

Assignment 2

Principles of Programming Languages

Number of questions: 10

Total Score: 100 points

Due day: 2:00 PM 9th June 2020

P.S.:

- (1) You need to type your answers and print them out in papers. And then hand the answer sheets to TAs.**
 - (2) Late submission will not be accepted.**
 - (3) Copying other student's answers is strictly prohibited.**
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(1) (9 points)

What follows is a C program excerpt.

```
void bar()  
{ int tuv[10][10];  
    :  
    :  
}
```

- (a) What meaning does `tuv` represent?
- (b) What meaning does `tuv[1]` represent?
- (c) Could we change the value of `tuv[1][1]`?

Ans.

(2) (12 points)

What follows is a Java program excerpt.

```
class Circle
{
    int setVariable(int s)
    { int r;

        r=6;
        return s+r;
    }
}
```

```
public class xyz{
    :
    public static void main(String [] args)
    { Circle tuv[][]=new Circle[10][10];
        :
    }
}
```

- (a) What data type does tuv have?
- (b) What data type does tuv[1] have?
- (c) Could we change the value of tuv[1][1]?

Ans.

(3) (12 points)

What follows is a Java program excerpt.

```
class Circle
{
    int setVariable(int s)
    { int r;

        r=6;
        return s+r;
    }
}

public class Geometry{
    :
    public static void main(String [] args)
    {
        String t=new String("Welcome"); // location 1
        String s=new String("Welcome"); // location 2
        Circle shape[][]=new Circle[3][3]; // location 3
        :
    }
}
```

(a)

Assume "Welcome" does not appear in any other statement before location 1, how many new String objects will be created by the Java statement at location 1?

(b)

Assume "Welcome" does not appear in any other statement before location 1, how many new String objects will be created by the Java statement at location 2?

(c)

How many objects will be created by the Java statement at location 3?

(d)

How many variables will be created by the Java statement at location 3?

Ans.

(4) (12 points)

C, C++, and Fortran do not specify range checking of array subscripts. Assume a C compiler allocates memories for arrays declared in the same declaration statement in adjacent areas. For example for the following declaration statement, `int t[10], u[10], v[10];`, the compiler allocates memory for array `t` first. The memory of array `u`'s is right after the memory of array `t`. The memory of array `v`'s is right after the memory of array `u`. Assume the compiler utilizes row major order to store elements in an array. What follows is a C program.

```
#include<stdio.h>

main()

{ int a[10][10], b[10][10], c[10][10];

  int i,j;

  for(i=0;i<10;i++)
    for(j=0;j<10;j++)
    {
      a[i][j] = 1;
      b[i][j] = 2;
      c[i][j] = 3;
    }

  b[17][9]=4;    /*location 1*/
  b[17][16]=5;   /*location 2*/
  b[-3][7]=6;    /*location 3*/
  b[-3][-6]=7;   /*location 4*/
}
```

- (a) The value of which array element will be changed by the statement at location 1?
- (b) The value of which array element will be changed by the statement at location 2?
- (c) The value of which array element will be changed by the statement at location 3?
- (d) The value of which array element will be changed by the statement at location 4?

Ans.

(5) (8 points)

If dynamic scope is used in the following program. at location 10 (a) what is the value of variable a? (b) what is the value of variable b?

```
int car()
{ int e, f;

  e=7;
  f=8;
  return e+c+a; //location 1
}

int bar()
{ int c=4, d=5, e=6;
  c=car()+b; //location 2
  a=5; //location 3
  e=9; //location 4
  return c; //location 5
}

int main()
{ int a, b, c;

  a=1; //location 6
  b=2; //location 7
  c=3; //location 8
  b=bar()+c; //location 9
  return 1; //location 10
}
```

Ans.

(6) (8 points) The following C program can be compiled successfully. But what error does the following program have?

```
#include<stdio.h>

main()

{ int *p;

  *p=100;

}
```

Ans.

(7) (8 points) What follows is a C program.

```
#include<stdio.h>

#define SMALL_NUMBER_1 0.000007

#define SMALL_NUMBER_2 0.000009

main()

{

  float a, b, c, d, e;

  a=SMALL_NUMBER_1;

  b=c=SMALL_NUMBER_2;

  printf("a=%f\n", a);

  d=(a/(b*b*b*b*b*b*b*b*b*b)); /*location 1*/

  e=(a/(b*b*b*b))* (c/(b*b*b*b))* (c/(b*b)); /*location 2*/

  d=d*c*c; /*location 3*/

  printf("(1)d = %f\n", d); /*location 4*/

  printf("(2)e =%f\n", e); /*location 5*/

}
```

(a) From the point of view of mathematics, the computation executed by the statement at location 1 and the statement at location 3 together is equivalent to the computation executed by the statement at location 2. In other words, the expression consisted of the statements at locations 1 and 3 is equivalent to the expression consisted of the statement at location 2. Hence, when the statement at location 3 is completed, variable d and variable e are supposed to have the same value. But statements at location 4 and location 5 show that variables d and e have different values? Explain the reason.

(b) Write a C program as the above one to find two equivalent expressions with different evaluation orders that have different values. (P.S.: You must paste your program and its execution result on your answer sheet.)

Ans.

(8) (12 points)

What follows is a C program named `test_address.c`.

```
#include <stdio.h>

int t;

int *p;

main()
{ int q ;

    t=987 ;

    p=&t;

    printf("Hello \n"); /* location 1 */

}
```

Assume after program `test_address.c` is compiled by a C compiler, the addresses of variables t and p are 678 and 123 respectively. Then after the program is executed and the execution flow arrives at **location 1**, what are the values of $\&p$, p , and $*p$ respectively?

Ans.

(9) (7 points) Consider the following program:

```
procedure Main is
  X, Y, Z : Integer;
  procedure Sub1 is
    A,Y,Z : Integer;
    procedure Sub2 is
      A,B,Z : Integer;
      begin -- of Sub2
        . . .
      end; -- of Sub2
    begin - of Sub1
      . . .
    end; -- of Sub1
  procedure Sub3 is
    A,X,W : Integer;
    begin -- of Sub3
      . . .
    end; -- of Sub3
begin -- of Main
  . . .
end; -- of Main
```

List all the variables, along with the program units where they are declared, that are visible in the bodies of Sub1, Sub2, and Sub3, assuming static scoping is used.

Ans.

(10) (12 points) Consider the following program:

```
procedure Main is
  X, Y, Z : Integer;
  procedure Sub1 is
    A, Y, Z : Integer;
  begin -- of Sub1
    . . .
  end; -- of Sub1
  procedure Sub2 is
    A, B, Z : Integer;
  begin -- of Sub2
    . . .
  end; -- of Sub2
  procedure Sub3 is
    A, X, W : Integer;
  begin -- of Sub3
    . . .
  end; -- of Sub3
begin -- of Main
  . . .
end; -- of Main
```

Given the following calling sequences and assuming that dynamic scoping is used, what variables are visible during execution of the last subprogram activated? Include with each visible variable the name of the unit where it is declared.

- (a) Main calls Sub1; Sub1 calls Sub2; Sub2 calls Sub3.
- (b) Main calls Sub1; Sub1 calls Sub3.
- (c) Main calls Sub2; Sub2 calls Sub3; Sub3 calls Sub1.
- (d) Main calls Sub3; Sub3 calls Sub1.
- (e) Main calls Sub1; Sub1 calls Sub3; Sub3 calls Sub2.
- (f) Main calls Sub3; Sub3 calls Sub2; Sub2 calls Sub1.

Ans.