DATA 8

Summer 2018

Lecture 33

Machine Learning

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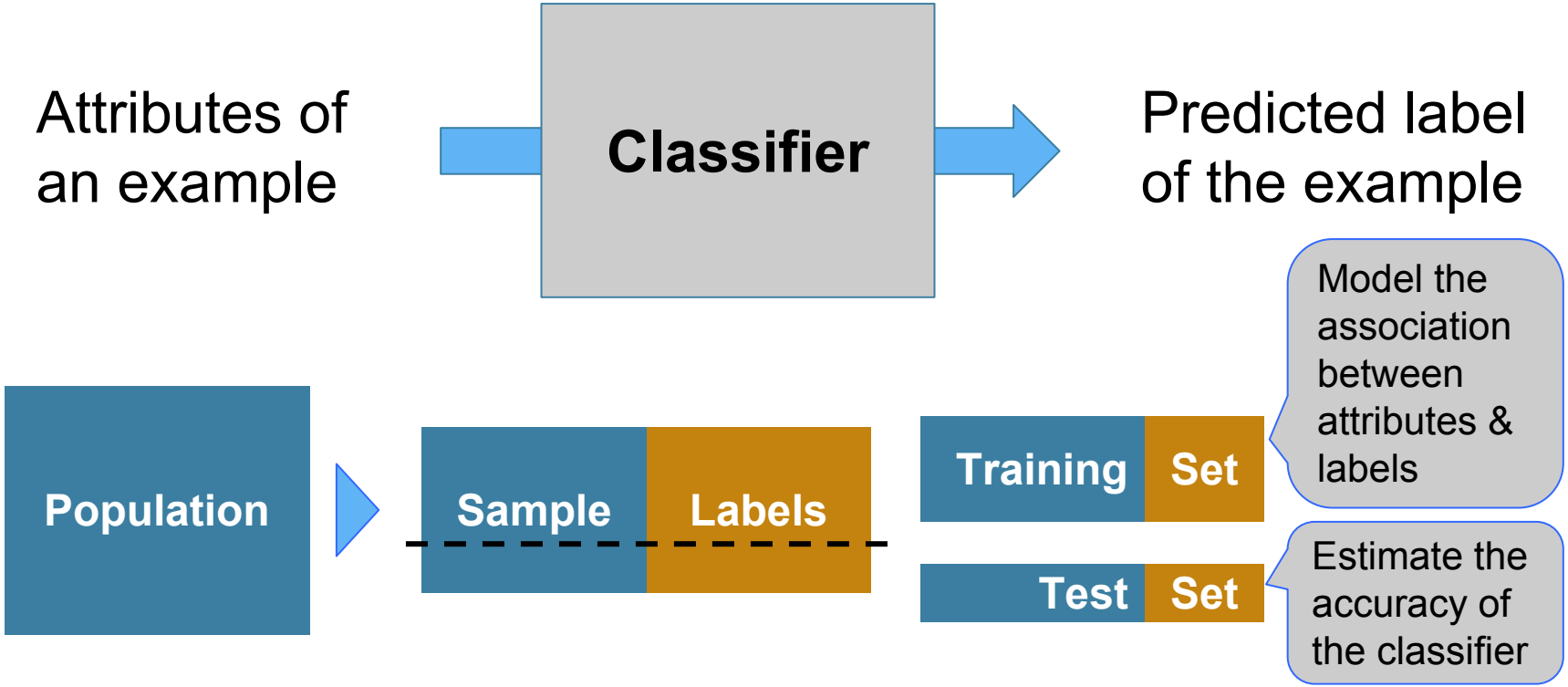
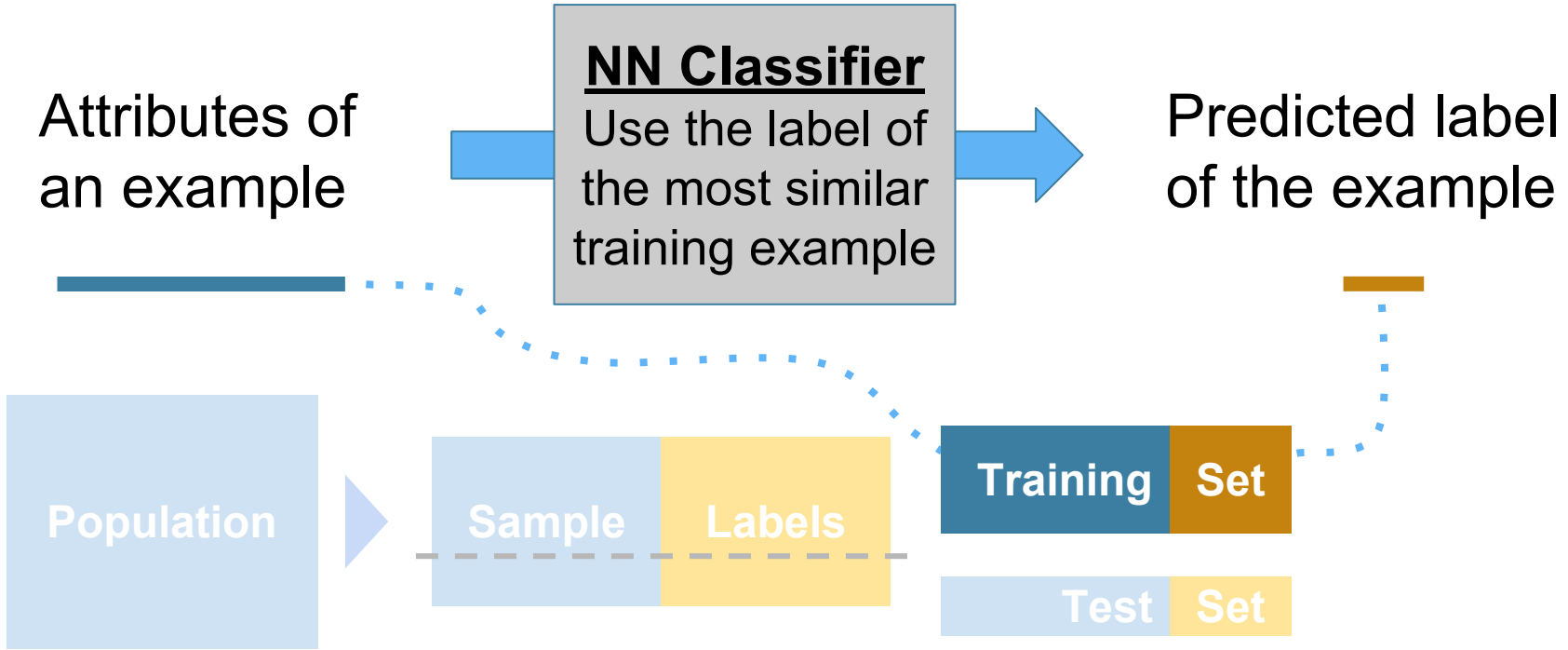
Announcements

