Artficial Intelligence

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Homework 2

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Missionaries and Cannibals

1. Precisely formulate the problem by:

   (a) Define a state by giving the minimal set of information needed to uniquely identify it.

   A state will be able to be identified by the following:

   - Which side of the river you (the boat) are on (Right / Left)
   - Number of cannibals present
   - Number of missionaries present

   (b) Specifying the initial state

   The initial state will be on the Left side of the river with 3 Missionaries and 3 Cannibals

   (c) Defining a function ACTIONS(s) for an arbitrary state s which returns the set of actions that can be executed in state s. The actions available to an arbitrary state s are:

   - MOVE(numCannibals, numMissionaries): Crosses the river with the specified number of cannibals/missionaries, because there are only 2 sides possible there is no need to specify direction. May result in a dead state based on this action, and the maximum number occupants may not exceed 2.

   (d) Defining a transition model by specifying a function RESULT(s,a) which returns the state that results from executing action a in state s. Transition Model:

   - RESULT(s, MOVE(numCannibals, numMissionaries)): Switches the agent to the opposite state along with the modified number of cannibals/missionaries ferried. This costs one point.

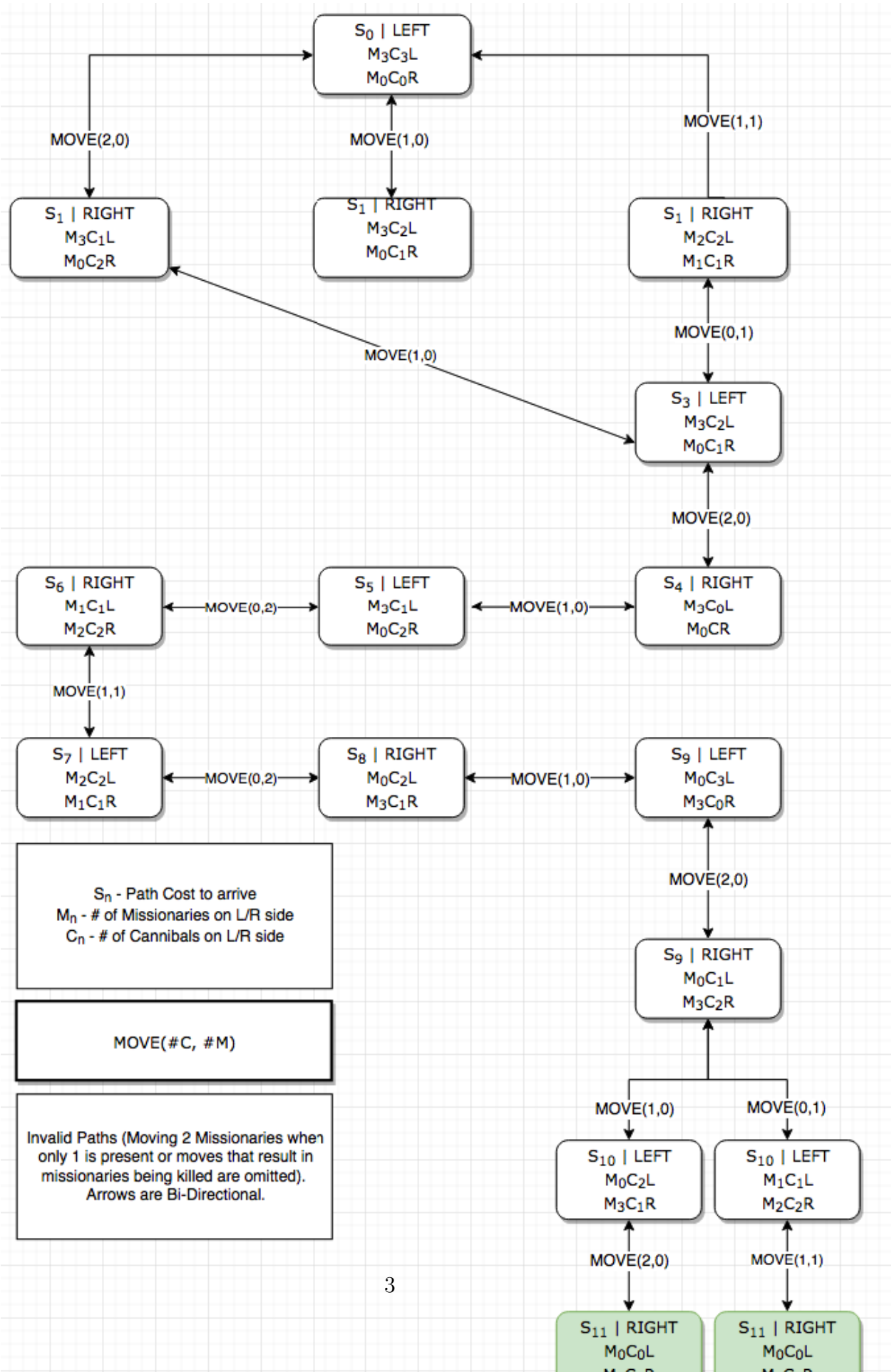
   (e) Defining a test to determine whether a given state is a goal state.

