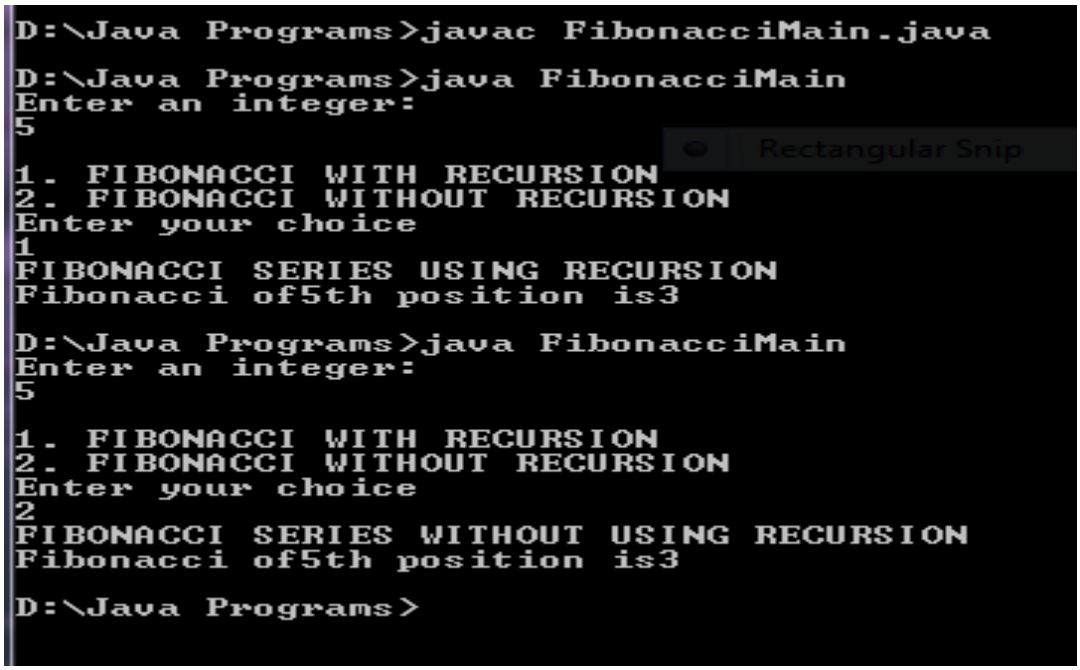
1. **The fibonacci sequence is defined by the following rule. The first 2 values in the sequence are 1,1. Every subsequent value is the sum of the 2 values preceding it. Write a java program that uses both recursive and non recursive functions to print the nth value of the Fibonacci sequence**

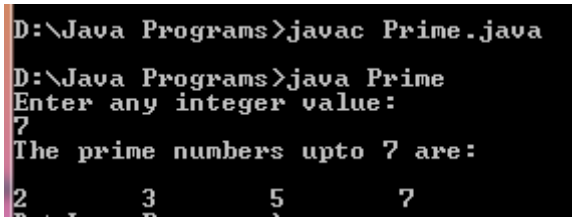
```
import java.io.*;
import java.lang.*;
import java.util.*;
class fib
{
int fibrec(int n)
{
if(n==1)
return 0;
else if(n==2)
return 1;
else
return(fibrec(n-1)+fibrec(n-2));
}
int fibnonrec(int n)
{
int a=0,b=1,c=0;
for(int i=3;i<=n;i++)
{
c=a+b;
a=b;
b=c;
}
return c;
}
}
class FibonacciMain
{
public static void main(String args[]) throws IOException
```

```
{
BufferedReader br=new BufferedReader(new
InputStreamReader(System.in));
int result,result1;
System.out.println("Enter an integer:");
int n=Integer.parseInt(br.readLine());
fib f=new fib();
System.out.println("\n1. FIBONACCI WITH RECURSION \n2.
FIBONACCI WITHOUT RECURSION");
System.out.println("Enter your choice");
int ch=Integer.parseInt(br.readLine());
switch(ch)
{
case 1:
System.out.println("FIBONACCI SERIES USING RECURSION");
result=f.fibrec(n);
System.out.println("Fibonacci of"+n+"th position is"+result);
break;
case 2:
System.out.println("FIBONACCI SERIES WITHOUT USING
RECURSION");
result1=f.fibrec(n);
System.out.println("Fibonacci of"+n+"th position is"+result1);
break;
}
}
}
```


D:\Java Programs>javac FibonacciMain.java
D:\Java Programs>java FibonacciMain
Enter an integer:
5
1. FIBONACCI WITH RECURSION
2. FIBONACCI WITHOUT RECURSION
Enter your choice
1
FIBONACCI SERIES USING RECURSION
Fibonacci of5th position is3
D:\Java Programs>java FibonacciMain
Enter an integer:
5
1. FIBONACCI WITH RECURSION
2. FIBONACCI WITHOUT RECURSION
Enter your choice
2
FIBONACCI SERIES WITHOUT USING RECURSION
Fibonacci of5th position is3
D:\Java Programs>