Review: Classifiers

Training a Classifier



Nearest Neighbor Classifier



Finding the *k* Nearest Neighbors

To find the *k* nearest neighbors of an example:

- Find the distance between the example and each example in the training set
- Augment the training data table with a column containing all the distances
- Sort the augmented table in increasing order of the distances
- Take the top *k* rows of the sorted table

(Demo)

The Classifier

To classify a point:

- Find its *k* nearest neighbors
- Take a majority vote of the *k* nearest neighbors to see which of the two classes appears more often
- Assign the point the class that wins the majority vote

(Demo)

Evaluation

Accuracy of a Classifier

The accuracy of a classifier on a labeled data set is the proportion of examples that are labeled correctly

Need to compare classifier predictions to true labels

If the labeled data set is sampled at random from a population, then we can infer accuracy on that population

(Demo)

Machine Learning

What is ML?

A **machine learning** algorithm enables a computer to

- identify patterns in observed data
- build models that explain the world
- and predict things without having explicit pre-programmed rules and models.

All you'll need to know from this lecture -- the difference between supervised and unsupervised ML

Supervised Machine Learning

Input: Labeled data

Output: Prediction for unlabeled example

High computational complexity

Unsupervised Machine Learning

Input: Unlabeled data

Objective: Recognize underlying patterns in data

Low computational complexity

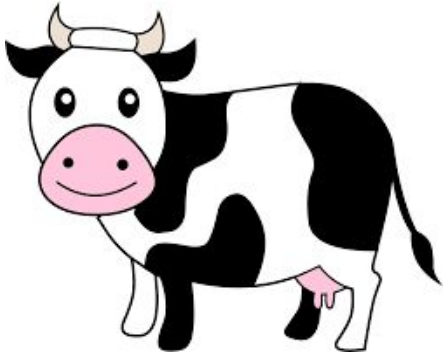
Semi-Supervised Machine Learning

Input: Some labeled data, but majority unlabeled

Dog

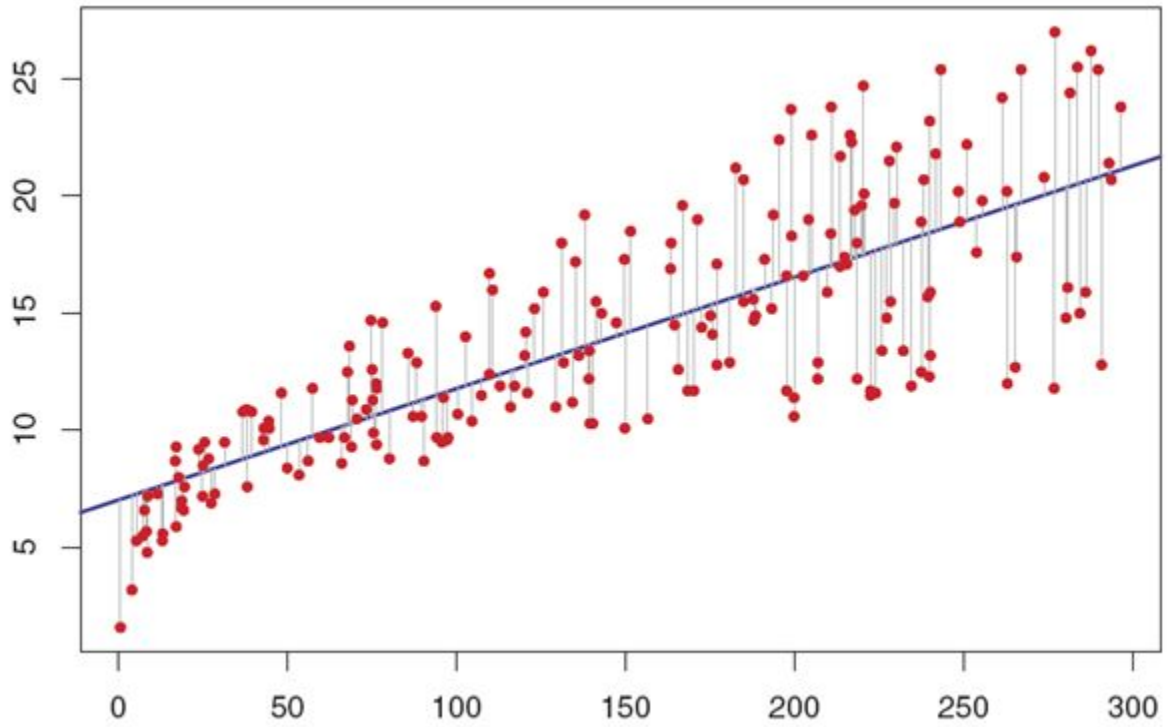
4 legged animal

Dog



Dog

What we've learned: Regression



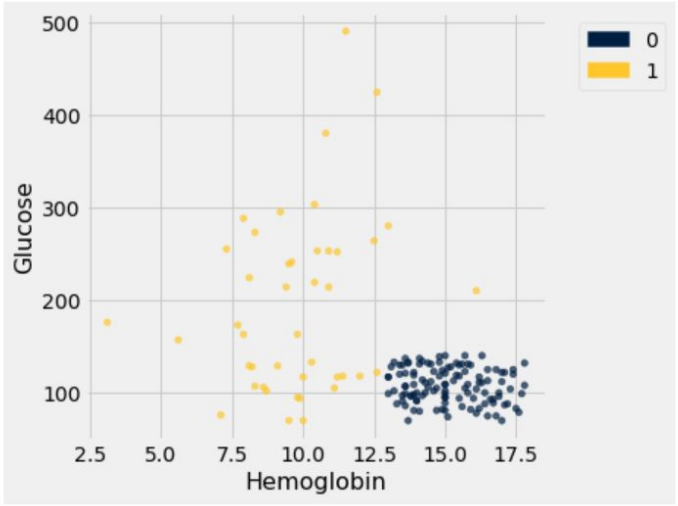
Is Linear Regression supervised?

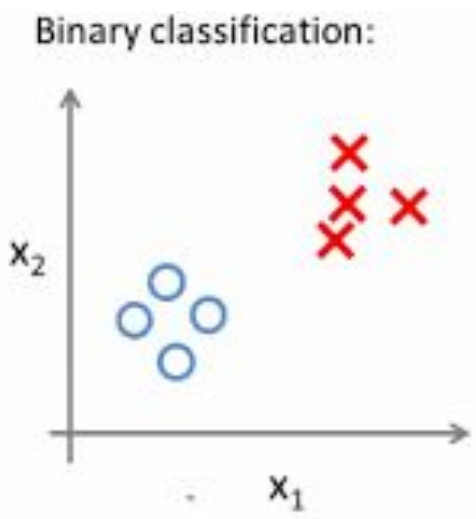
Yes!

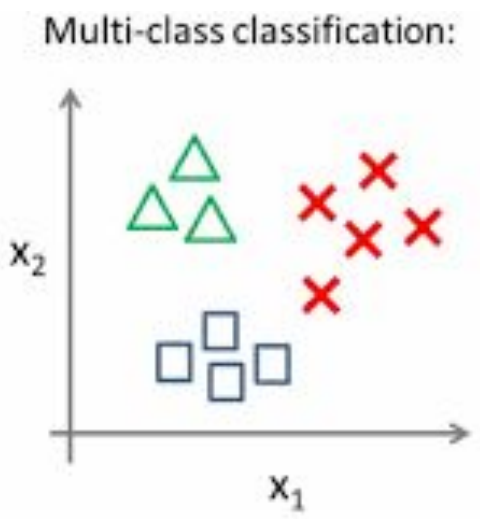
What we've learned: Classification

Is Classification supervised? Yes!

```
ckd.scatter('Hemoglobin', 'Glucose', colors='Class')
```



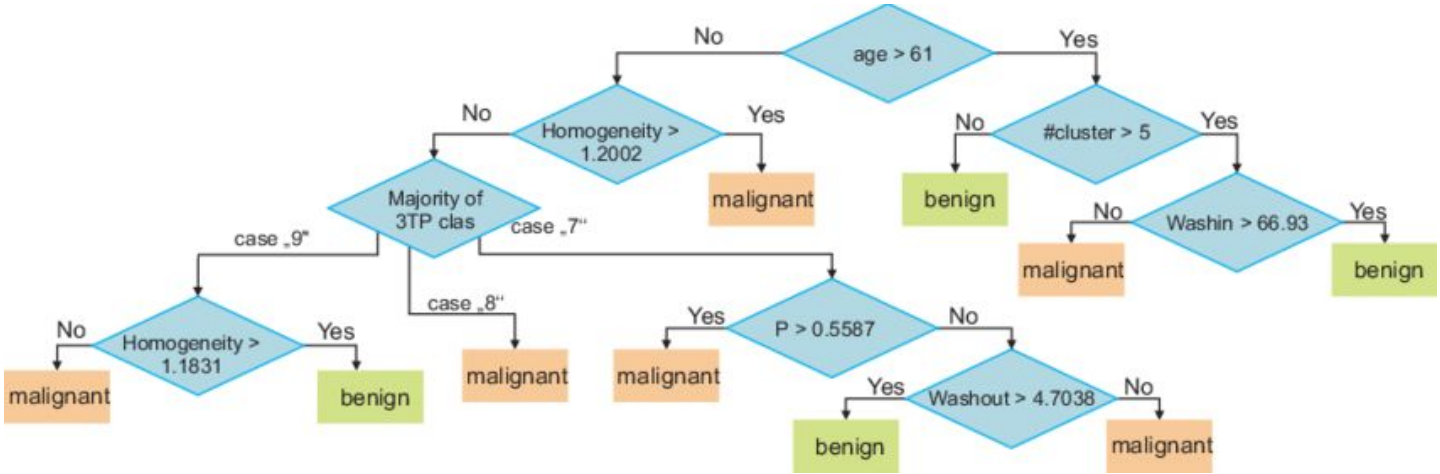




Interesting Material (that will not be tested!)

