MA1264

Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin
Ollscoil Átha Cliath | The University of Dublin

Faculty of Engineering, Mathematics and Science

School of Mathematics

JF Maths/TP/TSM **Trinity Term 2017**

Mathematics 1234: C, C++ programming

Wednesday, May 10 **RDS** **09:30 — 11:30**

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Instructions to Candidates:

Attempt 3 questions

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

1. (a) Convert 2017 to short int (4 hex digits, big-endian).

   (b) Convert -18284 to short int.

   (c) Add the above two numbers as short ints.

   (d) Given `int a[10]; double b[10][10];`
   (Recall that ints are 4 bytes and doubles are 8 bytes.) Suppose that a begins at location 4159, and b begins immediately after a.

   i. Calculate the address where b starts.

   ii. Calculate `b[3]`.

   iii. Calculate the address (outside the range of a) of `a[25]`.

   iv. Does this address coincide with that of any entry `b[i][j]`?

2. (a) Consider the following progam.

```
#include <stdio.h>
#include <stdlib.h>
int xxx ( int m, int n )
{ if ( m == 0 )
    return 0;
  else
  { int r = m % 3;
    int s = xxx ( m/3, n );
    if ( r == 0 )
      return 3 * s;
    else if ( r == 1 )
      return 3 * s + n;
    else
      return 3 * s + n + n;
  }
}
```

```
main ( )
{ int p = xxx ( 5, 10 );
  printf("xxx ( 5, 10 ) == %d\n", p);
}
```

i. Carefully simulate the program, showing what it prints.

ii. What does `xxx (m,n)` return, for general $m \geq 0$?

(b) Identify 3 errors in the following program (there are more than 3).

```
#include <stdio.h>
main ()
{ int m = atoi ( argv [1] );
  while ( x = m );
  { ++ x; }
  if ( x == 0 )
  { printf("zero\n") };
  else
  { printf("nonzero\n") };
}
```

3. (a) Given the type definition below, write code for the functions `make_zero_matrix()` and `matrix_sum` (which returns `NULL` if the matrices have different sizes).

```
#include <stdlib.h>
typedef struct MATRIX
{ int height, width;
  double ** entry;
} MATRIX;
MATRIX * make_zero_matrix ( int ht, int wdth )
{ ... complete the code here ... }
MATRIX * matrix_sum ( MATRIX * a, MATRIX * b )
{ ... complete the code here ... }
```

(b) Given the type definition below, write code for (i) the constructor and (ii) the [ ] subscripting operator.

```
typedef class Matrix
{ public:
    Matrix ( int the_ht, int the_wdth );
    double * operator [] ( int i );
  private:
    int ht, wdth;
    double * workspace;
} Matrix;
```

4. (a) Write a complete C program which reads in a list of numbers (doubles) from standard input, stores them in an array and counts them, and prints the count, the sample mean, and the sample variance.

(As for storing in an array, you may assume that at most 1000 numbers will be input.)

(b) Write a complete C++ program which reads in a list of numbers (doubles) from standard input, storing them in `vector <double>` object, sorts them, and prints the count, the sample mean, the sample variance, and the median. (For this question, by 'median' we mean the item indexed $(n-1)/2$ in sorted order, where n is the count).