NUI MAYNOOTH

Ollscoil na hÉireann Má Nuad

OLLSCOIL NA hÉIREANN MÁ NUAD

THE NATIONAL UNIVERSITY OF IRELAND MAYNOOTH

SEMESTER 1
2005-2006

ARTIFICIAL INTELLIGENCE & NATURAL LANGUAGE PROCESSING
PAPER CS404

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Time allowed: 2 hours

Answer ***three*** questions

All questions carry equal marks

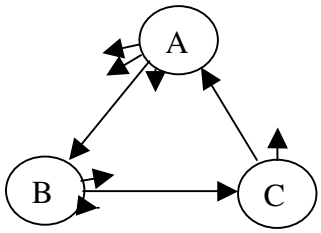
[25 marks]

1 (a) Define the terms *precision* and *recall*, explaining their relevance to information retrieval. **5 marks**

(b) Describe how the notion of a random walk can be useful for query independent document retrieval. **5 marks**

(c) Write down the PageRank function, explaining each of the terms. Describe the distinction between *inlinks* and *outlinks*, using an appropriate diagram to illustrate your answer. **5 marks**

(d) With the aid of a suitable diagram, illustrate how an indirect feedback loop in the citation database can influence the PageRank value of a document. Discus the relevance of these feedback loops to the iterative calculation of the PageRank function. **5 marks**



(e) What is the relevance of a term/word index to document retrieval? How can the word/term index influence the relative ranking of documents in relation to a specific search term? **5 marks**

[25 marks]

2 (a) Describe the operation of a Chart parser. **10 marks**

(b) Describe how registers are used to enforce agreement in sentences, such as subject-verb agreement. Use appropriate examples to highlight your answer. **5 marks**

(c) Write down a simple English sentence that highlights one example of a long-distance dependency and name that dependency. Do bi-grams deal with these long-distance dependences and if so, how? **5 marks**

(d) What problem is presented by encountering a novel word-pair when calculating the joint probability of a word sequence? How can these problems be overcome? **5 marks**

[25 marks]

3 (a) Describe in detail the role that isomorphic structures plays in the interpretation of analogical comparisons. Briefly describe any assumptions you make about the representation of the domains involved. Use an appropriate diagram to illustrate your answer. **10 marks**

(b) Describe in detail any one algorithm for identifying the inter-domain mapping. **10 marks**

(c) Briefly describe the CWSG (Copy With Substitution and Generation) inference algorithm and its relevance to interpreting analogical comparisons. **5 marks**

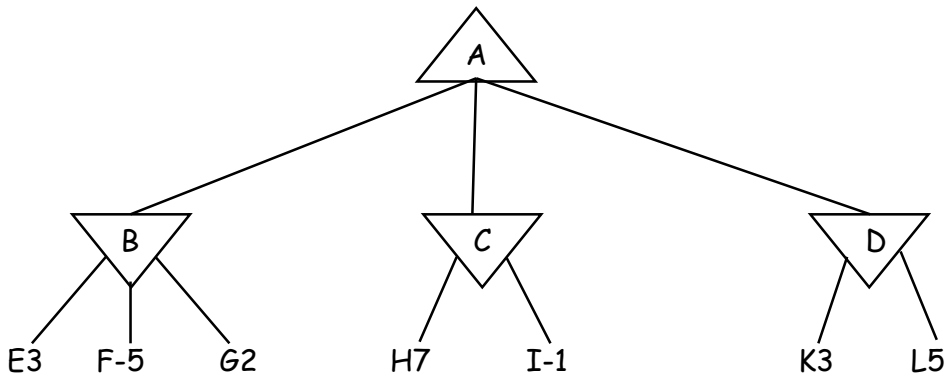
Answer Either Question 4.1 OR Question 4.2 (below)

[25 marks]

4.1 (a) Describe how a search mechanism can be adapted to solve problems like the 8-tile puzzle or the Farmer-Fox-Goose problem. **5 marks**

(b) Describe how the MiniMax algorithm can be used to solve adversary-search problems, such as chess or the OXO game. What are the main limitations of the MiniMax algorithm? **5 marks**

(c) Describe the operation of the MiniMax algorithm when presented with the following search tree. (Letters refer to search states while the numbers represent the heuristic's evaluation of that state). Which move (letter) will ultimately be selected by MiniMax? **5 marks**



(d) Describe how α–β pruning improves the performance of adversary search algorithms. You may use an appropriate example to illustrate your answer. **10 marks**

OR

[25 marks]

4.2 (a) Describe how case frames can be used to represent the semantic commonality between two distinct sentences. How can case frames be used to process sentences in the active and passive voices? Use appropriate examples to illustrate your answer. **10 marks**

(b) What is meant by the semantics of language? What is the Stroop effect and what is its relevance to semantics? **5 marks**

(c) Discuss how the WordNet represents information. Make reference to the relationships that are used by WordNet in your answer. **5 marks**

(d) Describe any two similarity metrics used to compare WordNet synsets. **5 marks**