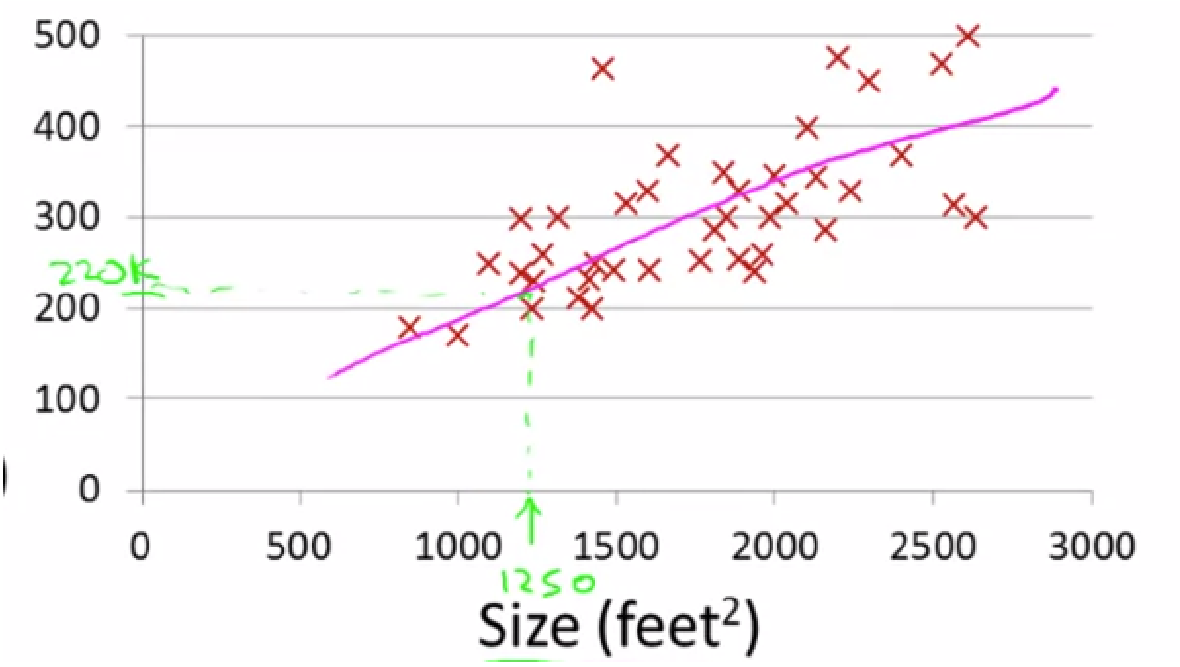
Model and Cost Function

Let's take an example of a sample dataset which contains the housing prices in a particular city.



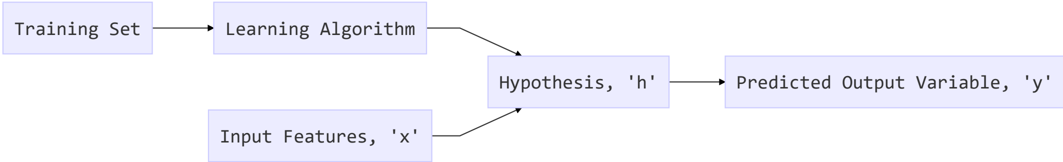
This is an example of:

- **Supervised Learning**: Given the "correct answer" for each example in the dataset
- **Regression Problem**: Objective is to predict real-valued output

Size in ft^2 (x)	**Price in \$100 (y)**
2104 ($x^{(1)}$)	460 ($y^{(1)}$)
1416 ($x^{(2)}$)	232 ($y^{(2)}$)
1534 ($x^{(3)}$)	315 ($y^{(3)}$)
852 ($x^{(4)}$)	178 ($y^{(4)}$)
...	...

Notation:

- ***m***: Number of training examples
- ***x's***: "Input" Variable
- ***y's***: "Output" Variable
- ***(x, y)***: Single Training Example
- ***($x^{(i)}$, $y^{(i)}$)***: i$^{(th)}$ Training Example



What is Hypothesis?

