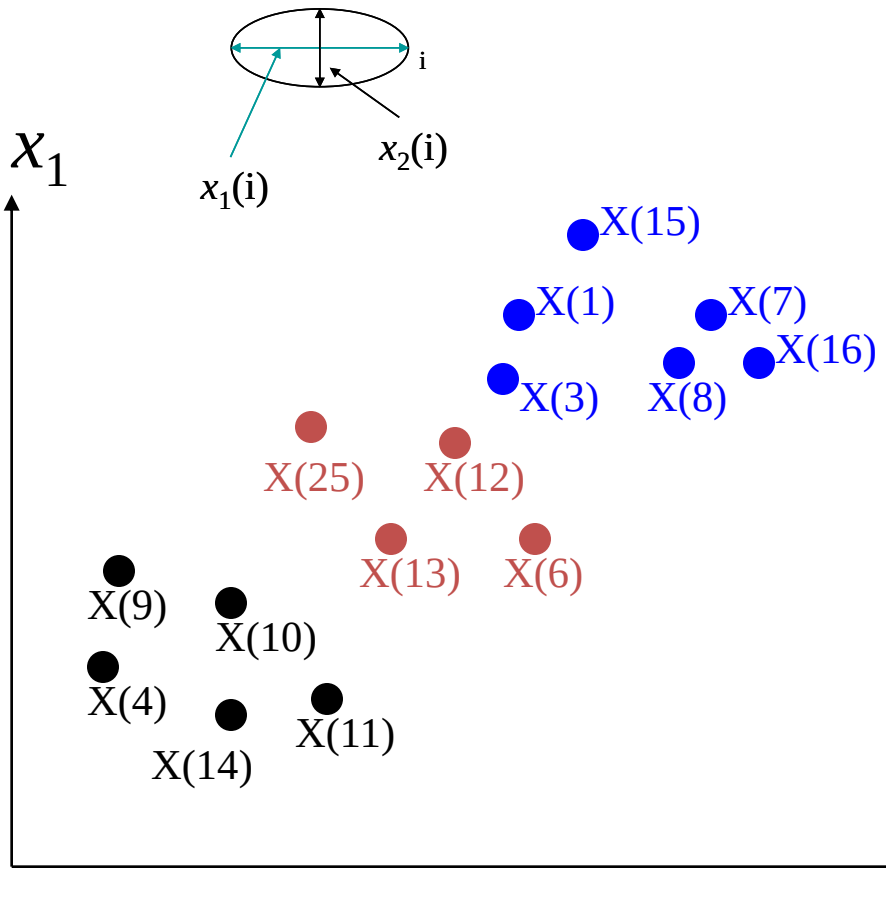
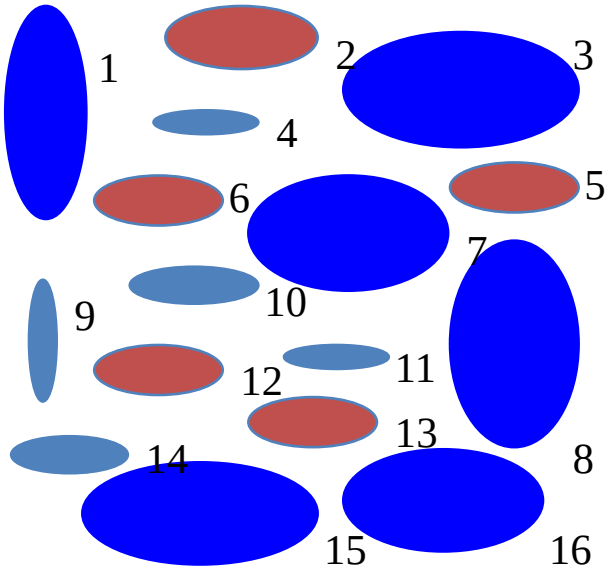
Machine Learning

