## CSCE 580/581: Intr AI/ Trusted AI Prof. Biplav Srivastava, Fall 2023

## Quiz 2 / October 3, 2023/ Instructions Nathanael Oliver

* Upload a .pdf with your answer to Blackboard before the end of day on Tuesday (Oct 10, 2023)
* For coding part (Q3), implement a python notebook or in Collab. Call it – “<Yourname>-Quiz2-Response”.
* Send email confirming submission made to both Instructor and TA

Total points = (10 + 60 + 30): 100 points, Obtained =

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**The quiz is to test your understanding of concepts of search.**

**Q1: Search and Heuristics** [2 + 2 + 2 + 4 = 10 points]

**Instructions**: Give your answers in bullet points.

a) What is an admissible heuristics? [2 points]

An admissible heuristic is a heuristic that estimates the cost to be less than or equal to the actual cost of the optimized solution.

b) Suppose you are given “h = 0” as the heuristics for a problem. Is it admissible ? [2 points]

Yes. This is admissible because h\*(S) must be greater than or equal to 0, so h(s) will always be less than or equal to h(s).

c) Suppose you are given “h = k” as the heuristics for a problem, where k is any number e.g., k=1? Can you say it is admissible ? [2 points]

No, this is not admissible because it could overestimate the cost of the heuristic.

d) You are given 3 heuristics: h1, h2 and h3 of which you are sure that one is admissible. Will   
h = min (h1, h2, h3) be admissible ? What can we say about h = max (h1, h2, h3) as admissible ?

[2 + 2 = 4 points]

We know that the minimum of h1, h2, and h3 will be admissible because we know that it will always be the smallest of the 3 and we know that at least one of them is smaller than the optimal solution and therefore, the minimum of the 3 is admissible.

We cannot determine whether the maximum of h1, h2, and h3 is admissible unless we know that h1, h2, and h3 are admissible.

**Q2: Using search for a practical problem** [30 + 30 = 60 points]

Consider the missionaries and cannibals problem. Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. Find a way to get everyone to the other side, without ever leaving a group of missionaries in one place

outnumbered by the cannibals in that place.

* States: a state consists of an ordered sequence of three numbers representing the number of missionaries, cannibals, and boats on the bank of the river from which they started. Thus, the start state is (3,3,1).
* Operators: from each state the possible operators are to take either one missionary, one cannibal, two missionaries, two cannibals, or one of each across in the boat. Thus, there are at most five operators,
* Goal test: reached state (0,0,0).
* Path cost: number of crossings.

a) Use any uninformed search method and solve this problem? Show code, solution and time. [30 points]

b) Use any informed search method and solve this problem ? (Example: choose A\* and any admissible heuristic). Show code, solution and time. [30 points]

**Q3: Formulating CSPs**  [30 points]

a) Consider the cryptanalyst problem:

T W 0

+ T W 0

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F O U R

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Where each character stands for a unique number in the range (0-9). Formulate it as a CSP.

What are the variables, their domains and constraints? [15 points[30 points]]

b) Can we try to solve it using node, arc and path consistency? Show the closest you can come to a solution? [15 points]