Other Interesting Techniques

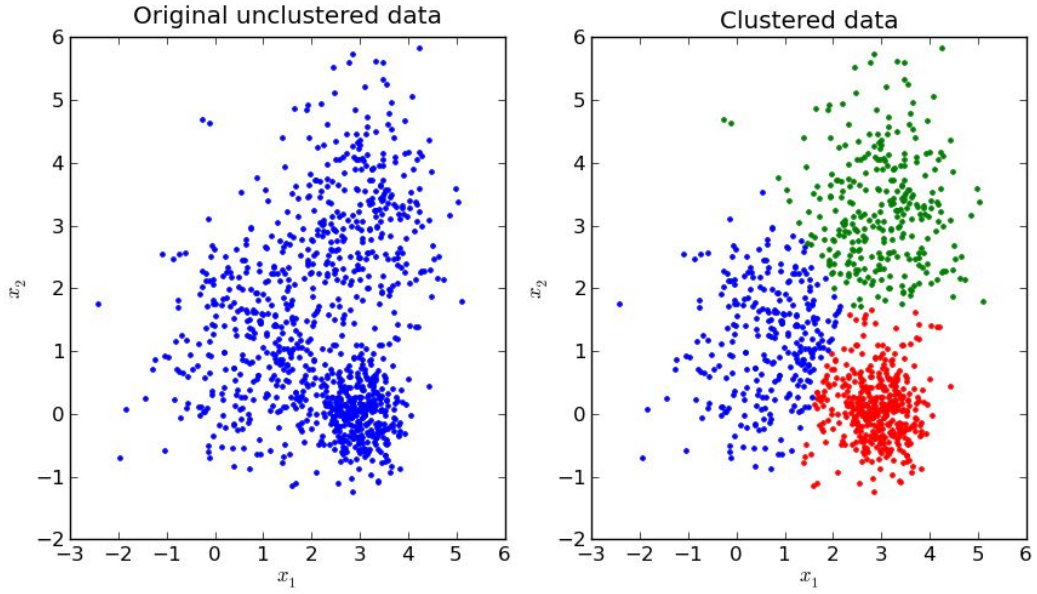
Decision Trees -- supervised? Yes!



If you like this, take DATA 100, STAT 154, CS 189

Other Interesting Techniques

Clustering -- supervised? No!