Lecture 6

K-Nearest Neighbor Classifier

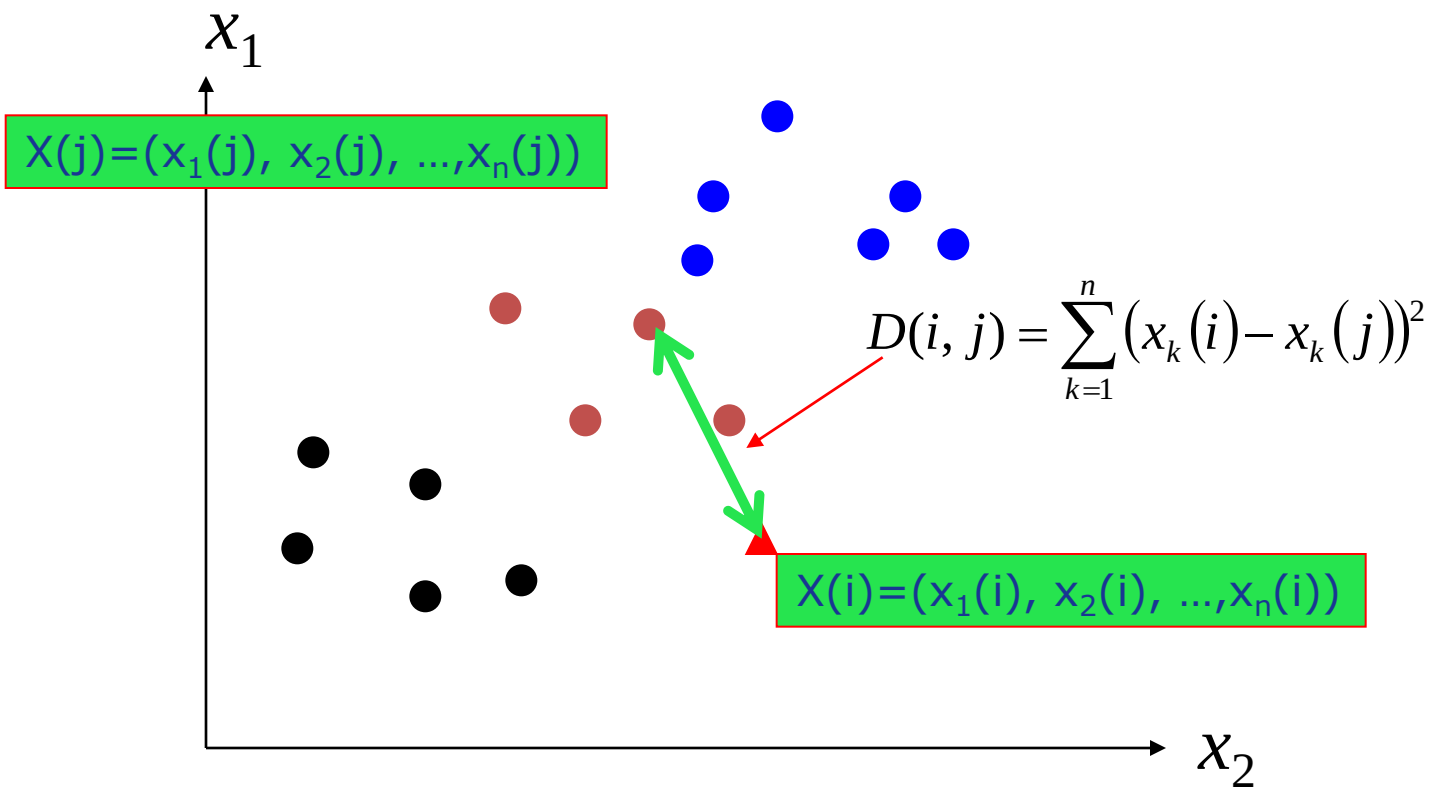
Objects, Feature Vectors, Points





Elliptical blobs (objects)

Nearest Neighbours



Nearest Neighbour Algorithm

- Given training data (X(1),D(1)), (X(2),D(2)), …, (X(N),D(N))

- Define a distance metric between points in inputs space. Common measures are:

