SOEN 6011 - Software Engineering Process

SUMMER 2 - 2022

ETERNITY: FUNCTION - 5

ab^x

Project Deliverable

Bariq Ishtiaq Mohammed

Student ID : 40208194

https://www.overleaf.com/project/62ded0164ab44420bf8b9a59

https://github.com/BariqIshtiaq/SOEN6011-_F5

Table of Contents

Introduction 2
Problems 2
Problem 1 2
Problem 2 4
Problem 3 6
Problem 4 10
Problem 5 12
Conclusion 13
References 14

Introduction

To implement a power function of the form

$$f(x) = ab^x \tag{1}$$

where a and b are constants, and x is a real number.

The current research is thought to meticulously carry out a number of procedures as a component of an engineering project with various structural features. Additionally, the project's focus is on how many components, including agile techniques and DevOps, are heavily included in the present investigation. The process of creating a console-based application to compute the exponent of the product of two user-input integers is thought to be included in the study's development outlook. The full application effectively explains how to create an application that can carry out computational procedures and scientific computations. The idea of a transcendental function, on the other hand, is also used in this research to quickly define a polynomial function. According to the description, these functions cannot be expressed as common algebraic finite combinations like additions, raising to a power, extracting roots, and so on. Exponential, logarithmic, and trigonometric functions can all be used to express these functions. This calculator is thought to execute those processes to figure out the outcomes of those functions. The goal of this study is to accurately create the result of ab^x by computing the F5 function.

Domain for the model

The set of all real numbers constitutes the function's domain. (- ∞,∞)

Co-Domain for the model

The set of all real numbers also serves as the function's co-domain.

Context Diagram

Users:-

Programmers

It is typically used by the system's makers to determine whether the system is performing as intended.

Testing Team

Make sure the testing is done in accordance with the established standards and processes, and check to make sure the functions are functioning properly.

Assessment Group

Make sure the testing is done in accordance with the established standards and processes, and check to make sure the functions are functioning properly.

Students

The calculator is available for use by course participants to determine the output of the aforementioned function. It can be used as a guide for implementing a calculator in the future.

Research Scholars

The function's output may be calculated since it may be of interest to researchers. To compare, contrast, and adjust the system further, find discrepancies in the system's design and behaviour.

