UNIVERSITY OF SKÖVDE

School of Informatics

WRITTEN EXAMINATION

Course IT776A Artificial Intelligence A1N

Examination

Course code IT776A

Credits for written examination 4.5

Date 2024-12-12

Examination time 14:15-17:30

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, 2024

December 12th, 2024

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. AI in general

1.1. Provide and explain the definition of machine learning that we discussed during the course (Mitchell's definition). Describe and <u>explain</u> what the three elements included in the definition are and what they mean. (3 points)

1.2. Describe why knowledge about machine learning is of importance for a data scientist and for which purposes a data scientist will most likely use machine learning. <u>Motivate your answer.</u> (3 points)

1.3. Define artificial intelligence, in accordance with Marvin Minsky's definition. (2 points)

1.4. Describe what is meant by an AGI? (2 points)

2. Agents

2.1. List the four different agent types that we have discussed in the lectures and describe their differences with regard to the two most important characteristics of these agent types that we have discussed in the lectures. (4 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).

   2.2.1. What type of agent is <u>the simplest type of agent</u> that is capable of cleaning the whole floor in the picture below and how would you ensure that this agent actually does clean the whole floor? <u>Motivate your answer.</u> (2 points)

   2.2.2. What input processing capabilities are necessary for the agent to work <u>Motivate your answer</u>. (2 points).

2.3. Describe what kind of environment this autonomous vacuum cleaner is working in. <u>Motivate your answer</u>. (2 points)
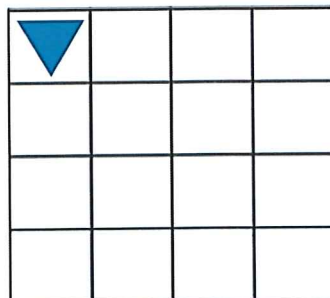
3. Search

Consider the sliding puzzle problem below. To the left you see the initial state and to the right you see the goal state that we want to achieve using a search strategy.

|	1
3	2

1	2
3	

    Initial state   Goal state

3.1. How deep would a complete search tree for this problem be? Motivate your answer (1 point)

3.2. What is the branching factor for the search tree? Motivate your answer. (1 Point)

3.3. Which uninformed search algorithms, that we have discussed in the lectures, will provide a path to a goal state in a finite amount of time? Name the algorithms and explain for each of them how they work in general. (4 points)

3.4. Explain what it means when a search strategy is optimal (1 point)

3.5. Explain what it means when a search strategy is complete (1 point)

3.6. Describe which of the uniformed search strategies, discussed in the lectures are optimal and/or complete and explain why/how they fulfill these requirements (2points)

4. Machine Learning

4.1. Consider the diagram below with two different groups of elements, defined by the features x_1 and x_2. What type of neural network that we have discussed in the lectures could successfully distinguish these two classes of elements?
Draw the network and describe how it manages to distinguish the two classes of elements. Make your solution id as simple as possible (2 points)
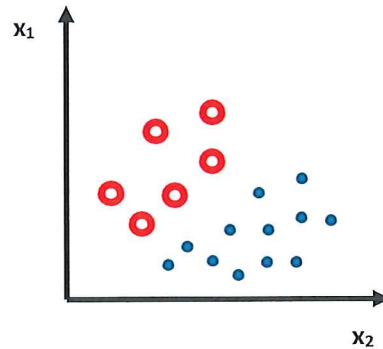
4.2. Consider the diagram below with three different types of elements described by the features x_1 and x_2. What type of neural network that we have discussed in the lectures could successfully distinguish these three classes of elements. (1 point)

4.2.1. There are two different approaches of using this method to solve the problem what are they called? (1 point)

4.2.2. Draw two one network for each of the two different approaches and describe how they each manages to distinguish the three classes of elements. Make sure that your network design is as simple as possible (6 points).