

A thick dark blue vertical bar runs down the left side of the page. A blue arrow points to the right from this bar, containing the text 'User's Manual'. In the bottom left corner, there are several thin, curved lines in dark blue and light gray.

User's Manual

Boolean Expression Minimizer

Machine Problem 1

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BS COMPUTER SCIENCE

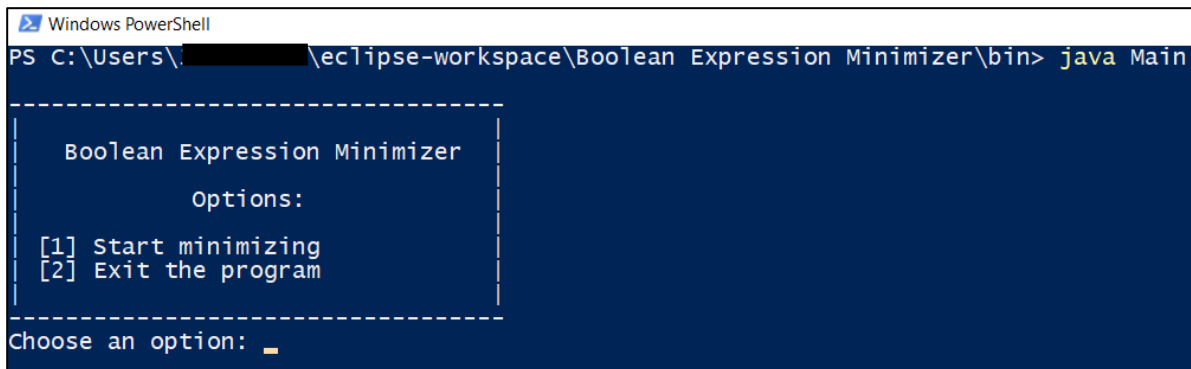
Introduction

What is Tabulation Method?

The **Tabulation method**, also known as the **Quine-McCluskey method**, is one way to minimize Boolean expressions, other than the Karnaugh map method. The method is particularly useful for minimizing functions with large number of variables, as doing the K-map method with more inputs make the grouping quite tedious, sometimes impossible. The Tabulation method and K-map method is functionally similar, but the Tabulation method is more efficient for use in computer algorithms. The method will be discussed further in the Technical Manual.

What is Boolean Expression Minimizer?

Boolean Expression Minimizer (BooM) is a console application that simplifies Boolean expressions using the algorithm of Tabulation Method. It is written in Java programming language.

A screenshot of a Windows PowerShell terminal window. The title bar says "Windows PowerShell". The command prompt shows the path "C:\Users\...eclipse-workspace\Boolean Expression Minimizer\bin>" followed by the command "java Main". The application output is displayed in a blue box with white text. It shows "Boolean Expression Minimizer" followed by "Options:" and a list: "[1] Start minimizing" and "[2] Exit the program". Below this, it says "Choose an option:" followed by a cursor.

```
PS C:\Users\...eclipse-workspace\Boolean Expression Minimizer\bin> java Main

Boolean Expression Minimizer

Options:
[1] Start minimizing
[2] Exit the program

Choose an option: _
```

Figure 1 Boolean Expression Minimizer (BooM) being run in Windows PowerShell

Features:

Here are some of the features of the application.

1. Can support up to 26 variables.
2. Users can customize the variable assignment (*Note: Only Alphabetic Characters are allowed*).
3. Users can add don't care conditions.

Getting Started

Requirements:

1. Java

To run BooM, you need to have **Java** installed at your computer.

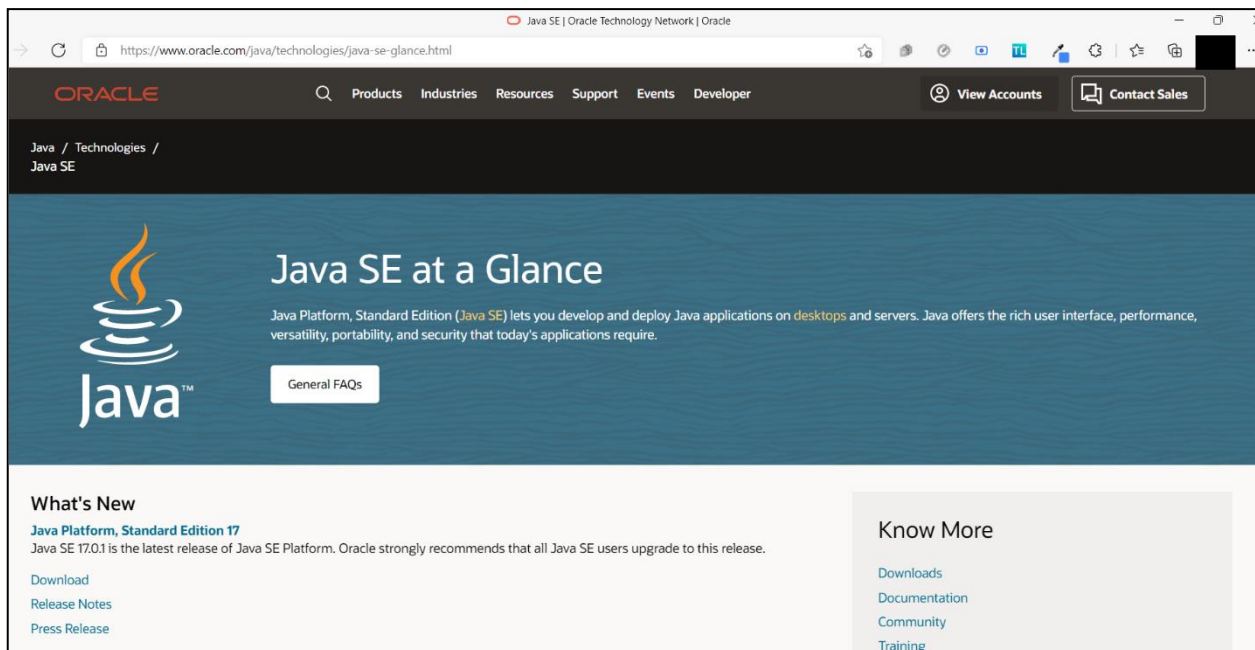
To check if it is installed, type 'java -version' in Command Prompt (for Windows).

```
Command Prompt
Microsoft Windows [Version 10.0.19043.1288]
(c) Microsoft Corporation. All rights reserved.

C:\Users\>java -version
java version "17" 2021-09-14 LTS
Java(TM) SE Runtime Environment (build 17+35-LTS-2724)
Java HotSpot(TM) 64-Bit Server VM (build 17+35-LTS-2724, mixed mode, sharing)
```

If it is already installed, you can skip to 'Optional'. If not, follow the steps below:

1. Go to <https://www.oracle.com/java/technologies/java-se-glance.html>



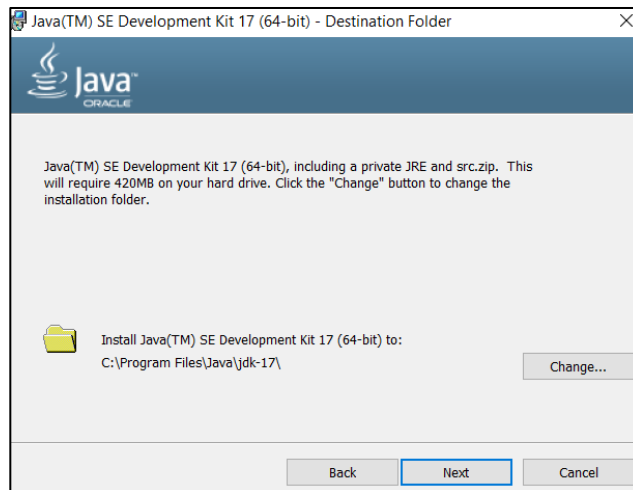
- Click 'Download'. You should be redirected to the download page.

The screenshot shows the Oracle Java Downloads page for JDK 17 on Windows. The page has a dark header with the Oracle logo and navigation links. The main content area is white and features a section titled 'Java 17 available now' with a brief description and a link to learn about Java SE Subscription. Below this is a section titled 'Java SE Development Kit 17.0.1 downloads' with a thank you message and a description of the JDK. A table lists the download options for Windows, including x64 Compressed Archive, x64 Installer, and x64 MSI Installer, with their respective file sizes and download links. At the bottom, there is a section for 'JDK 17 Script-friendly URLs'.

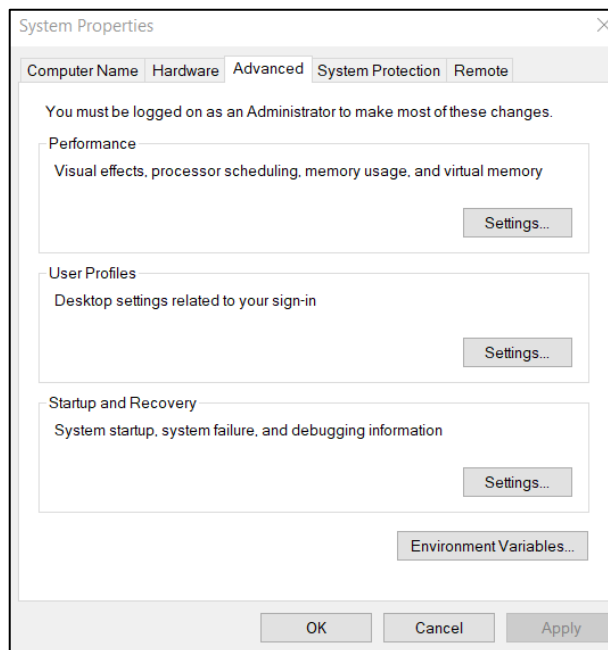
Product/file description	File size	Download
x64 Compressed Archive	170.66 MB	https://download.oracle.com/java/17/latest/jdk-17_windows-x64_bin.zip (sha256 🔗)
x64 Installer	152 MB	https://download.oracle.com/java/17/latest/jdk-17_windows-x64_bin.exe (sha256 🔗)
x64 MSI Installer	150.89 MB	https://download.oracle.com/java/17/latest/jdk-17_windows-x64_bin.msi (sha256 🔗)

- Select the OS and download the 'x64 Installer' (in Windows) by clicking the link.
- After downloading the installer, install the 'jdk-17_windows-x64_bin'.
- Follow the instructions in the installer.