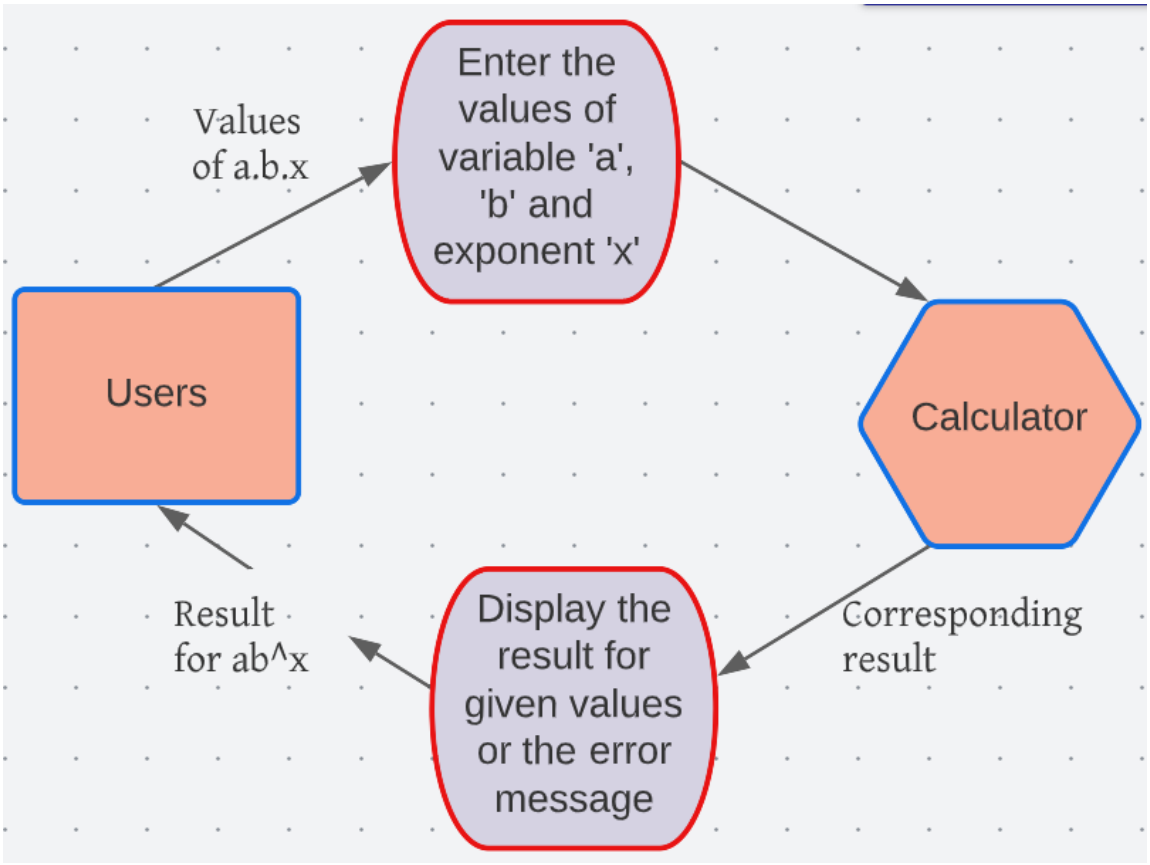

Figure 1: Context of Use Model
(Source:LucidChart)

With the help of Java code, we intend to build a mathematical function that will allow us to compute ab^x. For the variables "a," "b," and exponent "x," the user may enter the required values as input. For the values they provided, users receive the output that corresponds to those values.

Problems

Problem 1

a) The procedure must be set up to develop the project using a suitable coding system, infrastructure, and frequent coding techniques in order to conduct this study. The project is briefly described at this step of the procedure. Additionally, the domain and codomain functions must be declared in the process description. The combustion domain offers all linguistic inputs that might be used to develop the output result and construct the function.

"*The domain is the set of all possible inputs of a function.*", In order to create acceptable outcomes, the procedure is described in a clear sequence by the set of loaded inputs. The primary purpose of the programme is linked to this domain. By invoking the procedure, the main application may locate every element in this domain. As a result, the codomain aids in describing the "set of its potential outcomes or outputs" for the domain's input values. This approach is used by the domain function to analyse the result: f (x) = x^2. On the basis of the input data, the domain can process the data for the codomain and produce every feasible result.

The key and embellished components of the process that give the model its individuality are its characteristics. The model's attributes have been implemented based on -

In object-oriented programming, the object is specified in a porous way to create the architecture of the model and to develop the analysis of the programming approach. This aids in creating all of the reference charts and the object domain. The job must specify the platform independence in order to design the object-oriented programming method.

The application of the model's results contributes to the creation of the model's calculator system. A simple technique that yields the value of each square point is offered by the calculator system. Programming uses the distinctiveness of the coding approach to provide a clear picture of the model. As a result, the model's implementation concentrated on calling a and b to load the variables into the process. The study was not complete. The mathematical equation is used to support the code section. The value is requested by the built-in calling function of a. The procedure has to load the values for the implementation after printing the system. The system requires the loading methods to import the value and save it in the domain. The domain can easily load the value in a. Therefore, load the value in the process that has designed the system for b. This area is also the domain to store the data on the basis of the input. Load the data into these systems; the function needs to multiply the values. The value multiplication of the process needs to be elaborated in the process. Make the multiplication by value in the system so the task sends the value for the square. The process is defined in a clear way—suppose a section holds the value of 5, and b section loads the value of 2. The 2-step calculation process has been built to deliver the output of a*b multiplication. The 1st stage of the process generates a value of 10. The next stage of this process helps to build the calculator and generates the square value of a*b. The generated output of the process provides the value of 10's square that is 100. All these results can be executed with the help of the x value. Therefore, if x is considered as 3, then the result must come with the cube value. Now, 10 is the result of a and b, and x is kept as 3. Therefore, the final result of the process must be 1000.

This type of multiplication technique is used in the process of categorising every calculator based on the value of x. In order to carry out the computation correctly, the x value

is crucial. Additionally, this part is noted as a special and distinctive Java model. The calculator has the ability to construct the calculation using its surroundings as a foundation.

b) This section of this model provides the specification of the construct method in the scheme of the calculation. The calculation of the process needs the proper specification of the calling values. If the calling values in the model can be clearly specified by the users, then the users can easily load the value into one calculator. In a technical model specification, the process can easily get the data from the input values. The gathered data can easily be loaded into the optimizer and send the values to the model. The calculator model can easily implement the process of declaring all the function protocols in the system. As a result, the model may simply connect to the calling configuration and create the system's model architecture. The system's definition makes it simple to use the data and create the computation model. The non-technical values can readily satisfy the ideal order x values. Additionally, the non-technical system protocol methodology elaborates on objects in the same way. The task needs to load the value in the process after declaring it in the model. Calculate the load option as you proceed. The values for the upcoming stage must be multiplied. The duty to explain the arithmetic is carried out by the method in this sequence.

