5.

(a)

(i)

$$\theta^{(i)} = \sum_{j=1}^{i} \beta_j \phi(x^{(j)}), \quad \theta^{(0)} = \sum_{j=1}^{0} \beta_j \phi(x^{(j)}) = \vec{0}$$

(ii)

$$\begin{aligned}
h_{\theta^{(i)}}\left(\phi(x^{(i+1)})\right) &= g\left(\theta^{(i)T}\phi(x^{(i+1)})\right) \\
&= \text{sign}\left(\theta^{(i)T}\phi(x^{(i+1)})\right) \\
&= \text{sign}\left(\left(\sum_{j=1}^{i} \beta_j \phi(x^{(j)})\right)^T \phi(x^{(i+1)})\right) \\
&= \text{sign}\left(\sum_{j=1}^{i} \beta_j \langle \phi(x^{(j)}), \phi(x^{(i+1)})\rangle\right) \\
&= \text{sign}\left(\sum_{j=1}^{i} \beta_j K(x^{(j)}, x^{(i+1)})\right)
\end{aligned}$$

(iii)

$$\begin{aligned}
\theta^{(i+1)} &:= \theta^{(i)} + \alpha\left(y^{(i+1)} - h_{\theta^{(i)}}(\phi(x^{(i+1)}))\right)\phi(x^{(i+1)}) \\
&= \sum_{j=1}^{i} \beta_j \phi(x^{(j)}) + \alpha\left(y^{(i+1)} - \text{sign}\left(\sum_{j=1}^{i} \beta_j K(x^{(j)}, x^{(i+1)})\right)\right)\phi(x^{(i+1)}) \\
\beta_{i+1} &= \alpha\left(y^{(i+1)} - \text{sign}\left(\sum_{j=1}^{i} \beta_j K(x^{(j)}, x^{(i+1)})\right)\right)
\end{aligned}$$