2. **Write a java program that prompts the user for an integer and then prints out all the prime numbers up to that integer**

```
import java.io.*;
import java.lang.*;
import java.lang.String;
class Prime
{
public static void main(String args[]) throws IOException
{
BufferedReader br=new BufferedReader(new
InputStreamReader(System.in));
int i,j,n,count;
System.out.println("Enter any integer value:");
n=Integer.parseInt(br.readLine());
System.out.println("The prime numbers upto "+n+" are:\n");
for(i=0;i<=n;i++)
{
count =0;
for(j=1;j<=i;j++)
{
if(i%j==0)
count=count+1;
}
if(count==2)
System.out.print(i+"\t");
}
}
}
```



3. **Write a java program that checks whether a given string is palindrome or not. Ex. MALAYALAM is a palindrome.**

```
import java.io.*;
import java.lang.String;
import java.util.*;
class StrPalindrome
{
public static void main(String args[])
{
Scanner sc=new Scanner(System.in);
System.out.println("\nEnter a string value\n");
String st=sc.nextLine();
String temp=st;
StringBuffer sb=new StringBuffer(st);
sb.reverse();
st=sb.toString();
if(temp.equals(st))
{
System.out.println("\n" +st+ "is a palindrome string.\n");
}
else
{
System.out.println("\n" +st+ "is not a palindrome string.\n");
}
}
}
```

```
D:\Java Programs>javac StrPalindrome.java
D:\Java Programs>java StrPalindrome
Enter a string value
MADAM
MADAMis a palindrome string.

D:\Java Programs>java StrPalindrome
Enter a string value
COMPUTER
RETUPMOCis not a palindrome string.
```

4. **Write a java program for sorting a given list of names in ascending order**

```
import java.io.*;
import java.lang.*;
import java.util.*;
class NameSorting
{
void sortStrings()
{
Scanner sc = new Scanner(System.in);
System.out.println("Enter the value of n: ");
int n = sc.nextInt();
String[] str = new String[n];
System.out.println("Enter strings: ");
for(int i = 0; i < n; i++)
{
str[i] = new String(sc.next());
}
for(int i = 0; i < n; i++)
{
for(int j = i+1; j < n; j++)
{
if(str[i].compareTo(str[j])>0)
{
String temp = str[i];
str[i] = str[j];
str[j] = temp;
}
}
}
System.out.println("Sorted list of strings is:");
for(int i = 0; i < n ; i++)
{
System.out.println(str[i]);
```

```
}
}
}
class NamesSorting
{
public static void main(String[] args)
{
NameSorting obj = new NameSorting();
obj.sortStrings();
}
}
```

```
D:\Java Programs>NamesSorting.java

D:\Java Programs>javac NamesSorting.java

D:\Java Programs>java NamesSorting
Enter the value of n:
4
Enter strings:
java
computer
information
technology
Sorted list of strings is:
computer
information
java
technology
```

5. **Write a java program that illustrates how runtime polymorphism is achieved .**

```
import java.io.*;
import java.lang.*;
class Bike
{
void ride()
{
System.out.println("riding....");
}
}
class Hero extends Bike
{
void ride()
{
System.out.println("riding hero...");
}
}
class Honda extends Bike
{
void ride()
{
System.out.println("riding honda...");
}
}
class Bajaj extends Bike
{
void ride()
{
System.out.println("riding bajaj...");
}
}
class RunTimePolymorphism
{
```

```
public static void main(String args[])
{
Bike b;
b=new Hero();
b.ride();
b=new Honda();
b.ride();
b=new Bajaj();
b.ride();
}
}
```

```
D:\Java Programs>javac RunTimePolymorphism.java

D:\Java Programs>java RunTimePolymorphism
riding hero...
riding honda...
riding bajaj...
```

6. Write a Java Program to create and demonstrate packages.

```
package pack;
public class Addition
{
private double d1,d2;
public Addition(double a, double b)
{
d1=a;
d2=b;
}
public void sum()
{
System.out.println("\n Sum is"+(d1+d2));.
}
}
```


```
//2
package pack;
public class Subtraction
{
public static double sub(double a, double b)
{
return(a-b);
}
```

}

```
D:\Java Programs>javac Subtraction.java

D:\Java Programs>java Subtraction
Exception in thread "main" java.lang.NoClassDefFoundError: Subtraction (wrong na
me: pack/Subtraction)
        at java.lang.ClassLoader.defineClass1(Native Method)
        at java.lang.ClassLoader.defineClass(ClassLoader.java:800)
        at java.security.SecureClassLoader.defineClass(SecureClassLoader.java:14
2)
        at java.net.URLClassLoader.defineClass(URLClassLoader.java:449)
        at java.net.URLClassLoader.access$100(URLClassLoader.java:71)
        at java.net.URLClassLoader$1.run(URLClassLoader.java:361)
        at java.net.URLClassLoader$1.run(URLClassLoader.java:355)
        at java.security.AccessController.doPrivileged(Native Method)
        at java.net.URLClassLoader.findClass(URLClassLoader.java:354)
        at java.lang.ClassLoader.loadClass(ClassLoader.java:425)
        at sun.misc.Launcher$AppClassLoader.loadClass(Launcher.java:308)
        at java.lang.ClassLoader.loadClass(ClassLoader.java:358)
        at sun.launcher.LauncherHelper.checkAndLoadMain(LauncherHelper.java:482)


D:\Java Programs>javac -d . Subtraction.java
```

