

Graduate Comprehensive Exam: Artificial Intelligence (Fall 2005)

Answer all questions on the exam. You may use the back for additional space. Total: 100 points. Good Luck.

1. (20 pts) On logic inference rules:
 - (a) There are several logic inference rules, including resolution. For what kind of knowledge representation would you prefer resolution over the other rules?
 - (b) Convert the following into clauses suitable for resolution:
 - i. $\exists x \text{TeachesAt}(x, FIT) \wedge \text{TeachesSubject}(x, CS)$
 - ii. $\forall x \exists y \text{Student}(x) \Rightarrow \text{Teaches}(y, x)$
2. (25 pts) What are the properties for a heuristic in A*? Explain a generic mechanism for building an A* heuristic for a new problem. Show how that mechanism can be used to provide an A* heuristic for solving the traveling salesman problem (find the shortest cycle that visits all nodes in a graph).
3. (25 pts) On Constraint Satisfaction Problems (CSPs):
 - (a) What is a CSP?
 - (b) Model the following problem as a CSP: Consider a tournament with five teams. Each pair of the five teams has to play each other within a one-week period. There are two available stadiums and two games can be held in each of them every day. A team cannot play more than twice in any three consecutive days.
4. (30 pts) Consider a tic-tac-toe game with players A and B:
 - (a) Define an evaluation function that scores a board state.
 - (b) Build a minimax game tree with 2 plys (levels) from Player A's perspective (symmetric board states need not be included).
 - (c) Use the evaluation function to score all leaf nodes in the game tree.
 - (d) Apply alpha-beta pruning to the game tree, indicate nodes (if any) that are pruned, show the score at the root, and state the best move Player A should take.