EASTERN MEDITERRANEAN UNIVERSITY

COMPUTER ENGINEERING DEPARTMENT

CMPE-CMSE461 Artificial Intelligence

SPRING 2021-2022

I. Midterm-Exam

19 April 2022, 14:30

90 minutes, attempt all...

Student No :..... Adnan Acan & Ahmet Unveren.

Name Surname :..... Solution Key

Grades Collected	
Q1	
Q2	
Q3	
Q4	
Q5	
TOTAL	

Question 1: (20 pnts.) (5 pts each)

a) Write down the four directions of research in Artificial Intelligence and explain characteristics of each of them with one sentence.
b) Describe the fundamental characteristics of a rationally intelligent agent.
c) Explain the use of a utility function in intelligent agent architectures.
d) What are the basic elements we use in modeling a problem as a search problem?

a) 1. Acting humanly: Intelligence is defined in actions that are similar to human behavior. The Turing test was designed to test if an intelligen system has human-level performance in action.

2. Thinking humanly: Intelligence is defined as a Thought process as human beings do. This The approach followed by cognitive science researchers.

3. Acting rationally: An agent acts to achieve its goals in its environment and "the right action" is one That makes The agent closer to its goals while also maximiting its utility function.

4. Thinking rationally: Intelligence is defined as a Thought process That is described logical and mathematical reasoning principles.

b) A rational agent is one That The right things in a goal directed manner and acts in a way to maximize its performance measure with all possible actions.

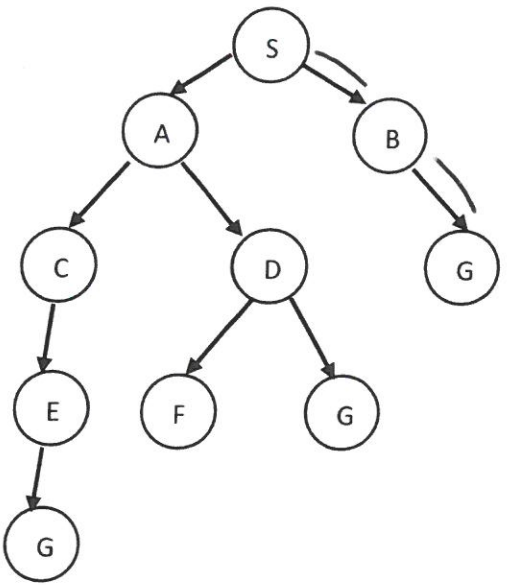
c) An agent's preferences are captured by a utility function that maps actions' outputs to a utility value. The higher This value The more That agent likes That outcome.

d) States, actions, goal description, initial state

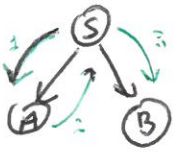
Question 2: (20 pnts.)

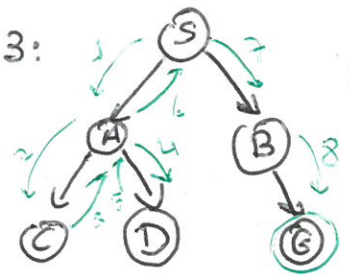
a) Consider the search problem represented in the following figure, where **"S"** is the start node and **"G"** is the goal node.

Which sequences of paths are explored by **IDS (Iterative Deepening Search)** in this problem? Show every step, in detail.(Use alphabetical ordering for neighbor search)



Level 1: (S) Queue: S

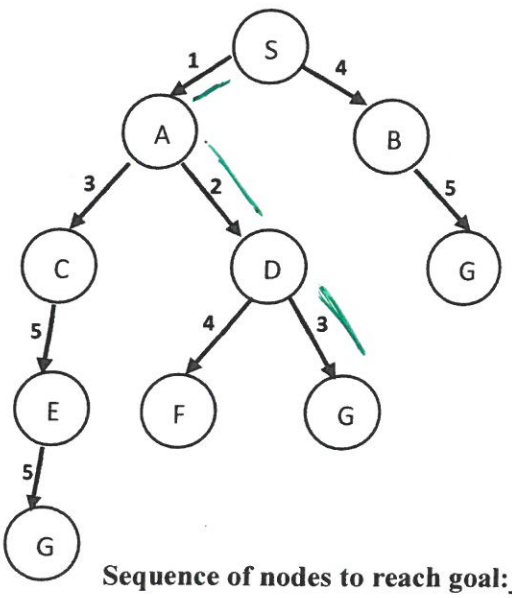
Level 2:  Queue: ~~S~~ ~~A~~ ~~B~~

Level 3:  Queue: ~~S~~ ~~A~~ ~~B~~ ~~C~~ ~~D~~ ~~B~~ ~~G~~

Sequence of nodes to reach goal: S → B → G **?**

b) Consider the search problem represented in the following figure, where **"S"** is the start node and **"G"** is the goal node.

