CIS604: Techniques in Artificial Intelligence

Exercise2, Fall 2014

1. TRUE/FALSE

a) In any finite state space, random-restart hillclimbing is an optimal algorithm.

b) If a CSP is arc consistent, it can be solved without backtracking.

c) Hill climbing is a complete algorithm for solving constraint satisfaction problems.

d) The computed Minimax value of a state is always less than or equal to the Expectimax value of that state.

e) α-β pruning can alter the computed Minimax value of the root of a search tree.

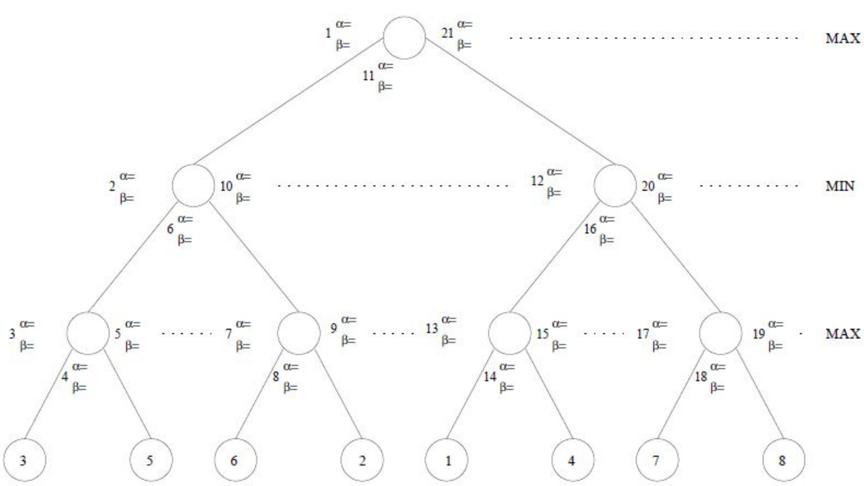
f) When doing α-β pruning on a tree which is traversed from left to right, the leftmost branch will never be pruned.

2. Adversial Search

Perform the alpha-beta algorithm on the following tree, searching left before right:

- Record to the left of a node the alpha and beta values upon first visiting the node.
- Record under a node the alpha and beta values after visiting the left child of the node.
- Record to the right of a node the alpha and beta values upon visiting both children.
- Circle any nodes (including leaves) that are not visited.
- Alpha and beta values need not be written for unvisited nodes nor for leaf nodes.
- Write in the game-theoretic value of the root node in the circle.
- Describe the path that would result if both players made optimal decisions.

Note that the numbers on the figure now are just identifiers of the α-β values at that stage of the algorithm. They have no numerical meaning.



Note also that the value of β never changes at a MAX node, since MIN has no control. Likewise, the value of α never changes at a MIN node, since MAX has no control.

3. Please answer the questions on the following web page.

https://courses.edx.org/courses/BerkeleyX/CS188.1x/2013_Spring/courseware/Week_4/Homework_2_CSPs/

4. TRUE/FALSE

a) All sentences are valid or unsatisfiable.

b) If A B, then A is true in all interpretations in which B is true.

c) Testing the validity of a sentence in first-order logic can be done in time exponential in the size of sentence.

d) $(C \lor (\neg A \land \neg B)) \equiv ((A \rightarrow C) \land (B \rightarrow C))$

e) For any propositional sentence α, β, γ, if $\alpha \models (\beta \land \gamma)$ then $\alpha \models \beta$ and $\alpha \models \gamma$

f) For any propositional sentence α, β, γ, if $\alpha \models (\beta \lor \gamma)$ then $\alpha \models \beta$ or $\alpha \models \gamma$ (or both)

5. Propositional Logic

Decide whether each of the following sentence is valid, unsatisfiable or neither. Verify your decision with truth tables or the equivalence rules :

1) $Smoke \rightarrow Smoke$

2) $Smoke \rightarrow Fire$

3) $(Smoke \rightarrow Fire) \rightarrow (\neg Smoke \rightarrow \neg Fire)$

4) $Smoke \lor Fire \lor \neg Fire$

5) $Big \lor Dumb \lor (Big \rightarrow Dumb)$

6) $(Big \land Dumb) \lor \neg Dumb$

b. Conjunctive Normal Form

Convert the following sentence to CNF

1) $(A \land B) \lor \neg(C \rightarrow D)$

2) $(P \rightarrow (Q \rightarrow R)) \rightarrow (P \rightarrow (R \rightarrow Q))$

3) $(P \rightarrow Q) \rightarrow ((Q \rightarrow R) \rightarrow (P \rightarrow R))$

6. Propositional Resolution

a. Show by resolution that the following set of clauses is inconsistent (derive empty clause from it):

[P, Q, R], [P, Q, ¬R], [P, ¬Q, R], [P, ¬Q, ¬R]

[¬P, Q, R], [¬P, Q, ¬R], [¬P, ¬Q, R], [¬P, ¬Q, ¬R]

b Prove the following using resolution.

i) $P \wedge Q \vdash P \vee Q$

ii) $\{P \vee Q, Q \rightarrow (R \wedge S), (P \vee R) \rightarrow U\} \vdash U$