

Learning Paradigms

Supervised Learning

Unsupervised Learning

Supervised Learning



Supervised Learning

This is a pawn!



This is a knight!



This is a king!



Supervised Learning

- ▶ Labeled data;
- ▶ Has a “supervisor”;
- ▶ Classifies unseen instances (classification) or predicts values (regression).

Unsupervised Learning



Unsupervised Learning

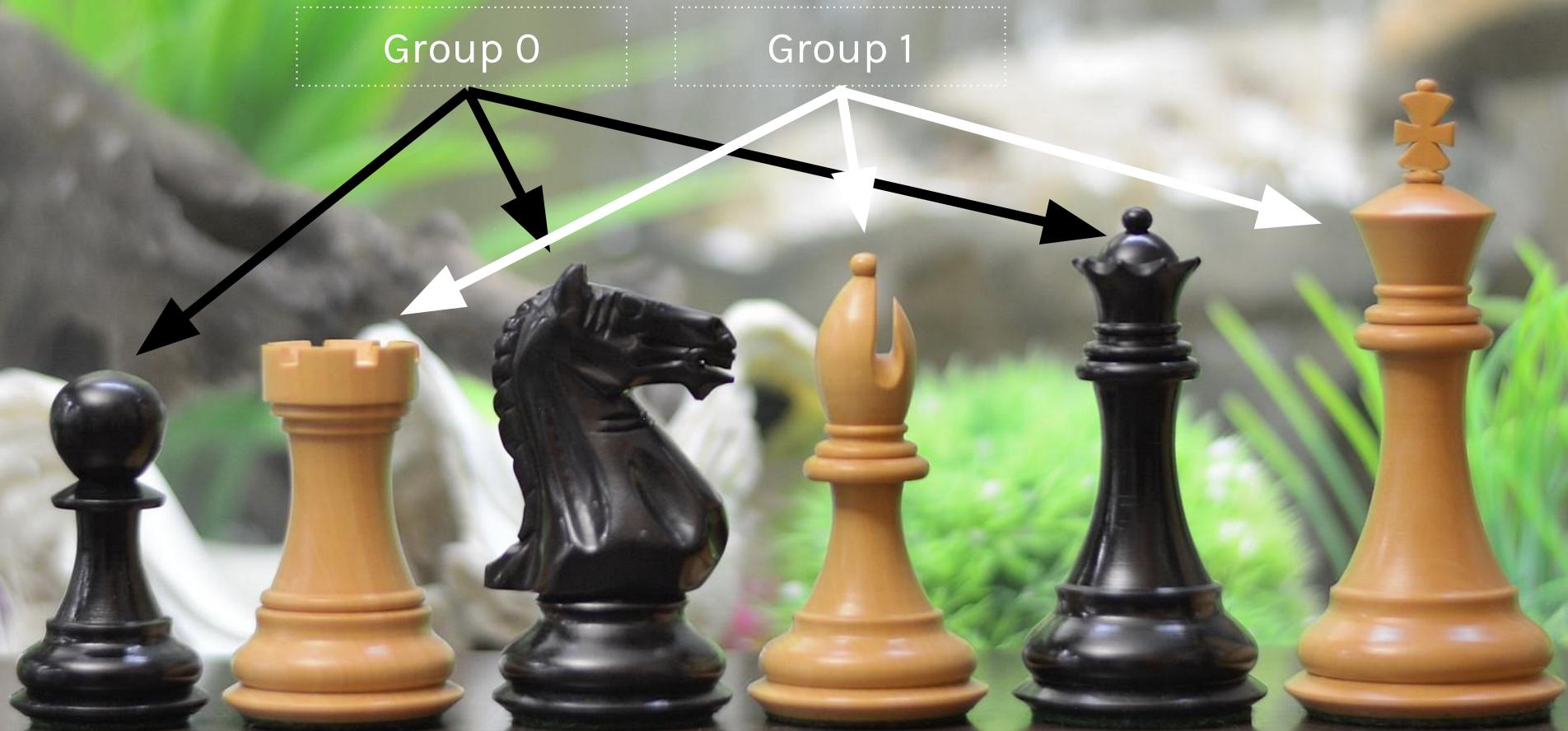
Smaller than others, with a ball on the top:
group 0!

Not conic, nothing
on the top: group 1!

Higher than others,
with cross on the top:
group 2!



Unsupervised Learning



Unsupervised Learning

- ▶ No labeled data;
- ▶ No “supervisor”;
- ▶ Finds the regularities in the input.

Task Categories

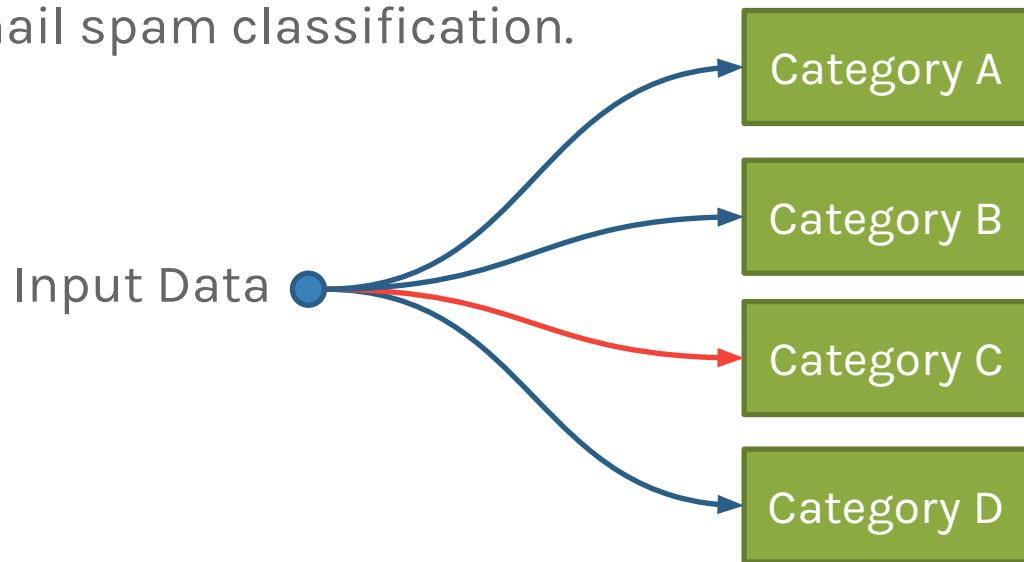
Classification

Regression

Clustering

Classification

- ▶ Classifies a given element in a category;
- ▶ Output as discrete labels (categories);
- ▶ Email spam classification.



Classification

From: fake@watches.com
To: my@email.com

Fake Watches Advertising

Don't miss the chance !
Buy fake watches right now !

Click here

Not spam

Spam

Classification



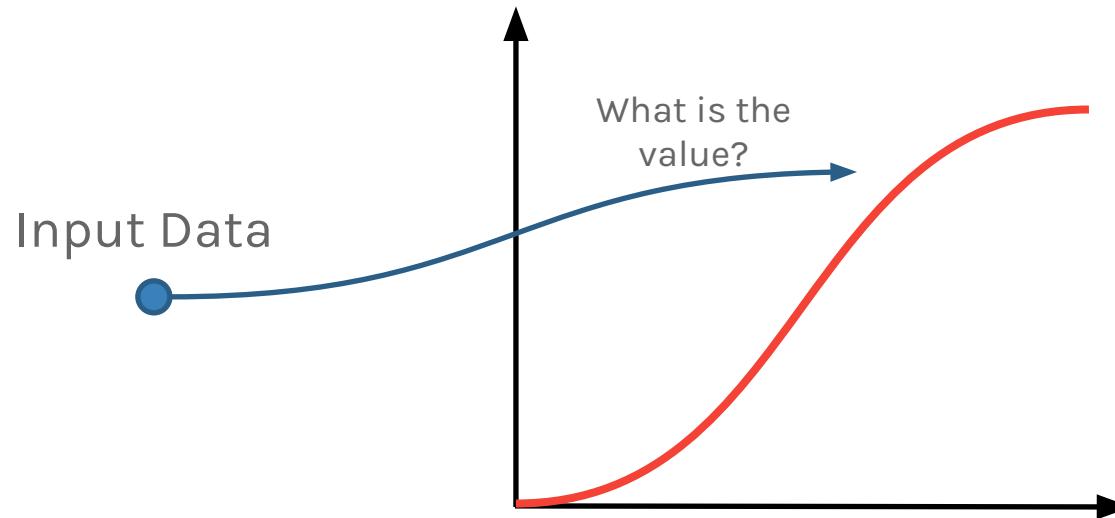
Human

Car

Tree

Regression

- ▶ Forecast/projection of given element
- ▶ Output as continuous values
- ▶ Predict house price given its features



