Exam 2 is next Wednesday
April 12, 2017

Class time
Homework 5  Monday April 10
11:50 pm

- percepts
- actions

- logic
- reasoning under uncertainty
- probabilistic reasoning
- subjective

\[
\begin{align*}
p(9) &= \frac{1}{4} = \frac{13}{52} \\
p(90) &= \frac{1}{52}
\end{align*}
\]
Pat goes in for a routine check-up and takes a test for a rare disease. The test is 99% accurate.

- A very small amount of false positives: $P(\text{false positive}) = 0.01$
- No false negatives: $P(\text{false negatives}) = 0$

What is $P(\text{Pat has the disease})$?

(a) $\frac{1}{10,000}$
(b) 0.9%
(c) $(1 - \frac{1}{10,000})$

$1 - P(\text{disease } \land \text{false positive}) = 1 - \left( \frac{1}{10,000} \cdot 0.01 \right)$

$P(\text{disease } \land \text{false positive}) = 0.9\% = \frac{1}{1M} = 10^{-6}$
$\frac{1}{10,000} \cdot \frac{98}{100}$
Bayesian reasoning
I set the process in motion and it came defective.

What's the process in motion (O.8)?

6.17 / 0.8 = 7.7 = transmission

0.13 / 0.41 = 0.31

CA 0.8

0.7 / 0.5 = 1.4

0.5 / 0.8 = 0.625

From NY 35%

From TX 45%

20% 20%
$3 \times 2 = 6$

State: defective

Joint probability distribution table

Bayes' rule

$$P(H|E) = \frac{P(H \cap E)}{P(E)}$$

$$= \frac{P(E|H)P(H)}{P(E)}$$

$P(\text{has disease} | \text{test positive})$

$$= \frac{P(\text{test positive} | \text{has disease})P(\text{has disease})}{P(\text{test positive})}$$

$$= \frac{P(\text{test positive} | \text{has disease})P(\text{has disease})}{P(\text{test positive} | \text{has disease})P(\text{has disease}) + P(\text{test positive} | \text{no disease})P(\text{no disease})}$$
Dog bark put dog out when they go out when has fleas

Dog does not sometimes barks light on?

Dog barks sometimes hear bark

\[ P(\text{dog out} | \text{hear bark}) \]

\[ 2^5 = 32 \]

A Bayesian network is a directed graph that codes direct relationships and infers indirect relationships. It must be acyclic.

\[ P(f_{10}) = 0.15 \]

P(light on) = 0.6

P(light on | f_{10}) = 0.05

\[ P(h_{10} | f_{10}) = 0.7 \]

\[ P(h_{10} | \neg f_{10}) = 0.01 \]

\[ P(h_{10} | f_{0, hf}) = 0.99 \]

\[ P(\neg f_{10} | f_{10}, hf) = 0.99 \]

\[ P(\neg f_{10} | \neg hf, f_{10}) = 0.97 \]

\[ P(\neg f_{10} | \neg hf, \neg f_{10}) = 0.3 \]

P(dog out | f_{10}, hf) = 0.99

P(dog out | \neg f_{10}, hf) = 0.99

P(dog out | \neg hf, f_{10}) = 0.97

P(dog out | \neg hf, \neg f_{10}) = 0.3

Conditional probability distribution tables...
5 variables

BBN: $1 + 1 + 4 + 2 + 2 = 10$ numbers

Full joint probability distribution table would need $2^5 = 32$ numbers

7 variables: $2^7 = 128$ numbers

BBN: $10 + 1 + 2 + 4 = 17$

Rain

Wet

$2^3 = 8$