Problems 2

The process for creating functions and maintaining guidelines from ISO/IEC/IEEE 29148 standards is thoroughly described in the project's current documentation. Additionally, a number of projects needs and their products adhere to the standards throughout the project's life cycle (standards.ieee.org, 2022). It is thought that upholding these principles will make the process of creating recursive and iterative apps easier. Given the information provided in the aforementioned method, it can be successfully communicated that adhering to these standards helps the application achieve its goals. These instructions are mainly in charge of directing people to carry out activities with the greatest degree of accuracy and to make advantage of the subjective usage of terminology.

In the entire study, all of these guidelines are significantly maintained that are effectively analyzed from the results of this application. This guideline has provided general frameworks for depicting and describing the entire life cycle of the applications created by individuals. As per the illustrations of Andrianarivelo (2018), designing a java calculator with one of the transcendental functions is to be performed while maintaining ISO/IEC/IEEE 29148 standards.

The guidelines are the most essential option to build an innovative model. This section of this process helps to elaborate the proper order guidelines for the working process together. In order to build the proper order architecture the task needs to follow some essential rules. The perfect order and rules make the model position very well decorated.

The "ISO/IEC/IEEE International" standard provides the system managers in the model to describe the selected sources and structure description in the model specification. The model specification and requirements follows the rules to build the model. The process needs to fulfill the requirements in terms of the model composition. The model was established in a proper way to elaborate the system. In order to maintain the system the process needs to clarify the system cycle and make each step in a significant order. The document provides the correct order of the required modification to generate the system composition and area of the output structure can be described in the proper way. "Requirements for the system management of information the users can see the details".

Based on the facts stated in the above section it can be effectively considered that the entire section depicts the procedure of developing applications thereby accomplishing their objectives. Moreover, there are numerous considerations and principles that are followed such as ***investing in the early stages of projects***, ***integrating systems engineering and project management***, ***alternative systems perspectives***, and ***principles governing the process***. These principles are significantly followed so that the entire developmental aspects can be significantly performed maintaining ethical considerations.

The problem is associated with the unique identifier that needs to elaborate the system prospects to make the model. The system identifier builds the model with the calling values in the model. Declaring the value in the model, the task needs to load the value in the process. compute the load option in the process the task needs to multiply the values for the next stage. compete the next stage of the task need to load the.

The prerequisites for the study, both functional and non-functional, are as follows.

Requirements

Functional Requirements

1. **The system must perform symbolic or numerical calculations.**
    - **ID for the function:** FR-1 ab^x
    - **Owner:** Bariq Ishtiaq Mohammed
    - **Version:** 1.0

- **Motive:** This criteria was put in place to encourage the development of a calculator that can handle both symbolic and numerical computations.

2. **The system must accept real numbers as input values.**
   - **ID for the function** FR-2 ab^x
   - **Owner:** Bariq Ishtiaq Mohammed
   - **Version:** 1.0
   - **Motive:** The goal of this criterion is to limit the function's computations to real values.
3. **The system must provide effective solutions for all the problems within its expected range.**
   - **ID for the function** FR-3 ab^x
   - **Owner:** Bariq Ishtiaq Mohammed
   - **Version:** 1.0
   - **Motive:** To ensure that the system provides acceptable outputs for the supplied inputs, this criterion was put in place. The outcomes must fall within the anticipated range.
4. **The system must effectively handle the errors and generate error messages.**
   - **ID for the function** FR-4 ab^x
   - **Owner:** Bariq Ishtiaq Mohammed
   - **Version:** 1.0
   - **Motive:** This requirement aids in the development of an error-tolerant system. This is mostly done for "error-handling" purposes.
5. **The system must conform to the standard style of programming.**
   - **ID for the function** FR-5 ab^x
   - **Owner:** Bariq Ishtiaq Mohammed
   - **Version:** 1.0
   - **Motive:** This criterion was put in place to ensure that the system would adhere to the accepted coding standards.

Non-Functional Requirements

1. **Calculations must be finished by the system in the expected timeframe.**
   - **ID for the function** NFR-1 ab^x
   - **Owner:** Bariq Ishtiaq Mohammed
   - **Version:** 1.0
   - **Motive:** This requirement's goal is to create a system that performs well and produces accurate calculations. The system is anticipated to deliver the anticipated output in the anticipated amount of time.
2. **There must be no platform or tool dependencies in the source code.**
   - **ID for the function** NFR-2 ab^x
   - **Owner:** Bariq Ishtiaq Mohammed
   - **Version:** 1.0

- **Motive:** The source code shouldn't be reliant on any one IDE or tool. It should function normally with all systems.

3. **Debugging tools must be incorporated into the system.**
   - **ID for the function** NFR-3 ab^x
   - **Owner:** Bariq Ishtiaq Mohammed
   - **Version:** 1.0
   - **Motive:** To ensure that all debugging tools are incorporated into the system, this need was put in place.

