

Software Development Java

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Project Structure for the IntelliJ Project.



The project is called **Activites**. Entry point for the project is the **Main class**.

All the Activities are Classes in this project with the sub programs as functions.

The screenshot shows the 'Main.java' file in the IntelliJ IDEA editor. The code is as follows:

```
1 public class Main {  
2     public static void main(String[] args) {  
3         Activity1.driver();  
4         Activity2.driver();  
5         Activity3.driver();  
6         Activity4.driver();  
7         Activity5.driver();  
8         Activity6.driver();  
9         Activity7.driver();  
10    }  
11 }
```

1. Activity 1

Code

```
1 Activity1.java
1 import java.util.*;
2 public class Activity1{
3     public static void main(String[] args){
4         Convert obj = new Convert();
5         System.out.println("45 GBP in USD: "+obj.convertPoundToDollar(45));
6         System.out.println("100°F in °C: "+obj.convertFahrenheitToCelsius(100));
7         System.out.println("69°C in °F: "+obj.convertCelsiusToFahrenheit(69));
8         System.out.println("Average of 10, 47.5, 39, 52.1: "+obj.average(10,47.5,39,52.1));
9         System.out.println("15% off on 273 is "+obj.discount(273,15));
10    }
11 }
12 class Convert{
13
14     public double convertPoundToDollar(double pound){
15         return pound * 1.2;
16     }
17
18     public double convertFahrenheitToCelsius(double frnt){
19         return ((frnt-32)/1.8);
20     }
21
22     public double convertCelsiusToFahrenheit(double cel){
23         return ((cel*1.8) + 32);
24     }
25
26     public double average(double a, double b, double c, double d){
27         return ((a+b+c+d)/4);
28     }
29
30     public double discount(double price, double N){
31         return (price - (price * N/100));
32     }
33 }
```

Output

```
ubuntu 0ms ~/qwerty/work/9_feb_2023
$ java Activity1.java
45 GBP in USD: 54.0
100°F in °C: 37.77777777777778
69°C in °F: 156.2
Average of 10, 47.5, 39, 52.1: 37.15
15% off on 273 is 232.05
ubuntu 495ms ~/qwerty/work/9_feb_2023
$
```

2. Activity 2

A) To find whether a given year is a leap year or not

```
public static boolean isLeap(int year){
    boolean leap = false;
    if (year % 4 == 0) {
        if (year % 100 == 0) {
            // if year is divided by 400 then it is a leap year
            if (year % 400 == 0)
                leap = true;
            else
                leap = false;
        }
        else
            leap = true;
    }
    else
        leap = false;
    return leap;
}
```

B) To test if the date entered comes before or after today

```
1 usage
public static int dateCheck(String date){
    LocalDate nw = LocalDate.now();
    LocalDate inpt = LocalDate.parse(date);
    if(nw.isBefore(inpt)){
        return 1;
    }else{
        return -1;
    }
}
```

C) To read the age of a candidate and determine whether they are eligible to vote

```
1 usage
public static boolean canVote(int age){
    if(age >= 18) return true;
    return false;
}
```

D) To find the largest of three numbers

```
public static int largest(int a, int b, int c){  
    if(a > b){  
        if(a > c){  
            return a;  
        }  
    }  
    else if(b > c){  
        return b;  
    }  
    return c;  
}
```

E) To convert a month number (1 to 12) entered by the user into the month name

```
public static String getMonth(int num){  
    if(num == 1) return "January";  
    else if(num == 2) return "February";  
    else if(num == 3) return "March";  
    else if(num == 4) return "April";  
    else if(num == 5) return "May";  
    else if(num == 6) return "June";  
    else if(num == 7) return "July";  
    else if(num == 8) return "August";  
    else if(num == 9) return "September";  
    else if(num == 10) return "October";  
    else if(num == 11) return "November";  
    else if(num == 12) return "December";  
    else return "Enter a valid month number";  
}
```

Output

```
ubuntu@fedora:~/qwerty/work/9_feb_2023$ java Activity2.java  
Enter year to check if its leap: 2014  
Is 2014 a leap year: No  
Enter date in YYYY-MM-DD format: 2024-01-01  
2024-01-01 comes after today  
Enter age to check if eligible to vote: 21  
Can vote!  
Enter 3 numbers  
4  
7  
6  
Largest number is 7  
Enter Month number: 3  
March  
ubuntu@fedora:~/qwerty/work/9_feb_2023$
```