Regression



House features

Area crime rate: 2.5

Bedrooms: 5

Age: 45

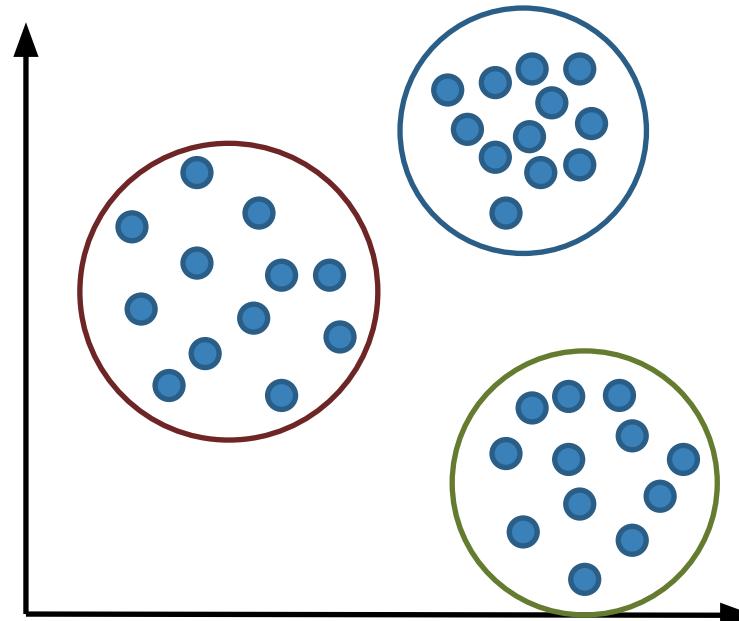
Dist. to business district: 8

House value

USD 303,365.00

Clustering

- ▶ Find groups from a dataset of elements
- ▶ Related news in websites



Clustering



USA TODAY

See realtime coverage

Through adversity, Warriors show again why they're a force to be emulated

USA TODAY - 2 hours ago



OAKLAND - Every so often during this relentless Golden State Warriors run, there's a reminder that they haven't been the kings of the NBA mountain for nearly as long as it might seem.

Portland makes the shift, then Golden State changes the game [ESPN \(blog\)](#)

Warriors put off Curry questions with big comeback win over Blazers

Sports Illustrated

Related

[Golden State Warriors »](#)

[Portland Trail Blazers »](#)

Local Source: Was emotional loss to Golden State Warriors a death blow for the Trail Blazers?

[OregonLive.com \(blog\)](#)

Opinion: NBA: Thompson sparkles as Warriors overpower Blazers [Inquirer.net](#)

In Depth: Blazers take best shot they have in Game 2, but still can't faze Warriors [CBSSports.com](#)

Clustering



USA TODAY

See realtime coverage

Through adversity, Warriors show again why they're a force to be emulated

USA TODAY - 2 hours ago



OAKLAND - Every so often during this relentless Golden State Warriors run, there's a reminder that they haven't been the kings of the NBA mountain for nearly as long as it might seem.

Portland makes the shift, then Golden State changes the game [ESPN \(blog\)](#)

Warriors put off Curry questions with big comeback win over Blazers

Sports Illustrated

Related

[Golden State Warriors »](#)

[Portland Trail Blazers »](#)

Local Source: Was emotional loss to Golden State Warriors a death blow for the Trail Blazers?

[OregonLive.com \(blog\)](#)

Opinion: NBA: Thompson sparkles as Warriors overpower Blazers [Inquirer.net](#)

In Depth: Blazers take best shot they have in Game 2, but still can't faze Warriors [CBSSports.com](#)

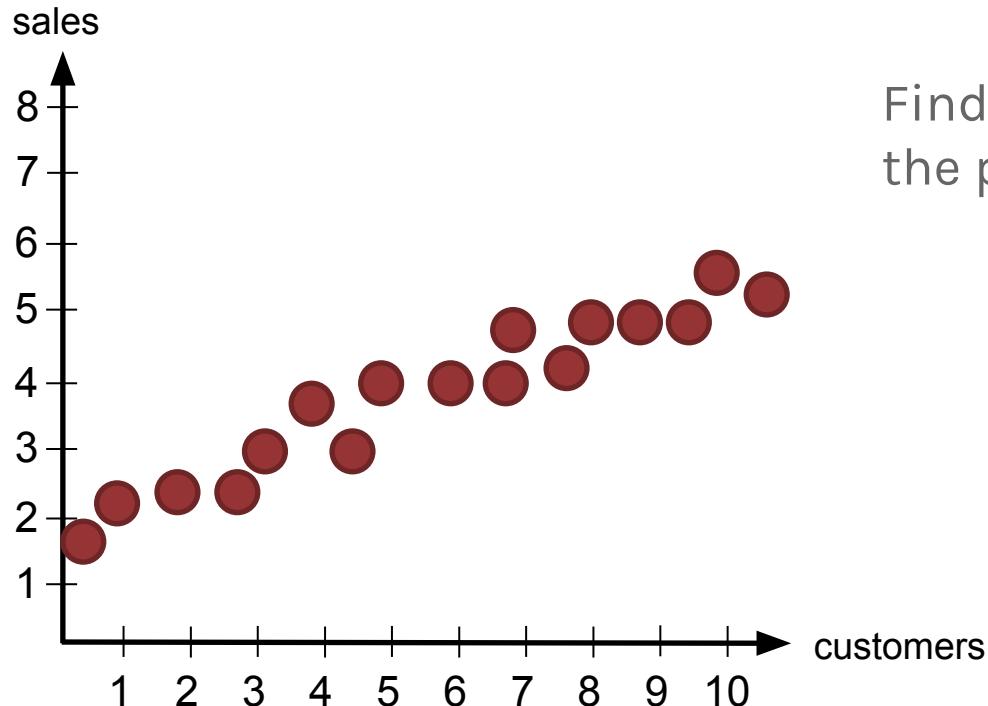
2. ALGORITHMS

The fun part ☺

Linear Regression

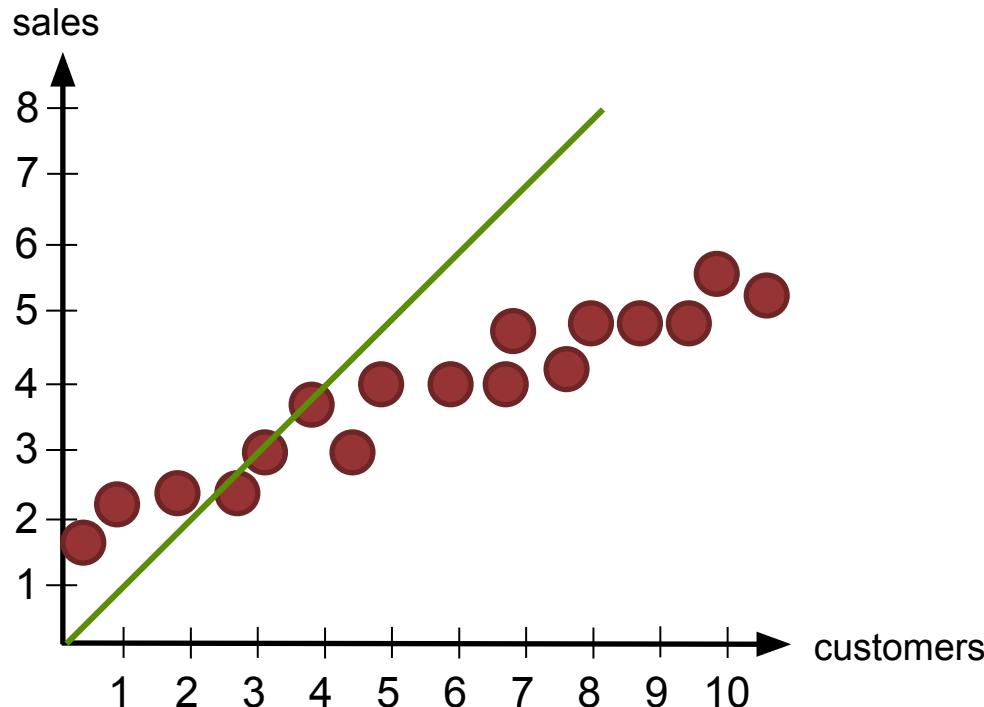
- ▶ Supervised learning;
- ▶ Regression.