Euclidean Distance

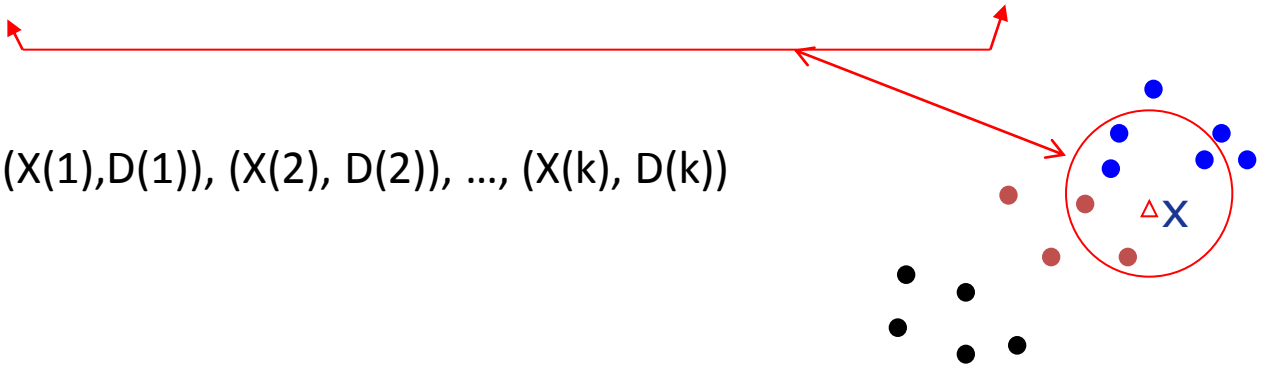
$$D(i,j)=\sum_{k=1}^{n}\left(x_k(i)-x_k(j)\right)^2$$

K-Nearest Neighbour Model

Given test point X

- Find the K nearest training inputs to X
- Denote these points as

(X(1),D(1)), (X(2), D(2)), …, (X(k), D(k))



K-Nearest Neighbour Model

Classification

- The class identification of X

Y = most common class in set {D(1), D(2), …, D(k)}

K-Nearest Neighbour Model

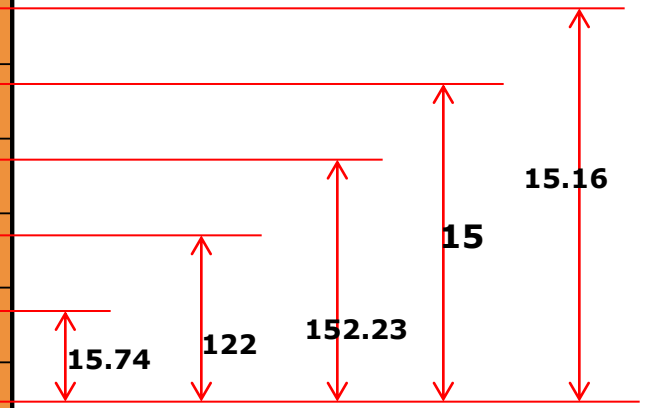
- Example : Classify whether a customer will respond to a survey question using a 3-Nearest Neighbor classifier

Customer	Age	Income	No. credit cards	Response
John	35	35K	3	No
Rachel	22	50K	2	Yes
Hannah	63	200K	1	No
Tom	59	170K	1	No
Nellie	25	40K	4	Yes
David	37	50K	2	?

K-Nearest Neighbour Model

- Example : 3-Nearest Neighbors

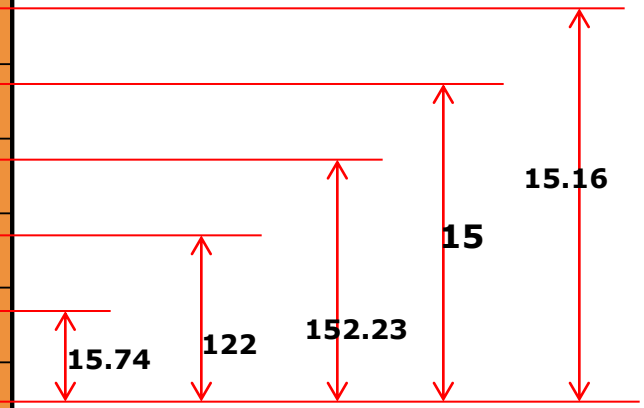
Customer	Age	Income	No. credit cards	Response
John	35	35K	3	No
Rachel	22	50K	2	Yes
Hannah	63	200K	1	No
Tom	59	170K	1	No
Nellie	25	40K	4	Yes
David	37	50K	2	?