Problems 3

(a) The Platform independent provides the algorithm to make "all API's are compiled into bytecodes". In order to lead the task with the help of the byte-code, the task needs to build the source of the coding system. Whereas the source code of the model has been implemented with the programming method. The source code considers the method to send the codes to the java compiler. In addition to the code, the process extracts the significance of the data and merges tech data to set order. The compiler sends the code method to the computer and arranges all the segments in the process to detect the result. The compiler helps to declare all the error selection that comes through the complication. The error decision of the model detects the position of the error significance and the model needs to remove the error from the building programming. The byte code option provides the data to the virtual machine and all the elements transform into the machine code. In order to arrange the machine code, the process sends the data to the output.

The entire development section is considered to describe the procedure of utilizing a recursive algorithm for achieving the entire task. As per the consideration of OuYang (2018), the utilization of advanced information procedure elaborately describes the utilization of functions to choose the best among both iterative and recursive algorithms. Considering the entire approach, the current problem is recursive as it calls itself on getting a certain input by the user and returns a value until a certain condition is satisfied.

(b) The current procedure is considered to incorporate the utilization of two different approaches such as recursive and iterative approaches. As per the consideration of Villalobos-Arias *et al.* 2018, automation with testing performed as a model-based approach is considered essential for the study. Considering the entire procedure, the Java application is considered for developing the algorithm considering both its advantages and disadvantages of such.

Iterative Algorithm

The iterative algorithm is considered to be an approach to repeating a certain step over and over again in the form of a loop and it gets terminated once a certain condition gets disapproved.

Advantages

- This algorithm is considered to implement the use of several statements for repeating itself over and over again for achieving the desired result.
- This procedure is considered to utilize simple programming code blocks instead of using complicated codes.

Disadvantages

- An essential disadvantage of this kind of algorithm is that more resources can be essentially utilized.
- A rigid developmental phase and no overlaps of the codes.

Recursive Algorithm

A recursive approach is considered to solve the problem by breaking a larger section of code into smaller sections as a repetitive approach that an iterative approach can not handle due to its complexity.

Advantages

- This procedure is considered to add clarity to the code block and dubbed the code efficiently.
- Utilizes a tree structure for a better problem-solving procedure capability

Disadvantages

- A recursive function has high time complexity as compared with a non-recursive algorithm.
- This approach is considered to acquire lots of memory spaces in the entire system

(c) The present step elaborates the development of a mind map for developing the working procedure of the chosen algorithm. This pseudo-code format is decided on the development of the mind map describing each section of this code. As per the illustration of Dhika *et al.* (2019), these codes are essentially artificial and performed in an informal language that aids the developer to develop such algorithms. Illustrating the entire procedure, it can be significantly conveyed that the approach is essential for highlighting the process of describing the coding section in a general language, not in a coding language.

The figure in the above section is considered to develop a mind map for highlighting the steps that are utilized for the entire development procedure.

(d) This section of this research provides the appropriate explanation of the code attached below. The Pseudo-code helps to describe the system of the inbuilt fountain. The function model helps to analyze the system in the java. With the help of the code the process can easily describe the stages where the model is build.

The types of Mind Map for pseudocode are

- Java Compatibility Pseudocode
- Pascal Style Pseudocode
- C Style Pseudocode
- Mathematical Programming Language Style Pseudocode
- Natural language Style Pseudocode
- Fortran Style Pseudocode
- Structured Basic Style Pseudocode