Linear Regression

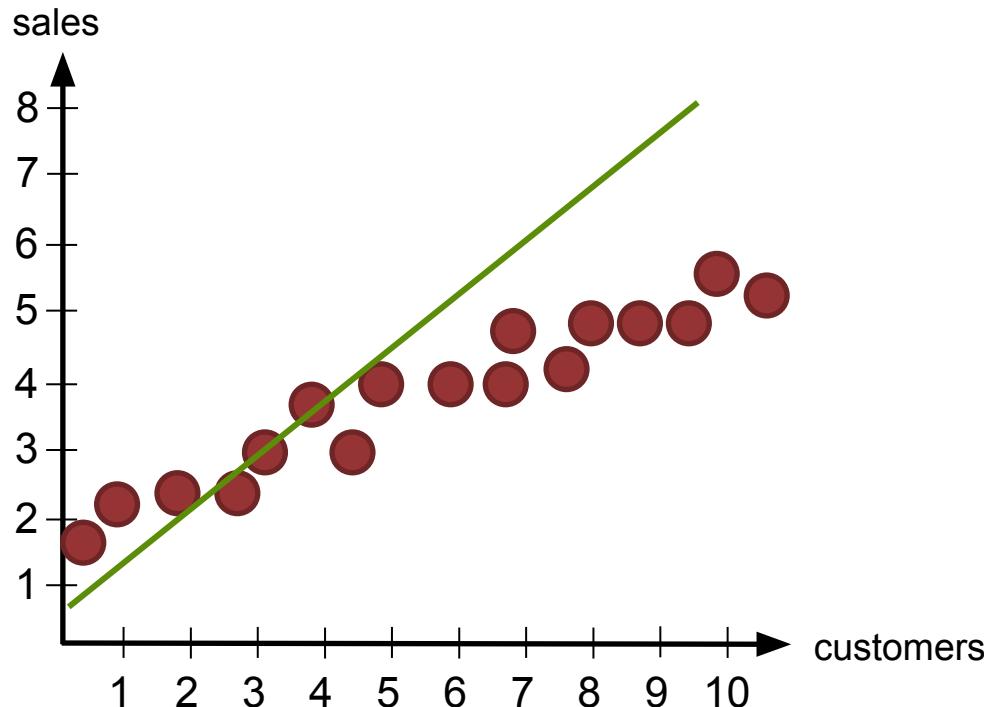


Find a line to fit
the point cloud

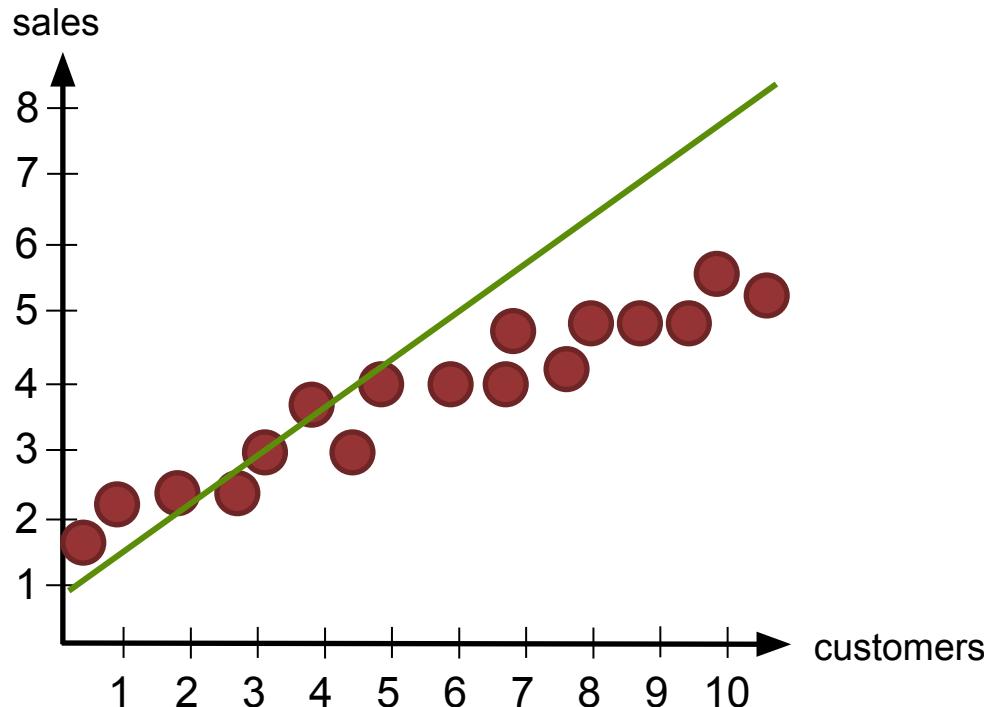
Linear Regression



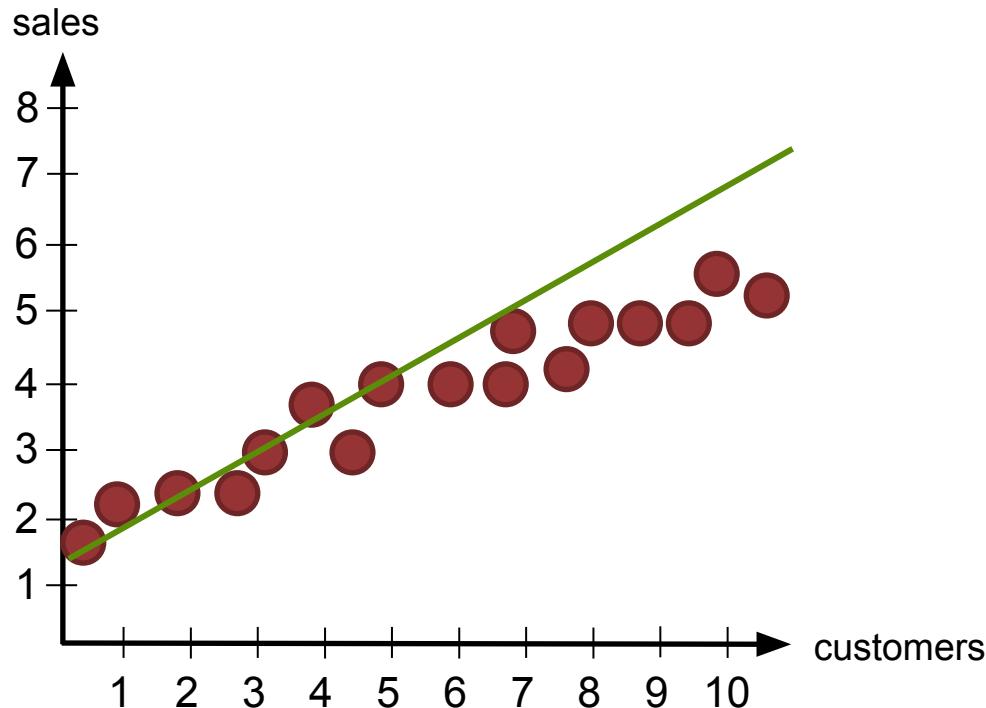
Linear Regression



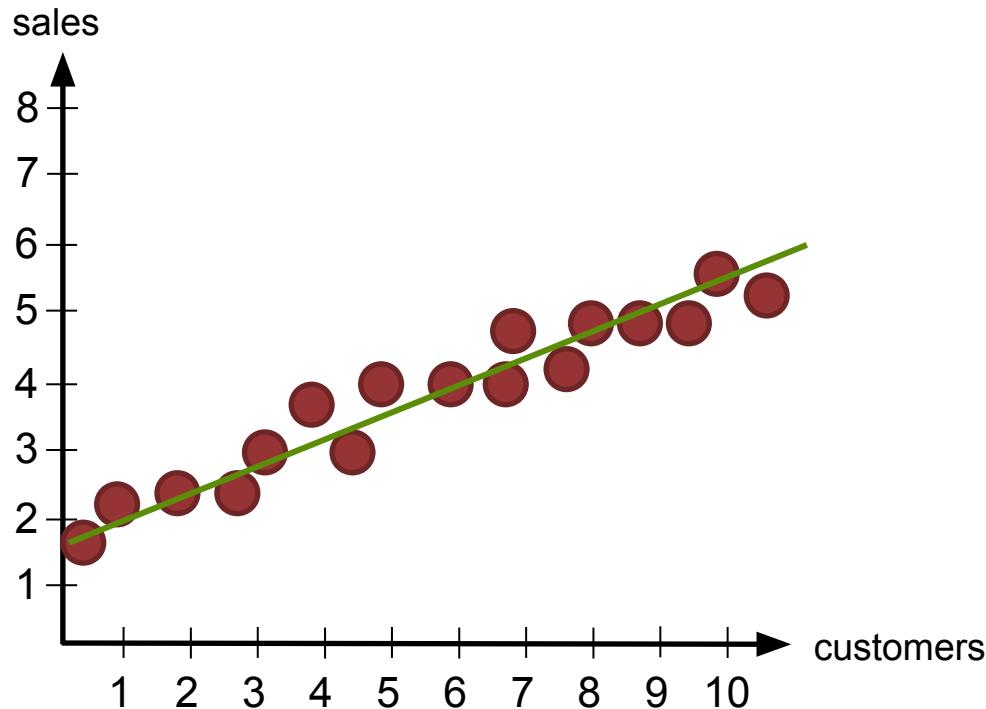
Linear Regression



