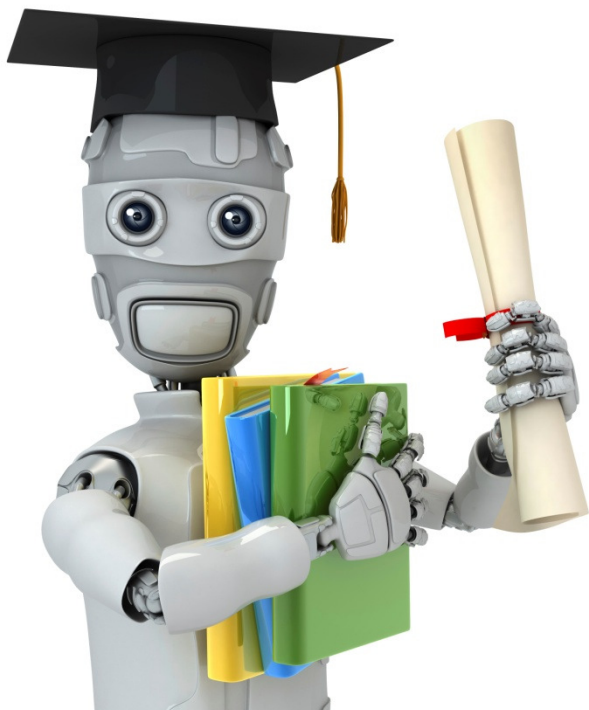




Machine Learning

# Octave Tutorial

## Basic operations



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Moving data around



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## Computing on data



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## Plotting data



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Control statements: for,  
while, if statements



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## Vectorial implementation

## Vectorization example.

$$h_{\theta}(x) = \sum_{j=0}^n \theta_j x_j$$
$$= \underline{\theta^T x}$$

Hand-drawn diagram illustrating the vectorization of the hypothesis function. It shows the parameter vector  $\theta$  and the input vector  $x$  as column vectors. The vector  $\theta$  is represented as  $\begin{bmatrix} \theta_0 \\ \theta_1 \\ \theta_2 \\ \theta_3 \end{bmatrix}$  and the vector  $x$  is represented as  $\begin{bmatrix} x_0 \\ x_1 \\ x_2 \end{bmatrix}$ . A red box labeled  $\theta(1)$  points to the second element of the  $\theta$  vector,  $\theta_1$ .

## Unvectorized implementation

```
prediction = 0.0;
for j = 1:n+1,
    prediction = prediction +
        theta(j) * x(j)
end;
```

## Vectorized implementation

```
prediction = theta' * x;
```

matriz dos input  
dados

## Vectorization example.

C++

$$\begin{aligned}h_{\theta}(x) &= \sum_{j=0}^n \theta_j x_j \\ &= \theta^T x\end{aligned}$$

### Unvectorized implementation

```
double prediction = 0.0;
for (int j = 0; j < n; j++)
    prediction += theta[j] * x[j];
```

### Vectorized implementation


```
double prediction
    = theta.transpose() * x;
```



# Gradient descent

$$\theta_j := \theta_j - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)}) x_j^{(i)} \quad (\text{for all } j)$$

multiplos


$$\theta_0 := \theta_0 - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)}) x_0^{(i)}$$

$$\theta_1 := \theta_1 - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)}) x_1^{(i)}$$

$$\theta_2 := \theta_2 - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)}) x_2^{(i)}$$

$$\theta_0 := \theta_0 - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)}) x_0^{(i)}$$

$$\theta_1 := \theta_1 - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)}) x_1^{(i)}$$

$$\theta_2 := \theta_2 - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)}) x_2^{(i)}$$

(n = 2)

$$u(j) = 2v(j) + 5w(j) \quad (\text{for all } j)$$

$$u = 2v + 5w$$

$$\theta := \theta - \alpha \delta, \text{ where } \delta = \frac{1}{m} \sum_i (h_{\theta} x - y) x$$

$$\delta = \begin{bmatrix} \delta_0 \\ \delta_1 \\ \delta_2 \end{bmatrix}, \delta_0 = \frac{1}{m} \sum_i (h_{\theta} x - y) x$$