DATA SCIENCE

V. CLASSIFICATION WITH K-NEAREST NEIGHBORS

SUPERVISED VS. UNSUPERVISED LEARNING

	continuous	categorical
supervised	regression	
classification		
unsupervised	reduction dimension	clustering

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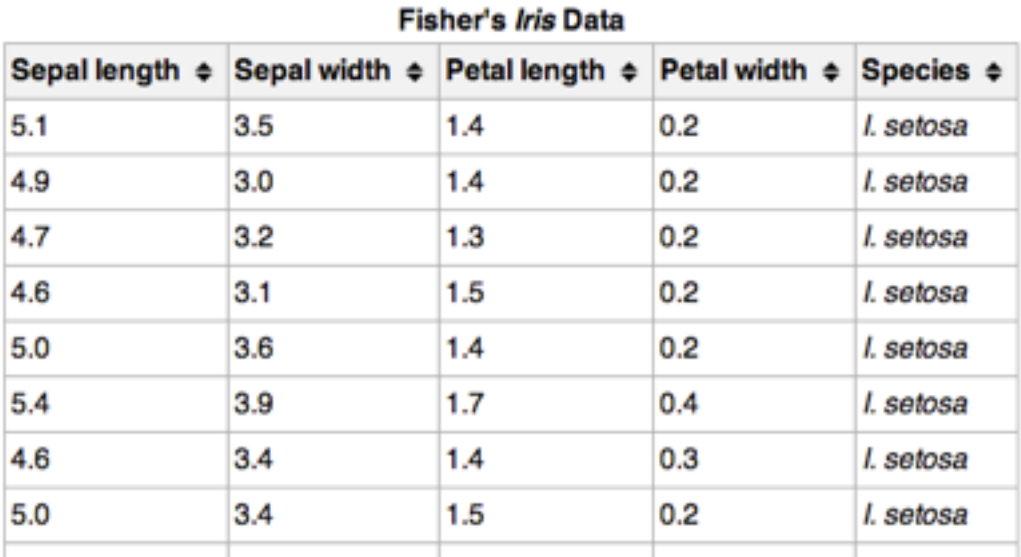


Fisher's *Iris* Data

Sepal length ⬍	Sepal width ⬍	Petal length ⬍	Petal width ⬍	Species ⬍
5.1	3.5	1.4	0.2	*I. setosa*
4.9	3.0	1.4	0.2	*I. setosa*
4.7	3.2	1.3	0.2	*I. setosa*
4.6	3.1	1.5	0.2	*I. setosa*
5.0	3.6	1.4	0.2	*I. setosa*
5.4	3.9	1.7	0.4	*I. setosa*
4.6	3.4	1.4	0.3	*I. setosa*
5.0	3.4	1.5	0.2	*I. setosa*

150 observations *(n = 150)*

response

4 predictors (p = 4)

Q: How does a classification problem work?
A: Data in, predicted labels out.

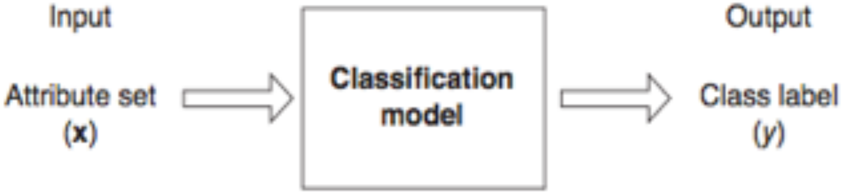


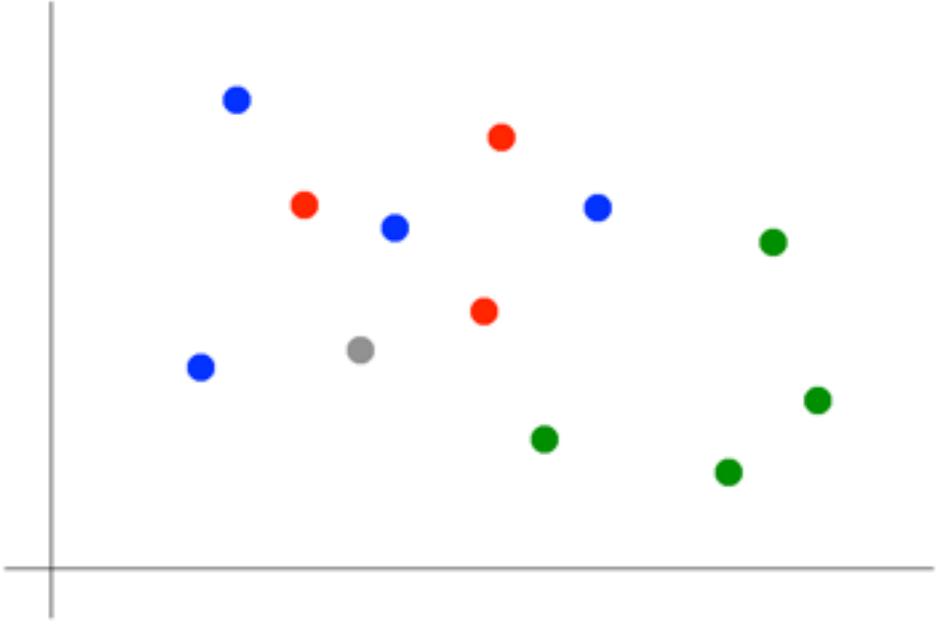
Figure 4.2. Classification as the task of mapping an input attribute set $\mathbf{x}$ into its class label y.

