2910310 Artificial intelligence

Examination paper: Zone A

Time allowed: two hours and fifteen minutes

There are **five** questions on this paper.

Do not attempt more than **four** questions. All questions carry equal marks and full marks can be obtained for complete answers to **four** questions.

Questions involving a description or explanation should, wherever possible, be accompanied by an appropriate example.

1. (a) What is meant by the term 'Regular Expression' (RE) and what symbols are used in its representation? [4]

   (b) Specify how to construct a Non-deterministic Finite Automaton (NFA) from a given RE, describing any diagramming tools you use. [4]

   A language L consists of all strings of the following form: -

   The symbols "fl" followed by
   either one or more occurrences of the symbol "o" followed by the symbol "w"
   or the symbol "a" followed by zero or more occurrences of the symbol "r"
       followed by the symbol "e".

   (So, for example, flow, floow, floooow, flae, flare, flarrrrre are all in L, but examples of strings **not** in L are flo, flw, flre, floare, flar)

   (c) Write down a RE describing the strings in L [3]

   (d) Use the method you specified in (b) to construct a NFA that recognises strings in L, showing all stages of construction. [7]

   (e) Any Regular Set (a language denoted by a Regular expression) is a context free language. Give reasons why Regular Expressions, rather than a Context Free Grammar, are used to define the lexical syntax of a language. [4]

   (f) Some languages that can be described by a Context Free Grammar contain structures that cannot be described by a Regular Expression. Give a simple example of such a language and write down a Context Free Grammar that can describe it. [3]

Question 1

a) Using part picking as an example, explain the terms percepts, actions, goals and environment in the context of intelligent agents.

[12]

b) Agents are classified according to whether they are:
   i)   Reflex
   ii) Programs with internal states
   iii) Goal based
   iv) Utility based

   Define each of these terms and give an example of each situation that they describe.

[12]

c) Can an agent belong to more than one of the classes defined in your answer to part b) above?

[1]

Question 2

a) Explain the concept of search and how any problem can be thought of as a search problem.

[4]

b) Explain the different search techniques that could be used for looking for a name in a paper based telephone directory.

[5]

c) Define the terms: initial state, search state, operator, goal test and path cost function.

[5]

d) Sketch an algorithm for a breadth first search.

[5]

e) Give the space and time complexity of breadth first search and state whether such searches are optimal and whether they are complete.

[4]

f) In the example of a phone directory which search technique would be more appropriate? Justify your answer.

...

Question 4

A language (*language 1* say) has the following grammatical and lexical rules:

s	→	np vp	det	→	[the]
np	→	det n	n	→	[dog]
vp	→	v np	v	→	[bit]

a) What is the one sentence that is possible in this language? (Show how you obtain your answer)

[4]

b) Draw the syntactic tree of this sentence.

[4]

c) How many more sentences can we make by adding the following rules to *language 1* to form *language 2*? Give your reasoning.

det	→	[every]
det	→	[a]
n	→	[cat]
n	→	[mouse]

[4]

d) What will be the effect on the language of adding the rules below to *language 2* to form *language 3*?

vp	→	vp prep
prep	→	prep np
prep	→	[over]

[4]

e) Give two sentences that are possible in *language 3 but illustrate problems with the language* together with syntax trees for them that show the difficulties with language 3. State the difficulties shown.

[6]

f) What is linguistically wrong with the sentence; 'the cake bit the dog"?

[3]

Question 5

a) Summarise the arguments against the possibility that at some time in the future machines will be deserve to be called intelligent.

[9]

b) Turing argued that a machine that mimics human behaviour can be said to have real understanding. Outline the example that he used to make this argument and the replies that are given by the sceptics.

[9]

c) In your view what current applications show the most promising progress towards AI? Give reasons for your choice.

[7]