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# Basics of Neural Network Programming

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## Vectorization

# What is vectorization?



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**More vectorization  
examples**

# Neural network programming guideline

Whenever possible, avoid explicit for-loops.

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# Vectors and matrix valued functions

Say you need to apply the exponential operation on every element of a matrix/vector.

$$v = \begin{bmatrix} v_1 \\ \vdots \\ v_n \end{bmatrix}$$

```
u = np.zeros( (n,1) )  
for i in range(n):  
    u[i]=math.exp(v[i])
```

# Logistic regression derivatives

$J = 0, \quad dw_1 = 0, \quad dw_2 = 0, \quad db = 0$

for  $i = 1$  to  $n$ :

$$z^{(i)} = w^T x^{(i)} + b$$

$$a^{(i)} = \sigma(z^{(i)})$$

$$J += -[y^{(i)} \log \hat{y}^{(i)} + (1 - y^{(i)}) \log(1 - \hat{y}^{(i)})]$$

$$dz^{(i)} = a^{(i)}(1 - a^{(i)})$$

$$dw_1 += x_1^{(i)} dz^{(i)}$$

$$dw_2 += x_2^{(i)} dz^{(i)}$$

$$db += dz^{(i)}$$

$$J = J/m, \quad dw_1 = dw_1/m, \quad dw_2 = dw_2/m, \quad db = db/m$$



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## Broadcasting in Python



# Broadcasting example

Calories from Carbs, Proteins, Fats in 100g of different foods:

	Apples	Beef	Eggs	Potatoes
Carb	56.0	0.0	4.4	68.0
Protein	1.2	104.0	52.0	8.0
Fat	1.8	135.0	99.0	0.9

```
cal = A.sum(axis = 0)  
percentage = 100*A/(cal.reshape(1,4))
```

# Broadcasting example

$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix} + 100$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} + [100 \quad 200 \quad 300]$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} + \begin{bmatrix} 100 \\ 200 \end{bmatrix}$$

# General Principle



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A note on python/  
numpy vectors

# Python Demo

# Python / numpy vectors

```
import numpy as np  
  
a = np.random.randn(5)  
  
a = np.random.randn(5, 1)  
  
a = np.random.randn(1, 5)  
  
assert(a.shape == (5, 1))
```