

Faculty of Engineering, Mathematics and Science

School of Mathematics

JF Mathematics/TP

Hilary Term 2021

Mathematics MAU11601: intro programming in C

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12 noon, deadline 6pm

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Instructions that apply to all take-home exams

1. This is an open-book exam. You are allowed to use your class notes, textbooks and any material that is available through the internet. However, you are not allowed to collaborate, seek help from others, or provide help to others. You are not allowed to post questions on online forums such as Stack Exchange.

2. If you have any questions about the content of this exam, you may seek clarification from the lecturer using the e-mail address provided. You are not allowed to discuss this exam with others.

3. Solutions must be submitted through Blackboard by the deadline listed above. You must submit a single pdf file for each exam separately and sign the following declaration in each case. Please check that your submission has uploaded correctly.

Plagiarism declaration: I have read and I understand the plagiarism provisions in the General Regulations of the University Calendar which are available through https://www.tcd.ie/calendar.

Signature: ____

Additional instructions for this particular exam

- A. Check that this document has your name and e-mail address.
- B. Credit will be given for the best 3 questions answered.
- C. Show all work.

Question 1.

(1a) [8 marks] Calculate the short integer representation of 4953 and -3195 (big endian, hexadecimal). Calculate the sum as short integers (big endian).

(1b) [12 marks] Calculate the single precision (32 bit) encoding of the number 3.0/7 giving the result in hexadecimal (little endian).

Question 2.

(2a) [10 marks] Simulate the program below, using indentation to distinguish the different calls to xxx() and the different stack frames, and showing what gets printed.

```
#include <stdio.h>
int xxx ( int n, int a[] )
{ if ( n == 0 )
    return 0;
    else
    return xxx(n-1,a) + a[n-1];
}
main()
{ int a[3] = {1,2,3};
    printf("xxx produces %d\n", xxx(3,a));
}
```

(2b) [10 marks]

Identify 5 errors in the following program.

```
#include <stdlib.h>
int main()
{ int a[3] = {1,2,3};
    int i,sum, oddcount, evencount;
    for (i=0; i<=3; ++i)
    {</pre>
```

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```
if ( a[i] % 2 == 0 );
    odd_count = odd_count + 1;
    else
        evencount = evencount + 1;
    sum = sum+a[i];
    }
    printf("3 numbers, %d odd %d even average %f\n", oddcount,
        evencount, sum/3);
}
```

Question 3. [20 marks]

Write a complete C program which (i) reads and counts lines of text, but not more than 1000 (using fgets()), (ii) stores them in an array char * line[1000], identifies the (iii) first and (iv) last in alphabetical order (using strcmp()), and (v) counts the number of lowercase vowels in all the strings together. You may use the function copy_string() from the notes.

The program should print the number of lines, the number of lowercase vowels (a,e,i,o,u), and the first and last lines in alphabetical order. For example

% cat text We know that you highly esteem the kind of Learning taught in those Colleges, and that the Maintenance of our young Men, while with you, would be very expensive to you. % a.out < text 5 lines, 53 lowercase vowels first in alphabetical order: Colleges, and that the Maintenance last in alphabetical order: you, would be very expensive to you.

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Question 4.

(4a) [10 marks] Write a function

```
MATRIX * product ( MATRIX * a, MATRIX * b )
```

which creates a new matrix containing the product of a and b, and returns the new matrix. You may use the MATRIX structure type definition in the notes and you may use the make_matrix() function from the notes. You may assume that the matrices are compatible (i.e., a - n = b - m).

(4b) [10 marks] Write a function

int isprod (MATRIX * a, MATRIX * b, MATRIX * c)

which returns 1 if c equals the product of a and b, 0 otherwise. You may assume that $a \ge n$ == $b \ge m$, $a \ge m$ == $c \ge m$, and $b \ge n$ == $c \ge n$.