CS 461 – ARTIFICIAL INTELLIGENCE

HOMEWORK #2 (5% OR 10 POINTS)

Assigned: Wed 23 Oct 2019

Due: Thu 7 Nov 2019 ** 2 pm ** NOTE THE UNUSUAL DUE DATE (owing to DEMO #1 on Wed 6 Nov)

You can do this homework in groups of 5 (or less). Your group for this homework should normally coincide with your term project group. In any case, do not forget to indicate clearly the students who are submitting this homework (i.e., write at most five names on the submission).

You must submit your entire homework (include all the original code written) to our TAs. Just a single submission per group! Our TAs will soon send you a note explaining the mechanics of submissions. They may also tell you whether there'll be a need to submit hardcopy, etc.

Any programming language can be used as long as you have it available on a portable computer. Needless to say, a group member should be prepared to give a homework demo (individually and using that portable computer) when requested to do so by our TAs.

This homework is a continuation of the work you've done in HOMEWORK #1. It consists of two parts:

I. (8 points) 6 missionaries and 6 cannibals should cross a river. The capacity of the boat is 5. You must list the shortest sequence of crossings which does the job.

II. (2 points) 4 missionaries and 4 cannibals should cross a river. The capacity of the boat is 3. This time, you must calculate the number of shortest sequence of crossings (viz. the number of shallowest goals).

(As was the case with HW #1, there is a paper relevant to this assignment and it may be very useful to take a look at it: https://dl.acm.org/citation.cfm?id=144106)

*HINT: Earlier you've most probably used **xMyCb** as a state representation, where x is the number of missionaries (M) on the west bank, y is the number of cannibals (C) on the west bank, and b is 1 if the boat is on the west bank (and 0, if it is on the east bank). This representation is still good but notice that now the welfare of the passengers in the boat is also crucial. (This you didn't have to worry about when the capacity of the boat was 2.)*

Your program must use the A* search strategy to solve part (I). (Just implement, in a straightforward manner, the pseudocode given in Winston, Chapter 5.) It is your responsibility to design an admissible heuristic h(n), where n is a node in the state space. In the beginning of your program, you should have a block comment where you explain clearly which h(n) you are using and why you think it is admissible.

You must check for repeated states. It is entirely up to you to add a dynamic programming component to your program. (In other words, you won't lose points if you don't have such a component.)

What should be the output of your program?

> **A sequence of crossings will do the job for part (I).** For instance, in the classical version of the problem (start state = 3M3C1 and boat capacity = 2) the program might produce a sequence which begins:

```
CCC
MMM


SEND    2 CANNIBALS 0 MISSIONARIES
C                     CC
MMM

RETURN  1 CANNIBALS 0 MISSIONARIES
CC                    C
MMM
```

. . .

> **For part (II), a number is required and you can use any search strategy**. (But do not forget to clearly state---again in a block comment---what strategy it is.)

Your program should have a simple control for 'single stepping' (tracing your code) so that you and the TAs can inspect the intermediate stages of the problem-solving process in an incremental fashion. Needless to say, this is also useful for debugging your program during the development stage.

GENERAL REMARKS (THESE ARE APPLICABLE TO ALL HOMEWORK ASSIGNMENTS)

- IF YOU ARE REQUESTED TO SUBMIT A HARDCOPY AT ANY TIME IN THIS COURSE, MAKE SURE THAT WHAT YOU SUBMIT IS CLEAN AND FULLY MACHINE-GENERATED. IF THERE IS A HANDWRITTEN ADDITION OR CORRECTION ON A PRINTOUT, YOU'LL DEFINITELY LOSE POINTS.
- Late submissions will first have 2 points deducted categorically. Then they'll have 2 points deducted for every late day. (A new day begins at 12:01 midnight.)
