THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

This exam paper must not be removed from the venue

Venue _____

Seat Number _____

Student Number |__|__|__|__|__|__|__|__|

Family Name _____

First Name _____

School of Mathematics & Physics

EXAMINATION

Semester Two Final Examinations, 2013

MATH4202 Advanced Topics in Operations Research

This paper is for St Lucia Campus students.

Examination Duration: 90 minutes

Reading Time: 10 minutes

Exam Conditions:

This is a School Examination

This is an Open Book Examination

During reading time - writing is not permitted at all

This examination paper will be released to the Library

Materials Permitted In The Exam Venue:

No restrictions

Materials To Be Supplied To Students:

Access to laboratory computers

Instructions To Students:

You will need to submit your Python code by Blackboard.

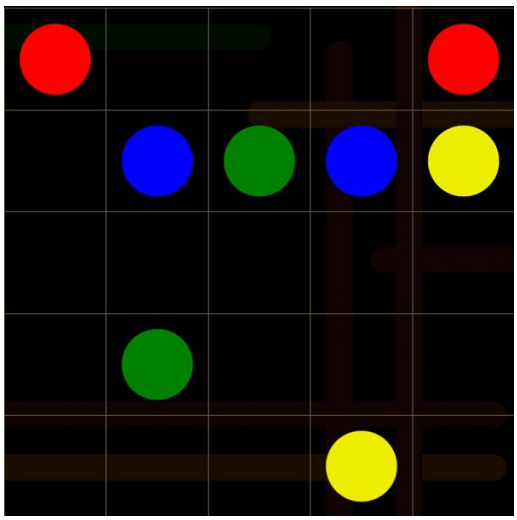
For Examiner Use Only

Question	Mark
1a	
1b	
1c	

Total _____

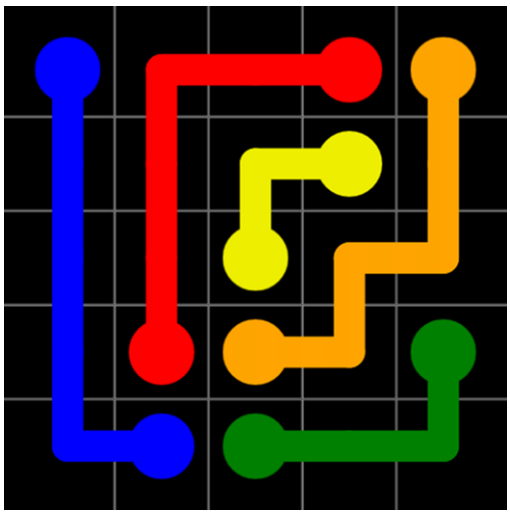
Question 1

The game “Flow Free” is currently a very popular app. A typical input to the game is shown below.



The object of the game is to connect the dots of the same colour, using only orthogonal lines, so that no lines cross and so that every square is filled in.

Some typical solutions to the game are displayed below:



Note that the solution on the right is not unique. In particular, the white line could have some of its “extensions” truncated and filled in by additional loops of other colours.

a) Formulate the problem of finding a solution to “Free Flow” as a Mixed Integer Program and write the formulation in the space on page 4. One set of constraints should potentially have very many members. (*5 marks*)

b) Two data files and stub code to read in the data files are provided. The data files represent a grid containing either a letter (the first letter of a colour) or a dash for a blank square. The reading code creates an array (`Board`) of characters corresponding to the input; a list of the unique letters (`C`); and a map (`Val`) which contains 0 for blank squares and an index of for the colour otherwise. You can use this code as is or modify it for your own purposes.

   Implement your MIP in Python, so that it finds at least one legal solution for each data file. Note that when writing out the solution, it will be sufficient to write out the letter for the colour that is “assigned” to each square.

   Some marks will be awarded for comments showing your intent, if your code does not work. (*12 marks*)

c) Extend your implementation to find all unique solutions for each data file. (*3 marks*)

END OF EXAMINATION