Project 1

Using REDLIB to solve the cannibals & missioneries game.

Farn Wang

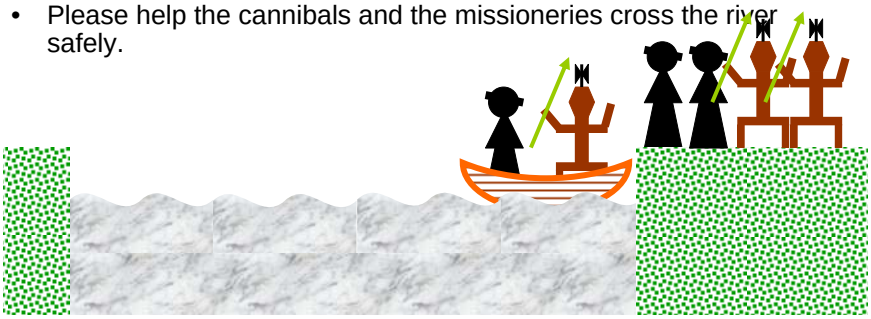
Fall 2008

Project 1: *Cannibals & Missioneries* (1/6)

3 cannibals and 3 missioneries at a bank.

They want to cross the river.

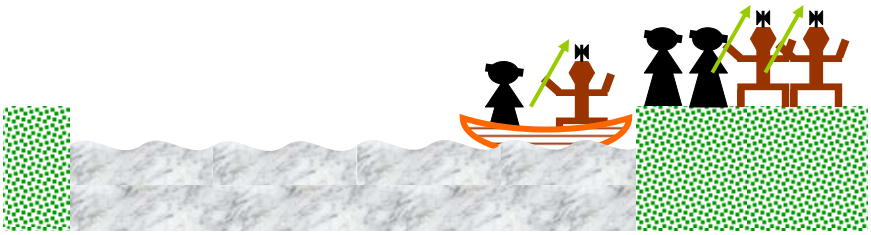
- Only 1 boat.
- At most 2 persons in the boat at at time.
- At a bank, if there are more cannibals than missioneries, the cannibals will eat the missioneries.
- Please help the cannibals and the missioneries cross the river safely.



Project 1:
Cannibals & Missioneries (2/6)

LEMMA: If there is a solution sequence, then the sequence is no longer than 4×4=16.

Proof: At any step, there can be 0, 1, 2, 3 missioneries and 0, 1, 2, 3 cannibals at the starting bank. ■



Project 1:
Cannibals & Missioneries (3/6)

Representing a solution sequence with logics.

atomic propositions of the form s(i,j,k)

- i ∈{0,1,2,3}
- j ∈{0,1,2,3}
- k ∈{1,2,…,16}

s(i,j,k) : at step k, there are i missioneries and j cannibals at the starting bank.

Project 1:
Cannibals & Missioneries (4/6)

What is a safe step?

s(i,j,k) ➔ i ≥ j

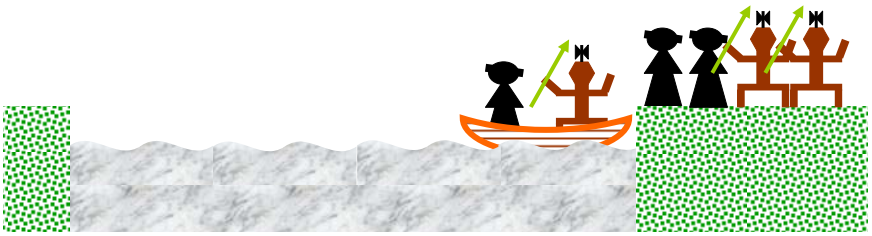
What is a safe step ?

s(0,0,k)
∨ s(1,0,k) ∨ s(1,1,k)
∨ s(2,0,k) ∨ s(2,1,k) ∨ s(2,2,k)
∨ s(3,0,k) ∨ s(3,1,k) ∨ s(3,2,k) ∨ s(3,3,k)

Project 1:
Cannibals & Missioneries (5/6)

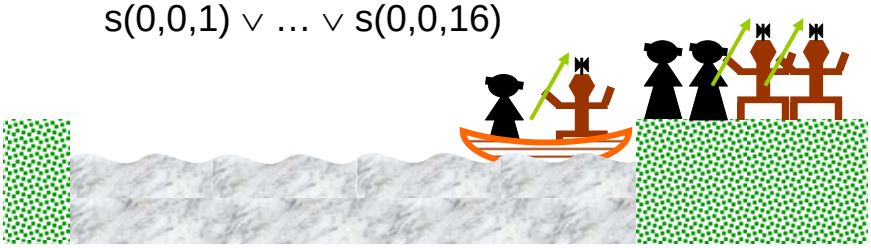
What is the relation between two steps ?

s(i,j,k)➔ (s(i-1,j,k+1) ∨ s(i,j-1,k+1)
∨ s(i-1,j-1,k+1) ∨ s(i+1,j+1,k+1)
∨ s(i-2,j,k+1) ∨ s(i,j-2,k+1)
∨ s(i+2,j,k+1) ∨ s(i,j+2,k+1))



Project 1: *Cannibals & Missioneries* (6/6)

- What is the initial step ? s(3,3,1)
- What is the mutual exclusion of different steps ?
  $\forall i,\forall j,\forall k,\ (s(i,j,k) \rightarrow \forall i',\forall j',(s(i',j',k) \rightarrow (i=i' \wedge j=j')))$
- What is a solution ?
  $\exists k, s(0,0,k)$, or we can write
  $s(0,0,1) \vee \ldots \vee s(0,0,16)$



Project 1 assignment

Please use **REDLIB** at

http://sourceforge.net/projects/redlib

to construct a program that does the following.

- The program accepts an input natural number *n*.
- The program answer if there is a step sequence to move *n* missioneries and *n* cannibals crossing the river safely.
- If there is, the program also out the step sequence.