

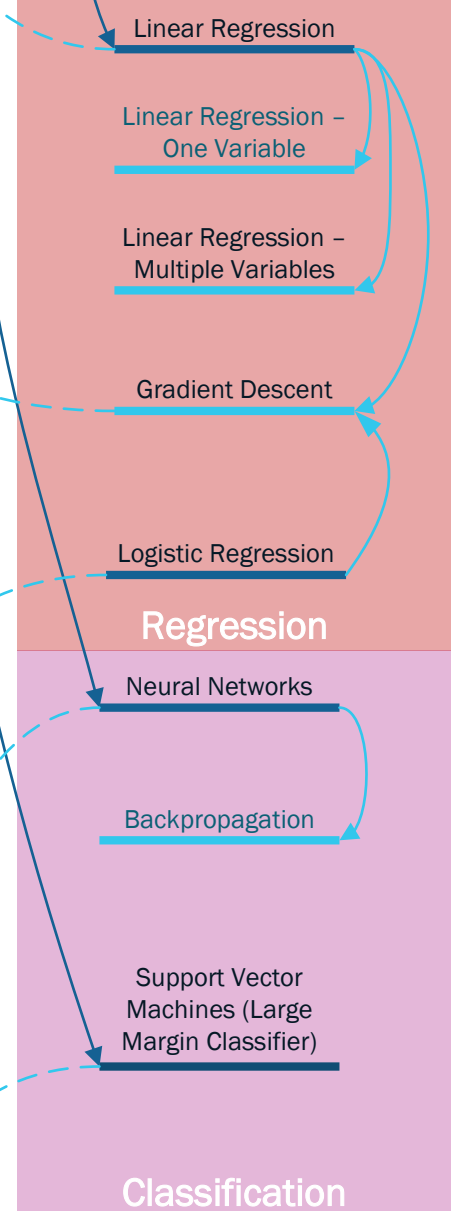
Regression  
Used for predicting a continuous „real“ number according to provided input features.

Classification  
Used for predicting to which category data belongs to. The number of categories is discrete „countable“.

