

CS 601: Advanced Algorithms
Instructor: Professor Zahra Derakhshandeh
Assignment 1

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Q1 Solution:

(a) Algorithm is a step-by-step procedure to solve a problem to accomplish some end given an initial situation(input).

Or

It is a finite sequence of unambiguous executable steps that will terminate if followed.

Properties of algorithm:

- Definiteness- Each step must be precisely defined.
- Finiteness- Algorithm must be finite, it should come to a solution after a finite number of steps is executed.
- Input and Output- An algorithm has zero or more inputs and Outputs.
- Efficiency- Algorithms will consume time and space as necessary.

1. As we use laundry machine in our everyday life to make washing clothes easier. I have mentioned the example of doing laundry with all the steps.

Step 1: start

Step 2: Separate clothes into white clothes and colored clothes.

Step 3: Add 1 cup of laundry detergent to tub.

Step 4: For white clothes: Set water temperature to hot. Place white clothes in tub.

Step 5: For colored clothes: Set water temperature to cold. Place colored clothes in tub.

Step 6: Close machine door, add coins and press the start button.

Step 7: When washer is done, put your clothes into the dryer.

Step 8: Fold the clothes after they dry and keep them in cupboard.

Step 9: Stop

Q2 Solution: (a) and (b)

```
package sumComplexity;

import java.util.Scanner;

public class assignment1 {

    public static void main(String[] args)

    {

        Scanner inputRead = new Scanner(System.in);

        int n;

        double[] a;

        System.out.print("How many numbers in input , i.e range of n : ");

        n = inputRead.nextInt();           //1 assignment operation

        // Create an array of n elements

        a = new double[n];                  //1 assignment operation

        int i;

        // Read the inputs to the list

        for ( i = 0; i < a.length; i++ )    //1 + (n+1) + n
```

```

{
    System.out.print("Enter a number till the \"n\" items are read : ");

    a[i] = inputRead.nextDouble(); //1 assignment operation
}

// calculate the summation of numbers inputed

double sum;

sum = 0;                                //1 assignment operation

for ( i = 0; i < a.length; i++ )        // 1 + (n+1) + n
{
    sum = sum + a[i];                    //1 assignment operation
}

System.out.println( sum );

}
}

```

Each element of the input is processed and is a Linear time. Basic number of operations in each loop for above algorithm is

$$f(n) = 1 + 1 + [1 + (n+1) + n] + 1 + [1 + (n+1) + n] + 1$$

where n is the number of input elements.

