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# Basics of Neural Network Programming

## Computation Graph

# Computation Graph

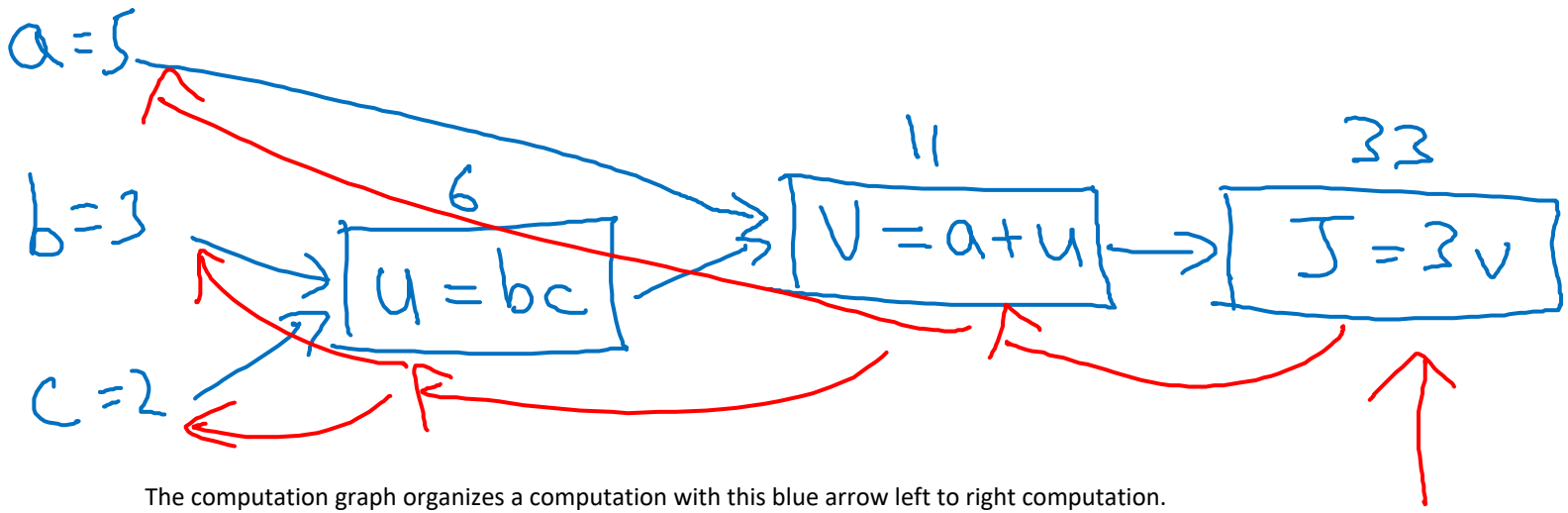
$J(a,b,c) = 3(a+bc) = 3(5+3\times 2) = 33$

$u$, $v$, $J$

$u = bc$

$v = a+u$

$J = 3v$




The computation graph organizes a computation with this blue arrow left to right computation. Backward red arrow right to left computation of the derivatives, that will be the most natural for computing the derivatives.

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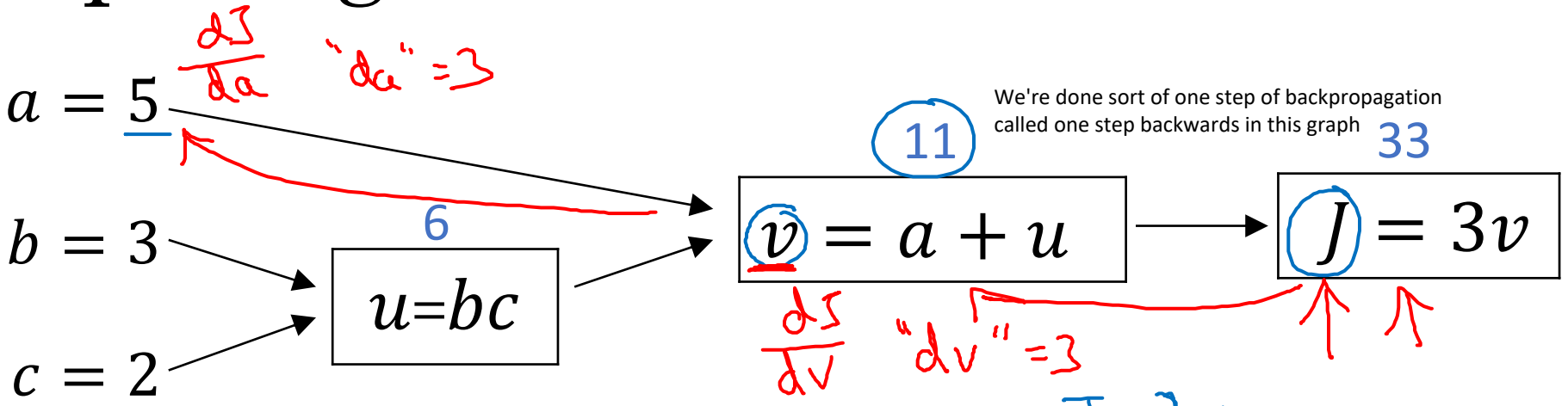
# Derivatives with a Computation Graph