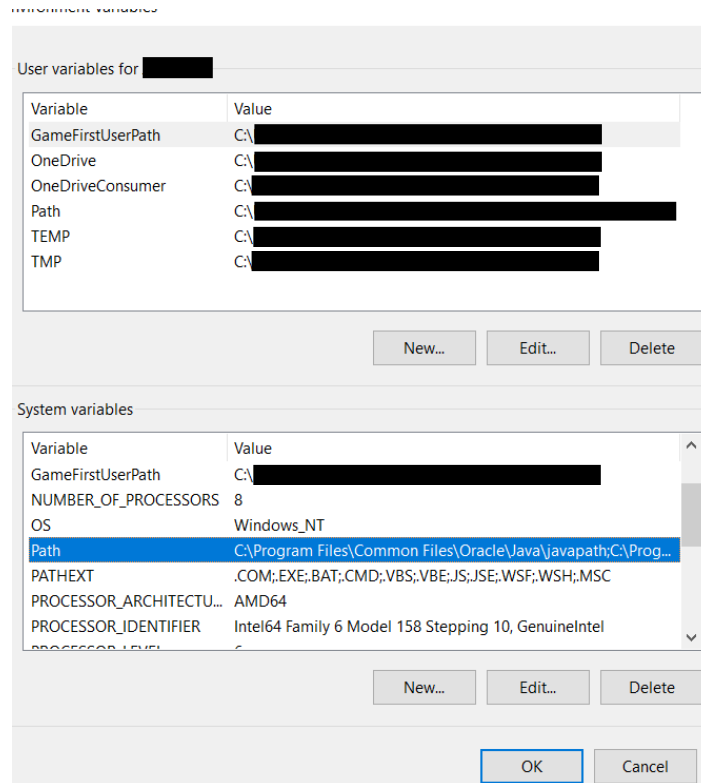




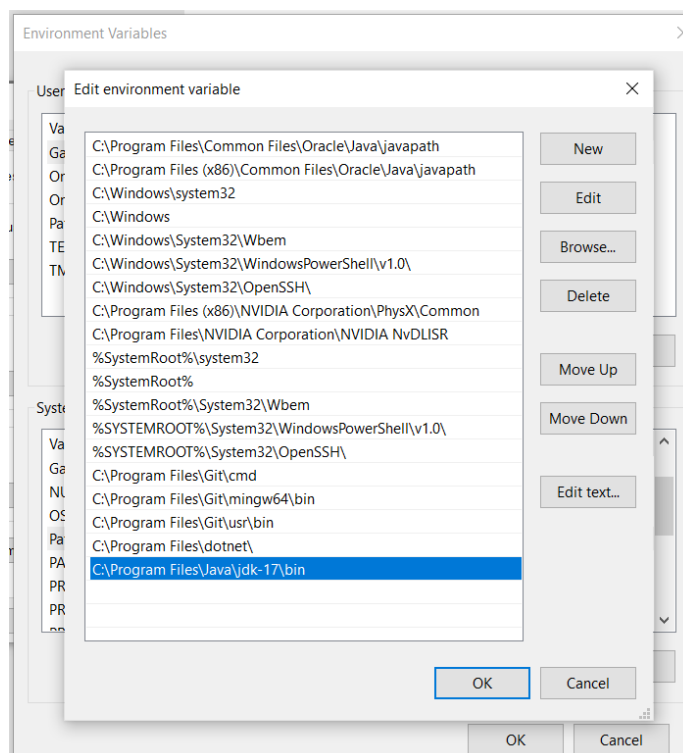
6. After installing, go to 'System Properties' (Can be found on Control Panel > System and Security > System > Advanced System Settings).



7. Click 'Environment Variables'.



8. Click 'Path' under 'System Variables' (the highlighted one). Then, click 'Edit'.



9. Click 'New'. Then enter 'C:\Program Files\Java\jdk-17\bin' (the directory of the installation of Java with '\bin').
10. Press 'OK'.

Note: To check if the installation is successful, go to Command Prompt and enter 'java -version' to check if it is installed. Refer to the first picture in 'Getting Started'.

Optional: Java IDE

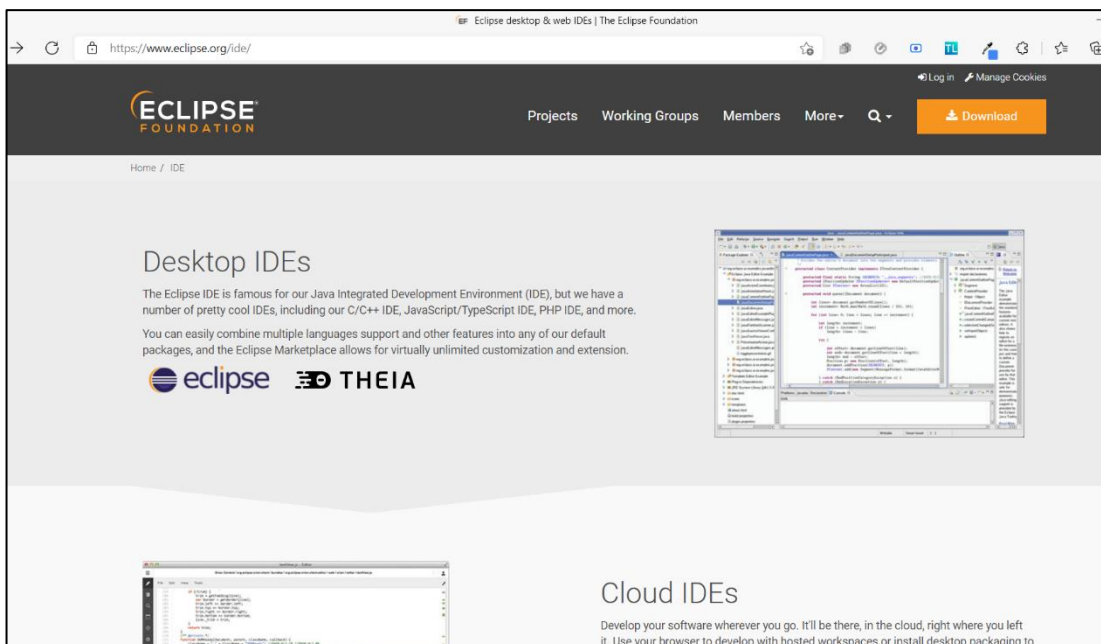
It is not really required to install an IDE to run the program. You can run the program using Command Prompt or Windows PowerShell and edit the code using Notepad. But this is not advisable, especially the latter, because it is easy to miss errors in editing when using Notepad. Because of this, it is advisable to download an IDE.

For suggested Java IDE to use, **Eclipse** is recommended, as it is also the IDE that is used to program the application.

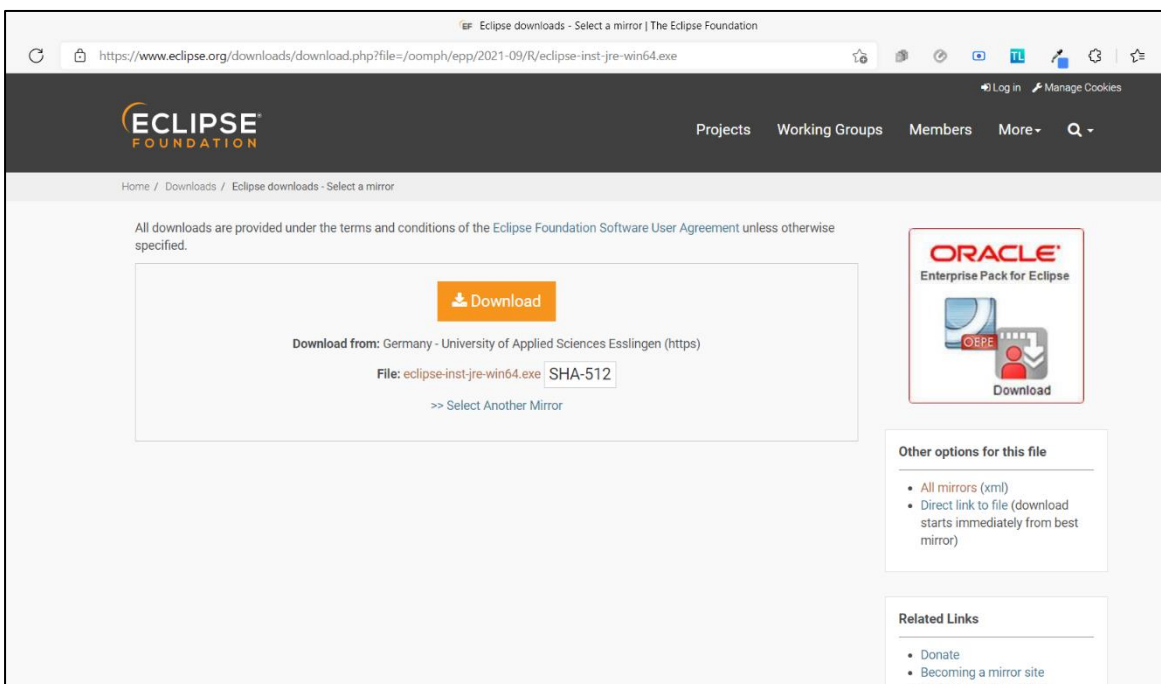
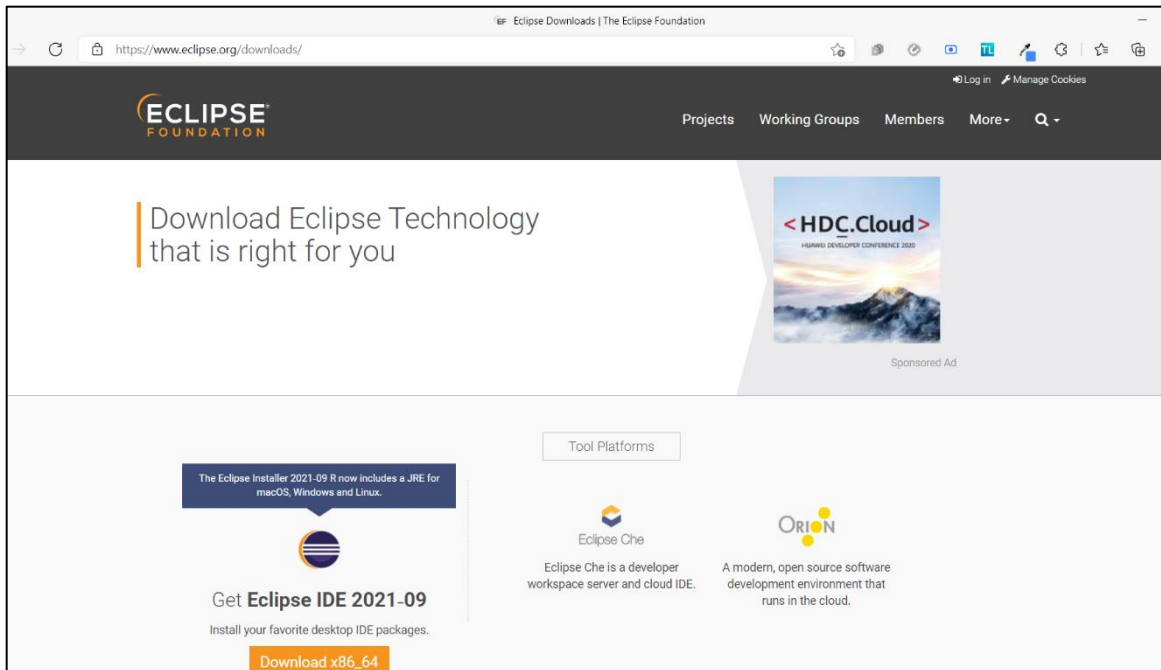
If you want to install Eclipse, follow the steps below. Else, proceed on the 'Running the Program' part of this guide.

