CS 411: Artificial Intelligence I
Grad Homework 2
Due: Sunday of Week 4, 11:59pm

You may discuss the assignment with other students, but if you do you must note on your submission who you discussed it with. The actual submission must be entirely your own work. It must be submitted via gradescope. Please make sure to tag which page(s) each problem is answered on at the appropriate step in the submission process.

1. **Approximate admissibility** Sometimes non-admissible heuristics can be useful too. Let $h^*(n)$ be the shortest distance between state n and the goal state. Call a heuristic h an ϵ-admissible heuristic if $0 \leq h(n) \leq h^*(n) + \epsilon$. That is, it is allowed to be pessimistic about the cost of reaching the goal, but only by ϵ. Assume that $h(n) = 0$ if n is a goal state. Prove that A* tree search finds a goal state whose cost is worse than the optimal by at most ϵ. Hint: Start with the proof from the slides of the optimality of A* tree search and think about what needs to change.

2. **Arc Consistency** Suppose we are running the AC-3 CSP algorithm (see pseudocode in slides). Prove that if an arc (X_i, X_j) is not currently in the queue, then the current D_i and D_j must satisfy that X_i is arc-consistent with respect to X_j. Hint: use proof by induction / loop invariant.

3. **Cutset Conditioning** An alldiff constraint specifies that some set of variables in a CSP must all take on different values. Should we expect cutset conditioning to be effective when our problem has large alldiff constraints? Explain.

Grading standards:

- Full Credit (1.0) - All questions attempted, most with minor or no errors
- Partial Credit (0.5) - A number of questions may have significant errors
- Some Credit (0.25) - Many questions attempted with answers demonstrating some understanding of relevant concepts
- Insufficient evidence (0) - Many questions either not attempted or with answers not demonstrating understanding of relevant concepts