K-Nearest Neighbour Model

- Example : 3-Nearest Neighbors

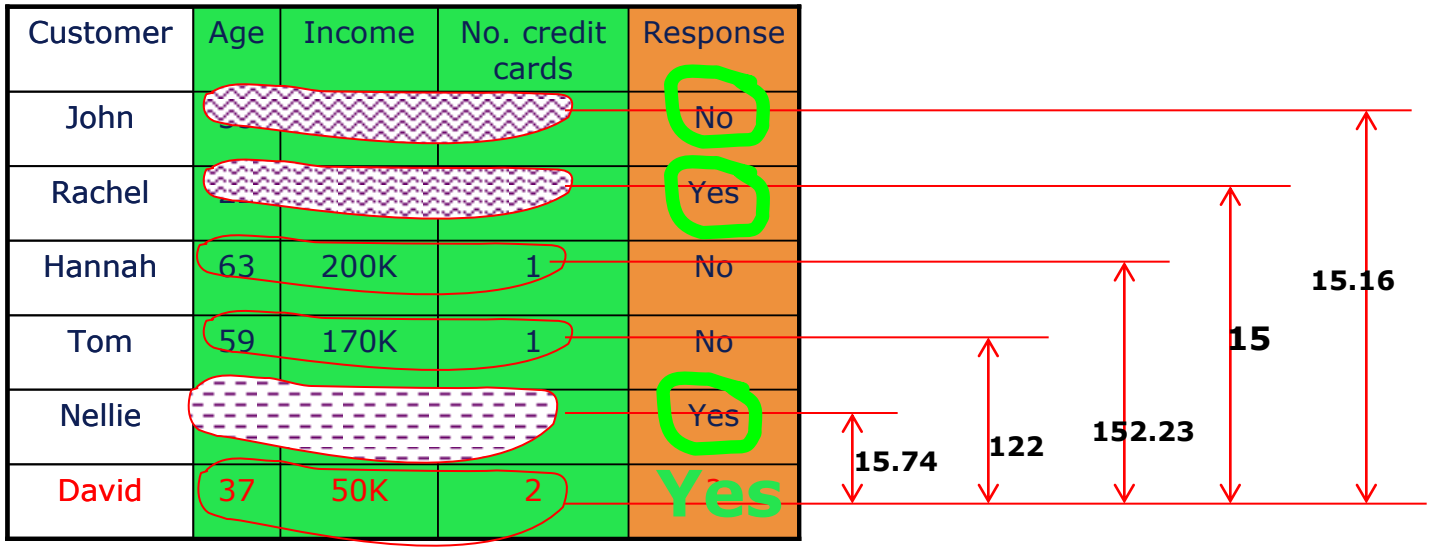
Customer	Age	Income	No. credit cards	Response
John				No
Rachel				Yes
Hannah	63	200K	1	No
Tom	59	170K	1	No
Nellie				Yes
David	37	50K	2	?



Three nearest ones to David are: No, Yes, Yes

K-Nearest Neighbour Model

- Example : 3-Nearest Neighbors



Three nearest ones to David are: No, Yes, Yes

K-Nearest Neighbour Model

- Picking K
  - Use N fold cross validation – Pick K to minimize the cross validation error
  - For each of N training example
    - Find its K nearest neighbours
    - Make a classification based on these K neighbours
    - Calculate classification error
    - Output average error over all examples
  - Use the K that gives lowest average error over the N training examples

K-Nearest Neighbour Model

- Example: For the example we saw earlier, pick the best K from the set {1, 2, 3} to build a K-NN classifier

Customer	Age	Income	No. credit cards	Response
John	35	35K	3	No
Rachel	22	50K	2	Yes
Hannah	63	200K	1	No
Tom	59	170K	1	No
Nellie	25	40K	4	Yes
David	37	50K	2	?

Further Readings

1. T. M. Mitchell, Machine Learning, McGraw-Hill International Edition, 1997

Chapter 8

Tutorial/Exercise Questions

1. K nearest neighbor classifier has to store all training data creating high requirement on storage. Can you think of ways to reduce the storage requirement without affecting the performance? (hint: search the Internet, you will find many approximation methods).