CS 188 Spring 2014 | Introduction to Artificial Intelligence | Section Handout 9 Value Of Information

Used Car Purchase

[Adapted from problem 16.11 in Russell & Norvig]

A used car buyer can decide to carry out various tests with various costs (e.g., kick the tires, take the car to a qualified mechanic) and then, depending on the outcome of the tests, decide which car to buy. We will assume that the buyer is deciding whether to buy the car and that there is time to carry out at most one test which costs \$50 and which can help to figure out the quality of the car. A car can be in good shape (of good quality $Q = q^+$) or in bad shape (of bad quality Q=q^-), and the test might help to indicate what shape the car is in. There are only two outcomes for the test T: pass (T=pass) or fail (T=fail). The car costs \$1,500, and its market value is \$2,000 if it is in good shape; if not, \$700 in repairs will be needed to make it in good shape. The buyers estimate is that the car has 70% chance of being in good shape.

1. Draw the decision network that represents this problem.

2. Calculate the expected net gain from buying the car, given no test.

3. Tests can be described by the probability that the car will pass or fail the test given that the car is in good or bad shape. We have the following information:

$$P(T = \text{pass}|Q = q^+) = 0.9$$
$$P(T = \text{pass}|Q = q^-) = 0.2$$

Calculate the probability that the car will pass (or fail) its test, and then the probability that it is in good (or bad) shape given each possible test outcome.

4. Calculate the optimal decisions given either a pass or a fail, and their expected utilities.

5. Calculate the value of (perfect) information of the test. Should the buyer pay for a test?

6. The value of the information in this problem depends greatly on the prior probability $P(Q = q^+)$. What do you think happens to the VPI as you vary $P(Q = q^+)$? What happens when $P(Q = q^+)$ approaches 1? Approaches 0? Approaches 0.5?

7. If you still have time, try calculating some VPI's for different values of $P(Q = q^+)$ from the previous part. (Using Python or Excel is a good idea here!) Where is/are the break-even point(s)? Where is the maximum?