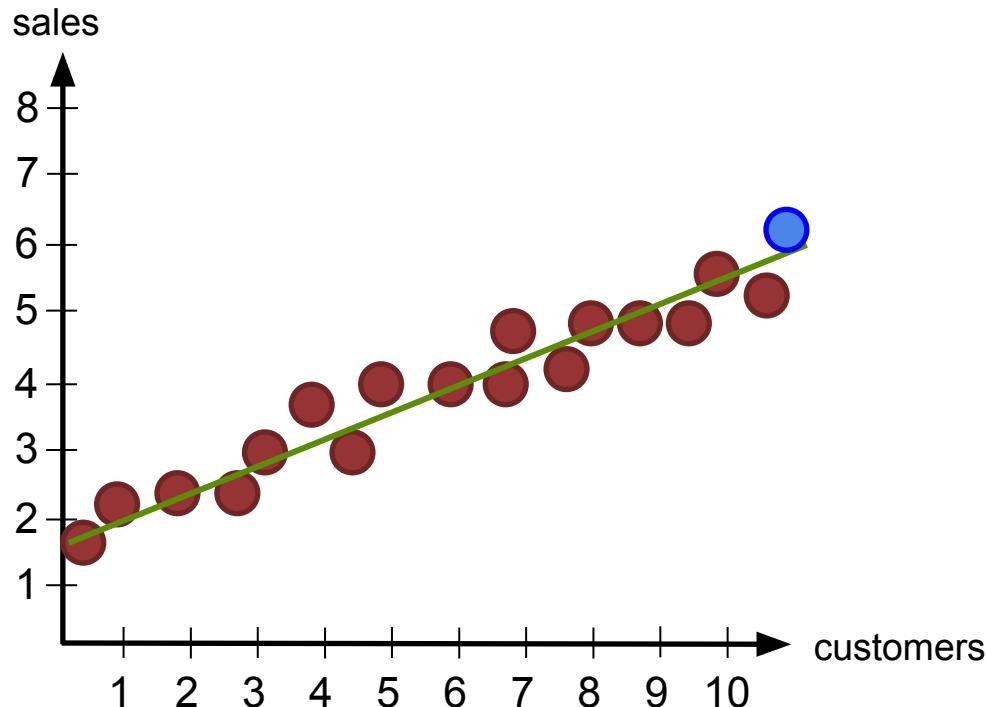
Linear Regression



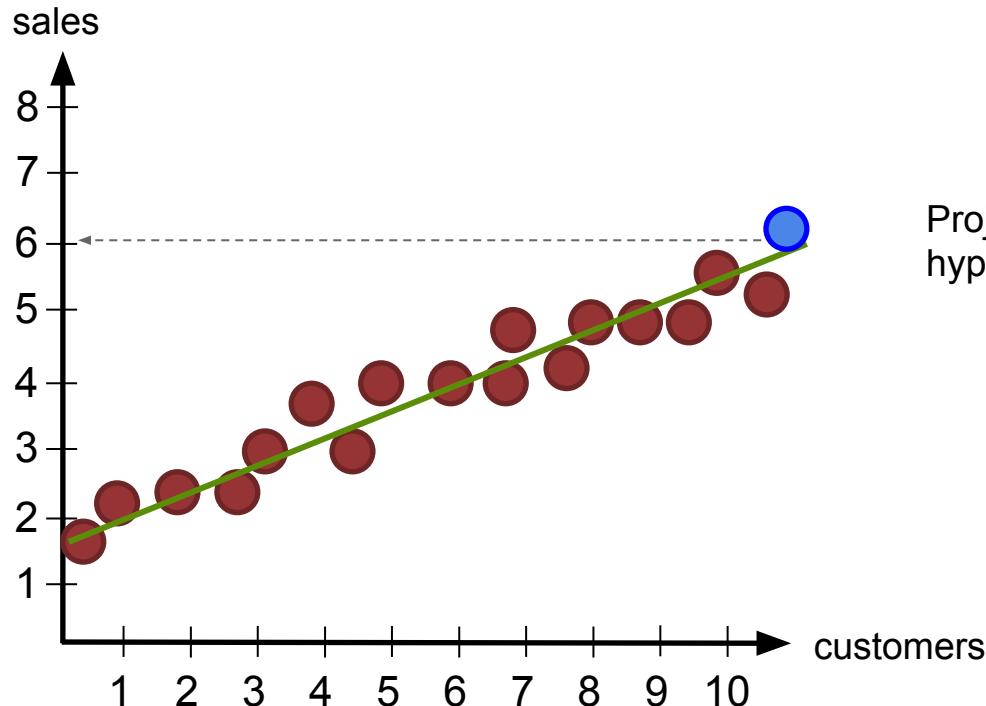
Linear Regression



Linear Regression

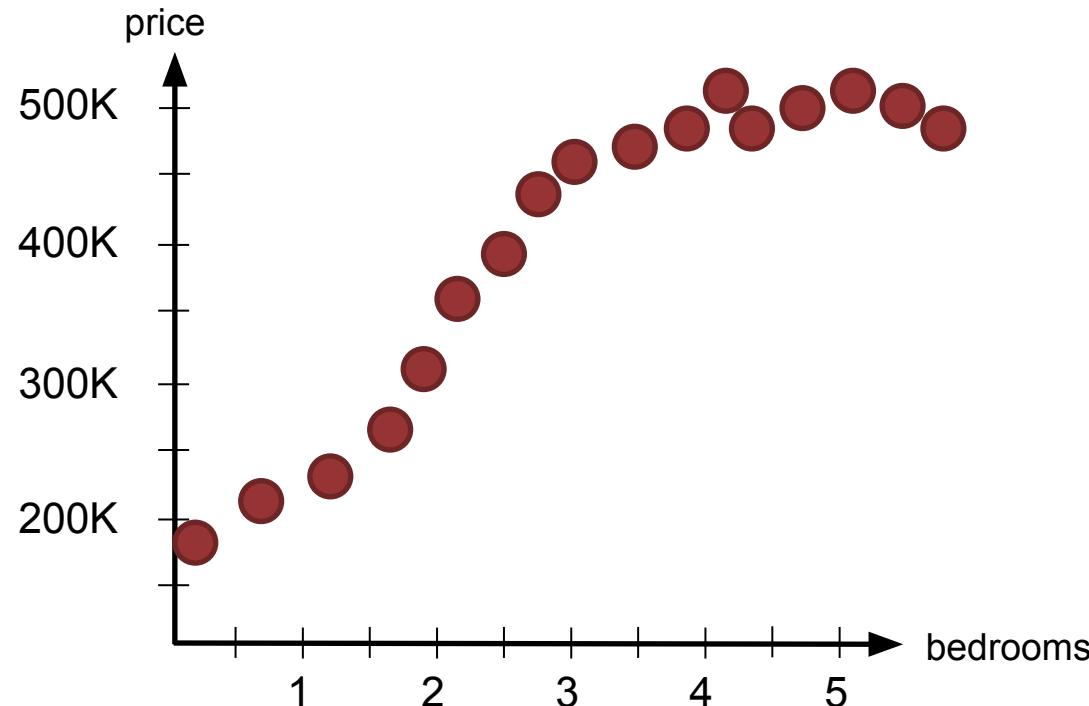


Linear Regression

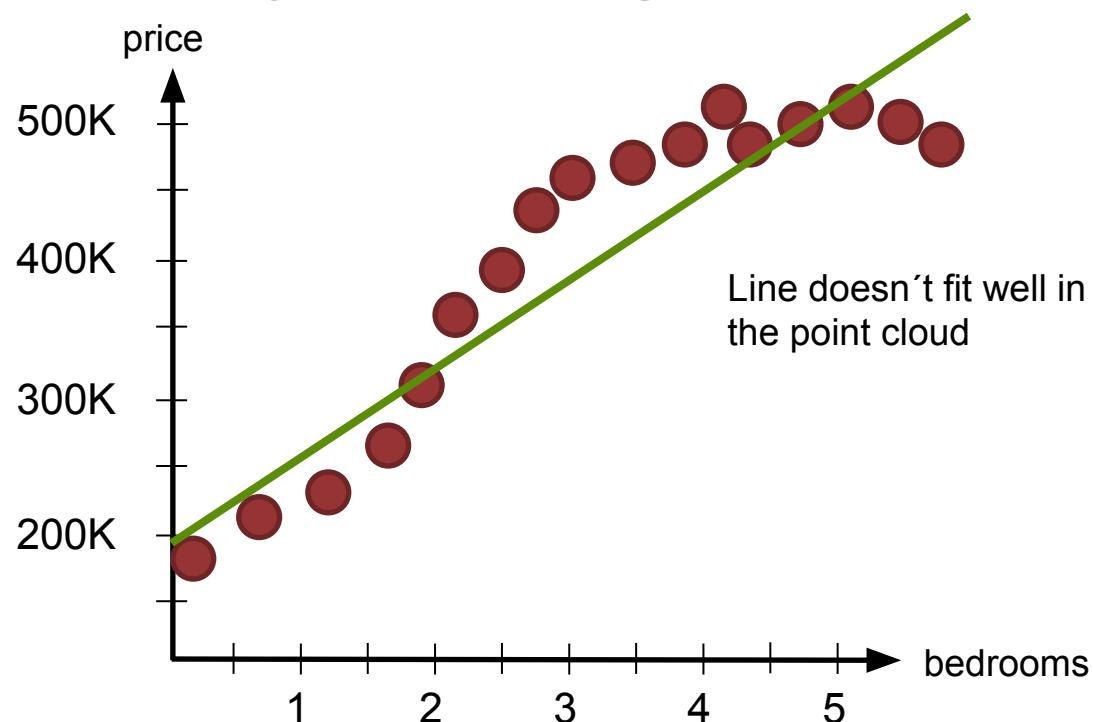


Project the value of
hypothetical point.

