Engineering, science and creative programming require a lot of imagination, analysis and computation. With top-down design methodology and easy introduction to simple GUI for inputs and outputs Java is used from cell phones to smart cards. Unlike C++ and Excel, Java can create good graphical user interfaces with less lines of code. The fact is use of Java technology in the engineering and scientific field has become unavoidable.

**Baby steps in Java programming**

Java is an object-oriented portable programming language and is a consequence of a research project funded by Sun Microsystems and developed in a C++ based language named Oak in 1991. Sun later renamed it as Java. Java programs consist of classes which include methods. However programmers use existing classes from Java class libraries (Java API) or create their own. Reusability of the classes helps programmers build reliable systems.

**Operating systematically**

Here are some of the engineering/scientific examples solved using Java coding with relevant outputs.

**Tsiolkovskii’s equation** applies Newton’s law of motion to rocket flight. The following equation is applied sequentially to each rocket stage to calculate final velocity.

\[
\text{Final velocity of the rocket} = \text{Initial velocity of the rocket} + \text{Velocity of the rocket motor exhaust gas relative to the rocket} \times \log\left(\frac{\text{Initial mass of the rocket}}{\text{Final mass of the rocket}}\right)
\]

The Java source code Tsiolkovskii’s equation.java is used to solve this engineering problem.

```java
/* Tsiolkovskii’s equation.java*/
/* @author Meerajoseph */
/* java packages - collection of classes*/
import javax.swing.*;
import javax.swing.JOptionPane; // program uses JOptionPane
public class eq {
    /* main method begins execution of Java application*/
    public static void main(String[] args)
    {
        double mi=20000.0; mi<31000.0; mi=mi+1000.0
        double finvel = Math.floor(vt + vrel*(Math.log(mi/mf)));
        JOptionPane.showMessageDialog(null,"java for engineers and Scientists:n+ "
        "nTsiolkovskii’s EQUATION:n+ "
        "nRocket initial velocity t R+ vt + "m/s+ "
        "nGas relative velocity t + vrel + "m/s+ "
        "nRocket final mass t + mf + "kg"+"nRocket initial mass t + mi + "kg"+"nRocket final velocity +finvel + "m/s","Tsiolkovskii’s Equation",
        JOptionPane.INFORMATION_MESSAGE);
    }
}
```

**Bungee jumping** is a popular sport. A cord of fixed length \( D \) is attached to an elastic cord of unstretched length \( l \) and force constant \( k \). The static cord is attached to the ankles of the jumper. For a jumper of mass \( m \), the value of the maximum length of the stretched bungee system, where \( g \) is the acceleration of gravity. The following problem computes \( y_{max} \) for \( m,k \) and \( l \) for \( D = 1.5 \) to \( 10 \) m in steps of \( 0.5 \) (The values \( m,k \) and \( l \) are given in the program.)

Java coding for is given in Bunjee jumpers.java.

```java
/* Bunjee jumpers beware.java*/
/* @author MeeraJoseph */
import javax.swing.*;
import javax.swing.JOptionPane;
public class bungeejump {
    /* main method begins execution of Java application*/
    public static void main(String init[])
    {
        String s11=JOptionPane.showInputDialog("Weight of the bungee jumper");
        double m=Double.parseDouble(s11);
        double g=9.8; double l=10.0; double k=10;
        for ( double D=1.5; D<=10.0; D=D+0.5 )
        {
```

Output of Tsiolkovskii’s equation.
/* @author Meerjose – Draw shapes with Java2D*/
public void paint(Graphics g)
{
    super.paint(g); // calls super class paint
    Graphics2D g2d = (Graphics2D) g;
    int xP[]={60,72,114,78,88,60,32,42,6,48);
    Graphics2D gr = (Graphics2D) g;
    GeneralPath s=new GeneralPath();
    s.moveTo(xP[0]*5,yP[0]*7);
    //set the initial coordinates of General path
    for (int ct=5;ct<XP.LENGTH;CT++)
        s.lineTo(xP[ct],yP[ct]);
    s.closePath();
    gr.translate(400,300); //translate the origin to 400,300
    for( int ct=1;ct<=50;ct=ct+1){
        gr.rotate(5); // rotate coordinate system
        gr.setColor(new Color((int)(Math.random()*156),
        (int)(Math.random()*156))); // set random drawing color
        gr.fill(s); } } // end method paint

Graphics with Java

To begin drawing you need an understanding of the coordinate system and graphics context.

A part of the Java code which creates the Output of graphics problem 1.

A sample Applet which calculates monthly installment is shown in Monthly instalment calculator.
(This program involves a lot of mathematical calculations).

Conclusion

All developers/engineers can express design easily with Unified Modeling Language. But developing actual web-based applications or object-oriented programs is a challenging experience. The use of Swing, Java API, Java2D / 3D, JDB, J2ME, JMS and various GUI components has made Java a world class programming language which can be used for computations, charting, networking, create animations, wireless applications, distributed systems and to create and deploy Java Server Pages.

References

dwzone=java
2. www.dietel.com
6. To download a powerful Java integrated development environment use the following link- http://developers.sun.com/

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