# CSci 4511
# Midterm 2

Name: _____

Student ID: _____

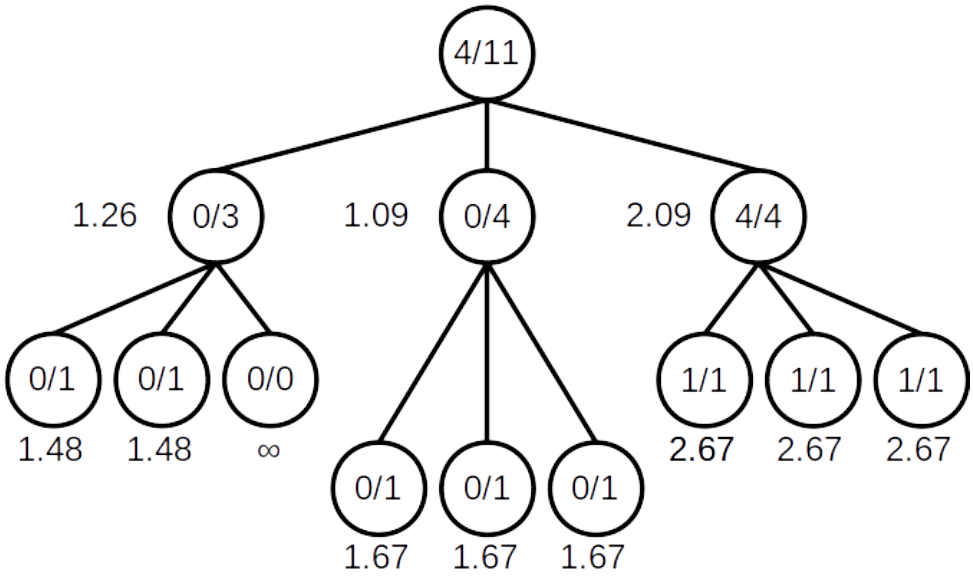
*Instructions*: The time limit is 75 minutes. Please write your answers in the space below. If you need more space, write on the back of the paper. The exam is open book and notes. You may not use the internet or any other outside resources. For all questions you must **show work** to receive full credit.

**Problem (1)** [20 points]
Assume you have the following KB:
$(A \iff \neg B \vee C), (A \Rightarrow D), ((A \vee C) \Rightarrow (B \vee \neg D))$

(Part 1) Does KB $\models \alpha$ (entailment), where $\alpha = (A \Rightarrow C)$
(Part 2) Does KB $\models \alpha$ (entailment), where $\alpha = (B)$
(Part 3) Does KB $\models \alpha$ (entailment), where $\alpha = ((A \wedge C) \Rightarrow (D \vee (E \Rightarrow A)))$

**Problem (2)** [10 points]
Below a Monte-Carlo tree search in progress on a tree with branching factor of three. Inside the circle are the "win/play" counts. Outside the circles (but near) the UCT values. Do the following:

- (Part 1) Indicate how/where the tree will change in the next iteration.
- (Part 2) State whether you think the "random play" will lead to a "win" or "loss".
- (Part 3) Show the part of the updated tree after applying your guess from (Part 2). (You do not need to draw the whole tree, but you do need to be clear on which part you are changing and how.)



**Problem (3)** [20 points]
Assume you have a CSP with variables and domains: $a, b, c \in \{0, 1, 2, ...9\}$. Your problem has the following constraints:

- $a + b > c^2$
- $2a > b + 4$
- $b + c = 10$
- $a < c$

Find the domains of $a, b$, and $c$ after applying 2-consistency.

**Problem (4)** [20 points]
Provide a payoff matrix with exactly 2 pure Pareto optimum, where there are also exactly 2 pure Nash equilibrium on the Pareto optimum points (one on each). (Note: row player payoff is the first number in the pair.) Then find the mixed Nash equilibrium of your payoff matrix you just created.

**Problem (5)** [30 points]
Assume you have a depth 3 tree that you want to apply alpha-beta pruning to. This tree has three different branching factors: 2, 3 and 4. However, you can choose which depth these branching factors occur at. For example you could have a branching factor of 2 from the root to depth 1 or a branching factor of 3 from the root. Between each depths needs a unique branching factor (you cannot choose the branching factor of "2" multiple times). What combination could potentially (if you could choose the leaf values) allow you to search the fewest number of leaf nodes?

- (Part 1) Find the combination of branching factors that lets you prune the most leaf nodes (i.e. search the least amount of the tree).
- (Part 2) Also find **the second combination** of branching factors that lets you prune the second most leaf nodes. In other words, if you had to choose some other combination that your answer in (Part 1), what should you choose?