Kuncheng Feng
CSC 416

Modeling Challenge: Missionaries and Cannibals State Space Problem Solver

1. PROBLEM STATEMENT

Three missionaries and three cannibals are at the left side of a river bank. They have a boat that fits at most two people at once, and it needs at least one person to operate. At any point if there are more cannibals than missionaries on one side of the river, the missionaries will get eaten. The task is to get all six individuals to the right side of the river bank alive.

2. THE OBJECTS OF THE STATE SPACE WORLD

The state space will consist of two objects, each containing a list at most of length 7.

- Bank *left-bank*, with an initial value of (m m m c c c b).
- Bank *right-bank* with an initial value of ().

3. REPRESENTATION OF A STATE OF THE WORLD

We can represent the world in the following form :- <(m m m c) (c c b)>, where m represents the missionary, c represents the cannibal, and b represents the boat.

4. THE STATE SPACE DESCRIPTION

- Initial state :- <(m m m c c c b) ()>
- Goal state :- <() (m m m c c c b)>
- State space operator :-

  O = {(b c) (b m) (b c c) (b c m) (b m m)}, where

  (b c) = <(m m m c c c b) ()> —> <(m m m c c) (c b)>
  <(m m m c c) (c b)> —> <(m m m c c c b) ()>

  (b m) = <(m m m c c c b) ()> —> <(m m c c c) (b m)>
  <(m m c c c) (b m)> —> <(m m m c c c b) ()>

  (b c c) = <(m m m c c c b) ()> —> <(m m m c) (b c c)>
  <(m m m c) (b c c)> —> <(m m m c c c b) ()>

  (b c m) = <(m m m c c c b) ()> —> <(m m c c) (b c m)>
  <(m m c c) (b c m)> —> <(m m m c c c b) ()>

  (b m m) = <(m m m c c c b) ()> —> <(m c c c) (b m m)>
  <(m c c c) (b m m)> —> <(m m m c c c b) ()>

  The current bank is where the boat is, and the elements included with the boat will travel to the other side of the bank, with previously stated constraints and comment sense.

5. STATE SPACE GRAPH

6. STATE SPACE SOLUTION

left-bank *right-bank*

```
1. (B C C)        <(m m m c c c b) ()> —> <(m m m c) (b c c)>
2. (B C)          —> <(m m m c c b) (c)>
3. (B C C)        —> <(m m m) (b c c c)>
4. (B C)          —> <(m m m c b) (c)>
5. (B M M)        —> <(m c) (b c c m m)>
6. (B M C)        —> <(m m c c b) (c m)>
7. (B M M)        —> <(c c) (b c m m m)>
8. (B C)          —> <(c c c b) (m m m)>
9. (B C C)        —> <(c) (b c c m m m)>
10.   (B C)       —> <(b c c) (c m m m)>
11.   (B C C)     —> <()(b c c c m m m)>
```