Infrastructure of Neural Network

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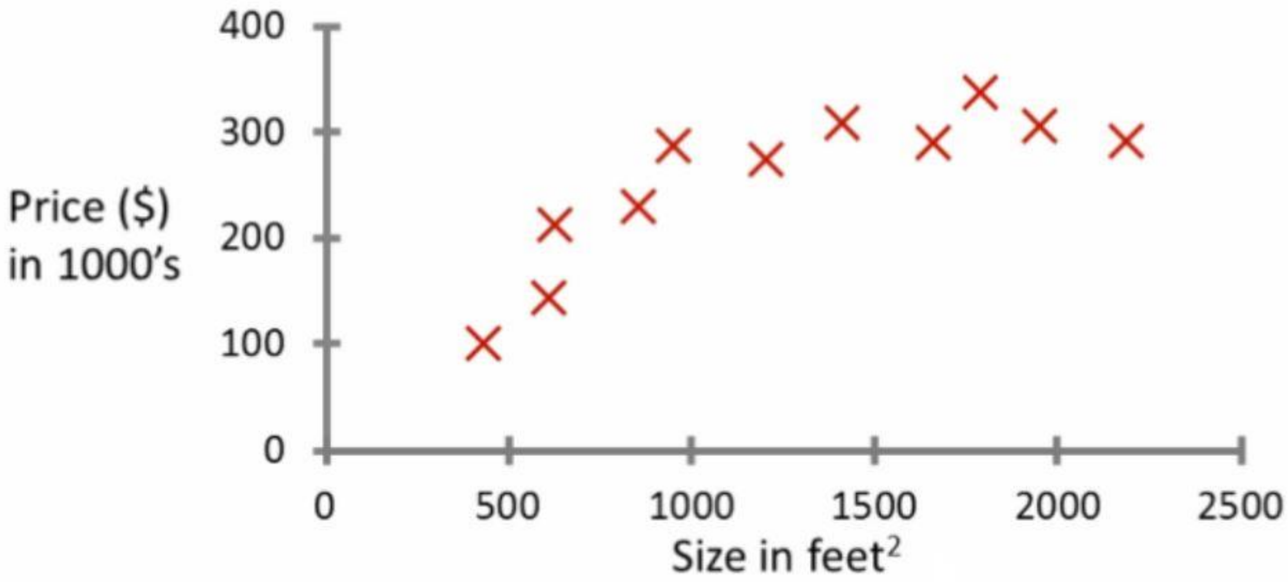
- Linear Regression with one Variable
- Hypothesis
- Cost Function
- Mathematical equation of Linear Regression

Linear Regression

- Linear Regression with one variable
- Cost Function
- Parameter Learning

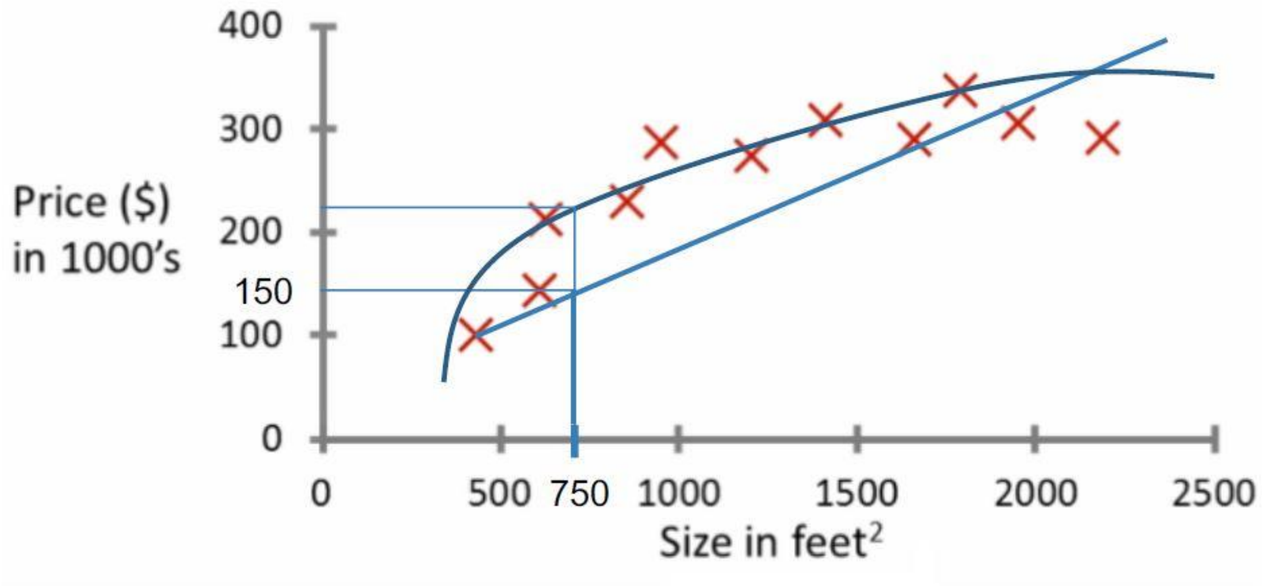
Linear Regression with One Variable (1)

- Probably the most common problem type in machine learning
- Example : Predicting House Price



Linear Regression with One Variable (2)

- What is the price of a house whose size is 750 sq. feet?



