

CHAPTER 3

Output: Knowledge Representation

Outline

- ✧ Tables
- ✧ Linear Models
- ✧ Trees
- ✧ Rules
- ✧ Instance-based Representation
- ✧ Clusters

Tables

Classification
learning

Decision or regression table

Table 1.2 Weather Data

Outlook	Temperature	Humidity	Windy	Play
Sunny	hot	high	false	no
Sunny	hot	high	true	no
Overcast	hot	high	false	yes
Rainy	mild	high	false	yes
Rainy	cool	normal	false	yes
Rainy	cool	normal	true	no
Overcast	cool	normal	true	yes
Sunny	mild	high	false	no
Sunny	cool	normal	false	yes
Rainy	mild	normal	false	yes
Sunny	mild	normal	true	yes
Overcast	mild	high	true	yes
Overcast	hot	normal	false	yes
Rainy	mild	high	true	no

Exemplar
view

Linear Models (1/2)

$$\text{PRP} = 37.06 + 2.47 * \text{CACH}$$

Numeric prediction

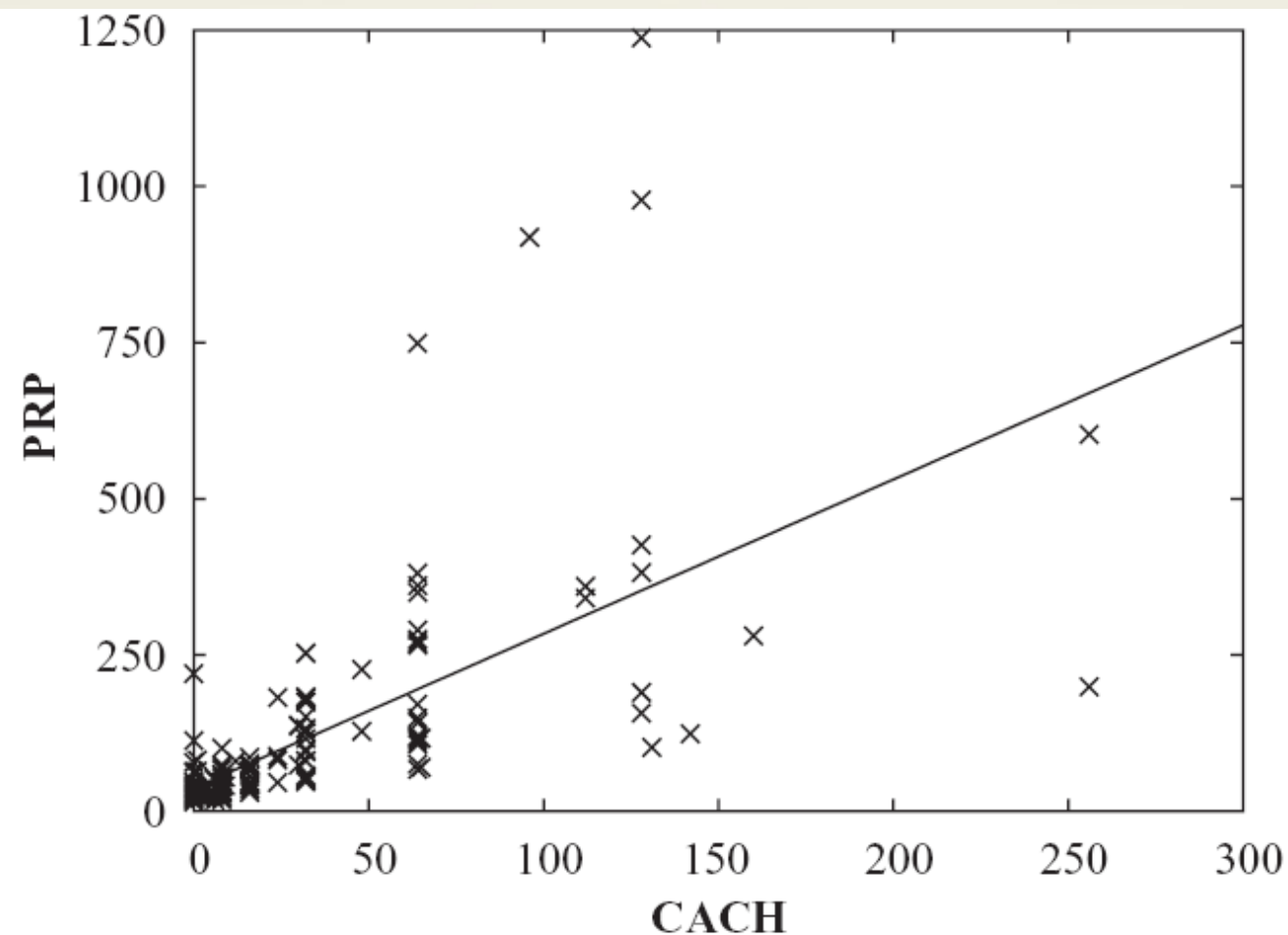


FIGURE 3.1

A linear regression function for the CPU performance data.

Linear Models (2/2)