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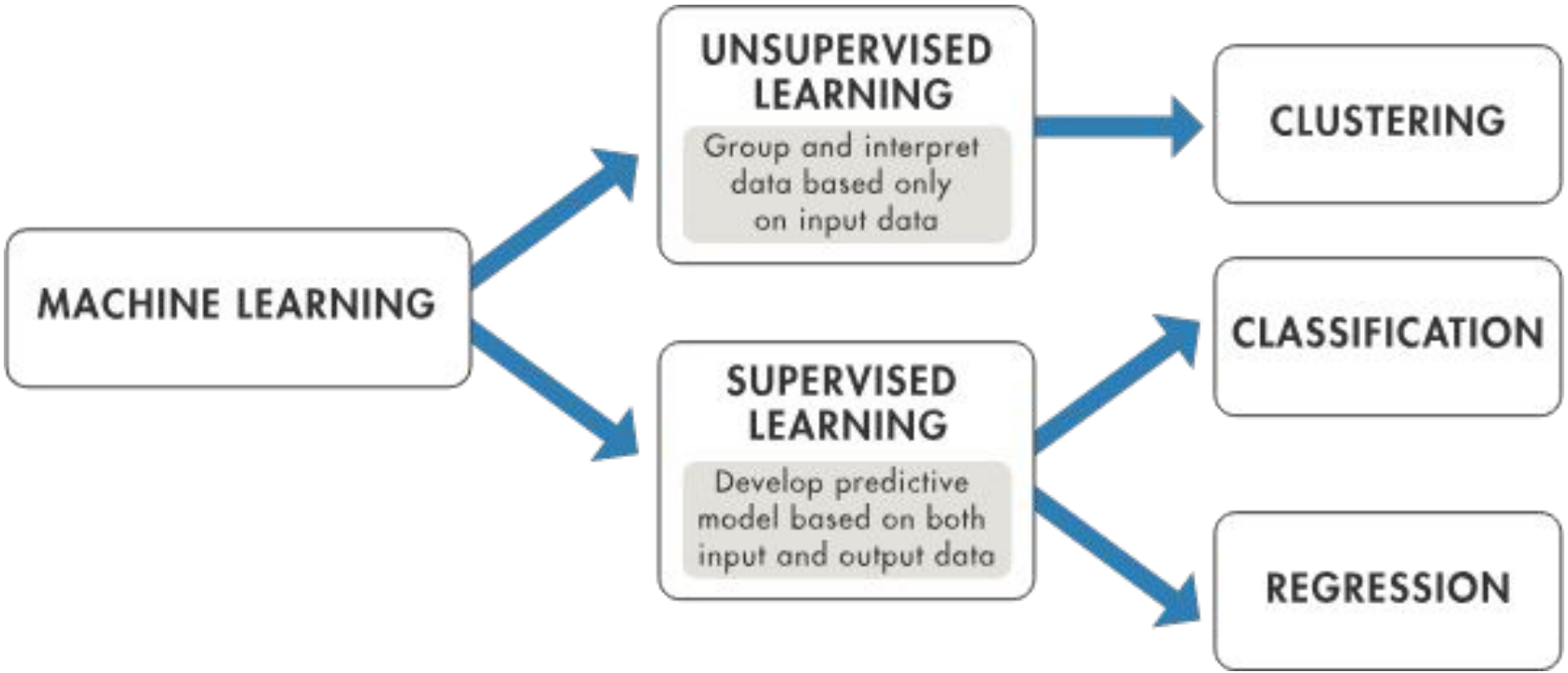
