Grad. Comp. Exam: Artificial Intelligence (Fall 2015) Student ID: _____

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

1. (25 pts) Search algorithms

   (a) Use a counter-example to prove that Greedy (or Greedy Best-first) search is not optimal.

   (b) A* and Uniform-cost search are both optimal, discuss why Uniform-cost search can be considered as a special case of A*.

   (c) Given two admissible heuristics $h_1(n)$ and $h_2(n)$, discuss when *and* why you would choose one over another.

   (d) If $h(n)$ is perfect (estimated cost is the same as the actual cost), discuss with an example the behavior of A*.

3. (25 pts) Constraint Satisfaction

   (a) What are the elements of a CSP?

   (b) Provide the CSP model to solve the meeting scheduling problem of Alice, Bob and Carol, where they can meet any day of a given week at any of their houses, but Alice cannot go Tuesday to Carol and Bob cannot go Monday and Wednesday to Alice.

   (c) Describe the min-conflict heuristic for local search?

   (d) How does constraint weighting relate to tabu search, and why does it improve the likelihood of finding solutions?

   (e) Provide an intuition as to why is forward checking frequently faster than conflict-directed backjumping.

2. (25 pts) Logical reasoning.

   (a) Use an example to discuss the difference in expressive power of propositional logic and predicate (or first-order) logic.

   (b) Given predicates: $at(person, organization)$ and $isKind(person)$, use predicate logic to express:

   - "Someone at FIT is kind."
   - "Everyone at FIT is kind."

   (c) Given the following logical sentences:

   - $A \Rightarrow B$
   - $\neg A \Rightarrow C$
   - $C \Rightarrow D$
   - $\neg D$

   i. convert the sentences into clauses (CNF)

   ii. show your steps in using the clauses and Resolution to prove the value of B.

   iii. use the sentences and a truth table (enumeration) to prove the value of A.

4. (25 pts) Uncertainty

   (a) What is the difference between prior probabilities and posterior probabilities?

   (b) Use probabilities as a language to express the problem in Question 3b.

   (c) What is the sum of all values in a joint probability table, and why?

   (d) Give Bayes' Rule.