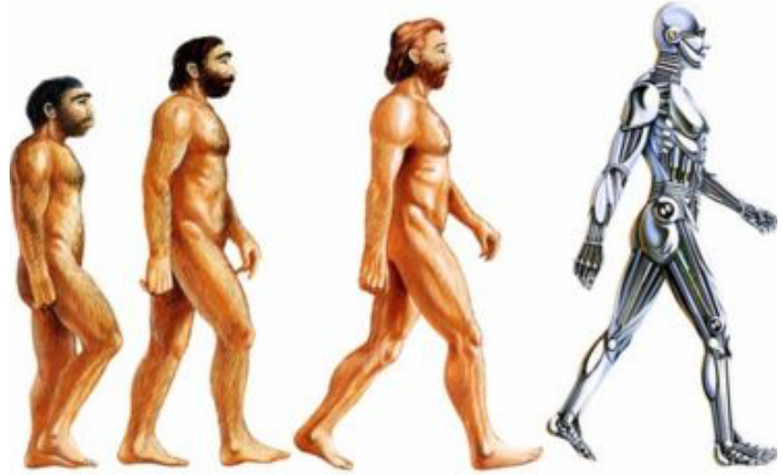
Machine Learning

Mid-year seminar



Machine learning tasks are typically classified into two broad categories, depending on the nature of the learning.

Supervised learning:

The computer is presented with example inputs and their desired outputs, given by a "teacher", and the goal is to learn a general rule that maps inputs to outputs.

Unsupervised learning:

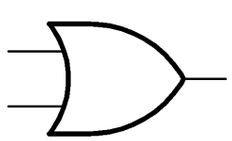
No labels are given to the learning algorithm, leaving it on its own to find structure in its input.

Supervised learning

The machine learning task of inferring a function from labeled training data.

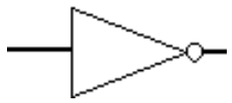
Supervised learning is fairly common in classification problems because the goal is often to get the computer to learn a classification system that we have created. Supervised learning is the most common technique for training neural networks and decision trees.

