EEN511
Tiny Little Test
21st March 2016
No Books or anything,
Especially No Puppies.

Name:

Student number:

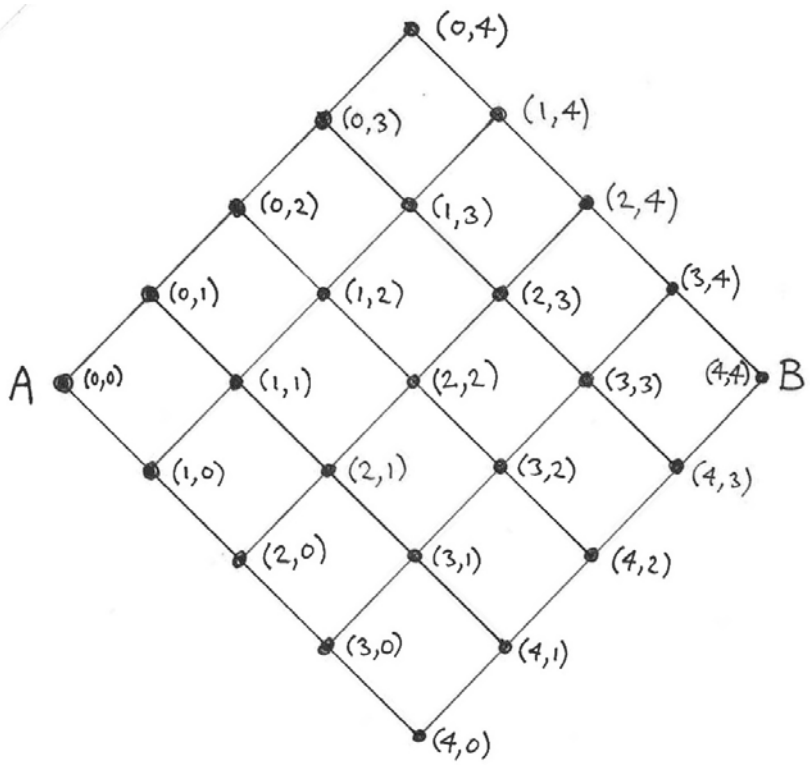
Sign here if you did not give or receive aid in any form during this test, and did not consult any written or printed material apart from this test:

Don't write in these boxes.

Question	Out of	Grade
1	33	
2	33	
3	33	
4	1	

1.

A “diamond graph” of size N is a square arrangement of N×N nodes, each with a connection to all of its immediate (up, down, left, right) neighbours, but it is rotated by 45° so that it takes on a diamond shape.



The left-most mode (0,0) is known as A, and the rightmost node (N-1,N-1) is known as B.

When travelling through a diamond graph, it is only possible to move from left to right. That is, each step must take you further from A and closer to B. Or in other words, you can move from (e,f) to (g,h) if g=e+1 or if h=f+1.

The question is, how many different paths are there from A to B?

Produce a dynamic programming solution to this problem. The input is the number N, the output should be the number of different paths from (0,0) to (N-1,N-1).

State your reasoning for each step.

2.

The numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 13 are to be added to an initially empty 2-3-tree, one at a time, in the order given.

Draw the 2-3-tree as it would be after each individual insertion. There are 13 numbers to insert, therefore you should provide 13 tree pictures.

Take care to ensure that the structure of the trees is clear.

3.

a.

In the theory of computing, what exactly is an enumeration?

b.

Write in C++ a function which would produce (if it were allowed to run for ever) an enumeration of all possible pairs of natural numbers, such as (0,0) (7,3) (2,11) (3,7) (9,0) and so on, but probably in a more rational order.

c.

Prove that the set of all rational numbers A/B (where A and B are natural numbers, and B is not 0) is the same size as the set of all natural numbers.

4.

Draw a picture of a cat sitting in an AVL tree.