Due: 03/26/2024 23:59

Foundations of Artificial Intelligence: Homework 1

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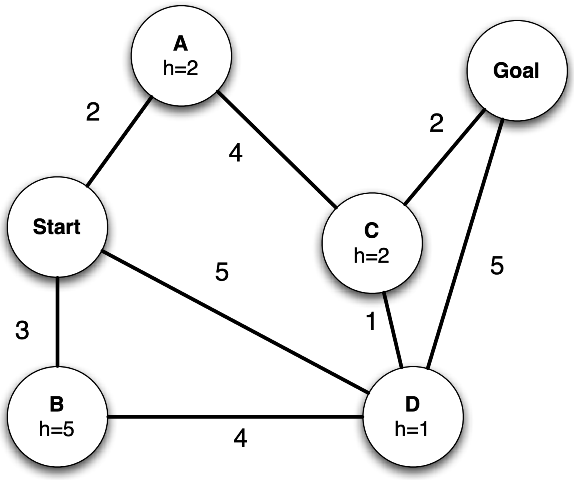
Problem 1 (10 points)



Write down the order of state expansion and the final path returned by each of the graph search (as oppose to tree search) algorithms below. You can assume ties are resolved alphabetically.

a) Depth-first search.

b) Breadth-first search.

c) Uniform cost search.

d) Greedy search with the heuristic h shown on the graph.

e) A^* search with the same heuristic.

Problem 1

(a) DFS

States Expanded: S, A, C, D, G

Path Returned S - A - C - G

(b) BFS

States Expanded: S, A, B, D, C, G

Path Returned: S - D - G

(c) UCS

States Expanded: S, A, B, D, C, G

Path Returned: S - A - C - G

(d) Greedy

States Expanded: S, A, C, G

Path Returned: S - A - C - G

(e) A^* search

States Expanded: S, A, D, C, G

Path Returned: S - A - C - G

Problem 2 (10 points)

```
function A* GRAPH SEARCH(problem)
    fringe ← an empty priority queue
    fringe ← INSERT(MAKE-NODE(INITIAL-STATE[problem]), fringe)
    closed ← an empty set
    ADD INITIAL-STATE[problem] to closed
    loop
        if fringe is empty then
            return failure
        end if
        node ← REMOVE-FRONT(fringe)
        if GOAL-TEST(problem, STATE[node]) then
            return node
        end if
        for successor in GETSUCCESSORS(problem, STATE[node]) do
            if successor not in closed then
                ADD successor to closed
                fringe ← INSERT(MAKE-SUCCESSOR-NODE(successor, node), fringe)
            end if
        end for
    end loop
end function
```

The implementation of the A^* graph search algorithm above is incorrect. Briefly explain the bug in this implementation and justify your answer.

Problem 3 (10 points)

You are scheduling for 5 classes on the same day taught by 3 instructors. Of course, each instructor can only teach one class at a time.

The classes are:

- Class 1 - Intro to Programming: 8:00-9:00am
- Class 2 - Intro to Artificial Intelligence: 8:30-9:30am
- Class 3 - Natural Language Processing: 9:00-10:00am
- Class 4 - Computer Vision: 9:00-10:00am
- Class 5 - Machine Learning: 10:30-11:30am

The instructors are:

- Instructor A - Can teach Classes 1, 2, and 5.
- Instructor B - Can teach Classes 3, 4, and 5.
- Instructor C - Can teach Classes 1, 3, and 4.

