COMP3620/COMP6320 - Tutorial 1
Answers

1

There are many ways to answer this question, here are some examples:

Arts student: 1, because the sun has always risen before, so why should tomorrow be any different.
Maths student: Use Laplace's rule. $\frac{d+1}{n+2}$ where d is the number of times the sun rose in previous observations and n is the total number of observations (in this case $n = d$). If student is 20 years old then about 0.99986.
Statistics student: $1 - \epsilon$, where ϵ is the small probability that a star (chosen at random) explodes on any given day.
Physics student: Derive the probability from the type, age, size and temperature of the sun. Probability is too hard to compute.
Philosophy student: What if I die today then there will be no tomorrow for me, how will I then know that the sun rose tomorrow? What if the sun does not exist and is simply a figment of our imagination?

2

a) The next number could be 3, it could be 4 (powers of two), could be 1 again. Not enough numbers to be sure.
b) The obvious answer is that these are natural numbers and so the next number is 5. It could also be 29 if we try to fit a degree 4 polynomial: $A(n) = n^4 - 10n^3 + 35n^2 - 49n + 24, n \geq 1$. It could also be 1 if the formula is $A(n) = n\%4 + 1, n \geq 0$.
c) The obvious answer is that these are primes and so the next number is 61. It could also be 60 since this is the order of the next simple group.
d) These are digits of π, so the next number is 5.

Check out the online encyclopedia of integer sequences for more continuations. http://www.research.att.com/~njas/sequences/

3

Proof of Bayes' rule

If $A \cap B = \emptyset$ then $p(A \cup B) = p(A) + p(B)$ from (v) and (vi). For finite I, by induction we have $\sum_{i \in I} p(H_i) = p(\cup_i H_i) = p(\Omega) = 1$ from (iv). Let $p'(\cdot|D) = p(\cdot)$ then we get $\sum_{i \in I} p'(H_i|D) = \sum_{i \in I} p(H_i) = 1$ (1).

Conditional probability: $p(H_i|D)p(D) = p(D \cap H_i) = p(D|H_i)p(H_i)$ (2).
Using (1) and (2) gives $p(D) = 1 \times p(D) = \sum_{i \in I}(p(H_i|D))p(D) = \sum_{i \in I}(p(H_i|D)p(D)) = \sum_{i \in I}(p(H_i|D)p(D))$ (3).
Finally rearranging (2) and using (3) gives $p(H_i|D) = \frac{p(D|H_i)p(H_i)}{p(D)} = \frac{p(D|H_i)p(H_i)}{\sum_{i \in I} p(H_i|D)p(D)}$.

Answer to problem:

$p(D = \text{true}) = 0.01$ this means that $p(D = \text{false}) = 0.99$
$p(T = +\text{ve}|D = \text{true}) = 0.95$ this means that $p(T = \text{-ve}|D = \text{true}) = 0.05$
$p(T = \text{-ve}|D = \text{false}) = 0.95$ this means that $p(T = +\text{ve}|D = \text{false}) = 0.05$

We use Bayes' rule to find the probability of having the disease after testing positive:
$p(D = \text{true}|T = +\text{ve}) = \frac{p(T=+\text{ve}|D=\text{true})p(D=\text{true})}{p(T=+\text{ve}|D=\text{true})p(D=\text{true})+p(T=+\text{ve}|D=\text{false})p(D=\text{false})}$
$p(D = \text{true}|T = +\text{ve}) = \frac{0.95 \times 0.01}{0.95 \times 0.01 + 0.05 \times 0.99} = \frac{0.0095}{0.059} = 16\%$ only!

4

Function 1 advance-vacuum-cleaner(currLoc, prevLoc, status)

```
if status = Dirty then
  return Suck
else if currLoc = A then
  return Right
else if currLoc = B then
  if prevLoc = A then
    return Right
  else if prevLoc = C then
    return Down
  end if
else if currLoc = C then
  return Left
else if currLoc = D then
  return Up
else if currLoc = E then
  return Left
else
  return NoOp
end if
```