Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Experiment No 1

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Aim: - Implement Basic Constructs/Notions like Constants, variables and data types, Operators and Expressions, Branching and looping in Java

Theory: -

1. What is Java?

Java is a popular programming language created in 1995. Java is used to develop mobile apps, web apps, desktop apps, games, Database connection **and much more.**

Features of Java Programming Language

1. **Object Oriented**
   In Java, everything is an Object.
2. **Platform Independent**
   Unlike many other programming languages including C and C++, when Java is compiled, it is not compiled into platform specific machine, rather into platform-independent byte code. This byte code is distributed over the web and interpreted by the Virtual Machine (JVM) on whichever platform it is being run on.
3. **Simple**
   Java is designed to be easy to learn. If you understand the basic concept of OOP Java, it would be easy to master.
4. **Secure**
   With Java's secure feature it enables to develop virus-free, tamper-free systems. Authentication techniques are based on public-key encryption.
5. **Architecture-neutral**
   Java compiler generates an architecture-neutral object file format, which makes the compiled code executable on many processors, with the presence of Java runtime system.
6. **Portable**
   Being architecture-neutral and having no implementation dependent aspects of the specification makes Java portable. The compiler in Java is written in ANSI C with a clean portability boundary, which is a POSIX subset.
7. **Robust**
   Java makes an effort to eliminate error-prone situations by emphasizing mainly on compile time error checking and runtime checking.
8. **Multithreaded**
   With Java's multithreaded feature it is possible to write programs that can perform many tasks simultaneously. This design feature allows the developers to construct interactive applications that can run smoothly.

9. **Interpreted**
   Java byte code is translated on the fly to native machine instructions and is not stored anywhere. The development process is more rapid and analytical since the linking is an incremental and light-weight process.
10. **High Performance**
    With the use of Just-In-Time compilers, Java enables high performance.

11. **Distributed**
Java is designed for the distributed environment of the internet.

2. Compilation and Execution of a Java Program

Java, being a platform-independent programming language, doesn't work on the one-step compilation. Instead, it involves a two-step execution, first through an OS-independent compiler; and second, in a virtual machine (JVM) which is custom-built for every operating system.

1. Compilation: -

First, the source '.java' file is passed through the compiler, which then encodes the source code into a machine-independent encoding, known as Bytecode. The content of each class contained in the source file is stored in a separate '.class' file.

2. Execution

The class files generated by the compiler are independent of the machine or the OS, which allows them to be run on any system. To run, the main class file (the class that contains the method main) is passed to the JVM and then goes through three main stages before the final machine code is executed. These stages are:
These states do include:

A. Class Loader
B. Bytecode Verifier
C. Just-In-Time Compiler

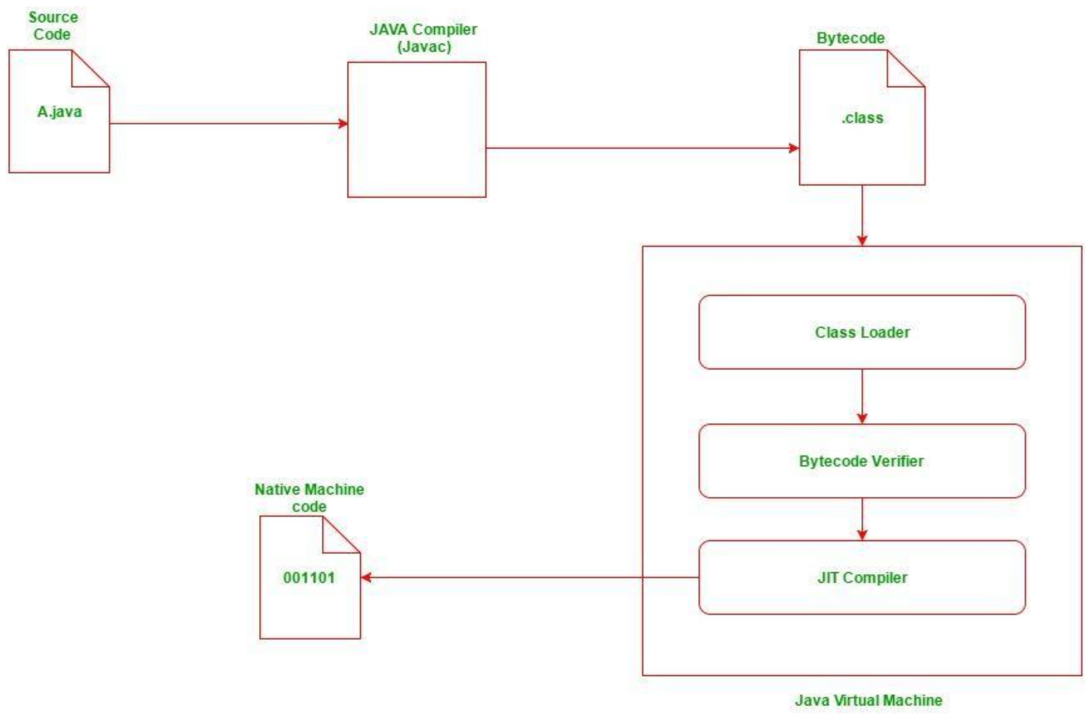
A. Class Loader
The main class is loaded into the memory bypassing its '.class' file to the JVM, through invoking the latter. All the other classes referenced in the program are loaded through the class loader. A class loader, itself an object, creates a flat namespace of class bodies that are referenced by a string name.

B. Bytecode Verifier
After the bytecode of a class is loaded by the class loader, it has to be inspected by the bytecode verifier, whose job is to check that the instructions don't perform damaging actions. The following are some of the checks carried out:

Variables are initialized before they are used.
Method calls match the types of object references.
Rules for accessing private data and methods are not violated.
Local variable accesses fall within the runtime stack.
The run-time stack does not overflow.
If any of the above checks fail, the verifier doesn't allow the class to be loaded.

C. Just-In-Time Compiler

This is the final stage encountered by the java program, and its job is to convert the loaded bytecode into machine code. When using a JIT compiler, the hardware can execute the native code, as opposed to having the JVM interpret the same sequence of bytecode repeatedly and incurring the penalty of a relatively lengthy translation process. This can lead to performance gains in the execution speed unless methods are executed less frequently.



3. Steps to install Java

To check if you have Java installed on a Windows PC, search in the start bar for Java or type the following in Command Prompt (cmd.exe):

```
C:\Users\Your Name>java –version
```

If Java is installed, you will see something like this (depending on version):

```
java version "11.0.1" 2018-10-16 LTS
Java(TM) SE Runtime Environment 18.9 (build 11.0.1+13-LTS)
Java HotSpot(TM) 64-Bit Server VM 18.9 (build 11.0.1+13-LTS, mixed mode)
```

If you do not have Java installed on your computer, you can download it for free at oracle.com.

Setup for Windows

To install Java on Windows:

1. Go to "System Properties" (Can be found on Control Panel > System and Security > System > Advanced System Settings)
2. Click on the "Environment variables" button under the "Advanced" tab
3. Then, select the "Path" variable in System variables and click on the "Edit" button
4. Click on the "New" button and add the path where Java is installed, followed by **\bin**. By default, Java is installed in C:\Program Files\Java\jdk-11.0.1 (If nothing else was specified when you installed it). In that case, You will have to add a new path with: **C:\Program**

Files\Java\jdk-11.0.1\bin
Then, click "OK", and save the settings

5. At last, open Command Prompt (cmd.exe) and type **java -version** to see if Java is running on your machine

4. Java Syntax

```
public class Main {
  public static void main (String [] args) {
    System.out.println("Hello World");
  }
}
```

Explanation of above example

Every line of code that runs in Java must be inside a class. In our example, we named the class Main. A class should always start with an uppercase first letter. Java is case-sensitive: "MyClass" and "myclass" has different meaning. The name of the java file must match the class name. When saving the file, save it using the class name and add ".java" to the end of the filename.

The main Method

The main () method is required and you will see it in every Java program:

public static void main (String [] args)

Any code inside the main () method will be executed.