Installing Eclipse IDE

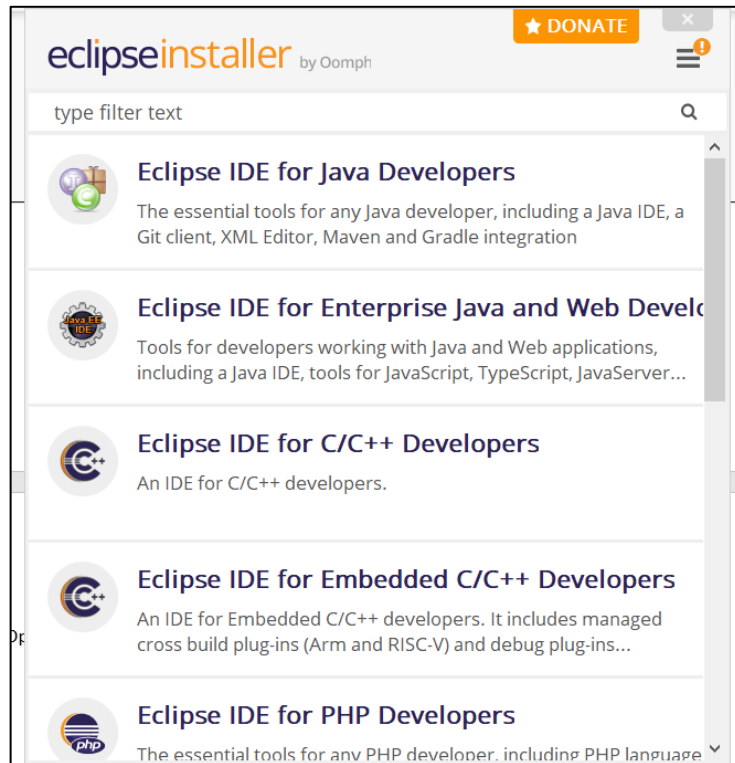
1. Go to <https://www.eclipse.org/ide/>



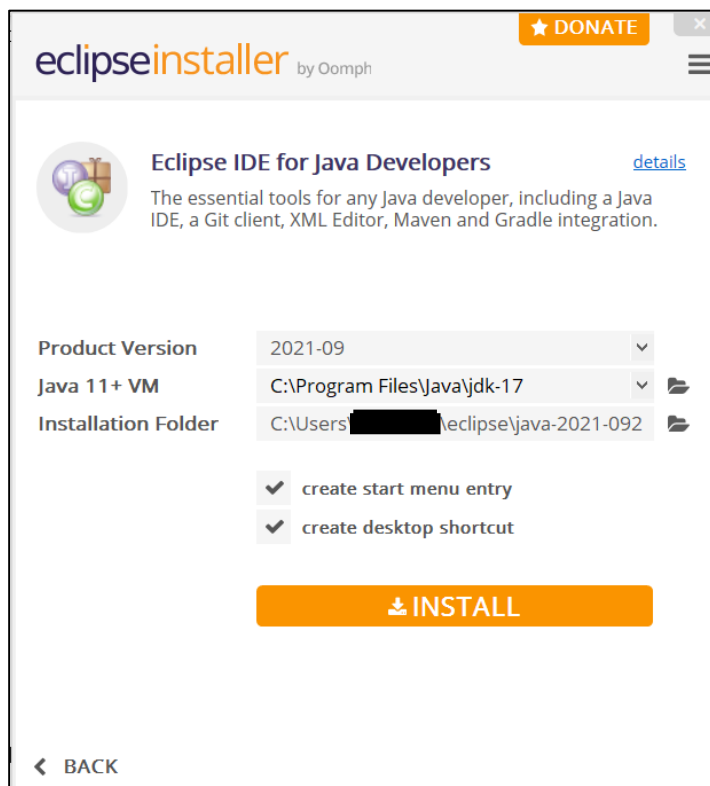
- Click 'Download'. This will redirect you to another site. Then, click 'Download x86_64'. After that, click 'Download'.



3. Open 'eclipse-inst-jre-win64.exe'



4. Click 'Eclipse IDE for Java Developers'. Then, click 'Install'. After that, you are done.



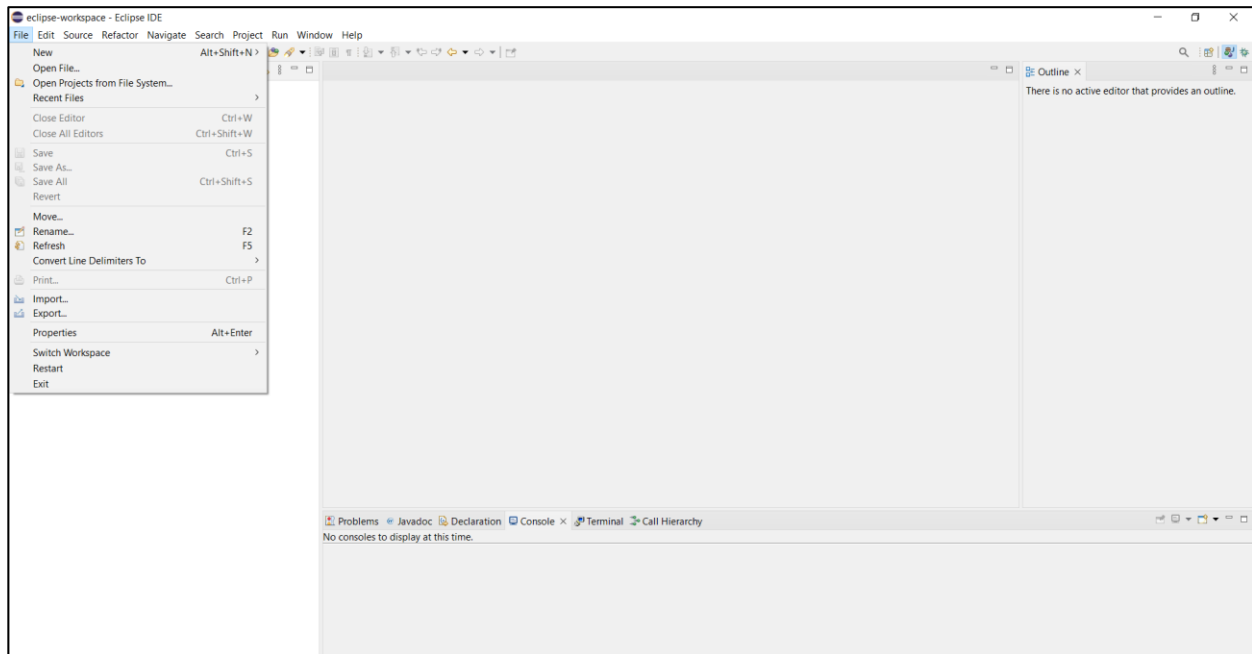
Running the Program

There are three ways to run BooM (assuming that the user is using Windows as OS): by running it in the IDE (Eclipse), by using the Windows PowerShell, or by using the Command Prompt. This section of the guide will discuss these three ways.

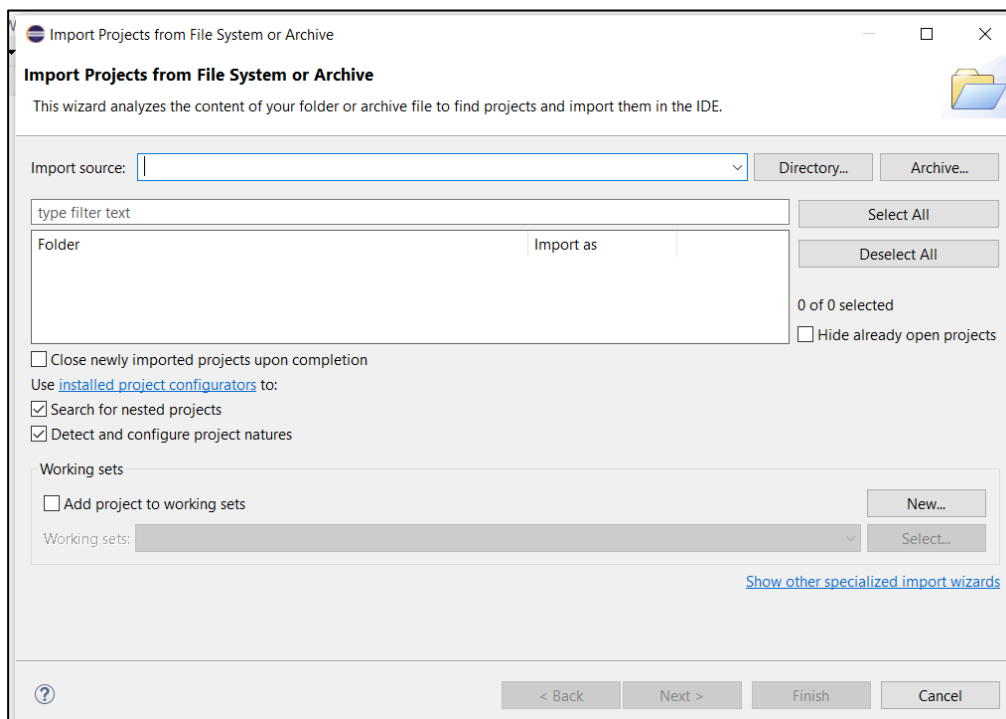
Running BooM in the IDE (Eclipse)

