KING SAUD UNIVERSITY
COLLEGE OF COMPUTER AND INFORMATION SCIENCES
COMPUTER SCIENCE DEPARTMENT

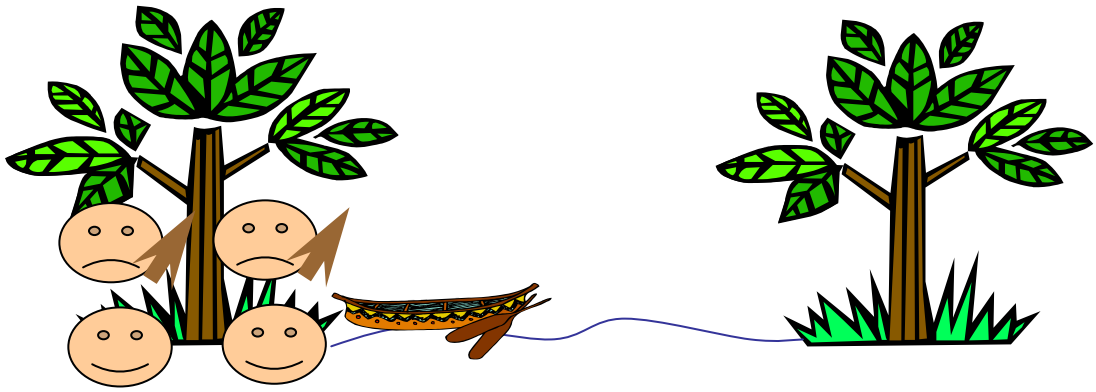
CSC 361: Artificial Intelligence **Final Exam** **2nd Semester 1428/1429**

Date: June 5, 2008 **Time: 8:00 – 11:00**

Question 1

Consider the problem of missionaries and cannibals. There are 2 cannibals and 2 missionaries on the left bank of a river. There is one canoe which can hold one or two people. The problem is to find a way to get everyone to the right bank, without ever leaving a group of missionaries in one place outnumbered by cannibals in that place.

a. Give a formulation for this problem by specifying **state representation**, **operators**, **initial state**, **goal state** and **path cost** knowing that initially the cannibals, the missionaries and the canoe are on the left bank of a river (see figure below).



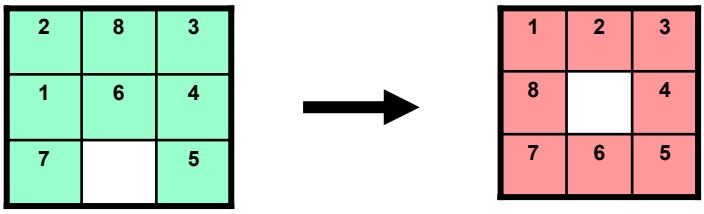
b. Solve this problem using BFS - a blind search technique (Breadth First Search). **Do not expand the repeated states**.

c. Solve this problem using DLS (DepthLimit = 5). **Do not expand the repeated states**.

Note: Operators should be used in this **order**: Take one cannibal, Take one missionary, Take one cannibal and one missionary, Take two cannibals, or Take two missionaries.

Question 2

Consider the following 8-puzzle problem:



Initial State Goal State

a. Give a formulation for this problem.

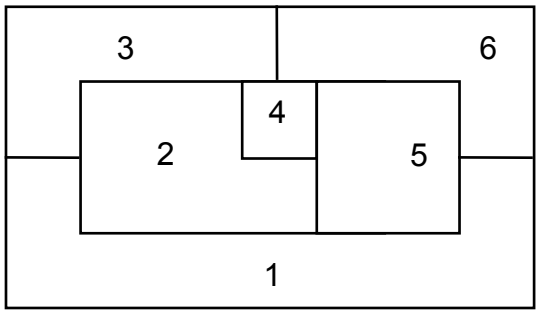
b. Solve the 8-puzzle problem using A* search (with systematic checking of repeated states) with the heuristic **f(n) = g(n) + h_1(n)** where g(n) is the number of steps from the initial state and **h_1(n) is the number of misplaced tale**s.

c. Solve the 8-puzzle problem using IDA* search (with systematic checking of repeated states) with the heuristic **f(n)= g(n) + h_2(n)** where g(n) is the number of steps from the initial state and **h_2(n) is the Manhattan distance**.

Note: Operators should be used in this **order**: Slide blank up, Slide blank down, Slide blank left, Slide blank right. Do not expand repeated states.

Question 3 [10 marks]

Consider the following map. The task is to color the map using the four colors Red, Blue, Green, and Yellow, such that no two adjacent regions take the same color.



a. Formulate this problem as a CSP. Clearly state the variables, domains, and constraints.

b. Describe the topology of the constraint graph.

c. Color the map using a Backtracking Search with Arc Consistency heuristic. Show the steps.

Note: **Variables and values are ordered as follows**:

i. Variables: 1, 2, 3, 4, 5 and 6 (ascending order).
ii. Values: Red, Blue, Green and yellow.

Question 4

Consider the following Saudi-Arabia-map. The task is to color the map using the four colors **Red**, **Green**, **Blue** and **Yellow**, and such that **no two adjacent regions take the same color**.

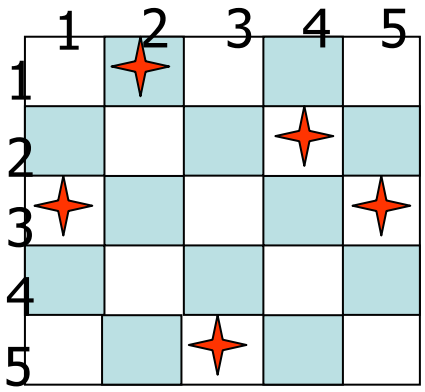
2. Formulate this problem as a CSP. Clearly state the variables, domains, and constraints.
3. Describe the topology of the constraint graph.
4. What is the size of the search space?
5. Color the map using Backtracking search with Forward Checking.
6. Color the map using Backtracking Search with MCV heuristic.
7. Describe the way to use Genetic Algorithms to solve this problem.
8. Is it possible to solve this problem using only three colors? If the response is yes, give the solution.

Note: **Variables and values are ordered as follows**:

i. Variables: 1, 2, 3 … 13 (ascending order).
ii. Values: Red, Blue, Green and yellow.

Question 5

Consider the 5-Queens problem:



a. Describe the way to use Hill Climbing to solve this problem.

b. Describe the way to use Genetic Algorithms to solve this problem.

Question 6

Consider the following Knowledge Base:

Rule 1: If A and B Then C

Rule 2: If A and not(B) Then D

Rule 3: If C and D Then E

Rule 4: If B and E and F then G

Rule 5: If A and E Then H

Rule 6: If D and E and H Then I

Rule 7: If not(C) Then E

Rule 8: If A and E and I Then G

Rule 9: If H and G Then K

a. Given these facts in working memory initially: **A** and **F**

List the different facts deduced by the inference engine when using **forward chaining** (data driven reasoning). For conflict resolution, use rule order as implied priority (if there is a conflict, choose the rule with smallest number).

b. Given the facts in working memory initially: **A**

Is the goal **I** true of false? Justify using **backward chaining** (Goal driven reasoning). For conflict resolution, use rule order as implied priority (if there is a conflict, choose the rule with smallest number).