Introduction to Data Science

What is Machine Learning?

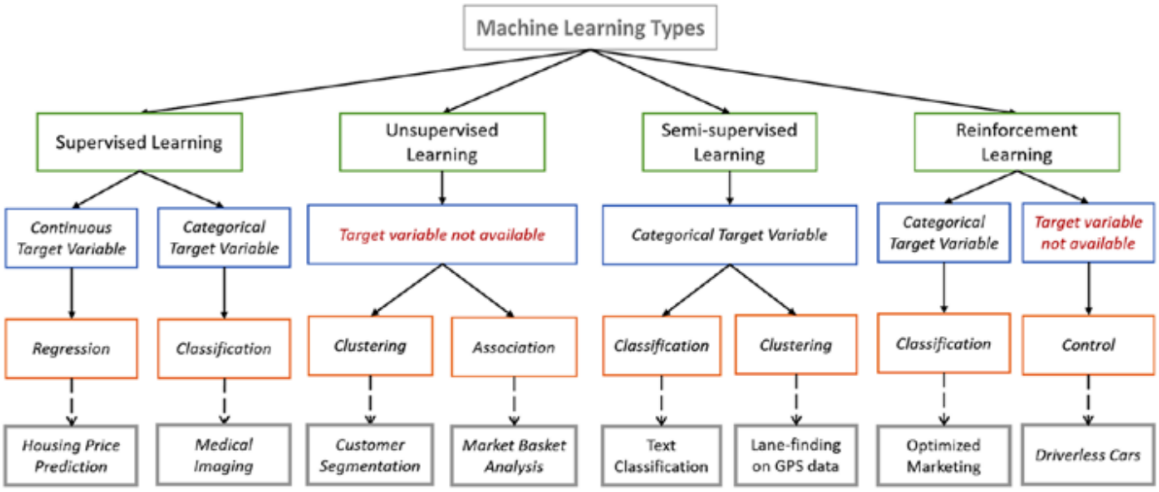
- Learning is any process by which a system improves performance from experience
- Algorithms that can figure out how to perform a task from exmaples

- Learning **task T** is any process by which a system improves performance **measured by P** from experience **E.**
    - Example:
        - **T:** SPAM-filtering
        - **P:** % of SPAM/HAM-mails filtered out
        - **E:** emails that are labelled as SPAM/HAM

Advantages of Machine Learning?

- Can automatically adapt to changes and individual users
- Discover new knowledge
- Mimic human intelligence
- Human engineering is sometimes too difficult

Types of Machine Learning



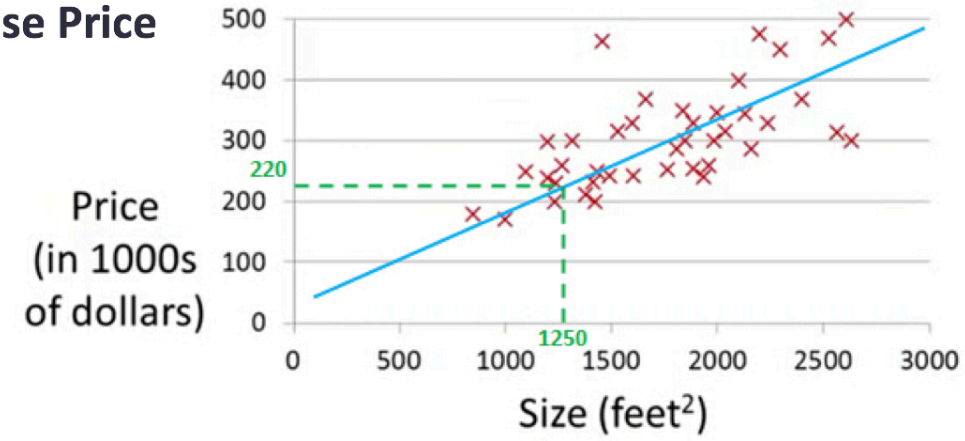
Linear Regression

Regression:

- Estimate the relationship between variables, **using information about examples**