You can run the program in the IDE by following these steps:

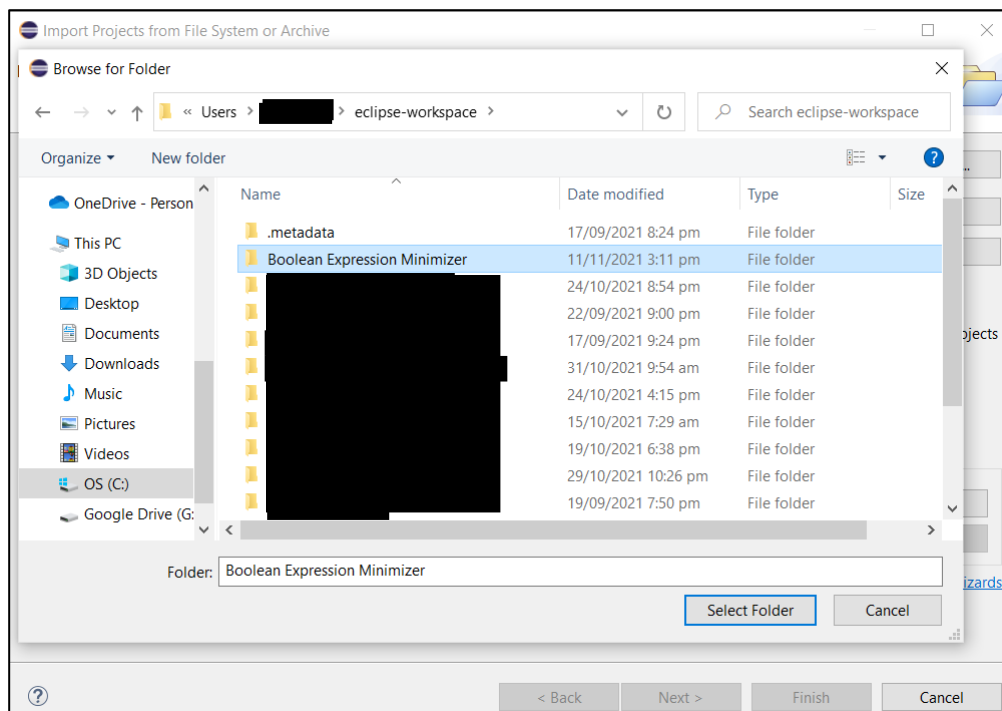
1. Open Eclipse IDE.
2. Click 'File'



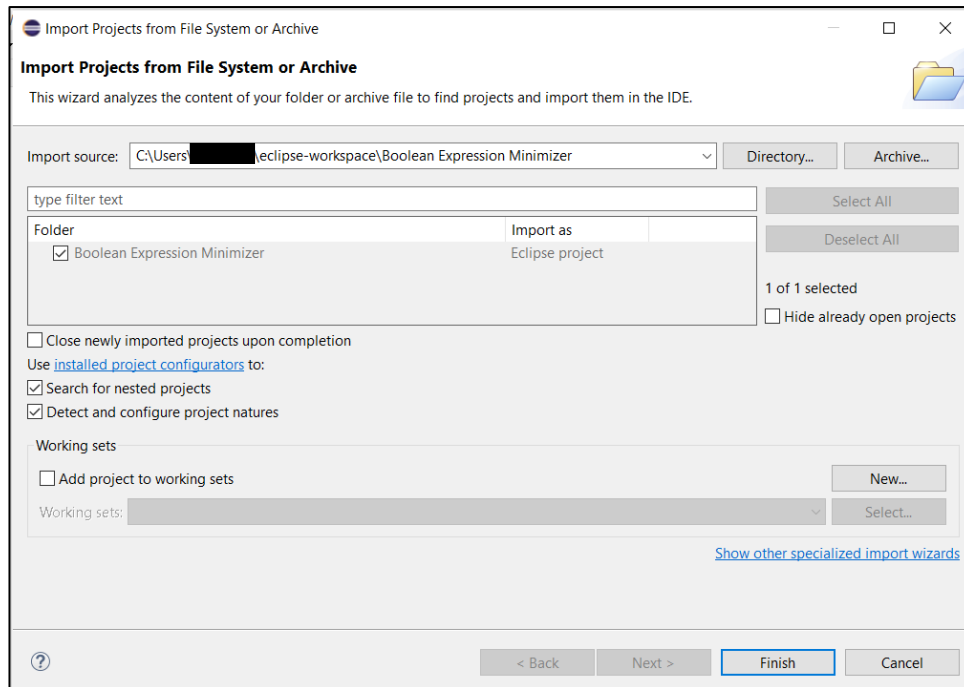
3. Click 'Open Projects from File System'.



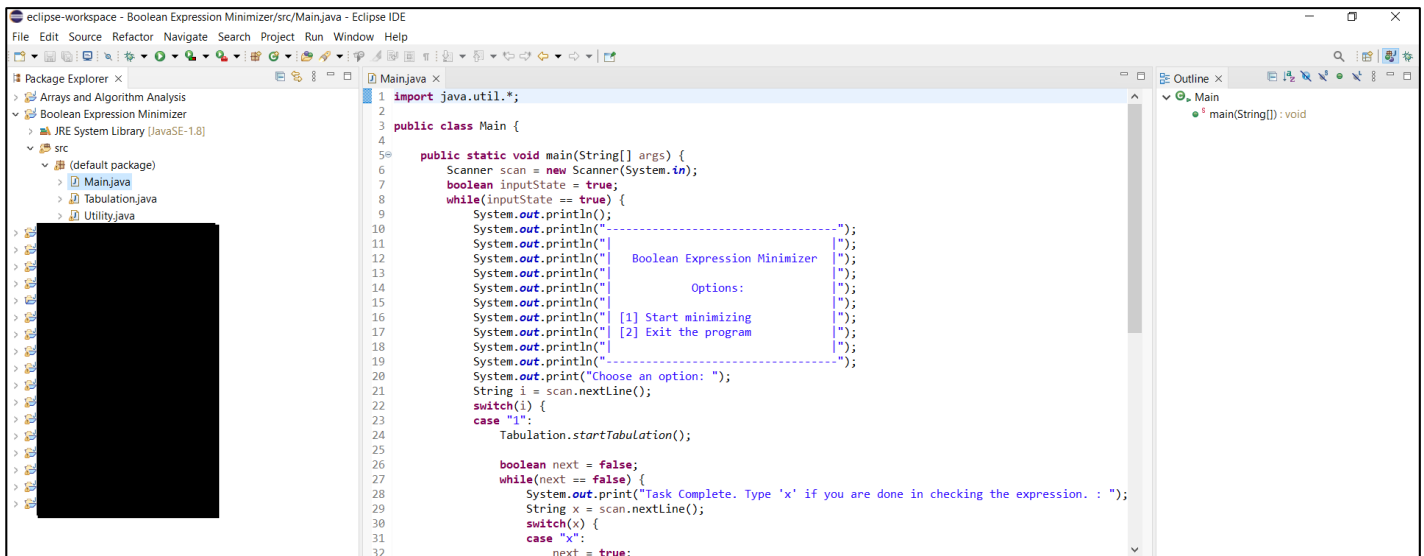
4. Click 'Directory' and find the folder 'Boolean Expression Minimizer' and select that folder.



5. Click 'Finish'



6. The folder should be visible now on the 'Package Explorer'. Now, click the following: Boolean Expression Minimizer > src > (default package) > Main.java.



- Click 'Run' > 'Run'. Alternatively, you can click 'CTRL + F11' to run the program. The program will be accessible through the console below.

The screenshot shows the Eclipse IDE with a Java file named 'Main.java' open. The code is a Java application that uses a Scanner to read input and a while loop to keep the program running. It prints a menu with two options: 'Start minimizing' and 'Exit the program'. The console output shows the program's execution, including the menu and the prompt 'Choose an option: '.

```

1 import java.util.*;
2
3 public class Main {
4
5     public static void main(String[] args) {
6         Scanner scan = new Scanner(System.in);
7         boolean inputState = true;
8         while(inputState == true) {
9             System.out.println();
10            System.out.println("-----");
11            System.out.println("Boolean Expression Minimizer");
12            System.out.println("Options:");
13            System.out.println("-----");
14            System.out.println(" [1] Start minimizing");
15            System.out.println(" [2] Exit the program");
16            System.out.println("-----");
17            System.out.print("Choose an option: ");
18            String i = scan.nextLine();
19            switch(i) {
20                case "1":
21                    Tabulation.startTabulation();
22
23                    boolean next = false;
24                    while(next == false) {
25                        System.out.print("Task Complete. Type 'x' if you are done in checking the expression. : ");
26                        String x = scan.nextLine();
27                        switch(x) {
28                            case "x":
29                                next = true;
30                        }
31                    }
32            }
33        }
34    }
35}

