

## KBS EXAM SOSE-2022

First Name	Last Name	Matriculation No.

Task	Maximum Points	Points Achieved
1	20	
2	30	
3	30	
4	10	
5	10	
Exam	100	
Homework	0	
Bonus	20	
Pre-Final (x)	120	
Final (y)		

**(DO NOT WRITE ANYTHING IN THE ABOVE TABLE.)**

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## General Guideline

- **Duration and place:** 16:00 - 18:00, LE 105
- **Total exam credit:** 100
- **Identification:** Write your name and matriculation No. (Immatrikulation No.) on all pages.
- **Language:** All tasks are in English. Answers should be in English too. Fallback to German is allowed if you get stuck. 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.
- **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, i.e., 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 early, 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 (20 points)

A hospital in Duisburg asked 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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<p><b>Task 2 (30 points)</b></p>
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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 an MLP (MultiLayer Perceptron or FeedForward) neural model. You claim that this model hardly learns the task. What would be your argument to support your claim?

*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 reports 98% accuracy on the same dataset. Do you accept using this trained model? Why? If not, what is your concern and proposed solution to it?

*Answer:*

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### Task 3 (30 points)

According to our discussion during the course:

- (a) What is priori and posteriori knowledge? Give an example for each of them.

*Answer:*

- (b) Define knowledge.

*Answer:*

- (c) Is a true belief equivalent to a truth? Explain your answer with an example.

*Answer:*

### Task 4 (10 points)

Are reflex actions (such as moving your hand away from a hot stove) rational? Are they intelligent?

*Answer:*

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### Task 5 (10 points)

A common way to measure similarity between two concepts is to compute the distance between the vector representations of the concepts in a latent space. The cosine function is a good mathematical tool to estimate the distance between vectors.

- (a) Write the formulation of the cosine similarity function.

*Answer:*

- (b) What are the minimum and maximum values of the cosine function?

*Answer:*

- (c) Compute the cosine similarity between the vectors,  $x = [12.5; 0; -0.25]$ , and  $y = [0; 5.63; 0]$ .

*Answer:*

- (d) What is the angle between these two vectors?

*Answer:*

**End.**