//3

```
import pack.Addition;
import pack.Subtraction;
import java.io.*;
import java.lang.*;
class ArithPack
{
public static void main(String args[]) throws IOException
{
BufferedReader br=new BufferedReader(new
InputStreamReader(System.in));
System.out.println("\nEnter a value\n");
int a=Integer.parseInt(br.readLine());
System.out.println("Enter b value\n");
int b=Integer.parseInt(br.readLine());
Addition obj = new Addition(a,b);
obj.sum();
double res = Subtraction.sub(a,b);
System.out.println("\nSubtraction is"+res);
}
}
```

```
D:\Java Programs>javac ArithPack.java

D:\Java Programs>java ArithPack

Enter a value

5
Enter b value

9

 Sum is14.0

Subtraction is-4.0
```

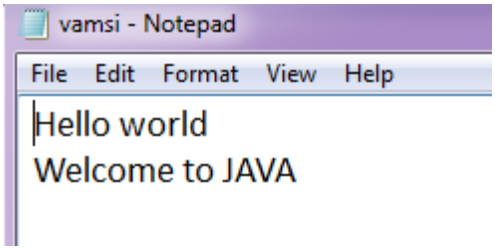
7. Write a Java Program, using StringTokenizer class, which reads a line of integers and then displays each integer and the sum of all integers.

```
import java.io.*;
import java.lang.*;
import java.util.*;

class StringTokenizerDemo
 {
   public static void main(String args[]) {
      int n;
      int sum = 0;
      Scanner sc = new Scanner(System.in);
      System.out.println("Enter values:");
      String s = sc.nextLine();
      StringTokenizer st = new StringTokenizer(s, " ");
      while (st.hasMoreTokens()) {
         String temp = st.nextToken();
         n = Integer.parseInt(temp);
         System.out.println(n);
         sum = sum + n;
      }
      System.out.println("sum of the integers is: " + sum);
      sc.close();
   }
}
```

```
D:\Java Programs>javac StringTokenizerDemo.java

D:\Java Programs>java StringTokenizerDemo
Enter values:
1 3 5 9 4 5 3
1
3
5
9
4
5
3
sum of the integers is: 30
```

8. Write a Java Program that reads on file name form the user then displays information about whether the file exists, whether the file is readable/ writable, the type of file and the length of the file in bytes and display the content of the using FileInputStream class.

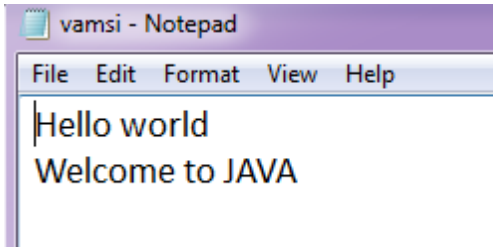
```
import java.io.*;
import java.lang.*;
class ReadFile
{
public static void main(String args[])
{
File f=new File("vamsi.txt");
if(f.exists())
{
System.out.println("File is exist and details about file");
System.out.println("File name is"+f.getName());
System.out.println("File path location is"+f.getAbsolutePath());
System.out.println(f.canRead()?"File is readable":"File is not readable");
System.out.println(f.canWrite()?"File is writable":"File is not writable");
System.out.println(f.isFile()?"F is file":"F is directory");
System.out.println("Length of the file" +f.length()+"bytes");
}
else
{
System.out.println("File not existed..!!");
}
}
}
```



```
D:\Java Programs>javac ReadFile.java

D:\Java Programs>java ReadFile
File is exist and details about file
File name isvamsi.txt
File path location isD:\Java Programs\vamsi.txt
File is readable
File is writable
F is file
Length of the file28bytes
```

9. Write a Java Program that displays the number of characters, lines and words in a text/text file.

```
import java.io.*;
import java.lang.*;
class FileDisplay
{
public static void main(String args[]) throws IOException
{
System.out.println("Enter the name of file:");
BufferedReader br=new BufferedReader(new
InputStreamReader(System.in));
String s=new String(br.readLine());
FileInputStream f=new FileInputStream(s);
int n;
int nc=0,nl=0,nw=0;
n=f.read();
while(n!=-1)
{
if(n=='\n')
nl++;
if(n==' '||n=='\n')
nw++;
n=f.read();
nc++;
}
f.close();
System.out.println("Number of lines are "+nl);
System.out.println("Number of words are"+nw);
System.out.println("Number of characters are"+nc);
}
}
```




```
D:\Java Programs>javac FileDisplay.java

D:\Java Programs>java FileDisplay
Enter the name of file:
vamsi.txt
Number of lines are 1
Number of words are4
Number of characters are28
```