Classification problem

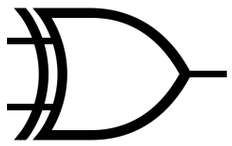


OR gate

AND gate

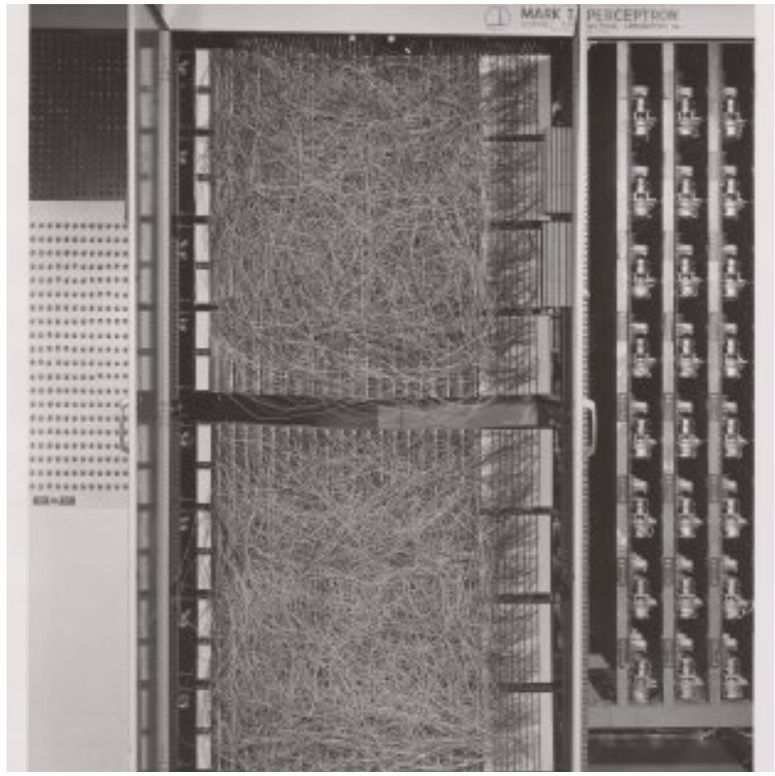


NOT gate



XOR gate

Perceptron



```
public static Tuple<double[], int, bool, string> tranningDivace(double[][] inputs, double[] outputs,                                    string
name) {
    int count = 0;
    bool fixPoint = true;
    double threshold = 0.5;
    double learning_rate = 0.1;
    double[] weights = new double[inputs[1].Length];
    while (true && count < 20) {
        fixPoint = count + 1 == 20 ? false : true;
        count++;
        double error_count = 0;
        for (int i = 0; i < inputs.Length; i++) {
            double[] arr1 = new double[inputs[1].Length];
            for (int j = 0; j < inputs[i].Length; j++) {
                arr1[j] = inputs[i][j];
            }
            double num = 0;
            if (dot_product(arr1, weights) != threshold) {
                num = dot_product(arr1, weights) > threshold ? 1 : 0;
            } else {
                num = 0.5;
            }
            double error = outputs[i] - num;
            if (error != 0) {
                error_count += 1;
                int index = 0;
                foreach (double q in arr1) {
                    weights[index] += learning_rate * error * q;
                    index++;
                }
            }
        }
        if (error_count == 0) {
            return Tuple.Create(weights, count, fixPoint, name);
        }
    }
    return Tuple.Create(weights, count, fixPoint, name);
}

public static double dot_product(double[] values, double[] weights) {
    double sum;
    sum = values.Zip(weights, (X, Y) => X * Y).Sum();
    return sum;
}
```

You like beef steak

01

Buy the finest cut.

Using all the budget, good dinner achieved.

02

Cutting the budget

It does not have to be that good to achieve the goal.

03

Cutting the budget

Continuously cutting the budget, as long as you are happy.

04

Stop on the threshold

Set the budget to minimal.

Perceptron

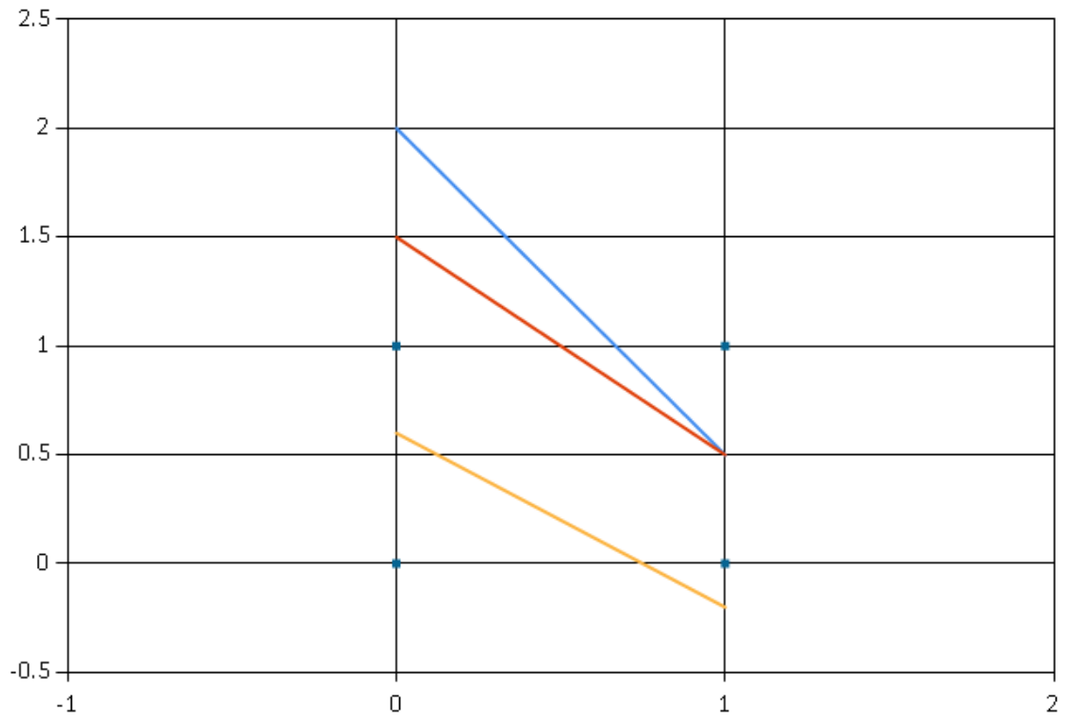
Cooking a dinner.