```

Console Output:

```

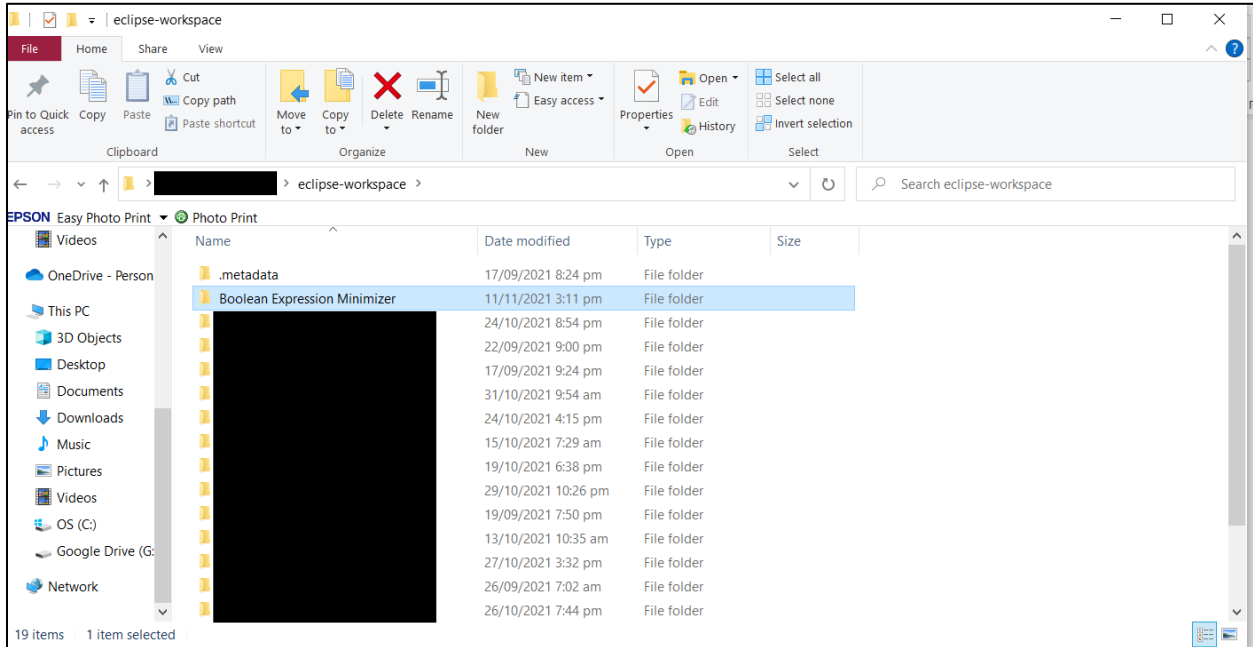
Main (5) [Java Application] C:\Program Files\Java\jdk-17\bin\javaw.exe (11 Nov 2021, 11:17:42 pm)
Boolean Expression Minimizer
Options:
-----
 [1] Start minimizing
 [2] Exit the program
-----
Choose an option: |

```

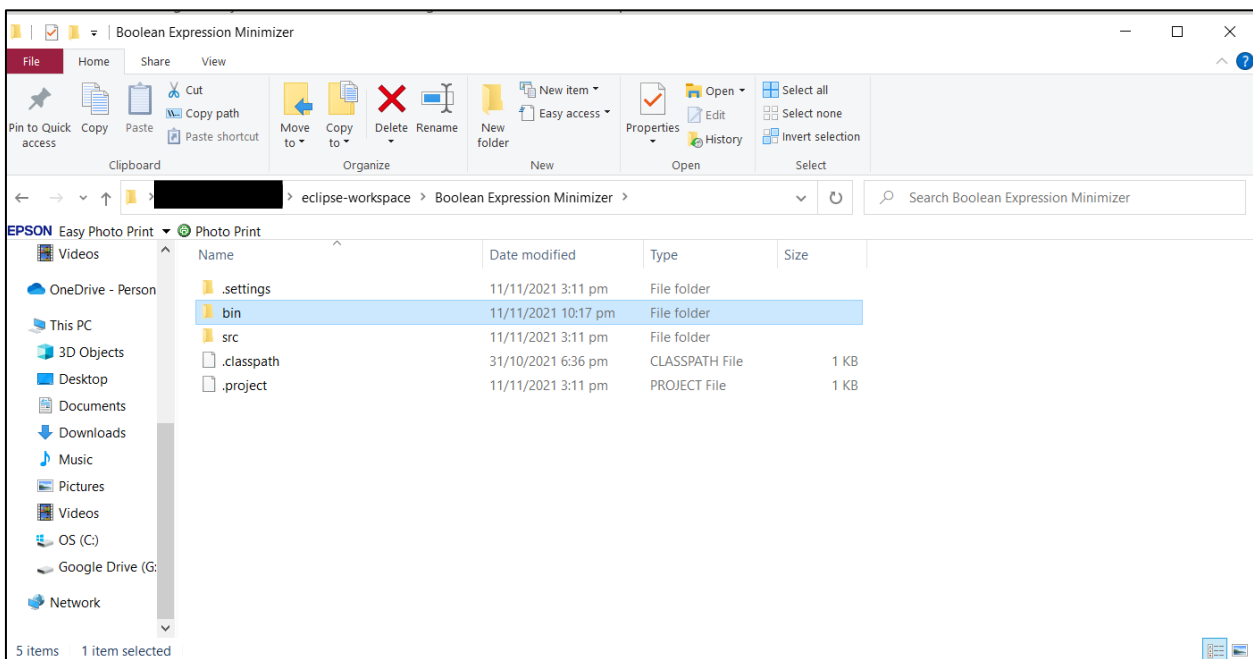
Alternative: Running BooM on Windows PowerShell

In case that you did not install Eclipse (or any other IDE), you can still run BooM using Windows PowerShell. Follow these steps to run BooM on Windows PowerShell:

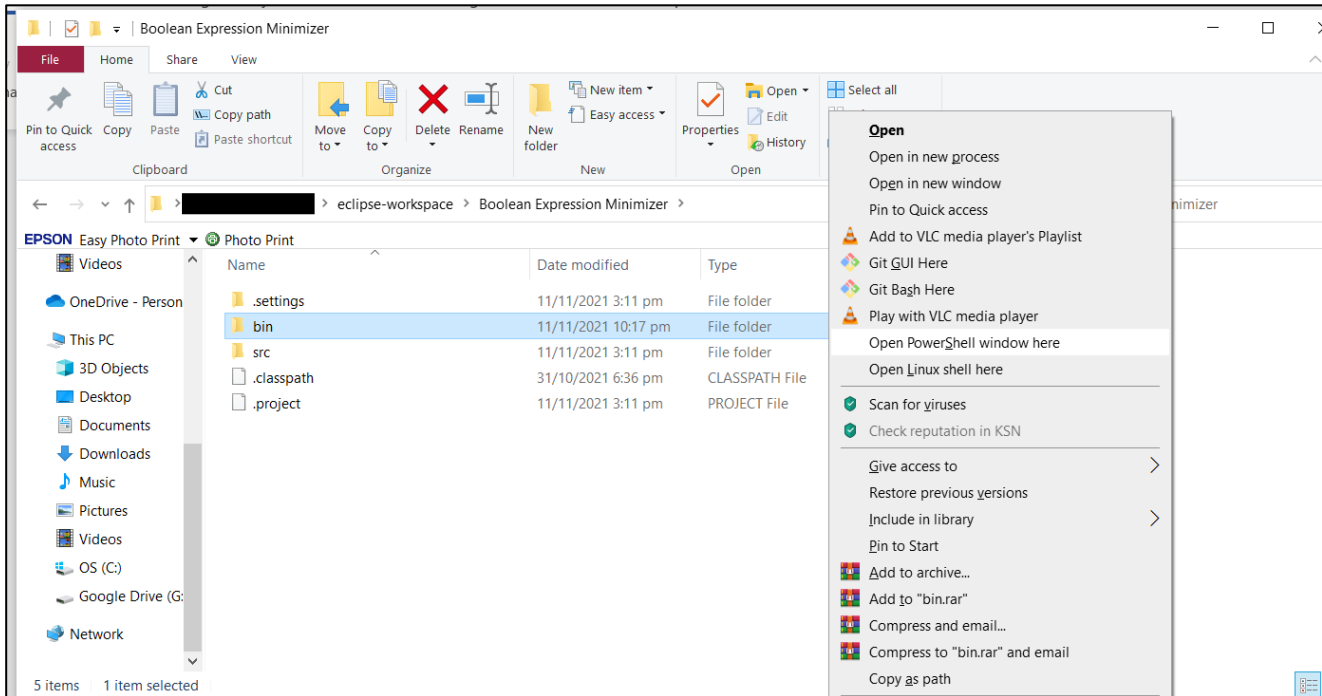
1. Open 'Boolean Expression Minimizer' folder.



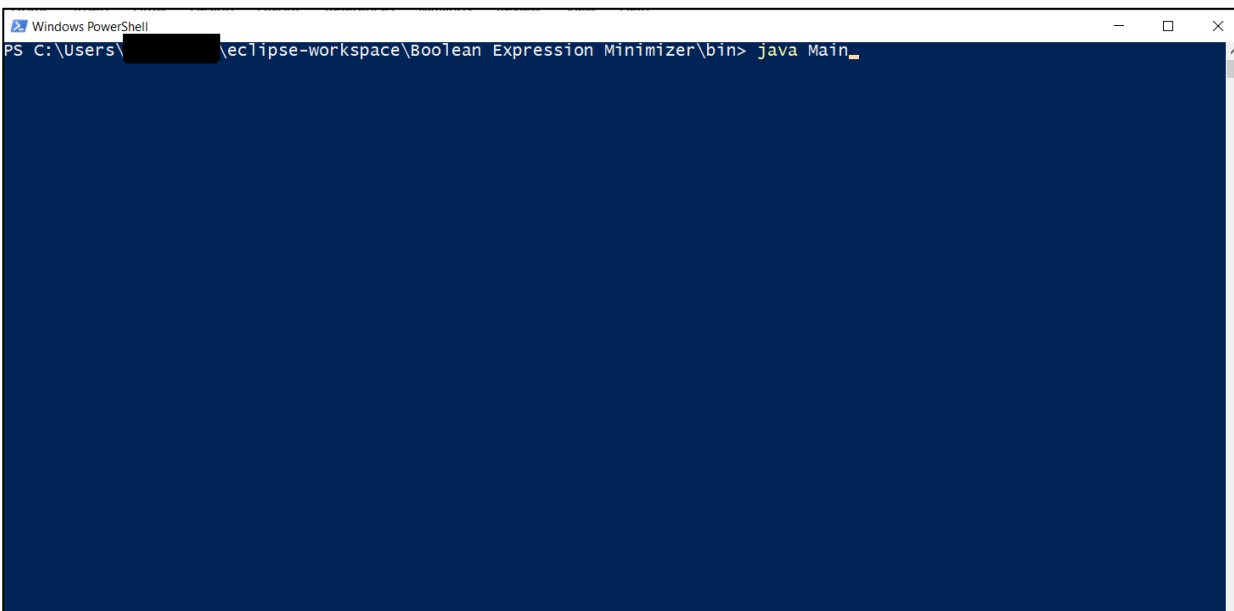
2. After opening the said folder, press 'SHIFT + RIGHT MOUSE CLICK' on 'bin' folder.