Linear Regression with One Variable (1)

- Training Set of Housing Prices

Size in feet^2 (x)	Price ($) in 1000's (y)
2104	460
1416	232
1534	315
852	178
….	….

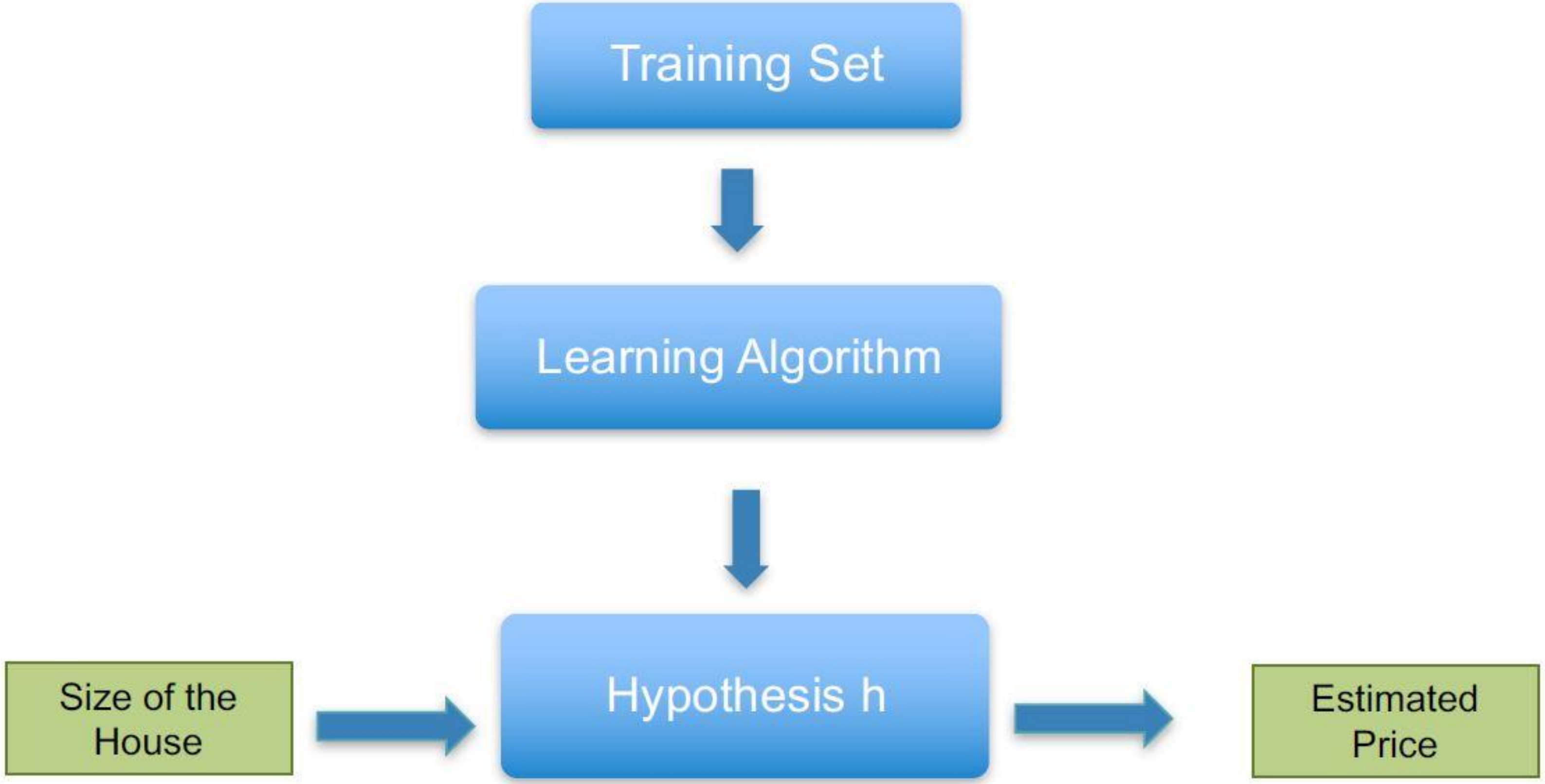
- Notations
  - m = Number of Training Examples
  - x's = input variables (also called features)
  - y's = output variables (also called target variable)

Linear Regression with One Variable (2)