3. Activity 3

A) Use type char (e.g. (char) 65 = 'A') to print the alphabet in both lower case (a-z) and upper case (A-Z).

```
Usage
public static void printAlpha(){
    for(char ch='A'; ch<='Z'; ++ch){
        System.out.print(ch);
    }
    System.out.println();
    for (char ch='a'; ch<='z'; ++ch) {
        System.out.print(ch);
    }
    System.out.println();
}
```

B) Print the alphabet backwards (both lower and upper case)

```
Usage
public static void printAlphaR(){
    for(char ch='Z'; ch>='A'; --ch){
        System.out.print(ch);
    }
    System.out.println();

    for (char ch='z'; ch>='a'; --ch) {
        System.out.print(ch);
    }
    System.out.println();
}
```

C) Print every second letter in the alphabet (both lower and upper case)

```
public static void printAlpha2(){
    for(char ch='B'; ch<='Z'; ch+=2){
        System.out.print(ch);
    }
    System.out.println();

    for (char ch='b'; ch<='z'; ch+=2) {
        System.out.print(ch);
    }
    System.out.println();
}
```

- D) Ask the user to enter a number – find how many times the number can be halved before it becomes smaller than 1.

```
1 usage
public static int halfTimes(int num){
    int res = 0; // number of times num can be halved
    while(num > 1){
        ++res; // each time num is divided by 2 increase res
        num = num/2;
    }
    return res;
}
```

- E) Generate a random number between 1 and 100. Ask the user to guess, and prompt with “Too High” or “Too Low” until they guess it correctly.

```
1 usage
public static void guessGame(){
    int rnum = ((int) (Math.random() * (100 - 1))) + 1; // random number between 1 and 100
    boolean gameOver = false; // variable to tell if its game over
    System.out.print("Guess the number: ");
    while(!gameOver){ // keep playing until user guesses the right answer
        int guess = inpt.nextInt(); // user input
        if(guess == rnum){ // user won
            System.out.println("Yay you guessed it right!");
            gameOver = true;
            break;
        }
        else if(guess > rnum) System.out.println("Too High");
        else System.out.println("Too Low");
    }
}
```

Output

```
ubuntu@fedora:~/qwerty/work/9_feb_2023
$ java Activity3.java
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
ZYXWVUTSRQPONMLKJIHGFEDCBA
zyxwvutsrqponmlkjihgfedcba
BDFHJLNPRTVXZ
bdfhjlnpqrtvxz

Enter a number: 4
4 can be halved 2 times

Guess the number: 50
Too Low
75
Too Low
100
Too High
80
Too Low
90
Too Low
95
Too Low
98
Too High
96
Too Low
97
Yay you guessed it right!
ubuntu@fedora:~/qwerty/work/9_feb_2023
$
```


4. Activity 4

THIS disp FUNCTION IS USED IN SUBPROGRAMS (A) AND (B) TO DISPLAY ARRAY

```
2 usages
public static void dispArr(int[] arr){
    for(int i=0; i<arr.length; ++i){
        System.out.print(arr[i]+" ");
    }
    System.out.println();
}
```

A) To store elements in an array (5 numbers given as input) and print the array

```
Scanner inpt = new Scanner(System.in);
int[] arr = new int[5];
System.out.println("Enter 5 numbers: ");
for(int i=0; i<5; ++i){
    arr[i] = inpt.nextInt();
}
dispArr(arr);
```

B) To display the contents of an array (5 numbers given as input) in reverse order

```
System.out.println("Enter 5 numbers: ");
for(int i=4; i>=0; --i){
    arr[i] = inpt.nextInt();
}
dispArr(arr);
```

C) To find the sum of all elements in an array

```
1 usage
public static int addArr(int[] arr){
    int sum=0;
    for(int i=0; i<arr.length; ++i){
        sum += arr[i];
    }
    return sum;
}
```

