GKI EXAM SOSE-2022

First Name	Last Name	Matriculation No.

Task	Maximum Points	Points Achieved
1	50	
2	10	
3	15	
4	10	
5	15	
Exam	100	
Homework Bonus	9	
Extra Bonus	5	
Pre-Final (x)	114	
Final (y)		

(DO NOT WRITE ANYTHING IN THE ABOVE TABLE.)

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General Guideline

- **Duration:** 08:30 - 10:30
- **Total exam credit:** 100
- **Identification:** Write your name and matriculation No. (Immatrikulation No.) on all pages.
- **Language:** You choose **either** English or German to write your answers. Thus, you cannot answer some questions in English and some in German. In such cases, we choose one language on our decision and ignore the answers written in the other language. You can use keywords in English even if you answer in German.You may use a dictionary book, if you have to.
- **Resources:** This exam is **closed-book**. So you should not use a textbook, a computer, calculator or any other materials during the exam. However, you may use a one-page "cheat sheet". One A4 paper **hand-written** note double-sided. Student's name should be on both sides of the cheat sheet paper.
- **Preparation:** Turn off all digital devices before starting the exam. Your backpack should be placed where organizers show.
- **During Exam:**
  - No credit will be given for questions left unanswered.
  - Write your answer to each question or problem in the space provided. If more space is needed just raise your hand.
  - Ensure to write neatly and answer all questions unambiguously. We do not give credit to answers that we cannot read or decipher.
  - Answer the question directly, without writing extra and unnecessary information. Any false information affects your credit negatively.
  - If you need to leave for the restroom, we'll keep your exam here and note down the times in the protocol.
  - If you finish earlier, you can hand in your exam and leave. Please be silent while you are doing so.
  - Most importantly: **Enjoy the exam!**

Good Luck!

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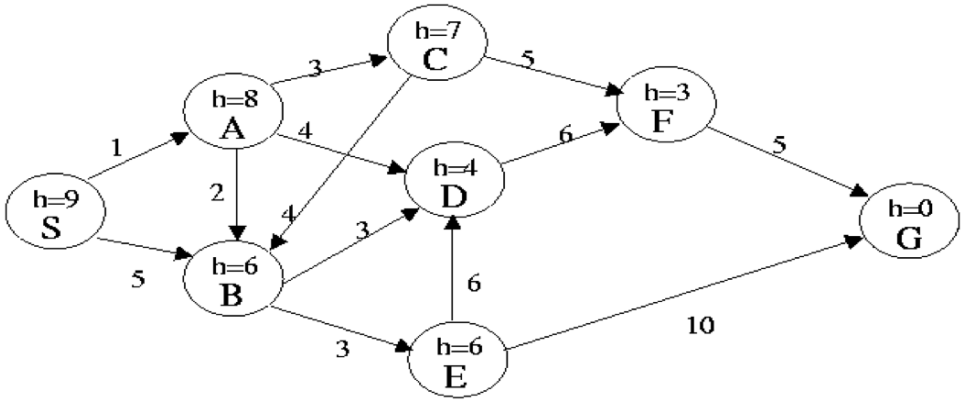
Task 1 (50 points)

In this problem the start state is S, and the goal state is G. The transition costs are next to the edges, and the heuristic estimate, h, of the distance from the state to the goal is in the state's node. Assume ties are always broken by choosing the state which comes first alphabetically.



(a) What is the order of states expanded using Depth First Search (DFS)? Assume that DFS terminates as soon as it reaches the goal state?
Answer:

(b) What is the order of states expanded using Breadth First Search (BFS)?
Answer:

(c) What is the order of states expanded using Best First Search? Assume that the algorithm terminates as soon as it reaches the goal state.
Answer:

(d) What is the order of states expanded using A* search?
Answer:

(e) What is the least cost path from S to G?
Answer:

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Task 2 (10 points)

TRUE or **FALSE** Circle the correct answer.

(a) **TRUE** **FALSE** An agent that senses only partial information about the state cannot be perfectly rational.

(b) **TRUE** **FALSE** Random restarts are often used in local search to diminish the problem of local maxima.

(c) **TRUE** **FALSE** An important advantage of support vector machines (SVMs) is that they can directly implement classifiers with a large number of classes.

(d) **TRUE** **FALSE** The agent program runs on the physical architecture to produce agent function.

(e) **TRUE** **FALSE** Breadth First Search (BFS) is a complete algorithm.

(f) **TRUE** **FALSE** A probability p attached to a statement means that the statement is true with p%.

(g) **TRUE** **FALSE** Support vector machines give a probability distribution over the possible labels given an input example.

(h) **TRUE** **FALSE** Two benefits of using convolutional layers instead of fully connected ones are parameter sparsity and parameter sharing.

(i) **TRUE** **FALSE** An agent that solves crossword puzzles is interacting with a fully observable environment.

(j) **TRUE** **FALSE** Given two admissible heuristics h1 and h2, we prefer h2 over h1 if h2 always estimates lower or equal costs than h1.

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Task 3 (15 points)

Suppose that we are given the following set of data with three Boolean features x1, x2 , and x3. We are also given a single Boolean output variable Y. We should use a naive Bayes classifier to predict the Y's value from the feature values.

x1	x2	x3	Y
1	0	1	1
1	1	1	1
0	1	1	0
1	1	1	0
1	0	1	0
0	0	0	1
0	0	0	1
0	0	1	1

(a) What is the prior probability of Y?

Answer:

(b) According to the naive Bayes classifier, what is $P(Y = 1 \mid x_1 = 1, x_2 = 1, x_3 = 0)$?

Answer:

(c) According to the naive Bayes classifier, what is $P(Y = 0 \mid x_1 = 1, x_2 = 1)$?

Answer:

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Task 4 (10 points)

A hospital in Duisburg asks you to design an AI agent to identify the type of a patient's disease based on the four symptoms. The hospital gives you a set of data as follows:

fever	vomiting	diarrhea	shivering	diagnosis
no	no	no	no	healthy (H)
average	no	no	no	Covid-19 (C)
high	no	no	yes	Covid-19 (C)
high	yes	yes	no	salmonella poisoning (S)
average	no	yes	no	salmonella poisoning (S)
no	yes	yes	no	bowel inflammation (B)
average	yes	yes	no	bowel inflammation (B)

In this task, you should follow the equations until you need a calculator. Then, you can leave the equations there.

(a) What is the entropy of the given dataset?

Answer:

(b) What is the entropy of the given dataset if we know the value of the vomiting feature?

Answer:

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Task 5 (15 points)

You and your friend are given a dataset of images. Each image shows either a cat or a dog. Let's assume 2000 images show a cat and 8000 images show a dog. You and your friend should build a classifier to identify what an image shows.

(a) Your friend suggests building decision trees. You believe that a neural-based classifier is a better choice than decision trees. What would be your argument?
Answer:

(b) Your friend accepts your argument and asks you to propose a neural architecture. What neural architecture do you suggest?
Answer:

(c) Your friend trains the neural model on these images and reportes 98% accuracy on the same dataset. Why don't you accept using this trained model? What is your alternative solution to evaluate the model?
Answer:

End.