Which sequences of paths are explored by **UCS (Uniform Cost Search)** in this problem? Show every step, in detail.



Cost so far: 0 Goal: "G"

step1: open List: S(0)

step2: Open List: A(1) B(4) Go with A Cost: 1

step3: open List: B(4) C(4) D(3)
sort ⇒ D(3) B(4) C(4) Go with D Cost: 3

Step4: Open List: B(4) C(4) F(7) G(6)
sort ⇒ B(4) C(4) G(6) F(7) cost: 4

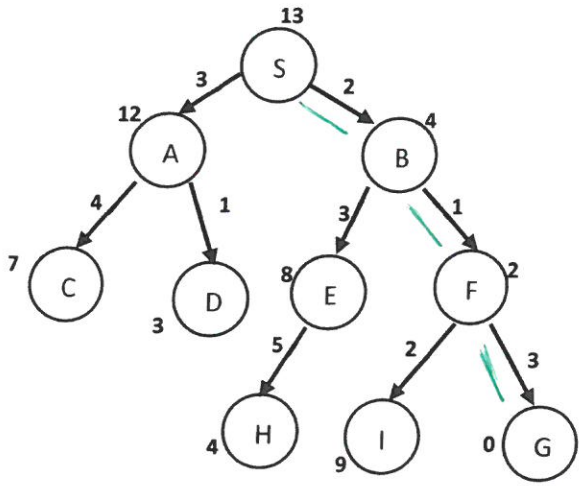
step5: Open List: C(4) G(6) F(7) G(9) cost: 4

step6: Open List: G(6) F(7) G(9) E(9) cost: 6

Sequence of nodes to reach goal: S → A → D → G **? Optimal Cost:** 6 **?**

Question 3: (20 pnts.)

Consider the graph shown below. The nodes are represented in circles, and the weights of the paths along the nodes are given. The numbers above the nodes represent the heuristic value of the nodes. Show every step to reach the goal node by using **A* Algorithm**, where **"S"** is the start node and **"G"** is the goal node.



Step 1: Open List : S (0+13=13)

Step 2: Open List : B (2+4=6), A(3+12=15)

Step 3: Open List: F(3+2=5) E(5+8=13) A(3+12=15)

Step 4: Open List: G(6+0=6) E(5+8=13) I(5+9=14)
A(3+12=15)

Step 5: Open List: E(5+8=13) I(5+9=14)
A(3+12=15)

Sequence of nodes to reach goal: S → B → F → G **? Optimal Cost:** 6 **?**

Question 4: (30 pnts.) (6 pts each part)

You are required to produce a schedule three professors A, B, C in computer engineering. These professors will teach five classes C1, C2, C3, C4, C5. You will assign a professor to each class under the following constraints:

(1) each professor only teaches one class at a time;

(2) each class is taught by only one professor; and

(3) some professors can only teach some of the classes.

You must produce a complete and consistent schedule. You are required to formulate this task as a CSP in which classes are the variables (named C1 through C5) and professors are the domain values (named A, B, and C). After you have solved the CSP, each class (variable) will be assigned one professor (value), and all constraints will be satisfied. The classes (variables) are:

- C1 : meets from 8:00-8:50am
- C2 : meets from 8:30-9:20am
- C3 : meets from 9:00-9:50am
- C4 : meets from 9:00-9:50am
- C5: meets from 9:30-10:20am

The professors (domain values) are:

- A, Professor A, who is available to teach Classes C3 and C4.
- B, Professor B, who is available to teach Classes C2, C3, C4, and C5.
- C, Professor C, who is available to teach Classes C1, C2, C3, C4, C5.

a) For each variable C1-C5, write down its domain as a subset of the values {A, B, C}.

C1 = {C}

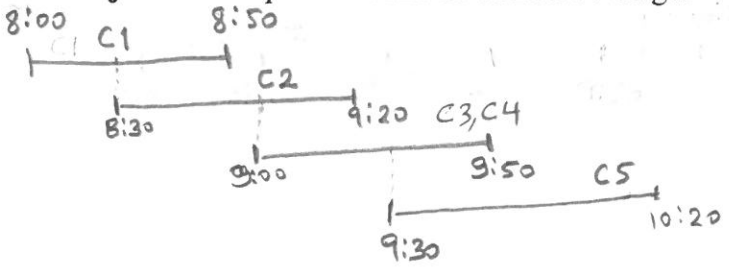
C2 = {B, C}

C3 = {A, B, C}

C4 = {A, B, C}

C5 = {B, C}

b) Write down all constraints that are associated with this CSP. Write each constraint implicitly as **Ci ≠ Cj** for all classes **Ci** and **Cj** that overlap in time and so cannot be taught by the same professors.