Source: http://www-users.cs.umn.edu/~kumar/dmbook/ch4.pdf

Suppose we want to predict the color of the gray dot.

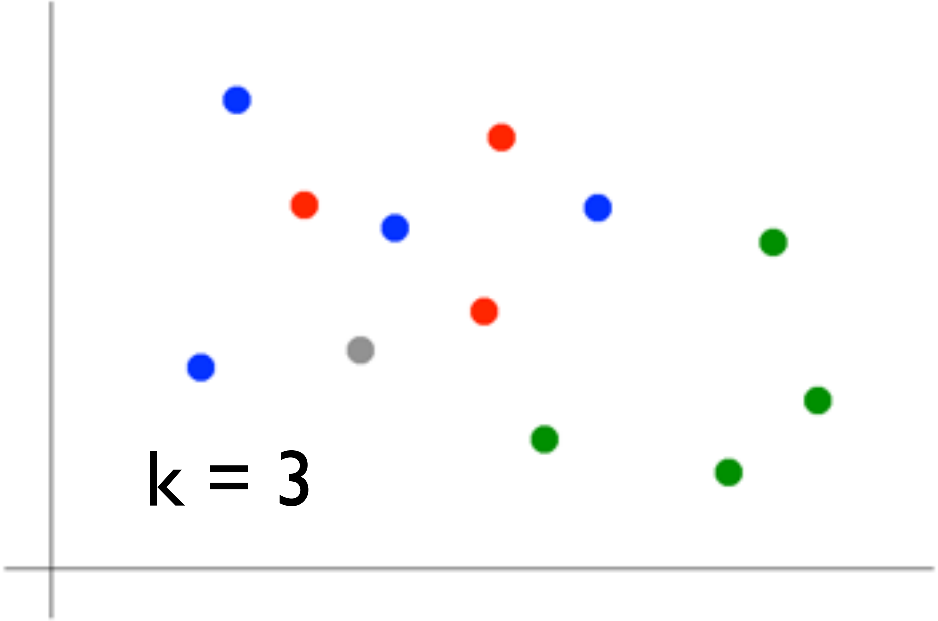
QUESTION:

What are the predictors?
What is the response?



Suppose we want to predict the color of the gray dot.

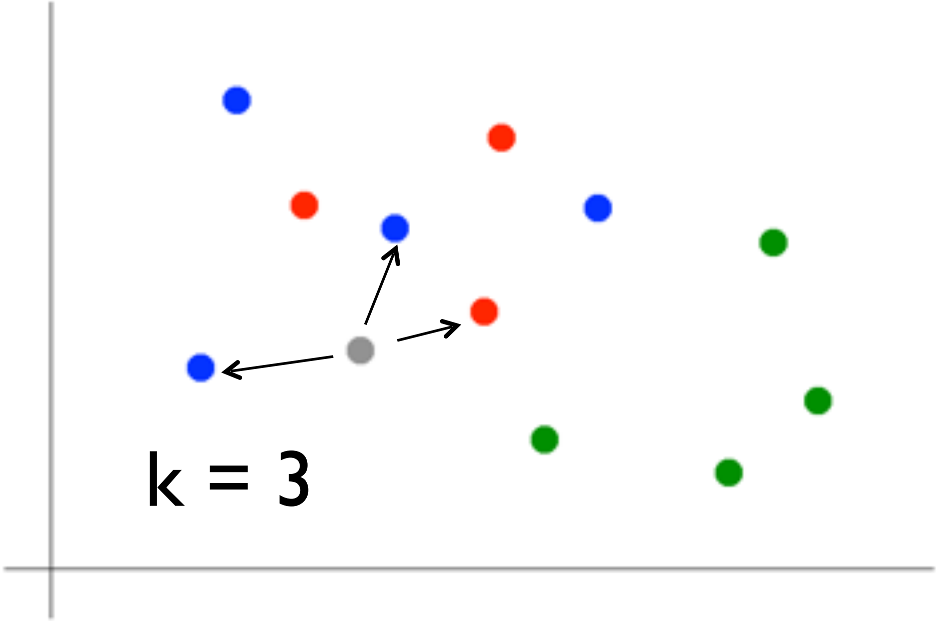
1) Pick a value for k.



