Artificial Intelligence II

Lesson 9 - Classification

First Code Academy

Today's Plan

Teach Back	00 - 5 min
Classification	10 - 15 min
Bayes Classifier	15 - 20 min
K-nearest neighbors	15-20 min
Quiz	20-25 min
Break	25 - 28 min
Project - Spam Filter	28 - 55 min

What did we learn last time?

Teach Back

____ Neural Networks are most used with images.

____ _____ involves using more than one **hidden layer** in our network

Deep Learning

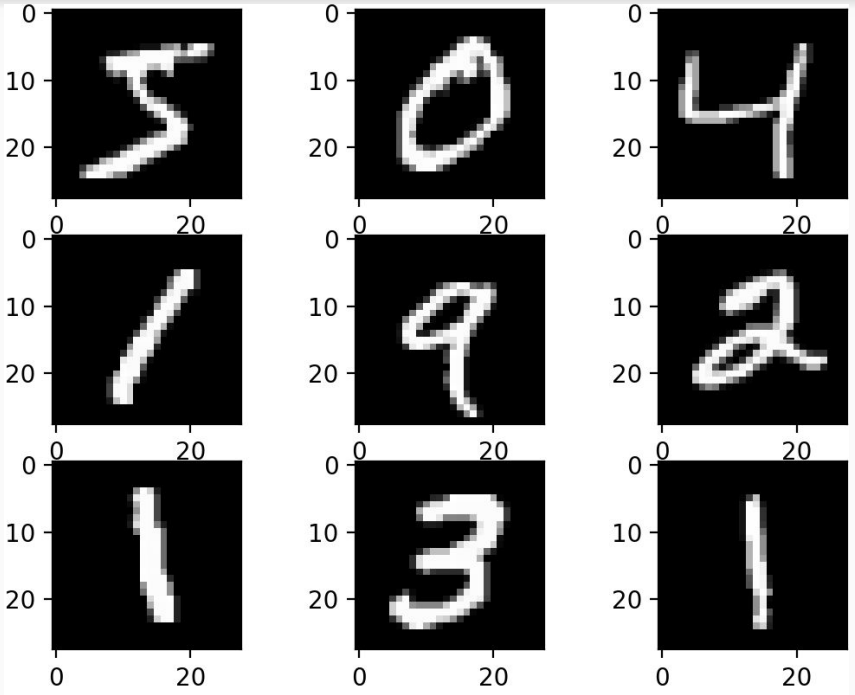
Deep learning just involves using a neural network with at least one **hidden layer**.

These networks sometimes use many hidden layers, so they become deep!

Deep learning helps us find more complicated **patterns in data**

Number Detector

We made our program to recognize handwritten digits!



Key Terms

Classification

Bayes' Classifier

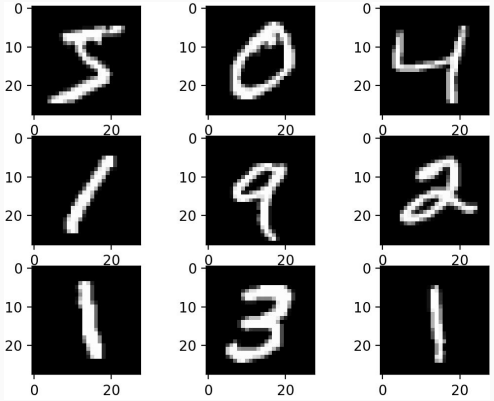
Classification

If we have a set of classes **X**, we have to assign a new piece of data to one of the classes.

[rabbit] [cat] [dog]

Classification

We have already done classification before:



Recognizing Digits

Here we classify each picture as one of 10 classes (0-9)

Classification

Many different approaches to classification problems:

- **Bayes Classifier:** Measures the probability of belonging to a class given some previous event/characteristic.
- **K-Nearest-Neighbors:** To which group do the most similar data points belong?
- **Neural Networks:** Try to *learn* the relationship between different input characteristics to make a decision.

Bayes Classifier

Terms

x can be an event

P(x) is the probability of X happening/being true.

P(x|y) is the probability of x **given that** y happens.

Bayes Classifier

$$P(c|x) = \frac{P(x|c)P(c)}{P(x)}$$

P(c|x): probability of belonging to class c *given* x.

P(x|c): probability of x happening if point belongs to class c.

P(c): probability of belonging to class c in general..

P(x): probability of x being true in general.