D) To separate odd and even integers into separate arrays

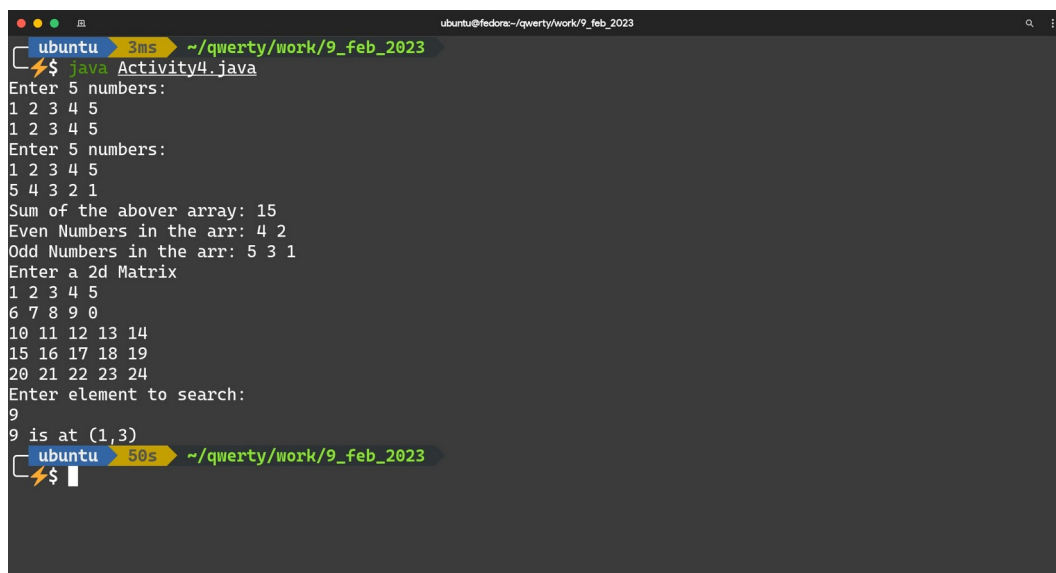
```
1 usage
public static void oddEv(int[] arr){
    String odd = "";
    String ev = "";

    for(int i=0; i<arr.length; ++i){
        if(arr[i] % 2 == 0){
            ev = ev + arr[i] + " ";
        }else{
            odd = odd + arr[i] + " ";
        }
    }
    System.out.println("Even Numbers in the arr: "+ev);
    System.out.println("Odd Numbers in the arr: "+odd);
}
```

E) Search for an element in a 2D array

```
System.out.println("Enter a 2d Matrix");
int[][] mat = new int[5][5];
for(int i=0; i<5; ++i)
    for(int j=0; j<5; ++j)
        mat[i][j] = inpt.nextInt();
System.out.println("Enter element to search: ");
int toFind = inpt.nextInt();
boolean found=false;
for(int i=0; i<5; ++i){
    found = false;
    for(int j=0; j<5; ++j){
        if(mat[i][j] == toFind){
            System.out.println(toFind+" is at (" +i+", "+j+"");
            found=true;
            break;
        }
    }
    if(found)break;
}
if(!found){
    System.out.println("Not Found");
}
```

OUTPUT



```
ubuntu@fedora:~/qwerty/work/9_feb_2023
$ java Activity4.java
Enter 5 numbers:
1 2 3 4 5
1 2 3 4 5
Enter 5 numbers:
1 2 3 4 5
5 4 3 2 1
Sum of the abover array: 15
Even Numbers in the arr: 4 2
Odd Numbers in the arr: 5 3 1
Enter a 2d Matrix
1 2 3 4 5
6 7 8 9 0
10 11 12 13 14
15 16 17 18 19
20 21 22 23 24
Enter element to search:
9
9 is at (1,3)
ubuntu@fedora:~/qwerty/work/9_feb_2023
$
```


5. Activity 5

THE MAIN FUNCTION FOR THE FOLLOWING FUNCTIONS IS

```
public static void driver() {  
    System.out.print("Enter your name: ");  
    String name = inpt.next();  
    greet(name);  
  
    System.out.println("Enter two numbers ");  
    int a=inpt.nextInt();  
    int b=inpt.nextInt();  
    System.out.println("Product of the above two numbers is "+product(a,b));  
  
    double finalPrice = calcVat();  
    System.out.println("Final price is " + finalPrice);  
  
    String st = inpt.next();  
    if(isPalindrome(st))System.out.println("Palindrome");  
    else System.out.println("Not a Palindrome");  
}
```

- A) Ask the user to enter their full name, and then call a function that will display the message “Hello” followed by the provided name

```
public static void greet(String name){  
    System.out.println("Hello "+name);  
}
```