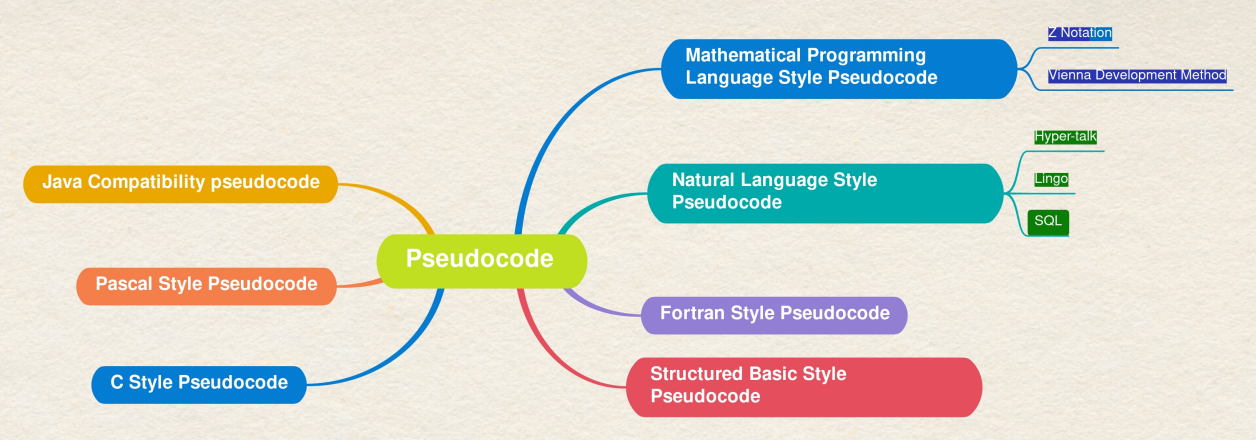

Figure 2: Mind Map for utilised Pseudocode
(Source Fabricated in GitMind)

```
“import java.util.*;
        public class main {
        public static void main(String[] args) {
        Scanner sc= new Scanner(System.in);
        System.out.print("Enter first number (a): ");
        int base1= sc.nextInt();
        System.out.print("Enter Second number (b): ");
        int base2= sc.nextInt();
        System.out.print("Enter the exponent(x) ");
        int exponent= sc.nextInt();
        long product = base1 * base2;
        long result = 1;
        while (exponent != 0) {
        result = result * base2;
        exponent--;
        } long product = result * base1; try{
        System.out.println("Answer = " + product); }
        catch (Exception e) {
        System.out.println("Something went wrong.");
        }
        }
        }”
```

Table 1: Pseudocode elaboration

(Source: Developed by the learner)

Natural Language Pseudocode

The scientific study of language from a computational viewpoint, with an emphasis on the interactions between natural (human) languages and computers, is known as natural language (also known as computational linguistics). In order for the software to process information in a particular language like a person would, it must be able to comprehend both the contents communicated with it and the contextual subtleties of the language. From the shared papers, our technology can precisely extract data and insights and even categorise and organise the actual documents.

Benefits of Natural language Pseudocode

- The source code is simple for stakeholders without programming experience to comprehend.
- Simple to read
- It's easy to write.

Pseudocode

Step 1: Import "java.util". It will allow us to access all sorts of packages, classes and methods in a Java program.

Step 2: Write a public class which uses String value

Step 3: A Scanner will help in scanning the overall system.

Step 4: The user is asked to enter the integer value of variable 'a'

Step 5: The system will scan the input value

Step 6: The user is asked to enter the integer value of variable 'b'

Step 7: The system will scan the input value

Step 8: The user is asked to enter the integer value of exponent 'x'

Step 9: The system will scan the input value

Step 10: The system will multiply base1(a) with base2(b^x)

Step 11: The user will get the output in long

Step 12: If the system catches any exception, it will return "Something went wrong" message as output

