Procedure in Classification 1/3

1. Build a **classifier** from Training data (observed data)
2. Use **classifier** on unseen data

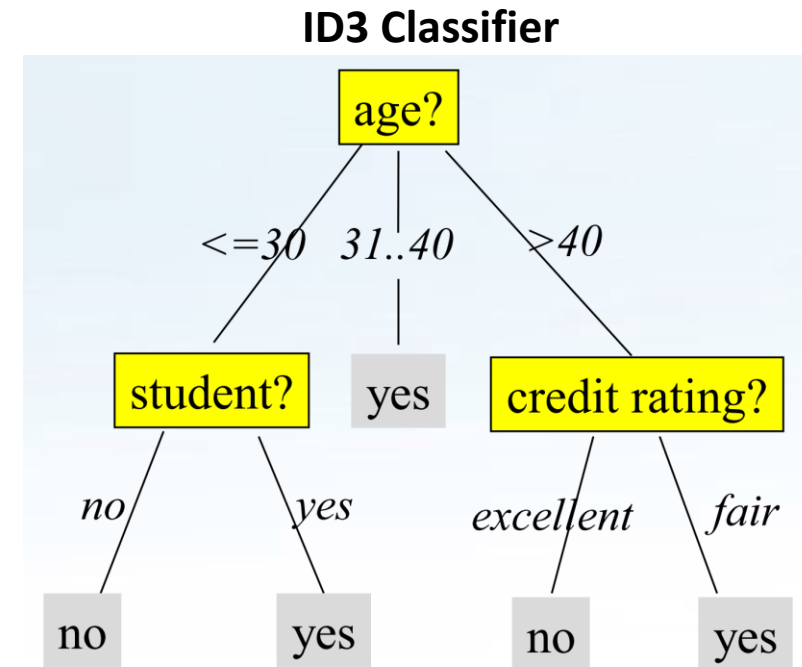Training data: examples with label

Unseen data: examples without label

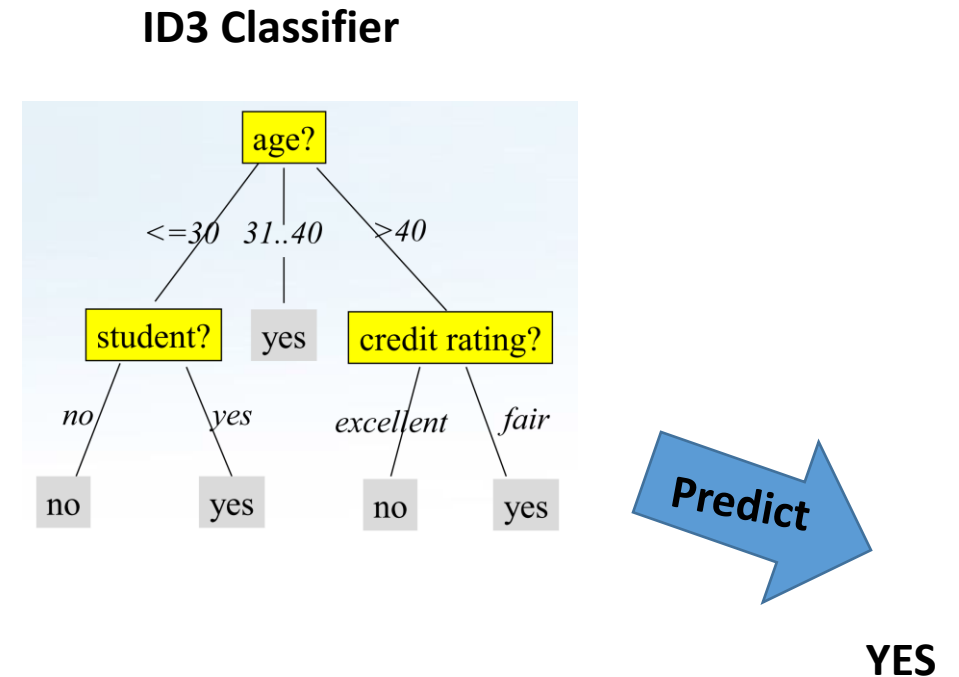Apply to any classifier

Procedure in Classification 2/3

1. Build a **classifier** from Training data (observed data)

Training data

label

<=30	high	no	fair		no
<=30	high	no	excellent		no
31…40	high	no	fair		yes
>40	medium	no	fair		yes
>40	low	yes	fair		yes
>40	low	yes	excellent		no
31…40	low	yes	excellent		yes
<=30	medium	no	fair		no
<=30	low	yes	fair		yes
>40	medium	yes	fair		yes
<=30	medium	yes	excellent		yes
31…40	medium	no	excellent		yes
31…40	high	yes	fair		yes
>40	medium	no	excellent		no

Training

ID3 Classifier

age?

