Färg!

UNIVERSITY
OF SKÖVDE

Cover sheet with information to the invigilator

School of Informatics

Course IT776A Artificial Intelligence A1N

Examination

Course code IT776A

Credits for written examination 4.5

Date 2023-12-15

Examination time 14:15 – 17:30

Available teacher Joe Steinhauer

Available on phone number 079 3354587

Visiting the examination ☐ Yes, at

☒ No

Aids and other information for invigilators

Calculator ☐ Provided by the University

☐ Student's own calculator

☒ Not allowed

If you copy the exam papers yourself, provide the number of copies

Instructions to examinations responsible

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WRITTEN EXAMINATION

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Date 2023-12-15

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Examination responsible Joe Steinhauer

Teachers concerned Joe Steinhauer

Aid at the exam/appendices

Other

Instructions

- ☐ Take a new sheet of paper for each teacher.
- ☒ Take a new sheet of paper when starting a new question.
- ☒ Write only on one side of the paper.
- ☒ Write your name and personal ID No. on all pages you hand in.
- ☒ Use page numbering.
- ☒ Don´t use a red pen.
- ☒ Mark answered questions with a cross on the cover sheet.

Grade points 40

Examination results should be made public within 18 working days

Good luck!

Total number of pages

Artificial Intelligence, IT776A

Exam, autumn term, 2023

December 15th, 2023

Rules

- All questions are to be answered within the context of artificial intelligence and the contents of lectures, slides and assignments.
- You are expected to answer in a thorough, yet concise manner. That is, elaborate on your answers without dwelling on aspects which are not strongly related to the question at hand.
- Write in an intelligible manner. If your writing needs to be decoded, no points will be awarded.
- Use a clear handwriting, if your text is not readable, no points will be awarded.
- The exam has 4 parts à 10 points. To pass this exam you have to pass each of the 4 parts by reaching no less than 5 points. If you successfully pass all parts your final grade will be determined by the sum of all points and the following grading scheme:

Sum of Points	Final Grade
36 – 40	A
32 – 35	B
28 – 31	C
24 – 27	D
20 – 23	E
< 20	F

Table 1: Exam grading scheme.

Good luck!

1. Artificial Intelligence

1.1. How do the areas of AI and data science relate to each other? (2 point)

1.2. What techniques within AI will a Data scientist most likely be using? (2 point)

1.3. How is intelligent behavior defined by Russel & Norvig (2 points)

1.4. Provide a definition that is most commonly used to define what artificial intelligence is (as discussed in the lectures). (2 points)

1.5. What is meant by an AGI? Provide an explanation. (2 points)

2. Agents

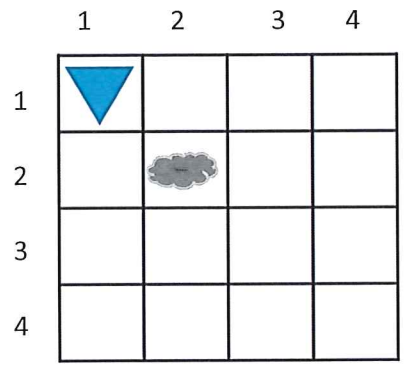
In this question you will need to describe and build several (potentially different) autonomous agents.

2.1. List the four different agent types that we have discussed in the lectures and describe their differences using the two most important characteristics of these agent types.
(2 points)

2.2. The picture below shows a room represented as a grid with an autonomous vacuum cleaner represented as a triangle. The agent (vacuum cleaner, can move left, right, up or down). What type of agent is the simplest type of agent that is capable of cleaning the whole floor in the picture below? Motivate your answer and describe how the agent moves to achieve coverage of the whole floor.
(2 points)

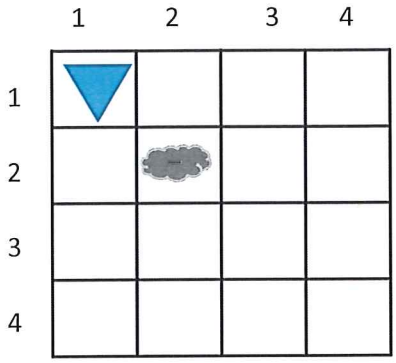
2.3. What type of agent do you need if you want it to go directly to the dirty spot and clean only that dirty spot?
2.3.1. Describe the agent type, which type do you need to use and why?
2.3.2. What input does the agent need?
2.3.3. What will the agent do internally to solve this problem (what functionality does it need to have)?
(3 points)

2.4. In this question, you want your vacuum cleaner to be able to clean any dirty spot on the floor (clean the whole floor), but it should never run out of battery. What type of agent do you need to achieve that? Explain your agent and explain how it makes sure that it will be able to clean and never run out of battery.
(3 points)



3. Search

Consider the same problem as in question 2. An autonomous vacuum cleaner, that operates in a grid space is supposed to clean the floor. The agent is represented by the blue triangle and the one and only spot of dirt is represented by the grey cloud. The agent can move up, down, left or right.



3.1. Uninformed Search

3.1.1. The agent can move up, down, left or right in any order, how many possible paths are there from its current starting position to the goal state (position of the dirt)? Motivate your answer. (1 point)

3.1.2. What is the branching factor for the search tree that describes this problem? (1 Point)

3.1.3. Which uninformed search algorithms will provide a path to a goal state in a finite amount of time? Name the algorithms, explain how they work in general, and show, using a search tree, how each of algorithms will find the goal state. (Make sure you clearly indicate the order of nodes in that each algorithm will traverse the tree.) (3 points)

3.2. Uniform cost search

A move left or right costs the agent 2 dollars, whereas a move up or down only cost 1 dollar.

3.2.1. Explain how uniform cost search works (2 points)

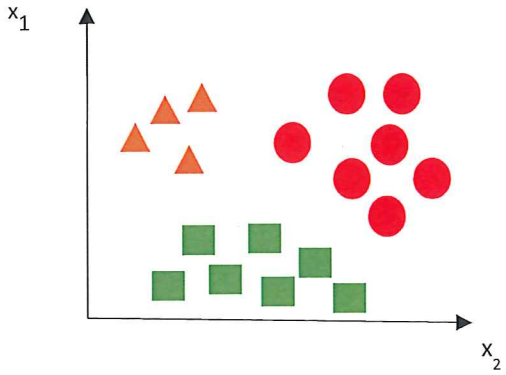
3.2.2. Given the costs described above,

a) in which order will the agent traverse through the search tree.
b) Provide the cost function for each node
c) Provide the final path from start to goal that the uniform cost search algorithm found.

(3 points)

4. Machine Learning

In the picture below there are three groups of objects, they each are represented by their x_1 and x_2 coordinates in the coordinate system.
If given an object at a coordinate (x_1, x_2) a neural network should make a prediction which group that object belongs to.



4.1. What type of machine learning will solve this problem? Describe what is necessary to use this type of machine learning, and how the problem at hand satisfies these prerequisites. (2 point)

4.2. During the lectures we discussed two different approaches to solve this problem with a single layer perceptron.

4.2.1. Name the two different approaches and explain how each of them would solve the task using the single layer perception (1 point).
Draw both single layer perceptrons and explain in natural language how each of the nodes of the single layer perceptrons contribute to solve the problem (2 points).

4.2.2. For each approach make a drawing of the coordinate system and show how the approach separates between the three groups (2 points)

4.3. In the picture below, a new object is included (its position is marked with a star), use your two single layer perceptrons to identify the new object.

4.3.1. Describe in detail how each of them determines the type of object (3 points)