End Semester Examination

Introduction to Computing (CS 101)

IIT Guwahati

April 29, 2014

Duration: 3 Hours

Instructions:

(1) Encircle the answer (A/B/C/D/E) in the space provided in the answer script.

(2) Each question has exactly one correct answer.

(3) There are a total of 50 questions. **Each question carries two marks.**

(4) **Negative Marking:** Each wrong answer will be penalised by $\frac{1}{2}$ **negative marks**.

(5) Please write your name and roll number on both the question paper and the answer script.

(6) Possession of either a mobile phone or a calculator is strictly prohibited during the exam.

(7) No doubts will be entertained during the exam.

(8) There are 6 pages of questions and 2 pages for rough work in the question paper. Please contact the invigilator, if otherwise.

Name: **Roll No:**

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1. The conversion of a program from some high-level programming language to machine language (object code) is done by a _____.

   (A) Compiler
   (B) Loader
   (C) Linker
   (D) All of the above
   (E) None of the above

2. Which of the following is not a storage device?

   (A) Hard Disk
   (B) CD ROM
   (C) Keyboard
   (D) Floppy Disk
   (E) None of the above

3. In C programming, the name of an *array* indicates the _____.

   (A) Address of the first element of the array
   (B) First element of the array
   (C) Number of elements in the array
   (D) Data type of the elements stored in the array
   (E) None of the above

4. Which of these data types is used by an operating system to manage the recursion in C programming?

   (A) Stack
   (B) Queue
   (C) Linked List
   (D) Array
   (E) None of the above

5. Let A be an array containing n distinct integers. If $i < j$ and $A[i] > A[j]$, then the pair (i, j) is called an inversion of A. Which array containing the elements $\{1, 2, \ldots, n\}$ has the most and the least number of inversions, respectively?

   (A) Most: $\{1, 2, \ldots, n\}$, Least: $\{1, 2, \ldots, n\}$
   (B) Most: $\{1, 2, \ldots, n\}$, Least: $\{n, n-1, \ldots, 1\}$
   (C) Most: $\{n, n-1, \ldots, 1\}$, Least: $\{1, 2, \ldots, n\}$
   (D) Most: $\{n, n-1, \ldots, 1\}$, Least: $\{n, n-1, \ldots, 1\}$
   (E) None of the above

6. Identify the equivalent postfix representation for the following infix expression: $A + B * C + D$

   (A) $AB + CD + *$
   (B) $ABCD + +*$
   (C) $ABCD + *+$
   (D) $ABC * +D+$
   (E) None of the above

7. Evaluate the postfix expression: 2 3 $*$ 4 5 $*$ $+$

   (A) 36
   (B) 50
   (C) 70
   (D) 120
   (E) None of the above

8. Identify the correct statement.

   (A) Matrix multiplication of two $n \times n$ matrices can be done in $O(n^3)$ time.
   (B) Matrix multiplication of two $n \times n$ matrices can be done in $O(n^2)$ time.
   (C) Matrix multiplication of two $n \times n$ matrices can be done in $O(n)$ time.
   (D) All of the above
   (E) None of the above

9. Which of the following sorting algorithms has the fastest possible best-case time complexity for n elements?

   (A) Selection sort (without using an auxiliary array)
   (B) Selection sort (using an auxiliary array)
   (C) Insertion sort
   (D) Both A and B
   (E) All of the above

10. The worst-case time complexity for searching an element from a set of n sorted elements using binary search algorithm is

   (A) $O(\log n)$
   (B) $O((\log n)^2)$
   (C) $O(\log \log n)$
   (D) $O(1)$
   (E) None of the above

11. Consider the sorted array declared by "int A[9]={1, 2, 3, 4, 5, 6, 7, 8, 9};". What is the number of comparisons (between elements) required to find the element 7 using binary search? Note that $mid = \lfloor \frac{low+high}{2} \rfloor$.

   (A) 2
   (B) 3
   (C) 4
   (D) 5
   (E) 9

12. Consider the array declared by "int A[9]={9, 8, 7, 6, 5, 4, 3, 2, 1};". What is the number of comparisons (between elements) required to find the element 7 using linear search, starting from the beginning of the array?

   (A) 2
   (B) 3
   (C) 4
   (D) 5
   (E) 9

13. Suppose we have some distinct numbers between 1 and 1000 stored in a sorted array, and we want to search the number 500 using binary search. Which of the following is a valid binary search sequence?

