THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

JANUARY – APRIL 2020 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER AND LIBRARY SCIENCE

REGULAR PROGRAMME

CMT 208: INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Date: APRIL 2020	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any other TWO Questions	

Q1. a) Define the following terms:

i) Turing Test **(1 mark)**

ii) Agent **(1 mark)**

iii) Heuristic search **(1 mark)**

iv) Blind search **(1 mark)**

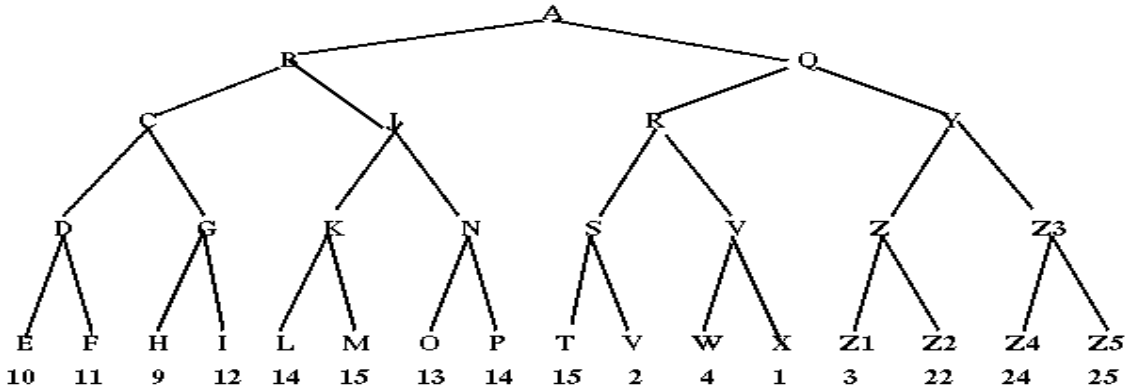
v) Logic **(1 mark)**

b) Describe four ways of evaluating a search algorithm's performance.

(4 marks)

c) Define four types of agents. **(4 marks)**

d) Apply minimax with Alpha-beta pruning on the following game tree.



i) Cross out the leaf nodes and/or branches where alpha-beta prunes. **(8 marks)**

ii) Indicate the branch node values that are evaluated. **(2 marks)**

e) Translate the following English sentences to Propositional Logic predicates using these atoms:
P: Amy passes the course
G: Amy gets a good grade
S: Amy studies hard
E: The exam is easy
i) If Amy gets a good grade she will pass the course. **(1 mark)**

ii) Amy will pass the course if she studies hard or the exam is not difficult. **(2 marks)**

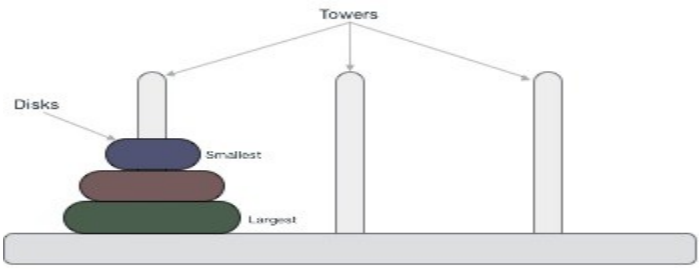
iii) If the exam is difficult and Amy does not study hard she will get a low grade. **(2 marks)**

iv) Amy will pass the course with a good grade if and only if she studies hard and the exam is easy. **(2 marks)**

Q2. a) Consider the missionaries and cannibals problem. Three missionaries and three cannibals must cross a river using a boat which can carry at most two people, under the constraint that for both banks, if there are missionaries present on the bank, they cannot be outnumbered by cannibals (if they were, the cannibals would eat the missionaries). The boat cannot cross the river by itself with no people on board. How can the boat be used to safely carry all the missionaries and cannibals across the river? Use state space search to find solution. **(10 marks)**

b) Consider the Towers of Hanoi Puzzle.
It consists of a collection of rings of different sizes and three posts mounted on a base. At the beginning all the rings are on the leftmost post as shown below and the goal is to move them all to the rightmost post by moving one ring at a time from one post to

another. But at no time may a larger ring be placed on top of a smaller one. Find the solution using a search tree. **(10 marks)**