Beef	Salad	Good Dinner
1	0	1
0	1	1
1	1	1
0	0	0

What if your wife is a vegetarian?

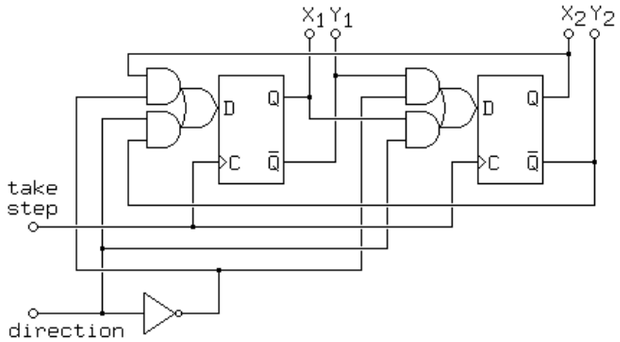
XOR senario

Beef	Salad	Good Dinner
0	0	0
1	0	1
0	1	1
1	1	0



It is mathematically impossible to make a XOR

with one single linear computation.



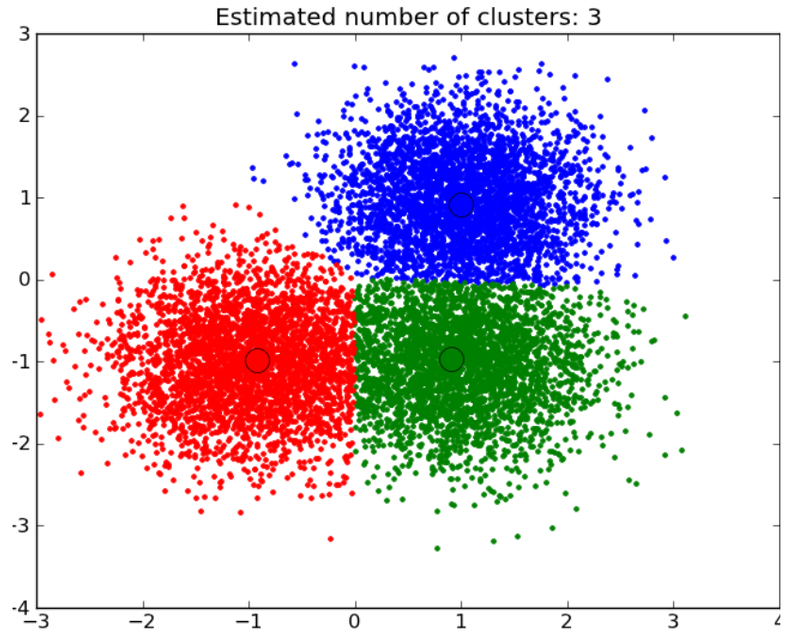
Make complex perceptron combinations. In XOR scenario we can compute the XOR by combining NAND, OR and AND.

Unsupervised learning

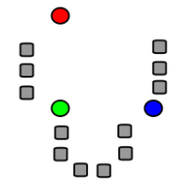
Allows us to approach problems with little or no idea what our results should look like

since there is no desired output in this case that is provided therefore categorisation is done so that the algorithm differentiates correctly between the face of a horse, cat or human (clustering of data)

k-means algorithm



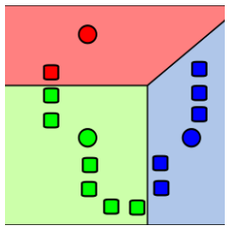
How does it work



Step 1

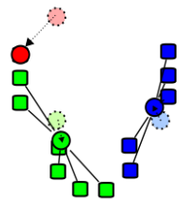
randomly generated means

within the data domain



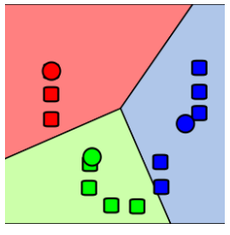
Step 2

clusters are created by associating observation with the nearest mean.



