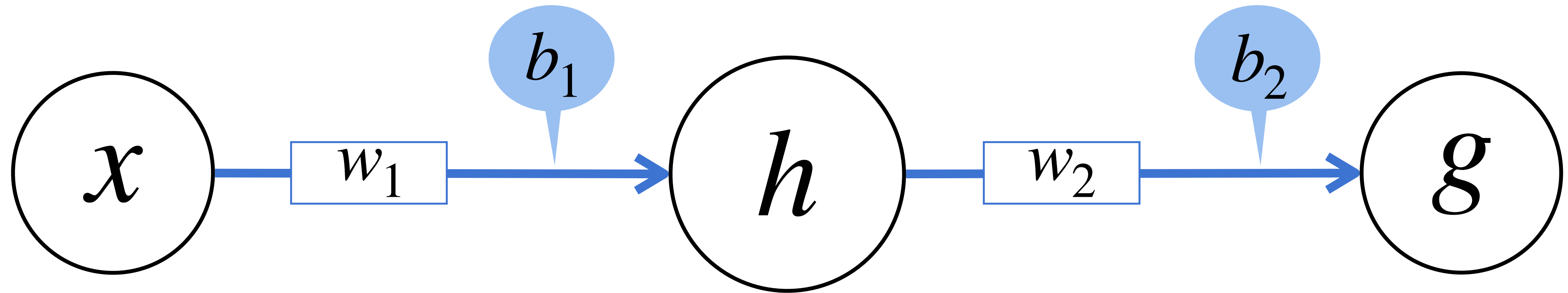


# Backpropagation



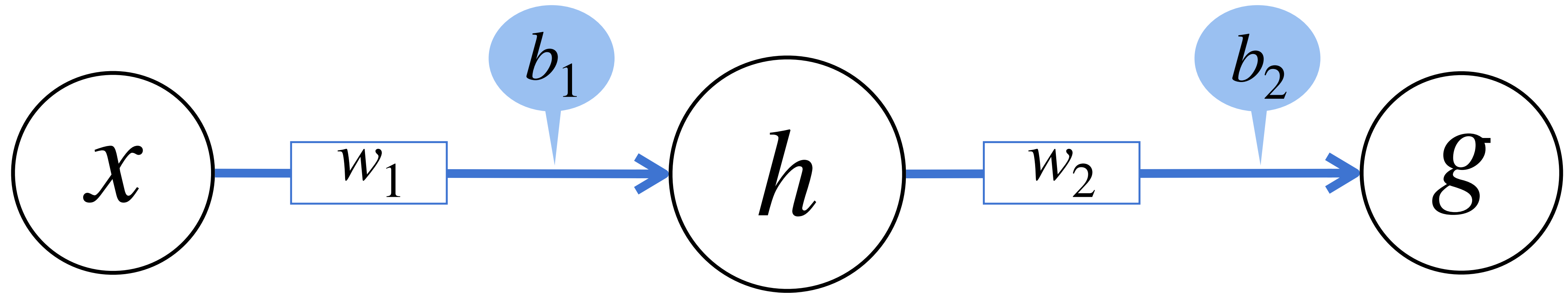
## Chain rule:

If we want to know how changing  $x$  affects  $f(g(x))$  we first need to think about how changing  $x$  affects  $g(x)$  and then how changing  $g(x)$  affects  $f(g(x))$ :

$$\frac{\partial f(g(x))}{\partial x} = \frac{\partial f}{\partial g} \cdot \frac{\partial g}{\partial x}$$

the derivative of the outer function  $f$  evaluated at  $g(x)$   
multiplied by the derivative of the inner function  $g(x)$

# Backpropagation



$$h = w_1 \cdot x + b_1$$

$$g = w_2 \cdot x + b_2$$

how close is  $g$  to our  
actual value?

Loss function (MSE):

$$\frac{1}{N} \sum_i^N (y_i - g_i)^2 \implies \frac{1}{N} \sum_i^N (y_i - \underbrace{(w_2 \cdot (w_1 \cdot x_i + b_1))}_{= h} + b_2)^2$$