TRINITY COLLEGE DUBLIN

THE UNIVERSITY OF DUBLIN

School of Mathematics

JF Mathematics **Trinity Term 2015**
SF TSM - Mathematics

MA1264 — C programming and computation

Thursday, May 14 **Luce Upper** **09.30 — 11.30**

Prof. Colm Ó Dúnlaing

Instructions to Candidates:

Attempt 3 questions.

Materials Permitted for this Examination:

Formulae and Tables tables are available from the invigilators, if required.

Non-programmable calculators are permitted for this examination,—please indicate the make and model of your calculator on each answer book used.

You may not start this examination until you are instructed to do so by the Invigilator.

1. (a) Convert 2718 and -668 to 2s complement short integers, and add them as short integers (little endian not required).

   (b) Given the following declarations on a 32-bit-address machine

   ```
   double a[10][10];
   double *b[100];
   ```

   Suppose that a begins at address 1000, and b begins immediately after a.

   i. How many bytes are occupied by the array a? By b?

   ii. At what address does b begin?

   iii. What is the address of a[2][3]?

   iv. a[11][11] is outside the range of a, it actually coincides with b[i] for some i. Calculate i.

2. (a) Write a C function `int count_vowels( char s[])` which counts the number of occurrences of `'a', 'e', 'i', 'o', 'u'` in s.

   (b) Write code for the constructor and the two operators (+,*) in the class Complex (obviously meant for complex numbers).

   ```
   typedef class Complex
   {
     public:
       Complex ( double, double );
       Complex operator + ( const Complex & other );
       Complex operator * ( const Complex & other );
       void print();
     private:
       double x,y;
   } Complex;
   ```

3. (a) Carefully simulate the following program, showing what it prints.

   ```
   #include<stdio.h>
   int xxx( int x, int n )
   ```

```
{ int y;
  if ( n == 0 )
    return x;
  else
  { y = xxx (x,n-1);
    return y*y;
  }
}
main()
{ printf("xxx(3,2) is %d\n", xxx(3,2));
}
```

(b) What does `xxx(x,n)` compute in general, $n \geq 0$?

(c) What does the following program print, and why?

```
#include <iostream>
using namespace std;
int n=15;
void b ( int & n )
{  cout << n++ << endl;
}
void c ( int & n )
{  cout << ++n << endl;
}
void c ( double & n )
{  cout << ++n << endl;
}
int main()
{ int n=3; double x=10;
  b(n); c(n); c(x); c(n); c(x);
}
```

4. (a) Write a full program in C or C++ which reads a single line and prints it in reverse. For example

```
Input:
A quick brown
Output:
nworb kciuq A
```

(b) Write a full program in C++ which reads text word-by-word from input and prints them in sorted order (one word per line). You may print all the occurrences of words in the text, or print each word just once: either is acceptable.

Useful STL features:

`set<...>::insert()`, `vector<...>::push_back()`, `sort ()`, `cin>>...`, `set<...>::iterator`