Informatics 2D: Tutorial 3

Adversarial Search and Propositional Logic

Week 4

1 Adversarial Search

This exercise was taken from R&N Chapter 5.

Consider the two-player game shown in Figure 1

1. Draw the complete game tree, using the following conventions:
   - Write each state as (S_A, S_B) where S_A and S_B denote token locations
   - Put each terminal state in square boxes and write its game value in a circle
   - Put *loop states* (states that already appear on the path to the root) in double square boxes. Since it is not clear how to assign values to loop states, annotate each with a "?" in a circle.
2. Now mark each node with its backed-up minimax value (also in a circle). You will have to think of a way to assign values to the loop states.
3. Explain why the standard minimax algorithm would fail on this game tree and briefly sketch how you might fix it, drawing on your answer to item (2) above. Does your modified algorithm give optimal decisions for all games with loops?

2 The Wumpus World

2.1 Propositional Rules

Translate the following statements into propositional logic formulae. You can use a schematic representation for the location of a square, e.g. use a proposition $W_{i,j}$ to represent that there is a wumpus in the square in the ith row and jth column (don't worry about the edges of the grid when formalising your propositions).

1. A square cannot contain the wumpus and a pit at.

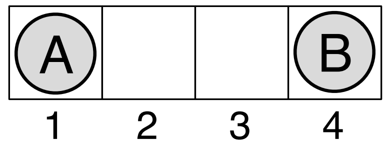

Figure 1: The starting position of a simple game. Player A moves first. The two players take turns moving, and each player must move their token to an open adjacent space in either direction. If the opponent occupies an adjacent space, then the player may jump over the opponent to the next available space. For example, if A is on 3 and B is on 2, then A may move back to 1. The game ends when one player reaches the opposite end of the board. If player A reaches space 4 first, then the value of the game to A is $+1$; if player B reaches space 1 first the value of the game to A is -1.

2. If a square is breezy then one of the (not diagonally) adjacent squares contains a pit.
3. There is a stench in the square if and only if it contains the wumpus or is (not diagonally) adjacent to the square containing the wumpus.

2.2 Entailment

Using the above rules, and the assumed facts, show the following statements are entailed by the knowledge base (either using a truth table or a diagram showing the possible models):

1. Assuming that there is a pit in square $(2, 2)$ show that the wumpus is not in square $(2, 2)$.
2. Assuming that there is a stench in square $(1, 1)$ and that there is not a wumpus in square $(1, 1)$ show that there is either a wumpus in $(1, 2)$ or a wumpus in $(2, 1)$. (Assume that the grid begins at (1,1) and ignore the off-grid squares in your rules).
3. Assuming that there is a breeze in square $(2, 2)$ and that there is not a pit in squares $(1, 2)$, $(2, 1)$ or $(3, 2)$, show that there is a pit in square $(2, 3)$.

3 *More to learn[1]

- Why is the 2-SAT problem so much easier than the 3-SAT problem?

[1] Starred *problems are outside the examinable course content. Feel free to ignore them completely