Classification
learning

$$2.0 - 0.5 * \text{PETAL-LENGTH} - 0.8 * \text{PETAL-WIDTH}$$

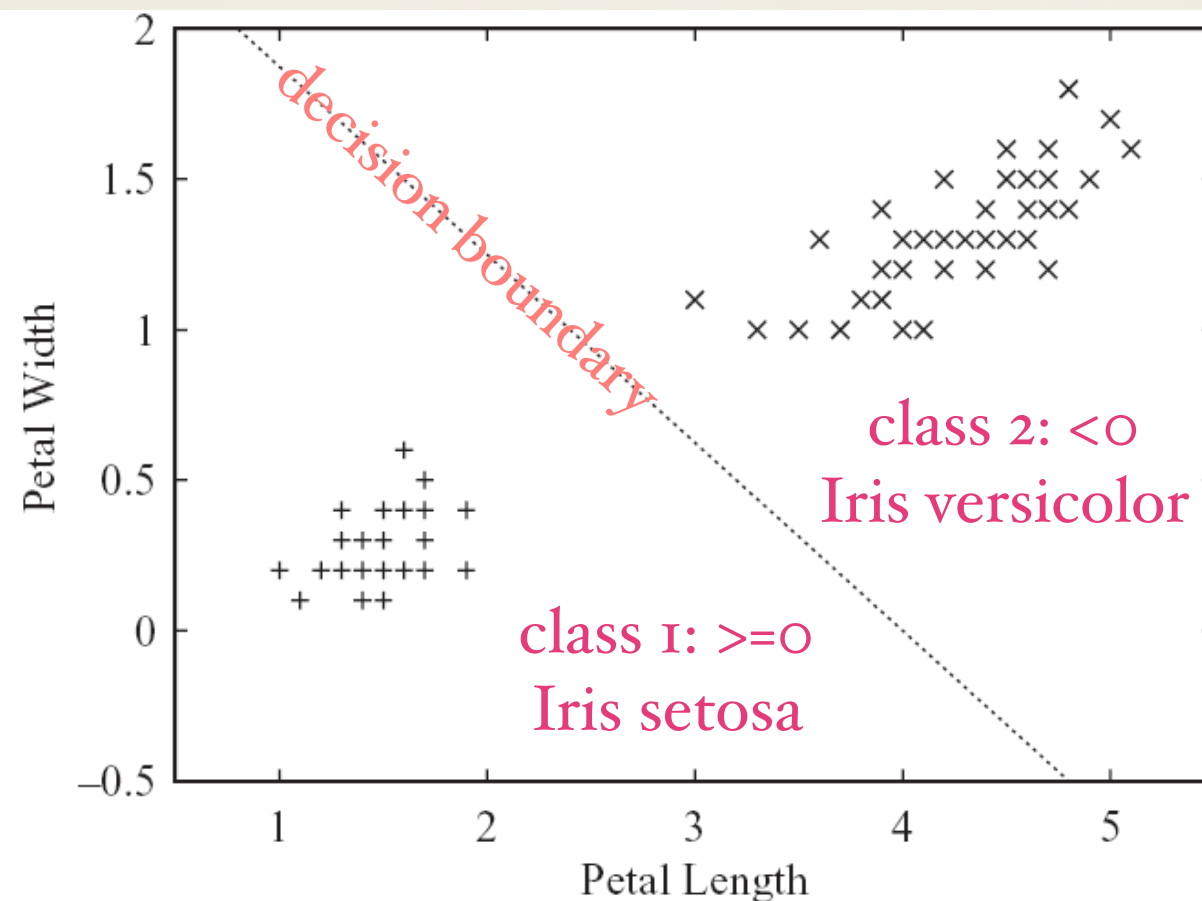


FIGURE 3.2

A linear decision boundary separating *Iris setosas* from *Iris versicolors*.

Tree (1/3)

