
Lab 10

Recursion and Review



CSE110: Programming Language I

No of Tasks			Points to Score Classwork $3 \times 10 = 30$
<i>Classwork</i>	Evaluation	Practice Problems	
3	0	11	

The students must complete the classwork tasks in the lab class to obtain the lab performance marks. They will also be marked based on the assessment tasks. The lab instructors may show/explain a few of the classwork tasks to the students if necessary. Any plagiarism in classwork or homework will lead to the student getting zero in the entire assignment. A random viva may take place.

You must not hard code any of the tasks, which means your code should work for any valid user input.

Classwork

ClassWork 1

A. Write a function called **oneToN** that prints 1 till N recursively.

Hint: N is a number taken as input from the user and you need to print the numbers starting from 1 to N recursively.

Sample Input	Sample Function Call	Output
N=5	oneToN(1,N);	1 2 3 4 5
N=11	oneToN(1,N);	1 2 3 4 5 6 7 8 9 10 11

B. Write a function **nToOne** that prints from N to 1 recursively.

Hint: N is a number taken as input from the user and you need to print the numbers starting from N to 1.

Sample Input	Sample Function Call	Output
N=6	nToOne(1,N);	6 5 4 3 2 1
N=3	nToOne(1,N);	3 2 1

C. Write a function called **recursiveSum** to sum till N recursively.

Hint: N is a number taken as input from the user and you need to add the numbers starting from 1 to N recursively and print the sum.

Sample Input	Sample Function Call	Output
N=4	recursiveSum(1,N);	10
N=12	recursiveSum(1,N);	78

ClassWork 2

Write a **recursive function** called **reverseDigits** that takes an integer n as an argument and prints the digits of n in reverse order.

Hint: Think about how you solved it using loop

Sample Input	Sample Function Call	Output
12345	reverseDigits(n)	5 4 3 2 1
649	reverseDigits(n)	9 4 6
1000	reverseDigits(n)	0 0 0 1

ClassWork 3

Write a **recursive function** called **sumDigits** that takes an integer n as an argument and sums up the digits of n then **returns** the result.

Hint: Think about how you would solve it using loop

Sample Input	Sample Function Call	Output
12345	int x = sumDigits(n); System.out.println(x);	15
649	int x = sumDigits(n); System.out.println(x);	19

Practice Problems (No Submission)

Strings

Task 1

Trace the following code and write the outputs.

public class Trace01{
public static void main(String[] args) {
String course = "";
int i = 2, j = 0, k = 18;
course = "-->cse";
while (i < 5) {
k--;
j = k;
while (j > 12) {
if (j % 2 != 0) {
course += "<--";
course = course + i + (j / 2);
} else {
course += "-->";
course = course + (i % 2) + j;
}
System.out.println(course);
if (j == 14) {
course = "-->cse";
}
--j;
}
i++;
}
}

Task 2

Write a method **modifyStrings()** that takes in three given strings **S**, **S1**, and **S2** consisting of different numbers of characters respectively, the task is to modify the string **S** by **replacing** all the **substrings S1** with the **string S2** in the string **S** and printing the modified string **S**.

Sample Input	Sample Output	Explanation
S = "abababa" S1 = "aba" S2 = "a" modifyStrings(S, S1, S2);	aba	Changing the substrings S[0, 2] (Referring to characters from the 0th index of S till the 2nd index of S and S[4, 6] (= S1) to the string S2 (= "a") modifies the string S to "aba". Therefore, print "aba".
S = "baddadda" S1 = "dd" S2 = "n" modifyStrings(S, S1, S2);	banana	Changing the substrings S[2,3] (Referring to characters from the 2nd and 3rd index of S) and S[5, 6] (= S1) to the string S2 (= "n") modifies the string S to "banana". Therefore, print "banana".

Strings + Arrays

Task 3

Given an array of email addresses, print the number of valid email addresses satisfying the following conditions.

- Each email contains an '@' character
- There is at least one character before and after '@' character and it has to start with letter
- There is a '.' character after the character(s) after '@' character
- There is at least one character after '.' character

Sample Input	Sample Output
email_list = {"abc@gmail.com", "!@cv.bd", "123cse@bracu.ac.bd"}	1
email_list = {"cse110@gmail.com", "government@cv.", "eee@bracu.ac.bd"}	2

Strings + Methods

Task 4

Write a method called `isHappyNumber` which takes an integer in its parameter to check whether a number is a happy number or not. If the number is a happy number then the method returns boolean `true` otherwise it returns boolean `false`. In number theory, a happy number is a number which eventually reaches 1 when replaced by the sum of the square of each digit. For instance, 13 is a happy number because $1^2 + 3^2 = 10$ and $1^2 + 0^2 = 1$. On the other hand, 4 is not a happy number because the process continues in an infinite cycle without ever reaching 1. Unhappy number ends in a cycle of repeating numbers which contains 4 .

