$$V = a + u$$

$$J = 3v$$





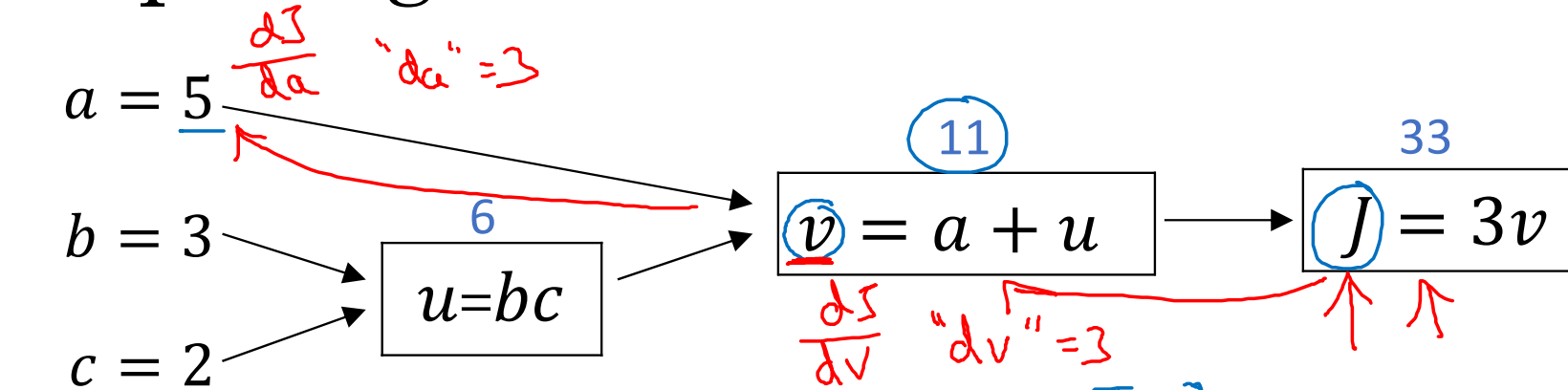
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## Derivatives with a Computation Graph

# Computing derivatives



$$\frac{dT}{dv} = ? = 3$$

$$\frac{dJ}{da} = 3 = \frac{dJ}{du} \frac{du}{da}$$

$\uparrow$   
 $3 \times 1$

$$\frac{dv}{da} = 1$$

$$a \rightarrow v \rightarrow j$$

$$J = 3V$$

$$v = 11 \rightarrow 11.001$$

$$J = 33 \rightarrow \underline{33.003}$$

$$a=5 \rightarrow \underline{5.001}$$

$$\rightarrow V = 11 \rightarrow 11 \cdot 601 \quad \underline{\quad}$$

$$J = JJ \rightarrow JJ.00J$$

$$\frac{\Delta \text{Final Output Var}}{\Delta \text{var}}$$

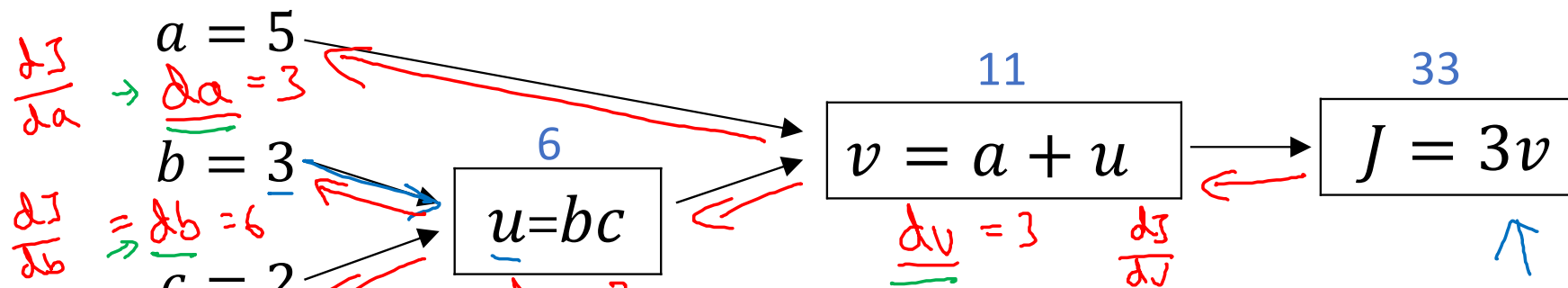
dvar

$$f(a) = 3a$$

$$\frac{df(\omega)}{d\omega} = \frac{df}{d\omega} = 3$$

$$J = 3v$$
$$\frac{dJ}{dv} = 3$$

# Computing derivatives



$$\frac{dJ}{du} = 3 = \frac{dJ}{dv} \cdot \frac{dv}{du}$$

3      1

$$\begin{aligned} u &= 6 \rightarrow 6.001 \\ v &= 11 \rightarrow 11.001 \\ J &= 33 \rightarrow 33.003 \end{aligned}$$

$$b = 3 \rightarrow 3.001$$

$$\begin{aligned} u &= b \cdot c = 6 \rightarrow 6.002 \\ J &= 33.006 \end{aligned}$$

$$\begin{aligned} c &= 2 \\ &1006 \end{aligned}$$

$$\begin{aligned} v &= 11.002 \\ J &= 3v \end{aligned}$$