<=30   31..40   >40

student?   yes   credit rating?

no / yes   excellent / fair

no   yes   no   yes

Procedure in Classification 3/3

2. Use **classifier** on unseen data

ID3 Classifier

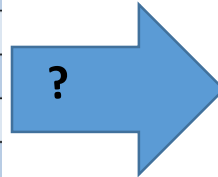? → YES

| >40 | medium | yes | fair |

Classifier models

- ID3: A decision tree

- Naïve Bayesian: Probabilities & Gaussian parameters

- KNN: Training examples and K
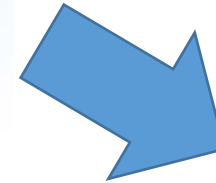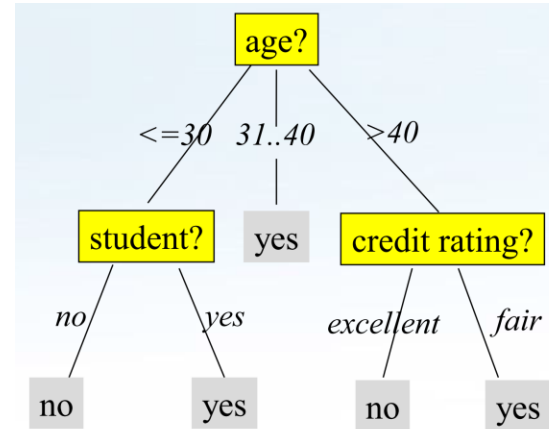
Testing a classifier 1/2

Test data   **label**

<=30	high	no	fair		no
<=30	high	no	excellent		no
31…40	high	no	fair		yes
>40	medium	no	fair		yes
>40	low	yes	fair		yes
>40	low	yes	excellent		no
31…40	low	yes	excellent		yes
<=30	medium	no	fair		no
<=30	low	yes	fair		yes
>40	medium	yes	fair		yes
<=30	medium	yes	excellent		yes
31…40	medium	no	excellent		yes
31…40	high	yes	fair		yes
>40	medium	no	excellent		no

?

ID3 Classifier

predictions

<=30	high	no	fair		**yes**
<=30	high	no	excellent		no
31…40	high	no	fair		yes
>40	medium	no	fair		ves
>40	low	yes	fair		**no**
>40	low	yes	excellent		no
31…40	low	yes	excellent		ves
<=30	medium	no	fair		**yes**
<=30	low	yes	fair		yes
>40	medium	yes	fair		yes
<=30	medium	yes	excellent		yes
31…40	medium	no	excellent		yes
31…40	high	yes	fair		yes
>40	medium	no	excellent		no

Testing a classifier 2/2

Label (actual data)	Prediction (output of classifier)
No	No
No	Yes
Yes	Yes
Yes	Yes
Yes	No
No	No
Yes	Yes
No	Yes
Yes	Yes
No	No