System.out.println()

Inside the main () method, we can use the println () method to print a line of text to the screen:

```
public static void main (String [] args) {
  System.out.println("Hello World");
}
```

The curly braces {} marks the beginning and the end of a block of code. System is a built-in Java class that contains useful members, such as out, which is short for "output". The println () method, short for "print line", is used to print a value to the screen (or a file). Just know that you need them together to print stuff to the screen. Each code statement must end with a semicolon (;).

5. Java Variables

Variables are containers for storing data values. In Java, there are different types of variables, for example:

String - stores text, such as "Hello". String values are surrounded by double quotes
int - stores integers (whole numbers), without decimals, such as 123 or -123
float - stores floating point numbers, with decimals, such as 19.99 or -19.99
char - stores single characters, such as 'a' or 'B'. Char values are surrounded by single quotes

Boolean - stores values with two states: true or false

Declaring (Creating) Variables

To create a variable, you must specify the type and assign it a value:
Syntax
type variableName = value;

Where type is one of Java's types (such as int or String), and variableName is the name of the variable (such as x or name). The equal sign is used to assign values to the variable.

To create a variable that should store text, look at the following example:

Example
Create a variable called name of type String and assign it the value "John":
String name = "John";
System.out.println(name);

Final Variables
If you don't want others (or yourself) to overwrite existing values, use the final keyword (this will declare the variable as "final" or "constant", which means unchangeable and read-only):

Example
final int myNum = 15;
myNum = 20; // will generate an error: cannot assign a value to a final variable

Data types are divided into two groups:

Primitive data types - includes byte, short, int, long, float, double, boolean and char
Non-primitive data types - such as String, Arrays and Classes

Java Type Casting
Type casting is when you assign a value of one primitive data type to another type.

In Java, there are two types of casting:

Widening Casting (automatically) - converting a smaller type to a larger type size
byte -> short -> char -> int -> long -> float ->

double int myInt = 9;
double myDouble = myInt; // Automatic casting: int to double

Narrowing Casting (manually) - converting a larger type to a smaller size type
double -> float -> long -> int -> char -> short -> byte

```
double myDouble = 9.78d;
int myInt = (int) myDouble; // Manual casting: double to int
```

6. Java Operators

Operators are used to perform operations on variables and values.

Java divides the operators into the following groups:

- **Arithmetic operators (+, -, *, /, %, ++, --)**
- **Assignment operators (=, +=, -=, *=, /=, %=)**
- **Comparison operators (==, !=, <=, >=, <, >)**
- **Logical operators (&&, ||,!)**
- **Bitwise operators**

7. Java conditional statements:

Use **if** to specify a block of code to be executed, **if a specified condition is true**
Use **else** to specify a block of code to be executed, **if the same condition is false**
Use **else if** to specify a new condition to test, **if the first condition is false**
Use **switch** to specify **many alternative** blocks of code to be executed

The if Statement
Use the if statement to specify a block of Java code to be executed if a condition is true.
Syntax
```
if (condition) {
  // block of code to be executed if the condition is true
}
```

The else Statement
Use the else statement to specify a block of code to be executed if the condition is false.
Syntax
```
if (condition) {
  // block of code to be executed if the condition is true
} else {
  // block of code to be executed if the condition is false
}
```

The else if Statement
Use the else if statement to specify a new condition if the first condition is false.

Syntax
```
if (condition1) {
  // block of code to be executed if condition1 is true
} else if (condition2) {
  // block of code to be executed if the condition1 is false and condition2 is true
} else {
  // block of code to be executed if the condition1 is false and condition2 is false
}
```

Java Switch Statements
Use the switch statement to select one of many code blocks to be executed.

Syntax

```
switch(expression) {
  case x:
    // code block
    break;
  case y:
    // code block
    break;
  default:
    // code block
}
```

This is how it works:
The switch expression is evaluated once.
The value of the expression is compared with the values of each case.
If there is a match, the associated block of code is executed.
The break and default keywords are optional

The break Keyword
When Java reaches a break keyword, it breaks out of the switch block.
This will stop the execution of more code and case testing inside the block.
When a match is found, and the job is done, it's time for a break. There is no need for more testing.

8. Java Loops
Loops can execute a block of code as long as a specified condition is reached.
Loops are handy because they save time, reduce errors, and they make code more readable.
while loop loops through a block of code as long as a specified condition is true:
Syntax

```
while (condition) {
  // code block to be executed
}
```

Do/While Loop
The do/while loop is a variant of the while loop. This loop will execute the code block once, before checking if the condition is true, then it will repeat the loop as long as the condition is true.
Syntax

```
do {
  // code block to be executed
}
while (condition);
```

For Loop

When you know exactly how many times you want to loop through a block of code, use the for loop instead of a while loop:

Syntax

```
for (statement 1; statement 2; statement 3) {
  // code block to be executed
}
```

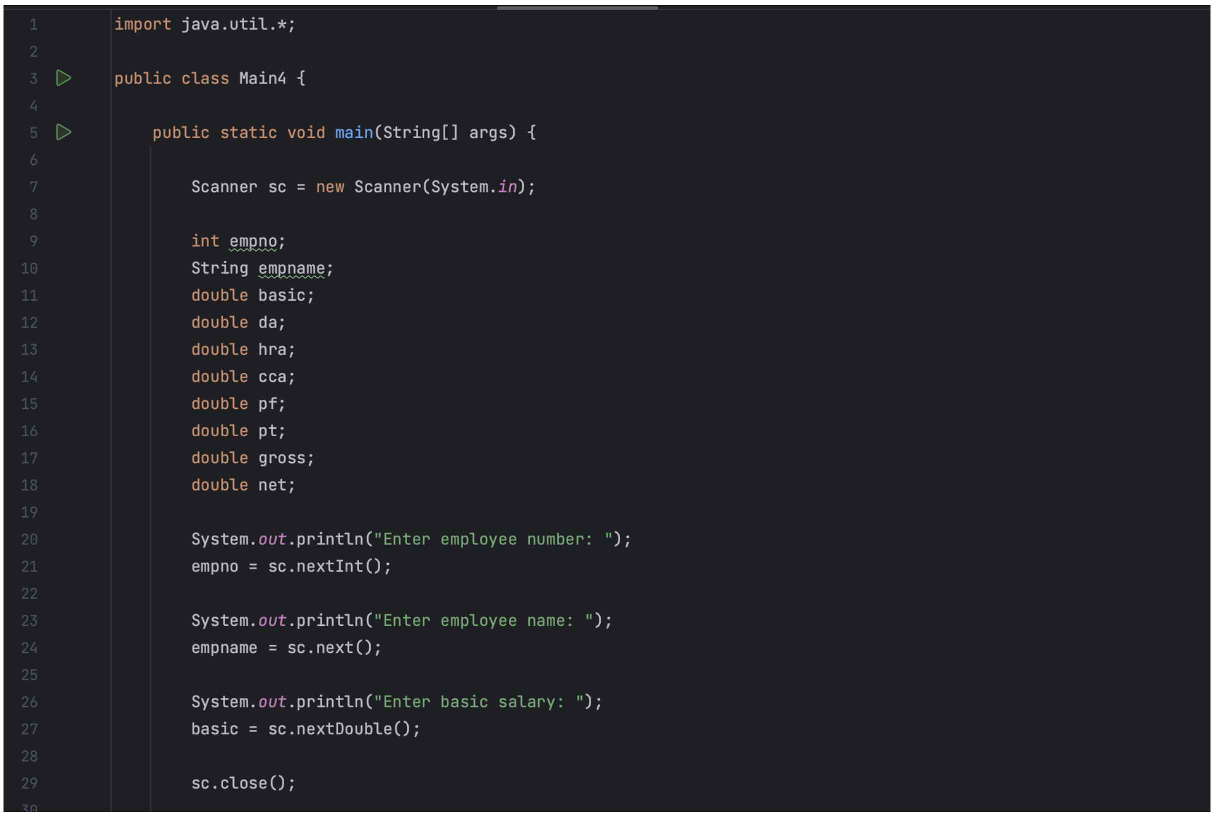
Statement 1 is executed (one time) before the execution of the code block.
Statement 2 defines the condition for executing the code block.
Statement 3 is executed (every time) after the code block has been executed.