$$f(n) = 8 + 4(n)$$

$$\Rightarrow 4 [2 + n]$$

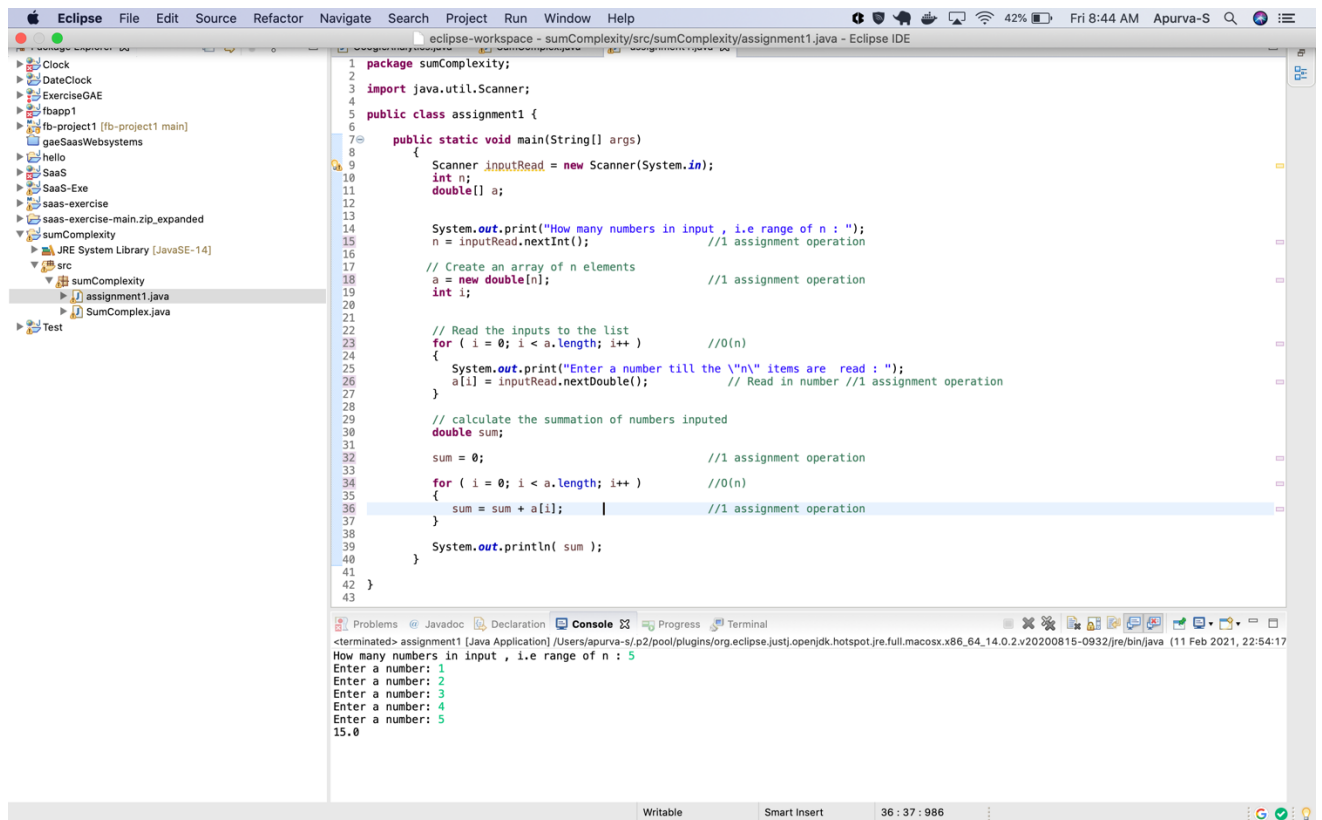
$$\Rightarrow 4[n] \quad // \text{ [ignore 2 as it is smaller than n]}$$

$$\Rightarrow n \quad // \text{ [ignore 4 as n is too big and 4 is negligible]}$$

$$\Rightarrow n \text{ can be read as Big O of N complexity}$$

$$\Rightarrow O(n)$$

Screenshot of output:



The screenshot displays the Eclipse IDE interface. The left sidebar shows a project hierarchy with 'sumComplexity' selected. The main editor window shows the source code for 'assignment1.java'. The code defines a package 'sumComplexity', imports 'java.util.Scanner', and defines a public class 'assignment1' with a 'main' method. The 'main' method uses a 'Scanner' to read input, prompts the user for the number of elements, reads those elements into an array, and then calculates their sum using a loop. The console at the bottom shows the execution output, including the prompt 'How many numbers in input , i.e range of n : 5' and the user's input of 5, followed by the prompt 'Enter a number:' and the user's inputs of 1, 2, 3, 4, and 5, resulting in a final sum of 15.0.

```
1 package sumComplexity;
2
3 import java.util.Scanner;
4
5 public class assignment1 {
6
7     public static void main(String[] args)
8     {
9         Scanner inputRead = new Scanner(System.in);
10        int n;
11        double[] a;
12
13        System.out.print("How many numbers in input , i.e range of n : ");
14        n = inputRead.nextInt(); //1 assignment operation
15
16        // Create an array of n elements
17        a = new double[n]; //1 assignment operation
18        int i;
19
20        // Read the inputs to the list
21        for ( i = 0; i < a.length; i++ ) //0(n)
22        {
23            System.out.print("Enter a number till the \"\n\" items are read : ");
24            a[i] = inputRead.nextDouble(); // Read in number //1 assignment operation
25        }
26
27        // calculate the summation of numbers inputed
28        double sum;
29
30        sum = 0; //1 assignment operation
31
32        for ( i = 0; i < a.length; i++ ) //0(n)
33        {
34            sum = sum + a[i]; //1 assignment operation
35        }
36
37        System.out.println( sum );
38    }
39 }
40
41
42
43 }
```

Problems Javadoc Declaration Console Progress Terminal

<terminated> assignment1 [Java Application] /Users/apurva-s/p2/pool/plugins/org.eclipse.justi.openjdk.hotspot.jre.full.macosx.x86_64_14.0.2.v20200815-0932/jre/bin/java (11 Feb 2021, 22:54:17)

How many numbers in input , i.e range of n : 5
Enter a number: 1
Enter a number: 2
Enter a number: 3
Enter a number: 4
Enter a number: 5
15.0

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