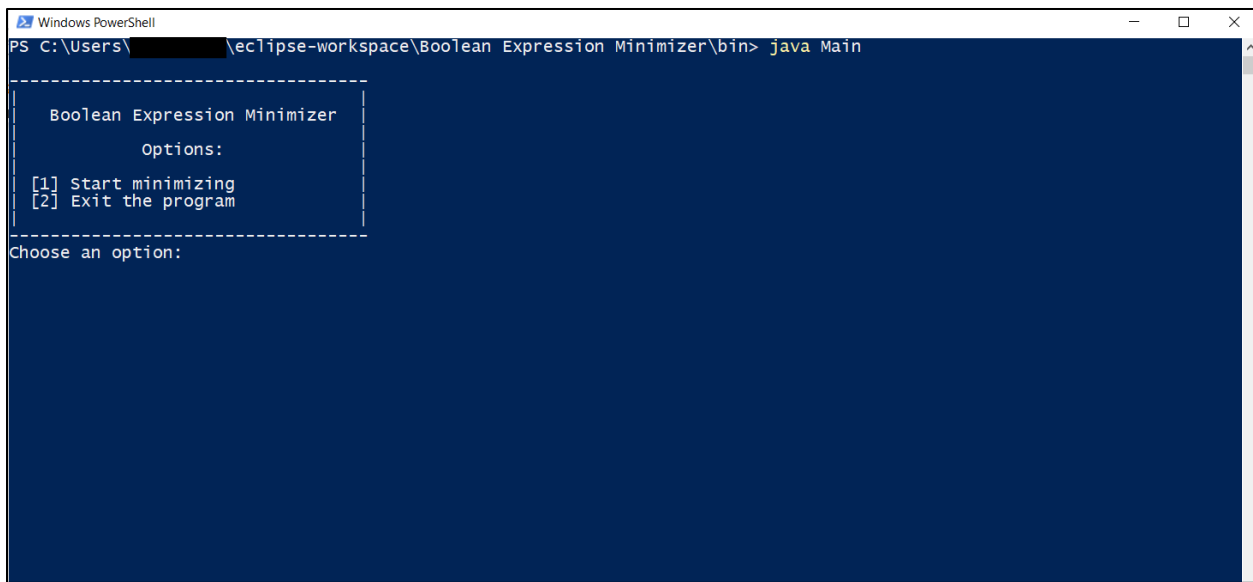
3. Click 'Open PowerShell window here'.



4. Once PowerShell is open, enter 'java Main', then press enter.



5. You should be able to use the program now.



The screenshot shows a Windows PowerShell window with a dark blue background. The title bar reads "Windows PowerShell". The command prompt shows the current directory as "C:\Users\[redacted]\eclipse-workspace\Boolean Expression Minimizer\bin" and the command "java Main" has been executed. The program output is displayed in a white dashed box. It shows the title "Boolean Expression Minimizer", followed by "Options:", and a list of two options: "[1] Start minimizing" and "[2] Exit the program". Below the dashed box, the prompt "Choose an option:" is visible.

```
PS C:\Users\[redacted]\eclipse-workspace\Boolean Expression Minimizer\bin> java Main

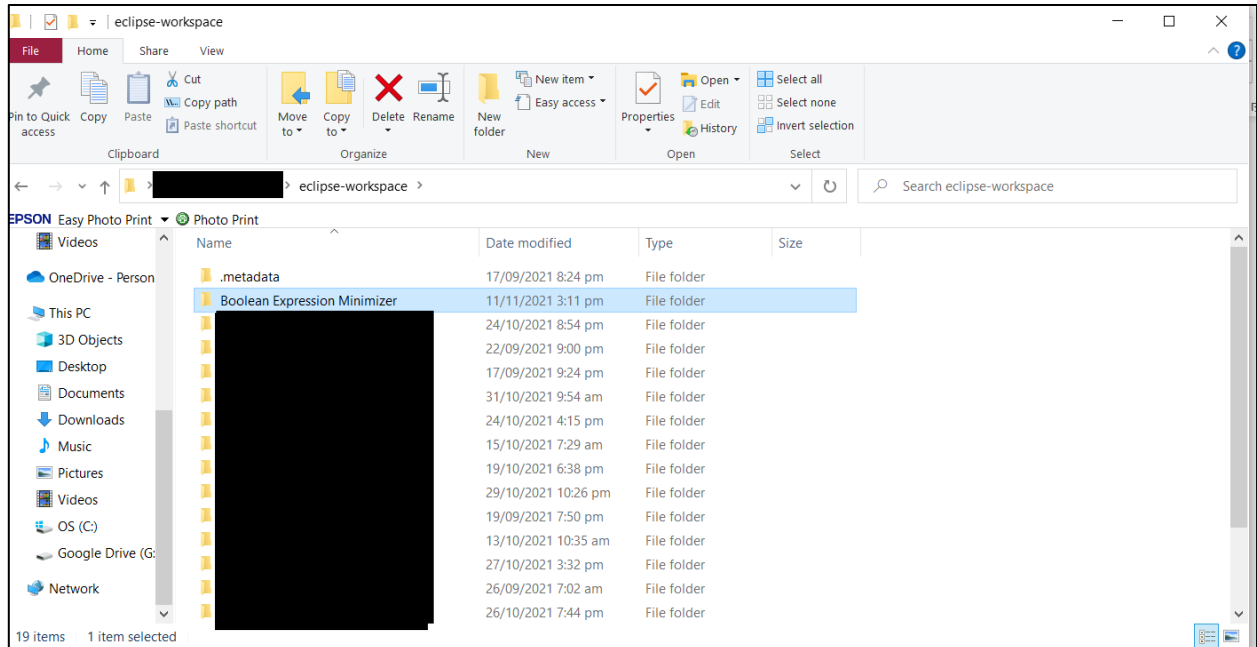
Boolean Expression Minimizer
Options:
[1] Start minimizing
[2] Exit the program

Choose an option:
```

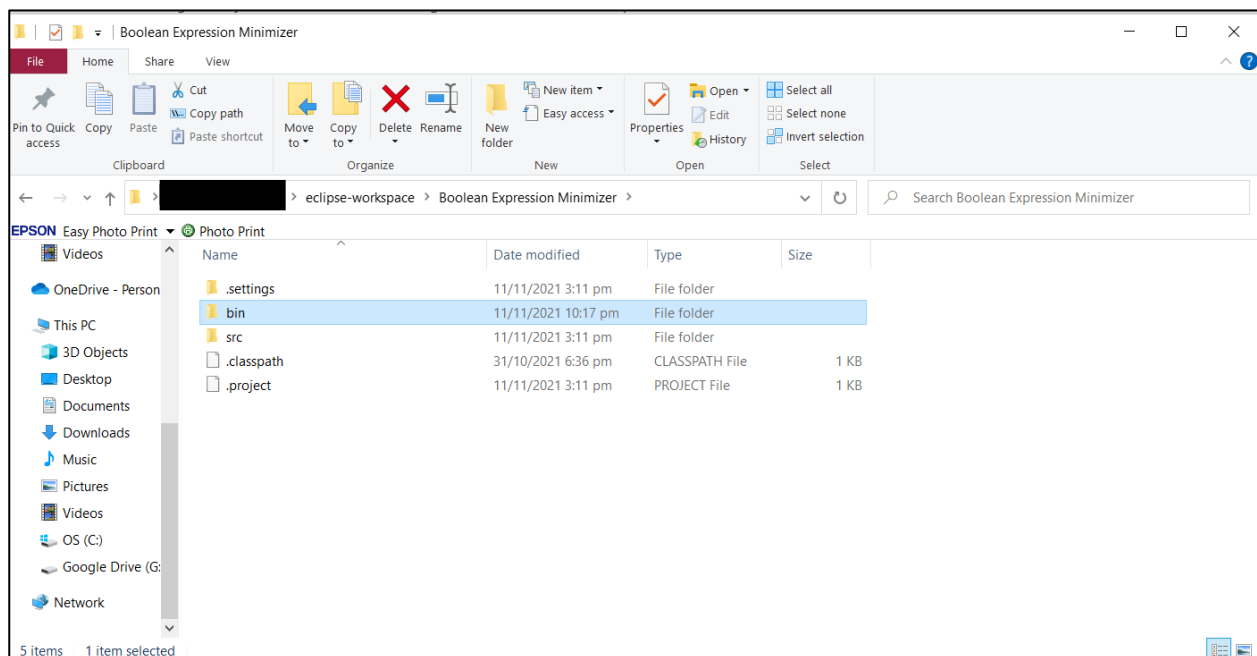

Alternative: Running BooM in Command Prompt

As an alternative, if you do not have Eclipse IDE or Windows PowerShell, you can use Command Prompt to run the program. Follow these steps for you to run BooM using Command Prompt:

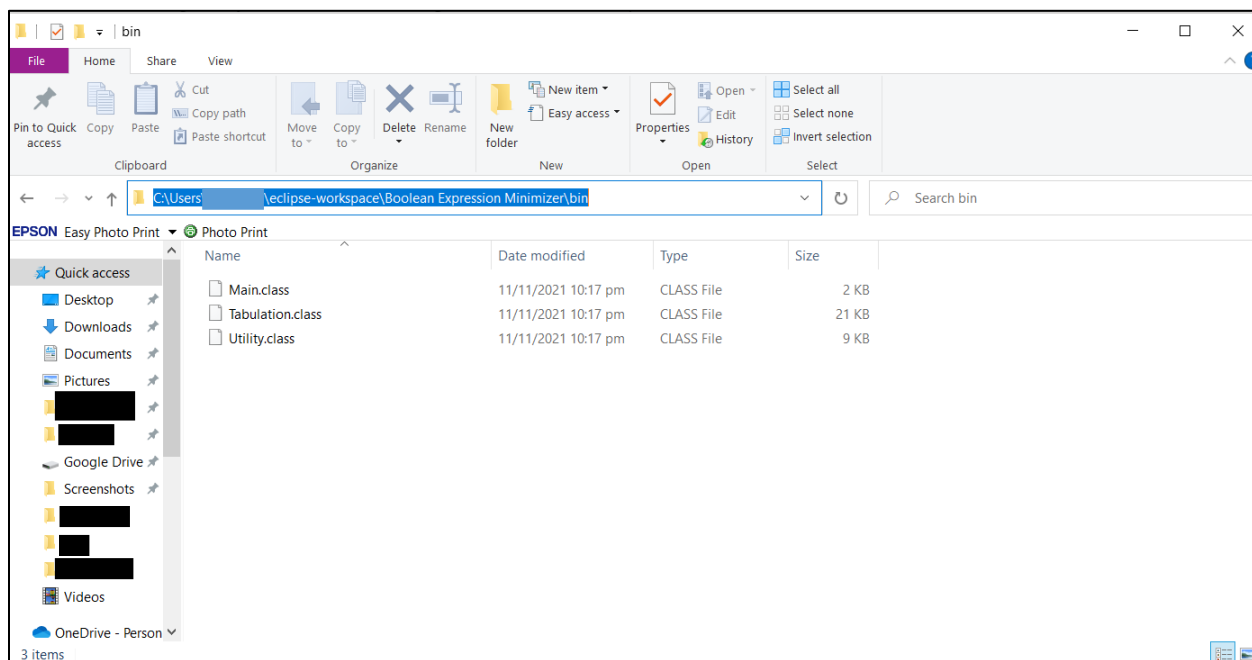
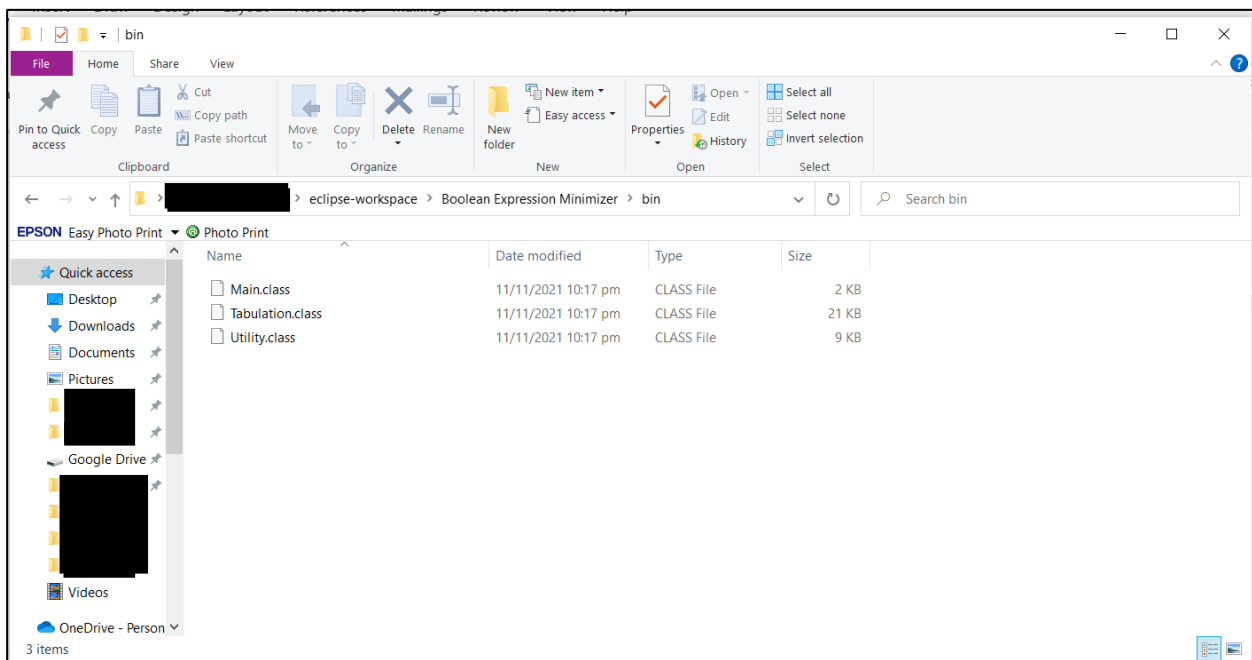
1. Open 'Boolean Expression Minimizer' folder.

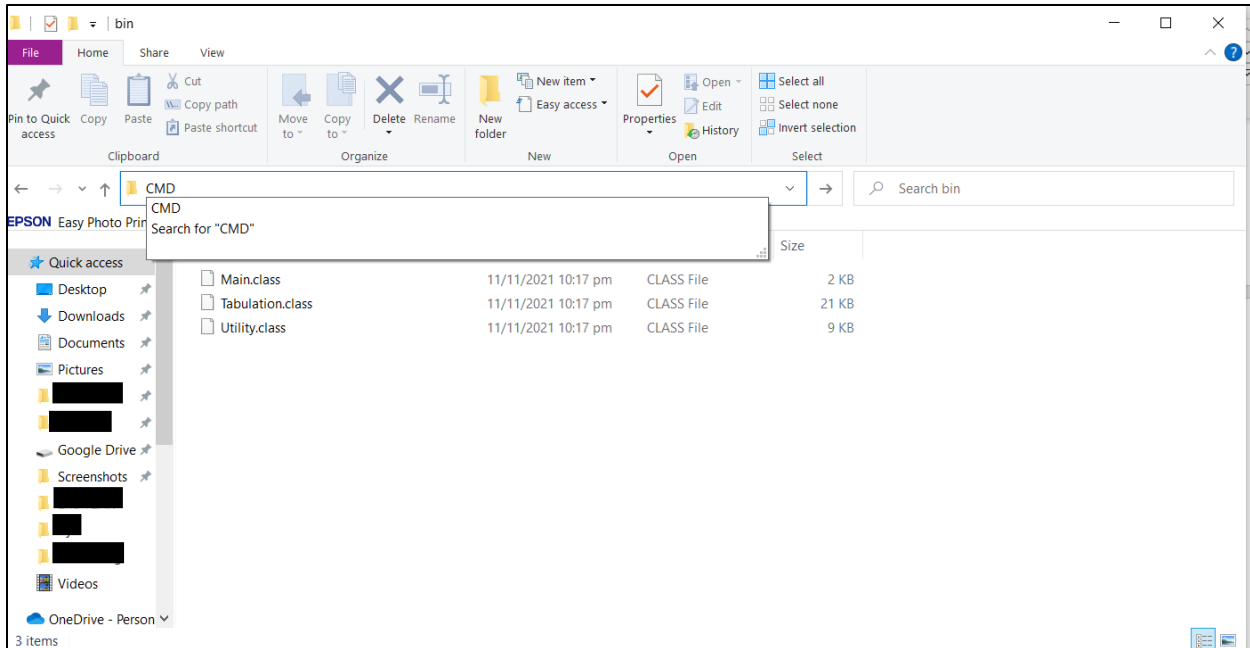


2. Open 'bin' folder.

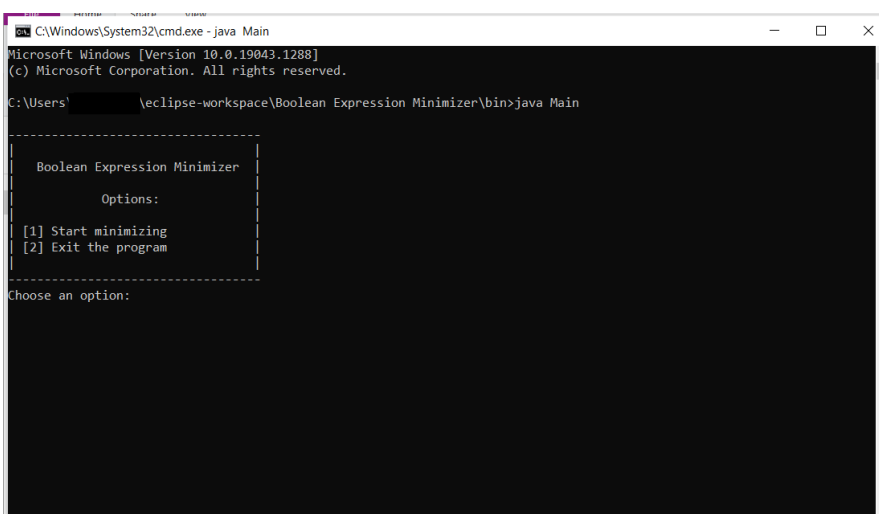
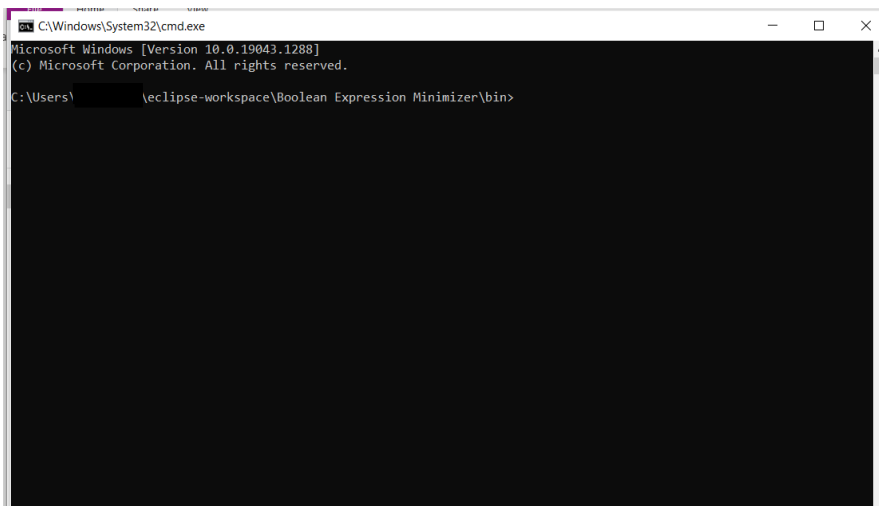


3. After opening the folder, change the address line into 'CMD'. The press 'ENTER'.





4. After that, Command Prompt will pop up. Then, enter 'java Main' and press 'ENTER'. You should be able to use the program now.