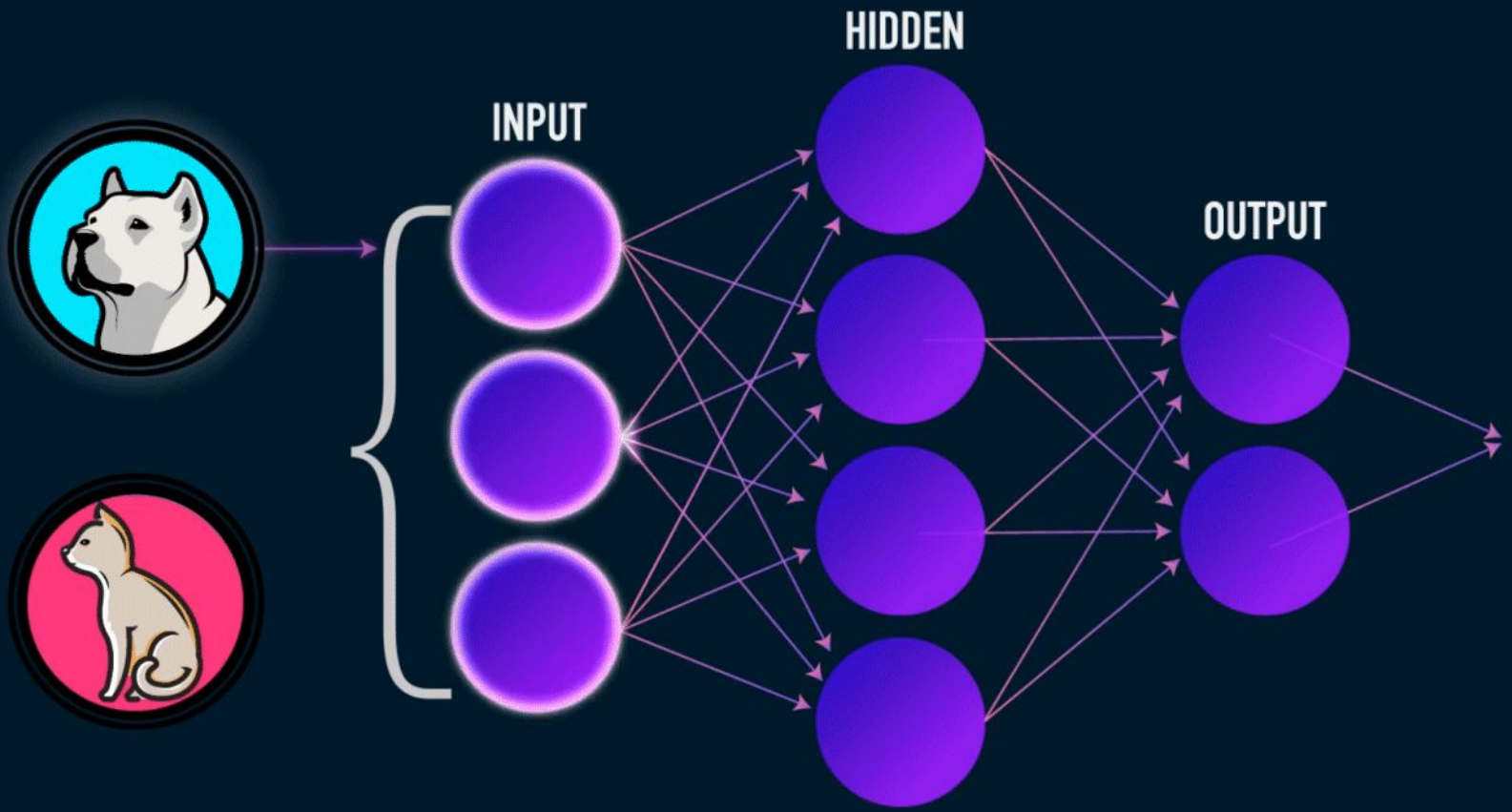
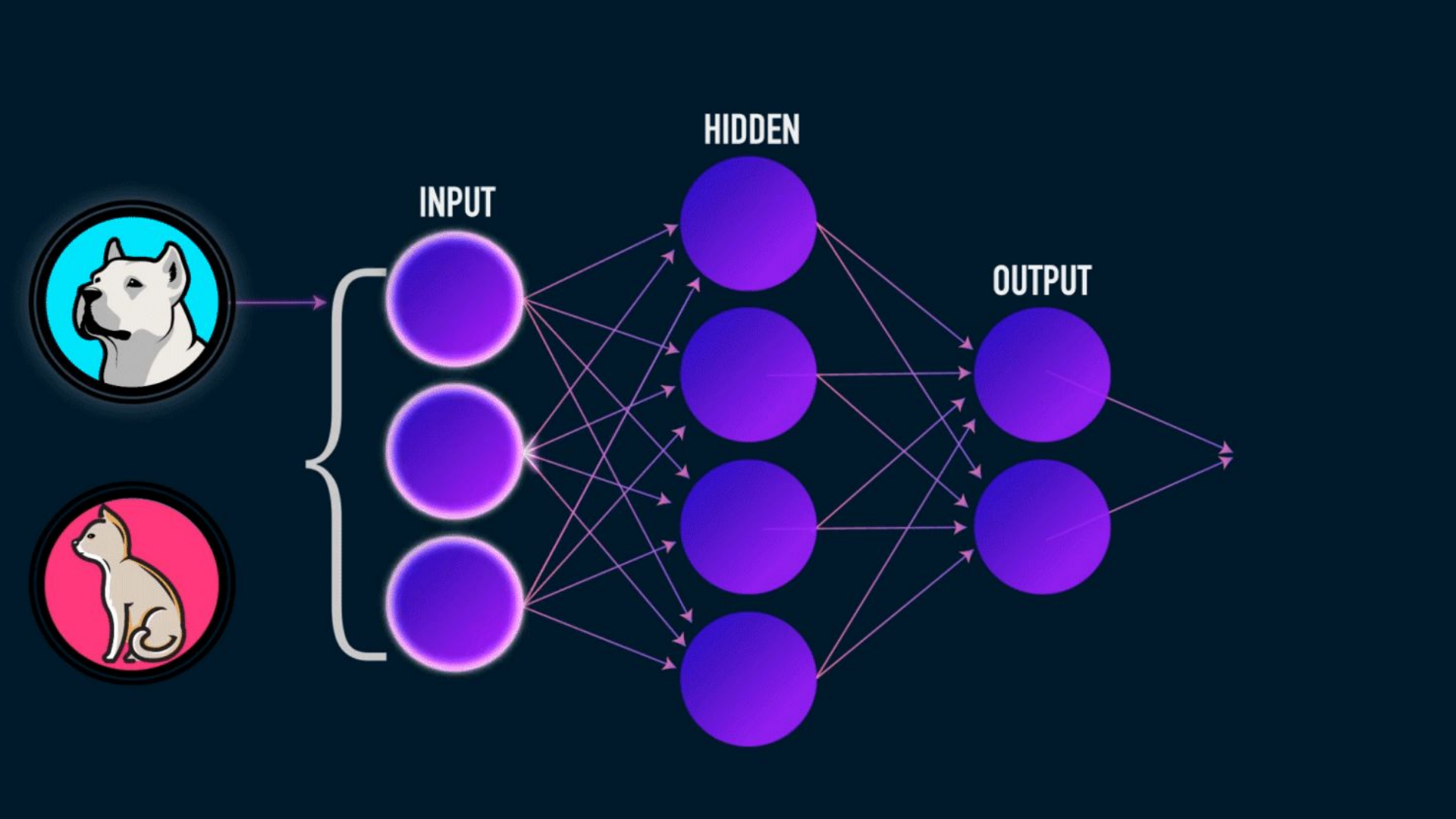