9. Implementation of First Java Program to print “Hello World”

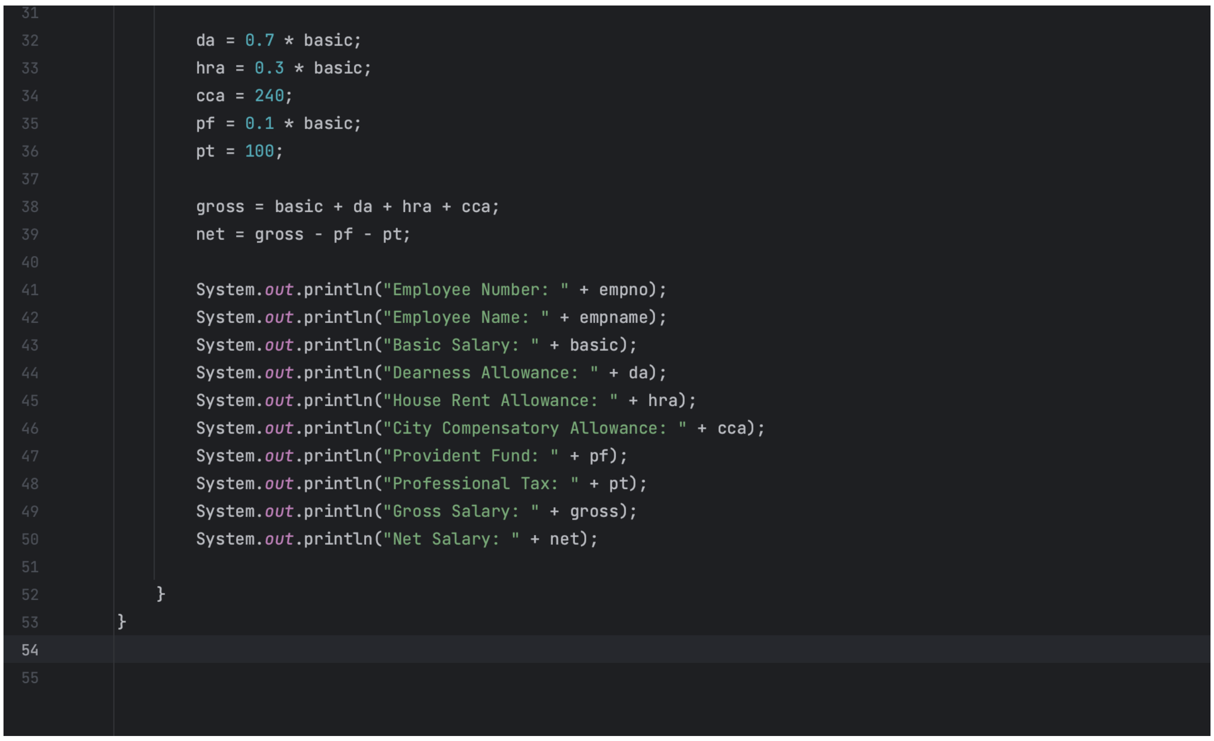
```
// Your First Program

class HelloWorld {
    public static void main (String [] args) {
        System.out.println("Hello, World!");
    }
}
```

10. Lab Assignments to complete in this session

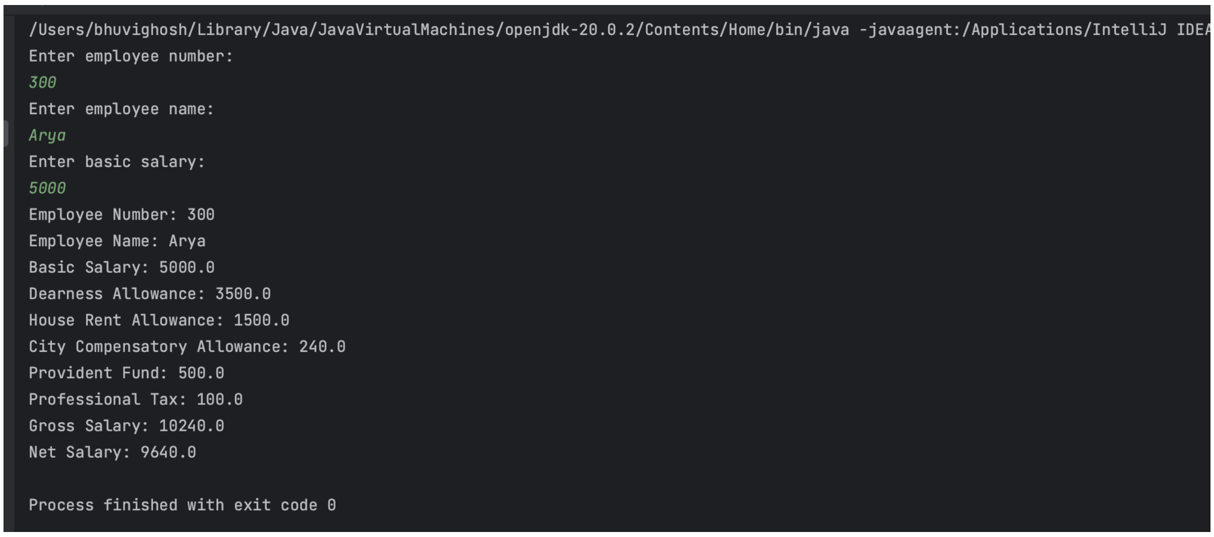
1. Implement a java program to calculate gross salary and net salary taking the following data.
   Input: empno, empname, basic
   Process
   DA=70% of basic
   HRA=30% of basic
   CCA= Rs. 240/-
   PF=10% of basic
   PT=Rs.100/-



```java
import java.util.*;

public class Main4 {

    public static void main(String[] args) {

        Scanner sc = new Scanner(System.in);

        int empno;
        String empname;
        double basic;
        double da;
        double hra;
        double cca;
        double pf;
        double pt;
        double gross;
        double net;

        System.out.println("Enter employee number: ");
        empno = sc.nextInt();

        System.out.println("Enter employee name: ");
        empname = sc.next();

        System.out.println("Enter basic salary: ");
        basic = sc.nextDouble();

        sc.close();
```

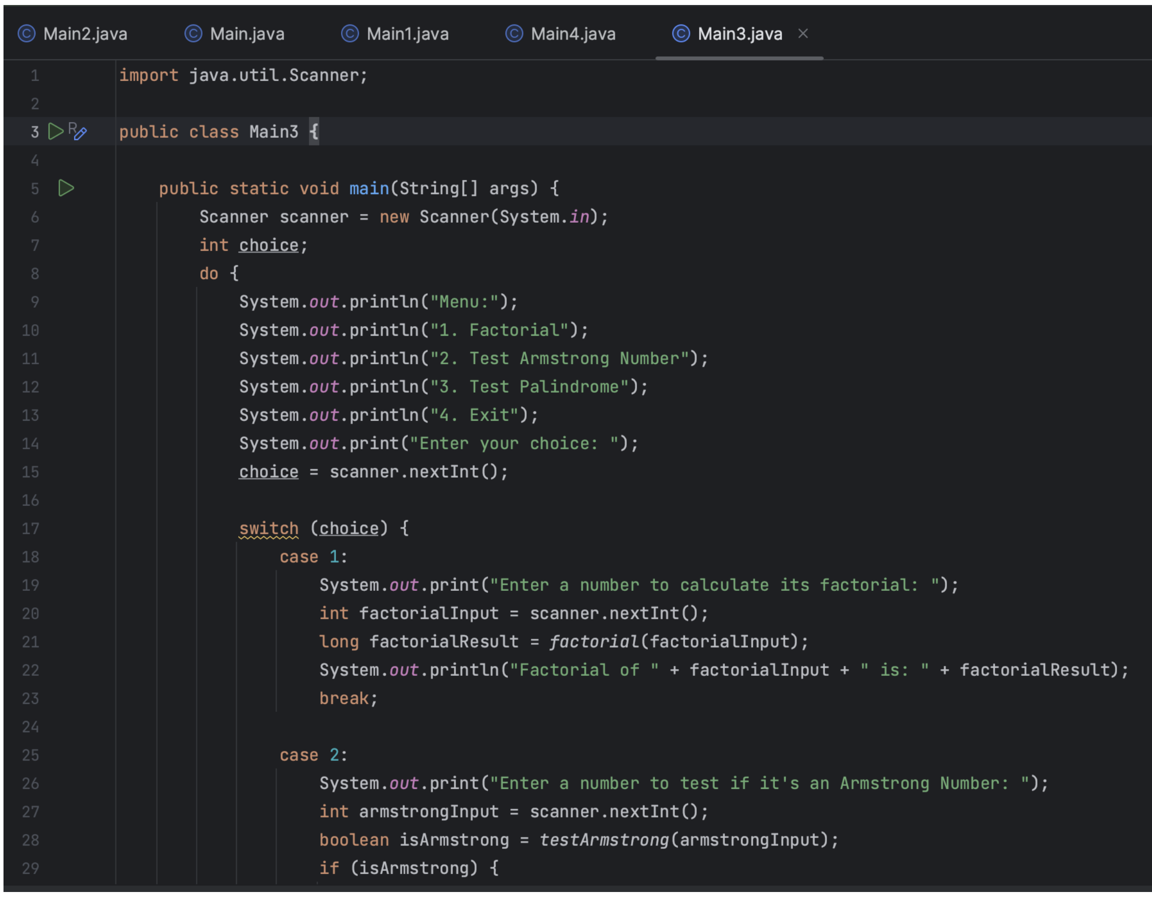


```java

        da = 0.7 * basic;
        hra = 0.3 * basic;
        cca = 240;
        pf = 0.1 * basic;
        pt = 100;

        gross = basic + da + hra + cca;
        net = gross - pf - pt;

        System.out.println("Employee Number: " + empno);
        System.out.println("Employee Name: " + empname);
        System.out.println("Basic Salary: " + basic);
        System.out.println("Dearness Allowance: " + da);
        System.out.println("House Rent Allowance: " + hra);
        System.out.println("City Compensatory Allowance: " + cca);
        System.out.println("Provident Fund: " + pf);
        System.out.println("Professional Tax: " + pt);
        System.out.println("Gross Salary: " + gross);
        System.out.println("Net Salary: " + net);

    }
}