- B) Ask the user to enter two numbers, and then call a function in which the product of these two numbers is returned. Display the returned value in your main program

```
public static int product(int a, int b){  
    return a*b;  
}
```

- C) Write a function to ask the user for a Price and a VAT rate (in %) and then return the resulting price including VAT. Display the returned value in your main program

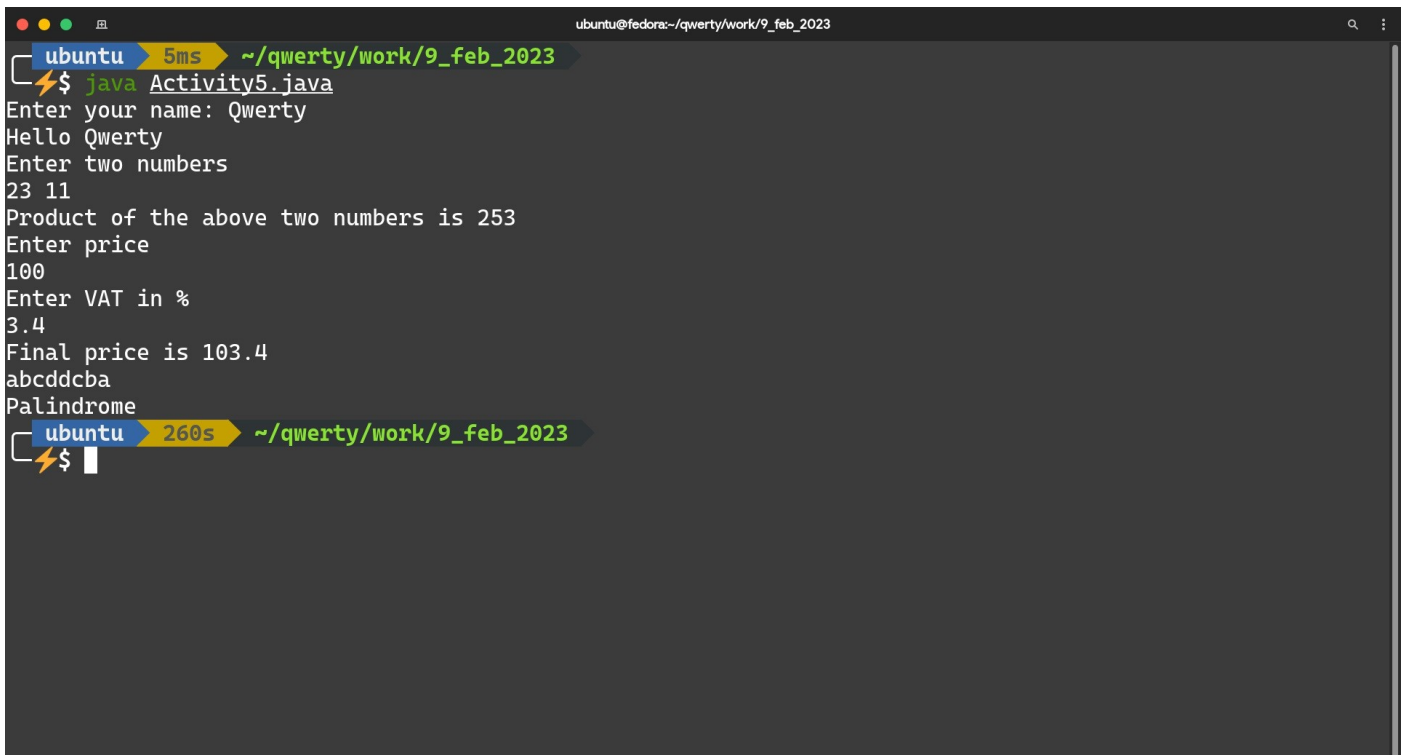
```
public static double calcVat(){  
    System.out.println("Enter price");  
    double price = inpt.nextDouble();  
    System.out.println("Enter VAT in %");  
    double vt = inpt.nextDouble();  
    double fin = price + (price*(vt/100));  
    return fin;  
}
```

D) Write a function to check if a word specified by the user is a palindrome.
Display the returned value in your main program.

