UNIVERSITY OF KENT

FACULTY OF SCIENCES

LEVEL 5 EXAMINATION

SCHOOL OF COMPUTING

Introduction to Intelligent Systems

Saturday, 26 May 2018 : 09.30 - 11.30

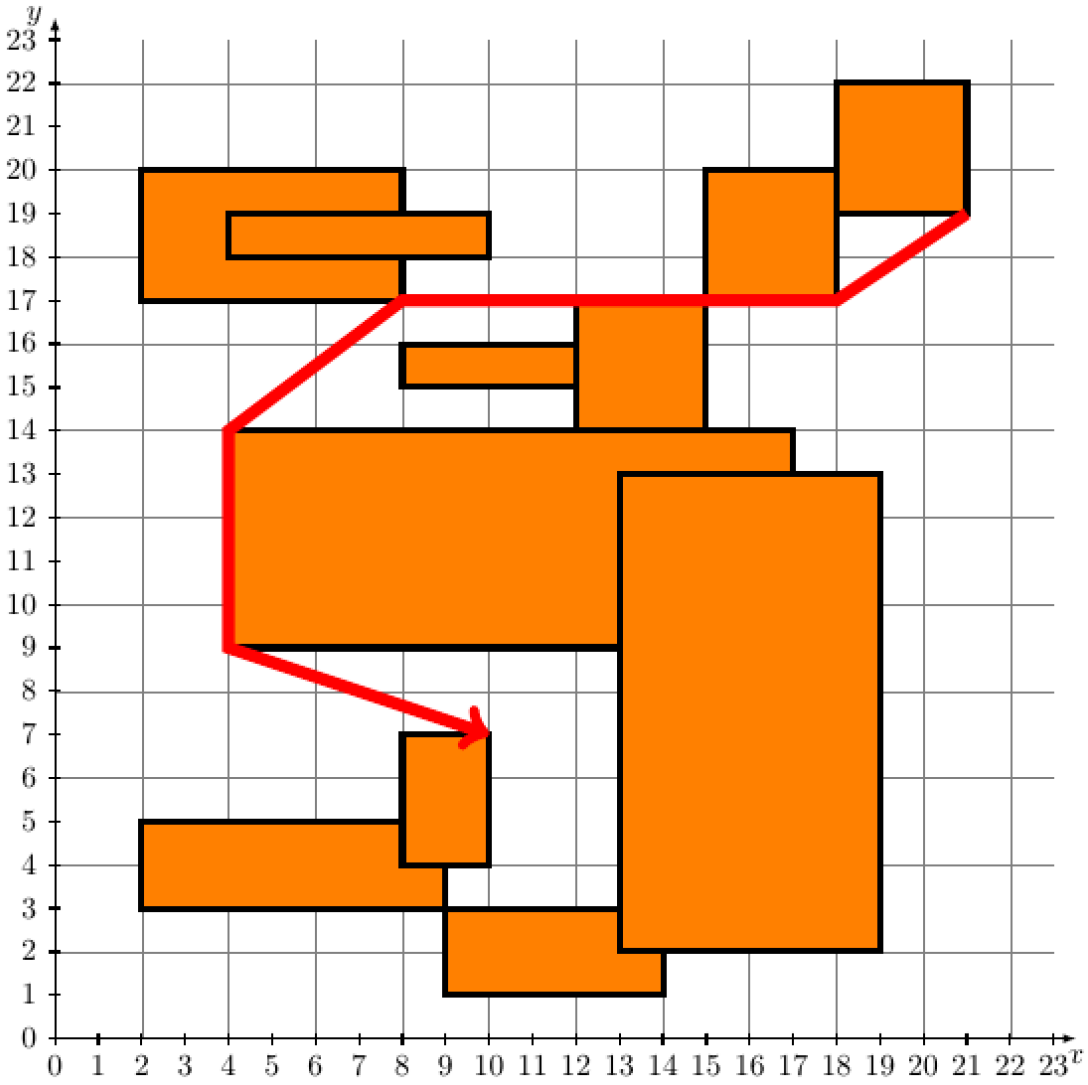
The paper contains THREE questions. Answer ALL the questions.

Calculators are not permitted.

Answer each question in a separate book.

Stationery: White Answer Booklet x 3

1. Consider the problem of navigating around a collection of rectangular boxes from a given start coordinate to a given end coordinate, where the path cannot pass through the interior of any rectangle. A path can only pass through integer (x, y) coordinates which are restricted to take a value between (0, 0) and (23, 23). The red arrow indicates one path from the coordinate (21, 19) to (10, 7), illustrating that a path can travel along the perimeter or a vertex of a rectangle.



(a) What would be a suitable set of states for tackling this navigation problem with a search algorithm? Explain your answer. [4 marks]

(b) Outline an operator (nextConfigs method) which would enumerate all the states which were directly reachable from a given state? You do not need to provide code; merely outline the key ideas. [8 marks]

(c) Suggest a suitable search algorithm for this problem, where the objective is to calculate a path comprising of the minimal number of (straight) line segments. You need to explain the properties of your algorithm which make it suitable. [4 marks]

(d) Suppose that the problem was changed from navigating around a mixture of rectangles and triangles. How would this impact on your solution? [4 marks]

2. (a) Explain the differences between best-first search and uniform-cost search: you need to describe the main idea behind each search algorithm and their key properties. [6 marks]

(b) Consider a two-player game in which 7 stones are placed on a table and the two players alternate in making a move. At each move, a player must divide a pile of stones into two non-empty piles of different sizes. The first person who cannot make a move loses the game.

You need to illustrate how a layered tree is constructed to describe all moves in any game. Then show how the nodes of the tree can be annotated with 0 or 1, explaining the meaning of this annotation. Then you need to explain how the tree predicts that the player who makes the first move will ultimately lose the game. [9 marks]

(c) What is program synthesis and how is it used in FlashFill? [5 marks]

3.

(a) Give four application areas in which neural networks have been successfully applied. [4 marks]

(b) Draw a schematic diagram of a perceptron with two inputs x and y, clearly labelling each of the components. [6 marks]

(c) Suppose the coordinates $\mathbf{p}_1 = (1,2)$, $\mathbf{p}_2 = (-1,2)$ and $\mathbf{p}_3 = (0,-1)$ are labelled by $t_1 = 1$, $t_2 = 0$ and $t_3 = 0$ respectively. Suppose that initial weights are assigned to $\mathbf{w}_0 = (-3, 0)$ and that the initial bias is set to $b_0 = 1$.

Compute $\mathbf{w}_1$ and b_1 (the weights and bias after one learning step) and then $\mathbf{w}_2$ and b_2 (the weights and bias after a second learning step) using Rosenblatt's learning rule. Give the working in your calculation. [7 marks]

(d) Give a problem for which Rosenblatt's learning rule will never terminate. Explain your answer. [3 marks]