Basics of Neural Network Programming

Derivatives with a Computation Graph

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Computation Graph

$$J(a,b,c) = 3(a + bc) = 3(5 + 3 \times 2) = 33$$

$$u = bc$$
$$V = a + u$$
$$J = 3v$$

Computing derivatives

$a = 5$

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

$b = 3$

$c = 2$

$u = bc$

6

11

$v = a + u$

$\frac{dJ}{dv}$ `dv` $= 3$

33

$J = 3v$

$a \rightarrow v \rightarrow J$

$J = 3v$

$v = 11 \rightarrow 11 \cdot 001$

$J = 33 \rightarrow 33 \cdot 003$

$\boxed{\frac{dJ}{dv} = ? = 3}$

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

3×1

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

$\boxed{\frac{d\ Final\ Output\ Var}{d\ var}}$

$dJdvar$

"$dvar$"
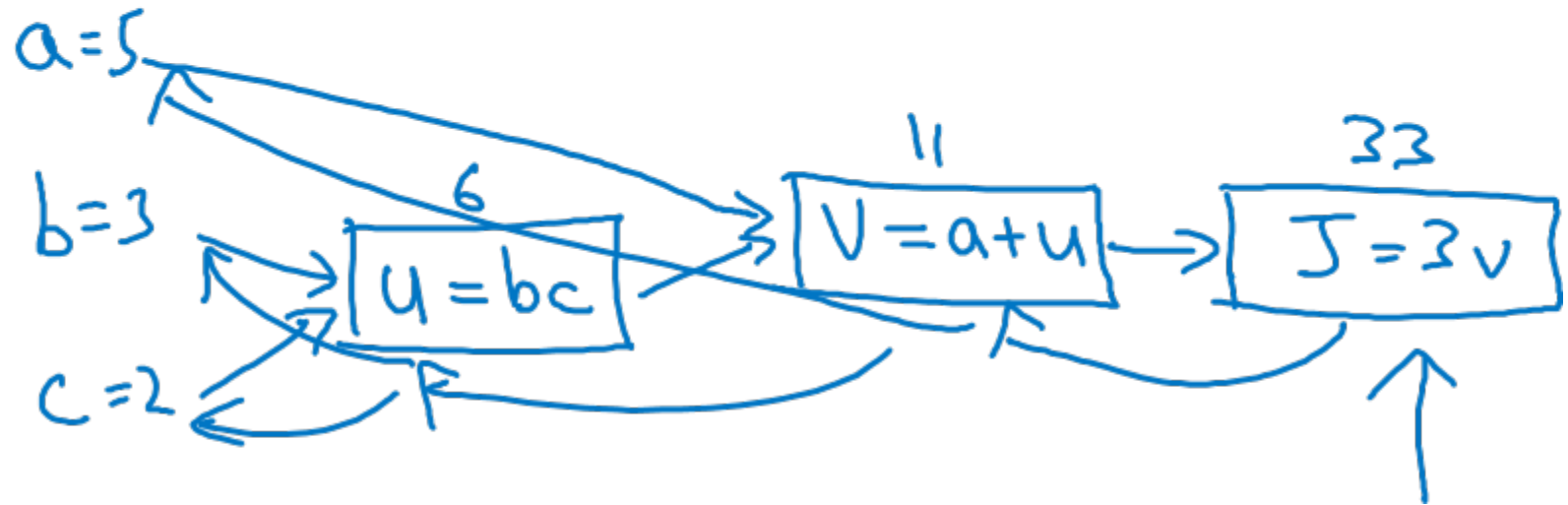
$a = 5 \rightarrow 5 \cdot \underline{001}$
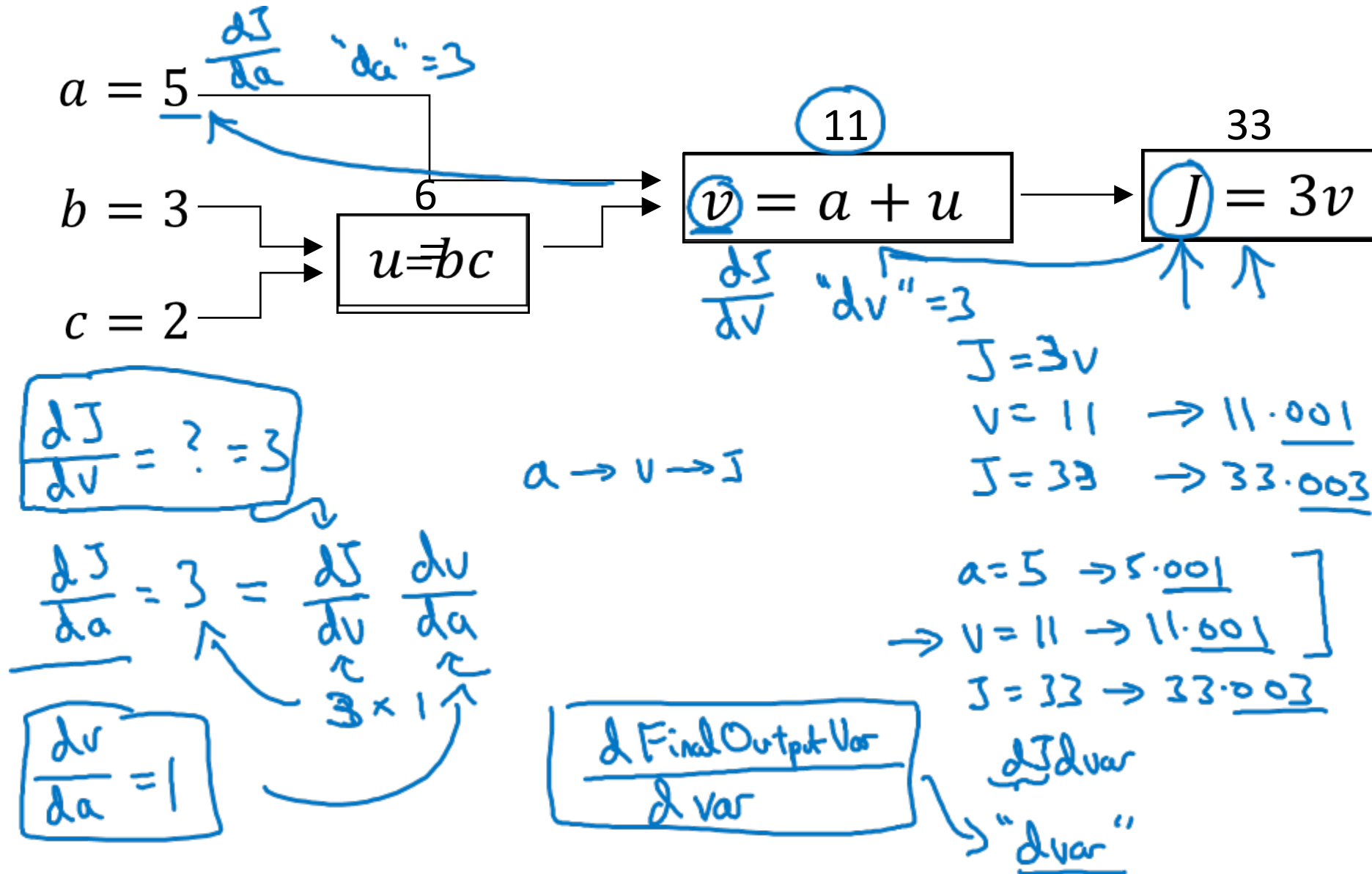
$\rightarrow v = 11 \rightarrow 11 \cdot \underline{001}$