Suppose we want to predict the color of the gray dot.

1) Pick a value for k.

2) Find colors of k nearest neighbors.

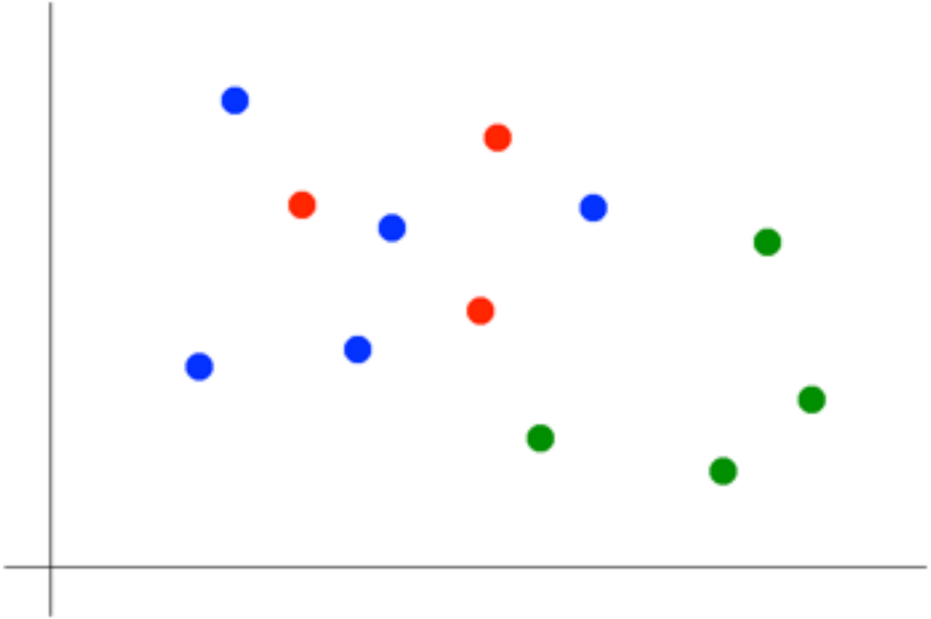


Suppose we want to predict the color of the gray dot.

1) Pick a value for k.

2) Find colors of k nearest neighbors.

3) Assign the most common color to the gray dot.



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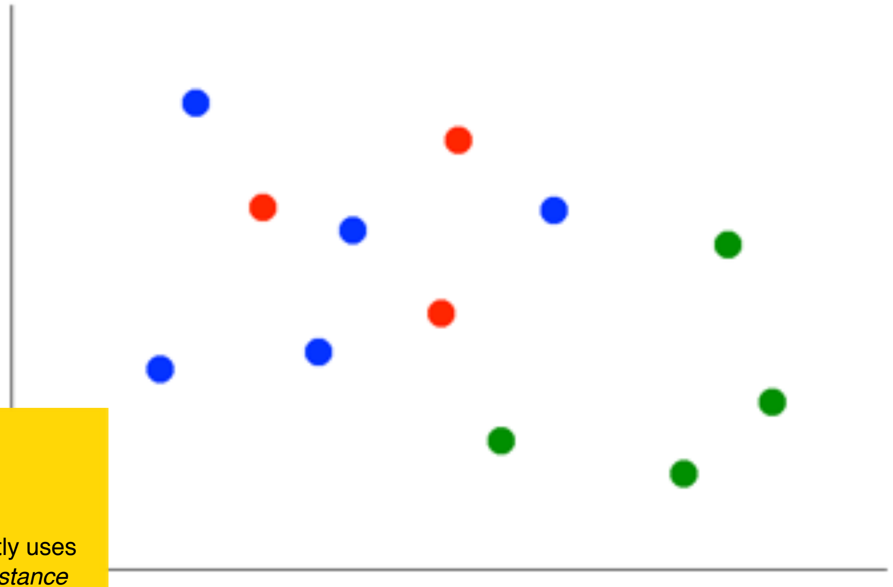

NOTE:

Our definition of "nearest" implicitly uses the *Euclidean distance function.*

Advantages of KNN:

- Simple to understand and explain
- Model training phase is fast
- Non-parametric (does not presume a “form” of the “decision boundary”)

Disadvantages of KNN:

- Prediction phase can be slow when n is large
- Sensitive to irrelevant features

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