

CSci 4511 Midterm 2

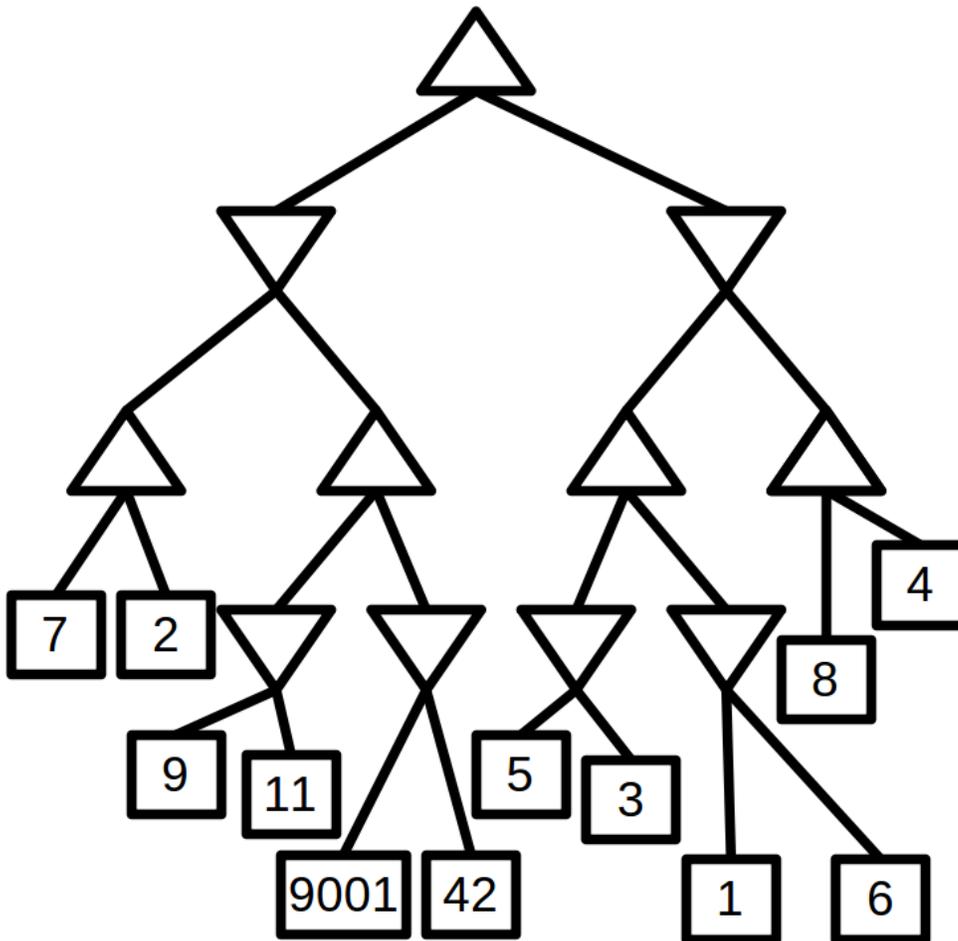
Name: _____

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]

Use alpha-beta pruning to show both the (1) best action from the root and (2) the value of this action. Also show (3) which branches can be pruned. Show as much work as possible for how you determined your pruning.



Problem (2) [25 points]

Sudoku Rules:

Sudoku is a game where you try and fill in numbers such that each sub-box, row and column all have unique digits. Sub-boxes never overlap. The digits are always 1 to the width of the board. Figure 1a shows a solution for a 4x4 Sudoku problem. For 4x4 Sudoku there are four 2x2 “sub-boxes”: one in the top-right, one in the top-left, one in the bottom-right and one in the bottom-left. For example, the top-left sub-box in Figure 1a is the (1, 2) along with the (3, 4) right below the (1, 2). If you still have questions on the goal of Sudoku, please raise your hand and ask.

Problem:

Your starting problem is shown in Figure 1b. There are two 1’s and one of each 2, 3 and 4 filled in the board already. Letters are in the blank/unknown spots. This question will focus on the domains of the top-left sub-box involving (A, 1) and (D, E) for the Sudoku board in Figure 1b:

(1) Write down the constraints using letters and numbers to formulate the Sudoku problem shown in Figure 1b as a constraint satisfaction problem. Show **only** the constraints involved in the top two rows, the left two columns and the top-left sub-box to ensure the rules of Sudoku are followed.

(2) Show the initial domains for letters $\{A, D, E\}$ that are valid for the initial board after applying 1-consistency.

(3) Find the domains of the letters $\{A, D, E\}$ that are 2-consistent. (Please be clear on how you are reaching 2-consistency.)

(Note: please write your answers on the next page, which is blank.)

1	2	3	4
3	4	1	2
2	1	4	3
4	3	2	1

(a) A sample solution for a 4x4 Sudoku board

A	1	B	C
D	E	1	2
F	4	G	3
H	I	J	K

(b) Problem 4’s Sudoku problem

Problem (3) [20 points]

Give a 2 by 2 payoff matrix where every point is Pareto optimal. What is the pure strategy Nash equilibrium of your matrix?

Problem (4) [20 points]

Find the mixed strategy Nash-equilibrium for the following payoff matrix (left number in the pair is the payoff for the row player). Justify your answer.

(3,5)	(1,6)
(4,7)	(2,7)

Problem (5) [15 points]

Answer each of the following questions:

- (1) Given the knowledge base below, show that the sentence $\alpha = (A \vee B)$ is not entailed (i.e. $KB \not\models \alpha$). $KB = (C \Rightarrow A) \wedge (B \Rightarrow (C \vee A))$
- (2) What is the simplest single sentence (i.e. least amount of symbols/variables and operations) that contains an “if and only if” (i.e. $X \iff Y$) that you can add to the KB so that α is entailed (i.e. $KB \models \alpha$)?
- (3) In general, explain why adding sentences to the knowledge base helps entailment.