$J = 33 \rightarrow 33 \cdot \underline{003}$

$\boxed{f(a) = 3a}$

$\frac{df(a)}{da} = \frac{df}{da} = 3$

$\boxed{J = 3v}$

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

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Computing derivatives

$\frac{dJ}{da}$

$a = 5$

$\rightarrow \underline{\underline{da}} = 3$

$\frac{dJ}{db} = \underline{\underline{db}} = 6$

$b = 3$

$c = 2$

$\rightarrow \underline{dc} = 9$

$u = bc$

$\underline{\underline{du = 3}}$

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

$\underbrace{\quad}_{3} \quad \underbrace{\quad}_{1}$

$\frac{dJ}{db} = \boxed{\frac{dJ}{du}} \frac{du}{db} = \underline{6}$

$\underbrace{\quad}_{\rightarrow 3} \quad \underbrace{\quad}_{=2}$

$\frac{dJ}{da} = \boxed{\frac{dJ}{du}} \cdot \frac{du}{da} = 9$

$\underbrace{3}_{} \times \underbrace{3}_{}$

11

$v = a + u$

$\underline{\underline{dv = 3}} \qquad \frac{dJ}{dJ}$

33

$J = 3v$

$u = 6 \rightarrow 6.001$

$v = 11 \rightarrow 11.001$

$J = 33 \rightarrow 33.\underline{003}$

$b = 3 \rightarrow \underline{3.001}$

$u = b \cdot c = 6 \rightarrow 6.\underline{\underline{002}} \qquad c = 2$

$J = 33.006 \qquad\qquad .006$

$v = 11.002$

$J = 3v$

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