# Computing derivatives




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

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

$3 \times 1$

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

$a \to v \to J$

$J = 3v$

$v = 11 \to 11.001$

$J = 33 \to 33.003$

$a = 5 \to 5.001$

$\to v = 11 \to 11.001$

$J = 33 \to 33.003$

$f(a) = 3a$

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

$J = 3v$

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

$\frac{d\,\text{FinalOutputVar}}{d\,\text{var}}$ "dvar"

dJdvar

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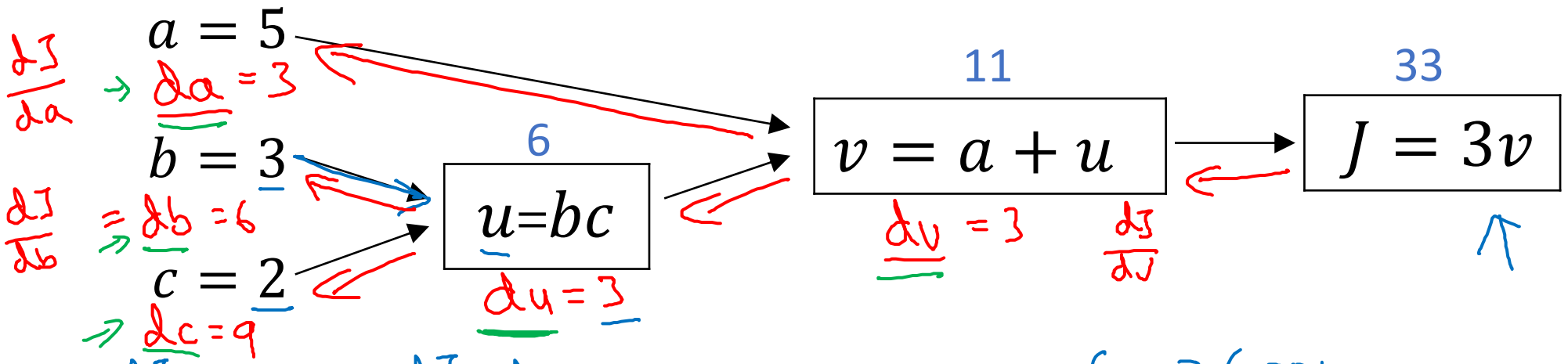
# Computing derivatives

When computing derivatives in computing all of these derivatives, the most efficient way to do so, is through a right to left computation following the direction of the red arrows.




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

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

$dc = 9$

$du = 3$

$dv = 3$

$\frac{dJ}{dJ}$

$\frac{dJ}{du} = 3 = \frac{dJ}{dv} \cdot \frac{dv}{du}$ (3 · 1)

$\frac{dJ}{db} = \frac{dJ}{du} \cdot \frac{du}{db} = 6$ (3 · 2)

$\frac{dJ}{da} = \frac{dJ}{du} \cdot \frac{du}{da} = 9$ (3 × 3)

$u = 6 \rightarrow 6.001$

$v = 11 \rightarrow 11.001$

$J = 33 \rightarrow 33.003$

$b = 3 \rightarrow 3.001$

$u = b \cdot c = 6 \rightarrow 6.002$

$J = 33.006$

$c = 2$

$.006$

$V = 11.002$

$J = 3V$

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