



Motivations

Neural Networks

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Model Representation II

To re-iterate, the following is an example of a neural net

$$\begin{aligned}a_1^{(2)} &= g(\theta_{10}^{(1)} x_0 + \theta_{11}^{(1)} x_1 + \theta_{12}^{(1)} x_2 + \theta_{13}^{(1)}) \\a_2^{(2)} &= g(\theta_{20}^{(1)} x_0 + \theta_{21}^{(1)} x_1 + \theta_{22}^{(1)} x_2 + \theta_{23}^{(1)}) \\a_3^{(2)} &= g(\theta_{30}^{(1)} x_0 + \theta_{31}^{(1)} x_1 + \theta_{32}^{(1)} x_2 + \theta_{33}^{(1)}) \\h_{\theta}(x) &= a_1^{(3)} = g(\theta_{10}^{(2)} a_0^{(2)} + \theta_{11}^{(2)} a_1^{(2)} + \theta_{12}^{(2)} a_2^{(2)} + \theta_{13}^{(2)})\end{aligned}$$

In this section we'll do a vectorized implementation of the functions. We're going to define a new variable $z_k^{(j)}$ that encompasses the parameters inside our g function. In our previous example if we replaced by the variable z for all parameters we would get:

$$\begin{aligned}a_1^{(2)} &= g(z_1^{(2)}) \\a_2^{(2)} &= g(z_2^{(2)}) \\a_3^{(2)} &= g(z_3^{(2)})\end{aligned}$$

In other words, for layer $j=2$ and node k , the variable z is

$$z_k^{(2)} = \theta_{k,0}^{(1)} x_0 + \theta_{k,1}^{(1)} x_1 + \cdots + \theta_{k,n}^{(1)} x_n$$

The vector representation of x and $z^{(j)}$ is:

$$\begin{array}{cc}x_0 & z_1^{(j)} \\x_1 & z_2^{(j)} \\ \cdots & \cdots \\x_n & z_n^{(j)}\end{array}$$

Setting $x = a^{(1)}$, we can rewrite the equation as: