$$J(w) = -\left[y^{(i)} \ln\left(\phi(z^{(2)})\right) + (1-y^{(i)}) \ln\left(1-\phi(z^{(2)})\right) \right]$$

$$\frac{\partial J}{\partial z^{(2)}} = -\left[\frac{+y^{(i)}}{\phi(z^{(2)})} \frac{\partial}{\partial z^{(2)}} \phi(z^{(2)}) + \frac{(1-y^{(i)})}{1-\phi(z^{(2)})} \frac{\partial}{\partial z^{(2)}} \left(1-\phi(z^{2})\right) \right]$$

$$= -\left[\frac{+y^{(i)}}{\phi(z^{(2)})} \phi(z^{(2)})(1-\phi(z^{(2)})) + \frac{(1-y^{(i)})}{1-\phi(z^{(2)})} \left[-\phi(z^{(2)})(1-\phi(z^{(2)})) \right] \right]$$

$$= -\left[y^{(i)} (1-\phi(z^{(2)})) + (-\phi(z^{(2)}))(1-y^{(i)}) \right]$$

$$= -\left[y^{(i)} - y^{(i)} \phi(z^{(2)}) + (-\phi(z^{(2)})) + \phi(z^{(2)}) y^{(i)} \right]$$

$$= -\left[y^{(i)} - \phi(z^{(2)}) \right]$$

$$= \left(\phi(z^{(2)}) - y^{(i)} \right)$$