   (A) $100, 400, 300, 600, 500$
   (B) $400, 800, 700, 600, 500$
   (C) $200, 100, 600, 800, 500$
   (D) $300, 900, 700, 800, 500$
   (E) None of the above

14. Assume A to be an array of integers (e.g., "int A[5] = {1, 2, 3, 4, 5};"). Indicating equivalence by '$\equiv$', which of the following statements is incorrect?

   (A) $A[i] \equiv *(A + i)$
   (B) $A \equiv \&A[0]$
   (C) $\&A[i] \equiv A + i$
   (D) $(i - j) \equiv (\&A[i] - \&A[j])$
   (E) None of the above

15. Identify the data structure (among the following ones) that consumes the highest amount of space to store a set of n integers. Assume that n is large. [Note: Consider the most space-efficient implementation of each data structure.]

   (A) One-dimensional array
   (B) Singly linked-list
   (C) Doubly linked-list
   (D) Stack
   (E) Queue

16. What will be the output for the code segment below?

```
#include<stdio.h>

int main()
{
 int a[] = {10, 20, 30, 40, 50};
 int i;

 for(i=0; i<5; ++i)
        printf("%d,", *(a+i));

 printf("\n");
 return 0;
}
```

   (A) $10, 10, 10, 10, 10,$
   (B) $10, 20, 30, 40,$
   (C) $10, 20, 30, 40, 50,$
   (D) Garbage values
   (E) None of the above

17. What will be the output for the code segment below?

```
#include<stdio.h>

int main()
{
 int a[3][3] = {1,2,3,4,5,6,7,8,9};
 int *ptr[3] = {a[0],a[1],a[2]};
 int i;

 for(i=0; i<3; ++i)
        printf("%d,", *ptr[i]);

 return 0;
}
```

   (A) $1, 1, 1,$
   (B) $1, 2, 3,$
   (C) $1, 4, 7,$
   (D) Garbage values
   (E) None of the above

18. What will be the output for the code segment below?

```
#include<stdio.h>

typedef struct {

        int i;
        float f;
        } values;

int main()
{
 values var={555, 67.05501};
 printf("%d,%.2f", var.i, var.f);
 return 0;
}
```

(A) 555, 67
(B) 555, 67.06
(C) 555, 67.05
(D) 555, 67.05501
(E) None of the above

19. The output of the following code segment is $0x7fff70b4e3b0$,_____. Choose the correct option for filling up the blank.

```
#include<stdio.h>
void main()
{
 int a[5] = {10, 20, 30, 40, 50};
 printf("%p,%p\n", a, &a);
}
```

(A) $0x7fff70b4e3b0$
(B) 10
(C) Address of the location containing $0x7fff70b4e3b0$
(D) Compile time error
(E) None of the above

20. Given an array $A = \{10, 30, 40, 50, 20\}$, calculate the number of swap operations required to sort the elements in an increasing order using Bubble sort.

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

21. Given an array $A = \{10, 20, 30, 40, 50\}$, calculate the number of comparisons (between elements) required to sort the elements in an increasing order using the most efficient implementation (one that requires the minimum number of comparisons in the best-case) of Bubble sort.

(A) 0
(B) 4
(C) 5
(D) 9
(E) 10

22. The following program will create a file **file.txt**. What will be the content of the **file.txt** after the execution of the program?

```
#include <stdio.h>

int main ()
{
   FILE *fp;
   fp = fopen("file.txt","w+");
   fputs("abcdef", fp);
   fseek(fp, -2, 1);
   fputs("pqrst", fp);
   fclose(fp);
   return(0);
}
```

(A) abcdefpqrst
(B) abcdepqrst
(C) abcdefqrst
(D) abcdpqrst
(E) None of the above

23. What will be the output for the code segment below?

```
#include <stdio.h>
#include <string.h>

int main ()
{
   char str1[15];
   char str2[15];
   int ret;
   strcpy(str1, "aAbBcC");
   strcpy(str2, "aABbcC");
   ret = strcmp(str1, str2);
   if(ret > 0)
      printf("str2<str1");
   else if(ret < 0)
      printf("str1<str2");
   else
      printf("str1=str2");
     return(0);
}
```

(A) str2<str1
(B) str1<str2
(C) str1=str2
(D) Compile time error
(E) None of the above

24. Given an array $A = \{40, 30, 10, 50, 20\}$, calculate the number of swap operations required to sort the elements in an increasing order using Selection sort that requires $O(1)$ (constant) worst-case space complexity, i.e., does not use an auxiliary array.