Decision Tree

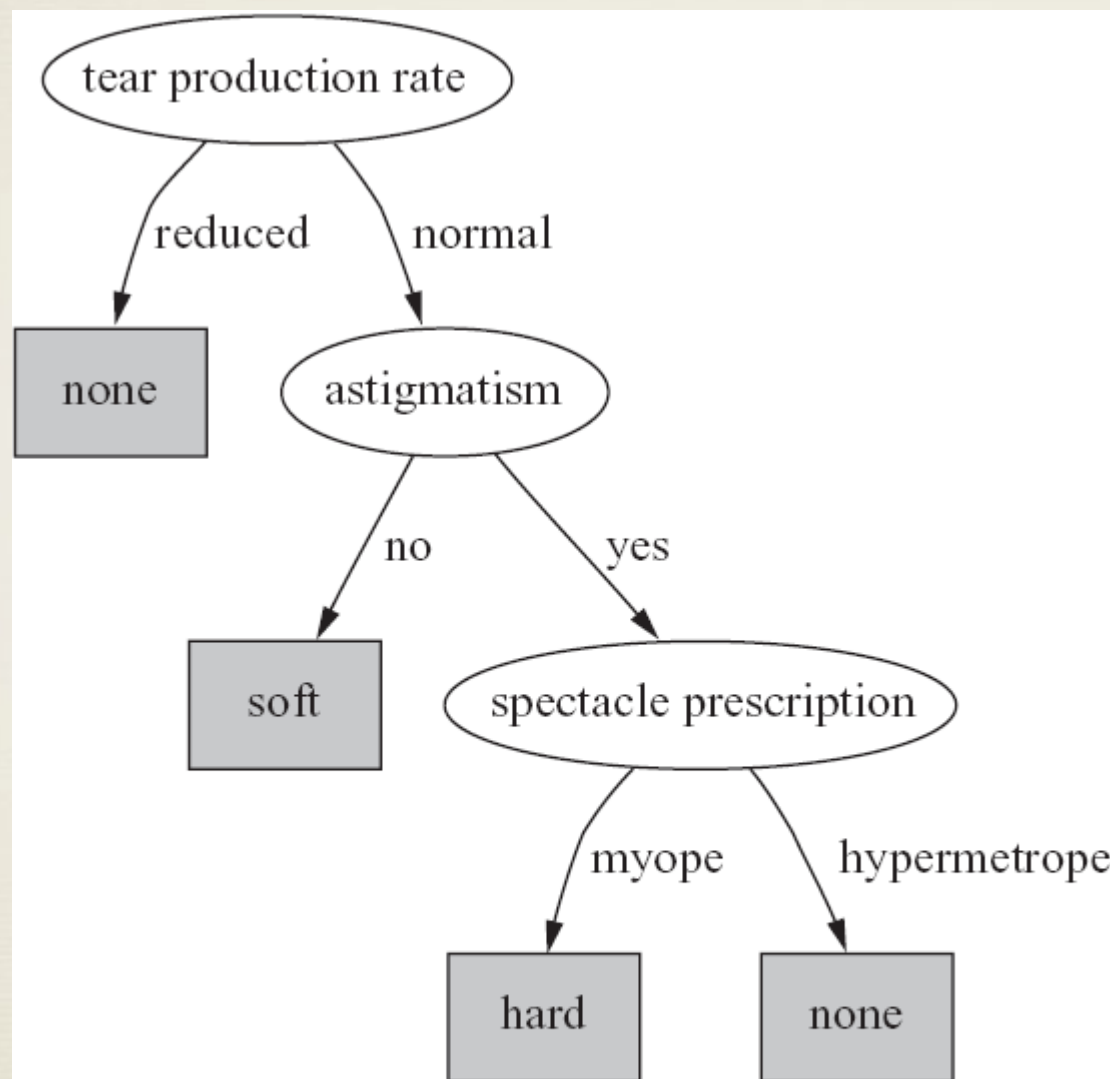


FIGURE 1.2

