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Linear Regression II

Univariate linear regression

#bedrooms	Price (1000$s)
3	400
3	330
3	369
2	232
4	540
⋮	⋮

$$wx + b$$

Multivariate linear regression

Living area (feet^2)	#bedrooms	Price (1000$s)
2104	3	400
1600	3	330
2400	3	369
1416	2	232
3000	4	540
$\vdots$	$\vdots$	$\vdots$

$$w_1x_1 + w_2x_2 + w_3x_3 + \cdots + w_nx_n + b$$

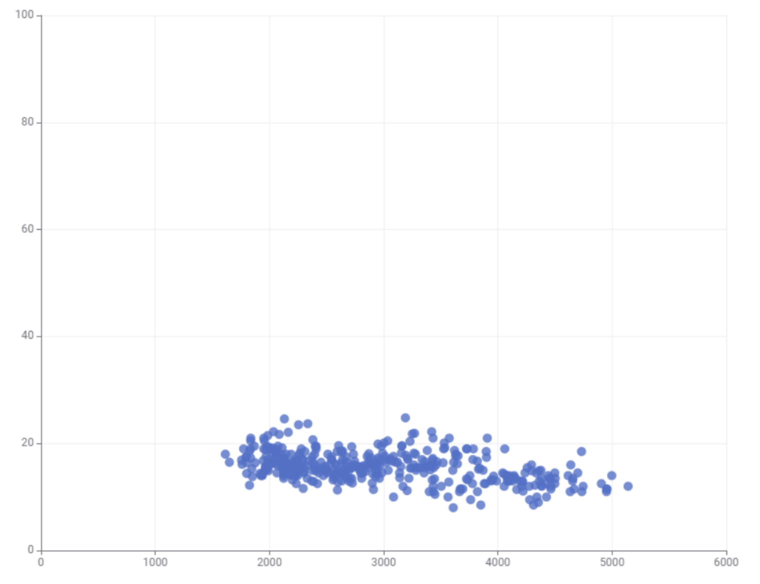
$$\mathbf{Y} = \begin{pmatrix} y_1 \\ \vdots \\ y_n \end{pmatrix} \qquad \mathbf{X} = \begin{pmatrix} 1 & x_{1,1} & \dots & x_{1,J} \\ 1 & x_{2,1} & \dots & x_{2,J} \\ \vdots & \vdots & \ddots & \vdots \\ 1 & x_{n,1} & \dots & x_{n,J} \end{pmatrix} \qquad \beta = \begin{pmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_J \end{pmatrix}$$

