

JOBSHEET 14

Recursive Function



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Class

1I

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Information Technology

Study Program

D4 Informatics Engineering

Labs Activity

Question! (Experiment 1)

1. After observing the experiment of recursive function above, what is the definition of recursive function?
2. How the recursive function works?
3. From the experiment above, do `factorialRecursive()` and `factorialIterative()` have the similar result? Then, what are the differences between recursive and iterative if both are having the same result?

Answer!

1. A recursive function is a function that calls itself in its own definition. In other words, it's a function that solves a problem by solving smaller instances of the same problem. Recursive functions typically have a base case to terminate the recursion and prevent an infinite loop.
2. When a recursive function is called, it breaks down the problem into smaller sub-problems, each closer to a base case. The function calls itself with these smaller sub-problems until it reaches the base case, at which point the recursion stops, and the results are combined to solve the original problem.
3. Yes, `factorialRecursive()` and `factorialIterative()` produce the same result - calculating the factorial of a given number.
The main differences are:
 - Recursive functions break down the problem into smaller subproblems, while iterative functions use loops to solve the problem iteratively.
 - Recursive functions place additional load on the call stack as they push new stack frames with each recursion. Iterative solutions do not use the call stack in this way.
 - Iterative solutions are generally more efficient and faster than recursive solutions.
 - Recursive solutions can be simpler to write and understand if the problem can be broken down recursively.

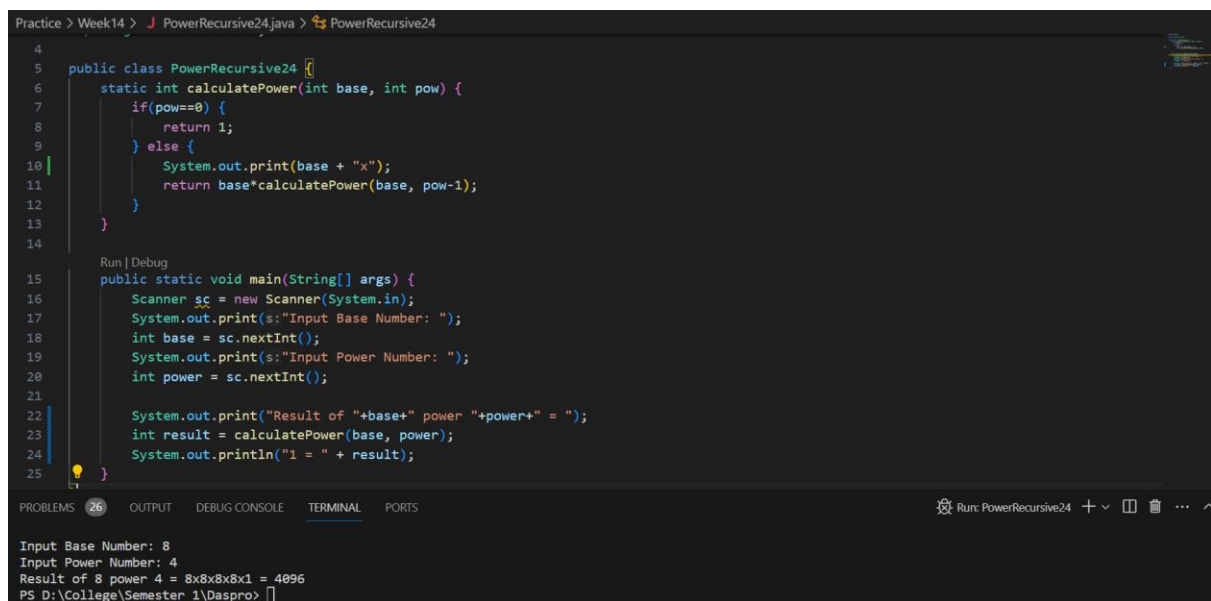
Question! (Experiment 2)

1. In Experiment 2, there is a recursive function call `calculatePower()` in the main function, then the function `calculatePower()` is called repeatedly. Explain how long the function calling process will run!

2. Add program code to print the power calculation series. Example: calculatePower(2,5) will print 2x2x2x2x2x1 = 32!

Answer!