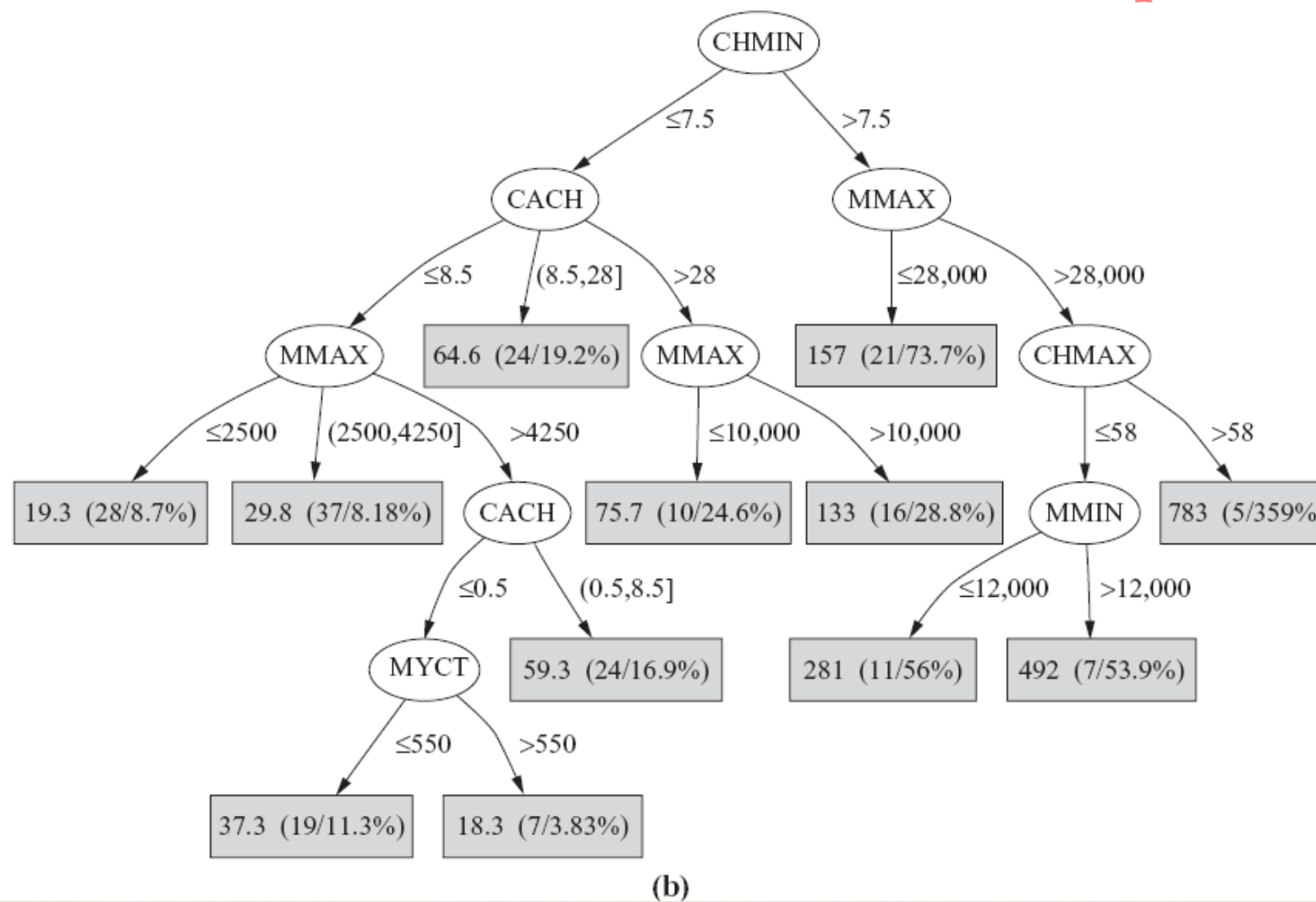
Decision tree for the contact lens data.

