Machine Learning Stanford Class

**Week 1 Notes**

Machine learning uses

Google searches

building truly intelligent machines that mimic human behavior

neurla networks

**Welcome**

machine learning at work

facebook photo image tagging recognition

spam filtering

building truly intelligent machines

machine learninging history

grew out of AI

best way to teach computers is have computers learn themselves

machine learning examples

database mining

web click data

figure out click data and how users interact with a site

medical records

understand disease better

biology

gene sequences and dna secquences

gives us a better idea of the human genome

engineering

applications that cannot be written by hand

autonomous helicopter

handwriting recognition

computer figures it out

natural language processing (NPL)

self-customizing programs

Amazon, Netflix, and other product recommendations

understanding human learning

brain and real AI

What is machine learning

Arthur Samuel: field of study that gives computer the ability to learn without being explicitly programmed

example of computer that plays checkers against itself

Tom Mitchell: computer learns from experience E with respect ot some task T and some performance measure P

E=Experience (experience of playing checkers)

T=Task (task of playing checkers)

P=Performance Measure (e.g. probability program will win the next game)

example

suppose you’re your email program watches which emails you do or do not mark as spam and learns how to better filter, what is T?

classify emails as spam or not spam=T

watching you label emails=E

fraction of emails correctly classified as spam/not spam=P

**2 main types of learning algorithms**

1. supervised learning

teach the computer how to do something

2. unsupervised learning

the computer will learn by itself

reinforcement learning and recommender systems

course will also cover practical versus non-practical items

Supervised learning

example of predicting housing prices

X-axis: size un feet of house

Y-axis: price of house in $1000s

a learning algorithm could help you put a straight line through the data

it could also help you create a quadratic function to fit a quadradic function to the data

supervised learning definition

the “right answers” are given

we tell the program what the right answers are

the program’s goal is to identify more right answers

this is also called a regression problem

predict the continuous valued output (price)

example of determining if tumor is malignant of benign

x-axis: tumor size

y-axis: 0 or 1 for malignant (1) benign (0)

this is an example of a classification problem

creates discrete valued output (0 or 1)

other types of classification problems could have more outputs

0=benign, 1=common, 2=stage 2, etc.

there may be more than 1 feature in other machine learning problems

example of “2 features” tumor size and age on benign and malignant

given a data set, the resulting line may separate 2 data sets using a line

data sets on one side of a line are likely malignant

data sets on the other size are benign

we will eventually deal with learning algorithms that can take an infinite number of features

main takeaway of supervised learning

we tell the computer what the “right answer” is

example question:

running a company and want to address 2 problems. 1. large inventory of identical items and want to predict how many of these items will sell over the next 3 months. 2. you like software to exame customer accounts and determine for each account if it has been hacked/compromoised. should you use classification or regression

answer:

treat problem 1: as regression

treat problem 2: as classification (0, 1) representing whether or not an account has been hacked

Unsupervised learning

unsupervised learning definition

given a data set without labels, find some structure to it

not told what the data set is

algorithms can break data into clusters-called a “clustering algorithm”

example-google news

google groups stories according to news story information

measuring how much individuals do or do not have specific genes

we are not telling computer who different types of people are

use the computer to figure out which types of people can be grouped together

other examples

social network analysis

organize data center

market segmentation-figure out who is part of what clusters

astronomical data analysis-figure out how galaxies are formed

example-cocktail paty problem

very loud party

2 speakers

2 microphones

microphones have different levels of sound according to how close someone is

you can give recordings to unsupervised algorithm

algorithm can separate the 2 sources into separate tracks

how complicated to implement?

algorithm can be done with one line of code

octave programming environment

you learn much faster if you learn using octave

this will give you an advantage, help you understand how to get things working

this will greatly enhance your development time

question

which of these following are unsupervised learning

given email labeled as spam/not spam learn a filter (not)

new stories group (yes)

customer data, discover segments (yes)

given dataset of patients diagnosted as having diabetes or nt, learn to classifiy new patients (no)

key is that we are not telling the program what is correct and what is incorrect

key takeaway

unsupervised learning figures out relationships between the data without knowing what is the “right answer”

big Takeaways:

1.

regression is finding exact values, classification is binary or is/isnot

**Linear regression with one variable**

Model and Cost Function

example-housing prices

x-axis: size feet squared

y-axis: price in 1000s of dollars

a friend wants to sell a house with 1250ft2

make a model with s straight line to draw through

this is an example of

a supervised learning problem-you are given the right answer for each example of data

regression problem-you predict the real-valued output

not classification which is a discrete-valued ouput (0,1,2, etc.)

training set of housing prices

m=number of training samples

x’s=input variables/features

y’s=output variables/target variables

(x,y)=one training example

(x(i),y(i)) ith training example

See paper notes for this section

cost function

See paper notes for this section