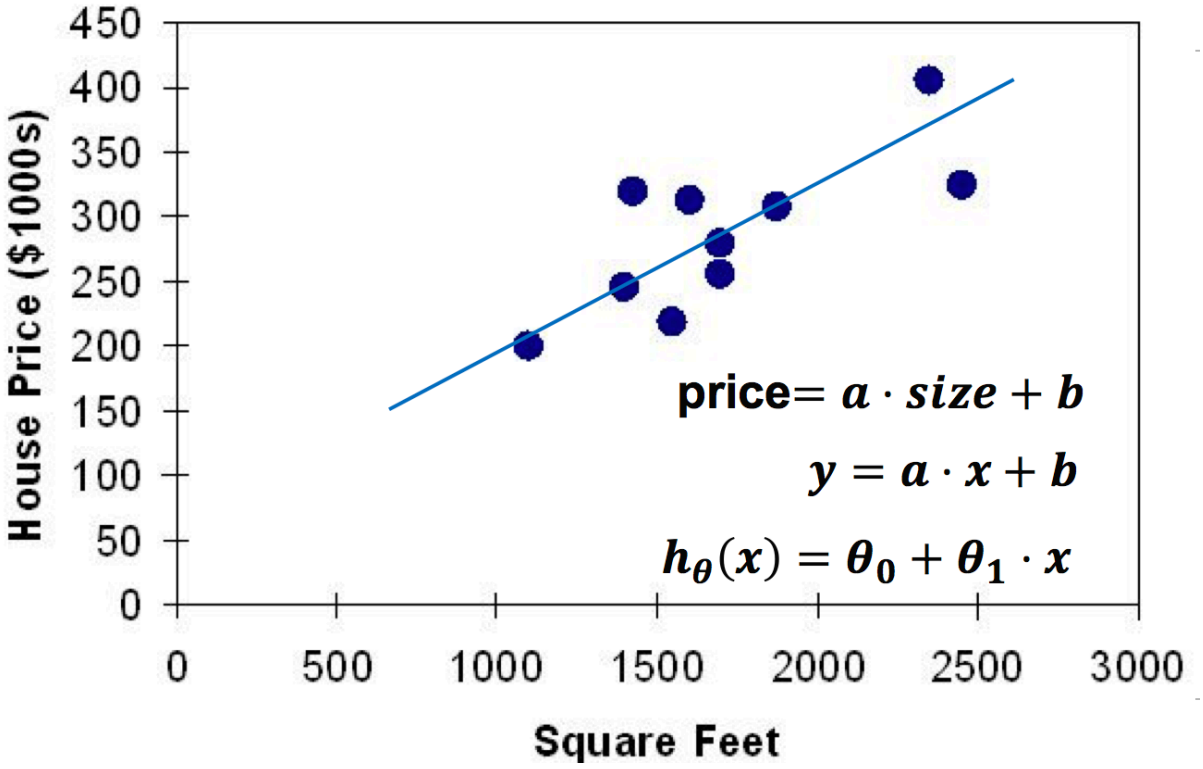
Estimate a target variable

e.g. **House Price**

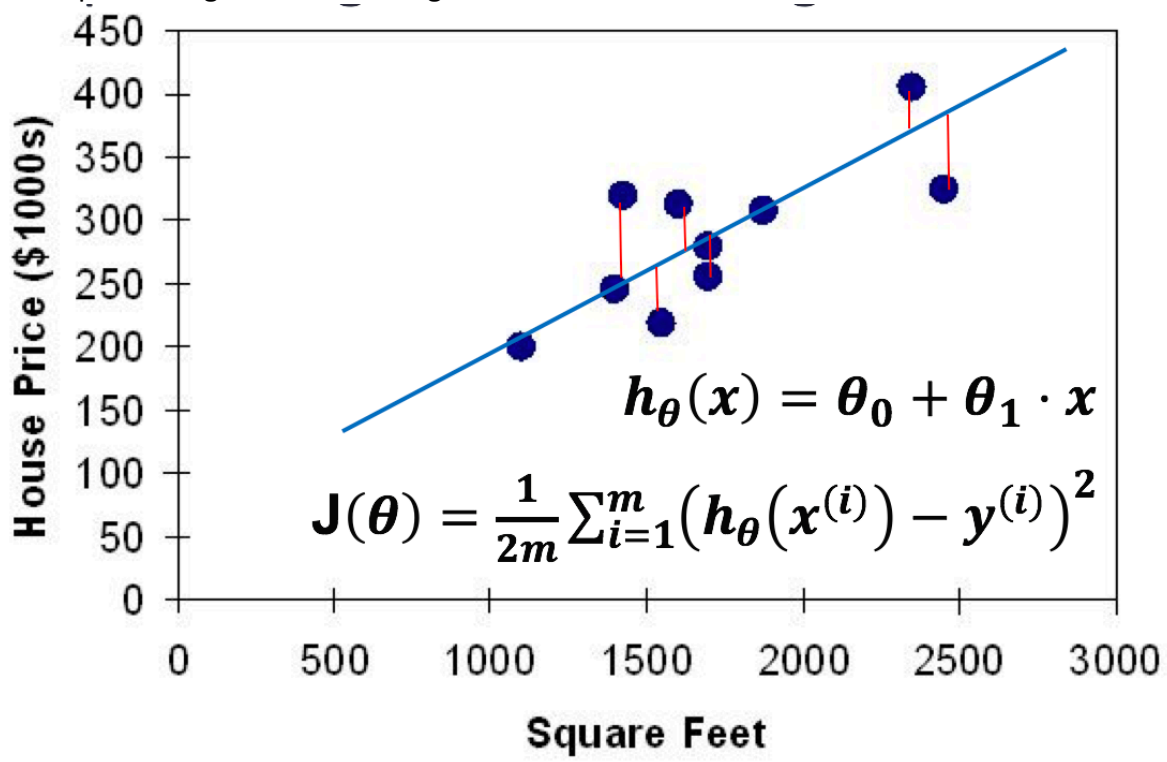


Using independent variables (features)

