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(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 1076 Roll No.

B. Tech.

(SEM. V) EXAMINATION, 2008-09

PRINCIPLES OF PROGRAMMING LANGUAGES

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all** questions.*

(2) You may choose the programming language with which you are familiar while answering.

*(3) Make **suitable** assumptions, wherever **necessary**.*

1 Attempt any **four** of the following :

(a) What are the most important properties of a good programming language?

(b) Describe the concept of orthogonality in programming language design.

(c) Differentiate between comiple time binding and run time binding.

(d) What is loader? Explain.

(e) Explain the concept of virtual computer with a suitable example.

(f) Some languages, notably C and Java, distintinguish between uppercase and lowercase in identifiers. What are the pros and cons of this design decision?

2 (a) Give the accessing formula for computing the location of component A(I)(J) of a matrix A declored as

int A[m][n];

where m and n are constants, and A is stored in row major order.

(b) For an elementary datatype in a language with which you are familiar, do the following :

(i) Show a situation during execution where a data object of that type exists that is neither a variable nor a constant.

(ii) Explain the difference between data objects of that type and the values that those data objects may contain.

(c) Write an algorithm for finding the location of the component V[N] of a vector V if V is stored in linked representation. Assume the address of the descriptor is α, its link field is at offset j and each component is stored in a separate block with the link stored at offset k in that block.

(d) For a language that provides a pointer type for programmer-constructed data objects and operations such as new and dispose that allocate and free storage for data objects, write a program segment that generates garbage (in the storage management sense). Write a program segment that generates a dangling reference. If one or the other program segment cannot be written explain why.

(e) For a language with which you are familiar, find an example of a primitive operation

(i) That has an implicit argument.

(ii) That is undefined for some data objects in its specified domain.

(f) In a language of your choice, define an abstract data type "stack of integers" and the operations PUSH and POP that insert and delete elements in a stack.

3 (a) Differentiate between call by reference and call by value result parameter passing mechanisms.

What will be the output of the following program assuming that parameter passing is

(i) Call by value

(ii) Call by reference

(iii) Call by value result

```
Procedure P (x,y,z)
        begin
                y : = y+1;
                z : z+x;
                end;
begin
        a: = 2;
        b: = 3;
        P (a+b, a, a);
        print (a);
        end.
```

(b) Consider the following C program

```
void abc (char *s)
{
    if (S[0]= =) 1o')
    return;
    abc (s+1);
    abc (s+1);
    printf ("% C", S[0]);
}
    main (-)
    { abc("123");
    }
```

(i) What will be the output of the program?

(ii) If abc (s) is called with a null terminated string S of length n characters (not counting the null ('10') character), how many characters will be printed by abc (r)?

(c) Consider the following program in pseudo pascal syntax.

```
Program main;
Var x: integer;
procedure θ (z: integer);
begin
z: = z+x;
writeln (z)
end;
```

```
Procedure P (y: integer);
    Var x: integer;
    begin
    x: y+z;
    θ (x);
    write ln (x)
    end;
    begin
    X: = 5;
    P (x);
    Q (x);
    write ln (x)
    end.
```

What is the output of the program, when

(i) The parameter passing mechanism is call-by-value and the scope rule is static scoping.

(ii) The parameter passing mechanism is call by-reference and the scope rule is dynamic scoping.

4 Attempt any **two** of the following :

(a) Give regular expressions for the following:

(i) Binary strings whose decimal representation is divisible by 5.

(ii) Binary strings consisting of an even number of 0's and one even number of 1's.

(b) (i) Let S be a regular set. Show that S^R (S-reversed, i.e., the set of strings in S written backward) is a regular set.

(ii) Show that the set of odd-length strings over the alphabet {a,b} that are not palindromes is context free.

(Note: Palindrome is a string that reads the same forward and backward.

(c) Write short notes on any **two** of the following :

(i) Static storage management

(ii) Heap-based storage management

(iii) Stack based storage management

5 (a) Suppose that sets are implemented as lists, where each element of a set appears exactly once in its list. Define functions that implement the following operations:

(i) Test whether an element is a member of a set.

(ii) Construct the union of two sets

(iii) Construct the intersection of two sets

(iv) Construct the difference of two sets that is the set of elements that are in the first set but not in the second.

(b) Verify the following equalities :

(i) $SII = \beta I$, where S is $\lambda xyz.\ (xz)\ (yz)$ and I is $\lambda x.x$

(ii) twice (twice) $f\ x = \beta\ f(f(f(fx)))$,
where twice is $\lambda\ f\ x \cdot f(fx))$

(c) Write short notes on any **two** of the following

(i) Object Oriented Languages

(ii) Coroutines

(iii) Functional Programming.