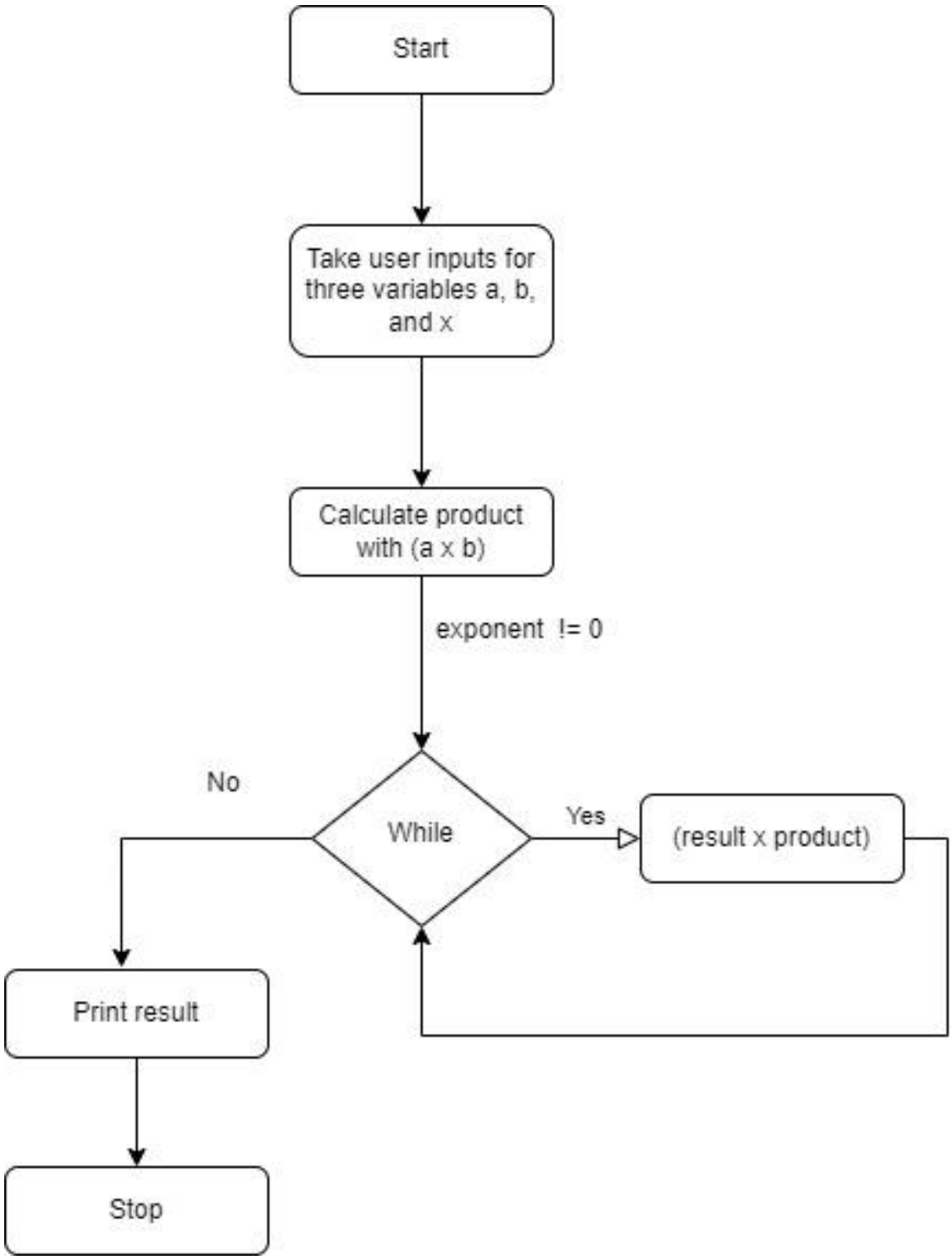

Figure 3: Flow-Chart for the source code
(Source:Fabricated in draw.io)

Algorithm for ab^x

Procedure F5 (a, b, x)
inputs: integers a, b, x
Output: double result
base1 = a
base2 = b^x
result = 1
while(exponent!=0)
return result*base2
exponent–
end
if product=result*base1
try
return answer
catch(Exception e)
return error
end

Problems 4

The developmental section of this study is essentially performed from scratch without using any libraries. The user interface of this function is designed to take input from the user and perform an arithmetic operation to provide the desired result. The user interface function can easily describe the proper order system protocol to analyze the system function and describe the algorithm.

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

Scanner sc= new Scanner(System.in);
System.out.print("Enter first number (a): ");
int base1= sc.nextInt();

System.out.print("Enter Second number (b): ");
int base2= sc.nextInt();

System.out.print("Enter the exponent(x) ");
int exponent= sc.nextInt();
```

Figure 4: Main Function to obtain input from user
(Source: Fabricated in Apache Netbeans IDE)

The above-pasted code provides the definition of the coding in the model. The proper method for the coding system, provides the definition of the loading system. The loading system of the java model clearly shows the conditions in the system. With the help of this code - public static void main(String[] args) the process starts the main function in the model to lead the oration. In order to build the main function the task needs to carry the new scanner. The new scanner is builded with the process to describe the method in an exact way.

This figure is considered to calculate the desired result for developing the solution of determining the power of a number without using library functions.

On execution of this code, the console code the console shows the desired result is obtained.

```
long product = base1 * base2;
long result = 1;