- Notations
  - m = Number of Training Examples
  - x's = input variables (also called features)
  - y's = output variables (also called target variable)

- More Notations
  - (x,y) – A single training example
  - $(x^{(i)}, y^{(i)})$ – i-th row in the training set
  - $x^2 = 1416$
  - $y^2 = 232$

Linear Regression with One Variable (3)



h maps x (size of the house) to y (price of the house)

Linear Regression with One Variable (4)

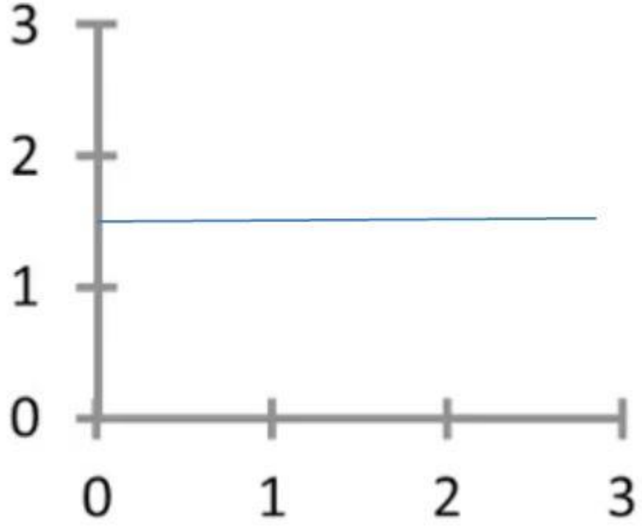
- How do we represent h?
  - $h_\theta(x) = \theta_0 + \theta_1 x$
  - y as linear function of x (straight line function)
  - Linear Regression with one variable
  - Univariate Linear Regression

- Training Set of Housing Prices

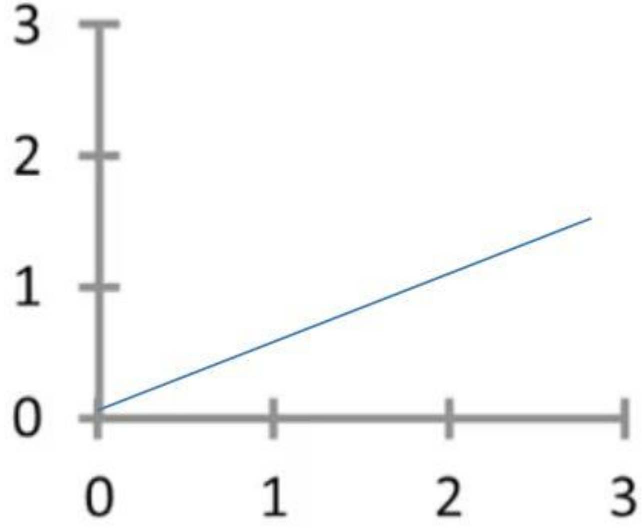
Size in feet^2 (x)	Price ($) in 1000's (y)
2104	460
1416	232
1534	315
852	178
….	….

- $h_\theta(x) = \theta_0 + \theta_1 x$
- θ_i : Parameters
- How to choose θ_i?