Classification
learning

Tree (2/3)

Regression Tree

Predict numeric quantities

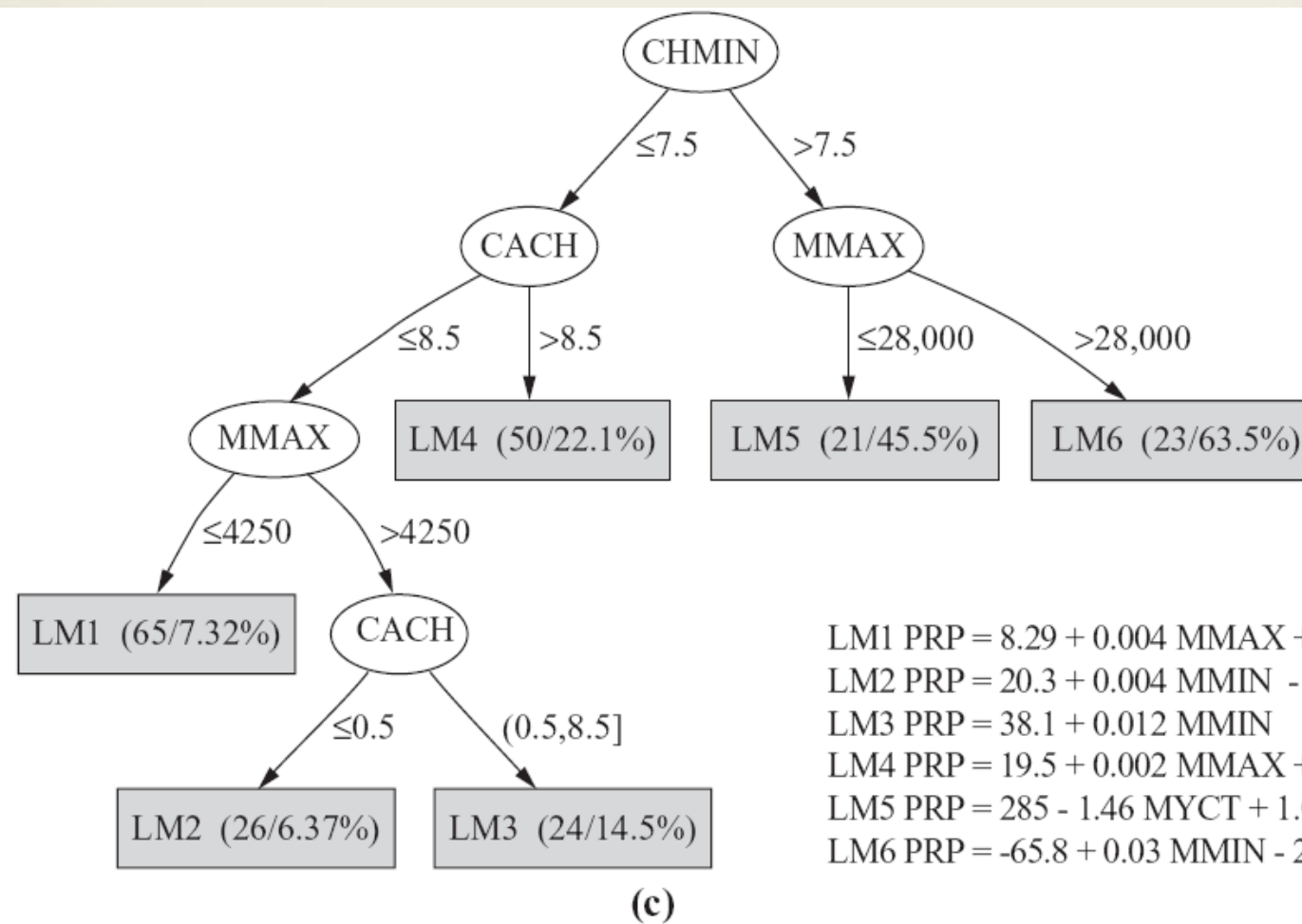


averaged
numeric values

Tree (3/3)

Model Tree

Predict numeric quantities



LM1 PRP = $8.29 + 0.004 \text{ MMAX} + 2.77 \text{ CHMIN}$
 LM2 PRP = $20.3 + 0.004 \text{ MMIN} - 3.99 \text{ CHMIN} + 0.946 \text{ CHMAX}$
 LM3 PRP = $38.1 + 0.012 \text{ MMIN}$
 LM4 PRP = $19.5 + 0.002 \text{ MMAX} + 0.698 \text{ CACH} + 0.969 \text{ CHMAX}$
 LM5 PRP = $285 - 1.46 \text{ MYCT} + 1.02 \text{ CACH} - 9.39 \text{ CHMIN}$
 LM6 PRP = $-65.8 + 0.03 \text{ MMIN} - 2.94 \text{ CHMIN} + 4.98 \text{ CHMAX}$

FIGURE 3.4