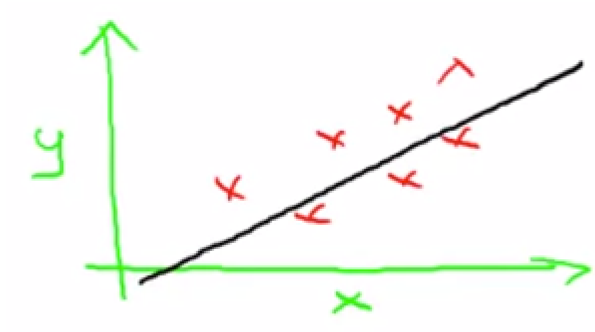
It maps from input features to output variables. It can be represented as

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

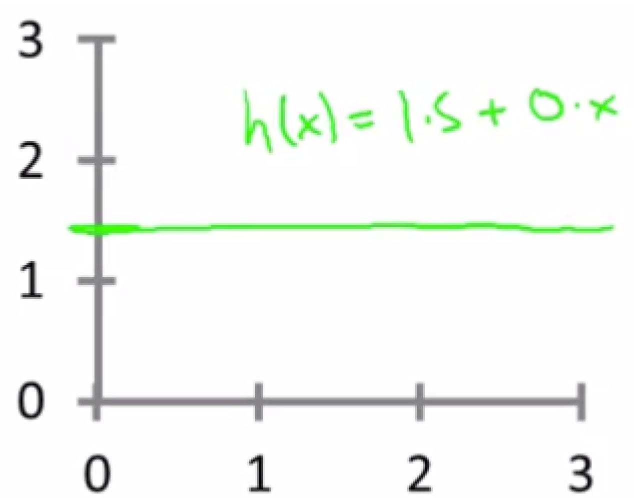
The shorthand notation for the above equation is

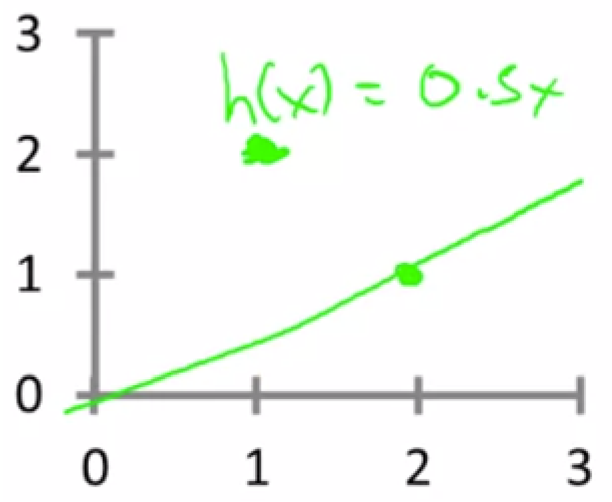
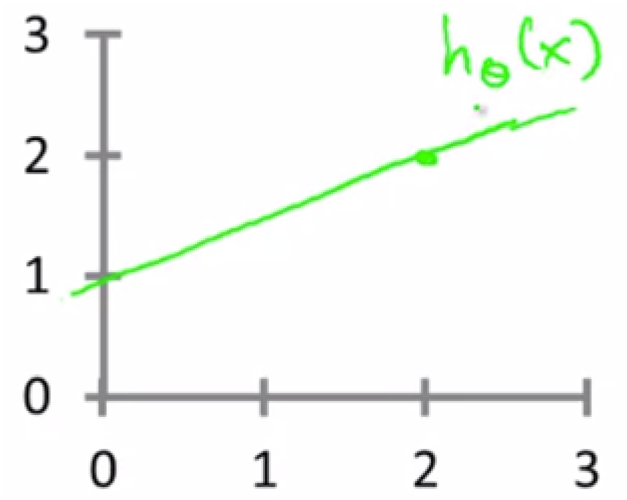
$$h(x) = \theta_0 + \theta_1 x$$

Here, θ_0 and θ_1 are the parameters



The black line represents the Hypothesis. This model is called **Univariate Linear Regression** or *Linear Regression with One Variable*. Below are some of the examples for certain values of the parameters θ_0 and θ_1.

Parameters	Graph
$\theta_0 = 1.5$ $\theta_1 = 0$ $h(x) = 1.5 + (0 * x)$	

Parameters	Graph
$\theta_0 = 0$ $\theta_1 = 0.5$ $h(x) = 0 + (0.5 * x)$	
$\theta_0 = 1$ $\theta_1 = 0.5$ $h(x) = 1 + (0.5 * x)$	

Choosing the Values of θ_0 and θ_1

- Choose θ_0 and θ_1 so that $h_\theta(x)$ is close to y for our training examples
- Formulation:

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

  Where,

  - $h_\theta(x^{(i)}) = \theta_0 + \theta_1 x^{(i)}$
  - $m =$ Number of training examples
- Cost Function (Squared Error Function):

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

- Therefore, in Linear Regression, the goal is:

  $minimize_{\theta_0\theta_1} J(\theta_0, \theta_1)$