10. Write a Java Program to implement a Queue, using user defined Exception Handling (also make use of throw, throws)

```
import java.util.Scanner;
import java.io.*;
import java.lang.*;
class ExceptionQueue extends Exception
{
ExceptionQueue(String s)
{
super(s);
}
}
class Queue
{
int front,rear;
int q[] = new int[10];
Queue()
{
rear = -1;
front = -1;
}
void enqueue(int n) throws ExceptionQueue
{
if(rear == 9)
throw new ExceptionQueue("Queue is full");
rear++;
q[rear]=n;
if(front == -1)
front = 0;
}
int dequeue() throws ExceptionQueue
{
if(front == -1)
throw new ExceptionQueue("Queue is empty");
```

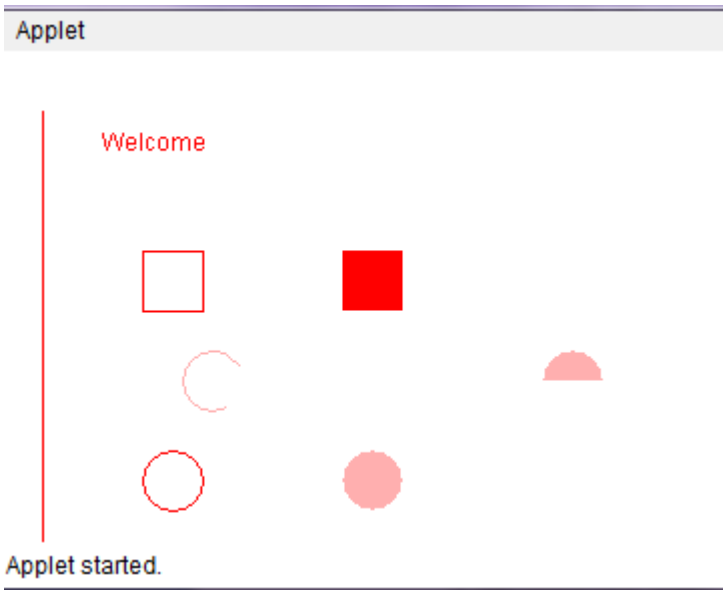
```
int temp = q[front];
if(front == rear)
front  = rear = -1;
else
front++;
return(temp);
}
}
class UseQueue
{
public static void main(String args[])
{
Queue a = new Queue();
try
{
a.enqueue(5);
a.enqueue(20);
}
catch(ExceptionQueue e)
{
System.out.println(e.getMessage());
}
try
{
System.out.println(a.dequeue());
System.out.println(a.dequeue());
System.out.println(a.dequeue());
}
catch(ExceptionQueue e)
{
System.out.println(e.getMessage());
}
}
}
```

```
D:\Java Programs>javac UseQueue.java

D:\Java Programs>java UseQueue
5
20
Queue is empty
```

11. Write an Applet that displays the content of a file.

```
import java.applet.Applet;
import java.awt.*;
public class GraphicsDemo extends Applet
{
public void paint(Graphics g)
{
g.setColor(Color.red);
g.drawString("Welcome",50,50);
g.drawLine(20,30,20,300);
g.drawRect(70,100,30,30);
g.fillRect(170,100,30,30);
g.drawOval(70,200,30,30);
g.setColor(Color.pink);
g.fillOval(170,200,30,30);
g.drawArc(90,150,30,30,30,270);
g.fillArc(270,150,30,30,0,180);
}
}
/*<applet code="GraphicsDemo.class"width="300"height="300">
</applet>
*/
```

```
D:\Java Programs>javac GraphicsDemo.java
D:\Java Programs>appletviewer GraphicsDemo.java
```

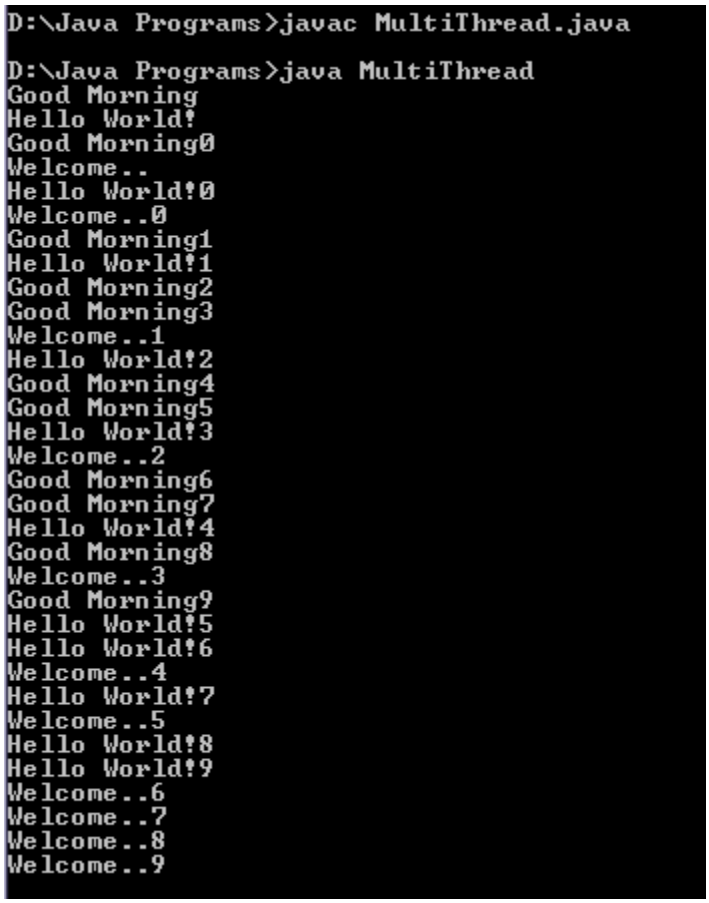

Applet
Welcome
Applet started.