while (exponent != 0) {

  result = result * product;
  exponent--;
}

System.out.println("Answer = " + result);
```

Figure 5: Code Block to calculate the result
(Source: Fabricated in Apache Netbeans IDE)

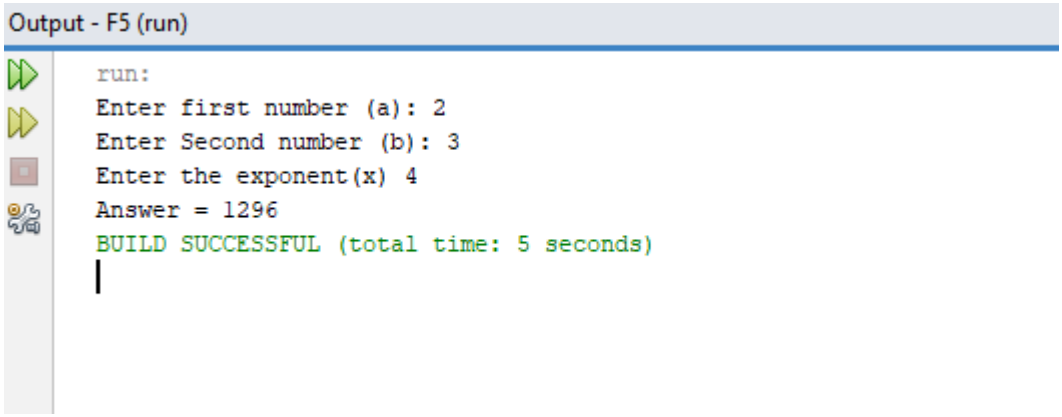

Figure 6: Obtaining output from the program
(Source: Fabricated in Apache Netbeans IDE)

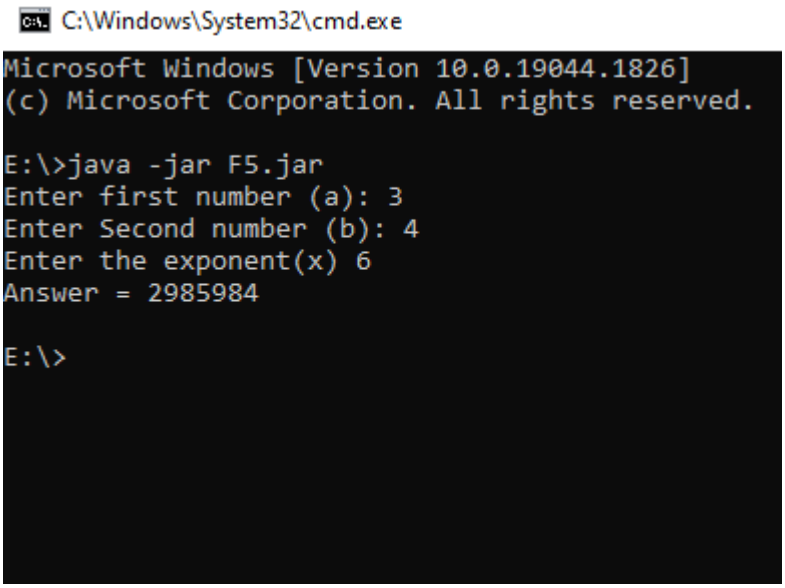

Figure 7: Execution of the Jar file in the console

The development of the jar file is performed with the command from the console with the command java -jar F5.jar.

Debugger

Debugging is the process of identifying and correcting script flaws. Debugging tools, a unique UI in developer tools that greatly simplifies debugging, are supported by all contemporary browsers and the majority of other environments. You may also follow the code's progression to determine exactly what's happening. Debuggers display the location of the error in the target application when it crashes. Most debuggers can stop at precise locations and run programs step-by-step in addition to halting at random points. They frequently have the ability to alter the status of running applications.

Debugger Utilised : Inbuilt debugger offered by IntelliJ IDEA

Pro's of Debugger

- An incorrect state is swiftly reported by the Debugger.
- The debugger makes the software development process problem-free by enabling early error identification.
- The developer can remove unnecessary and superfluous data with the help of debugging.
- Developers can save time and money by using debugging instead of building complicated code for one-off tests.

Con's of Debugger

- The debugger isn't very useful when the execution is stopped inside an invariant.
- The break-point condition will always return true if any of the previously unsupported expressions are used since the evaluation is failing. The debugger will halt in this situation.

The Quality attributes attained are:

Efficiency

- The program is executed within 2-4 nanseconds
- The answers which we get as output are accurate

Usability

- Users can submit data via a straightforward user interface.
- If the user enters the wrong input the system gives error messages

Maintainability

- The comments for the source code are added for the users to understand it better
- Code has been refactored periodically

Correctness

- Coding conventions are rigorously adhered to.
- JUnit tests have been implemented to check the correctness of the code

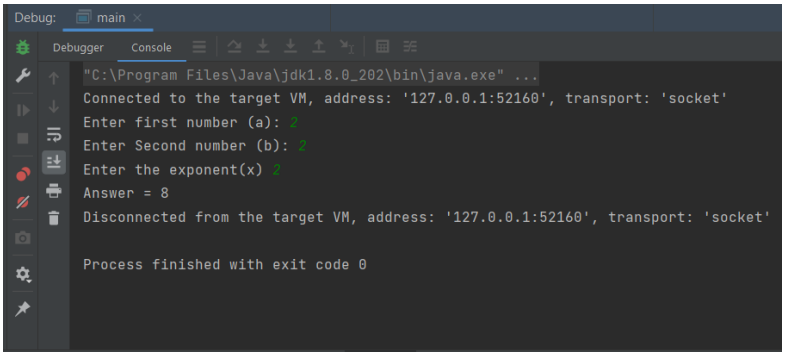

Figure 8: Execution of Debugger in the console

Problems 5

Manual and automated test case development is essentially performed in the current section to highlight the procedure of determining that a certain section of code is fit for global use. In the current scenario, there can be two different test cases. These cases are illustrated to be test case 1 and test case 2. As per the deliberation of Mandal and Dasgupta (2019), the development of mathematical calculation with the help of the Java programming language is an essential aspect of application development. Considering the entire procedure, it can be effectively conveyed that the overall unit testing procedure aids in scrutinising the individual operations in the entire algorithm.

Test case 1

The first test case is to utilise the scanner class to take user input of the entire calculation of ab^x. There are three unknown variables such as a, b, and x, in addition to this, their values are collected from the user and stored in variables base1, base2, and exponent. These values are utilised to calculate the desired result.

Test case 2

The second test case consists of adding the two functions together and fitting the result into a while loop for development, where the result is attained when the exponent value hits zero and the exponent value is lowered to one after each iteration.