```

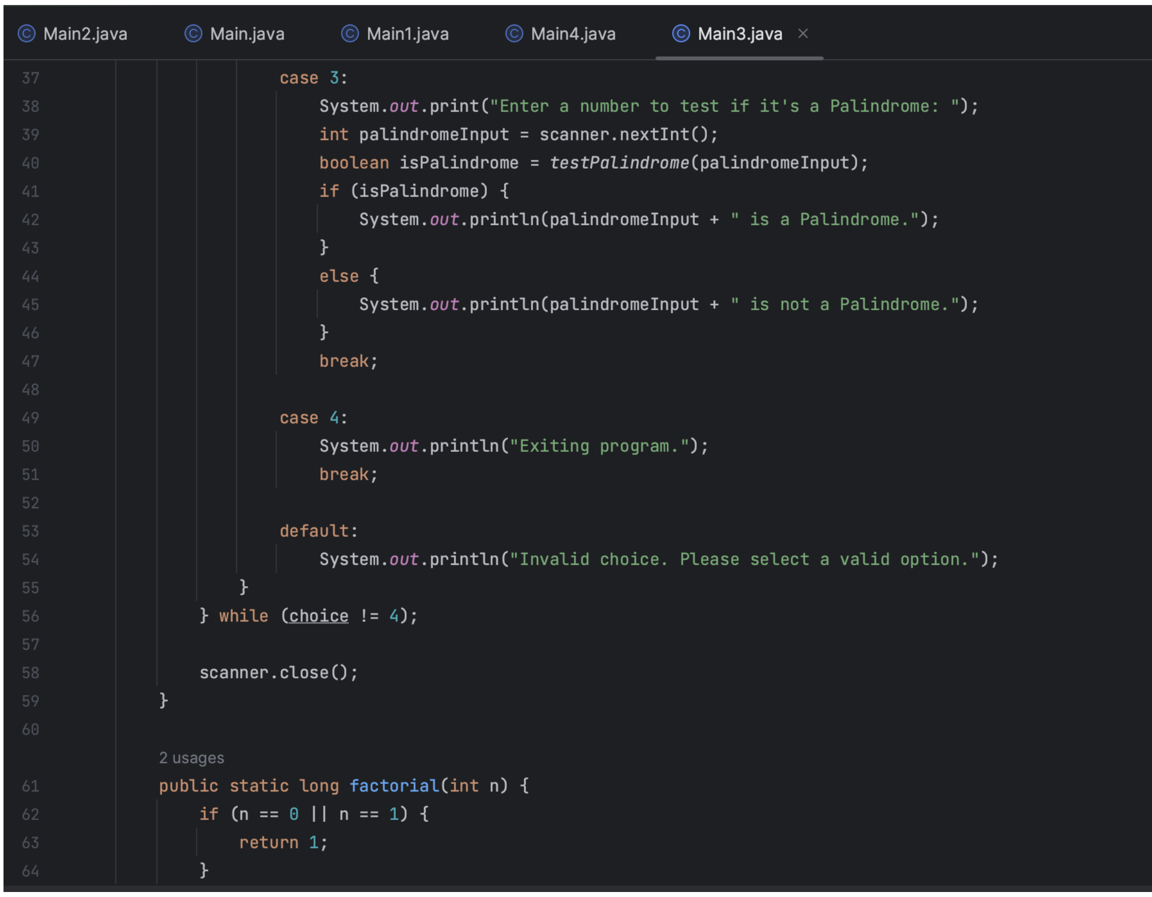


```
/Users/bhuvighosh/Library/Java/JavaVirtualMachines/openjdk-20.0.2/Contents/Home/bin/java -javaagent:/Applications/IntelliJ IDEA
Enter employee number:
300
Enter employee name:
Arya
Enter basic salary:
5000
Employee Number: 300
Employee Name: Arya
Basic Salary: 5000.0
Dearness Allowance: 3500.0
House Rent Allowance: 1500.0
City Compensatory Allowance: 240.0
Provident Fund: 500.0
Professional Tax: 100.0
Gross Salary: 10240.0
Net Salary: 9640.0

Process finished with exit code 0
```

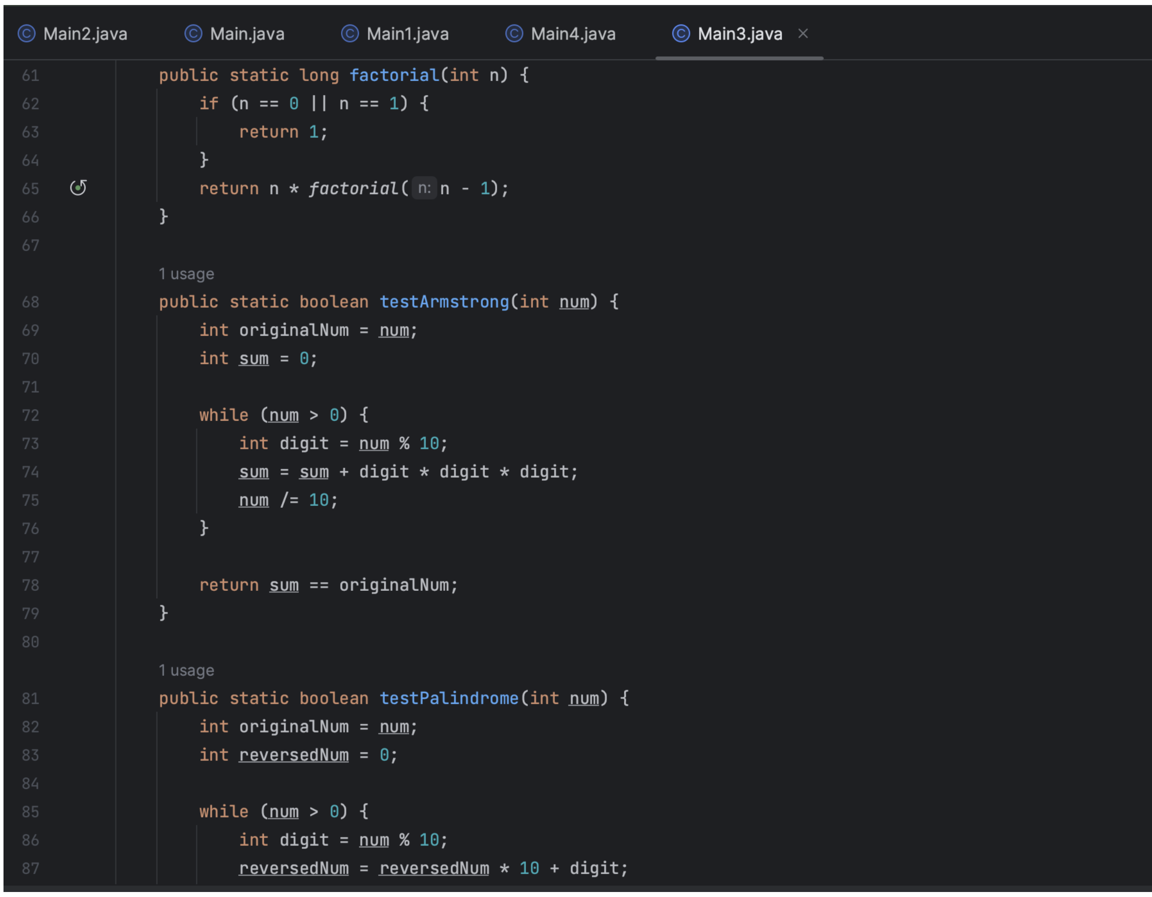
2. Write menu driven java program which will read a number and should implement following methods
    i. Factorial ()
    ii. testArmstrong ()
    iii. testPalindrome ()