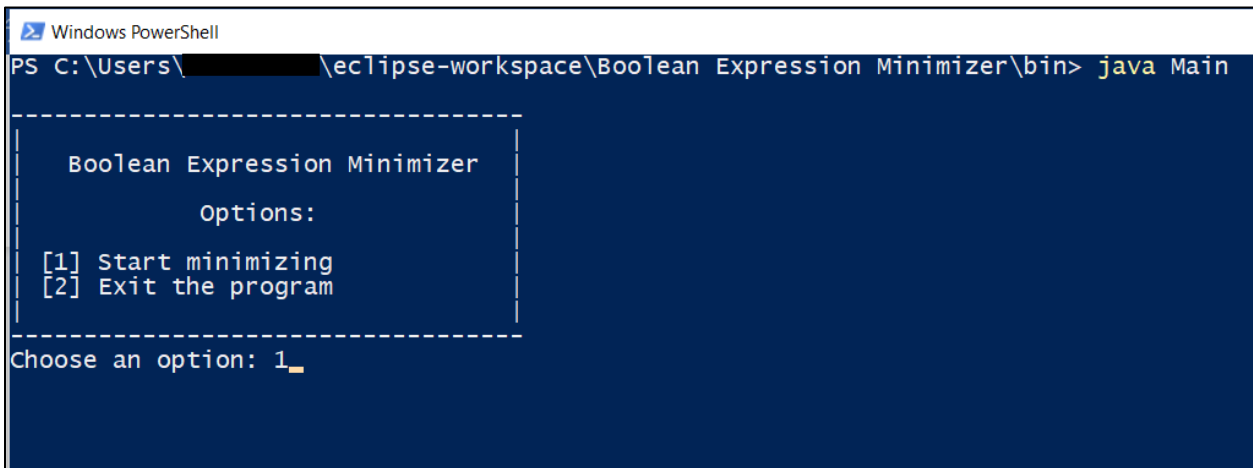
How to Use BooM

After knowing the different ways to run BooM, you can now use the program. This part of the guide will teach you how.

Steps:

Note: The steps here is applicable to all methods of running BooM. The pictures below will only show the application being run in Windows PowerShell.

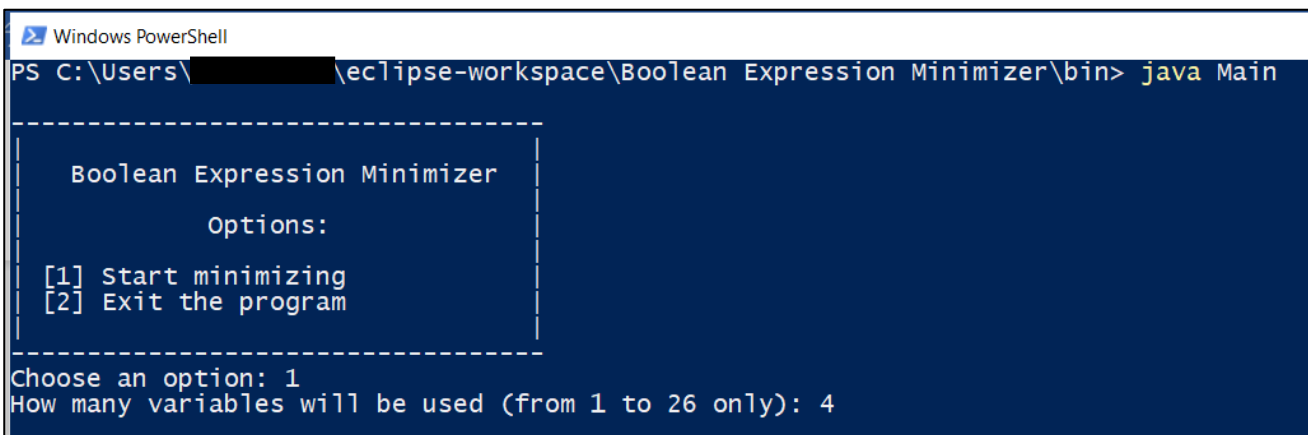
1. Select Option '1' by typing '1', then press 'ENTER'.



```
Windows PowerShell
PS C:\Users\...\eclipse-workspace\Boolean Expression Minimizer\bin> java Main

Boolean Expression Minimizer
Options:
[1] Start minimizing
[2] Exit the program
Choose an option: 1_
```

2. Enter the number of variables, then press 'ENTER'. Note: The application supports up to 26 variables only. In the example, '4' is set as number of variables.



```
Windows PowerShell
PS C:\Users\...\eclipse-workspace\Boolean Expression Minimizer\bin> java Main

Boolean Expression Minimizer
Options:
[1] Start minimizing
[2] Exit the program
Choose an option: 1
How many variables will be used (from 1 to 26 only): 4
```

3. The user will be asked if the user wants to customize the variable assignment. Type 'y' if you want to customize, otherwise type 'n', then press 'ENTER'. In this example, 'y' is entered.

```
Windows PowerShell
PS C:\Users\ [redacted] \eclipse-workspace\Boolean Expression Minimizer\bin> java Main

-----
      Boolean Expression Minimizer
      Options:
    [1] Start minimizing
    [2] Exit the program
    -----
Choose an option: 1
How many variables will be used (from 1 to 26 only): 4
Do you want to customize the variable assignments? (y/n): y
```

- 4.1. If you entered 'y', you will be asked to enter variable assignment from left to right. Enter the variable assignment (should be one letter), then press 'ENTER' to assign.

```
Windows PowerShell
PS C:\Users\ [redacted] \eclipse-workspace\Boolean Expression Minimizer\bin> java Main

-----
      Boolean Expression Minimizer
      Options:
    [1] Start minimizing
    [2] Exit the program
    -----
Choose an option: 1
How many variables will be used (from 1 to 26 only): 4
Do you want to customize the variable assignments? (y/n): y
Variable assigned for position 1: w
Variable assigned for position 2: x
Variable assigned for position 3: y
Variable assigned for position 4: z
```

- 4.2. If you entered 'n', you will be asked if the default variables will be in uppercase or lowercase. Enter 'u' if you want the variables to be in uppercase, otherwise enter 'l' (lowercase L).

```

Windows PowerShell
PS C:\Users\ [redacted] \eclipse-workspace\Boolean Expression Minimizer\bin> java Main

-----
      Boolean Expression Minimizer
      Options:
    [1] Start minimizing
    [2] Exit the program
    -----

Choose an option: 1
How many variables will be used (from 1 to 26 only): 4
Do you want to customize the variable assignments? (y/n): n
Do you want the variables to be UPPERCASE or lowercase? (u/l): u
  
```

5. Regardless of your previous choices in step 4, the next step is entering the minterms. Enter the minterm, then press 'ENTER', and then repeat for the next minterm. If you are done entering the minterms, type 'x' to proceed to the next step.

```

Windows PowerShell
PS C:\Users\ [redacted] \eclipse-workspace\Boolean Expression Minimizer\bin> java Main

-----
      Boolean Expression Minimizer
      Options:
    [1] Start minimizing
    [2] Exit the program
    -----

Choose an option: 1
How many variables will be used (from 1 to 26 only): 4
Do you want to customize the variable assignments? (y/n): y
Variable assigned for position 1: w
Variable assigned for position 2: x
Variable assigned for position 3: y
Variable assigned for position 4: z
Enter the minterm (type x to stop): 1
Enter the minterm (type x to stop): 2
Enter the minterm (type x to stop): 3
Enter the minterm (type x to stop): 4
Enter the minterm (type x to stop): 5
Enter the minterm (type x to stop): 6
Enter the minterm (type x to stop): x
  
```

6. After entering the minterms, you can also indicate the don't cares. To do that, enter the don't cares, then press 'ENTER'. Repeat this until you have entered all the don't cares and enter 'x' then press 'ENTER' to proceed. In the case that you do not need to assign don't care conditions, just enter 'x' then press 'ENTER' to proceed.

```
Windows PowerShell
PS C:\Users\ [redacted] \eclipse-workspace\Boolean Expression Minimizer\bin> java Main

-----
      Boolean Expression Minimizer
      Options:
[1] Start minimizing
[2] Exit the program
-----

Choose an option: 1
How many variables will be used (from 1 to 26 only): 4
Do you want to customize the variable assignments? (y/n): y
Variable assigned for position 1: w
Variable assigned for position 2: x
Variable assigned for position 3: y
Variable assigned for position 4: z
Enter the minterm (type x to stop): 1
Enter the minterm (type x to stop): 2
Enter the minterm (type x to stop): 3
Enter the minterm (type x to stop): 4
Enter the minterm (type x to stop): 5
Enter the minterm (type x to stop): 6
Enter the minterm (type x to stop): x
Enter the don't care (type x to stop): 7
Enter the don't care (type x to stop): 8
Enter the don't care (type x to stop): 9
Enter the don't care (type x to stop): 10
Enter the don't care (type x to stop): x
```

7. The result of minimization will show up. To go back to the options after seeing the result, enter 'x' then press 'ENTER'.

```

Windows PowerShell
PS C:\Users\██████████\eclipse-workspace\Boolean Expression Minimizer\bin> java Main

-----
      Boolean Expression Minimizer
      Options:
  [1] Start minimizing
  [2] Exit the program
-----

Choose an option: 1
How many variables will be used (from 1 to 26 only): 4
Do you want to customize the variable assignments? (y/n): y
Variable assigned for position 1: w
Variable assigned for position 2: x
Variable assigned for position 3: y
Variable assigned for position 4: z
Enter the minterm (type x to stop): 1
Enter the minterm (type x to stop): 2
Enter the minterm (type x to stop): 3
Enter the minterm (type x to stop): 4
Enter the minterm (type x to stop): 5
Enter the minterm (type x to stop): 6
Enter the minterm (type x to stop): x
Enter the don't care (type x to stop): 7
Enter the don't care (type x to stop): 8
Enter the don't care (type x to stop): 9
Enter the don't care (type x to stop): 10
Enter the don't care (type x to stop): x

Result of minimization:
w'x + w'z + w'y
Task Complete. Type 'x' if you are done in checking the expression. :

```

8. The options will show up again. If you want to minimize another expression, just repeat from step 1. Else, enter '2' and press 'ENTER' to exit.

With that, you are done. You can now use the program. To know more about the Tabulation Method, the program, and how it works, you can read the Technical Manual that comes with this User's Manual. Thank you for using Boolean Expression Minimizer!

References:

Java Getting Started. (n.d.). W3schools. Retrieved November 12, 2021, from

https://www.w3schools.com/java/java_getstarted.asp

Tabular Method of Minimisation. (n.d.). University of Surrey.

<http://www.ee.surrey.ac.uk/Projects/CAL/digital-logic/minimisation/tabular.html>

What are the advantages of using the tabulation method in digital electronics? (2017). Quora. Retrieved

November 12, 2021, from <https://www.quora.com/What-are-the-advantages-of-using-the-tabulation-method-in-digital-electronics>