

OLLSCOIL na hÉIREANN
THE NATIONAL UNIVERSITY of IRELAND

NATIONAL UNIVERSITY OF IRELAND, GALWAY

SUMMER EXAMINATIONS 2000

Fourth University Examination in Information Technology

CT421 Artificial Intelligence

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Time allowed: Three hours

Answer 2 questions from each section
All questions carry equal marks
Use separate answer books for each section

SECTION A

- Q.1.** (i) Genetic algorithms represent a powerful search mechanism. Explain the basic operation of a genetic algorithm discussing the operators: selection, crossover and mutation.
- (ii) Describe the main problems and shortcomings associated with genetic algorithms.
- (iii) The travelling salesman problem involves finding a path through a weighted graph such that the path starts and ends at the same node. The total weight of the path is to be minimised. Describe how you would attempt to solve the travelling salesman problem using a genetic algorithm.

- Q.2. (i) Agent-based systems offer a new paradigm for software design and development. Discuss.
- (ii) Explain the difficulties involved in natural language processing systems.
- (iii) Given the following grammar rules for a very restricted subset of the English language:
- sentence -> nounphrase
 - sentence -> nounphrase, verbphrase
 - verbphrase -> verb
 - verbphrase -> verb, nounphrase
 - nounphrase -> noun
 - nounphrase -> article, noun
 - article -> the, a
 - noun -> cat, dog
 - verb -> bites, kicks

Write a Prolog program that will verify valid sentences according to the above grammar.

How would you expand the Prolog program to deal with adjectives.

- Q.3. (i) In the symbolic search space paradigm, a common problem is that of searching through a search space looking for the goal state. *Depth-first* search, *breadth-first* search and *best-first* search are three search algorithms that can be used. Outline briefly, each of these algorithms. Compare and contrast the three approaches.
- (ii) With respect to adversary searching explain the *minimax* technique. Show how *alpha-beta pruning* can be used to reduce the search space.
- (iii) Given the game of *tic-tac-toe* (aka *noughts and crosses*), show an appropriate game tree. Develop a set of heuristics suitable for the game. Discuss how you might map a strategy to Prolog?

SECTION B

- Q.4.** Many contemporary PDA's incorporate some form of stylus-touch sensitive screen technology to allow the user to directly write-in letters/words which are then codified via some sort of handwriting-recognition software. Discuss in some detail the design, development and implementation of a specific Neural Network based solution to this, indicating the reasons for your particular recommendation.
- Q.5.** Describe the basic architecture of a typical expert system, mentioning the purpose of each of the main components, and describe its fundamental design philosophy and operation. An estate agent asks you to design an expert system to help people choose where to buy a house. Discuss whether this might be a suitable problem for an expert system, and say how you might start acquiring the necessary expert knowledge - continue with a design solution to this problem.
- Q.6.** Critics of Neural Networks often highlight the 'black box' aspect of a such systems as a serious failing, as one is limited in gaining insights into what ideally should be a coherent cognitive process - something that is more clearly evident with other, more high level areas of Artificial Intelligence. Discuss this statement in detail.