For checking if a given string is palindrome or not, we start checking the i^{th} and $n-i^{\text{th}}$ characters and if they differ then the string is not a palindrome.

```
1 usage
public static boolean isPalindrome(String st){
    for(int i=0; i<st.length(); ++i){
        if(st.charAt(i) != st.charAt(st.length()-1-i))return false;
    }
    return true;
}
```

OUTPUT

A terminal window screenshot showing the execution of a Java program. The window title is 'ubuntu@fedora:~/qwerty/work/9_feb_2023'. The prompt is 'ubuntu 5ms ~/qwerty/work/9_feb_2023'. The user enters 'java Activity5.java'. The program outputs: 'Enter your name: Qwerty', 'Hello Qwerty', 'Enter two numbers', '23 11', 'Product of the above two numbers is 253', 'Enter price', '100', 'Enter VAT in %', '3.4', 'Final price is 103.4', 'abccddcba', 'Palindrome'. The prompt then changes to 'ubuntu 260s ~/qwerty/work/9_feb_2023' and the user enters a dollar sign '\$' followed by a cursor.

```
ubuntu@fedora:~/qwerty/work/9_feb_2023
ubuntu 5ms ~/qwerty/work/9_feb_2023
$ java Activity5.java
Enter your name: Qwerty
Hello Qwerty
Enter two numbers
23 11
Product of the above two numbers is 253
Enter price
100
Enter VAT in %
3.4
Final price is 103.4
abccddcba
Palindrome
ubuntu 260s ~/qwerty/work/9_feb_2023
$
```

6. Activity 6

- A) Provide code for creating a Rectangle class in Java. The class should have attributes for the height and width of the rectangle and one method named "Area".

```
3 usages 1 inheritor
class Rectangle{
    2 usages
    double height;
    2 usages
    double width;
    2 usages
    public Rectangle(double h, double w){
        height = h;
        width=w;
    }
    2 usages
    public double Area() { return height*width; }
```

- B) Provide code for creating a Triangle class in Java. The class should have attributes for the height and width of the triangle and one method named "Area".

```
2 usages
class Triangle{
    2 usages
    double height;
    2 usages
    double width;
    1 usage
    public Triangle(double h, double w){
        height = h;
        width = w;
    }
    1 usage
    public double Area() { return 0.5*height*width; }
```

- C) Provide code for creating a Circle class in Java. The class should have an attribute for the radius of the circle and methods named "Area", "Diameter" and "Circumference"

```
2 usages
class Circle{
    4 usages
    double radius;
    1 usage
    public Circle(double r) { radius = r; }
    1 usage
    public double Area() { return radius*radius*3.14; }
    1 usage
    public double Circumference() { return Diameter()*3.14; }
    1 usage
    public double Diameter() { return 2*radius; }
}
```

D) Provide code for creating a Square class in Java. Class Square should be a subclass of class Rectangle and should check that height and width are equal

```
2 usages
class Square extends Rectangle{
    1 usage
    Square(double sd) { super(sd, sd); }
}
```

E) Provide code to create new instances of Rectangle, Triangle, Circle and Square, give them names and print the returned values of their methods.

```
class Activity6 {
    public static void driver() {
        Rectangle rect = new Rectangle(h: 5, w: 4);
        Triangle tri = new Triangle(h: 3, w: 4);
        Circle cr = new Circle(r: 10);
        Square sq = new Square(sd: 5);
        System.out.println("Area of rectanlge "+rect.Area());
        System.out.println("Area of Triangle "+tri.Area());
        System.out.println("Area of square "+sq.Area());
        System.out.println("Area of circle "+cr.Area());
        System.out.println("Circumference of circle "+cr.Circumference());
    }
}
```

OUTPUT

```
ubuntu@fedora:~/qwerty/work/9_feb_2023
$ java Activity6.java
Area of rectanlge 20.0
Area of Triangle 6.0
Area of square 25.0
Area of circle 314.0
Circumference of circle 62.800000000000004
ubuntu@fedora:~/qwerty/work/9_feb_2023
$
```

7. Activity 7

Basic and Advanced Calculator.

This code is a command Calculator with menu systems. There is a base calculator class that contains all the basic math operations. The Advance calculator is a derived class of the Calculator class, with additional trig functions along with factorial and power calculations. The history of calculations is stored in an history array.

