Basic Machine Learning

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What do we want machines to learn?
Example: Dogs vs Cats

https://www.kaggle.com/c/dogs-vs-cats

Input: Many images with labels (cat or dog)
Goal: Given new image, decide cat or dog.
Example: Netflix

Input: Movie ratings from users
Goal: Recommend new movies for users
Example: Community Finding

Input: List of friends
Goal: Find “communities”
Supervised vs Unsupervised

**Supervised**

Input: (data, label)
Output: Function $f$
Hope: $f(data) = label$

**Unsupervised**

Input: data
Output: “structure”
Hope: explain and predict

Supervised

Unsupervised
Example of Structure

- Movies have different genres.
- Users like different genres.
- Learning ~ Find the genres of movies and users
- To recommend
  - determine what genres the user likes
  - recommend a good movie in that genre.
Connection

MNIST: Given images recognize digits.

Unsupervised: Given images, cluster similar images

Unsupervised Learning $\Rightarrow$ features for Supervised Learning
How do we know machines have learned?

(General approach: Give an exam)
Human Learning, Machine Learning

- Take a course
- Understand the course material
- Take an exam

Goal of Exam: If the students understood the material, do well in exam.

- Get training examples
- Learn a hypothesis - maps input to labels
- Test on new examples

Goal of Test: If the hypothesis is good, do well in test samples.
What is a good hypothesis?

Ways to fail an exam
   Do not understand examples given in class
      (Make many mistakes on training samples)
   Only memorize the basic examples
      (Come up with a complicated hypothesis)

Good hypothesis = Simple + Do well on training
What we will see

PCA
Find basic directions

Least Squares/
Gradient Descent