THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

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Venue _____

Seat Number _____

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

Family Name _____

First Name _____

School of Mathematics & Physics

EXAMINATION

Semester Two Final Examinations, 2014

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	
1d	

Total _____

Question 1

A collection optimisation problem is defined on a grid as follows:

- A set of vehicles V will collect in a grid of cells for a number of time periods T
- Each vehicle may start in any square, then in each time period it moves to a neighbouring square (up, down, left or right)
- Each grid square has an associated value
- A grid square is considered "collected" if a vehicle visits the square
- No square may be visited more than once
- The objective is to maximise the sum of the values of the grid squares collected.

For example, the 10 by 10 grid below (which is the data generated by the code stub for this exam) is shown with two vehicles highlighted, each collecting for 8 time periods.

[3, 3, 3, 4, 3, 4, 0, 2, 4, 3]
[4, 0, 2, 1, 2, 2, 0, 1, 1, 4]
[3, 0, 3, 0, 3, 0, 0, 4, 1, 1]
[4, 4, 1, 4, 2, 3, 1, 4, 3, 4]
[4, 1, 1, 0, 0, 0, 1, 3, 0, 3]
[1, 1, 4, 2, 1, 2, 3, 0, 4, 0]
[3, 4, 0, 3, 1, 2, 0, 0, 0, 4]
[0, 3, 4, 4, 1, 1, 2, 3, 0, 3]
[3, 4, 0, 4, 0, 1, 3, 4, 1, 4]
[2, 1, 1, 0, 0, 0, 3, 4, 0, 0]

Part a (*5 marks*):

Formulate the problem of generating the optimal collections as an Integer Program. Write your formulation in the space below.

Part b (*8 marks*):

Using the data generated by the code stub Collect.py, implement your IP formulation in python. You may find the function “Neighbours” useful. Submit your python file via blackboard. Ensure the name of the file includes “PartB”.

Part c (*4 marks*):
If you modify your code so that there are 6 vehicles (V = range(6)) then it may take a very long time to run. In the space below, explain why this is the case and suggest alternative ways to formulate the problem to make it run faster.

Part d (*3 marks*):

Implement an IP formulation which can quickly solve the case with 6 vehicles. Submit your python file via blackboard. Ensure the name of the file includes "PartD".

The following code may be useful, though it is not part of the critical idea for solving the problem. This code starts with "plist", a list of lists. It uses some python tricks to eliminate any list which contains all the same elements as another list.

```
pSet = set(tuple(sorted(p)) for p in pList)
pList = [list(p) for p in pSet]
```

END OF EXAMINATION