Models for the CPU performance data: (a) linear regression, (b) regression tree, and (c) model tree.

Rules

Classification Rule



If outlook=sunny and humidity=high	then play=no
If outlook=rainy and windy=true	then play=no
If outlook=overcast	then play=yes
If humidity=normal	then play=yes
If none of the above	then play=yes

decision list

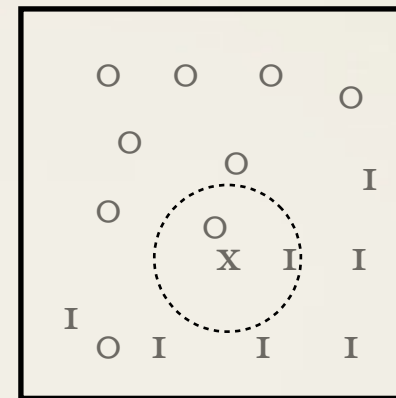
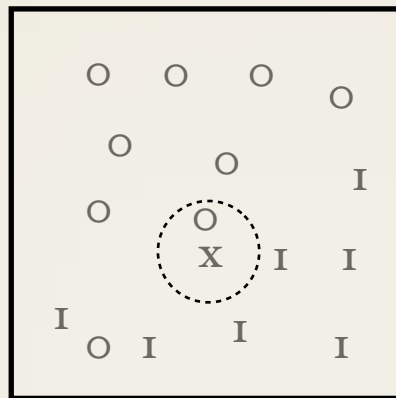
Association Rule

If temperature=cool	then humidity=normal
If humidity=normal and windy=false	then play=yes
If outlook=sunny and play=no	then humidity=high
If windy=false and play=no	then outlook=sunny and humidity=high