Sample Input	Sample Output
<code>boolean check = isHappyNumber(82)</code> <code>System.out.println(check)</code>	<code>true</code>
<code>boolean check = isHappyNumber(4)</code> <code>System.out.println(check)</code>	<code>false</code>

Task 5

Write a method called `toDecimal` which takes a binary number as a string in its parameter to convert the binary number to its decimal number and return the decimal value. After returning the decimal value, write another method called `toHex` which takes the converted decimal value in its parameter and calculates the hexadecimal value and then return the hex value.

Sample Input	Sample Output
<code>int decimal = toDecimal("1010")</code> <code>String hex = toHex(decimal)</code> <code>System.out.println(hex)</code>	<code>"A"</code>

Arrays

Task 6

Trace the following code and write the outputs.

class Trace02 {
public static void main(String args[]) {
int[] arr1 = {3, 1, 4, 1, 5, 9, 2};
int[] arr2 = {10, 20, 30, 40, 50, 60, 70};
int x = 0, y = 0;
while (x < arr1.length - 1) {
arr2[x] = arr1[y] * (x + 1) - arr2[y];
y = 1;
while (y <= x) {
arr2[x] = arr2[x] + arr1[y] - y;
y = y + 1;
}
System.out.println(arr2[x]);
x = x + 1;
}
System.out.println(arr2[arr1.length - 1]);
}
}

Task 7

You are given an integer array. You need to identify all the **prime numbers** and **perfect numbers** within the array and print the **indices** along with these **numbers** from the original array.

Sample Input	Sample Output
Sample Input: int arr[] = {6, 13, 28, 17, 3, 9, 11, 23, 10, 29, 12, 7}	Prime Numbers: 1: 13 3: 17 4: 3 6: 11

	7: 23 9: 29 11: 7 Perfect Numbers: 0: 6 2: 28
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Task 8

Trace the following code and write the outputs.

public class tracing1 {
public static void main(String[] args){
int i = 1;
int [] a = {5,6,7,8,9};
while (i <= 5){
int j = a[i%a.length];
while (j > 1){
System.out.print(j--);
if (j == 2)
break;
}
System.out.println("****");
++i;
}
double x = 7;
double y = 8;
double z = 9;
System.out.println(x < y y > z);
System.out.println(x < y && y > z);
System.out.println(x < y);
System.out.println(x + y < z);
System.out.println((x + y)-6 < z);
}
}

Task 9

Your professor expects only As, Bs, and Cs. In the following program, write a method called **getScores** that takes as input corresponding arrays **studentGrades** and **studentScores**. Write a method called **getScores** that assigns **index i** in **studentGrades** based on **index i** in **studentScores**. If a grade is **A**, assign **100**. If a grade is **B**, assign **90**. If a grade is **C**, assign **70**. If a grade is anything else, assign **0**.

Sample Input	Sample Output
<pre>char[] studentGrades = new char[]{'A', 'A', 'A', 'B', 'C', 'U', 'Z'}; int[] studentScores = new int[7];</pre>	<pre>Output expectation: 100 100 100 90 70 0 0</pre>

Arrays + Methods

Task 10

A. Write a method called **convertToCm()**, that takes as input a **type double** and **returns** the value converted from inches to centimeters.

Hint: There are 2.54 centimeters in an inch

Sample Method Call	Output
<pre>double t = convertToCm(16); System.out.println(t + " cm");</pre>	40.64 cm

B. Create an **array** of **type double** of length **5** called **cheetos_inches**, that stores the length of each of the Cheetos **from the user**. Send the array of length in inches into a method called **findAvgCm()** that **returns** the average length of the Cheetos **in cm to 2 decimal places**. The method **findAvgCm()** uses **convertToCm()** to convert the length of each Cheetos **from inches to cm**.

Note: You must call the method written in [Method Task A], otherwise this task would be considered invalid.

Sample Method Call	Output
<pre>Sample array: double [] cheetos_inches = new double[]{10.0, 12.0, 14.0, 16.0, 18.0}; averageLength = findAvgCm(cheetos_inches); System.out.println("The average Cheeto length is "+ averageLength + " cm");</pre>	The average Cheeto length is 35.56 cm

Arrays + Strings + Methods

Task 11

A. Write a method called **isVowel** which takes a string in its parameter and counts all the vowels in the String. If any vowel exists in the string then the method returns the **count**.

Sample Input	Sample Output
The quick brown fox jumps over the lazy dog	Number of vowels in the string: 11

B. Write a method called **isConsonant** which takes a string in its parameter and counts all the consonants in the String. If any consonant exists in the string then the method returns the **count**.

Sample Input	Sample Output
The quick brown fox jumps over the lazy dog	Number of consonants in the string: 24

C. Write a method called **vowel/consonantSum** which takes an array of strings in its parameter and returns the summation of the number of vowels/consonants.

Note: **You must call** the methods written in tasks A/B, otherwise this task will be **considered invalid**.

Given Array	Sample Output
<pre>String [] names = {"Bob", "Alice", "Max", "Marry", "Rosy"}; System.out.println("The total number of vowels in the array is:" + vowelSum(names)); System.out.println("The total number of consonants in the array is:" + consonantSum(names));</pre>	<p>The total number of vowels in the array is: 7</p> <p>The total number of consonants in the array is: 13</p>