ASSIGNMENT BOOKLET

M.Sc. (Mathematics with Applications in Computer Science) M.Sc.(MACS)

PROGRAMMING AND DATA STRUCTURES

(1st January, 2024 to 31st December, 2024)

- It is compulsory to submit the Assignment before filling in the Term-End Examination form.

- It is mandatory to register for a course before appearing in the Term-End Examination of the course. Otherwise, your result will not be declared.

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(2024)

Assignment
(To be done after reading the course material)

1. Write the output of the following C codes, with proper justification for each. (10)

   i)
```
main()
{
    int a = 2, b = 4, c = 5;
    a = b + c;
    b = a + c;
    c = a - b;
    printf("%d,%d,%d", a, b, c);
}
```

   ii)
```
main()
{
    printf("%d", 'C' + 'P' + 'r' + 'o' + 'g' + 'r' + 'a' + 'm');
}
```

   iii)
```
main()
{
    int i, j = 1;
    for(i = 1; i <= 10; i = i + 2)
    {
        j = i - j;
        while(j <= 2)
            printf("%d ", i+j++);
    }
}
```

   iv)
```
main()
{
    int a = 10, b = 20, c = 30;
    int *p = 2;
    a = c/*p;
    b = c;
    printf("a = %d, b = %d", a, b);
}
```

   v)
```
func(int x)
{
    static int a = 0;
    a += x;
    return(a);
}
main()
{
    int p;
    for(p = 1; p <= 5; ++p)
        printf("%d", fun(p));
}
```

2. (a) Explain the use of the functions **getchar()**, **putchar()**, **gets()** and **puts()** functions, with a suitable program. (6)

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(b) Arrange the following operators in descending order of their priority. If any two operators have the same priority, then specify their associativity. (4)

$+=, \quad \%, \quad +, \quad *, \quad *\text{(unary)}, \quad != , \quad -, \quad ++$

(c) Write a loop that examines each character in a character type array called `text`, and determines how many of the characters are letters, how many are digits, how many are whitespace characters, and how many are other characters. (5)

3. (a) Explain how will you read a three-dimensional array using for loops. (4)

(b) Suppose you wish to solve the equation $x^5 + 3x^2 - 10 = 0$ for x. Rearrange this equation to get an appropriate fixed point iteration method. Then write a program to get an approximate value of the root of the equation. The initial guess must be entered by the user. Your programme must be able to flag a warning message if the initial guess is too far from the exact root. In that case, your program must be able to suggest an initial guess to the user. Terminate the program and print the current value of the root as soon as the difference between two successive approximations becomes smaller than 0.005. (6)

4. (a) How is an external variable defined? How is it initialised? What happens when an external variable definition does not include the assignment of an initial value? (3)

(b) When passing an argument to a function, what is the difference between passing by value and passing by reference? (3)

(c) Explain the use of the string library functions `strncpy()` and `strncat()`, with the help of an example for each. (4)

5. (a) A C program contains the following statements:

```
char u, v = 'A';
char *pu, *pv = &v;
*pv = v+1;
u = *pv + 1;
pu = &u;
```

Suppose each character occupies one byte of memory. If the value assigned to `u` is stored in (hexadecimal) address `F8C` and the value assigned to `v` is stored in the address `F8D`, then

   i) What value is represented by `&v`?
   ii) What value is assigned to `pv`?
   iii) What value is represented by `*pv`?
   iv) What value is assigned to `u`?
   v) What value is represented by `&u`?
   vi) What value is assigned to `pu`? (6)

(b) How would you differentiate between the terms *pointer to an array* and *array of pointers*? Give proper examples. (4)

6. (a) What does the following C function compute? Discover. (5)

```
int some_fun(int n)
{
  if(n%2 == 0)
    return 2;
  int d, s = sqrt(n);
```

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```
          for(d = 3; d <= s; d = d+2)
            if(n%d == 0)
              return d;
          return n;
      }
```

(b) What do you understand by a *nested structure*? Explain with an example. Also, explain how would you access the members of a structure or a nested structure using pointers? (5)

(c) Consider the following structure declaration of a doubly linked list:

```
struct dlink
{
  int nodeid;
  dlink *next;
  dlink *prev;
} dlink_t;
```

A pointer of the head of the linked list is maintained as a global variable, whose definition is
`dlink_t *head;`
The function `remove_element(dlink_t *rp)` defined below needs to remove the node pointed to `rp` and adjust the head. The first node's `prev` and the last node's `next` are NULL.

```
remove_element(dlink_t *rp)
{
  rp->prev->next = rp->next;
  rp->next->prev = rp->prev;
  if(head == rp)
    head = rp->next;
}
```

Explain whether the function `remove_element()` works properly or not. (5)

7. (a) Write a C program which reads a line of text from keyboard, and writes the line to a file with lower case letters converted to upper case and vice-versa. (4)

(b) Write the inorder, preorder and postorder traversals of the following binary search tree. (3)
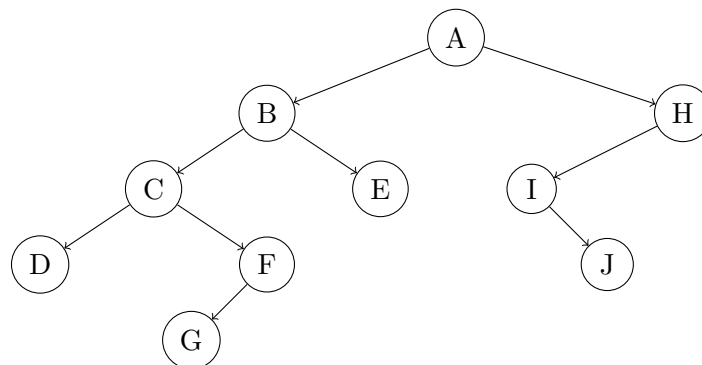
(c) Define a structure of type `hms` containing three integer members, called `hour`, `minute` and `second`, respectively. Then define a union containing two members, each a structure of type `hms`. Call the union members `local` and `home`, respectively. Declare a pointer variable called `time` that points to this union. (3)

8. Write a function that evaluates an expression in RPN that is given as a string. (10)

9. (a) Explain the meaning of the terms garbage collection, fragmentation, relocation and compaction. (5)

   (b) What do you understand by file organisation? Explain the methods of file organisation. (5)