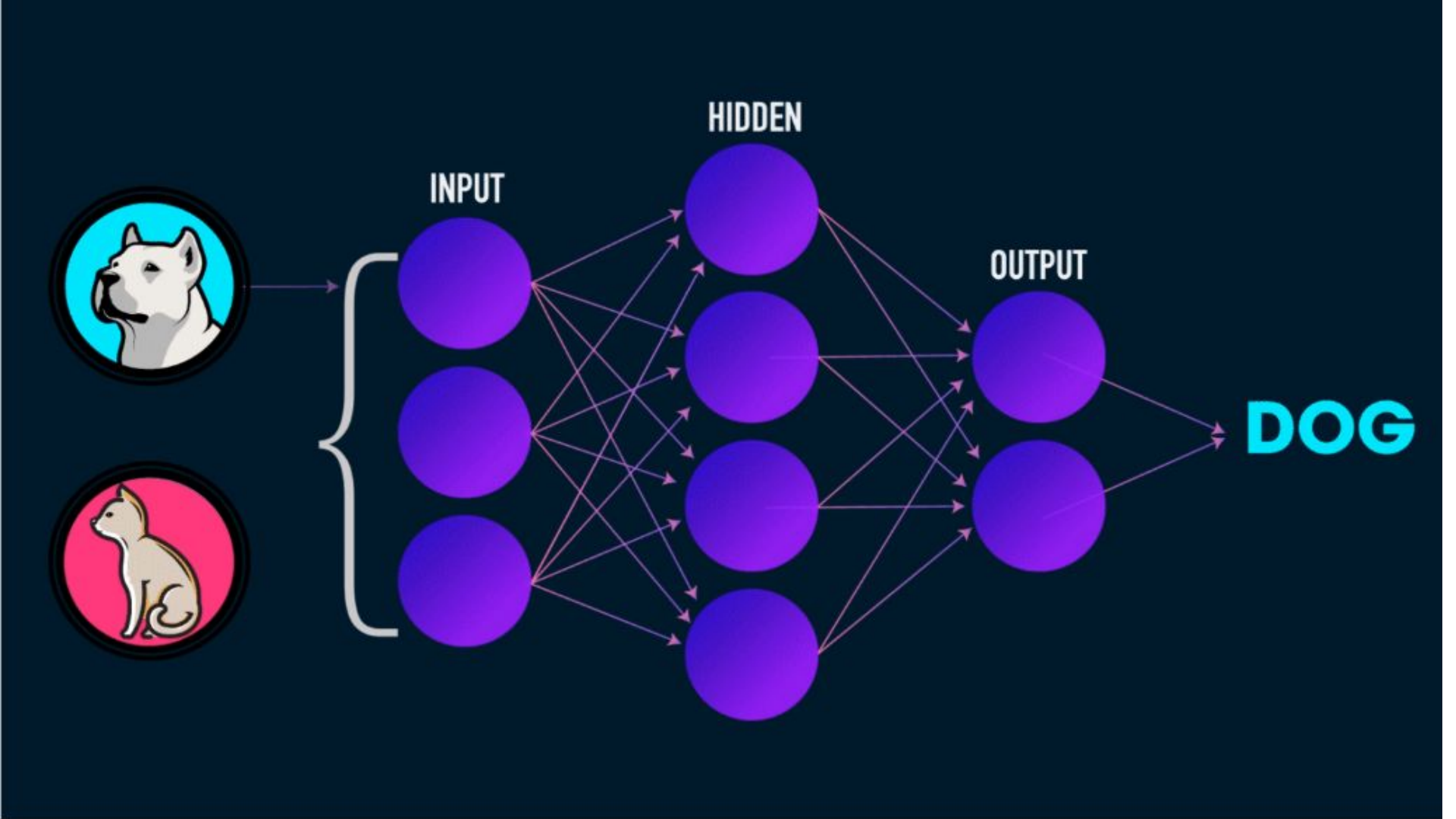
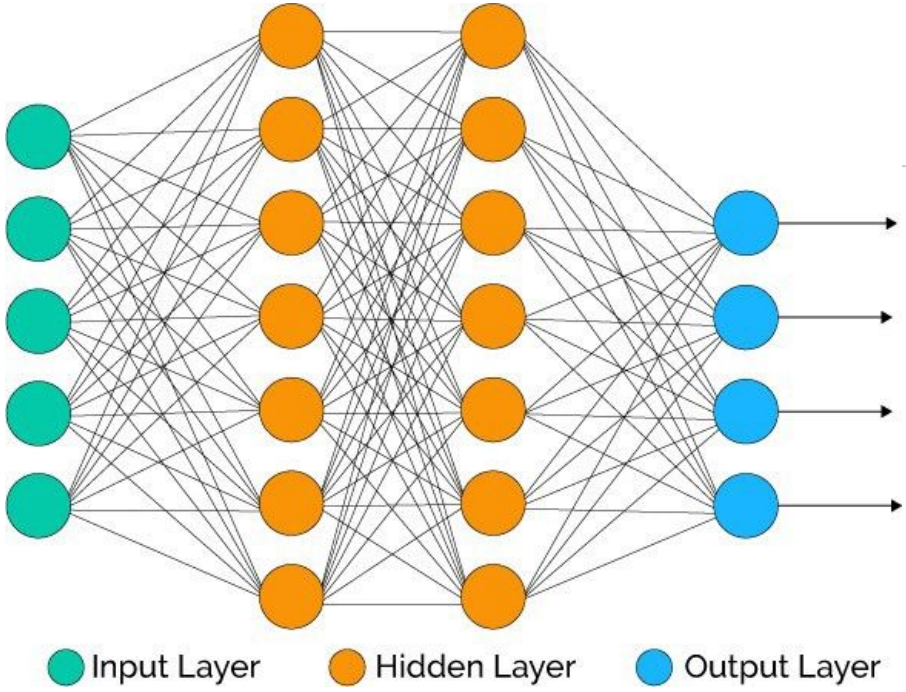