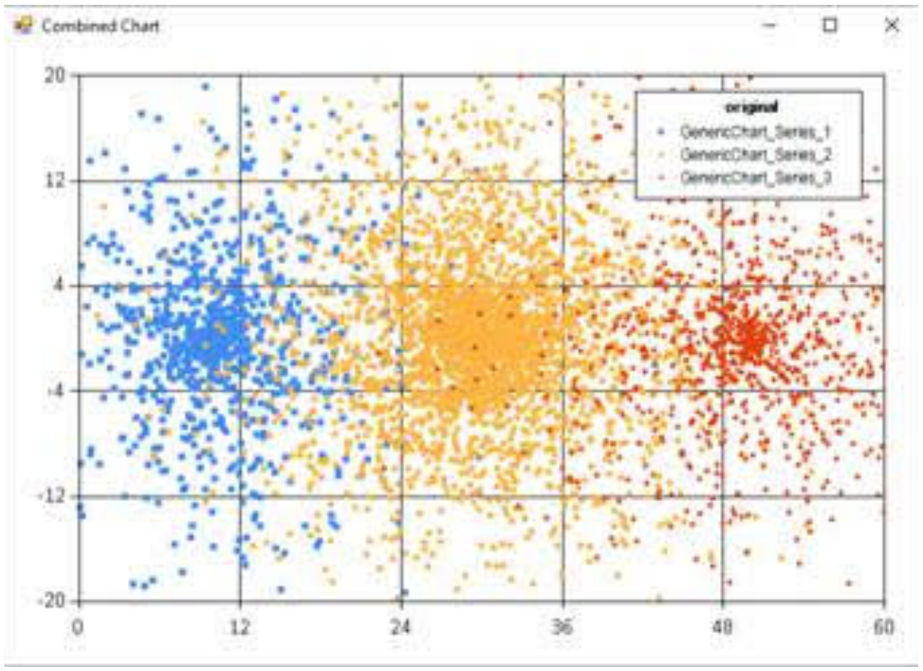
Step 3

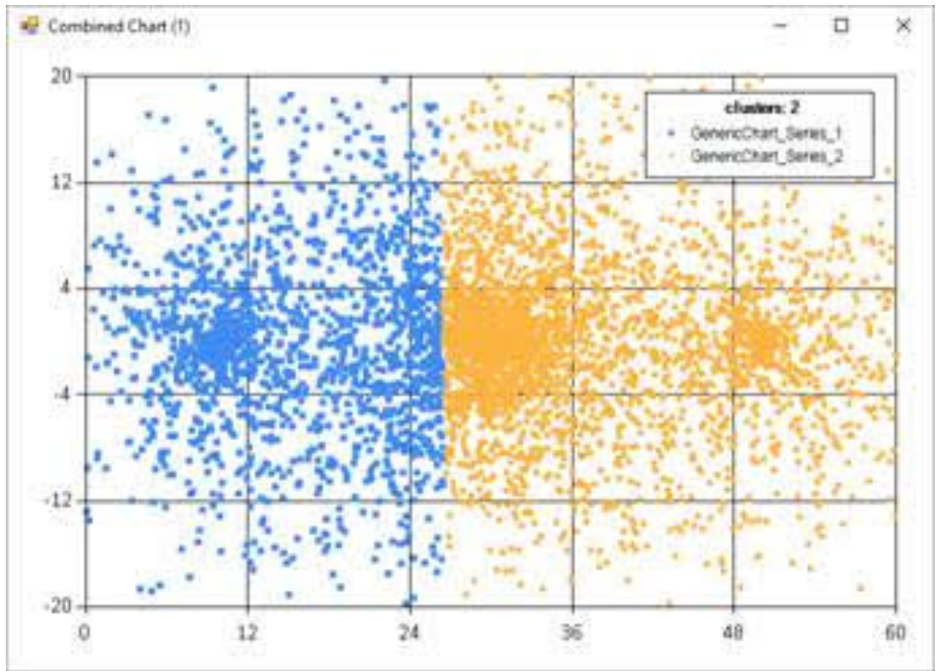
The centroid of each of the *k* clusters becomes the new mean.



Step 4

Repeat 2 and 3 until convergence has been reached.





