Assignment 2 of Principles of Programming Languages

Number of questions: 9

Total Score: 100 points   <u>**Due day: 5:00 PM 14th June 2021**</u>

(1) You need to write your answers in a file and submit your file to the TAs. You do NOT need to submit a hard copy of your answers to the TAs.

(2) Late submission will not be accepted.

(3) Copying other student's answers is strictly prohibited.

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(1) (12 points)

What follows is a C program excerpt.

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

          :

          :

}
```

(a) Could we change the value of `tuv`?

(b) Could we change the value of `tuv[0]`?

(c) Does `tuv` has the same value as `tuv[0]`?

(d) What is the data type of value `tuv`?

(e) What is the data type of value `tuv[0]`?

(f) Inside the body of function `bar()`, is `tuv[1]=tuv[2]` a legal statement?

Ans.

What follows is a Java program excerpt.

```
class xyz{

    :

  void bar()

  {  int  tuv[][]=new int[10][10];

        :

  }

}
```

(a) Could we change the value of `tuv`?

(b) Could we change the value of `tuv[1]`?

(c) Is the start address of the memory area referenced by `tuv` the same as the start address of the memory area referenced by `tuv[0]`?

(d) If we deem an object as a variable, how many variables are created by the following statement `int  tuv[][]=new int[10][10];`?

(e) Does statement `int tuv[][]` create an array?

(f) Inside the body of method `bar()`, is `tuv[1]=tuv[2]` a legal statement?

Ans.

(3) (8 points)
An object is a variable whose type is a `class`. An object needs a reference variable to access the object. However primitive types, such as type `int`, are not a `class` type. What follows is a Java program `ShowArea.java`.

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


     r=6;                        //location 1
     return s+r;
  }
}
```

```
public class ShowArea
{
   public static void main(String args[])
   {
      Circle cir= new Circle();    //location 2
      int a, b;                    //location 3


      a= cir.setVariable(8);
      b=a;                         //location 4
   }
}
```

In the above program, (i) If we deem an object as a variable, how many variables are created by the statement at location 2 and what are they?   (ii) What type of memory areas (stack, heap, data, or bss) provide the memory created by the above variables? Hint: A parameter is also deemed as a variable or an object.

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'is right after the memory of array t. The memory of array v'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>

void 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) (12 points) What follows is an excerpt of a C program. Assume this program will be executed on an X-86 computer, which means the size of a pointer is 4 bytes and the size of an integer variable or integer array element is 4 bytes.

```
#include <stdio.h>

void main()

{

    int  (*teacher)[10];     //location 1

    int * student[10];       //location 2

    int  grade[10][10]       //location 3

    int  * course[10]        //location 4

            :

}
```

(a) How many bytes are allocated for variable teacher?

(b) Does the definition statement at location 1 create an array?

(c) How many bytes are allocated for variable student?

(d) Does the definition statement at location 2 create an array?

(e) Is teacher=grade; a legal statement in this program?

(f) Is student=course; a legal statement in this program?

Ans.

(6) (10 points) (a) `String s=`**`new`**` String("Welcome");`

Assume the above statement is contained in a Java program and `"Welcome"` does not appear in any other statement in the program, how many `String` objects are created by this Java statement?

(b) `String t=`**`new`**` String("Welcome"); // statement 1`

`String s=`**`new`**` String("Welcome"); // statement 2`

Assume the above two Java statements are contained in a Java program and statement 1 is right before statement 2, how many `String` objects are created by statement 2?

Ans.

(7) (10 points) In the following **C** program,

(a) Right after the execution of the statement commented as ``Location 1'' is finished, do variable `j, h,` and `g` have the same value?

(b) Right after the execution of the statement commented as ``Location 2'' is finished, do variable `j, h,` and `g` have the same value?

```
#include<stdio.h>

void main()

{ float c,d,e,f,g,h;

  int   i,j,k;


  i=0.01;

  f=0.01;

  j=i*0.01;

  h=j;

  g=f*0.01;              /*Location 1*/

  i=123;

  f=123;

  j=123*123;

  h=j;

  g=f*123;               /*Location 2*/

 }
```

Ans.

(8) (12 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.

(9) (12 points) Consider the following program:

```
procedure Main is
   X, Y, Z : Integer;
   procedure Subl is
     A, Y, Z : Integer;
   begin -- of Subl
    . . .
   end;   -- of Subl
   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 Subl; Subl calls Sub2; Sub2 calls Sub3.

(b) Main calls Subl; Subl calls Sub3.

(c) Main calls Sub2; Sub2 calls Sub3; Sub3 calls Subl.

(d) Main calls Sub3; Sub3 calls Subl.

(e) Main calls Subl; Subl calls Sub3; Sub3 calls Sub2.

(f) Main calls Sub3; Sub3 calls Sub2; Sub2 calls Subl.

Ans.