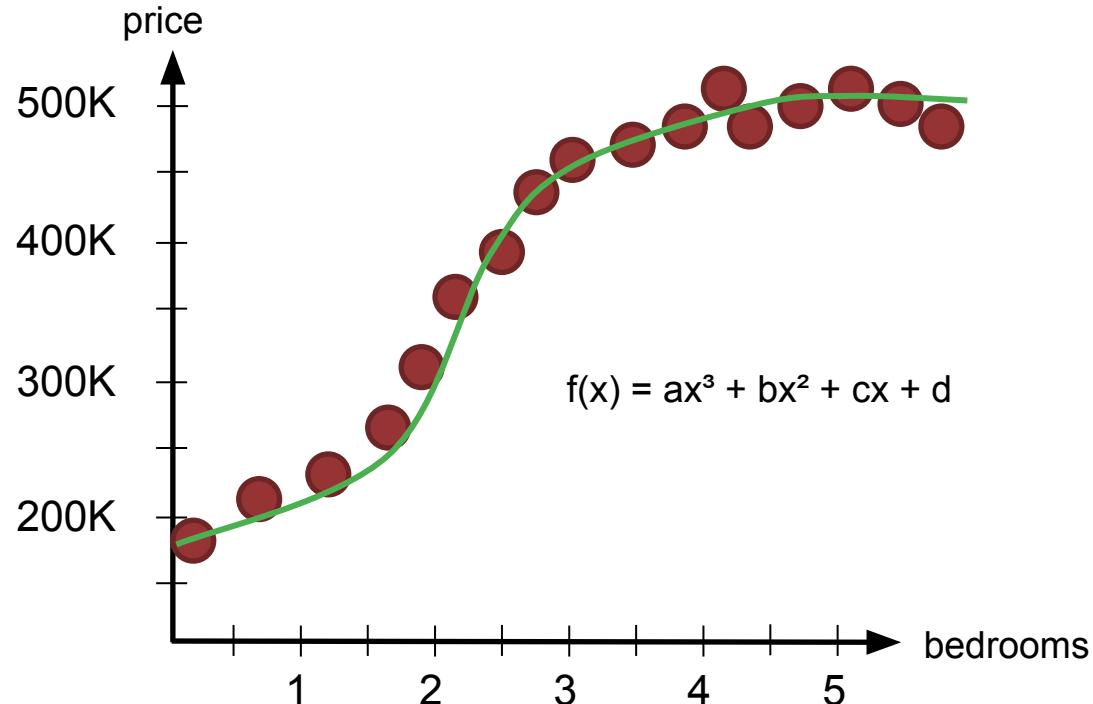
Polynomial Regression



Polynomial Regression



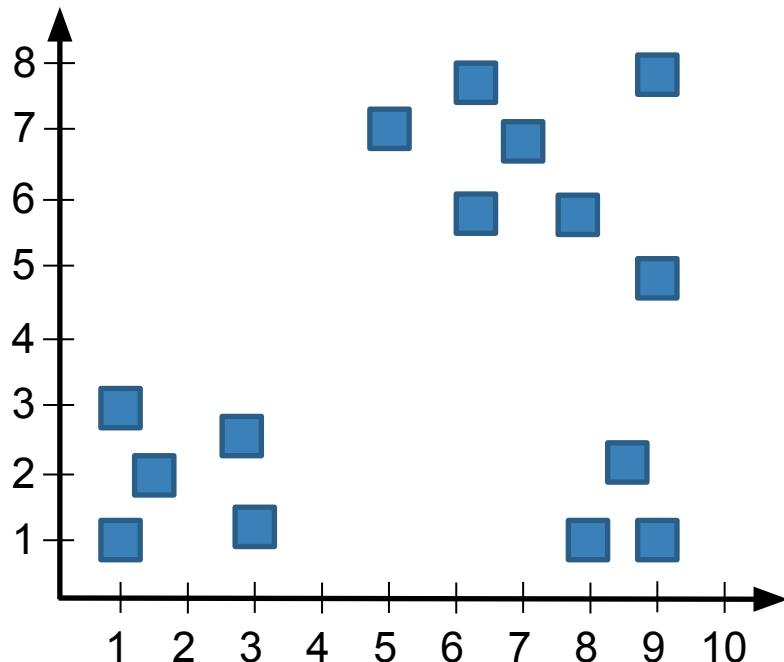
Polynomial Regression



K-means

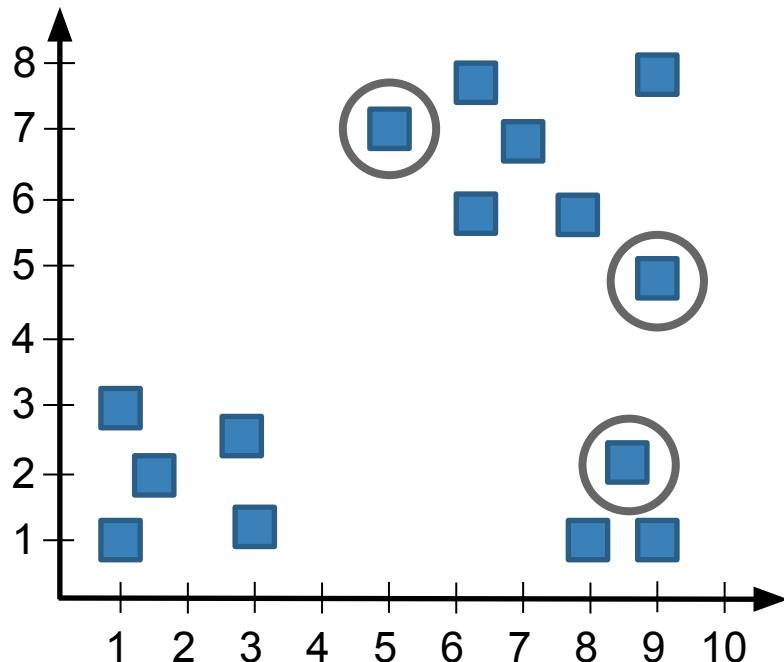
- ▶ Unsupervised learning;
- ▶ Clustering;
- ▶ Uses K to specify the number of clusters.

