

# Intelligent Systems: Reasoning and Recognition

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MoSIG M1

Final Exam – 10 May 2019

Conditions: You have the right to use any notes or written material. You may answer questions in English or in French. When appropriate, illustrate your answer with mathematics. Your written answers must be clear and legible. Illegible text will not be graded. Duration: 3 hours.

1) (4 points) What is an intelligent System? Provide a definition for an intelligent system and give three examples of intelligent systems. For each example of an intelligent system, propose a test that can be used to verify or measure intelligence.

2) (2 points) Provide the mathematical formulas for the Precision and Recall for a classifier and explain what they tell you about the classifier.

3) (8 points) You have been hired as a political analyst to work on the political campaign for a referendum. Your job is to identify the sectors of the population for which you can design targeted publicity. For this you prepare a questionnaire for a poll. Each question has a small number of possible responses. The questions are as follows:

- 1) What is your age? A) 18-29, B) 30-39, C) 40-49, D) 50-59, E) 60 or older
- 2) What is your level of education? A) Primary-school B) High-school C) University Diploma D) Masters E) Doctorate.
- 3) What is your annual salary? A) < 25,000 B) 25,001 to 50,000 C) 50,001 to 75,000 D) 75,001 to 100,000, E) >100,000.
- 4) How will you vote in the referendum? A) Yes, B) No, C) Undecided, D) I will not vote.

a) For the group who have responded A or B in Question 4, explain how to use a ratio of histograms to predict the most likely vote for each category of age. How many persons should be polled?

b) Explain how to use a ratio of histograms to predict the response to question 4 as a function of the answers to questions 1, 2, and 3. How many people must you poll? How can you estimate the probability of error for your prediction?

c) Explain how to use a Gaussian (multivariate normal) density functions to predict the most likely response to question 4 given the responses to questions 1, 2, and 3.

d) The components of a Gaussian Mixture Model can be interpreted as categories of voters. Explain how to use the EM algorithm to estimate a Gaussian Mixture Model to determine the average age, education level and salary for categories of voters who are undecided given their responses to questions 1, 2, and 3.

4) (4 points) You are asked to program a planning system for Block World using the GRAPHSEARCH algorithm. What cost function would you use for planning? Is there a heuristic for your cost function that will provide an optimal search? If yes, what is the heuristic? If no, can you still use the GRAPHSEARCH algorithm?

5) (2 points) Given the following deftemplates in CLIPS:

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(deftemplate OFFER (slot MERCHANT-ID)(slot PRODUCT-NAME)(slot PRICE))
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Write a rule in CLIPS that will select and print the MERCHANT-ID and PRICE for the least expensive OFFER for a given PRODUCT-NAME.