**EXAM 1** CSE 5290 (AI) / 4301 (Intro to-) Fall 2017

[4 questions, 40 points Undergrad, 50 points Grad, 45 min for Undergrad part,

Grad questions are take home, due on hard copy at class on Oct 3 Tuesday]

WRITE YOUR NAME and LAST 4 DIGITS OF ID:

**Q1.** Consider state space where the start state is number 1 and each state *k* has exactly three successors: numbering 3k, 3k+1, and 3k+2.

**1a.** Draw the tree for depth 3 (considering the root is at depth=1). [2]

**1b.** What is the number of nodes for depth *n*? [2]

**1c.** Suppose the goal state is at 11. List the order in which nodes will be visited for the breadth first search, depth limited search with limit 4, and iterative deepening search. [6]

**Grad 1d.** Consider two successors 2k and 2k+1 for *k*-numbered node in the above problem **instead of three successors**. Find an algorithm to get to the goal without any search? Show how will it work for node *k*=12. *Hint: Consider bit string representation for states. Find out if your search should go to the right node or the left node in each step.* [4]

**Q2.** Consider Fig. 3.31 of polygons (to be supplied) and consider the problem of finding a shortest path from the point *S* (dot at the lower left) to the point *G* (dot at the upper right)*.* [Mark the lower rectangle as *A* and the upper one as *H*.]

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**2a.** Suppose the state space is represented by the coordinate system (x, y), with two real numbers *x* and *y.* How many states are there in the search problem formulation? [2]

**2b.** What should be an obvious choice for a better state space? Explain why. [4]

**2c.** Draw what you think as a shortest path now on your state space as answered above. Explain qualitatively why you think that as the shortest path. [4]

**Grad 2d.** Device an admissible heuristic for the search problem formulation as your answer in 2c, and explain. [2]

**Q3.** Draw a 5x5 grid with the origin (0, 0) at the center, coordinates *x* and *y* (integers) increasing toward North and East respectively, so that the upper right corner of the grid is (2,2). Each point in the grid is a node in the search space.

**3a.** What is the branching factor in this state space? [2]

**3b.** How many distinct state spaces are there at depth *k* (for *k* >0, which is the root)? [4]

**3c.** List the order of nodes expanded by a breadth first search to go from node (0,0) to (2,2), excluding all previously visited nodes. [4]

**Grad 3d.** What should be the objective function for a “shortest path” finding algorithm in this problem space? [2]

**Q4a.** Draw all 13 basic relations from a time interval to another. [4]

**Q4b.** Consider the problem of *k* rooks not attacking each other on an *n x n* chessboard (rooks attack along straight lines), where ***k ≤n2***. Considering each rook as a variable what is the domain size of each variable? [2]

**Q4c.** What are the constraints in the above problem between a pair of variables? [4]

**Grad 4c.** *Compose* the following two basic time-interval relations, by drawing three respective intervals: *before* and *after*. [2]