$$P(h=1,v) = \frac{P(v,1)}{\sum_h P(v,h)}$$

$$h \in \{0,1\}' \to \sum_h P(v,h) = P(v,0) + P(v,1)$$

$$\to P(h=1,v) = \frac{P(v,1)}{P(v,0)+P(v,1)} = \frac{1}{1+\frac{P(v,0)}{P(v,1)}} \quad (1)$$

$$\frac{P(v,0)}{P(v,1)} = \frac{\exp(-E(v,0))}{\cancel{Z}} \cdot \frac{\cancel{Z}}{\exp(-E(v,1))} = \frac{\exp(-E(v,0))}{\exp(-E(v,1))}$$

$$= e^{-E(v,0)} e^{E(v,1)} = e^{E(v,1)-E(v,0)} \quad (2)$$

$$E(v,1)-E(v,0) = \cancel{b}^T v - v^T W - \cancel{b}^T v - c^T h$$

$$= -v^T W - c^T h \quad \to \text{let } x = v^T W + c^T h$$

$$\to -v^T W - c^T h = -x \to E(v,1)-E(v,0) = -x \quad (3)$$

Sub (3) into (2): $e^{E(v,1)-E(v,0)} = e^{-x}$

Sub (2) into (1):

$$P(h=1,v) = \frac{1}{1+\frac{P(v,0)}{P(v,1)}} = \frac{1}{1+e^{-x}} = \boxed{\frac{1}{1+\exp(-x)}}$$