What is vectorization?

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$$z = w^T x + b$$

$$W = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w \end{bmatrix} \quad X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x \end{bmatrix} \quad w \in \mathbb{R}^{n_x} \quad x \in \mathbb{R}^{n_x}$$

Non-vectorized

```
z = 0
for i in range(n_x):
    z += w[i] * x[i]
z += b
```

Vectorized:

```
z = np.dot(w, x) + b
```

$w^T x$

Whenever possible, avoid explicit for-loops

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$u = Av$

$u_i = \sum_j A_{ij} v_j$

```
u = np.zeros(0,0)
for i ... <
    for j ... <
        u[i] += A[i][j] * v[j]
```

```
u = np.dot(A,v)
```

Vector and Matrix Values Functions

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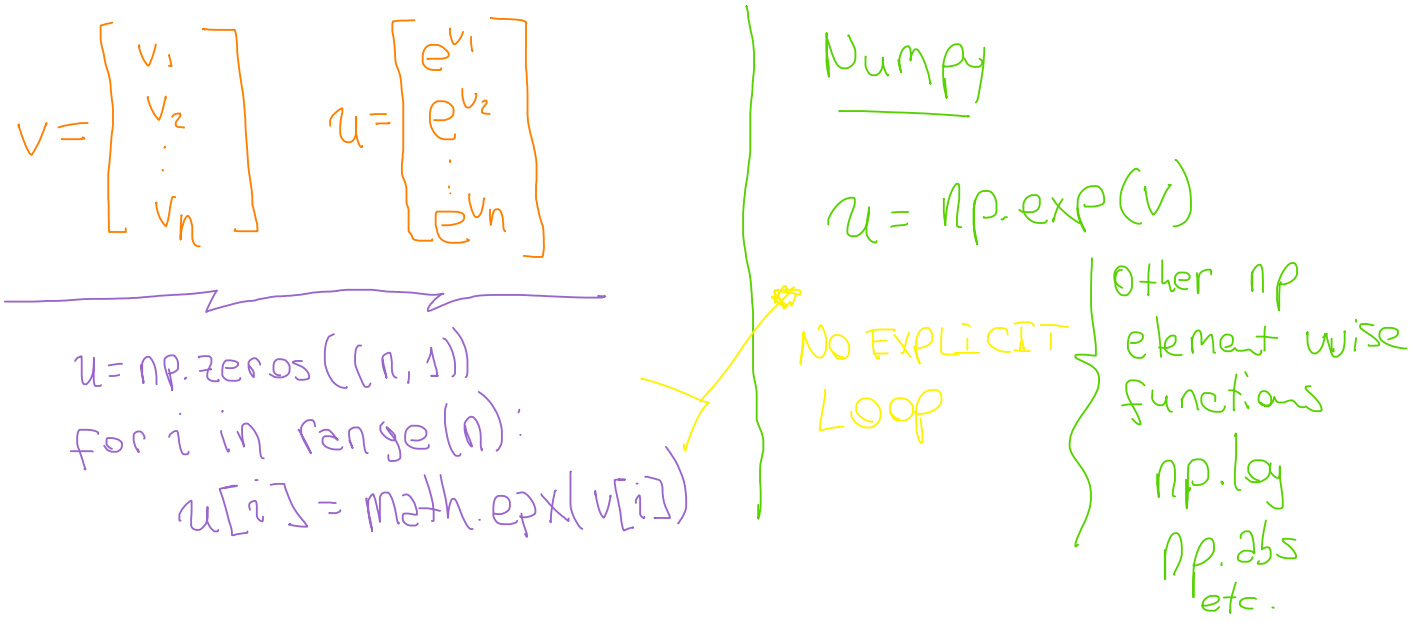

Vectorizing Logistic Regression

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$$X = \begin{bmatrix} | & | & | & | \\ x^{(1)} & x^{(2)} & x^{(3)} & x^{(m)} \\ | & | & | & | \end{bmatrix}_{(n_x, m)} \qquad \mathbb{R}^{n_x \times m}$$

$$Z = \begin{bmatrix} z^{(1)} & z^{(2)} & z^{(3)} \dots z^{(m)} \end{bmatrix} = w^T X + b$$

$$[b, b, b \dots b]_{1 \times m}$$

$$= w^T \begin{bmatrix} | & | & & | \\ x^{(1)} & x^{(2)} & \cdots & x^{(m)} \\ | & | & & | \end{bmatrix} + b$$

$$= \begin{bmatrix} w^T x^{(1)} + b & w^T x^{(2)} + b & \cdots & w^T x^{(m)} + b \end{bmatrix}$$

PYTHON:

```
Z = np.dot(w.T, X) + b
```