

DUBLIN INSTITUTE OF TECHNOLOGY  
KEVIN STREET, DUBLIN 8

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BSC IN COMPUTER SCIENCE

YEAR 4

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**SUMMER EXAMINATIONS 2003**

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KNOWLEDGE BASED DECISION SUPPORT SYSTEMS

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Answer **FOUR** questions

**All questions carry equal marks**

1. (a) Identify and discuss the types of problems that are most suitable for expert system solutions. **(8 marks)**
- (b) Discuss, compare and contrast the following types of expert system:  
(i) Rule based system  
(ii) Model based system  
(iii) Case based system **(17 marks)**
2. (a) Identify what you consider to be the most important issues in knowledge representation, and discuss why, in your opinion, the problem of knowledge representation is so difficult. **(10 marks)**
- (b) A modern approach to solving difficult problems seems to be to distribute the problem across the Internet.  
  
Identify clearly what the *Semantic Web* is, and discuss how it is taking a distributed approach to the problem of representing large amounts of knowledge. **(8 marks)**
- (c) Discuss Rodney Brooks' novel approach to building an *intelligence without representation*. **(7 marks)**
3. (a) With reference to probability theory, define  
(i) Prior probability  
(ii) Posterior probability **(4 marks)**
- (b) State and explain Bayes' theorem. **(4 marks)**

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- (c) A diagnostic test has a probability of 0.95 of giving a positive result when applied to a person suffering from a certain disease, and a probability of 0.10 of giving a (false) positive when applied to a non-sufferer.

It is estimated that 0.5% of the population are sufferers. Suppose that the test is now administered to a person about whom we have no relevant information relating to the disease (apart from the fact that he/she comes from this population).

Calculate the following probabilities that:

- (i) The test result will be positive
- (ii) Given a positive result, the person is a sufferer
- (iii) Given a negative result, the person is a non-sufferer
- (iv) The person will be misclassified

**(11 marks)**

- (d) Give a brief account of *Bayesian Belief Networks*, identifying their differences from normal Bayesian reasoning.

**(6 marks)**

4. (a) One of the limitations of probabilistic approaches to uncertainty is their use of a single quantity to measure what may be a very complex situation.

Discuss the Dempster-Shafer Theory of Evidence and how it attempts to address the issue identified in the statement above.

**(6 marks)**

- (b) State and explain Dempster's rule for combining evidence.

**(3 marks)**

- (c) Some very old jewels have been stolen in a museum. The three suspects and their details are listed below.

<b>Name</b>	<b>Gender</b>	<b>Hair</b>
David	Male	Dark
Larry	Male	Fair
Mary	Female	Fair

Two police inspectors are sent to investigate. They each interview **ten different** witnesses and discover the following evidence:

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**First Inspector**

- 5 witnesses saw a male
- 2 saw a fair person
- 3 express no opinion

**Second Inspector**

- 6 witnesses think they saw David
- 4 express no opinion

Use Dempster's rule to combine the evidence above and establish the belief that each person, or group of persons is suspect.

**(9 marks)**

- (d) Stanford Certainty Theory, as used in the MYCIN expert system is based on the combination of *certainty factors* of premises and rules.

In a given system the following rules have the certainty factors shown:

**IF PATIENT HAS SYMPTOM1 AND SYMPTOM2  
THEN HE HAS DISEASE1 (CF = 0.7)**

**IF PATIENT HAS SYMPTOM1 AND TESTA IS  
POSITIVE THEN HE HAS DISEASE1 (CF = 0.9)**

In a given diagnosis the following was established

**PATIENT HAS SYMPTOM1 CF = 1  
PATIENT HAS SYMPTOM2 CF = 1  
TESTA RESULT IS POSITIVE CF = 0.6**

Using Stanford Certainty Theory, combine the above evidence to calculate the certainty that the patient has DISEASE1.

**(7 marks)**

5. (a) Give an overview of Minsky's theory of *frames* for knowledge representation.

**(4 marks)**

- (b) Explain in detail how frames are used for *vision*.

**(7 marks)**

- (c) Explain in detail how frames are used for *language*.

**(7 marks)**

- (d) Explain in detail how frames are used for *memory and learning*.

**(7 marks)**

6. (a) Artificial Intelligence has often been considered a search problem, where a state-space of alternative solutions is explored in order to find a solution for a given problem.

Discuss, compare and contrast *data driven search* and *goal driven search*.

**(5 marks)**

- (b) Describe, using an example problem, what is meant by the term *heuristic*.

**(4 marks)**

- (c) What is meant by the following terms when considered in terms of heuristics

- (i) Admissible
- (ii) Informedness
- (iii) Monotonicity

**(3 marks)**

- (d) Alan Turing wrote in 1950 about an *imitation game* which could be used as a test for establishing machine intelligence, which subsequently became known as the *Turing Test*.

Discuss the contribution of Turing's paper towards the question "Can computers think?".

**(7 marks)**

- (e) Some of the finest achievements of Artificial Intelligence have been in very specific domains, such as medical expert systems or chess playing.

State your own opinion on whether these programs can be considered intelligent. Justify your answer.

**(6 marks)**