Bayes Classifier

$$P(c|x) = \frac{P(x|c)P(c)}{P(x)}$$

This equation relates the frequency of a point belonging in c with the frequency of x happening.

If x happens often when a data point belongs in c, then if we see x, we would think the point belongs in c.

Bayes Classifier Example

How likely is it that an animal with pointy ears is a cat?

c = “The animal is a cat”

x = “The animal has pointy ears”

P(c|x) = “Likelihood that an animal is a cat if it has pointy ears.”

Bayes Classifier Example

Then

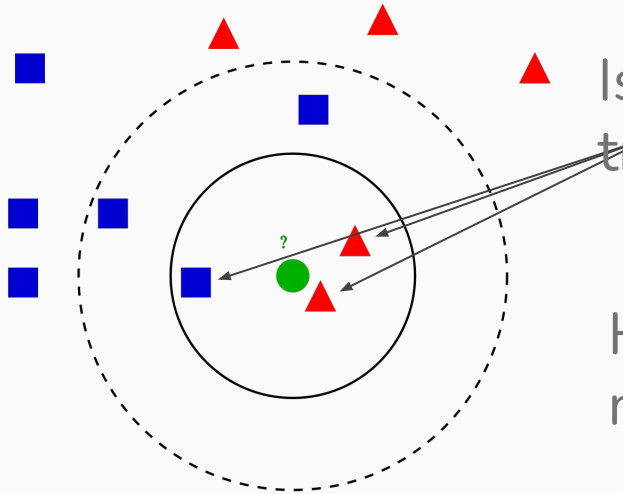
$$P(\text{cat given pointy ears}) = \frac{P(\text{animal has pointy ears given it's cat})P(\text{cat})}{P(\text{animals have pointy ears})}$$

We would have to know (or estimate) all the other values to use this method.

K-Nearest Neighbors

K-Nearest Neighbors

If we have a data point, we check those “similar” to it in order to classify this data point.



Is the green point a square or a triangle?

Out of the green point’s 3 nearest neighbors, 2 are triangles and 1 is a square

However, out of 5 closest neighbors there are more squares!

K-Nearest Neighbors

For each point in the test set, compare the closest points from the training set.

Trade off: The more neighbors we check, the more information we have, but we lose some accuracy.

The best amount of neighbors to check will vary.

Quiz: bit.ly/FCA_Quiz_AI

Project : Spam Filter

Spam Filter

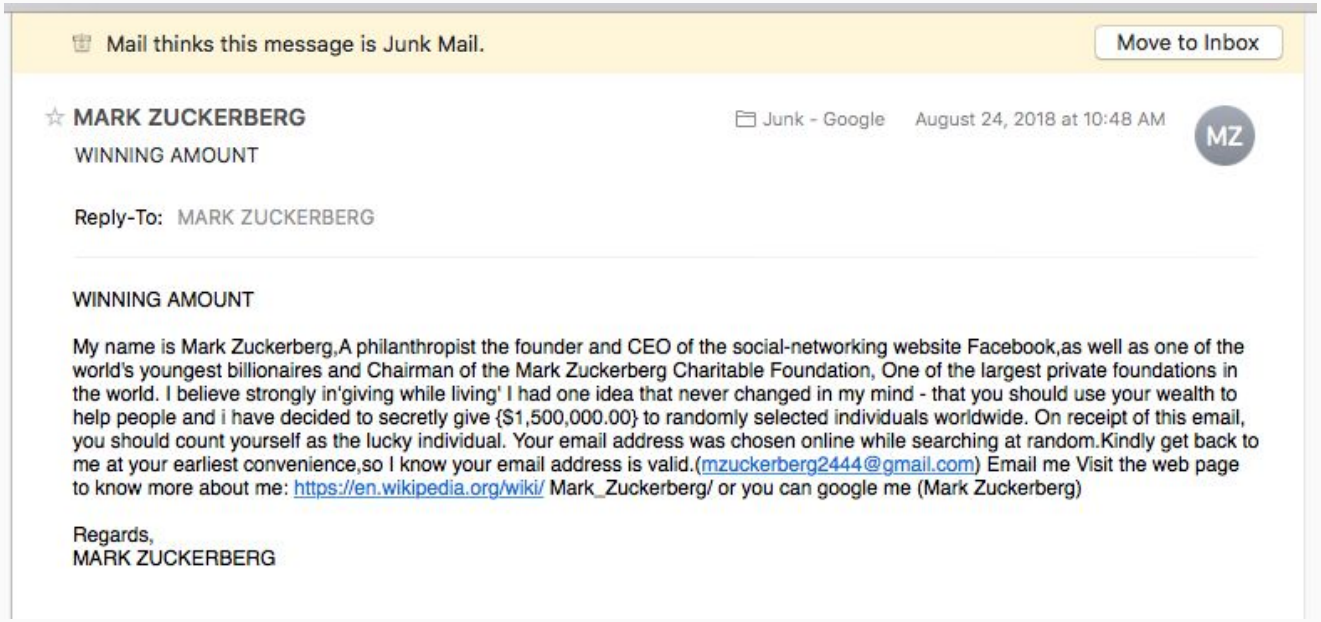
Spam is emails that try and trick you into doing something, such as going to a suspicious website or send your personal information to someone you don't know. **Ham** messages are normal messages.