## Machine Learning (ML)

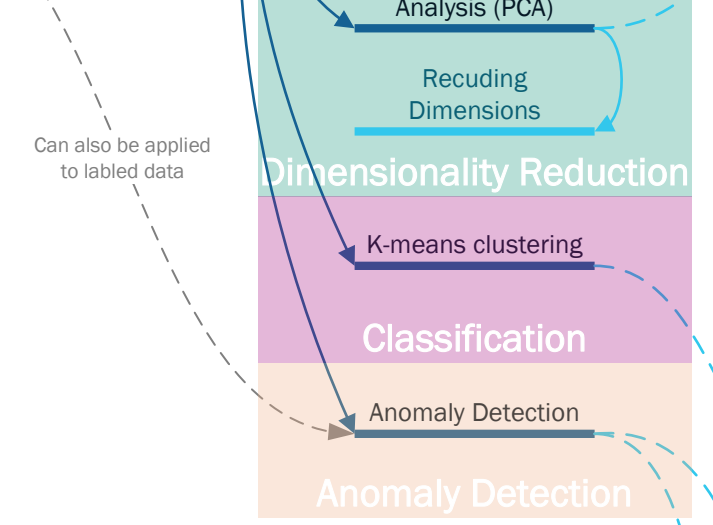
### Supervised Learning

Problems with labeled data  $(x^{(i)}, y^{(i)})$

