1	2	3	4	5	6	7	8	9	Total

Indian Institute of Technology Mandi

IC150: Final Exam

14th June 2012, 9:00-12:00

Final Exam

Answer all questions. ***No calculators or cellphones***. Maximum marks: 70

0) One lesson learnt in this course that I will remember for the rest of my life is: [½]

1) Fill in the blanks: [5]

a) An _____ clause is often used after an `if` clause.

b) A C expression involving the operator '=', eg. `x = y = 5`, is evaluated from _____

c) The decimal value of 2^{16} is _____

d) The number of bytes of memory allocated to a variable depends on its _____

e) A standard C function to convert a string to an integer is _____.

f) The standard C function to clear the I/O buffers is _____

g) The standard C function to allocate memory dynamically is _____.

h) The time complexity of binary search in an array of `N` integers is _____

i) The function prototype of the main function in a C program is normally written as

```
int main(_____ _____, _____ _____)
```

2) Answer briefly: [12]

a) Explain the difference between the file open modes `"w"` and `"w+"`.

b) Explain the possible return values of `strcmp(s, t)`.

c) Write C statements to declare an integer variable containing the value 17, and a pointer variable that points to this integer.

d) Is the Bisection Method guaranteed to converge? Explain.

e) List three sources of error in numerical analysis.

f) Explain either *least squares fit* or *minimax fit* (choose any one).

g) Explain *space-time tradeoff* with an example.

h) Why do C and Linux provide the abstraction of an *I/O stream*?

3) (a) Write Scilab code to create the polynomial $3x^3 - 4x^2 + 5x - 12$ and store it in the variable `p`. [2]

(b) Give 3 important advantages of Scilab over C. [3]

4) Do the indicated conversions [4½]

a) $(603)_{10}$ to binary

b) $(110101)_2$ to unsigned decimal

c) $(110101110101101)_2$ to hexadecimal

5) (a) Create a `struct Ticket` to hold details of a travel booking. For each booking the details are name (max 30 characters), 5-digit train numer (eg, 12353) and price of the ticket in rupees. [3]

(b) Fill in the code for the function `TotalPrice()` that returns the total price of the `num` tickets in `group`. [2]

```
int TotalPrice(struct Ticket group[], int num)
{

  _____________________________________

  _____________________________________

  _____________________________________
}
```

6) (a) Write a complete C program `recho.c` that outputs its command-line arguments in reverse order. I.e., if we type at the terminal prompt : [5]

```
$ recho one two three
```

the output will be:

```
three two one
```

(b) Specify two test cases for your program, one "normal" and the other a "boundary" test case (different from the example given above).

7) Given 3 sides of a triangle, a, b and c as real numbers. [4]
   a) Write a snippet of C code that sets the variable `isRt` to 1 or 0 depending on whether the 3 numbers represents a right-angled triangle or any other triangle.

   b) Under what conditions (specific values of a, b and c) is your code likely to fail to give the correct result?

8) Given the function $f(n) = (n/2)!$ For even n [5]
$= n \times f(n-1)$ For odd n

a) What is the value of $f(3)$ and $f(8)$?

b) Draw a neat flowchart to iteratively compute the value of $f(n)$ for any positive n.

9) After execution of the following program, are the elements in `array6` reversed? Justify your answer in short. Outline the ***minimum necessary changes*** to ensure that the elements in `array6` are reversed at the end. List the changes clearly. [4]

```
#include <stdio.h>
int main(void)
{
    int array6[5] = {1,2,3,4,5,6};
    int tmp;

    for(i=0; i<=5; i++)
    {
        tmp         = array6[i];
        array6[i]   = array6[5-i];
        array6[5-i] = tmp;
    }
}
```

10) The file input.dat contains one integer on each line. Write a C programme that reads `input.dat` and writes all the non-negative integers only to the file `output.dat`, one number per line. Assume that both files exist and are readable/writeable respectively. [5]

11) A binary tree is a dynamic data structure that is similar to a linked list. Consider the code below. Draw a neat picture of the memory allocated, showing the fields of each structure and their numeric values at the end of execution. Also draw arrows for the pointers. Assume that an int and a pointer occupy 4 bytes each, and that the variables are allocated to contiguous memory locations starting at location 120. [4]

```
struct node {
  struct node *left, *right;
  int val;
} *root, n1, n2, n3, n4, n5;

root = &n1;
n1.val = 10; n1.left = &n2; n1.right = &n3;
n2.val =  5; n2.left = &n4; n2.right = &n5;
n3.val = 15; n3.left = NULL; n3.right = NULL;
n4.val =  1; n4.left = NULL; n4.right = NULL;
n5.val =  6; n5.left = NULL; n5.right = NULL;
```

12) Suppose $p(x) = 3x^3 - 4x^2 + 5x - 12$. [5]

(a) Use Horner's method to find the value of $p(4)$. Show your calculations clearly.

(b) Given the initial interval $[x_0, x_1] = [0, 2]$, what is the new interval after one iteration of the Regula-falsi method?

13) Consider the function `int Vpattern(int a[], int aSize)` which takes as input an array of distinct integers called `a` and an integer `aSize` that gives the number of elements present in `a`. The function returns 1 if the integers in the array are such that the first half is a decreasing sequence and the second half is an increasing sequence, otherwise it returns 0. Assume that the array size is even. [6]

(a) Give an example array of size 8 integers that satisfies the above condition.

(b) Give an example array of size 8 integers that does not satisfy the above condition.

(c) Explain the algorithm you would use to solve the problem (use pseudo-code).