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# Basics of Neural Network Programming

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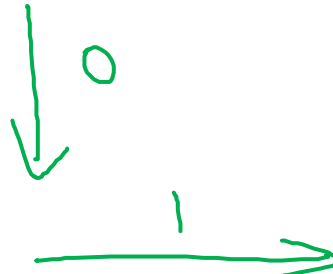
## Broadcasting in Python

# 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	= A (3,4)
Protein	1.2	104.0	52.0	8.0	
Fat	1.8	135.0	99.0	0.9	

59 cal       $\frac{56}{59} \approx 94.9\%$



Calculate % of calories from Carb, Protein, Fat. Can you do this without explicit for-loop?

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

↑(3,4) / (1,4)

# Broadcasting example

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

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

$(m,n) \quad (2,3) \qquad (1,n) \rightsquigarrow (m,n) \quad (2,3)$

↓      ↓      ↓

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

$(m,n) \qquad (m,1) \rightsquigarrow (m,n)$

←  
←

# General Principle

$$\begin{array}{ccc} (m, n) & + & (1, n) \\ \text{matrix} & \underline{\quad} & \rightsquigarrow (m, n) \\ & * & \\ & / & (m, 1) \rightsquigarrow (m, n) \end{array}$$

$$\begin{array}{ccccc} (m, 1) & + & \mathbb{R} & & \\ \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} & + & 100 & = & \begin{bmatrix} 101 \\ 102 \\ 103 \end{bmatrix} \\ [1 \ 2 \ 3] & + & 100 & = & [101 \quad 102 \quad 103] \end{array}$$

Matlab/Octave: bsxfun