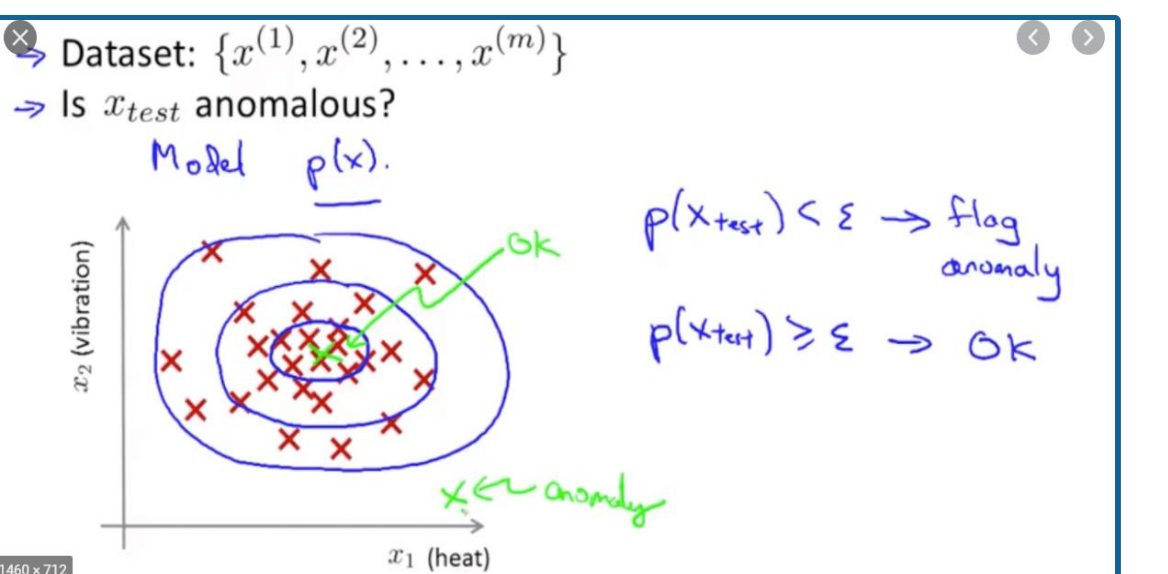
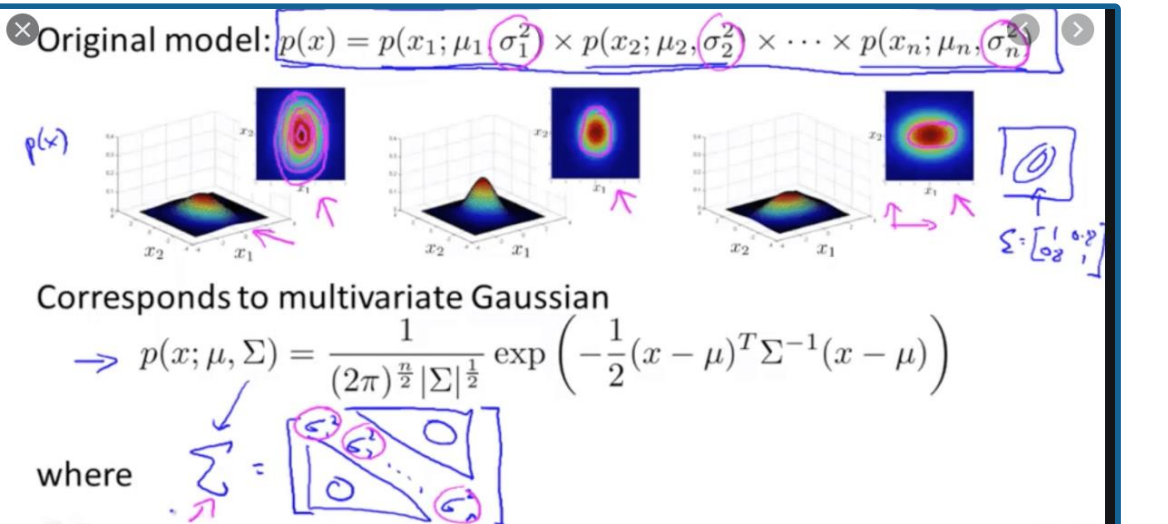
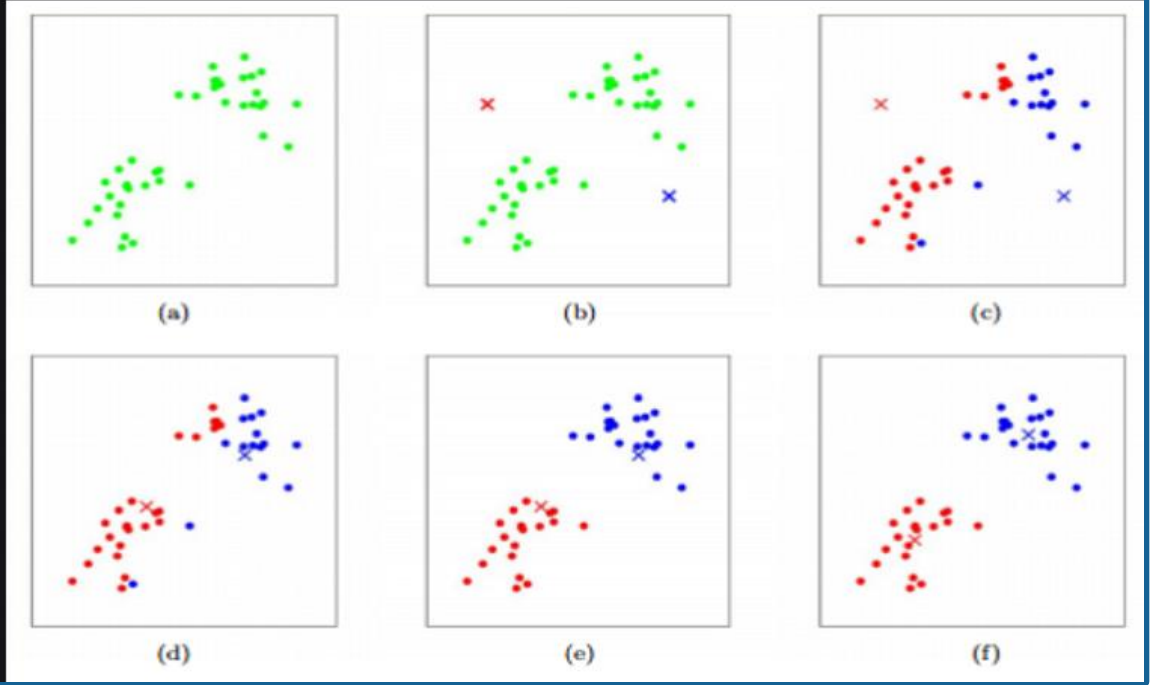
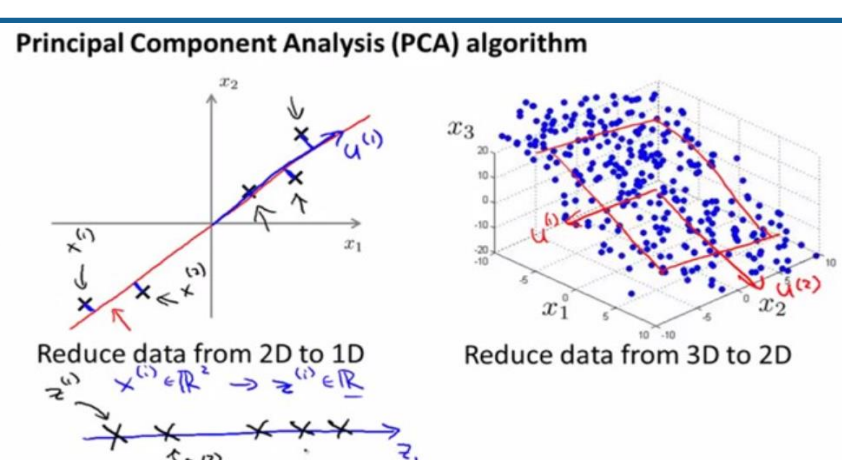