Code.

```
1  import java.util.Scanner;
2  import java.lang.Math;
3  class Activity7 {
4      public static void driver() {
5          Scanner inpt = new Scanner(System.in);
6          while(true){
7              System.out.println("Chose a calculator");
8              System.out.println("1. Basic Calculator");
9              System.out.println("2. Advance Calculator");
10             System.out.println("0. Exit");
11             int ch = inpt.nextInt();
12             if(ch == 1){
13                 Calculator obj = new Calculator();
14                 obj.mainLoop();
15             }else if(ch == 2){
16                 AdvCalculator obj = new AdvCalculator();
17                 obj.mainLoop();
18             }else break;
19         }
20     }
21 }
22
23
24 3 usages 1 inheritor
class Calculator{
26     3 usages
    public boolean gameOver; // variable to keep the menu system in a loop
27     11 usages
    public String[] hist; // array to store history of calculations
28     13 usages
    public int histCount; // number of calculations in the history
29
30     2 usages
    public Calculator(){
31         inpt = new Scanner(System.in);
32         hist = new String[100];
33         gameOver = false; // keep the calculator running
34         histCount=0;
35     }
36
37     2 usages
    public void Add(double a, double b){
38         double res = a+b;
39         System.out.println(res);
40         hist[histCount++] = ""+a+"+"+b+"="+res; // adding this calculation to the history array
41     }
42     2 usages
    public void Sub(double a, double b){
43         double res = a-b;
44         System.out.println(res);
45         hist[histCount++] = ""+a+"-"+b+"="+res; // adding this calculation to the history array
46     }
47     2 usages
    public void mult(double a, double b){
```


2 usages

```
47 public void mult(double a, double b){
48     double res = a*b;
49     System.out.println(res);
50     hist[histCount++] = ""+a+"*"+b+"="+res; // adding this calculation to the history array
51 }
```

2 usages

```
52 public void divide(double a, double b){
53     double res = a/b;
54     System.out.println(res);
55     hist[histCount++] = ""+a+"/"+b+"="+res;
56 }
57
```

2 usages

```
58 public void history(){ // displaying all the strings in the history arr
59     System.out.println("\n##### HISTORY #####");
60     for(int i=0; i<histCount; ++i){
61         System.out.println(i+1+. " "+hist[i]);
62     }
63     System.out.println("##### #####");
64 }
65
```

1 usage 1 override

```
66 public int menu(){ // Menu system for basic calculator
67     System.out.println("\nBasic Calculator");
68     System.out.println("Choose the operation");
69     System.out.println("1. Add");
70     System.out.println("2. Subtract");
71     System.out.println("3. Multiply");
```

```
70     System.out.println("2. Subtract");
71     System.out.println("3. Multiply");
72     System.out.println("4. Divide");
73     System.out.println("5. History");
74     System.out.println("0. Exit Calculator");
75     System.out.print("> ");
76     int choice = inpt.nextInt(); // user enters his choice
77     return choice;
```

```
78 }
79 // function to do the calculation depending upon what the user has chosen in the menu
80 // ch is the choice passed by menu() function
```

1 usage 1 override

```
81 public boolean draw(int ch){
82     if(ch == 0)return true;
83     double a=0,b=0;
84     if(ch < 5){
85         System.out.println("Enter operands");
86         System.out.print("> ");
87         a = inpt.nextDouble();
88         b = inpt.nextDouble();
89     }
90     System.out.print("=" );
91     if(ch == 1)Add(a,b);
92     else if(ch == 2)Sub(a,b);
93     else if(ch==3)mult(a,b);
94     else if(ch==4)divide(a,b);
95     else if(ch==5)history();
96     return false;
97 }
```



```

99      2 usages
100      public void mainLoop(){ // main loop that keeps the calculator running
101          while(!gameOver){
102              gameOver = draw(menu()); // menu() returns the choice of the users and passes this to draw
103              // draw returns a boolean value of true is the user has exited out or else false.
104              if(histCount >= 100)histCount=0; // if the records in the history reaches 100 start overwriting
105              //earliest records. History limits is 100
106          }
107      }
108
109      2 usages
110      class AdvCalculator extends Calculator{ // this is a sub class of Calculator
111
112          1 usage
113          public AdvCalculator(){
114              super();
115          }
116
117          1 usage
118          public void fact(double n){ // driver function of factorial calculations
119              double res = _fact(n);
120              System.out.println(res);
121              hist[histCount++] = ""+n+"! "+"="+res; // adding to the history
122          }
123
124          2 usages
125          public double _fact(double n){ // recursive factorial calculations
126              if(n == 0 || n == 1)return 1;
127              return n * _fact(n-1);
128          }
129
130          // trig functions
131          1 usage
132          public void sin(double a){
133              double res = Math.sin(a);
134              System.out.println(res);
135              hist[histCount++] = "sin("+a+")"+"="+res;
136          }
137
138          1 usage
139          public void cos(double a){
140              double res = Math.cos(a);
141              System.out.println(res);
142              hist[histCount++] = "cos("+a+")"+"="+res;
143          }
144
145          1 usage
146          public void tan(double a){
147              double res = Math.tan(a);
148              System.out.println(res);
149              hist[histCount++] = "tan("+a+")"+"="+res;
150          }
151
152          1 usage
153          public void power(double a, double b){
154              double res = Math.pow(a,b);
155              System.out.println(res);
156              hist[histCount++] = ""+a+" power "+b+"="+res;
157          }
158      }

