




Cost Function and Backpropagation

 Video: Cost Function
6 min

 **Reading:** Cost Function
4 min

 **Video:** Backpropagation Algorithm
11 min

 **Reading:** Backpropagation Algorithm
10 min

 Video: Backpropagation Intuition
12 min

✓ **Reading:** Backpropagation
Intuition
4 min

Backpropagation in Practice


 **Video:** Implementation
Note: Unrolling Parameters
7 min

 **Reading:** Implementation
Note: Unrolling Parameters
3 min

 **Video:** Gradient Checking
11 min

 **Reading:** Gradient Checking
3 min

 **Video:** Random Initialization
6 min

 **Reading:** Random Initialization
3 min

 **Video:** Putting It Together
13 min

 Reading: Putting It Together
4 min

Application of Neural Networks

Review

Implementation Note: Unrolling Parameters

With neural networks, we are working with sets of matrices:

$$\Theta^{(1)}, \Theta^{(2)}, \Theta^{(3)}, \dots$$

$$D^{(1)}, D^{(2)}, D^{(3)}, \dots$$

In order to use optimizing functions such as `fminunc()`, we will want to "unroll" all the elements and put them into one long vector:

```
1 thetaVector = [ Theta1(:); Theta2(:); Theta3(:); ]
2 deltaVector = [ D1(:); D2(:); D3(:) ]
```

If the dimensions of Theta1 is 10x11, Theta2 is 10x11 and Theta3 is 1x11, then we can get back our original matrices from the "unrolled" versions as follows:

```
1 Theta1 = reshape(thetaVector(1:110),10,11)
2 Theta2 = reshape(thetaVector(111:220),10,11)
3 Theta3 = reshape(thetaVector(221:231),1,11)
4
```

To summarize:

Learning Algorithm

- Have initial parameters $\underline{\Theta^{(1)}}, \underline{\Theta^{(2)}}, \underline{\Theta^{(3)}}$.

→ Unroll to get `initialTheta` to pass to

```
→ fminunc(@costFunction, initialTheta, options)
```

```
function [jval, gradientVec] = costFunction(thetaVec)
```

From `thetaVec`, get $\Theta^{(1)}, \Theta^{(2)}, \Theta^{(3)}$.

Use forward prop/back prop to compute $D^{(1)}, D^{(2)}, D^{(3)}$ and $J(\Theta)$.

Unroll $D^{(1)}, D^{(2)}, D^{(3)}$ to get `gradientVec`.