A_{ij} = "i,j entry" is the i^{th} row of j^{th} column

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

vector is a nx1 matrix. y_i is the i^{th} element.

1-indexed vector: $\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix}$; 0-indexed: $\begin{bmatrix} y_0 \\ y_1 \\ y_2 \end{bmatrix}$ (compare arrays in programming)

Matrix Addition

$$\underset{3\times 2}{\begin{bmatrix} 1 & 0 \\ 2 & 5 \\ 3 & 1 \end{bmatrix}} + \underset{3\times 2}{\begin{bmatrix} 4 & 5 \\ 2 & 5 \\ 0 & 1 \end{bmatrix}} = \underset{3\times 2}{\begin{bmatrix} 5 & 5 \\ 4 & 10 \\ 3 & 2 \end{bmatrix}}$$

⇒ Matrices need to be of the same dimension

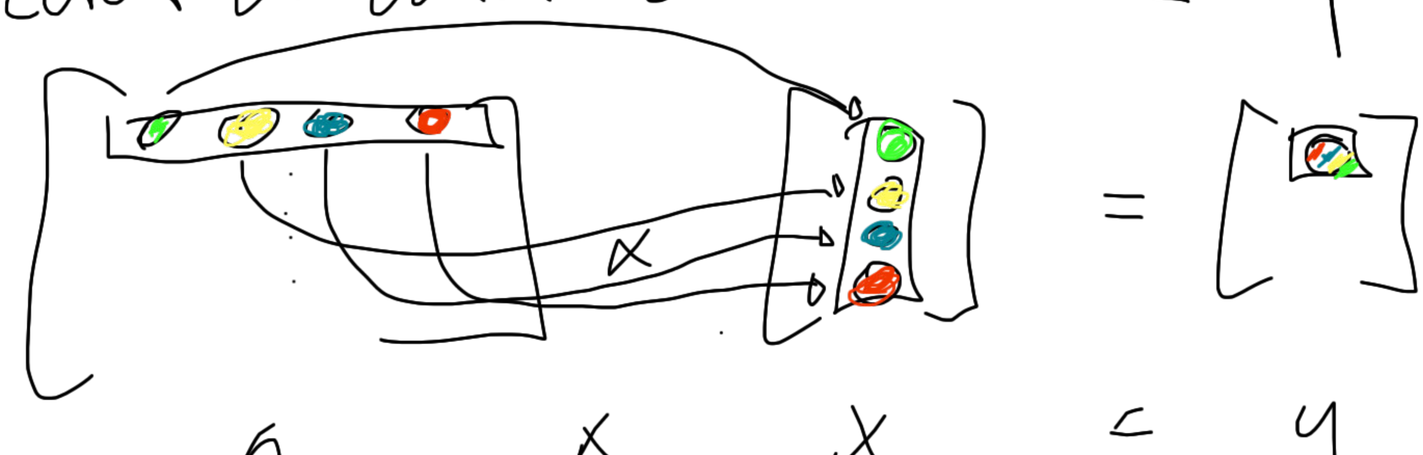
Matrix vector multiplication

$$\underbrace{\begin{bmatrix} 1 & 3 \\ 4 & 0 \\ 2 & 1 \end{bmatrix}}_{3\times 2} \underbrace{\begin{bmatrix} 1 \\ 5 \end{bmatrix}}_{2\times 1} = \begin{bmatrix} 1\cdot 1 + 3\cdot 5 \\ 4\cdot 1 + 0\cdot 5 \\ 2\cdot 1 + 1\cdot 5 \end{bmatrix} = \underbrace{\begin{bmatrix} 16 \\ 4 \\ 7 \end{bmatrix}}_{3\times 1}$$

$$\underset{3\times 2}{\begin{bmatrix} 1 & 3 \\ 4 & 0 \\ 2 & 1 \end{bmatrix}} \underset{2\times 1}{\begin{bmatrix} 1 \\ 5 \end{bmatrix}} = \ldots = \underset{3\times 1}{\begin{bmatrix} 16 \\ 4 \\ 7 \end{bmatrix}}$$

⇒ m×n matrix times n×1 matrix = m-dim vector

to get $y^{(i)}$: multiply A's i^{th} row with elements of vector x and sum them up.



A × x = y

Assume we're having a feature $x = \begin{bmatrix} 2104 \\ 1406 \\ 852 \end{bmatrix}$

and a hypothesis function: $h_\theta(x) = -40 + 0.25x$

How can we calculate $h_\theta(x_i)$ using matrix multiplication? Answer:

$$\begin{bmatrix} 1 & 2104 \\ 1 & 1406 \\ 1 & 852 \end{bmatrix} \times \begin{bmatrix} -40 \\ 0.25 \end{bmatrix} = \begin{bmatrix} -40\cdot 1 + 0.25\cdot 2104 \\ -40\cdot 1 + 0.25\cdot 1416 \\ -40\cdot 1 + 0.25\cdot 852 \end{bmatrix}$$

⇒ no need for looping through x

⇒ prediction = DataMatrix * parameter