### Unsupervised Learning

Problems with unlabeled data  $x^{(i)}$



Can also be applied to labeled data



### Special applications / topics

Recommender systems

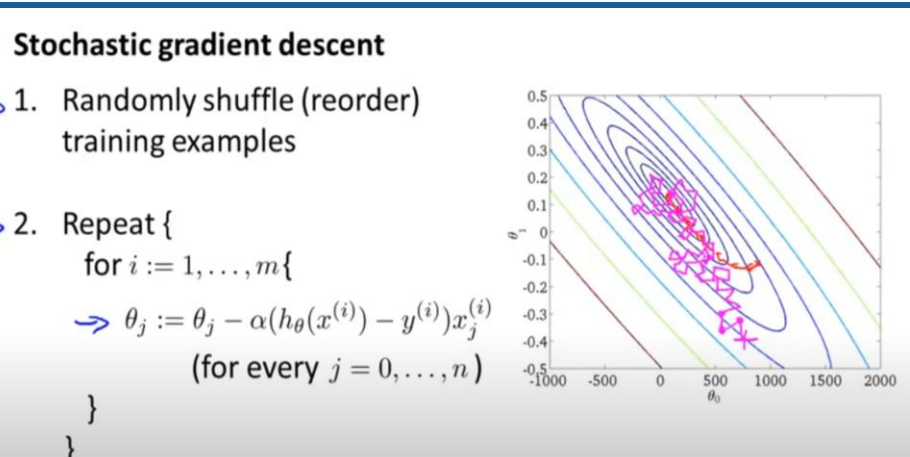
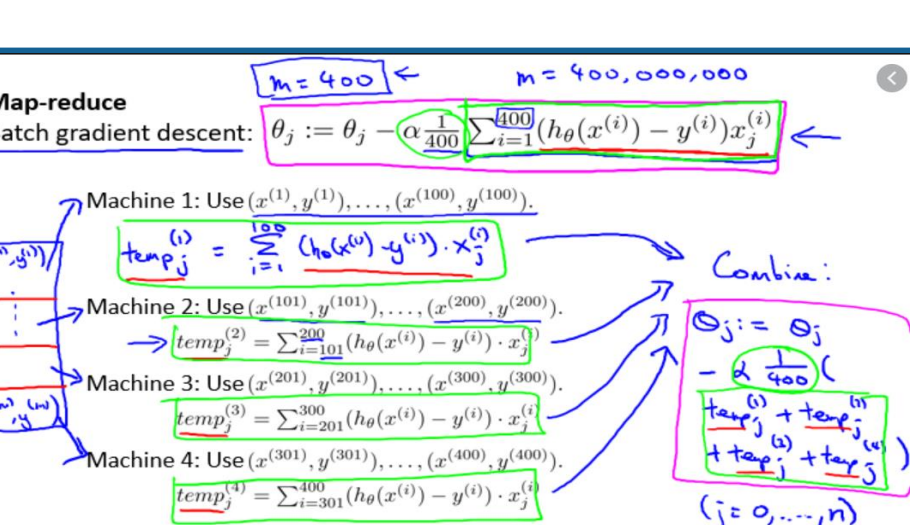
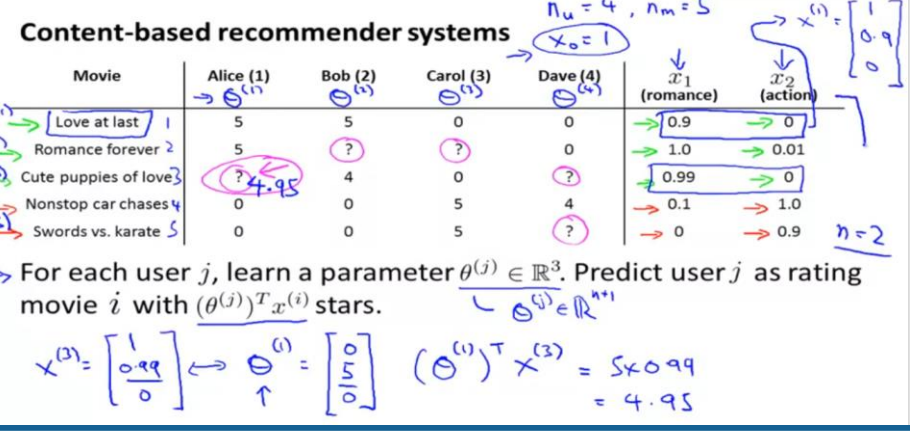
Collaborative Filtering

Mean Normalization

Large Scale Machine learning

Map Reduce

Stochastic Gradient Descent (SGD)