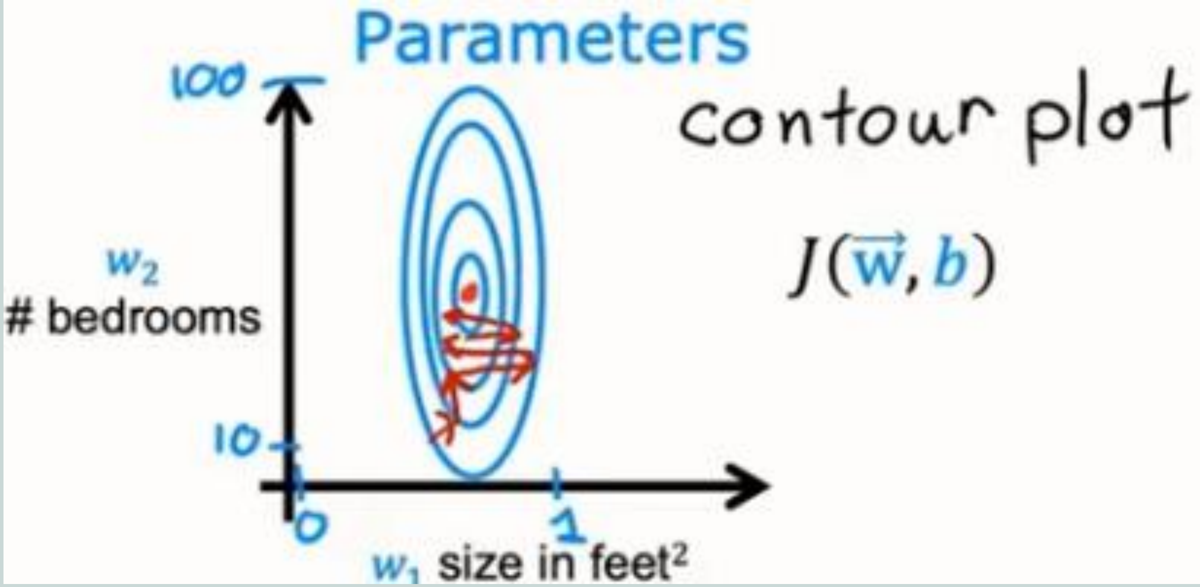
Multivariate Gradient Descent

- $w_1 = w_1 - \alpha \frac{\partial}{\partial w_1} J(w_1, b) \Rightarrow = \frac{1}{n} \times \sum_{i=1}^{n} (y - \hat{y}^{(i)}) \times x_1^{(i)}$
- $w_2 = w_2 - \alpha \frac{\partial}{\partial w_2} J(w_2, b)$
- $w_n = w_n - \alpha \frac{\partial}{\partial w_n} J(w_n, b) \Rightarrow = \frac{1}{n} \times \sum_{i=1}^{n} (y - \hat{y}^{(i)}) \times x_2^{(i)}$
- $b = b - \alpha \frac{\partial}{\partial b} J(w \quad , b) \Rightarrow = \frac{1}{n} \times \sum_{i=1}^{n} (y - \hat{y}^{(i)})$

Feature Scaling

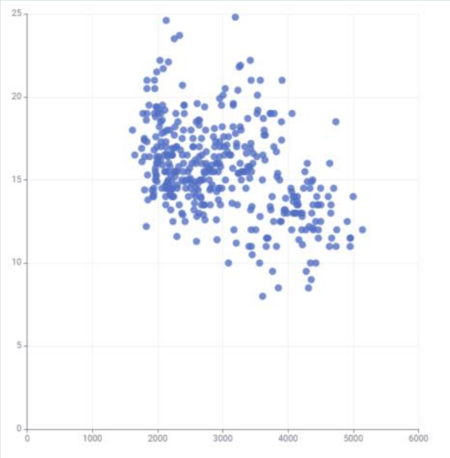
#bedrooms

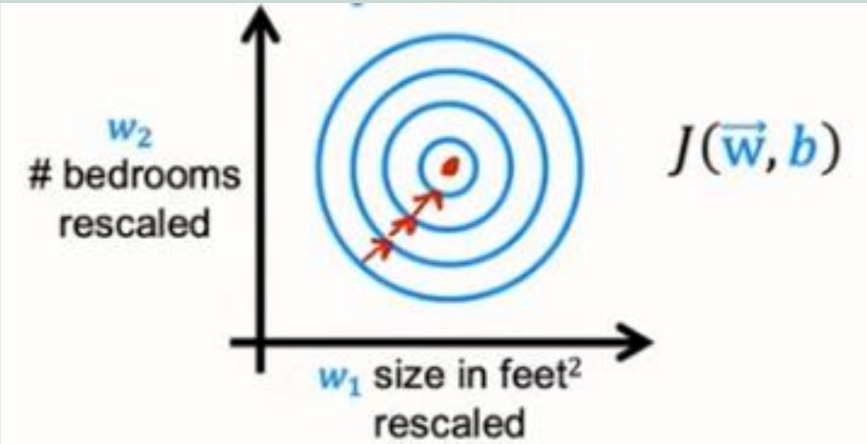




Size of house

$$x_n = \frac{x_n}{\sum_{j=1}^{m} x_n}$$





Lab time

Polynomial Regression for multiple variables

$$w_1x + w_2x^2 + w_3x^3 + \cdots + w_nx^n + b$$

$$\mathbf{Y} = \begin{pmatrix} y_1 \\ \vdots \\ y_n \end{pmatrix}, \qquad \mathbf{X} = \begin{pmatrix} 1 & x_1^1 & \dots & x_1^M \\ 1 & x_2^1 & \dots & x_2^M \\ \vdots & \vdots & \ddots & \vdots \\ 1 & x_n & \dots & x_n^M \end{pmatrix}, \qquad \boldsymbol{\beta} = \begin{pmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_M \end{pmatrix}$$

Lab time

The END