National University of Singapore
School of Computing

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CS4246/CS5446 AI Planning and Decision Making

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Tutorial Week 5: Decision Analysis

Guidelines

You may discuss the content of the questions with your classmates. But to everyone should work on and be ready to present ALL the solutions.

In this tutorial, we examine the notion of "value of information" in decision analysi. While the numbers may be worked out manually, you are encouraged to use one of the computer programs for decision modeling, e.g., the academic versions of Bayesfusion GeNIE modeler of SMILE engine (https://download.bayesfusion.com/files.html?category=Academia), Netica (www.norsys.com), etc., to manipulate the influence diagrams, and/or those for decision analysis, e.g., Syncopation DPL 9 (https://www.syncopation.com), TreeAge (www.treeage.com), etc., to manipulate the influence diagrams and the decision trees.

Mr. Bean's Decision...

Richie Bean is trying to strike it big in the stock market during the economic downturn. He is considering buying some options to a very risky stock on a diamond mine in Africa. There is only a 10% chance that the stock price will rise if he exercises his options, but the payoff is $200,000. It costs $10,000 to buy and exercise the options. The alternative is not to buy at all, in which case Mr. Bean's profit is zero.

Problem 1: Basic Risky Decision

a. Draw an influence diagram to represent Mr. Bean's problem. Clearly indicate all the options/outcomes and numbers. Should he buy the options?

b. Draw an decision tree to represent Mr. Bean's problem. Clearly indicate all the options/outcomes and numbers. Should he buy the options?

Problem 2: Value of Perfect Information

a. Represent the hypothetical situation where Mr. Bean will get perfect information before he makes the decision. How to represent this situation in an influence diagram? Clearly indicate all the options/outcomes and numbers.

b. How to represent this situation in the decision tree? What is the expected value of the decision with perfect information?

Problem 3: Value of Imperfect Information

Before buying the options, Mr. Bean is considering to consult a financial "guru" on precious ores, Dr. Nut, who can assess the promise of the diamond mine and the stock. Dr. Nut can tell Mr. Bean whether his prospects are "good" or "poor". But Dr. Nut is not a perfect predictor:

- If there is diamond (and the stock will definitely rise), the conditional probability is 0.95 that Dr. Nut will say prospects are good.
- If there is no diamond (and the stock will definitely fall), the conditional probability is 0.85 that Dr. Nut will say poor

Draw a decision tree that includes the "Consult Guru" alternative. Be careful to calculate the appropriate probabilities to include in the decision tree. Finally, calculate the expected value for the alternative that involves hiring Dr. Nut. If Dr. Nut charges $7000, should Mr. Bean hire this guru?