### Advice on building a ML system

Bias / Variance

Regularization

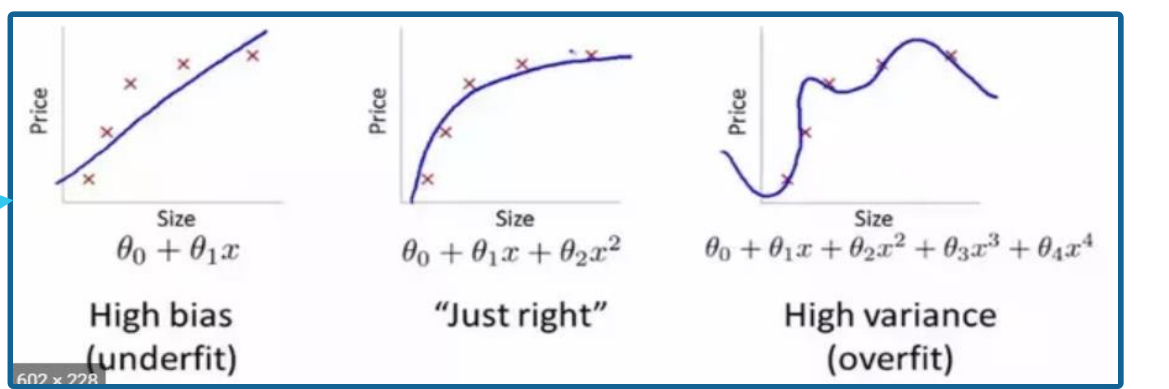
Deciding what to work on next: evaluation of learning algorithms - how to spend your time

