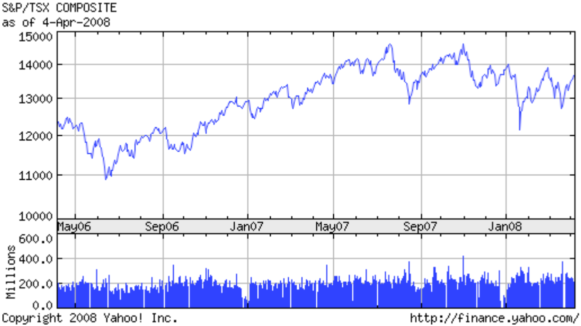
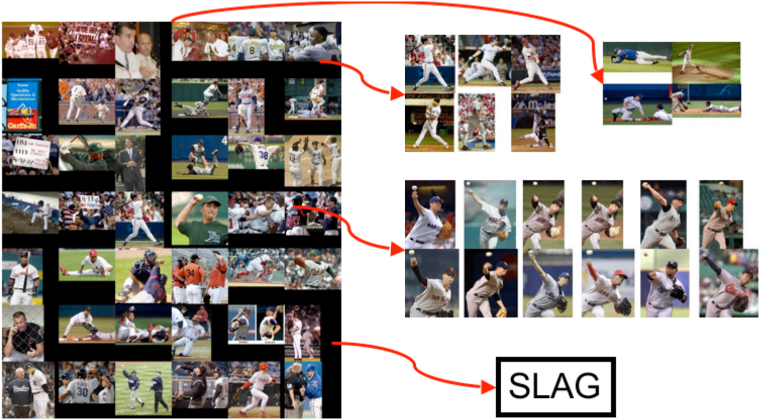
Stock Price Prediction



- Problems in which t_i is continuous are called regression
- E.g. t_i is stock price, x_i contains company profit, debt, cash flow, gross sales, number of spam emails sent, …

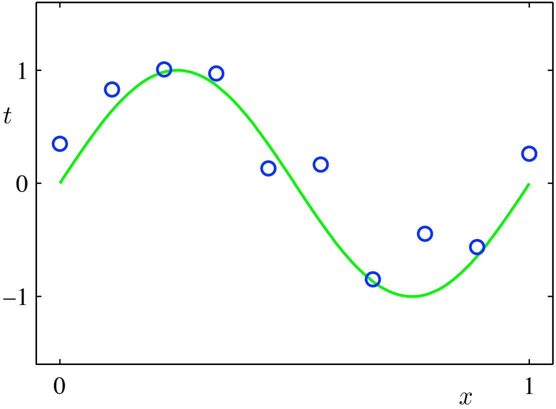
Clustering Images



Wang et al., CVPR 2006

- Only x_i is defined: unsupervised learning
- E.g. x_i describes image, find groups of similar images

An Example - Polynomial Curve Fitting

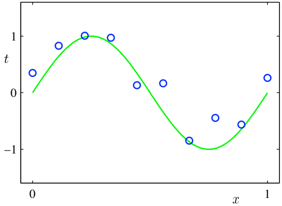


- Suppose we are given training set of N observations $(x_1, \ldots, x_N)$ and $(t_1, \ldots, t_N)$, $x_i, t_i \in \mathbb{R}$
- Regression problem, estimate $y(x)$ from these data

Polynomial Curve Fitting

- What form is $y(x)$?
  - Let's try polynomials of degree M:

$$y(x, \boldsymbol{w}) = w_0 + w_1 x + w_2 x^2 + \ldots + w_M x^M$$



- This is the hypothesis space.

- How do we measure success?
  - Sum of squared errors:

$$E(w) = \frac{1}{2} \sum_{n=1}^{N} \{y(x_n, w) - t_n\}^2$$

- Among functions in the class, choose that which minimizes this error

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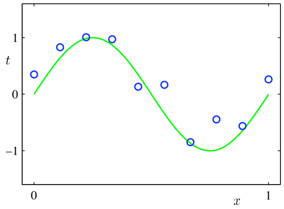

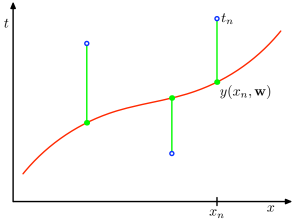

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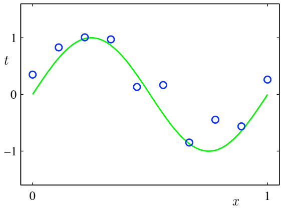
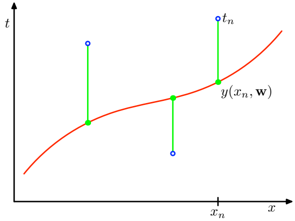




Polynomial Curve Fitting

- Error function

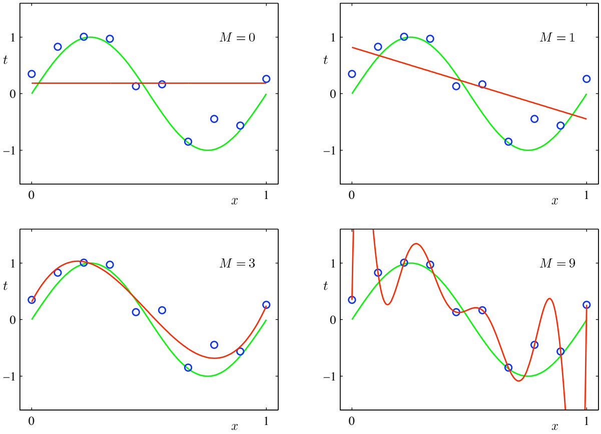
$$E(\boldsymbol{w}) = \frac{1}{2}\sum_{n=1}^{N}\{y(x_n, \boldsymbol{w}) - t_n\}^2$$

- Best coefficients

$$\boldsymbol{w}^* = \arg\min_{\boldsymbol{w}} E(\boldsymbol{w})$$

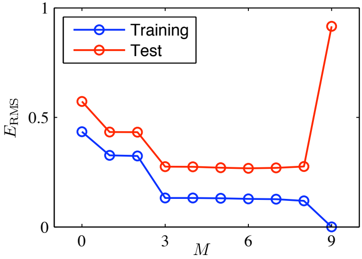
- Found using pseudo-inverse (more later)

Which Degree of Polynomial?



- A model selection problem
- $M = 9 \rightarrow E(\boldsymbol{w}^*) = 0$: This is over-fitting

Generalization



- Generalization is the holy grail of ML
  - Want good performance for new data
- Measure generalization using a separate set
  - Use root-mean-squared (RMS) error: $E_{RMS} = \sqrt{2E(\mathbf{w}^*)/N}$