1.1

$$g(z) = \frac{1}{1+e^{-z}}, \quad \text{show } \frac{\partial g(z)}{\partial z} = g(z)(1-g(z))$$

$$\frac{\partial g}{\partial z} = \frac{\partial g}{\partial(1+e^{-z})} \cdot \frac{\partial(1+e^{-z})}{\partial z}$$

$$= \frac{-1}{(1+e^{-z})^2} \cdot (-e^{-z})$$

$$= \frac{1}{1+e^{-z}} \cdot \frac{e^{-z}}{1+e^{-z}}$$

$$= g(z) \cdot (1-g(z)) \quad \#$$

1.2

$$J(\theta) = \frac{-1}{m}\sum_{i=1}^{m}\left(y^{(i)}\log(h_\theta(x^{(i)})) + (1-y^{(i)})\log(1-h_\theta(x^{(i)}))\right) + \frac{\lambda}{2m}\sum_{j=1}^{d}\theta_j^2$$

$$\frac{\partial J(\theta)}{\partial\theta} = \frac{-1}{m}\sum_{i=1}^{m}\left(y^{(i)} \cdot \frac{\frac{\partial h_\theta(x^{(i)})}{\partial\theta}}{h_\theta(x^{(i)})} + (1-y^{(i)}) \cdot \frac{-\frac{\partial h_\theta(x^{(i)})}{\partial\theta}}{1-h_\theta(x^{(i)})}\right) + \frac{\lambda}{2m} \cdot 2\sum_{j=1}^{d}\theta_j$$

$$= \frac{-1}{m}\sum_{i=1}^{m}\left[y^{(i)} \cdot \frac{\cancel{h_\theta(x^{(i)})} \cdot (1-h_\theta(x^{(i)})) \cdot x^{(i)}}{\cancel{h_\theta(x^{(i)})}} + (1-y^{(i)}) \cdot \frac{-h_\theta(x^{(i)})\cancel{(h_\theta(x^{(i)})-1)} \cdot x^{(i)}}{\cancel{1-h_\theta(x^{(i)})}}\right] + \frac{\lambda}{m}\sum_{j=1}^{d}\theta_j$$

$$= \frac{-1}{m}\sum_{i=1}^{m}\left[y^{(i)}(1-h_\theta(x^{(i)})) \cdot x^{(i)} + (1-y^{(i)}) \; -h_\theta(x^{(i)}) \cdot x^{(i)}\right] + \sim$$

$$= \frac{-1}{m}\sum_{i=1}^{m} x^{(i)}(y^{(i)} - h_\theta(x^{(i)})) + \frac{\lambda}{m}\sum_{j=1}^{d}\theta_j$$

$\#$