

Computational Engineering - Assignment 1

Due: 15/Jan, 4.00 pm

Type: Group Assignment of size 5/6

Note: Discuss as a group and submit one solution per group.

1. Read Octal and Hexa decimal representation from the Internet/text. Represent (i) 1234 (ii) 1234.123 in Octal and Hexa decimal system.
2. What is the smallest and the largest number that can be represented in Octal and Hexa system assuming the representation has k places. Write the decimal equivalent of the same.
3. For the binary number 1111111, represent the Octal and Hexa equivalent. Discover two different approaches to answer this question.
4. Can you generalize Hexa and think of base 32 system. Write down a strategy to convert an Hexa number into a base 32 number. Think of a simple and elegant strategy.

Assignment 3, Due: 22-Feb

1. How do you pass the value of the control string in a printf statement during execution. That is, variable length control string instead of `%4d`, `%7d`. Do this exercise for integer and float data types. Write the syntax for both.
2. Can we include printf inside scanf. Similarly, scanf inside printf. If multiple ways are possible, explore as many ways as you can. Explain with an example.
3. What do escape sequences `f` and `v` denote - explain with a suitable code.
4. How do we read an octal and a hexa decimal number and how do we print them. Can we print what is being read (octal/hexa) in decimal.
5. What is the output of the following code. Justify.

```
int a=2, b=3;
a=a+b-(b=a);
printf("%d%d", a, b);
```

6. What is the output of the following code. Justify.

```
int a=2, b=3;
a=a^b;
b=a^b;
a=a^b;
printf("%d%d", a, b);
```

7. What is the output of the following program. Justify your answer.

```
#include<stdio.h>
int i=10,p;
main()
{
    {
        int i=20;
        printf("duplicate declaration but still works ; value of 'i' is %d\n",i);
    }

    printf("strange question but works; value of 'i' is %d\n",i);
    int p=10;
    printf("program prints the value of p without error; the value of p is %d\n",p);
}
```

Assignment 4, Hand in: March 5

1. (3 marks) Assuming 32 bit representation for float, what is the representation (write mantissa, exponent) for
 - 65535
 - -12.76
 - The value of square root of 2

2. (2 marks) What is the output. What if (i) $x = 5.6$ (ii) $x = 5.20$

```
{
float x=5.1;
printf("the value of x is %f\n",x);
if(x==5.1)
printf("5.1 is stored as 5.1");
else
printf("5.1 is stored as 5.110000");
}
```

3. (2 marks) If you observe gcc compiler, the output of a float variable has 6 places in the fractional part. Present an intuitive argument in support of this observation.
4. (2 marks) What are *lvalues* and *rvalues*. Explain with an example.
5. (1 mark) Justify the output with a good reasoning.

```
int k=32;
if(32==k)
printf("if with a different conditional check");
int q=100;
q==3;
printf("\nthe value of q is %d",q==100);
```

6. (2 marks) What is the output of the following program.

```
int q=3;
switch(q)
{
default: printf("the value of q is more than 2\n");
q=0;

case 1: printf("the value of q is 1\n");
printf("the value of q is 0\n");
printf("the value of q is %d\n",q);

case 2: printf("the value of q is 2\n");
break;

}
```

7. (2 marks) What is the output of the following program. Check whether the code works if $x = 2$.

```

int x=3;
switch(x)
{ printf("i am inside switch\n");
  case 1: printf("the value of x is 1\n");
  break;
  case 4*1-2: printf("the value of x is 2\n");
  break;
  default: printf("the value of x is more than 2\n");
  break;

  printf("i am outside case\n");
printf("i am helpless, i may not be displayed\n");

}

```

8. (2 marks) Mention the output with a justification.

```

{
float d,e;
printf("enter the values of d and e\n");
scanf("%d%d", &d,&e);
printf("%f%f",d,e);
}

```

9. (2 marks) Is it true that any if-else block can be replaced with an equivalent switch-case statement. There is no restriction on if-else statement (it can have any number of if, nested if-else-if). Think as a programmer (not as a core mathematician) and convert the following code using switch-case. Any assumption must be stated clearly.

```

int m;
if(m<0)
{

}
else
{

}

```

10. (4 marks) Recall 'divisibility by 3' and 'div by 4' which we discussed in class. For each of the logic discussed, either present a proof of correctness that it indeed works for any integer or present a counter example (an example for which the logic fails).

Assignment 5, Due: April 3, 5 pm.

Instructions: (i) Do NOT submit a hard copy, instead submit a soft copy by email (just one .c file). Submit .c file and a.out file. (ii) You may discuss with me if you are NOT getting the logic or face any difficulty in answering these questions (iii) Make use of this really-long weekend effectively.

