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Fundamentals of Programing I – CSIT 111_04
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Lab 02 Report

Exercise 1: Two Meanings of Plus

In Java, the symbol + can be used to add numbers or to concatenate strings. This exercise illustrates both uses.

Observing the Behavior of + To see the behavior of + in different settings do the following:

```
public class PlusTest
{
// ------------------------------------------------
// main prints some expressions using the + operator
// ------------------------------------------------
        public static void main (String[] args)
        {
                System.out.println ("This is a long string that is the " +
                        "concatenation of two shorter strings.");
                System.out.println ("The first computer was invented about" + 55 +
                        "years ago.");

                System.out.println ("8 plus 5 is " + 8 + 5);
                System.out.println ("8 plus 5 is " + (8 + 5));
                System.out.println (8 + 5 + " equals 8 plus 5.");
        }
}
```

Compile and run the program. For each of the last three output statements (the ones dealing with 8 plus 5) write down what was printed. Now for each explain why the computer printed what it did given that the following rules are used for +.

Answer:

1. System.out.println ("8 plus 5 is " + 8 + 5); - This command prints out *8 plus 5 is 85*. Due to the first operand be a string, the second operand (8) is concatenated to the string becoming a new string. The new string (8 plus 5 is 8) is then concatenated to the last operand (5) resulting the string 8 plus 5 is 85.

2. System.out.println ("8 plus 5 is " + (8 + 5)); - This command prints out *8 plus 5 is 13*. The parentheses force the expression inside of it to be evaluated first. (8+5) becomes 13. The number 13 is then concatenated to the string resulting the string 8 plus 5 is 13
3. System.out.println (8 + 5 + " equals 8 plus 5."); - This command prints out *13 equals 8 plus 5*. There are no parentheses in this expression, therefore the program executes the command normally, from left to right. Since 8 and 5 are both numbers, the plus sign works as an addition sign and adds the two numbers, resulting 13. The number 13 is then concatenated to the string resulting the string 13 equals 8 plus 5.

Exercise 2: Area and Circumference of a Circle

Study the program below, which uses both variables and constants:

```
// ************************************************************
// Circle.java
//
// Print the area of a circle with two different radii
// ************************************************************
public class Circle
{
	public static void main(String[] args)
	{
		final double PI = 3.14159;
		int radius = 10;
		double area = PI * radius * radius;

		System.out.println("The area of a circle with radius " + radius + " is " + area);

		radius = 2 0;
		area = PI * radius * radius;
		System.out.println("The area of a circle with radius " + radius +" is " + area);
	}
}
```

Save this program, which is in file Circle.java, into your directory and modify it as follows:

1. The circumference of a circle is two times the product of Pi and the radius. Add statements to this program so that it computes the circumference in addition to the area for both circles.

Answer:

```
// ************************************************************
// Circle.java
//
// Print the area of a circle with two different radii
// ************************************************************
public class Circle
{
  public static void main(String[] args)
  {
    final double PI = 3.14159;
    int radius = 10;
    double area = PI * radius * radius;

    /* Declaring the variable circumference to store the value of the
     Circumference */
    double circumference = 2 * PI * radius;

    System.out.println("The area of a circle with radius " + radius +
     " is " + area);

    // Print statement for the circumference
    System.out.println("The circumference of a circle with radius " +
       radius + " is " + circumference);

    radius = 20;
    area = PI * radius * radius;
    circumference = 2 * PI * radius;
    System.out.println("The area of a circle with radius " + radius +
     " is " + area);

    // Print statement for the circumference
    System.out.println("The circumference of a circle with radius " +
     radius + " is " + circumference);
  }
}
```

2. When the radius of a circle doubles, what happens to its circumference and area? Do they double as well? You can determine this by dividing the second area by the first area. Unfortunately, as it is now the program overwrites the first area with the second area (same for the circumference). You need to save the first area and circumference you compute instead of overwriting them with the second set of computations. So you'll need two area variables and two circumference variables, which means they'll have to have different names (e.g., area1 and area2). Remember that each variable will have to be declared. Modify the program as follows:

- Change the names of the area and circumference variables so that they are different in the first and second calculations. Be sure that you print out whatever you just computed.
- At the end of the program, compute the area change by dividing the second area by the first area. This gives you the factor by which the area grew. Store this value in an appropriately named variable (which you will have to declare).

- Add a ***println*** statement to print the change in area that you just computed.
- Now repeat the last two steps for the circumference.

Look at the results. Is this what you expected?

