Lecture 34

Decisions

Announcements

Classifiers

Decision Boundaries

- A change in input attributes might change the prediction

- Inputs that are very close but result in different predicted labels are on either side of a ***decision boundary***

- To visualize, plot predictions of a regular set of inputs

(Demo)

Decisions

Decisions Under Uncertainty

Interpretation by Physicians of Clinical Laboratory Results (1978)

"We asked 20 house officers, 20 fourth-year medical students and 20 attending physicians, selected in 67 consecutive hallway encounters at four Harvard Medical School teaching hospitals, the following question:

"If a test to detect a disease whose prevalence is 1/1000 has a false positive rate of 5%, what is the chance that a person found to have a positive result actually has the disease, assuming that you know nothing about the person's symptoms or signs?"

Decisions Under Uncertainty

Interpretation by Physicians of Clinical Laboratory Results (1978)

"Eleven of 60 participants, or 18%, gave the correct answer. These participants included four of 20 fourth-year students, three of 20 residents in internal medicine and four of 20 attending physicians. The most common answer, given by 27, was that [the chance that a person found to have a positive result actually has the disease] was 95%.

Conditional Probability

Round One

- Scenario:
  - Class consists of second years (60%) and third years (40%)
  - 50% of the second years have declared their major
  - 80% of the third years have declared their major
  - I pick one student at random.
- Which is more likely: Second year or third year?
 - Second year, because they are 60% of the class

Round Two

- Slightly different scenario:

  ○ Class consists of second years (60%) and third years (40%)

  ○ 50% of the second years have declared their major

  ○ 80% of the third years have declared their major

  ○ I pick one student at random...
    That student has declared a major!

- Second Year or Third Year?

(Demo)