Debugging: Learning Curves

Debugging: Error Analysis

F1 Score

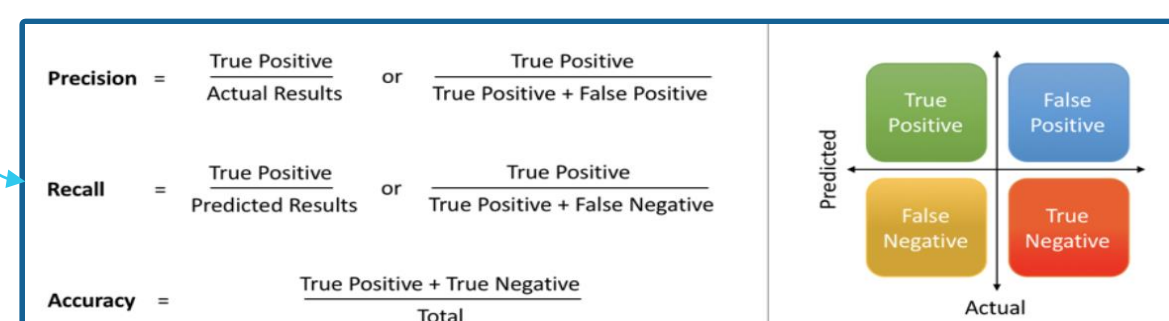
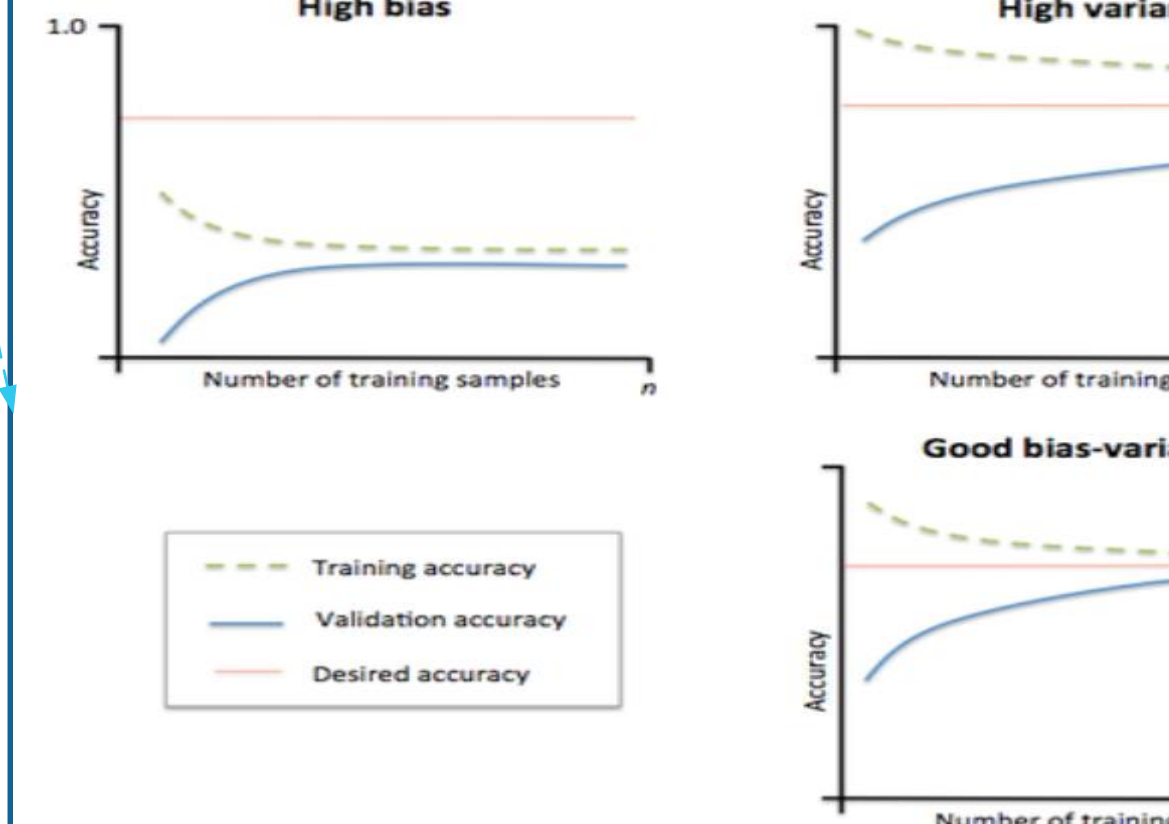
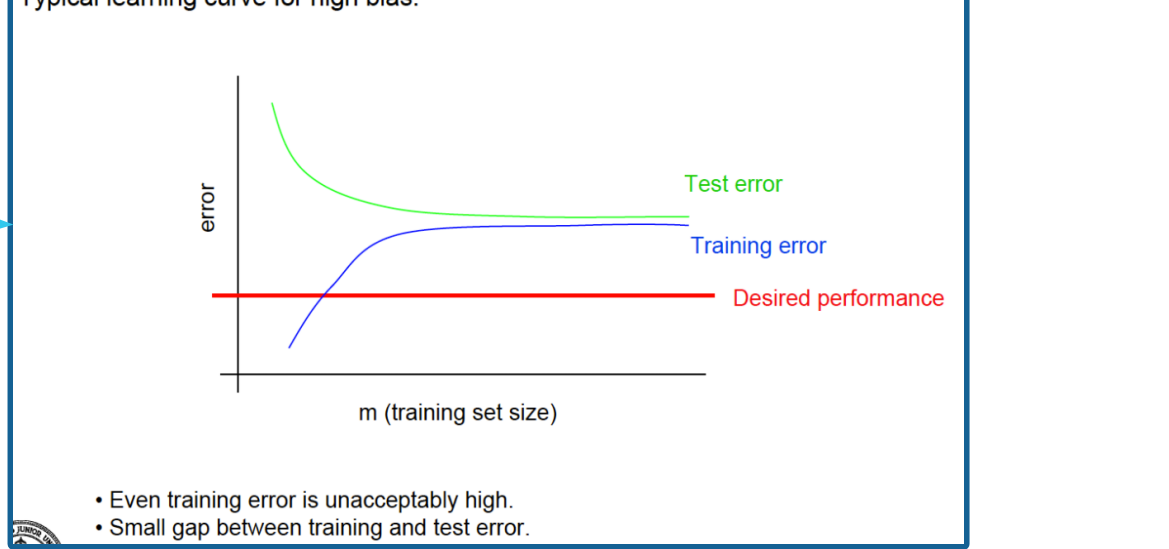
Debugging: Ceiling Analysis



Regularization Term

$$J(\theta) = \frac{1}{2m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)})^2 + \lambda \sum_{j=1}^n \theta_j^2$$

Regularization Parameter



Precision =  $\frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}$

Recall =  $\frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}}$

Accuracy =  $\frac{\text{True Positive} + \text{True Negative}}{\text{Total}}$

F1 Score:  $2 \frac{PR}{P+R}$

Estimating the errors due to each component (ceiling analysis)

Component	Accuracy
Overall system	72%
Text detection	89%
Character segmentation	90%
Character recognition	100%

### Reinforcement Learning

Robot Navigation

Learning Tasks

Game AI

Skill Acquisition

Real-time decision