12. Write a Java Program demonstrating the life cycle of a thread.

```
class First implements Runnable
{
Thread t;
First()
{
t=new Thread(this);
System.out.println("Good Morning");
t.start();
}
public void run()
{
for(int i=0;i<10;i++)
{
System.out.println("Good Morning"+i);
try
{
t.sleep(1000);
}
catch(Exception e)
{
System.out.println(e);
}
}
}
}
class Second implements Runnable
{
Thread t;
Second()
{
t=new Thread(this);
System.out.println("Hello World!");
```

```
t.start();
}
public void run()
{
for(int i=0;i<10;i++)
{
System.out.println("Hello World!"+i);
try
{
t.sleep(2000);
}
catch(Exception e)
{
System.out.println(e);
}
}
}
}
class Third implements Runnable
{
Thread t;
Third()
{
t=new Thread(this);
System.out.println("Welcome..");
t.start();
}
public void run()
{
for(int i=0;i<10;i++)
{
System.out.println("Welcome.."+i);
try
{
t.sleep(3000);
```

```
}
catch(Exception e)
{
System.out.println(e);
}
}
}
}
public class MultiThread
{
public static void main(String args[])
{
new First();
new Second();
new Third();
}
}
```

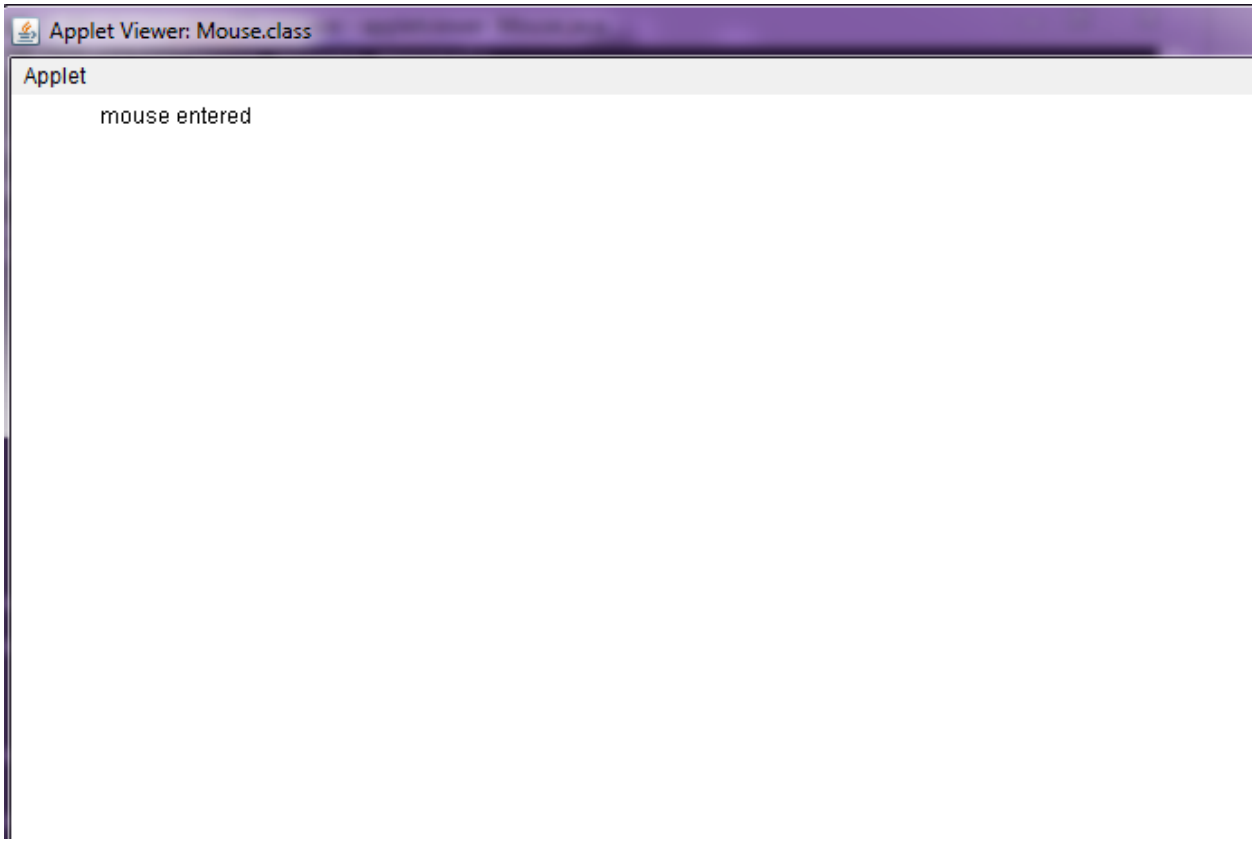

D:\Java Programs>javac MultiThread.java
D:\Java Programs>java MultiThread
Good Morning
Hello World!
Good Morning0
Welcome..
Hello World!0
Welcome..0
Good Morning1
Hello World!1
Good Morning2
Good Morning3
Welcome..1
Hello World!2
Good Morning4
Good Morning5
Hello World!3
Welcome..2
Good Morning6
Good Morning7
Hello World!4
Good Morning8
Welcome..3
Good Morning9
Hello World!5
Hello World!6
Welcome..4
Hello World!7
Welcome..5
Hello World!8
Hello World!9
Welcome..6
Welcome..7
Welcome..8
Welcome..9

13. Write a Java Program for handling mouse events

```
import java.awt.event.*;
import java.applet.*;
import java.awt.*;
/*<applet code="Mouse.class" height=800 width=800>
</applet>*/
public class Mouse extends Applet implements
MouseListener,MouseMotionListener
{
String msg;
int mousex=0,mousey=0;
public void init()
{
addMouseListener(this);
addMouseMotionListener(this);
}
public void mouseClicked(MouseEvent m)
{
mousex=0;
mousey=0;
msg="mouse clicked";
repaint();
}
public void mouseReleased(MouseEvent m)
{
mousex=m.getX();
mousey=m.getY();
msg="up";
repaint();
}
public void mouseEntered(MouseEvent m)
{
mousex=m.getX();
mousey=m.getY();
```

```
msg="mouse entered";
repaint();
}
public void mouseExited(MouseEvent m)
{
mousex=m.getX();
mousey=m.getY();
msg="mouse exited";
repaint();
}
public void mousePressed(MouseEvent m)
{