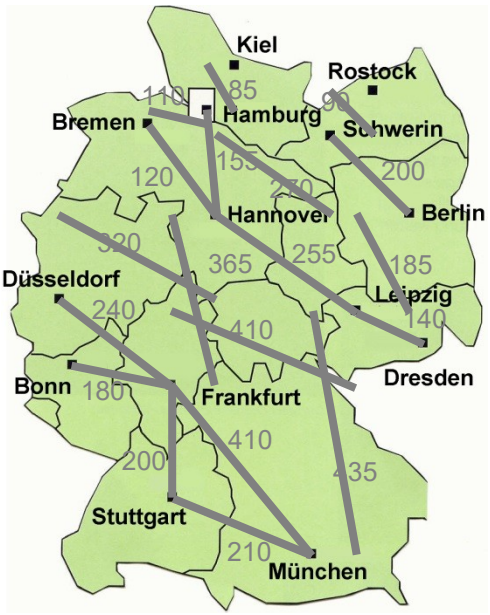


Q3. a) This problem asks about the map coloring problem. Each region must be colored one of Red (R), Green (G), Blue (B), or Yellow (Y). Neighboring regions must be a different color. The map is below. Show your constraint graph and the color of each region. **(12 marks)**

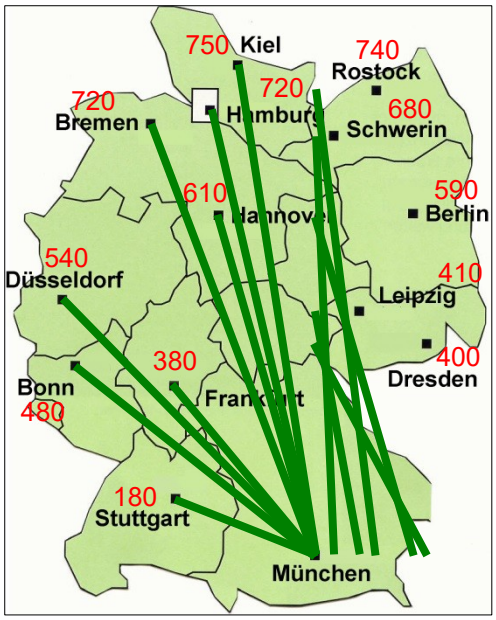
b) Describe the four components that define adversarial search. **(4 marks)**

c) A task environment is a set of four things with the acronyms PEAS. List them. **(4 marks)**

Q4. a) Consider the following maps:



Distance between cities



h(): SLD heuristic

The heuristic function h() to be used is the Straight Line Distance (SLD). We wish to move from Hannover to Munchen. Find the shortest path using A* search.

i) Provide a search tree for your solution, showing the cost at each node. **(12marks)**

ii) State the route you would take (solution path) and the cost of that route**. (2marks)**

b) Translate the following English sentences to first order logic.

i) Some dogs do not like any cats. **(2 marks)**

ii) Anyone passing his history exams and winning the lottery is happy. **(4 marks)**

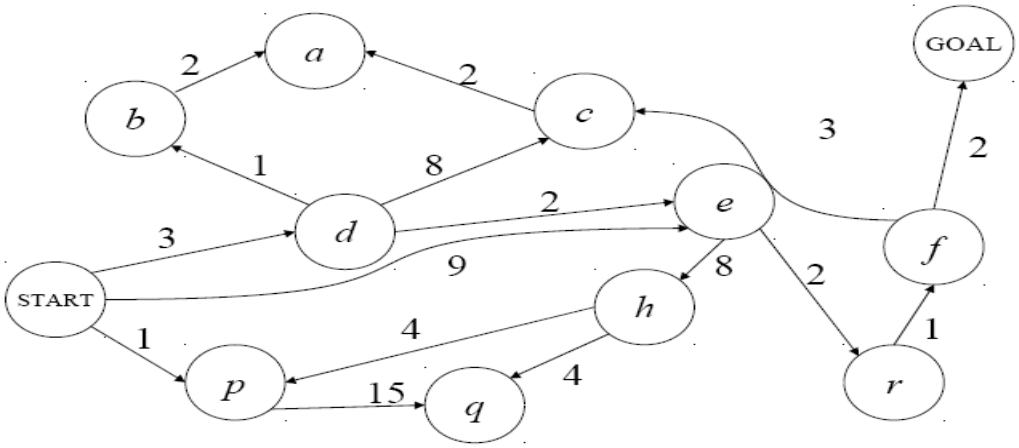
Q5. Consider a robo-soccer team agent.

a) Develop a description of the task environment using the PEAS description. **(4 marks)**

b) Describe the environment according to the following properties: fully vs partially observable, deterministic vs stochastic, episodic vs sequential, static vs dynamic, discrete vs continuous, single vs multi-agent **(6 marks)**

c) Suggest the most appropriate agent design by choosing the most appropriate of the following agent types: simple reflex agent, model-based reflex agent, goal-based agents, utility-based agent. **(2 marks)**

d) Consider the following graph:



Initial State is node START and goal state is node GOAL. Using Uniform Cost Search find:

i) Total cost to the goal node **(4 marks)**

ii) The solution path **(4 marks)**

END