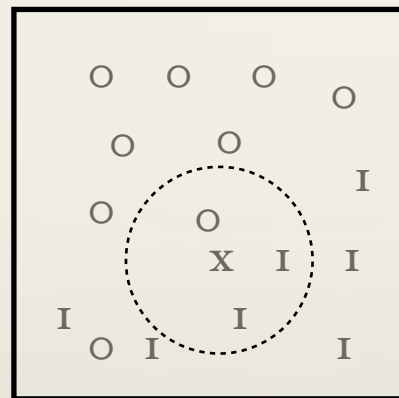
Instance-based Representation

Classification or Numeric prediction

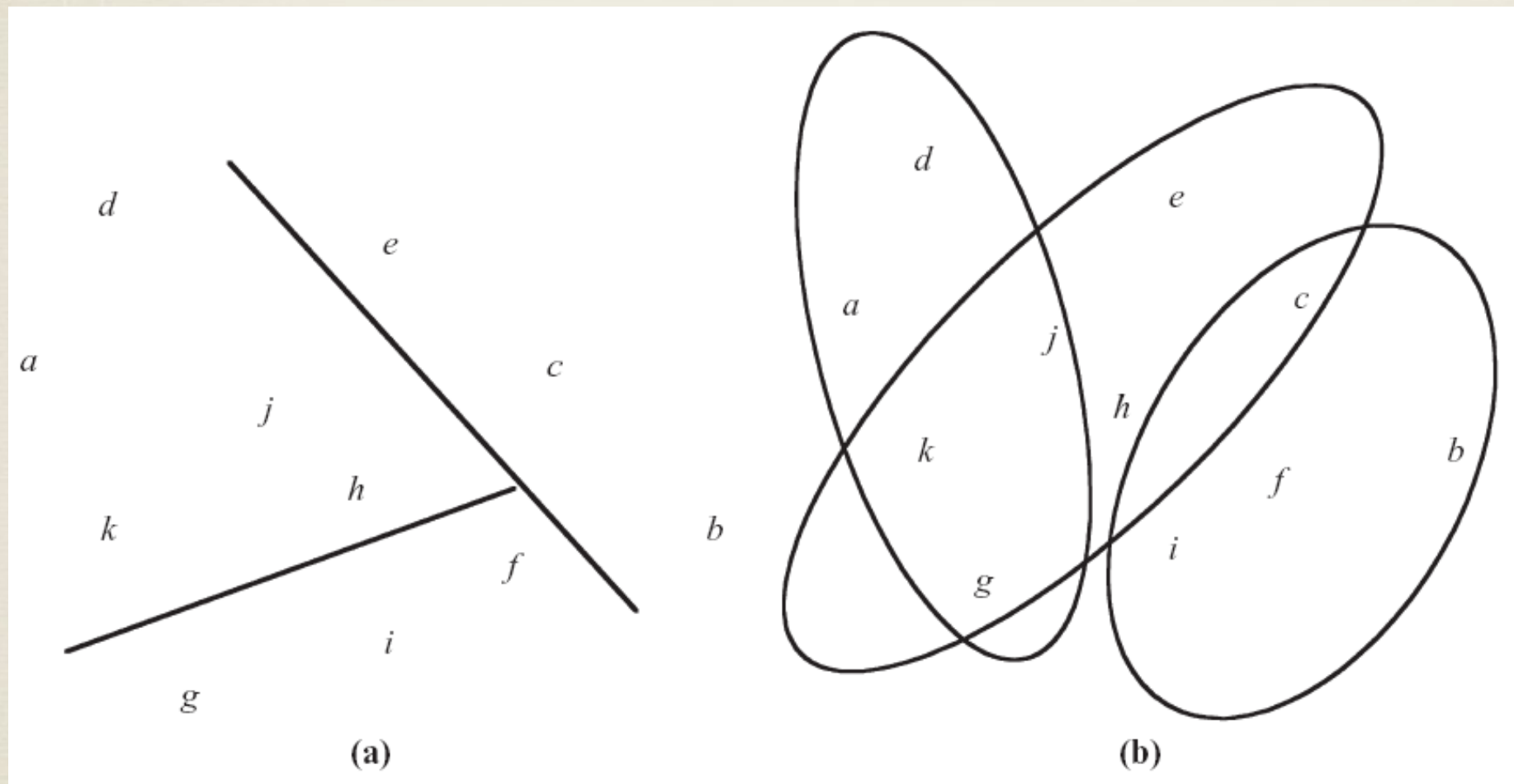
Exemplar
view



Randomly pick one or
select the closest one



Clusters (1/2)



probability

Clusters (2/2)