mousex=m.getX();
mousey=m.getY();
msg="mouse pressed";
repaint();
}
public void mouseDragged(MouseEvent m)
{
mousex=m.getX();
mousey=m.getY();
msg="mouse dragged";
repaint();
}
public void mouseMoved(MouseEvent m)
{
mousex=m.getX();
mousey=m.getY();
showStatus("moving at:"+mousex+","+mousey);
}
public void paint(Graphics g)
{
g.drawString(msg,mousex,mousey);
}
}
```

```
D:\Java Programs>javac Mouse.java

D:\Java Programs>appletviewer Mouse.java
Exception in thread "AWT-EventQueue-1" java.lang.NullPointerException: String is
 null
        at sun.java2d.SunGraphics2D.drawString(SunGraphics2D.java:2857)
        at Mouse.paint(Mouse.java:65)
        at sun.awt.RepaintArea.paintComponent(RepaintArea.java:264)
        at sun.awt.RepaintArea.paint(RepaintArea.java:240)
        at sun.awt.windows.WComponentPeer.handleEvent(WComponentPeer.java:347)
        at java.awt.Component.dispatchEventImpl(Component.java:4948)
        at java.awt.Container.dispatchEventImpl(Container.java:2287)
        at java.awt.Component.dispatchEvent(Component.java:4698)
        at java.awt.EventQueue.dispatchEventImpl(EventQueue.java:747)
        at java.awt.EventQueue.access$300(EventQueue.java:103)
        at java.awt.EventQueue$3.run(EventQueue.java:706)
        at java.awt.EventQueue$3.run(EventQueue.java:704)
        at java.security.AccessController.doPrivileged(Native Method)
        at java.security.ProtectionDomain$1.doIntersectionPrivilege(ProtectionDo
main.java:76)
        at java.security.ProtectionDomain$1.doIntersectionPrivilege(ProtectionDo
main.java:87)
        at java.awt.EventQueue$4.run(EventQueue.java:720)
        at java.awt.EventQueue$4.run(EventQueue.java:718)
        at java.security.AccessController.doPrivileged(Native Method)
        at java.security.ProtectionDomain$1.doIntersectionPrivilege(ProtectionDo
main.java:76)
        at java.awt.EventQueue.dispatchEvent(EventQueue.java:717)
        at java.awt.EventDispatchThread.pumpOneEventForFilters(EventDispatchThre
ad.java:242)
        at java.awt.EventDispatchThread.pumpEventsForFilter(EventDispatchThread.
java:161)
        at java.awt.EventDispatchThread.pumpEventsForHierarchy(EventDispatchThre
ad.java:150)
        at java.awt.EventDispatchThread.pumpEvents(EventDispatchThread.java:146)

        at java.awt.EventDispatchThread.pumpEvents(EventDispatchThread.java:138)

        at java.awt.EventDispatchThread.run(EventDispatchThread.java:91)
```