Answer:

```
// *************************************************************
// Circle.java
//
// Print the area of a circle with two different radii
// *************************************************************

public class Circle
{
  public static void main(String[] args)
  {
    final double PI = 3.14159;
    int radius = 10;
    double area1 = PI * radius * radius;

    /* Declaring the variable circumference to store the value
     of the circumference */
    double circumference1 = 2 * PI * radius;

    System.out.println("The area of a circle with radius " +
      radius + " is " + area1);

    // Print statement for the circumference
    System.out.println("The circumference of a circle with radius " +
      radius + " is " + circumference1);

    radius = 20;
    double area2 = PI * radius * radius;
    double circumference2 = 2 * PI * radius;
    System.out.println("The area of a circle with radius " +
       radius + " is " + area2);

    // Print statement for the circumference
    System.out.println("The circumference of a circle with radius " +
      radius + " is " + circumference2);




    /* Declaring the ratio between both area values and both
     circumference values */
    double areaRatio = area2/area1;
    double circumferenceRatio = circumference2/circumference1;

    // Print statements for the area and circumference ratio
```

```
    System.out.println("\nThe change in area when the " +
      "radius doubles from 10 to 20 is " +
      areaRatio + " times the initial area.");

    System.out.println("The change in circumference when the " +
      "radius doubles from 10 to 20 is " +
      circumferenceRatio + " times the initial circumference.");
  }
}
```

Output:

The area of a circle with radius 10 is 314.159
The circumference of a circle with radius 10 is 62.8318
The area of a circle with radius 20 is 1256.636
The circumference of a circle with radius 20 is 125.6636

The change in area when the radius doubles from 10 to 20 is 4.0 times the initial area.
The change in circumference when the radius doubles from 10 to 20 is 2.0 times the initial circumference.

Comments:

This is exactly what was expected because when you look at the equation of the circumference of a circle (2*PI*radius) you can see that if the radius doubles, the circumference should double. A similar idea follows for the area. However, since the formula of the area is 2*PI*radius*radius, where the radius is multiplied twice, if the radius doubles the area should be four times the initial area.

3. In the program above, you showed what happened to the circumference and area of a circle when the radius went from 10 to 20. Does the same thing happen whenever the radius doubles, or were those answers just for those particular values?

Answer:

```
// ************************************************************
// Circle.java
//
// Print the area of a circle with two different radii
// ************************************************************
import java.util.Scanner;

public class Circle
{
  public static void main(String[] args)
  {
```

```
        Scanner rad = new Scanner(System.in);
        final double PI = 3.14159;
        System.out.print("Please enter a value for the first radius: ");
        int radius = rad.nextInt();
        double area1 = PI * radius * radius;

        /* Declaring the variable circumference to store the value of the
          Circumference */
        double circumference1 = 2 * PI * radius;

        System.out.println("The area of a circle with radius " + radius +
          " is " + area1);

        //Print statement for the circumference
        System.out.println("The circumference of a circle with radius " +
          radius + " is " + circumference1);

        radius *= 2;
        double area2 = PI * radius * radius;
        double circumference2 = 2 * PI * radius;
        System.out.println("The area of a circle with radius " + radius +
          " is " + area2);

        //Print statement for the circumference
        System.out.println("The circumference of a circle with radius " +
          radius + " is " + circumference2);

        /* Declaring the ratio between both area values and both
           circumference values. */
        double areaRatio = area2/area1;
        double circumferenceRatio = circumference2/circumference1;
        System.out.println("\nThe change in area when the " +
          "radius doubles is " + areaRatio +
          " times the initial area.");
        System.out.println("The change in circumference when the " +
          "radius doubles is " + circumferenceRatio +
          " times the initial circumference.");
    }
}
```

Output (Example with the first radius = 14):
Please enter a value for the first radius: 14
The area of a circle with radius 14 is 615.75164
The circumference of a circle with radius 14 is 87.96452
The area of a circle with radius 28 is 2463.00656
The circumference of a circle with radius 28 is 175.92904

The change in area when the radius doubles is 4.0 times the initial area.
The change in circumference when the radius doubles is 2.0 times the initial circumference.

Output (Example with the first radius = 38):
Please enter a value for the first radius: 38
The area of a circle with radius 38 is 4536.45596
The circumference of a circle with radius 38 is 238.76084
The area of a circle with radius 76 is 18145.82384
The circumference of a circle with radius 76 is 477.52168

The change in area when the radius doubles is 4.0 times the initial area.
The change in circumference when the radius doubles is 2.0 times the initial circumference.

Comments:
We obtained the same result for the area and circumference ratio. As stated in the previous question, the reason for that is because of the equation for the circumference (2*PI*radius), where when the radius doubles the circumference doubles as well; and the equation of the area (2*PI*radius*radius), where the radius is multiplied twice, thus if the radius doubles the area quadruplicates.