K-means



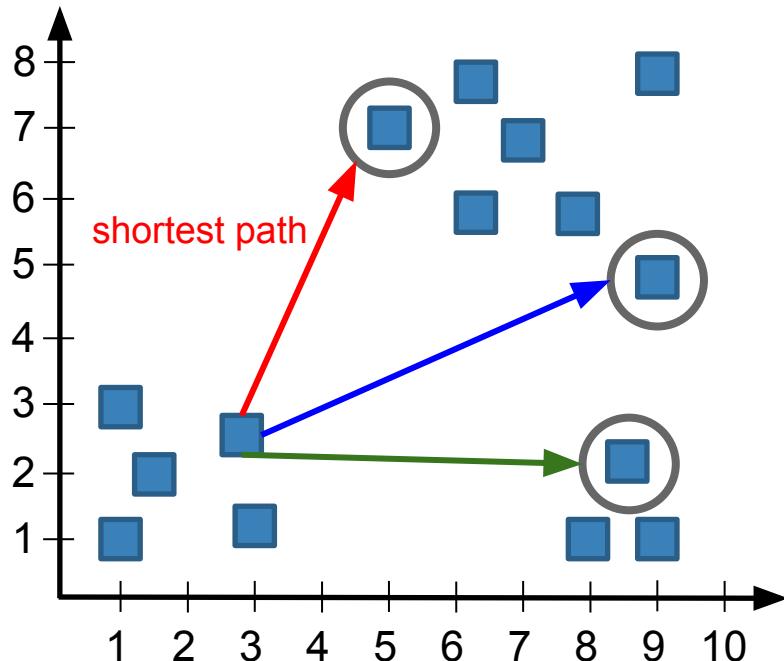
Find K clusters.
For K = 3

K-means



Step 1
Randomly choose
K initial samples
as cluster
centroids

K-means

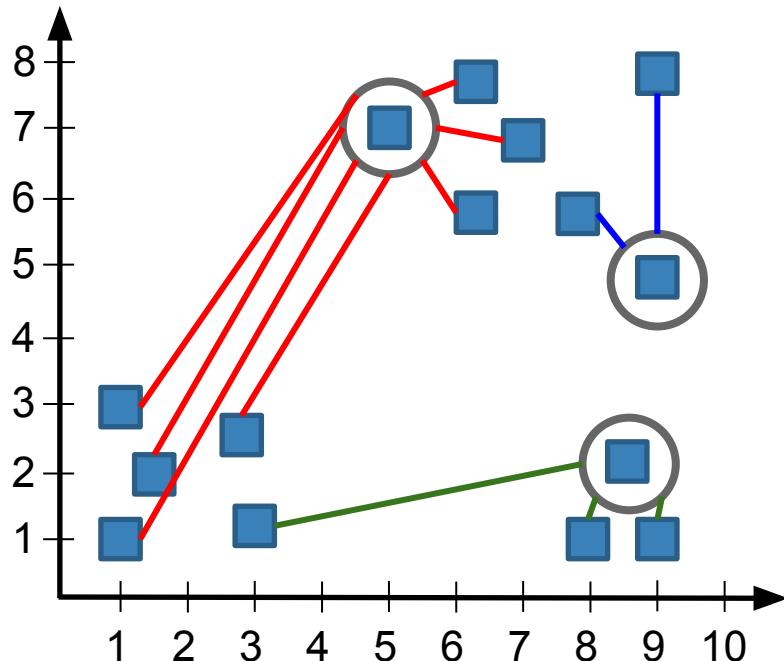


Step 2

For every sample,

- calculate distance to centroids
- pick cluster with closest centroid

K-means

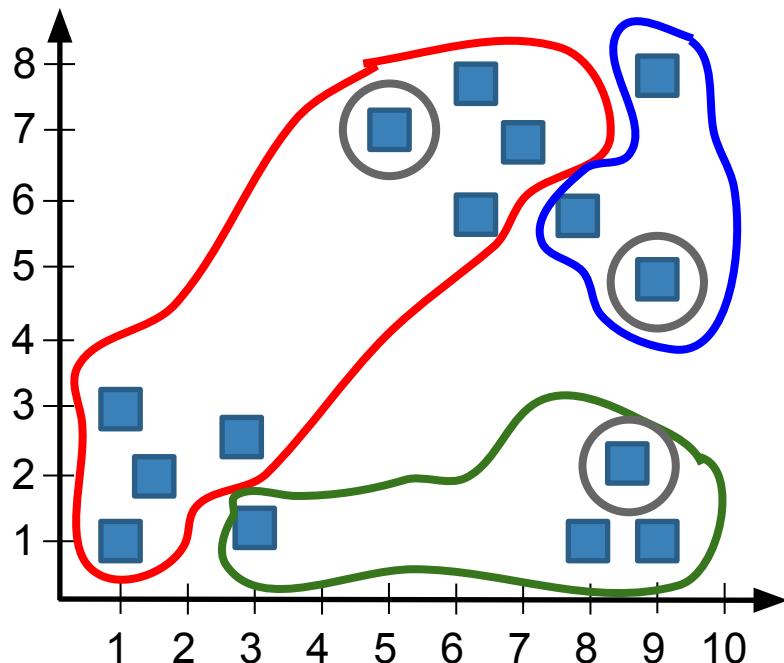


Step 2

For every sample,

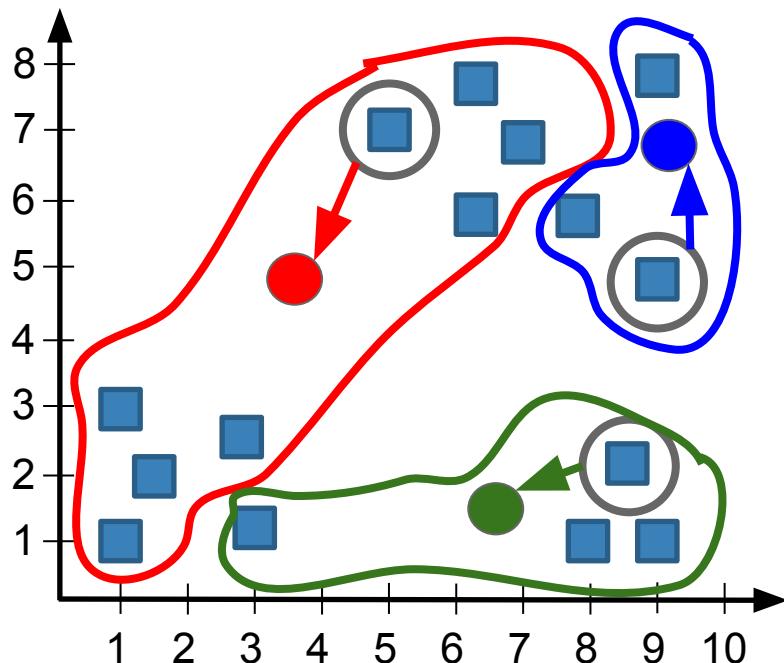
- calculate distance to centroids
- pick cluster with closest centroid

