CSci 4511
Midterm 2

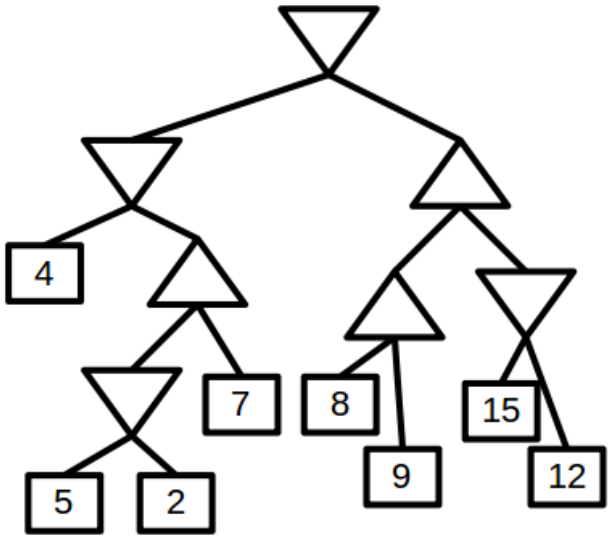
Name: _____

Student ID: _____

Instructions: The time limit is 75 minutes. Please write your answers in the space below. The exam is open book and notes. You may use electronic devices to ONLY look at either an e-book version or electronic notes. You may not use the internet, program/run code or any other outside resources. For all questions you must **show work**.

Problem (1) [20 points]
Assume you have a payoff matrix that is both zero-sum and no number appears twice. What can you say about the pure strategy Nash equilibrium and Pareto optimum?

Problem (2) [20 points]
Run alpha-beta pruning on the tree below. Clearly indicate what parts of the tree you can prune. (Before you ask, yes... the tree is supposed to look like this.)

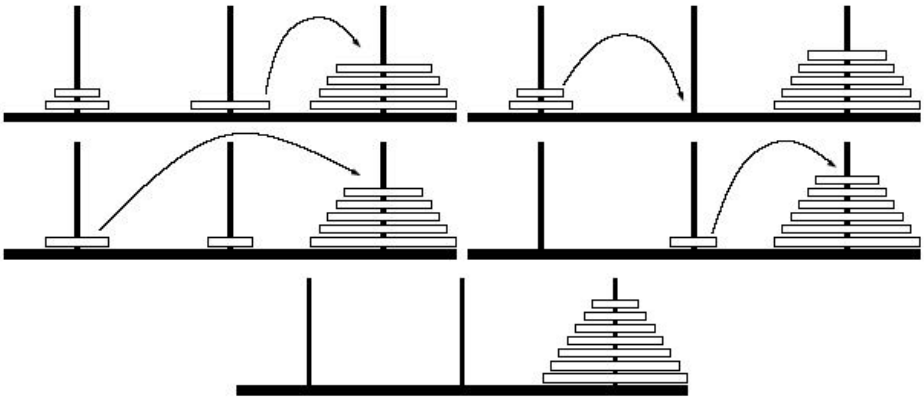


Problem (3) [20 points]
Suppose you have the following constraint satisfaction problem. What domain value (of which variable) is not 2-consistent? Which single constraint could you drop so that the original domains are 2-consistent?

Variables and domains:
w = {1, 4}
x = {2, 4, 5}
y = {2, 3, 4}
z = {1, 3}

Constraints:
$x \neq y$
$w \neq x$
$w < y$
$w < z$
$w * x < y + z$
$w + x$ is even
$x * z < 10$
$|y - z| = 1$
$w + y = z$

Problem (4) [20 points]
The tower of Hanoi you might have encountered when learning recursion. There are three pegs/sticks and a fixed number of different size disks. The disks all start sorted (largest on bottom, smallest on top) on the left peg and the goal is to have a sorted tower on the right peg. You can only move the topmost disk (on any peg), and you cannot have a larger disk on top of a smaller disk.



Suppose you did not know the systematic way to solve the puzzle and instead are going to use a search. Give **two** ways you can relax the problem (non-trivially). For each of the relaxations, describe what the optimal solution is and how to quickly generate a value for a state.

Problem (5) [20 points]
Answer the following questions (and as always, justify your answers):

- When using the genetic algorithm, we discussed the importance of keeping the "genes" diverse, yet there are other considerations as well. Give a concrete example (not just abstract) when you would want to carry over genes directly from the previous generation. Also give a concrete example when it would be fine to not carry over, and instead use cross-over to generate all of the next generation.

- Which of the single pair of algorithms are most similar to each other and describe what difference there is between them? (Basic) hill-climbing, Stochastic hill-climbing, Hill-climbing with random restart, Simulated annealing, Local beam search, and Genetic algorithm.

- Which of the algorithms use the most memory? (Basic) hill-climbing, Stochastic hill-climbing, Hill-climbing with random restart, Simulated annealing, Local beam search, and Genetic algorithm.