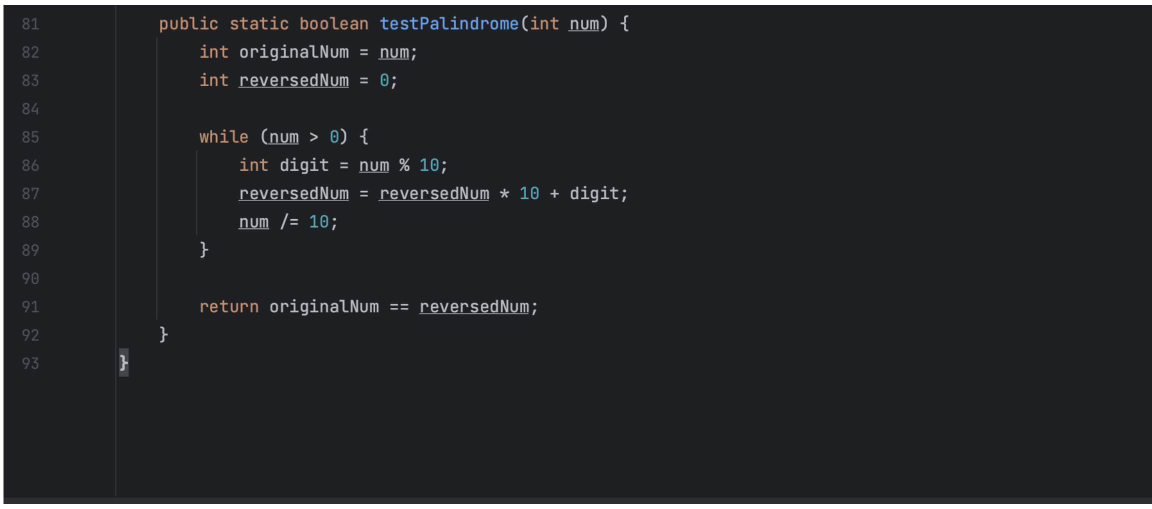
```java
import java.util.Scanner;

public class Main3 {

    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        int choice;
        do {
            System.out.println("Menu:");
            System.out.println("1. Factorial");
            System.out.println("2. Test Armstrong Number");
            System.out.println("3. Test Palindrome");
            System.out.println("4. Exit");
            System.out.print("Enter your choice: ");
            choice = scanner.nextInt();

            switch (choice) {
                case 1:
                    System.out.print("Enter a number to calculate its factorial: ");
                    int factorialInput = scanner.nextInt();
                    long factorialResult = factorial(factorialInput);
                    System.out.println("Factorial of " + factorialInput + " is: " + factorialResult);
                    break;

                case 2:
                    System.out.print("Enter a number to test if it's an Armstrong Number: ");
                    int armstrongInput = scanner.nextInt();
                    boolean isArmstrong = testArmstrong(armstrongInput);
                    if (isArmstrong) {
```



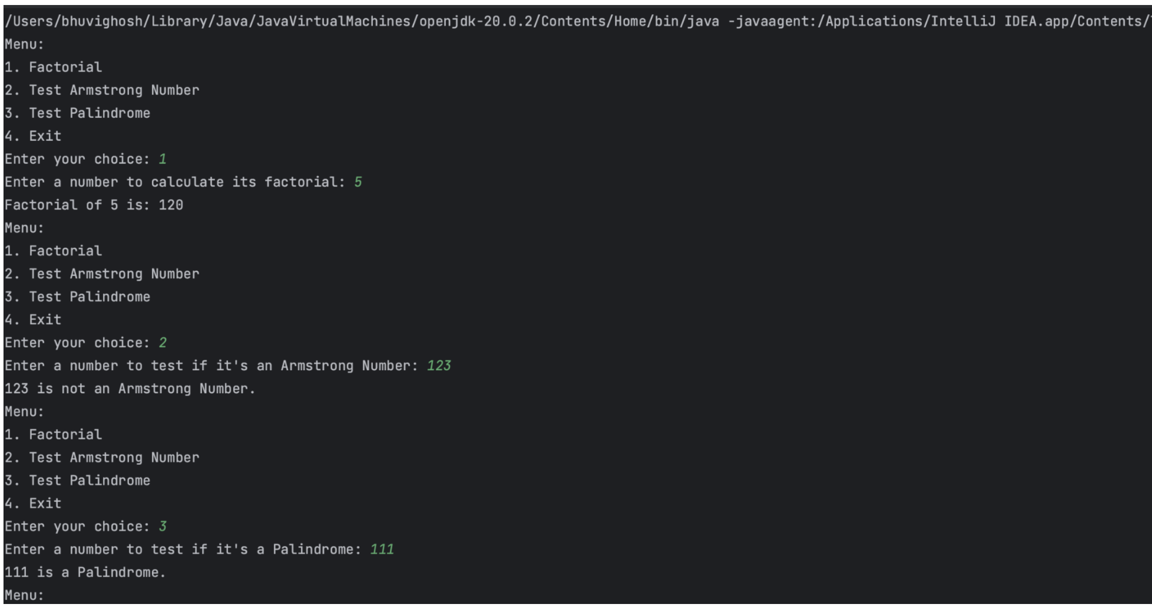
```
                case 3:
                    System.out.print("Enter a number to test if it's a Palindrome: ");
                    int palindromeInput = scanner.nextInt();
                    boolean isPalindrome = testPalindrome(palindromeInput);
                    if (isPalindrome) {
                        System.out.println(palindromeInput + " is a Palindrome.");
                    }
                    else {
                        System.out.println(palindromeInput + " is not a Palindrome.");
                    }
                    break;

                case 4:
                    System.out.println("Exiting program.");
                    break;

                default:
                    System.out.println("Invalid choice. Please select a valid option.");
            }
        } while (choice != 4);

        scanner.close();
    }

    2 usages
    public static long factorial(int n) {
        if (n == 0 || n == 1) {
            return 1;
        }
```



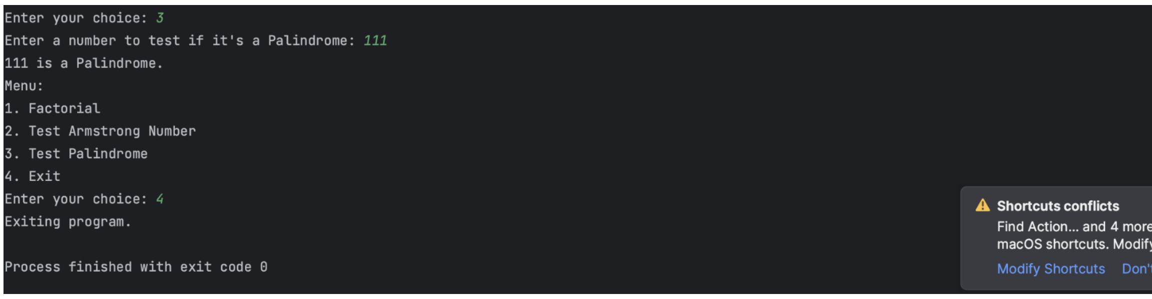
```
    public static long factorial(int n) {
        if (n == 0 || n == 1) {
            return 1;
        }
        return n * factorial( n: n - 1);
    }

    1 usage
    public static boolean testArmstrong(int num) {
        int originalNum = num;
        int sum = 0;

        while (num > 0) {
            int digit = num % 10;
            sum = sum + digit * digit * digit;
            num /= 10;
        }

        return sum == originalNum;
    }

    1 usage
    public static boolean testPalindrome(int num) {
        int originalNum = num;
        int reversedNum = 0;

        while (num > 0) {
            int digit = num % 10;
            reversedNum = reversedNum * 10 + digit;
```



```
    public static boolean testPalindrome(int num) {
        int originalNum = num;
        int reversedNum = 0;

        while (num > 0) {
            int digit = num % 10;
            reversedNum = reversedNum * 10 + digit;
            num /= 10;
        }

        return originalNum == reversedNum;
    }
}
```