   If the agent is on the Right side of the river with 3 missionaries and 3 cannibals you are in the goal state.

   (f) Defining the step cost (which also gives us the past cost as that's merely the sum of all the step costs associated with a path).

   Every instance of MOVE() called costs one step.

2. Professional render a diagram of the complete state space employing appropriate software such as Microsoft Visio or the free open-source software Dia.


S_0 | LEFT
M_3C_3L
M_0C_0R
MOVE(2,0)
MOVE(1,0)
MOVE(1,1)
S_1 | RIGHT
M_3C_1L
M_0C_2R
S_1 | RIGHT
M_3C_2L
M_0C_1R
S_1 | RIGHT
M_2C_2L
M_1C_1R
MOVE(0,1)
MOVE(1,0)
S_3 | LEFT
M_3C_2L
M_0C_1R
MOVE(2,0)
S_6 | RIGHT
M_1C_1L
M_2C_2R
MOVE(0,2)
S_5 | LEFT
M_3C_1L
M_0C_2R
MOVE(1,0)
S_4 | RIGHT
M_3C_0L
M_0CR
MOVE(1,1)
S_7 | LEFT
M_2C_2L
M_1C_1R
MOVE(0,2)
S_8 | RIGHT
M_0C_2L
M_3C_1R
MOVE(1,0)
S_9 | LEFT
M_0C_3L
M_3C_0R
S_n - Path Cost to arrive
M_n - # of Missionaries on L/R side
C_n - # of Cannibals on L/R side
MOVE(2,0)
MOVE(#C, #M)
S_9 | RIGHT
M_0C_1L
M_3C_2R
Invalid Paths (Moving 2 Missionaries when only 1 is present or moves that result in missionaries being killed are omitted). Arrows are Bi-Directional.
MOVE(1,0)
MOVE(0,1)
S_{10} | LEFT
M_0C_2L
M_3C_1R
S_{10} | LEFT
M_1C_1L
M_2C_2R
MOVE(2,0)
MOVE(1,1)
S_{11} | RIGHT
M_0C_0L
S_{11} | RIGHT
M_0C_0L

3. Find and report a path in the state space from the initial state to a goal state (i.e., a solution).

   (a) MOVE(1,1) – Cross with 1 Missionary and 1 Cannibal
   (b) MOVE(0,1) – Cross with 1 Missionary
   (c) MOVE(2,0) – Cross with 2 Cannibals
   (d) MOVE(1,0) – Cross with 1 Cannibal
   (e) MOVE(0,2) – Cross with 2 Missionaries
   (f) MOVE(1,1) – Cross with 1 Missionary and 1 Cannibal
   (g) MOVE(0,2) – Cross with 2 Missionaries
   (h) MOVE(1,0) – Cross with 1 Cannibal
   (i) MOVE(2,0) – Cross with 2 Cannibals
   (j) MOVE(1,0) – Cross with 1 Cannibal
   (k) MOVE(2,0) – Cross with 2 Cannibals