The missionaries and cannibals problem

- N missionaries and N cannibals are at the left bank of a river

- There is a boat that can hold K people

- Find a way to get everyone to the right bank

- So that at any time, at any place (on either bank, or in the boat), #missionaries $\geq$ #cannibals or #missionaries $=0$

Formulation of the MC problem

- States (M, C, B) where M − #missionaries, C − #cannibals at the left bank, $B = 1$ indicates the boat is at the left bank

- Actions (m, c) where m − #missionaries, c − #cannibals on the boat

- Precondition: #missionaries and #cannibals satisfy the constraint

- Effects: $(M, C, 1) \overset{(m,c)}{\Rightarrow} (M − m, C − c, 0)$ and $(M, C, 0) \overset{(m,c)}{\Rightarrow} (M + m, C + c, 1)$

Running breadth-first with cycle-checking for $M = 3$ and $K = 2$

(3,3,1)

(1,1) (0,1) (0,2)

(2,2,0) (3,2,0) (3,1,0)

(1,1) (0,1) (0,1) (0,2)

(3,3,1) (3,3,1) (3,2,1) (3,3,1)

(1,0) (0,1) (0,2)

(2,2,0) (3,1,0) (3,0,0)

(0,1) (0,2)

(3,1,1) (3,2,1)

(2,0) (0,1)

(1,1,0) (3,0,0)

(2,0) (1,1)

(3,1,1) (2,2,1)

(1,1) (2,0)

(1,1,0) (0,2,0)

(2,0) (0,1)

(2,2,1) (0,3,1)

(0,1) (0,2)

(0,2,0) (0,1,0)

(1,0) (0,1) (0,2)

(1,1,1) (0,2,1) (0,3,1)

(1,1) (0,2)

(0,0,0) (0,0,0)