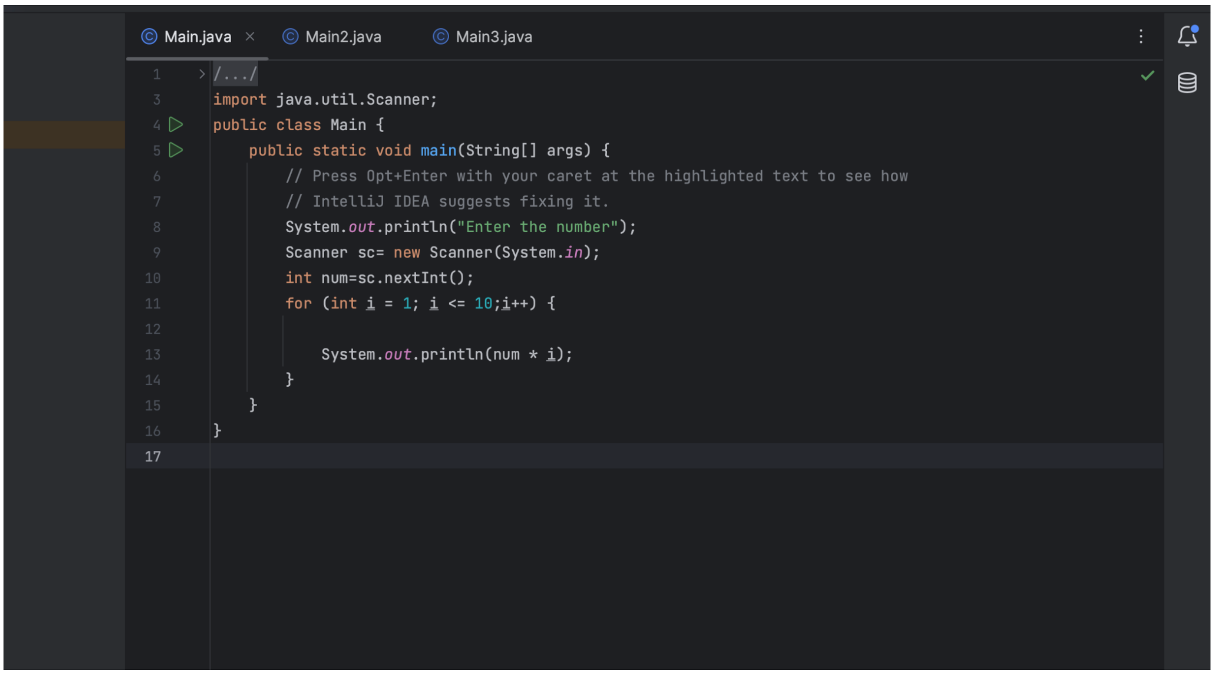


```
/Users/bhuvighosh/Library/Java/JavaVirtualMachines/openjdk-20.0.2/Contents/Home/bin/java -javaagent:/Applications/IntelliJ IDEA.app/Contents/
Menu:
1. Factorial
2. Test Armstrong Number
3. Test Palindrome
4. Exit
Enter your choice: 1
Enter a number to calculate its factorial: 5
Factorial of 5 is: 120
Menu:
1. Factorial
2. Test Armstrong Number
3. Test Palindrome
4. Exit
Enter your choice: 2
Enter a number to test if it's an Armstrong Number: 123
123 is not an Armstrong Number.
Menu:
1. Factorial
2. Test Armstrong Number
3. Test Palindrome
4. Exit
Enter your choice: 3
Enter a number to test if it's a Palindrome: 111
111 is a Palindrome.
Menu:
```

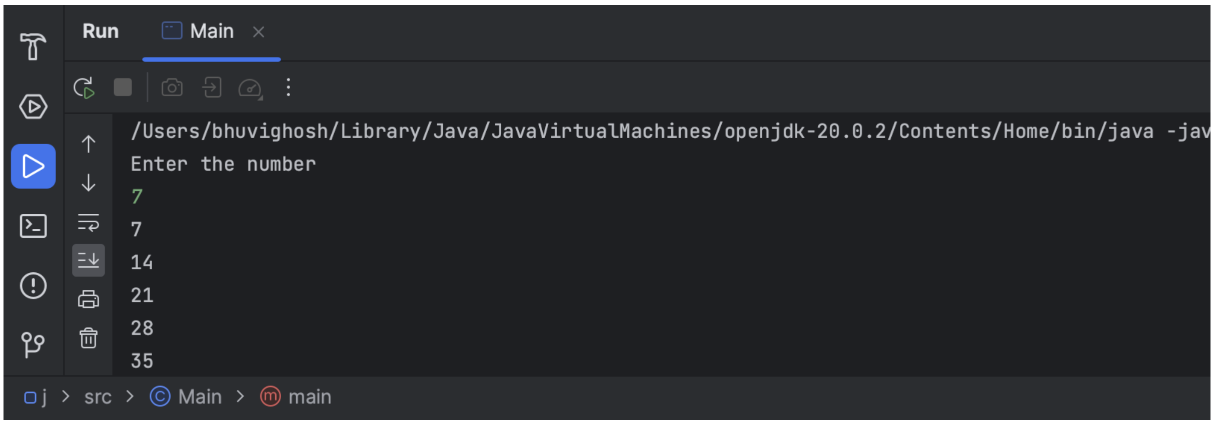


```
Enter your choice: 3
Enter a number to test if it's a Palindrome: 111
111 is a Palindrome.
Menu:
1. Factorial
2. Test Armstrong Number
3. Test Palindrome
4. Exit
Enter your choice: 4
Exiting program.

Process finished with exit code 0
```

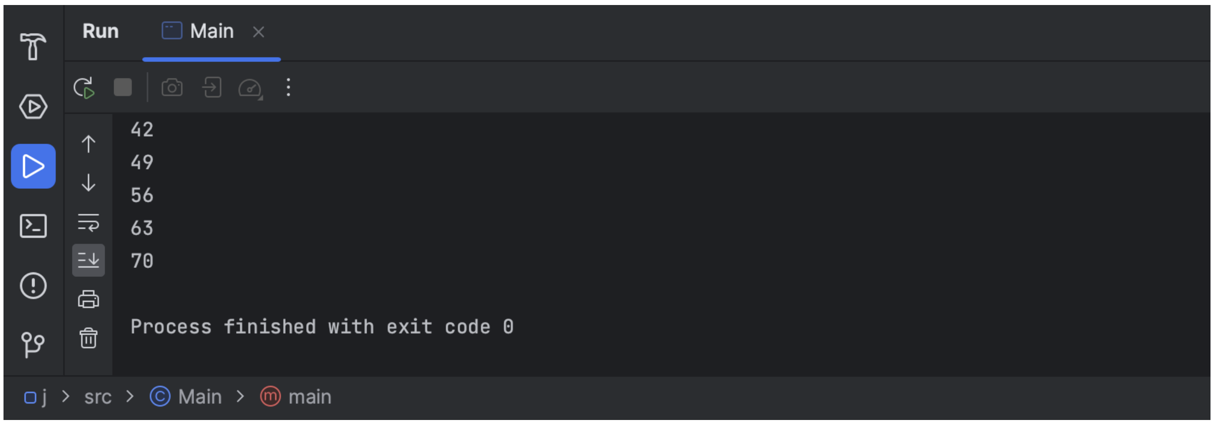
3. Write a Java Program to take an integer N and print its first 10 multiples. Each multiple N * i (where 1<=i<=10) should be printed on a new line in the form: N x i = result.



```java
/.../
import java.util.Scanner;
public class Main {
    public static void main(String[] args) {
        // Press Opt+Enter with your caret at the highlighted text to see how
        // IntelliJ IDEA suggests fixing it.
        System.out.println("Enter the number");
        Scanner sc= new Scanner(System.in);
        int num=sc.nextInt();
        for (int i = 1; i <= 10;i++) {

            System.out.println(num * i);
        }
    }
}
```