Applet Viewer: Mouse.class
Applet
mouse entered

14. Write a Java Program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +-*?% operations. Add a text field to display the result.

```
import java.awt.*;
import java.awt.event.*;
import java.applet.*;
import javax.swing.*;
/*
<applet code="MyCalculator" width=300 height=300>
</applet>
*/
public class MyCalculator extends Applet implements ActionListener
{
int num1,num2,result;
TextField T1;
Button NumButtons[]=new Button[10];
Button Add,Sub,Mul,Div,clear,EQ;
char Operation;
Panel nPanel,CPanel,SPanel;
public void init() {
nPanel=new Panel();
T1=new TextField(30);
nPanel.setLayout(new FlowLayout(FlowLayout.CENTER));
```

```
nPanel.add(T1);
CPanel=new Panel();
CPanel.setBackground(Color.white);
CPanel.setLayout(new GridLayout(5,5,3,3));
for(int i=0;i<10;i++) {
NumButtons[i]=new Button(""+i);
}
Add=new Button("+");
Sub=new Button("-");
Mul=new Button("*");
Div=new Button("/");
clear=new Button("clear");
EQ=new Button("=");
T1.addActionListener(this);
for(int i=0;i<10;i++) {
CPanel.add(NumButtons[i]);
}
CPanel.add(Add);
CPanel.add(Sub);
CPanel.add(Mul);
CPanel.add(Div);
CPanel.add(EQ);
SPanel=new Panel();
```

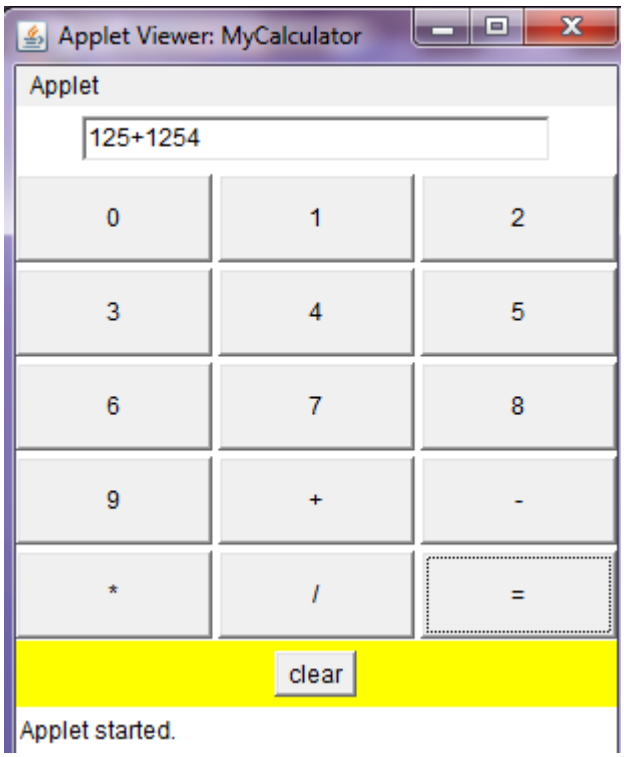
```
SPanel.setLayout(new FlowLayout(FlowLayout.CENTER));
SPanel.setBackground(Color.yellow);
SPanel.add(clear);
for(int i=0;i<10;i++) {
NumButtons[i].addActionListener(this);
}
Add.addActionListener(this);
Sub.addActionListener(this);
Mul.addActionListener(this);
Div.addActionListener(this);
clear.addActionListener(this);
EQ.addActionListener(this);
this.setLayout(new BorderLayout());
add(nPanel,BorderLayout.NORTH);
add(CPanel,BorderLayout.CENTER);
add(SPanel,BorderLayout.SOUTH);
}
public void actionPerformed(ActionEvent ae)
{
String str=ae.getActionCommand ();
char ch=str.charAt(0);
if(Character.isDigit(ch))
T1.setText(T1.getText()+str);
```

```
else
if(str.equals("+"))
{
num1=Integer.parseInt (T1.getText());
Operation='+';
T1.setText ("");
}
if(str.equals("-"))
{
num1=Integer.parseInt(T1.getText());
Operation='-';
T1.setText("");
}
if(str.equals("*"))
{
num1=Integer.parseInt(T1.getText());
Operation='*';
T1.setText("");
}
if(str.equals("/"))
{
num1=Integer.parseInt(T1.getText());
Operation='/';
```

```
T1.setText("");
}
if(str.equals("%"))
{
num1=Integer.parseInt(T1.getText());
Operation='%';
T1.setText("");
}
if(str.equals("="))
{
num2=Integer.parseInt(T1.getText());
switch(Operation)
{
case '+':
result=num1+num2;
break;
case '-':result=num1-num2;
break;
case '*':
result=num1*num2;
break;
case '/':
try
```

```
{
result=num1/num2;
}
catch(ArithmeticException e)
{
result=num2;
JOptionPane.showMessageDialog(this,"Divided by zero");
}
break;
}
T1.setText(""+result);
}
if(str.equals("clear"))
{
T1.setText("");
}
}
}
```

```
D:\Java Programs>javac MyCalculator.java
D:\Java Programs>appletviewer MyCalculator.java
```


Applet Viewer: MyCalculator
Applet
125+1254
0
1
2
3
4
5
6
7
8
9
+
-
*
/
=
clear
Applet started.