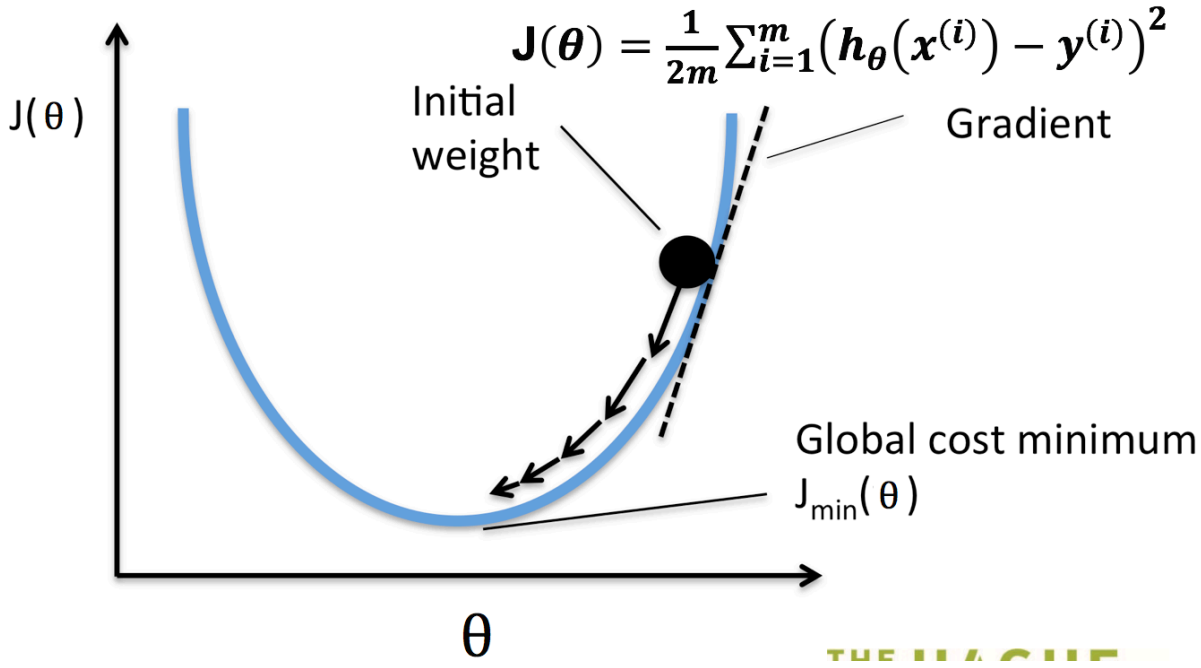
- Size
- Distance to city center



Find ‘optimal’ regression line using cost function

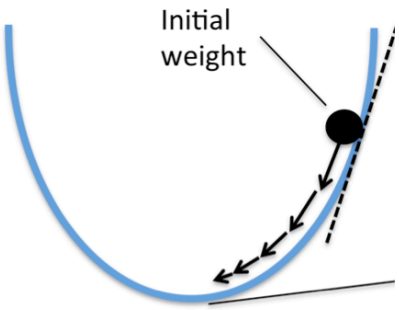


How to minimize a cost function



Update, by taking a small step towards minimum

$$\mathbf{J}(\boldsymbol{\theta}) = \frac{\mathbf{1}}{\mathbf{2m}}\sum_{\boldsymbol{i=1}}^{\boldsymbol{m}}\left(\boldsymbol{h_\theta}\left(\boldsymbol{x}^{(i)}\right) - \boldsymbol{y}^{(i)}\right)^{\mathbf{2}}$$



$$\boldsymbol{\theta} = \boldsymbol{\theta} - \frac{\boldsymbol{\delta}}{\boldsymbol{\delta\theta}}\boldsymbol{J}(\boldsymbol{\theta})$$

$$\boldsymbol{\theta_0} = \boldsymbol{\theta_0} - \boldsymbol{\alpha} \cdot (\boldsymbol{h_\theta}(\boldsymbol{x}^{(i)}) - \boldsymbol{y}^{(i)})$$

$$\boldsymbol{\theta_1} = \boldsymbol{\theta_1} - \boldsymbol{\alpha} \cdot \left(\boldsymbol{h_\theta}\left(\boldsymbol{x}^{(i)}\right) - \boldsymbol{y}^{(i)}\right) \cdot \boldsymbol{x}^{(i)}$$