

CSC 404 - HOMEWORK 1 - NAME:

Problem 1 (River crossing with a middle island!). On one bank of a river are **four** missionaries and **four** cannibals. There is one boat available that can hold up to **two** people and that they would like to use to cross the river. The river contains a middle island that can be used to assist the movement of missionaries and cannibals across the river. (Here we are allowed to cross from bank-to-bank without stopping at the middle island. If this were not allowed, we could not transport two cannibals across if a missionary were on the middle island.)

If the cannibals ever outnumber the missionaries on either of the river's banks, the missionaries will get eaten. How can the boat be used to safely carry all the missionaries and cannibals across the river?

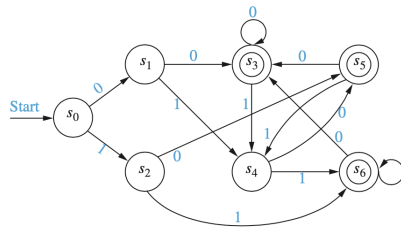


- a. Solve the riddle by drawing a diagram indicating the movement of missionaries and cannibals. Record the number of movements used.

- b. (Bonus) Solve the original riddle with the assumption that shore-to-shore travel is not allowed (i.e., you must stop at the middle island). Does this change the number of movements used?

- c. (Bonus) Solve the riddle with $N = 5$ missionaries and $N = 5$ cannibals (without and with shore-to-shore movement)
- d. (Bonus) Attempts at implementing a search algorithm (in a language of your choice) to construct a path from initial state to end state in the Missionaries and Cannibals (+ Middle Island) Riddle?

Problem 2. (Why do you hate 01?) Consider the following deterministic finite-state automaton (DFA).



a. Determine which of the following are accepted by the DFA. What state do they end at?

$w_1 = 101010$ (42!)

$w_2 = 000111$

$w_3 = 011100$

$w_4 = 10100111001$ (1337!)

b. Identify all bit-strings of length 3 that are accepted by the DFA.

000 001 010 011 100 101 110 111

c. Identify all bit-strings of length 4 that are accepted by the DFA.

0000 0001 0010 0011 0100 0101 0110 0111

1000 1001 1010 1011 1100 1101 1110 1111

d. Identify all bit-strings of length 5 that are accepted by the DFA.

00000 00001 00010 00011 00100 00101 00110 00111

01000 01001 01010 01011 01100 01101 01110 01111

10000 10001 10010 10011 10100 10101 10110 10111

11000 11001 11010 11011 11100 11101 11110 11111

e. (Bonus) Describe (in words) the set of bit-strings recognized by this DFA. (Hopefully you see a pattern in the mess that is this machine.)

f. Blank space – add some sweet pictures – yay! Fun fact, binary numbers that end with 01 are congruent to 1 modulo 4.

- Set of all bit-strings that contain the substring 001. (Use at most 4 states)
- Set of all bit-strings except 11 and 111 (Use at most 5 states)
- Set of all bit-strings where every 1 is followed by at least two 0s. (e.g., 0, 100, 01000, 1001000, ...)
- Set of all bit-strings that contain an even number of 0s and an even number of 1s. (Use 4 states)
- (Bonus) Set of bit-strings that contain an equal number of occurrences of the substrings 01 and 10. Note 101 is accepted because 101 contains a single 10 and a single 01, but 1010 is not because it contains two 10s and one 01.