1. - The calculatePower() function is a recursive function that calculates the power of a given base.
 - The function makes recursive calls, decrementing the power (pow) by 1 in each call until the base case is reached (pow == 0).
 - The function will continue to make recursive calls until it reaches the base case, at which point the recursion stops.
 - The duration of the function calling process depends on the value of the input power (Power). The function will make Power recursive calls before reaching the base case.



```
Practice > Week14 > J PowerRecursive24.java > PowerRecursive24
4
5 public class PowerRecursive24 {
6     static int calculatePower(int base, int pow) {
7         if(pow==0) {
8             return 1;
9         } else {
10            System.out.print(base + "x");
11            return base*calculatePower(base, pow-1);
12        }
13    }
14
15    Run | Debug
16    public static void main(String[] args) {
17        Scanner sc = new Scanner(System.in);
18        System.out.print(s:"Input Base Number: ");
19        int base = sc.nextInt();
20        System.out.print(s:"Input Power Number: ");
21        int power = sc.nextInt();
22
23        System.out.print("Result of "+base+" power "+power+" = ");
24        int result = calculatePower(base, power);
25        System.out.println("1 = " + result);
26    }
27
28 PROBLEMS 26 OUTPUT DEBUG CONSOLE TERMINAL PORTS
Input Base Number: 8
Input Power Number: 4
Result of 8 power 4 = 8x8x8x8x1 = 4096
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```

Question! (Experiment 3)

1. From the above experiment, which statements that is classified as “base case” and “recursion call”!
2. Explain using simulation or trace the expansion phase and substitution phase of

Answer!

1. In the calculateProfit function:
 - Base Case: if (period == 0), where the function returns the current balance when the investment period becomes zero.

- Recursion Call: return $1.11 * \text{calculateProfit}(\text{balance}, \text{period} - 1)$, where the function calls itself with a decremented investment period.

2. Let's trace the expansion and substitution phases for $\text{calculateProfit}(100000, 3)$:

- Expansion Phase:

$\text{calculateProfit}(100000, 3)$

Returns $1.11 * \text{calculateProfit}(100000, 2)$

Returns $1.11 * \text{calculateProfit}(100000, 1)$

Returns $1.11 * \text{calculateProfit}(100000, 0)$

Returns 100000 (base case)

- Substitution Phase:

Substitute the results back into the original expression:

$\text{calculateProfit}(100000, 3) = 1.11 * \text{calculateProfit}(100000, 2)$

Substitute $\text{calculateProfit}(100000, 2)$:

$\text{calculateProfit}(100000, 3) = 1.11 * (1.11 * \text{calculateProfit}(100000, 1))$

Substitute $\text{calculateProfit}(100000, 1)$:

$\text{calculateProfit}(100000, 3) = 1.11 * (1.11 * (1.11 * \text{calculateProfit}(100000, 0)))$

Substitute $\text{calculateProfit}(100000, 0)$:

$\text{calculateProfit}(100000, 3) = 1.11 * (1.11 * (1.11 * 100000))$

- Calculation:

Calculate the final result:

$\text{calculateProfit}(100000, 3) \approx 136763.31$

Assignment

1. Write a program to display numbers n to 0 using recursive functions and iterative functions. (DescendingSequenceRecursive).
2. Create a program to sum the numbers using recursive function. For example n = 8, then it will result $1+2+3+4+5+6+7+8 = 36$ (SummationRecursive).

3. Create a program that contains a recursive function to check whether a number n is a prime number or not. A number will not be classified as a prime number if it is divisible by a number less than n . (PrimeCheckingRecursive).
4. A pair of newborn guinea pigs (male and female) are placed in a nursery. After two months the guinea pig pair gave birth to a pair of twin guinea pigs (male and female). Every pair of guinea pigs that is born will also give birth to a pair of guinea pigs every 2 months. How many pairs of guinea pigs were there at the end of the 12th month? Write a program using a recursive function! (Fibonacci). And the following table illustrates the calculation.

Month	Pair Number		Pair Total
	Productive	Non-Productive	
1	0	1	1
2	0	1	1
3	1	1	2
4	1	2	3
5	2	3	5
6	3	5	8
7	5	8	13
8	8	13	21
9	13	21	34
10	21	34	55
11	34	55	89
12	55	89	144

Answer!

```
Practice > Week14 > Assignment1.java > Assignment1
1 package Week14;
2
3 public class Assignment1 {
4     Run | Debug
5     public static void main(String[] args) {
6         descendingSeqRecursive(n:5);
7     }
8
9     static void descendingSeqRecursive(int n) {
10         if(n==0) {
11             System.out.print(s:"0\n");
12         } else {
13             System.out.print(n+" ");
14             descendingSeqRecursive(n-1);
15         }
16     }
17 }
18
```

PROBLEMS 26 OUTPUT DEBUG CONSOLE TERMINAL PORTS

347c835eb98c8\redhat.java\jdt_ws\Daspro_e24281ec\bin' 'Week14.Assignment1'

5 4 3 2 1 0

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1.

```
Practice > Week14 > J Assignment2.java > Assignment2
6 public static void main(String[] args) {
7     Scanner sc = new Scanner(System.in);
8     System.out.print(s:"Input N: ");
9     int n = sc.nextInt();
10
11     System.out.print(s:"Result = ");
12     String expression = createSummationExpression(n);
13     System.out.print(expression + "+");
14     int result = sumRecursive(n);
15     System.out.println(" = " + result);
16 }
17
18 static String createSummationExpression(int n) {
19     StringBuilder expression = new StringBuilder(str:"1");
20     for (int i = 2; i <= n; i++) {
21         expression.append(str:"+").append(i);
22     }
23     return expression.toString();
24 }
25
26 static int sumRecursive(int n) {
27     if(n==1) {
28         return 1;
29     } else {
30         return n + sumRecursive(n-1);
31     }
32 }
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4.

```

4 public static void main(String[] args) {
5     int months = 12;
6
7     int[] productivePairs = new int[months];
8     int[] nonProductivePairs = new int[months];
9     int[] totalPairs = new int[months];
10
11     //initial values
12     productivePairs[0] = 0;
13     nonProductivePairs[0] = 1;
14     totalPairs[0] = 1;
15
16     //values for the second month
17     productivePairs[1] = 0;
18     nonProductivePairs[1] = 1;
19     totalPairs[1] = 1;
20
21     System.out.println(x:"Month\tProductive\tNon-Productive\tPair Total");
22
23     for (int i = 2; i < months; i++) {
24         productivePairs[i] = nonProductivePairs[i - 1];
25         nonProductivePairs[i] = productivePairs[i - 1] + nonProductivePairs[i - 1];
26         totalPairs[i] = totalPairs[i - 1] + productivePairs[i];
27     }
28
29     for (int i = 0; i < months; i++) {
30         System.out.println((i + 1) + "\t" + productivePairs[i] + "\t\t" + nonProductivePairs[i] + "\t\t" + totalPairs[i]);
31     }
32 }

```

Month	Productive	Non-Productive	Pair Total
1	0	1	1
2	0	1	1
3	1	1	2
4	1	2	3
5	2	3	5
6	3	5	8
7	5	8	13
8	8	13	21
9	13	21	34
10	21	34	55
11	34	55	89
12	55	89	144