A simple scenario with three Gaussian distributions


RED
TAYLOR SWIFT

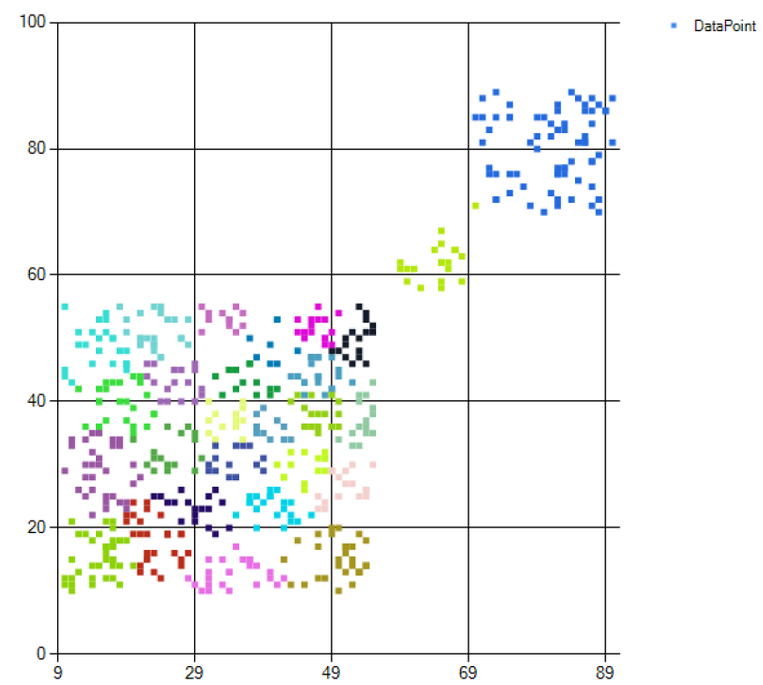

THE SHIP IS
OPERATING IN
RED
SANITATION
LEVEL

Red

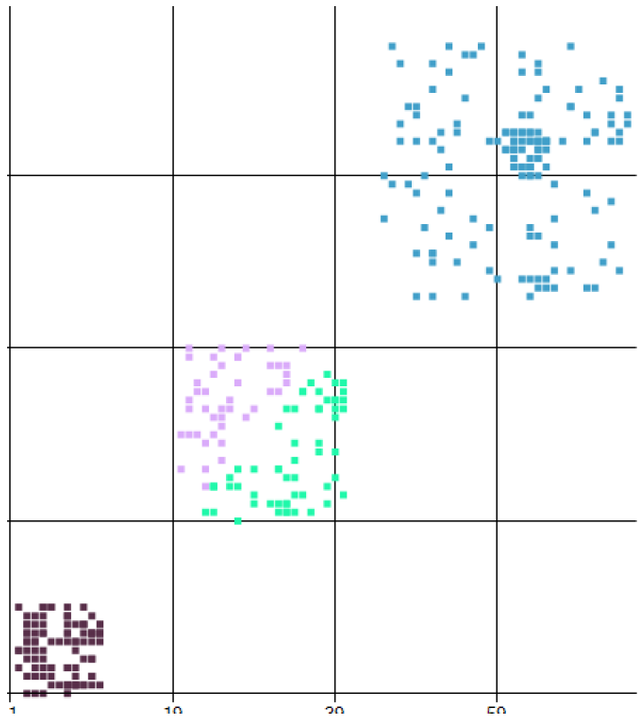
Red is the fourth studio album by American **singer-songwriter** Taylor Swift. It was released on October 22, 2012, by Big Machine Records, as the follow-up to her third studio **album**, *Speak Now*. The **album** title was inspired by the "semi-toxic relationships" that Swift experienced during the process of conceiving this **album**, which Swift described the emotions she felt as "red emotions" due to their intense and tumultuous nature. *Red* touches on Swift's signature themes of love and heartbreak, however, from a more mature perspective while exploring other themes such as fame and the pressure of being in the limelight. The album features collaborations with producers and guest artists such as Gary Lightbody of Snow Patrol and Ed Sheeran and is noted for Swift's experimentation with new **musical** genres. Swift completed The Red Tour in support of the album on June 12, 2014, which became the highest-grossing tour of all time by a country artist, grossing over $150 million.