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

25. Given an array $A = \{10, 20, 30, 40, 50\}$, calculate the number of comparisons (between elements) required to sort the elements in an increasing order using insertion sort.

    (A) 0

    (B) 4

    (C) 5

    (D) 9

    (E) 10

26. Consider an array $A = \{329, 457, 657, 839, 436, 720, 355\}$, which we are trying to sort using radix sort starting from the least significant digit, using 3 iterations. What would be the order of the elements after the second iteration?

    (A) $\{720, 355, 436, 457, 657, 329, 839\}$

    (B) $\{720, 329, 436, 839, 355, 457, 657\}$

    (C) $\{720, 329, 436, 839, 457, 355, 657\}$

    (D) $\{720, 329, 839, 436, 457, 355, 657\}$

    (E) None of the above

27. Which of the following sorting algorithms is stable?

    (A) Insertion sort

    (B) Bubble sort

    (C) Counting Sort

    (D) All of the above

    (E) None of the above.

28. Consider an empty stack S in which the following sequence of operations are performed: Push(4), Push(6), Pop(), Push(8), Push(9), Push(1), Push(2), Pop().

    Which of the elements are present in the stack after the above operations?

    (A) $4, 6, 8, 9$

    (B) $4, 8, 9, 1$

    (C) $8, 9, 1, 2$

    (D) $6, 8, 9, 1$

    (E) None of the above

29. Consider an empty queue Q in which the following sequence of operations are performed: Enqueue(4), Enqueue(6), Dequeue(), Enqueue(8), Enqueue(9), Enqueue(1), Enqueue(2), Dequeue().

    Which of the elements are present in the queue after the above operations?

    (A) $4, 6, 8, 9$

    (B) $4, 8, 9, 1$

    (C) $8, 9, 1, 2$

    (D) $6, 8, 9, 1$

    (E) None of the above

30. What will be the output for the code segment below?

```
#include <stdio.h>
void swap1(int a, int b)
{
        int temp;
        temp = a;
        a = b;
        b = temp;
}
void swap2(int *a, int *b)
{
        int temp;
        temp = *a;
        *a = *b;
        *b = temp;
}
void main()
{
 int i=10, j=20, k=30, l=40;
 swap1(i, j);
 swap2(&k, &l);
 printf("%d,%d,%d,%d\n",i,j,k,l);
}
```

    (A) $10, 20, 30, 40$

    (B) $20, 10, 30, 40$

    (C) $10, 20, 40, 30$

    (D) $20, 10, 40, 30$

    (E) None of the above

31. Consider a singly linked list L in which every node (structure) consists of two members. The first member is an integer data d. Identify the correct data type for the second member.

    (A) Integer

    (B) Pointer to an integer

    (C) Pointer to a pointer to an integer

    (D) Pointer to a node

    (E) None of the above

32. Identify the number of bytes required to store the string "This is an easy question" in a C program.

    (A) 20

    (B) 21

    (C) 24

    (D) 25

    (E) None of the above

33. Given an integer array declared by "int $A[3][5]$;", which of the following statements **does not** represent the element $A[2][3]$?

    (A) $(*(A[2] + 3))$

    (B) $(*(A + 2))[3]$

    (C) $(*((*(A + 2)) + 3))$

    (D) $(A[2] + 3)$

    (E) None of the above

34. Given an integer array declared by

"int $A[\ ] = \{2, 4, 6, 8, 3\}$;", what is the value of $A[A[1]]$?

(A) 2

(B) 4

(C) 6

(D) 8

(E) 3

35. Identify the 2's complement representation of the negative integer -127, using 8 bits.

(A) 10000001

(B) 11111111

(C) 01111111

(D) 10000000

(E) None of the above

36. The number of 1's in the binary representation of the integer $13 * 16^3 + 11 * 16^2 + 9 * 16 + 3$ is:

(A) 7

(B) 8

(C) 9

(D) 10

(E) None of the above

37. Given an integer array declared by "int $A[10]$;", what is the value of $((\&A[2]) - (\&A[6]))$? Assume that an integer takes 4 bytes.