1. Given a binary array (array containing just 0's and 1's), count the number of 0's and 1's.
2. Learn about two dimensional arrays. Accept two rectangular matrices and perform (i) matrix addition (ii) matrix subtraction (iii) matrix multiplication
3. Learn about nested loops (two or more loops). Accept a string and print the number of occurrences of each character in a string. Do NOT print the same message twice. For example, if the string="aaa", do not print the message 'a appears 3 times' , three times.
4. Palindrome is a string which reads the same forward and backward, for example, amma, appa, liril, malayalam, ramar. That is, a string and its reverse are same. Check whether a given integer (12321, 3333) is a palindrome or not. Similarly for a string.
5. Given two strings S_1 and S_2 check whether S_1 is a substring of S_2 . For example, turing is a substring of manufacturing, pen is a substring of pen as well as pencil.
6. SORTING: Learn about bubble sort from google. Implement bubble sort using while loops. Also, implement the same using IF-ELSE-GOTO without using loops. Can we implement using switch case + goto ? If so, make an attempt.
7. Implement GCD(m,n) and LCM(m,n).
8. Using just one loop (while or for), find the maximum and the minimum in an integer array. Do the same for float array and char array.
9. Using just one loop (while or for), reverse the contents of an integer array. For example, i/p: 123456, o/p: 654321
10. SEARCH: i/p: integer array, integer x , question: check whether x exists in the array. If yes, display the position of existence and the count (the number of times x appears in the array).
11. Refer to previous semester end-semester question paper; solve extra credits questions.

Computational Engineering - Assignment 1

Due: 24/Aug, 4.00 pm

Type: Group Assignment of size 6/7

Note: Discuss as a group and submit one solution per group.

1. Read Octal and Hexa decimal representation from the Internet/text. Represent (i) 1234 (ii) 1234.123 in Octal and Hexa decimal system.
2. What is the smallest and the largest number that can be represented in Octal and Hexa system assuming the representation has k places (digits). Write the decimal equivalent of the same.
3. Can you generalize Hexa and think of base 32 system. Write down a strategy to convert an Hexa number into a base 32 number. Think of a simple and elegant strategy.
4. How do you perform the subtraction of two numbers in Octal system. Define the subtraction rules clearly and explain with an example.
5. How do you perform the multiplication of two numbers in base 3 system. Define the multiplication rules clearly and explain with an example.
6. Given two binary numbers of size m and n , respectively. As a function of m and n , express the length of the output. As a function of m and n , express the number of bit additions and multiplications performed while computing $m \times n$.

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3. Learn about nested loops (two or more loops). Accept a string and print the number of occurrences of each character in a string. Do NOT print the same message twice. For example, if the string="aaa", do not print the message 'a appears 3 times' , three times.
4. Palindrome is a string which reads the same forward and backward, for example, **amma**, **appa**, **liril**, **malayalam**, **ramar**. That is, a string and its reverse are same. Check whether a given integer (12321, 3333) is a palindrome or not. Similarly for a string.
5. Given two strings S_1 and S_2 check whether S_1 is a substring of S_2 . For example, **turing** is a substring of **manufacturing**, **pen** is a substring of **pen** as well as **pencil**.
6. SORTING: Learn about bubble sort from google. Implement bubble sort using while loops. Also, implement the same using IF-ELSE-GOTO without using loops. Can we implement using switch case + goto ? If so, make an attempt.
7. Implement GCD(m,n) and LCM(m,n).
8. Using just one loop (while or for), find the maximum and the minimum in an integer array. Do the same for float array and char array.
9. Using just one loop (while or for), reverse the contents of an integer array. For example, i/p: 123456, o/p: 654321
10. SEARCH: i/p: integer array, integer x , question: check whether x exists in the array. If yes, display the position of existence and the count (the number of times x appears in the array).

Computational Engineering Assignment-1

Note: All assignments involve a team of size 6 or 7. No group can have less than 6 members. Due: 21/Jan. Submit one assignment per group. All group members must work together and must see 6 different hand writings. At least 30% of the questions of this type shall appear in Quizzes.

1. Given an integer n , how many bits do you need to represent n in (i) binary (ii) ternary system. Write the number as a function of n .
2. Perform 324×567 in Base 3 system. All intermediate steps must be in Base 3 system.
3. Perform $567 - 324$ in Base 2 system. Clearly mention all intermediate steps.
4. Perform $15 + 15 + 15 + 15 + 15$ in binary. This task must be done in one step and do not perform addition by taking two 15's at a time. Clearly mention addition rules for performing column-wise addition.
5. Assuming 6 bit system, what is the smallest and the largest number that can be represented in Octal and Hexa decimal system.
6. Assuming Base 3 system and the task is to multiply two integers a and b . As a function of a and b , count the number of bit-level multiplications and bit-level additions that take place as part of $a \times b$.
7. For a Base-12 system, define addition, subtraction and multiplication rules. Using the rules defined, perform (i) $1024 + 768$ (ii) $1024 - 768$ (iii) 1024×768 .

Assignment 2
Due: 7/Feb/2019.