15. Write a Java Program that lets users create Pie charts. Design your own user interface (with Swings & AWT).

```
import java.awt.*;
import java.awt.event.*;
import java.awt.font.*;
import java.awt.geom.*;
import java.awt.image.BufferedImage;
import java.text.NumberFormat;
import javax.swing.*;
public class PieChart
{
public static void main(String[] args)
{
JFrame f = new JFrame();
f.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
f.getContentPane().add(new PieChartPanel());
f.setSize(400,400);
f.setLocation(200,200);
f.setVisible(true);
}
}
class PieChartPanel extends JPanel
{
```

```
BufferedImage image;
final int PAD = 30;
Font font;
NumberFormat nf;
boolean showConstructionMarkers;

public PieChartPanel()
{
font = new Font("lucida sans regular", Font.PLAIN, 20);
nf = NumberFormat.getPercentInstance();
showConstructionMarkers = true;
addMouseListener(new Visibility(this));
addComponentListener(new ComponentAdapter()
{
public void componentResized(ComponentEvent e)
{
image = null;
}
});
}
protected void paintComponent(Graphics g)
{
super.paintComponent(g);
```

```
Graphics2D g2 = (Graphics2D)g;
g2.setRenderingHint(RenderingHints.KEY_ANTIALIASING,
RenderingHints.VALUE_ANTIALIAS_ON);
if(image == null)
createChartImage();
g2.drawImage(image, 0, 0, this);
}
private void createChartImage()
{
int[] data = { 320, 490, 100, 612 };
int w = getWidth();
int h = getHeight();
int cx = w/2;
int cy = h/2;
image = new BufferedImage(w, h, BufferedImage.TYPE_INT_RGB);
Graphics2D g2 = image.createGraphics();
g2.setRenderingHint(RenderingHints.KEY_ANTIALIASING,
RenderingHints.VALUE_ANTIALIAS_ON);
g2.setPaint(Color.white);
g2.fillRect(0, 0, w, h);
g2.setPaint(Color.black);
int dia = Math.min(w,h) - 2*PAD;
g2.draw(new Ellipse2D.Double(cx - dia/2, cy - dia/2, dia, dia));
```

```
double total = 0;
for(int j = 0; j < data.length; j++)
total += data[j];
double theta = 0, phi = 0;
double x, y;
for(int j = 0; j < data.length; j++)
{
x = cx + (dia/2) * Math.cos(theta);
y = cy + (dia/2) * Math.sin(theta);
g2.draw(new Line2D.Double(cx, cy, x, y));
phi = (data[j]/total) * 2 * Math.PI;
if(showConstructionMarkers)
{
g2.setXORMode(Color.cyan);
x = cx + (dia/2) * Math.cos(theta + phi/2);
y = cy + (dia/2) * Math.sin(theta + phi/2);
g2.draw(new Line2D.Double(cx, cy, x, y));
g2.setPaintMode();
}
x = cx + (9*dia/24) * Math.cos(theta + phi/2);
y = cy + (9*dia/24) * Math.sin(theta + phi/2);
if(showConstructionMarkers)
{
```

```
g2.setPaint(Color.blue);
g2.fill(new Ellipse2D.Double(x - 2, y - 2, 4, 4));
g2.setPaint(Color.black);
}
g2.setFont(font);
String s = String.valueOf(data[j]);
FontRenderContext frc = g2.getFontRenderContext();
float textWidth = (float)font.getStringBounds(s, frc).getWidth();
LineMetrics lm = font.getLineMetrics(s, frc);
float sx = (float)(x - textWidth/2);
float sy = (float)(y + lm.getAscent()/2);
g2.drawString(s, sx, sy);
x = cx + (dia/2 + 4*PAD/5) * Math.cos(theta + phi/2);
y = cy + (dia/2 + 4*PAD/5) * Math.sin(theta+ phi/2);
if(showConstructionMarkers)
{
g2.setPaint(Color.red);
g2.fill(new Ellipse2D.Double(x - 2, y - 2, 4, 4));
g2.setPaint(Color.black);
}
s = nf.format(data[j]/total);
textWidth = (float)font.getStringBounds(s, frc).getWidth();
lm = font.getLineMetrics(s, frc);
```

```
sx = (float)(x - textWidth/2);
sy = (float)(y + lm.getAscent()/2);
g2.drawString(s, sx, sy);
theta += phi;
}
g2.dispose();
}
public void toggleVisibility()
{
showConstructionMarkers = !showConstructionMarkers;
image = null;
repaint();
}
}
class Visibility extends MouseAdapter
{
PieChartPanel pie;
public Visibility(PieChartPanel pcp)
{
pie = pcp;
}
public void mousePressed(MouseEvent e)
{
```

```
if(e.getClickCount() > 1)
pie.toggleVisibility();
}
}
```

```
D:\Java Programs>javac PieChart.java
D:\Java Programs>java PieChart
```