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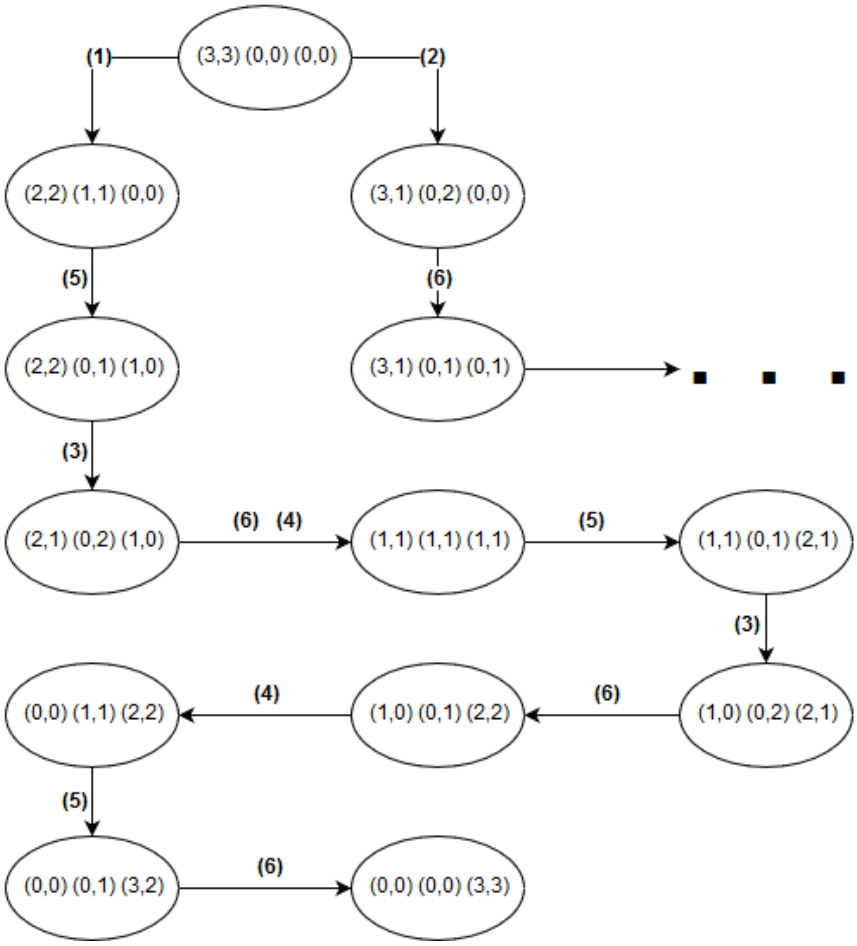
State Space Problem Solving Model for the Missionaries and Cannibals Problem

1. PROBLEM STATEMENT
   There are three Missionaries (M) and three Cannibals (C), and one boat on a river that fits at most two people. At least one person is required to operate the boat. All six missionaries and cannibals must safely cross the river – under one condition; at no point should the number of cannibals outnumber the missionaries at any spot (left bank, right bank, boat) – otherwise, the missionaries will be consumed.
2. THE OBJECTS OF THE WORLD
   - Three Missionaries
   - Three Cannibals
   - Three spots: The boat, the left bank and the right bank
3. REPRESENTATION OF A STATE IN THE WORLD
   - Let *m* be the number of marines in a given spot
   - Let *c* be the number of cannibals in a given spot
   - Let *B*, *LB* and *RB* represent the Boat, Left Bank and Right Bank respectfully
   - A state will be represented as: { LB = (m,c) | B = (m,c) | RB = (m,c) | m = 0,1,2,3 | c = 0,1,2,3 | **m ≥ c** | m+c < 2 for B }
4. THE STATE SPACE DESCRIPTION
   - Initial State: { LB = (3,3) | B = (0,0) | RB = (0,0) }
   - Goal State: { LB = (0,0) | B = (0,0) | RB = (3,3) }
5. PARTIAL STATE SPACE GRAPH/TREE
   - State Space Operators:
     (**1**) Place 1 M and 1 C on boat: LB = (m-1,c-1) | B = (1,1) | RB = (m,c)
     (**2**) Place 2 C's on boat: LB = (m,c-2)| B = (0,2) | RB = (m,c)
     (**3**) Place 1 C on boat (C already controlling boat): LB = (m,c-1) | B = (0,2) | RB = (m,c)
     (**4**) Place 1 M on boat (C already controlling boat): LB = (m-1,c) | B = (1,1) | RB = (m,c)
     (**5**) Drop M on RB: LB = (m,c) | B = (0,1)| RB = (m+1,c)
     (**6**) Drop C on RB: LB = (m,c) | B = (0,1)| RB = (m,c+1)

Graph is on next page



6. STATE SPACE SOLUTION

Step	State
–	(3,3) (0,0) (0,0)
(**1**)	(2,2) (1,1) (0,0)
(**5**)	(2,2) (0,1) (1,0)
(**3**)	(2,1) (0,2) (1,0)
(**6**)	(2,1) (0,1) (1,1)
(**4**)	(1,1) (1,1) (1,1)
(**5**)	(1,1) (0,1) (2,1)
(**3**)	(1,0) (0,2) (2,1)
(**6**)	(1,0) (0,1) (2,2)
(**4**)	(0,0) (1,1) (2,2)
(**5**)	(0,0) (0,1) (3,2)
(**6**)	(0,0) (0,0) (3,3)