C1 ≠ C2

C2 ≠ C3

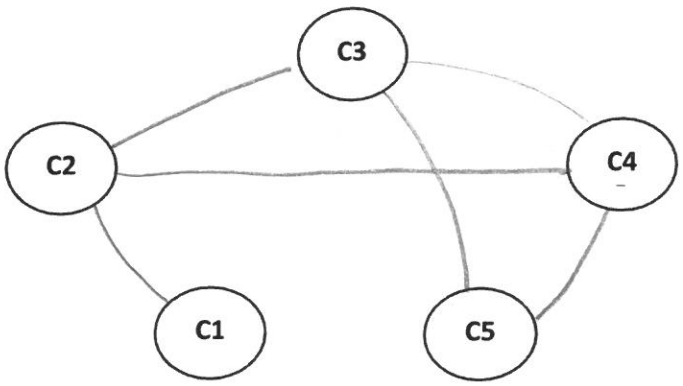
C2 ≠ C4

C3 ≠ C4

C3 ≠ C5

C4 ≠ C5

c) Draw the constraint graph associated with your CSP. The nodes are provided for you. Draw the arcs.



d) Run **Arc Consistency** on the domains of variables according to the constraints you set in part **b)** and the constraint graph you draw in part **c).** Write down the reduced domains that result when all inconsistent domain values are removed by Arc Consistency.

Variable C1 — reduced domain {C}

Variable C2 — reduced domain {B}, for value C, There exists no consistent value in C1's domain

Variable C3 — reduced domain {A, C}, for value B, There exists no consistent value in C2's domain

Variable C4 — reduced domain {A, C}, for value B, There exists no consistent value in C2's domain.

Variable C5 — reduced domain {B, C}

e) Give one solution to this CSP. A solution is a complete and consistent assignment.

C1 = C

C2 = B

C3 = C

C4 = A

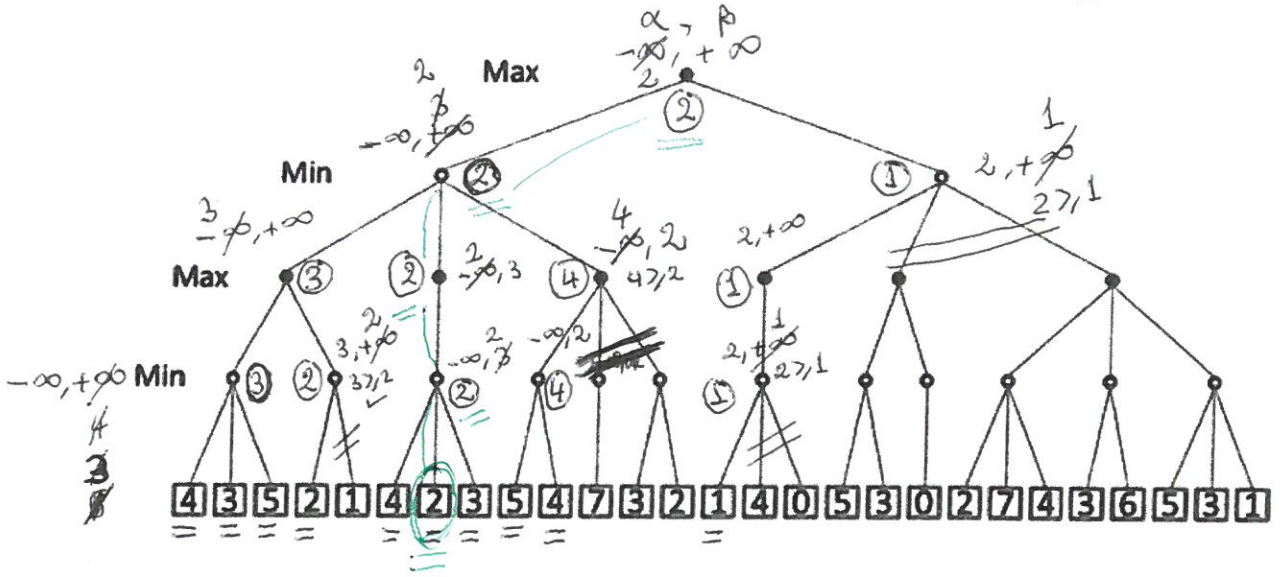
α - Max

β → Min

α ≥ β prune

Question 5: (20 pnts.)

a) Given the following game tree apply Alpha-Beta pruning from left-to-right and clearly show all the pruned branches. Unclearly written answers will not be graded.



b) Given the following game tree apply Alpha-Beta pruning from right-to-left and clearly show all the pruned branches. Unclearly written answers will not be graded.