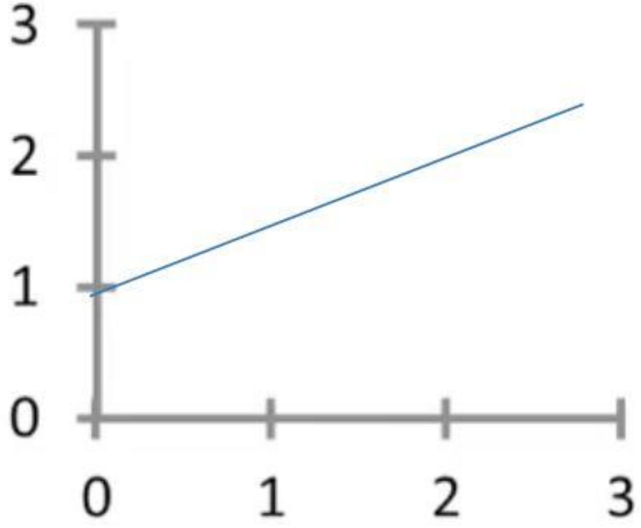
$$h_\theta(x) = \theta_0 + \theta_1 x$$



$\theta_0 = 1.5$
$\theta_1 = 0$

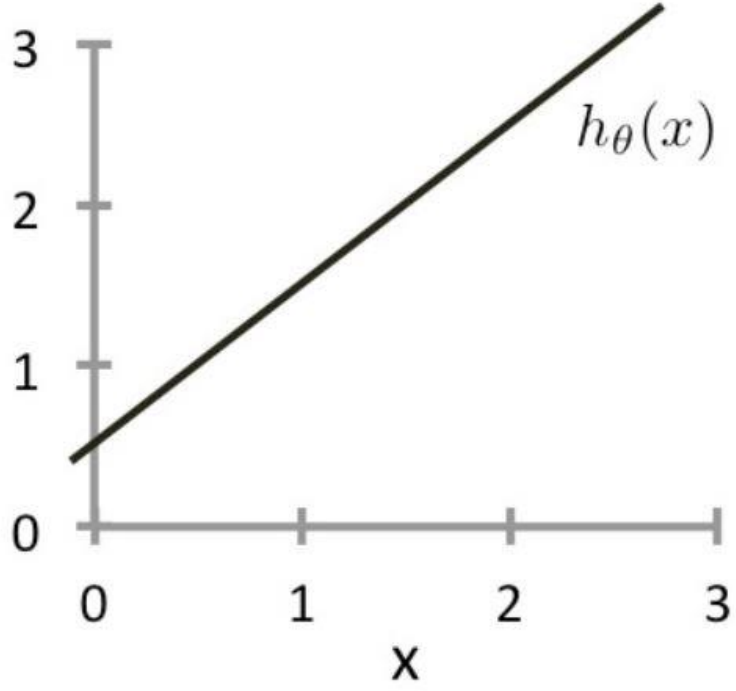


$\theta_0 = 0$
$\theta_1 = 0.5$

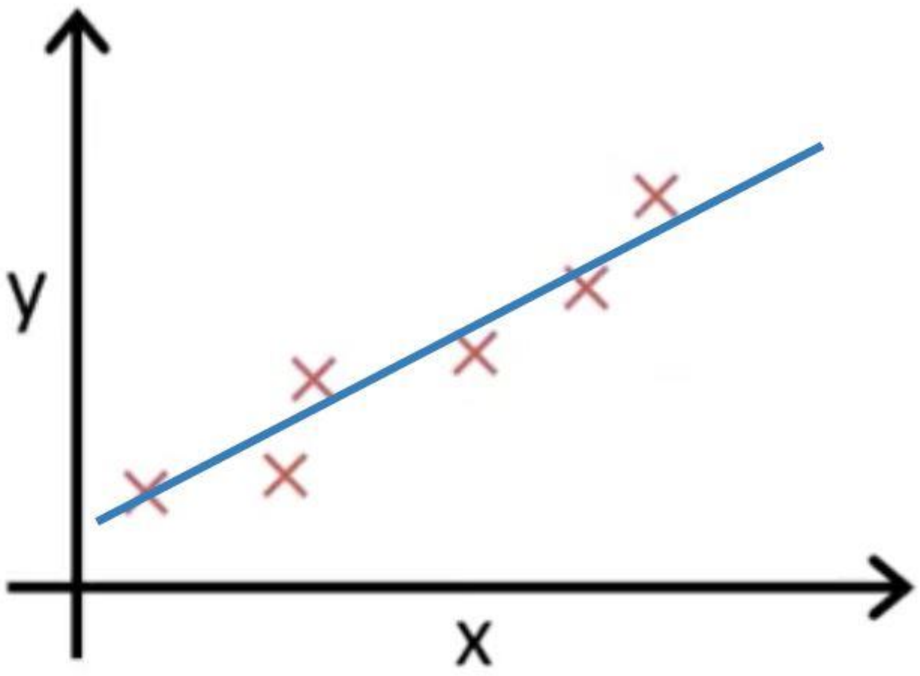


$\theta_0 = 1$
$\theta_1 = 0.5$

Consider the plot below of $h_\theta(x) = \theta_0 + \theta_1 x$. What are θ_0 and θ_1?



- $\theta_0 = 0, \theta_1 = 1$
- $\theta_0 = 0.5, \theta_1 = 1$
- $\theta_0 = 1, \theta_1 = 0.5$
- $\theta_0 = 1, \theta_1 = 1$



- Idea
  - Choose θ_1 and θ_2 so that $h_\theta(x)$ is close to y for our training example (x, y)

Cost Function (5)

$$\min_{\theta_0 \theta_1} \frac{1}{2m} \sum_{i=1}^{m} \left(h_\theta\left(x^i\right) - y^i\right)^2$$

- Find the values of θ_0 and θ_1 so that the average, the 1 over the 2m, times the sum of square errors between our predictions on the training set minus the actual values of the houses on the training set is minimized.
- So this is going to be my overall objective function for linear regression.

Cost Function Intuition (1)

- Hypothesis
  - $h_\theta(x) = \theta_0 + \theta_1 x$
- Parameters
  - θ_0, θ_1
- Cost Function
  - $J(\theta_0, \theta_1) = \frac{1}{2m} \sum_{i=1}^{m} \left(h_\theta\left(x^i\right) - y^i\right)^2$
- Goal
  - $\min_{\theta_0, \theta_1} J(\theta_0, \theta_1)$