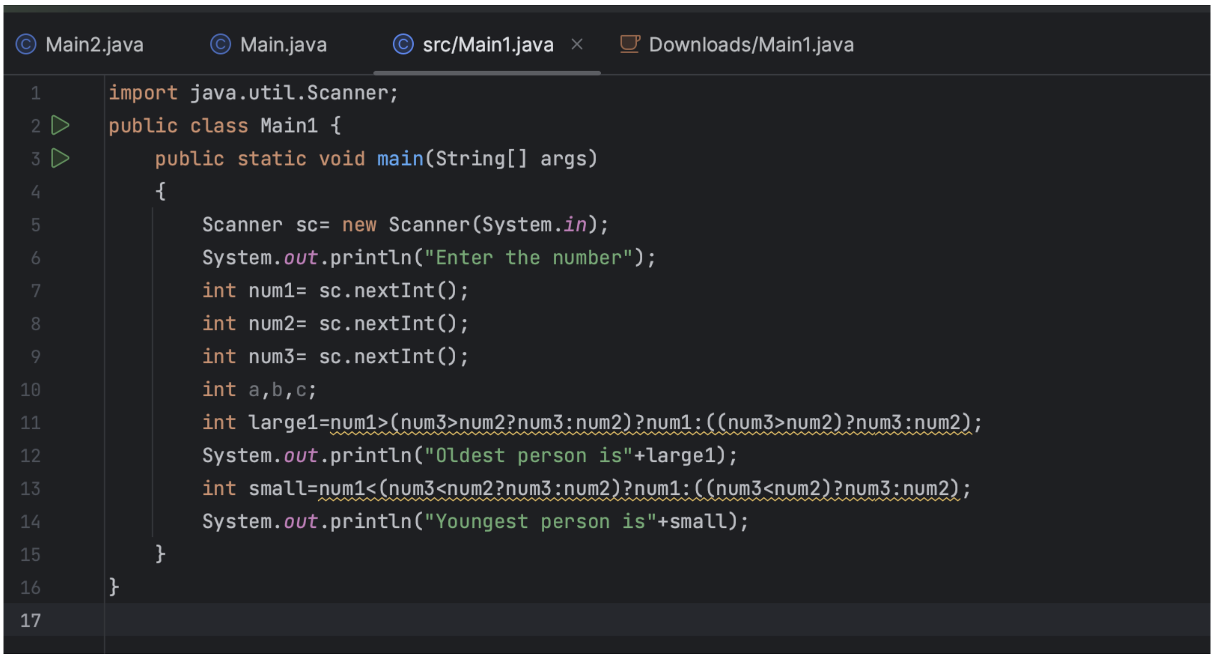


```
/Users/bhuvighosh/Library/Java/JavaVirtualMachines/openjdk-20.0.2/Contents/Home/bin/java -jav
Enter the number
7
7
14
21
28
35
```

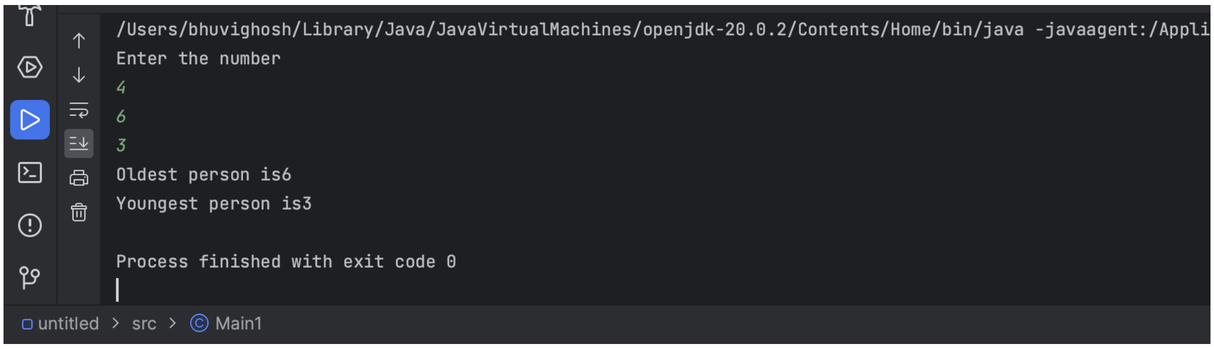


```
42
49
56
63
70

Process finished with exit code 0
```

4. Take input of age of three people by user and determine oldest and youngest among them.



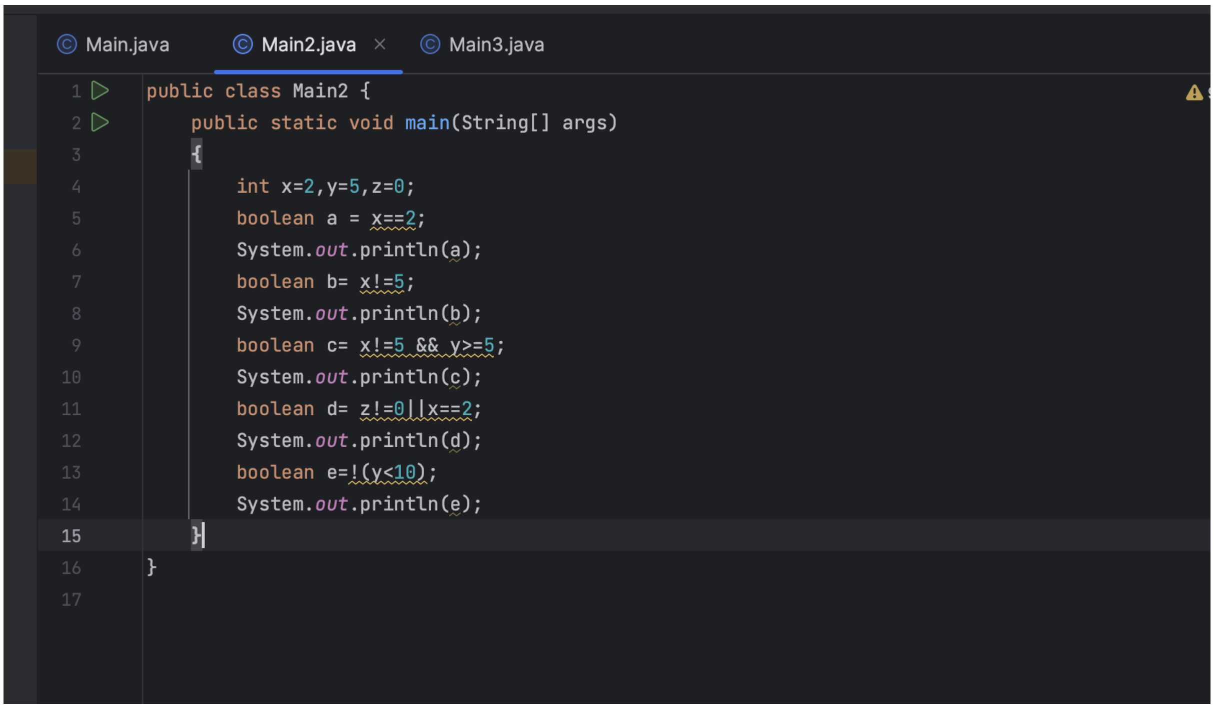
```java
import java.util.Scanner;
public class Main1 {
    public static void main(String[] args)
    {
        Scanner sc= new Scanner(System.in);
        System.out.println("Enter the number");
        int num1= sc.nextInt();
        int num2= sc.nextInt();
        int num3= sc.nextInt();
        int a,b,c;
        int large1=num1>(num3>num2?num3:num2)?num1:((num3>num2)?num3:num2);
        System.out.println("Oldest person is"+large1);
        int small=num1<(num3<num2?num3:num2)?num1:((num3<num2)?num3:num2);
        System.out.println("Youngest person is"+small);
    }
}
```