K-means



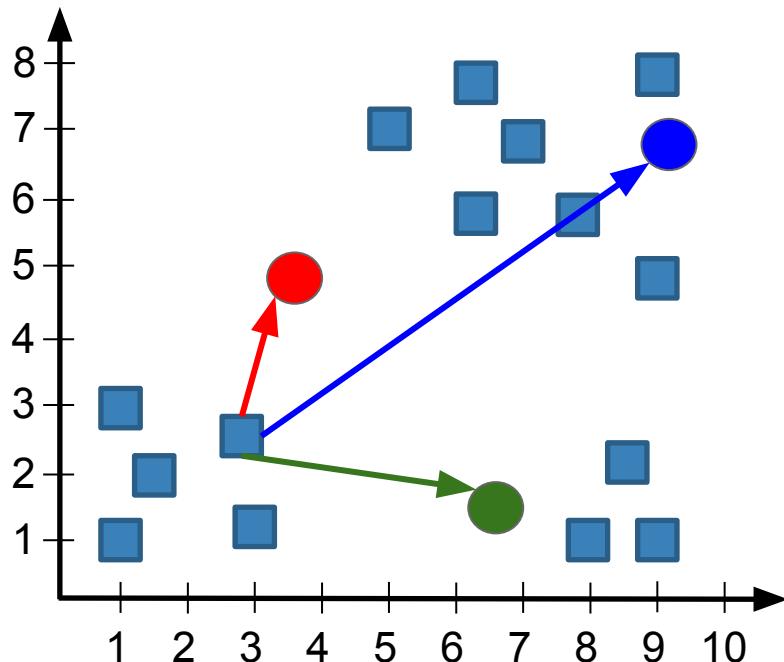
Resulting
clusters

K-means



Step 3
Recalculate
centroids from
cluster members

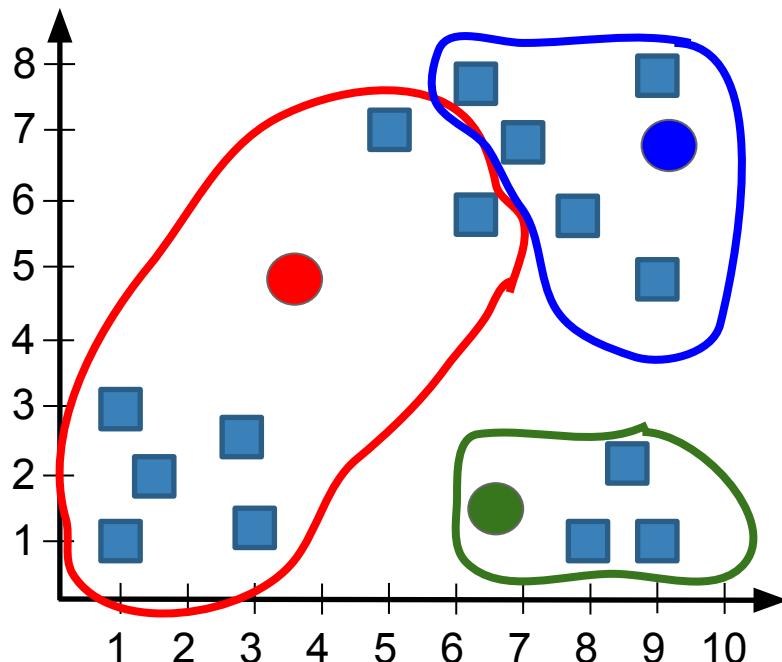
K-means



Step 4

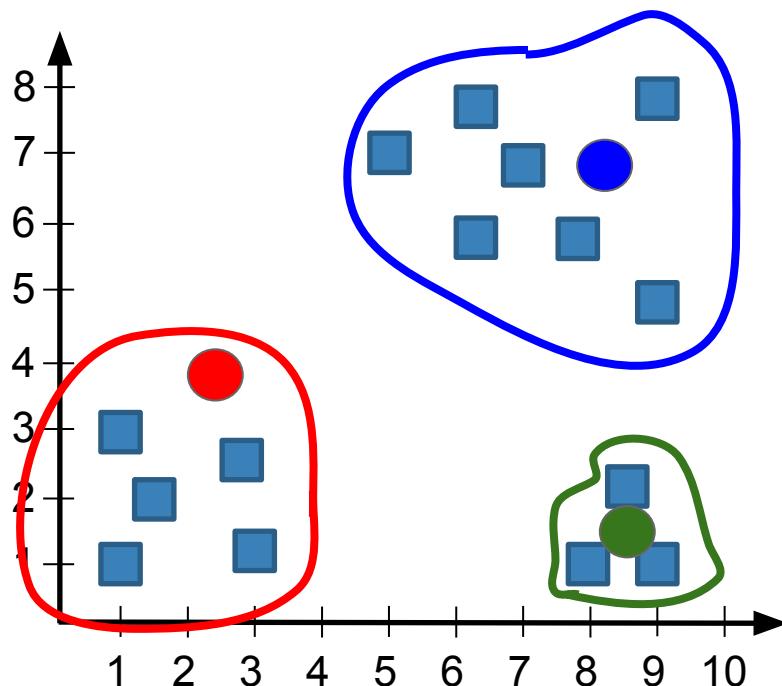
If centroids move
is bigger than
distance D, go
back to step 2 if
new centroids

