Machine Learning by Stanford University

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Intro to Machine Learning

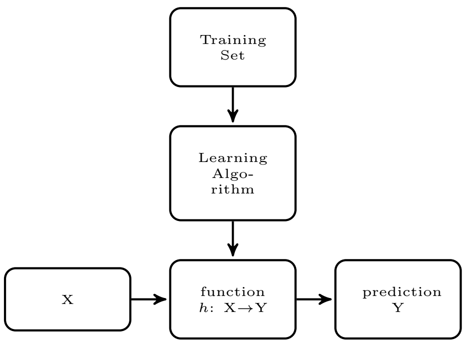
- **ML** – a computer program with increased performance P at some class of tasks T with experience E.
- **Supervised** – given a ['ground truth'] data set, predict output given the input. Types of prediction:

  1. **Regression** – continuous, numerical
  2. **Classification** – discrete, categorical

- **Unsupervised** – derive structure from data based on relationships among variables (with no prior knowledge as to what the results should look like)

Linear Regression with One Variable

- **Learning Goal** – given a training set, learn a function h: X→Y so $h(x)$ is a good y predictor



- **Hypothesis** – $h_\theta(x) = \theta_0 + \theta_1 x$
- **Cost Function** – takes an average difference of all results of the hypothesis with inputs from the x values and the actual y values. Goal: minimize θ_0, θ_1

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

(1) Squared Error function or Mean Squared Error function

- **Gradient Descent Algorithm** repeat until convergence

$$\theta_j := \theta_j - \alpha \frac{\partial}{\partial \theta_j} J(\theta_0, \theta_1) \tag{2}$$

Multivariate Linear Regression

$$h_\theta(x) = \begin{bmatrix} \theta_0 & \theta_1 & \dots & \theta_n \end{bmatrix} \begin{bmatrix} x_0 \\ x_1 \\ \vdots \\ x_n \end{bmatrix} = \theta^T x$$

- **Gradient Descent Algorithm** repeat until convergence

$$\theta_j := \theta_j - \alpha \frac{1}{m} \sum_{i=1}^{m} (h_\theta(x^{(i)} - y^{(i)}) \cdot x_j^{(i)} \text{ ; j:= 0...n} \tag{3}$$

- **Feature Scaling** – divide the input values by the range (max – min). Input values in roughly the same range speed up the convergence of gradient descent.
- **Mean Normalization** – subtract the mean for an input variable from the values for that input variable.

$$x_i := \frac{x_i - \mu_i}{s_i} \tag{4}$$

(4) μ_i is the average and s_i is the range, $(max - min)$, of all values for feature i