Bayes' Rule

Terminology

Bayes' Rule

0.5 Declared

Second
Year

0.5 Undeclared

0.6

0.4

0.8 Declared

Third
Year

0.2 Undeclared
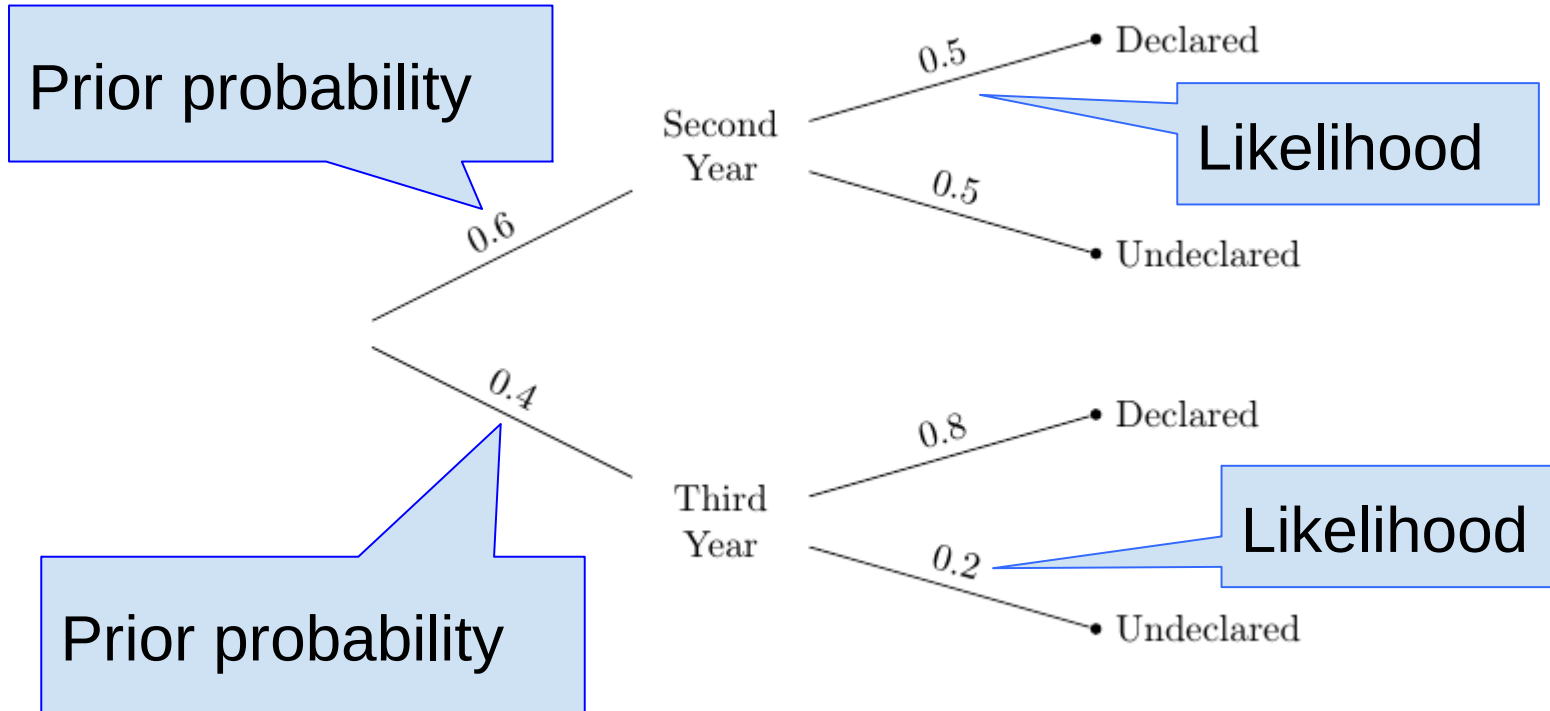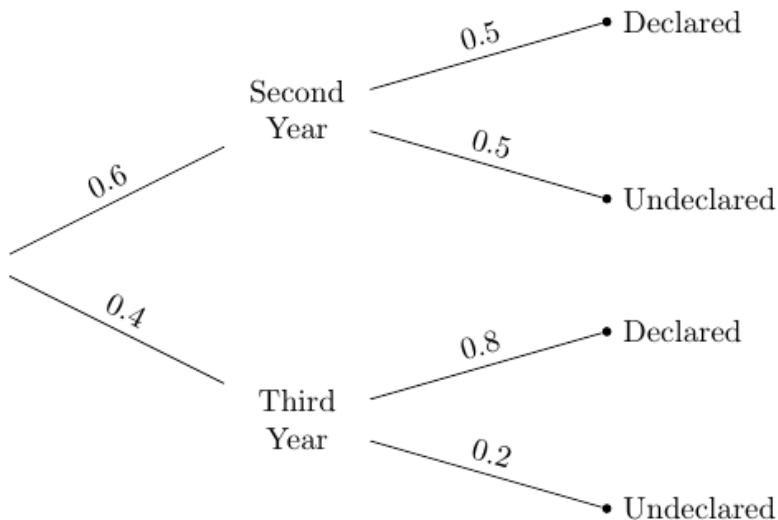
Pick a student at random.

Posterior probability:

P(Third Year | Declared)

$$= \frac{0.4 \times 0.8}{(0.6 \times 0.5) + (0.4 \times 0.8)}$$

$$= 0.5161\ldots$$

Purpose of Bayes' Rule

- Update your prediction based on new information

- In a multi-stage experiment, find the chance of an event at an earlier stage, given the result of a later stage

(Demo)

Example: Doctors & Clinical Tests

- Out of 1000 patients:

	Positive test result	Negative test result
Has disease	1	0
Doesn't have disease	49.95	949.05

- So only 1 / 50.95 of patients with positive test results have the disease.

Decisions

Subjective Probabilities

A probability of an outcome is…

- The frequency with which it will occur in repeated trials, *or*
- The subjective degree of belief that it will (or has) occurred

Why use subjective priors?

- When the subject of your prediction was not selected randomly from the population
- In order to quantify a belief that is relevant to a decision

(Demo)