Problem 2

① It didn't implement the part to handle f_value and g_value

the part "if successor not in closed then add to closed" should be modified to calcuating current node's g-value and comparing to check

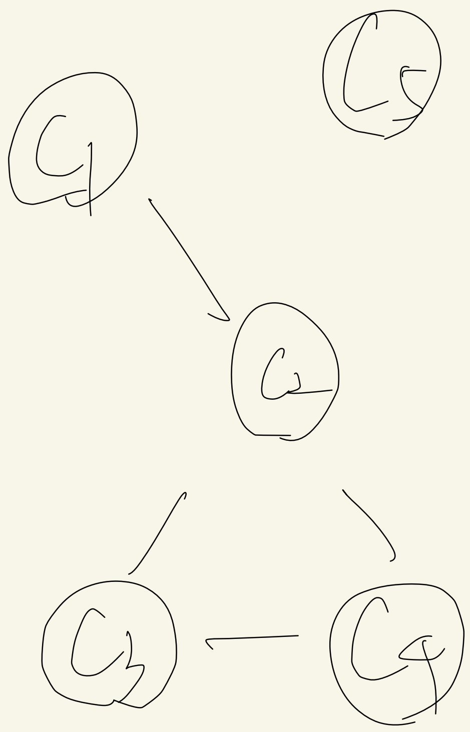
② the fringe should be implemented that it can popout the lowest f_value node

Problem 3

(1)

Variables	Domains	Constraints
C_1	A, C	$C_1 \neq C_2$
C_2	A	$C_2 \neq C_3$
C_3	B, C	$C_2 \neq C_4$
C_4	B, C	$C_3 \neq C_4$
C_5	A, B	

(2)



(5) If a CSP is tree structured ⇒ no loop ⇒ solve in polynomial time

(3) After running arc consistency to solve constraints

C_1 : C
C_2 : A
C_3 : B, C
C_4 : B, C
C_5 : A, B

⇒

(4) One possible solution is

C_1 = C
C_2 = A
C_3 = B
C_4 = C
C_5 = B

(1) Formulate this problem as a CSP. Describe the variables, domains and constraints.

(2) Draw the constraint graph associated with your CSP.

(3) Show the domains of the variables after running arc-consistency on this initial graph (after having already enforced any unary constraints).

(4) Give one solution to this CSP.

(5) Your CSP should look nearly tree-structured. Briefly explain (one sentence or less) why we might prefer to solve tree-structures CSPs.

Problem 4 (10 points)

Alice, Bob, Chris, and David are ordering food from pizza, quesadillas, ramen, and sushi. They have some strict preferences:

1. Chris will not order sushi.
2. Alice and Bob want to order different food.
3. Bob will only order pizza or ramen.
4. Alice and Chris want to order the same dish as each other but different from the remaining two people.
5. David will not order quesadillas.

a) Draw the constraint graph for this CSP.

b) Run the basic backtracking search. Use alphabetical order to both select unassigned variables and iterate over values. Write down the food assignment.

c) Assume that no variables have been assigned values yet. When running one iteration of forward checking, which value(s) will be removed for each variable if we assign "pizza" to Alice. Write down "None" if no values will be removed.

Problem 4

(a)

Variables	Domains
A (Alice)	P, Q, R,
B (Bob)	P, R
C (Chris)	P, Q, R
D (David)	P, R, S

Constraints

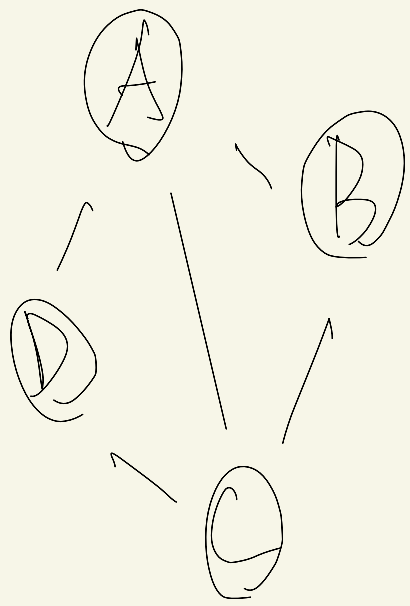
$A \neq B$

$A \neq D$

$B \neq C$

$C \neq D$

$A = C$

$\Rightarrow$ 

(b) Alice : Pizza

Bob : ramen

Chris : Pizza

David : ramen

(c) If Alice is assigned as P

$\Rightarrow$ $A \neq B$, Bob eliminates pizza

$A = C$, Chris eliminates quesdillas, ramen

$A \neq D$, David eliminates pissa