Red was well received by critics and earned Swift Grammy Award nominations for Best Country Album and **Album** of the Year. It debuted at number one on the US *Billboard* 200 chart, giving Swift her third consecutive chart topper in the US. Its first week sales of 1.21 million was the third biggest debut in history for a female artist and became the fastest-selling album in over a decade. It made **music** history for claiming the biggest first week sales of all time by a country act, the record previously held by Garth Brooks. *Red* is just the 18th album in United States history to sell one million copies in a single week. It was also a huge global success, becoming Swift's first chart-topper in the UK, and also topped the album charts in Australia, Canada, Ireland and New Zealand while charted in the top ten in every other major market including China.

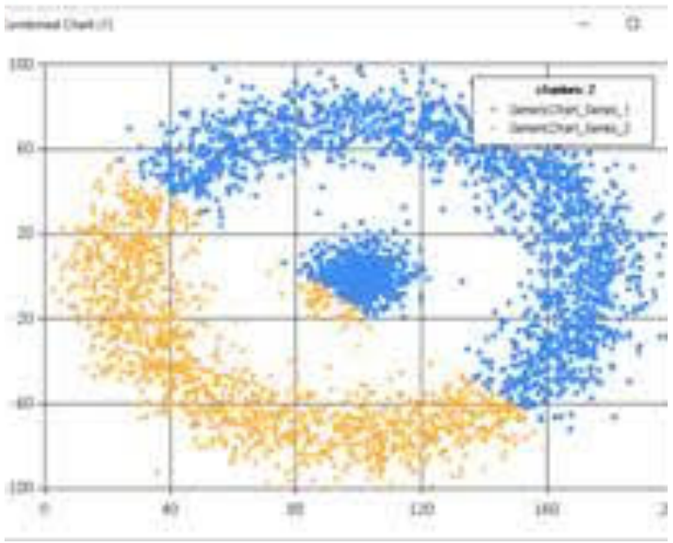
Worldwide, *Red* has sold 6 million copies as of August 2014. It was Swift's third consecutive top-seller and the second best-seller overall across all genres despite being out only for two months. This makes the fourth time Swift has an **album** ranked in the year's top three sellers. *Red* has been certified quadruple platinum by the **Recording Industry Association of America (RIAA)**, making it Swift's fourth consecutive album to reach this plateau.

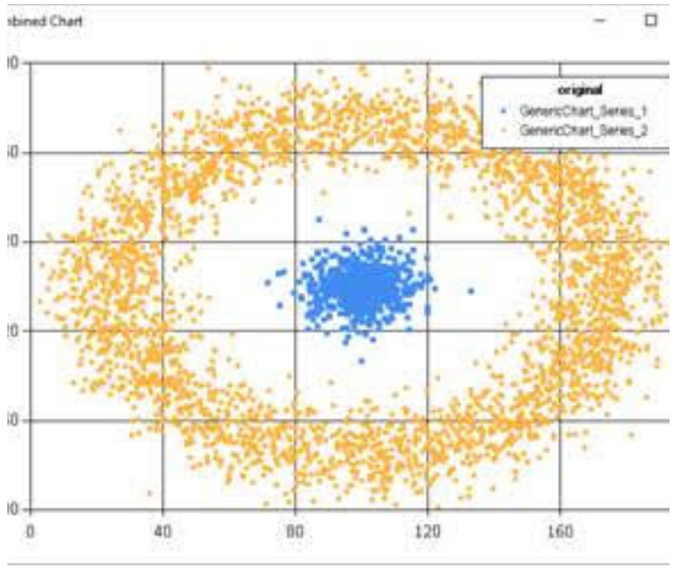


k-means will only
return local minimum.



Critical with selecting k value





The relationship between the data.

One more thing

C.N.T.K

Computational Network Toolkit

Deep learning framework

developed by Microsoft Research.

Microsoft

CNTK

CNTK was designed for peak performance for not only CPUS but also single-GPU, multi-GPU and multi-machine-multi GPU scenarios.

Performance

You can easily experiment with a wide range of architectures and training recipes with no long compilation cycles involved.

Flexibility

In addition to a wide variety of built-in computation nodes, CNTK provides a plug-in architecture allowing users to define their own computation nodes.

Extensibility

Thank You

Presenter: Jin Zhao