- 3 errors (out of 10)
- →70% examples are classified correctly
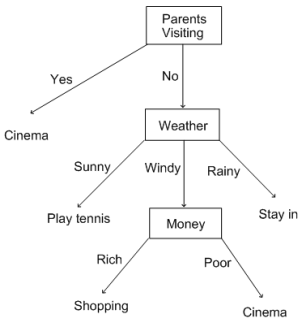
Binary classifier vs Multi-classes classifier
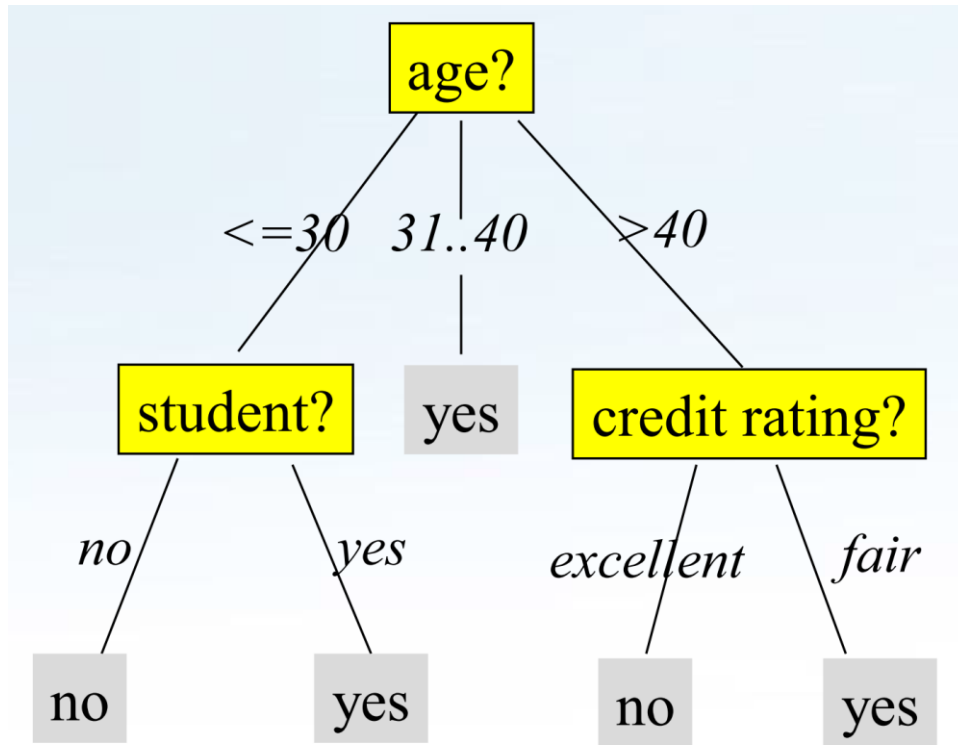
vs
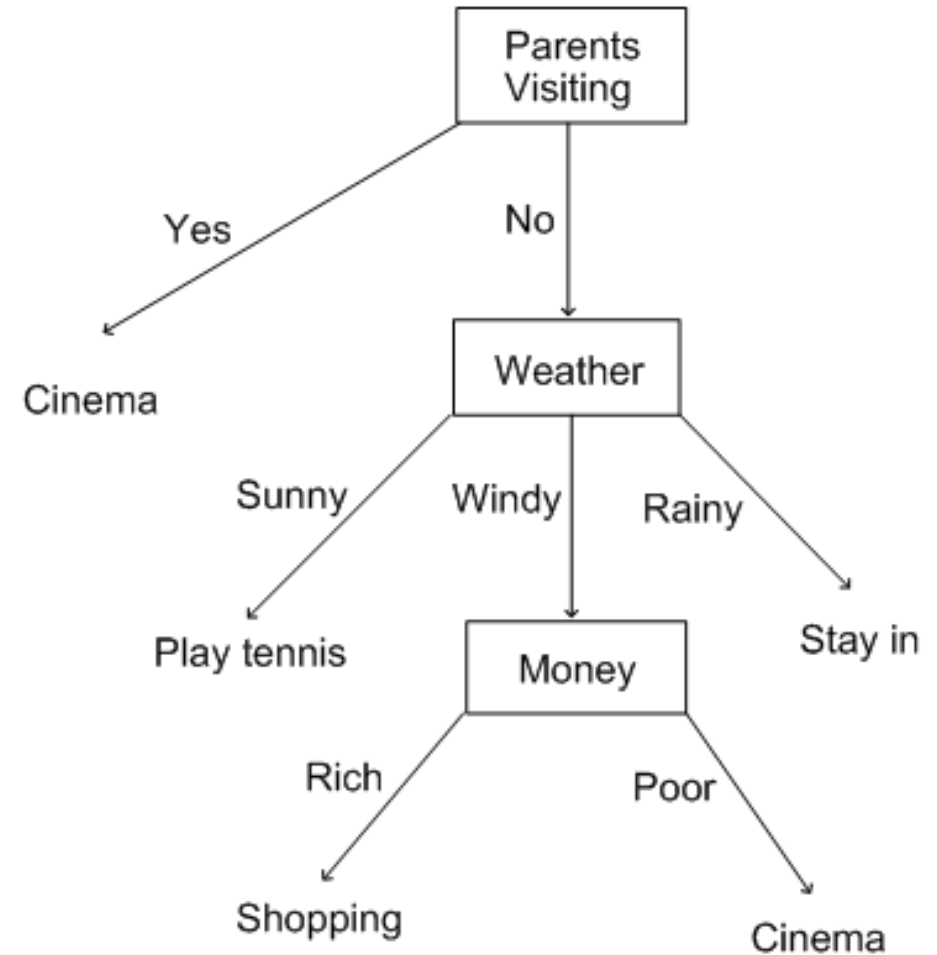
Confusion matrix
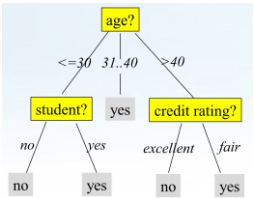
		Prediction	
Actual		Yes	No
	Yes		
	No		

		Prediction			
		Cinema	Tennis	Shopping	Stay-in
Actual	Cinema				
	Tennis				
	Shopping				
	Stay-in				

Example of measures

- **For each class:**
  - Precision, Recall, F1, …

  Precision(Cinema)= 101
  /(101+23+12+8)

  Recall(Cinema)= 101
  /(101+5+3+7)

- **In average:**
  - Precision, Recall, F1, …

  Precision= (101+98+58+198)
  /(Sum(Sum(Columns)))

		Prediction			
		Cinema	Tennis	Shopping	Stay-in
Actual	Cinema	**101**	5	3	7
	Tennis	23	**98**	12	16
	Shopping	12	11	**58**	5
	Stay-in	8	9	7	**198**

Next exercise 1/2

- Conduct in a group (3 students)
- Given a labeled (modified) dataset, evaluate some classifiers using 5-folds cross validation
  - Build 5 classifiers
  - Record the performance
    - Training time
    - Prediction time
    - Precision, Recall, F1
      - in average
      - on each Class
  - Write a report

Next exercise 2/2

- Report
  - The purposes of the report ?
    - E.g., to evaluate the performance of different classifiers
  - Summary of selected classifiers
    - E.g., KNN: A simple kernel method that classifies examples on the basis of their similarity
  - (Optional): advantages and disadvantages of classifiers (in theory)
  - The experiment
    - How?
      - E.g., data split, computer
    - Result:
      - Description, analysis, discussion
      - Table, graph
  - Conclusion