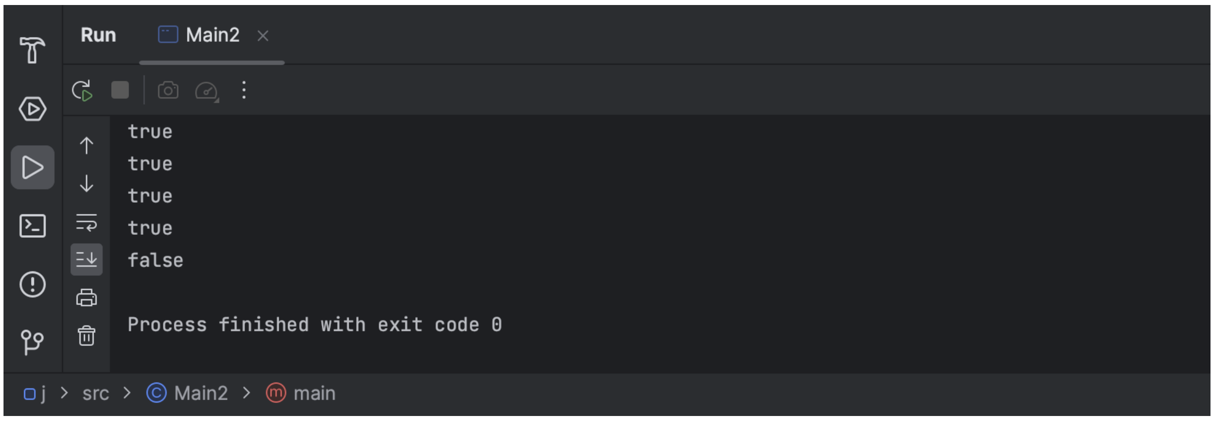
```
/Users/bhuvighosh/Library/Java/JavaVirtualMachines/openjdk-20.0.2/Contents/Home/bin/java -javaagent:/Appli
Enter the number
4
6
3
Oldest person is6
Youngest person is3

Process finished with exit code 0
```

5. If

x = 2
y = 5
z = 0
Then find values of the following expressions:
a. x == 2
b. x != 5
c. x != 5 && y >= 5
d. z != 0 || x == 2
e. !(y < 10)

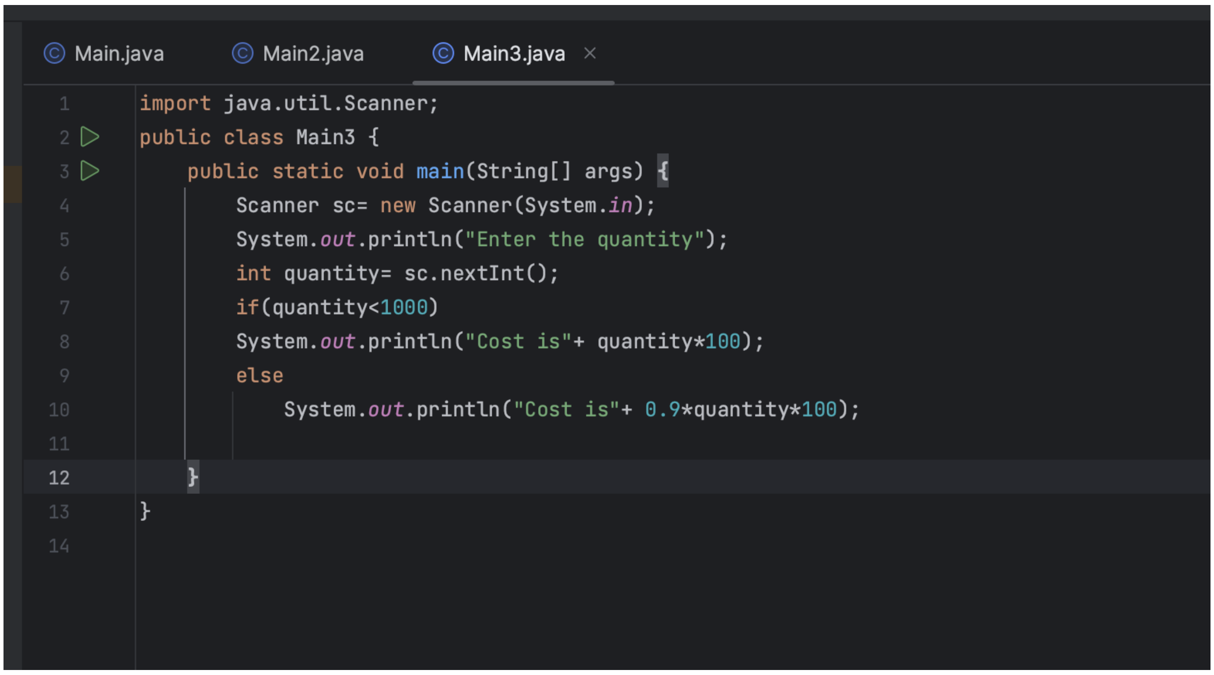


```java
public class Main2 {
    public static void main(String[] args)
    {
        int x=2,y=5,z=0;
        boolean a = x==2;
        System.out.println(a);
        boolean b= x!=5;
        System.out.println(b);
        boolean c= x!=5 && y>=5;
        System.out.println(c);
        boolean d= z!=0||x==2;
        System.out.println(d);
        boolean e=!(y<10);
        System.out.println(e);
    }
}
```

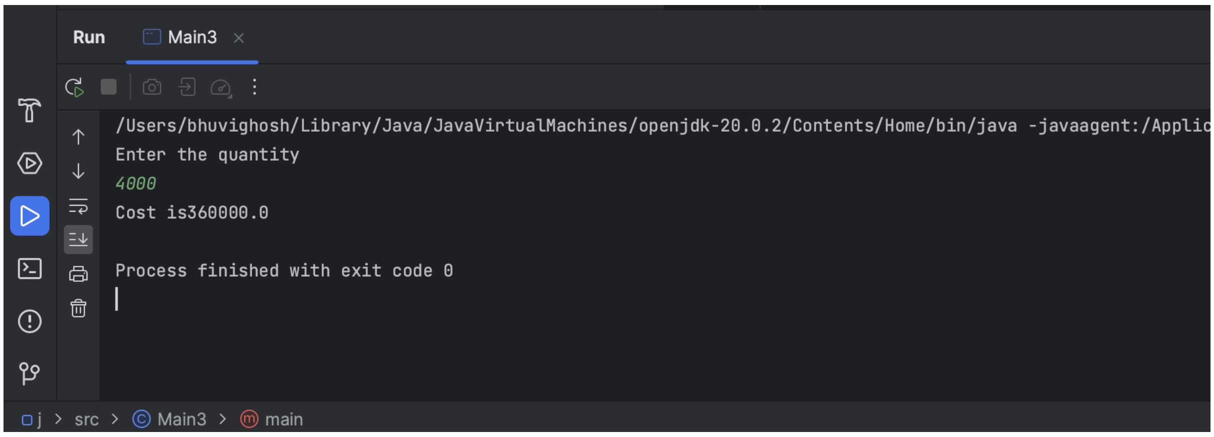


```
true
true
true
true
false

Process finished with exit code 0
```

6. A shop will give discount of 10% if the cost of purchased quantity is more than 1000.
   Ask user for quantity
   Suppose, one unit will cost 100.
   Judge and print total cost for u



```java
import java.util.Scanner;
public class Main3 {
    public static void main(String[] args) {
        Scanner sc= new Scanner(System.in);
        System.out.println("Enter the quantity");
        int quantity= sc.nextInt();
        if(quantity<1000)
        System.out.println("Cost is"+ quantity*100);
        else
            System.out.println("Cost is"+ 0.9*quantity*100);

    }
}

```



```
/Users/bhuvighosh/Library/Java/JavaVirtualMachines/openjdk-20.0.2/Contents/Home/bin/java -javaagent:/Applic
Enter the quantity
4000
Cost is360000.0

Process finished with exit code 0
```