```

```

147     }
148
149     1 usage
150     public int menu(){ // menu for advanced calculator
151         System.out.println("\nAdvance Calculator");
152         System.out.println("Choose the operation");
153         System.out.println("1. Add");
154         System.out.println("2. Subtract");
155         System.out.println("3. Multiply");
156         System.out.println("4. Divide");
157         System.out.println("5. sin");
158         System.out.println("6. cos");
159         System.out.println("7. tan");
160         System.out.println("8. Factorial");
161         System.out.println("9. Power");
162         System.out.println("10. History");
163         System.out.println("0. Exit Calculator");
164         System.out.print("> ");
165         int choice = inpt.nextInt();
166         return choice;
167     }
168
169     1 usage
170     public boolean draw(int ch){ // function to do the calculation depending upon what the user has chosen in the menu
171         if(ch == 0)return true;
172         double a=0,b=0;
173         if(ch < 5 || ch == 9){
174             System.out.println("Enter operands");
175             System.out.print("> ");

```

```

167
168     1 usage
169     public boolean draw(int ch){ // function to do the calculation depending upon what the user has chosen in the menu
170         if(ch == 0)return true;
171         double a=0,b=0;
172         if(ch < 5 || ch == 9){
173             System.out.println("Enter operands");
174             System.out.print("> ");
175             a = inpt.nextDouble();
176             b = inpt.nextDouble();
177         }
178         else if(ch >= 5 && ch <= 8){
179             System.out.print("> ");
180             a = inpt.nextDouble();
181         }
182         System.out.print("= ");
183         if(ch == 1)Add(a,b);
184         else if(ch == 2)Sub(a,b);
185         else if(ch==3)mult(a,b);
186         else if(ch==4)divide(a,b);
187         else if(ch==5)sin(a);
188         else if(ch==6)cos(a);
189         else if(ch==7)tan(a);
190         else if(ch==8)fact(a);
191         else if(ch==9)power(a,b);
192         else if(ch==10)history();
193         return false;
194     }

```

OUTPUT

```
Activities Terminal Fri Feb 10 15:03:00 ubuntu@fedora:~/qwerty/work/9_feb_2023
```

```
> 3
Enter operands
> 4 5
= 20.0

Basic Calculator
Choose the operation
1. Add
2. Subtract
3. Multiply
4. Divide
5. History
0. Exit Calculator
> 5
=
##### HISTORY #####
1. 3.0+4.0=7.0
2. 4.0*5.0=20.0
#####

Basic Calculator
Choose the operation
1. Add
2. Subtract
3. Multiply
4. Divide
5. History
0. Exit Calculator
> 0
Chose a calculator
1. Basic Calculator
2. Advance Calculator
0. Exit
0

ubuntu 25s ~/qwerty/work/9_feb_2023
```

```
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```

```
4. Divide
5. sin
6. cos
7. tan
8. Factorial
9. Power
10. History
0. Exit Calculator
> 10
=
##### HISTORY #####
1. cos(0.0)=1.0
2. 4.0! =24.0
#####

Advance Calculator
Choose the operation
1. Add
2. Subtract
3. Multiply
4. Divide
5. sin
6. cos
7. tan
8. Factorial
9. Power
10. History
0. Exit Calculator
> 0
Chose a calculator
1. Basic Calculator
2. Advance Calculator
0. Exit
0

ubuntu 53s ~/qwerty/work/9_feb_2023
```