MACHINE LEARNING
UNSUPERVISED LEARNING
Group and interpret data based only on input data
SUPERVISED LEARNING
Develop predictive model based on both input and output data
CLUSTERING
CLASSIFICATION
REGRESSION

Neural Networks


HIDDEN
INPUT
OUTPUT

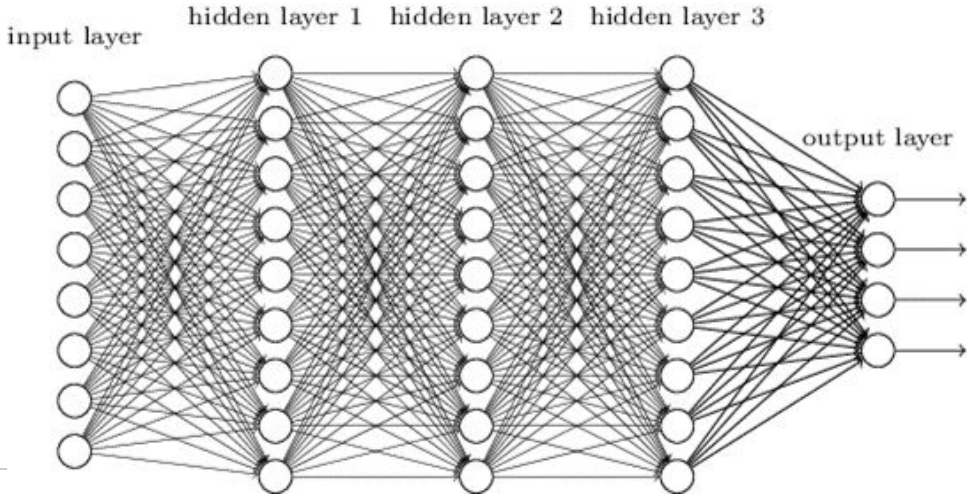

HIDDEN
INPUT
OUTPUT


HIDDEN
INPUT
OUTPUT
DOG



Deep Learning

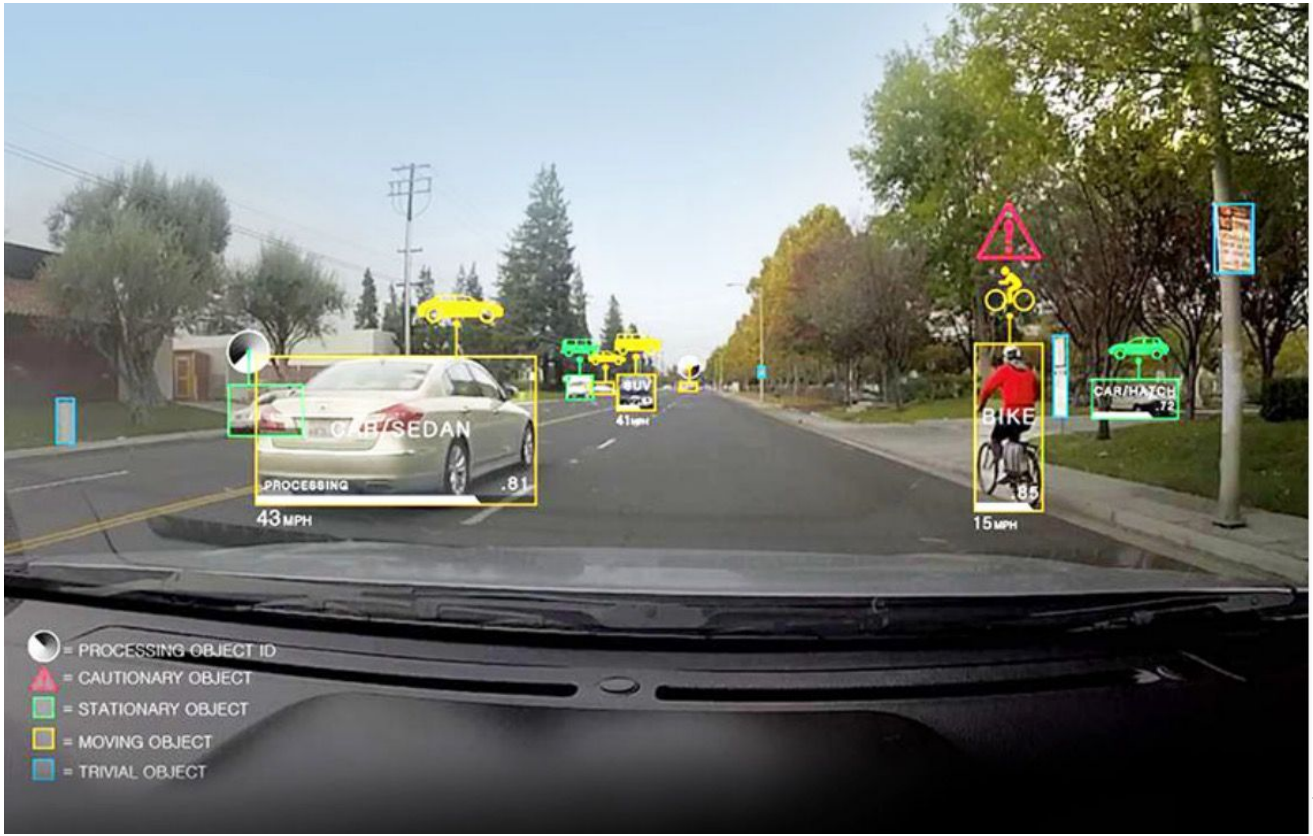
Supervised? Yes!



- Interpretability
- Security

Data Science problems for the next 10 years

Self-Driving Cars



State of the Art:
Deep Learning +
Computer Vision

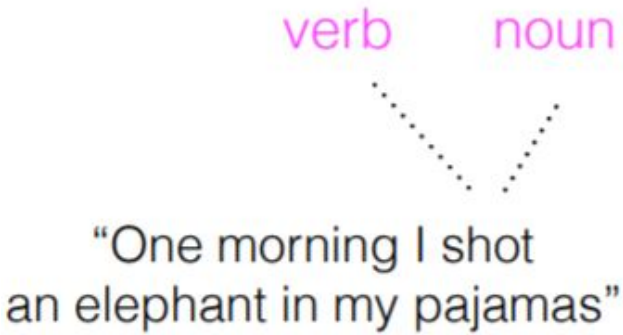
riselab
UC Berkeley

Berkeley DeepDrive

Natural Language Processing

How can a computer read a book?

- Machine Translation
- Question Answering
- Ambiguity

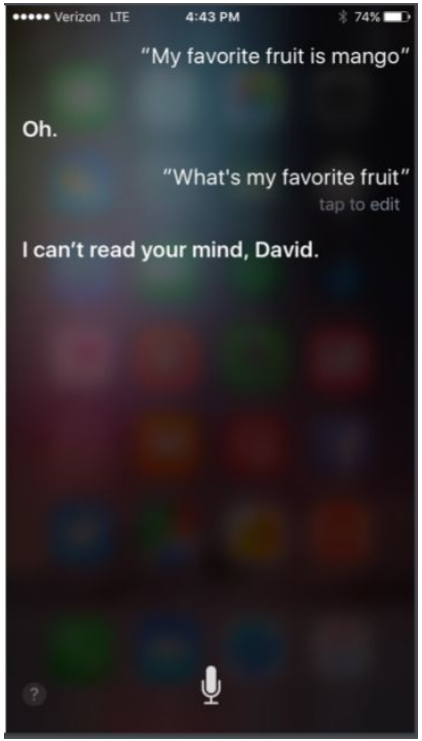


Can a computer play Jeopardy?

Yes! IBM Watson can.

If you like this, take INFO 159 (NLP), L&S 88 (Literature + Data Connector)

Conversational Agents



If you like this, take CS 188 (AI) and look into Human-Computer Interaction

Smart Home / IoT

If you like this, take Systems (CS 162) and Databases (CS 186)

And many more...

- Education
- Social Science
- Humanities
- Economics
- Environmental Science
- (We'll never finish listing them all)

You are data scientists now -- go out and change the world!