Have you ever gotten spam email?

Spam Filter

We want to allow **ham** messages and stop **spam** messages from coming in.

Spam example



Mail thinks this message is Junk Mail. Move to Inbox

☆ **MARK ZUCKERBERG** Junk - Google August 24, 2018 at 10:48 AM MZ

WINNING AMOUNT

Reply-To: MARK ZUCKERBERG

WINNING AMOUNT

My name is Mark Zuckerberg,A philanthropist the founder and CEO of the social-networking website Facebook,as well as one of the world's youngest billionaires and Chairman of the Mark Zuckerberg Charitable Foundation, One of the largest private foundations in the world. I believe strongly in'giving while living' I had one idea that never changed in my mind - that you should use your wealth to help people and i have decided to secretly give {$1,500,000.00} to randomly selected individuals worldwide. On receipt of this email, you should count yourself as the lucky individual. Your email address was chosen online while searching at random.Kindly get back to me at your earliest convenience,so I know your email address is valid.(mzuckerberg2444@gmail.com) Email me Visit the web page to know more about me: https://en.wikipedia.org/wiki/ Mark_Zuckerberg/ or you can google me (Mark Zuckerberg)

Regards,
MARK ZUCKERBERG

People don't usually give away free money!

Why does gmail think this is spam?

Spam Filter

Spam messages frequently use words such as “win”, “free”, “prize”, etc... quite often

Messages that use these words are more likely to be **spam**.

Note

We will need the `sklearn` library, so before we start type in your terminal

```
pip install sklearn
```

Format

The files `mail.txt` and `test_messages.txt` contain some spam/ham messages.

We will use the first file to train our model and the second one to test.

Steps

1. We first load our training data
2. Format the data nicely
3. Create our model and give it the training data
4. Load some new data and see how our model does!

Load Our Data

Load data from our file, and put it in a matrix

```
10  def load_data(filename='mail.txt'):
11   # A DataFrame is like a giant array, with class and message categories
12      data = DataFrame(columns=['class', 'message'])
13      lines = []
14      with open(filename, 'r') as f:
15          # Split every line into the message and it's class
16          lines = f.readlines()
17          lines = [line.split('\t') for line in lines]
18      # Make an array for easier processing later
19      data  = DataFrame(lines, columns=['class', 'message'])
20
21      return data
```

Format Data and Train Model

Let the classifier see how frequently words appear in spam/ham messages to calculate probability it's spam

```
26      # A vectorizer will remove punctuation from our strings,
27      # and count how many times a word appears
28      # This makes it harder to fool our system by adding symbols
29      vectorizer = CountVectorizer()
30      counts = vectorizer.fit_transform(data['message'].values)
31
32      # Get the answers to use for training
33      targets = data['class'].values
34
35      # Our classifier now knows which words appear in spam and ham messages
36      classifier = MultinomialNB()
37      classifier.fit(counts, targets)
```

Load the test data

Given some new messages it hasn't seen before, can our classifier correctly predict spam messages?

```
42      # make the format similar to our training_data
43      test_labels = test_data['class'].values
44      test_data_vec    = vectorizer.transform(test_data['message'].values)
45
46      # See what our model thinks the test messages are
47      preds = classifier.predict(test_data_vec)
48      correct = 0
```

Run!

Run the program to see how accurate our model is!

```
C:\Users\Andres Ponce\FCA_AI\FCA_AI2\L9>python L9.py
======
Msg 0:
 Aight will do, thanks again for coming

        Actual answer: ham Our Guess: spam
======
```

Key Terms

Classification

Naive Bayes’

That’s it for today!

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