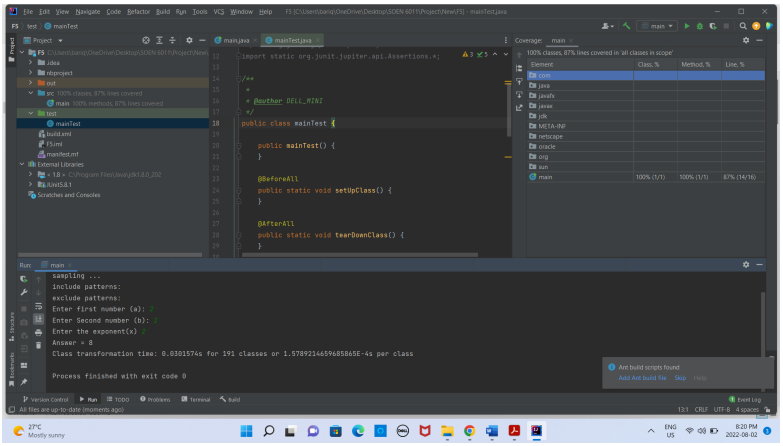

Figure 9: Execution of JUnit test in the console with coverage

Conclusion

The current section essentially concludes the procedure of implementing a recursive algorithm to effectively implement the transcendental function to find out the result of ab^x. The entire procedure has a user input section where the user provides input for three unknown variables such as a, b, and x. The algorithm is considered to incorporate the procedure of finding out the product of two numbers a and b. This result is fed to the while loop to calculate the power of the product. The entire procedure utilizes several procedures such as briefly describing the utilized function highlighting its unique characteristics, developing of calculator model, maintaining ISO-certified guidelines, and selecting of appropriate algorithms for the function. In addition to this, proper justification is providing a detailed justification about the advantages and disadvantages of including such a function. Considering the entire procedure, a mind map and pseudo-code are illustrated depicting the step-by-step procedure of the working of this algorithm. In this study, a proper description of the codes is also performed along with demonstrating the test case scenario to execute the code. Considering the entire procedure, the test case framework is developed by developing the jar file from the java main file to execute the calculator in a stand-alone format.

Reference List

Andriamasivelo, S.E., 2018. Calculator on Java Using the Method of Raoelina Andriambololona. Mathematics and Computer Science, 2(6), p.130.

Villalobos-Arias, L., Quesada-López, C., Martinez, A. and Jenkins, M., 2018, October. MBT4J: automating the model-based testing process for Java applications. In International Conference on Software Process Improvement (pp. 165-174). Springer, Cham.

Dhika, H., Isnain, N. and Tofan, M., 2019. Manajemen Villa Menggunakan Java Netbeans Dan Mysql. ikraith-informatika, 3(2), pp.104-110.

Rosyid, H.A., Widiyaningtyas, T. and Hadinata, N.F., 2019, October. Implementation of the exponential smoothing method for forecasting food prices at provincial levels on java Island. In 2019 Fourth International Conference on Informatics and Computing (ICIC) (pp. 1-5). IEEE.

Chang, K.C. and Liu, C.J., 2020. An algorithm of calculating transport parameters of thermoelectric materials using single band model with optimized integration methods. Computer Physics Communications, 247, p.106875.

Tarigan, J.T., Zamzami, E.M. and Ginting, C.L., 2018. Performance Analysis of BigDecimal Arithmetic Operation in Java. JOURNAL OF ICT RESEARCH AND APPLICATIONS, 12(3), pp.267-279.

Lyon, D.A. and Fitzsimmons, R., 2021. An Appstore for Java. International Journal of Computer and Systems Engineering, 2(1), p.1.

Winnie, D., 2021. How Java Works. In Essential Java for AP CompSci (pp. 19-22). Apress, Berkeley, CA.

OuYang, G., 2018, May. Design and Implementation of Body Mass Index Calculator Based on Android Technology. In 2018 2nd IEEE Advanced Information Management, Communicates, Electronic and Automation Control Conference (IMCEC) (pp. 2459-2462). IEEE.

Mandal, L. and Dasgupta, K., 2019, February. Use of Vedic Mathematics to Speed-up Basic Mathematical Operations in Android Based Calculator. In 2019 International Conference on Intelligent Sustainable Systems (ICISS) (pp. 162-165). IEEE.

Website

standards.ieee.org, 2022, *ISO/IEC/IEEE International Standard - Systems and software engineering - - Life cycle processes -- Requirements engineering*, Available at: https://standards.ieee.org/ieee/29148/6937/ [Accessed on: 22/07/2022]