(A) -4

(B) -16

(C) 4

(D) 16

(E) None of the above

38. If two pointers $p1$ and $p2$ are declared by "int *p1, *p2;", identify the invalid statements.

(A) $p1 = p1 + 2$;

(B) $p1 = p1 - 2$;

(C) $p1 = p1 * 2$;

(D) $int\ i = p1 - p2$;

(E) None of the above

39. Consider a singly linked-list with a head and a tail pointer (i.e., pointers to the first and last node in the list). Given this representation, which of the following operations **can not** be implemented in constant time (i.e., O(1) time)?

(A) Insert an item at the front of the list

(B) Insert an item at the rear of the list

(C) Delete the front item from the list

(D) Delete the rear item from the list

(E) None of the above

40. Consider the following code segment. Identify the invalid statement to assign a value to member1.

```
#include<stdio.h>
struct test{
        int member1;
} var;
void main()
{
 struct test *ptr=&var;
 /*identify the invalid statement.*/
}
```

(A) (*ptr).member1=5;

(B) *ptr.member1=5;

(C) (ptr)->member1=5;

(D) ptr->member1=5;

(E) None of the above

41. In C programming, the return type of a malloc() function is

(A) An integer

(B) A void pointer

(C) A pointer to an integer

(D) Pointer to an array

(E) None of the above

42. What is the equivalent pointer expression for referring the array element $A[i][j][k][l]$ in an integer array $A[10][10][10][10]$?

(A) ((((A+i)+j)+k)+l)

(B) (*(*(*(*(A+i)+j)+k)+l))

(C) (((A+i)+j)+k+l)

(D) ((A+i)+j+k+l)

(E) None of the above

43. In C programming, the size of a *union* is determined by the size of the _____.

(A) First member in the union

(B) Last member in the union

(C) Maximum-sized member in the union

(D) Sum of the sizes of all members

(E) None of the above

44. The C syntax for command-line argument is "int main(int argc, char *argv[ ])". What is indicated by argv[0] in command-line arguments?

(A) The name by which the program is invoked

(B) The name of the files which are passed to the program

(C) Count of the arguments in argv[ ] vector

(D) Both A and B

(E) None of the above

45. In C programming, the size of a *structure* is determined by the size of the _____, excluding the slack bytes.

    (A) First member in the structure

    (B) Last member in the structure

    (C) Maximum-sized member in the structure

    (D) Sum of the sizes of all members

    (E) None of the above

46. The deletion of a node can always be done in constant (i.e., $O(1)$) time from a linked list with n nodes if _____.

    (A) The linked list is singly and the element stored in the node to be deleted is given

    (B) The linked list is singly and the pointer to the node to be deleted is given

    (C) The linked list is doubly and the element stored in the node to be deleted is given

    (D) The linked list is doubly and the pointer to the node to be deleted is given

    (E) None of the above

47. In C programming, identify the valid declaration of a *three-dimensional array.*

    (A) int A[ ][2][2]={2,2,2,2};

    (B) int A[ ][ ][2]={2,2,2,2};

    (C) int A[2][2][ ]={2,2,2,2};

    (D) Both A and B

    (E) Both A and C

48. Which of the following code segments is invalid?

    (A) int A[20]; printf("%p", A+1);

    (B) int A[20]; printf("%p", (&A)+1);

    (C) int A[20]; printf("%p", (&(&A)+1));

    (D) Both B and C

    (E) None of the above

49. Consider the C code below. How many '*' will be printed by the following program?

```
#include<stdio.h>
 void quiz(int i)
    {
         if (i > 1)
         {
              quiz(i / 2);
              quiz(i / 2);
         }
         printf("*");
    }

void main()
{
         quiz(5);
}
```

    (A) 3

    (B) 5

    (C) 7

    (D) 9

    (E) None of the above

50. Consider the C code below. How many '*' will be printed by the following program?

```
#include<stdio.h>
 void quiz(int i)
    {
         if (i > 1)
         {
              quiz(i % 2);
              quiz(i / 2);
         }
         printf("*");
    }

void main()
{
         quiz(6);
}
```

    (A) 3

    (B) 4

    (C) 6

    (D) 7

    (E) None of the above