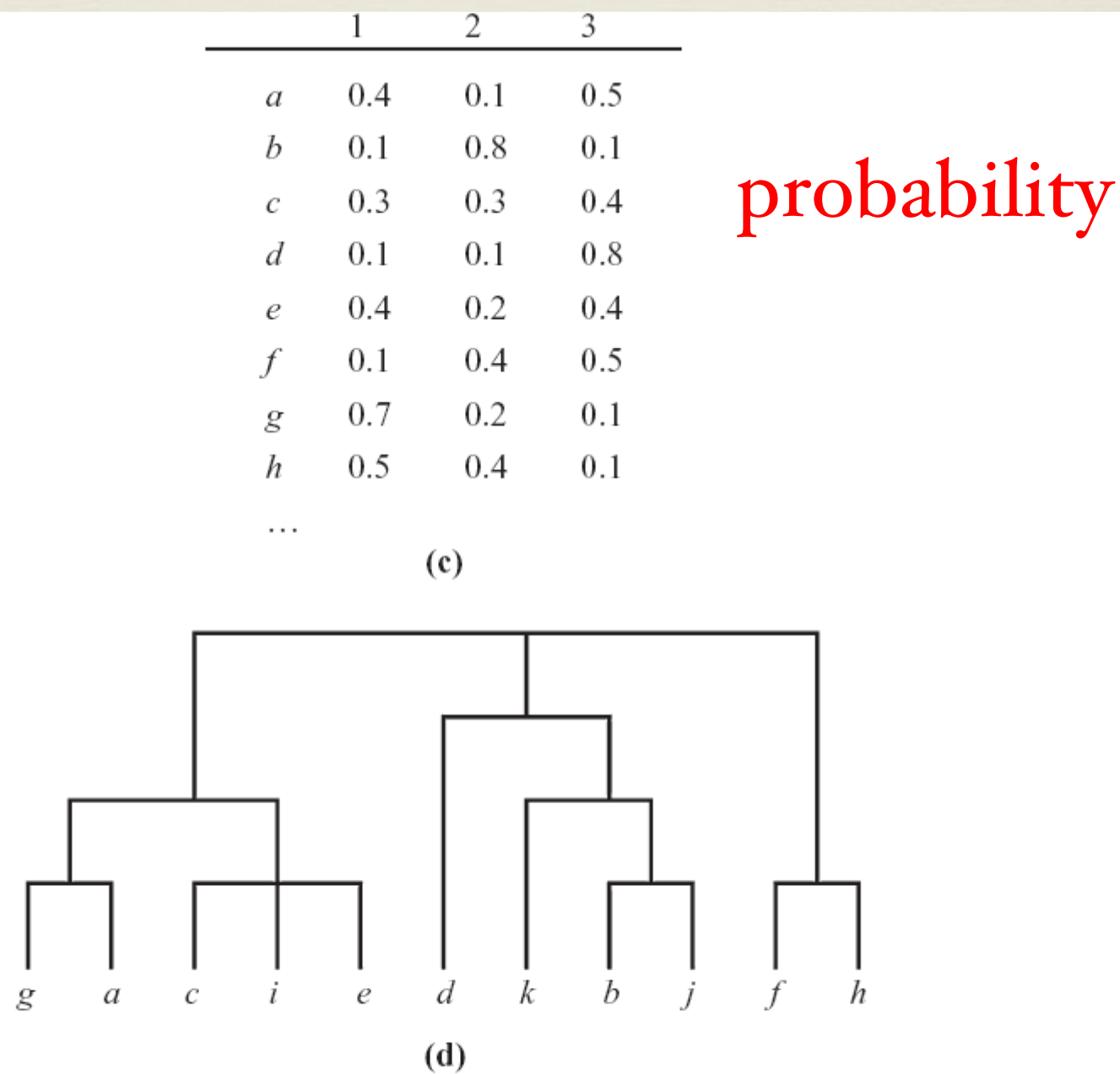


FIGURE 3.11

Different ways of representing clusters.