1. Write a program using IF + GOTO to count the number of digits in a given integer. Do NOT use loops.
2. Can the above question be answered using just sequence statements (no loops, no if+goto, no switch). If yes, write the code.
3. Accept the age of a person from the user (age is an integer variable). Classify the person as 'baby' if age is less than or equal to 5, between 6 and 12; 'kid', between 13 to 19; 'teen', 20 to 40; 'adult', beyond 40, 'old'. Use switch-case. Do not use if, for.
4. Count the number of executions of (i) for statement (ii) printf statement. Assume 'a' is an integer.

```
for(i=a; i<=n; i=i+1)
printf("%d",i)
```

5. Count the number of executions of (i) for statement (ii) printf statement. Assume 'a' is an integer.

```
for(i=a; i<=n; i=i*2)
printf("%d",i)
```

6. Implement the following code using switch-case. If required, you may use goto.

```
for(i=a; i<=n; i=i+1)
printf("%d",i)
```

7. Write a program which accepts an integer and checks whether its digits are distinct. I.e., 031, 1234, 56198 are integers with distinct digits, whereas 1213 is not.
8. You are asked to distribute 10 balls into two boxes. In how many different ways can this be done. For example; (10,0), (4,6), (3,7), (7,3) are some of the ways in distribution. Write a C program for the same.
9. Consider the series; 0 1 1 1 3 5 9 17 31 Write a C program to print this series upto 20 terms.
10. Present a logic for finding square root of a positive integer. Think as a programmer and present your logic and you need not write a C program. You may approximate upto 5 terms after the decimal point.

1. Assignment 5 was a group assignment. I suggest each one of you to make an attempt independently all questions in A5.
2. Questions given below are ranked based on difficulty level. I suggest you to try in the order of listing.
3. You may discuss with your friends before you catch me over email. As I am fully occupied with research and departmental activities, I may not be in a position to respond to all requests. No need to submit any of these codes, you must convince yourself that it works fine.

1 Light

1. Given an integer Array A and integer n , where elements of A are in the range $[0..n]$ and having the property that elements of A are distinct, write a program to identify the missing integer. Note that the range has $n + 1$ elements and A has n distinct elements. Present two different logic and C code.
2. Specification as above and in addition suppose two numbers from the range $[0..n]$ are missing. Write a C program to identify the missing pair.
3. Given two integers x and n , write a C program to compute x^n . Present three different logic and code.

2 Medium

1. Write a program that computes e^x , $\log(1+x)$, $\sin x$ using well known series. Accept x and the precision n (series has n terms) from the user.
2. Accept four numbers from the user. Write a C program (with a good logic) that prints (i) increasing sequence among four (ii) decreasing sequence among four. For example: if the input is $-2, 4, 1, -5$, then increasing sequence is $-5,-2,1,2$ and decreasing sequence is $2,1,-2,-5$. This must be done using selection and sequence statements only, NO looping statements.
3. Given an integer array A and an integer z ; Question: Does there exist $x, y \in A$ such that $z = x + y$. Present two different logic.
4. **Input:** Text T
Functionalities to be supported are ;
 - (a) Count the number of characters in T
 - (b) Count articles' count in T
 - (c) Count the no of vowels in T

3 Strong

1. How many numbers are there in the range $[1..100]$ that are neither divisible by 3 nor 4 nor 5. Write a C program to print the number. Can we solve this problem using just sequence statements. If so, make an attempt. Think of a good logic before attempting this question.
2. Given an integer array A , present an **efficient** algorithm to find duplicates in A and implement the same using C. Also, print for each element, the multiplicity (how many times a number appears in A). Think of two different logic.
3. Given an integer array A of size n (n is even), the objective is to partition A into two equal parts such that the difference between the sums of the integers in the two parts is maximized. Present an **efficient** algorithm and implement the same using C.

4. Present an efficient logic and C code to merge k sorted lists into one sorted list. n_i represents the size of the i^{th} list and n denotes the total number of elements.

4 Competitive Programming Questions

I am not sure whether you can cope up with the following questions. I still experiment to see the best in you. Read the question carefully, at least 5 times before make an attempt. For all, discover a logic and C code.

1. Coin Change Problem

Input: Denominations (d_1, \dots, d_k) and Rupee x (in integer)

Objective: To give change for x with a minimum number of currencies

2. Multi Container Loading

Input: Given n objects with capacities w_1, \dots, w_n , two containers (trucks) with capacities C_1, C_2

Objective: To place maximum number of containers into trucks such that the weighted sums of the objects placed in trucks do not exceed C_1 and C_2 , respectively.

3. Multi Processor Scheduling

Input: Given n tasks with service times s_1, \dots, s_n , two processors P_1, P_2

Objective: To schedule n tasks in two processors so that the final completion time is minimized, i.e., suppose out of n tasks, k are scheduled in P_1 and $n - k$ are scheduled in P_2 , the value of $\max\{f_k, f_{n-k}\}$ must be minimum, where f_k is the finish time of the k^{th} job at P_1 .