K-means



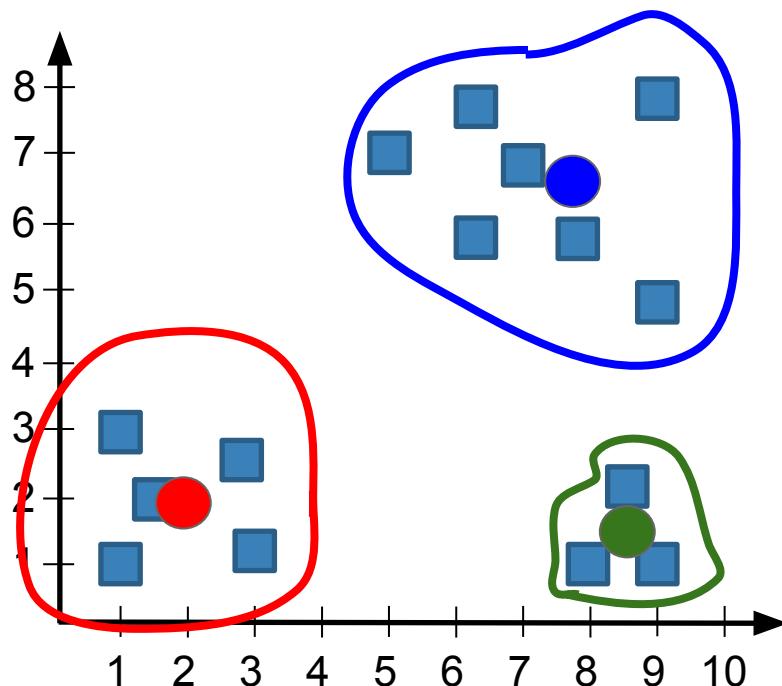
2nd iteration

K-means



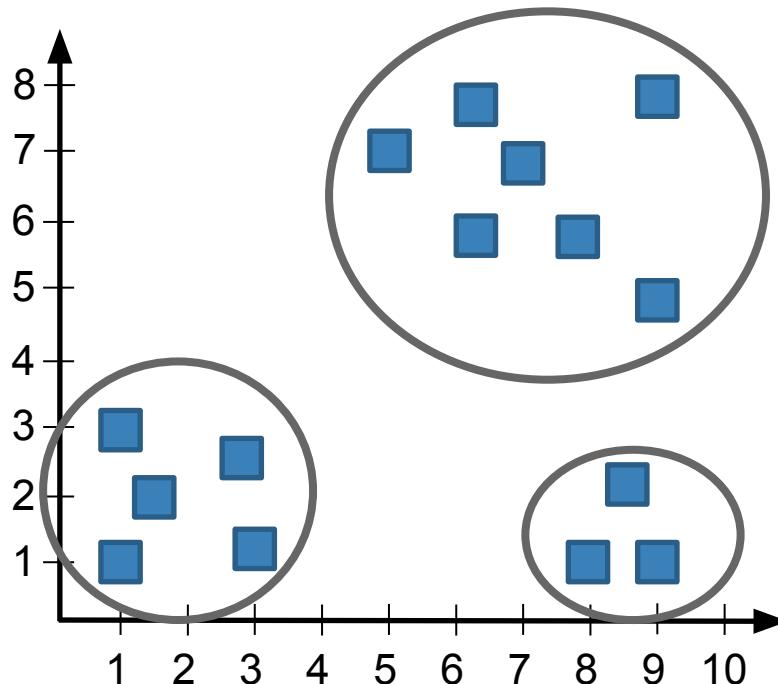
3rd iteration

K-means



4th iteration

K-means

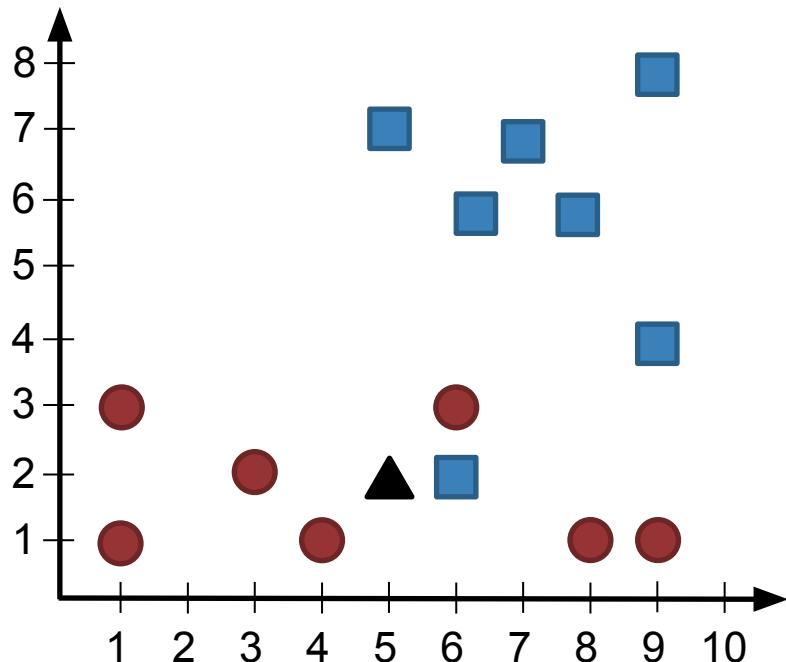


Find K clusters.
For K = 3

K-Nearest Neighbors (K-NN)

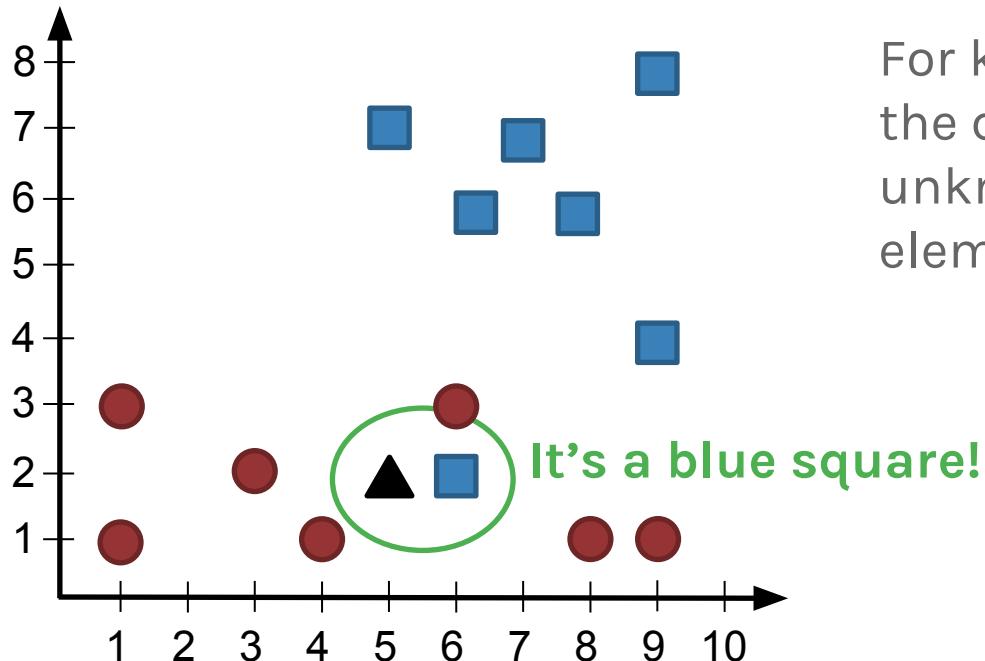
- ▶ Supervised learning;
- ▶ Classification and regression;
- ▶ **Lazy learning**;
- ▶ Uses the k closest instances to classify the unknown one;
- ▶ Easy to implement.

K-NN Example



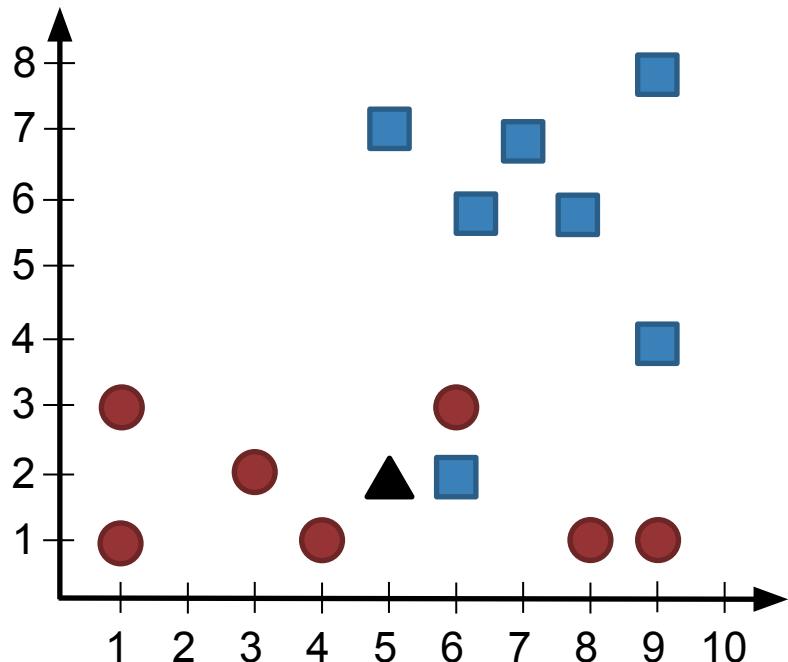
For $k=1$, what is the class of the unknown element (▲)?

K-NN Example



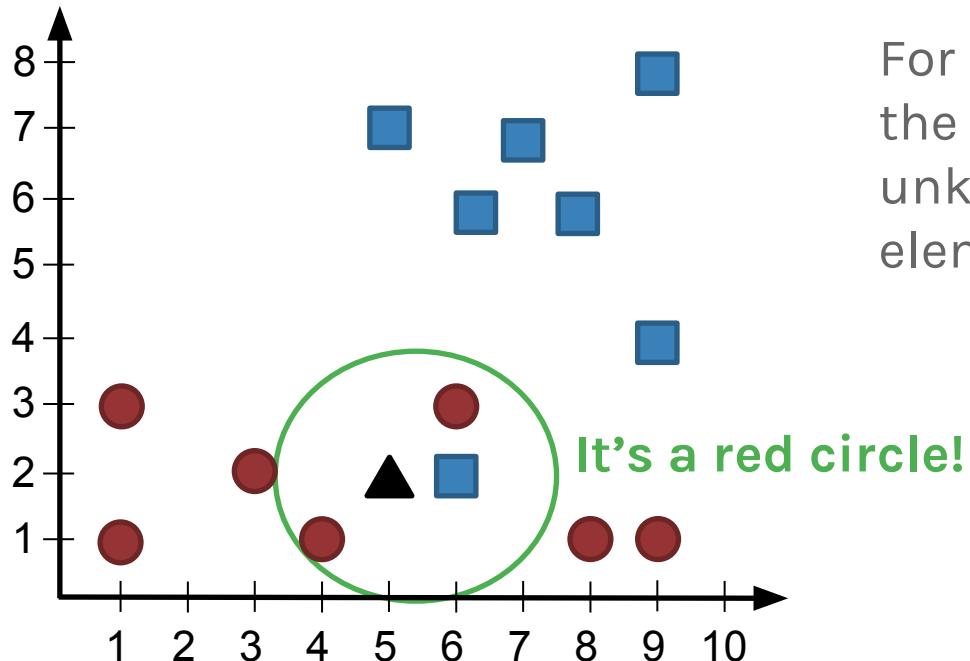
For k=1, what is
the class of the
unknown
element (\blacktriangle)?

K-NN Example



For $k=3$, what is the class of the unknown element (▲)?

K-NN Example



For $k=3$, what is the class of the unknown element (\blacktriangle)?

It's a red circle!