Dec 9, 2014 by whimsycwd

Overview

计算机图形学期末PJ

1. 多边形区域填充
2. 3D立方体投影展示程序

Requirements

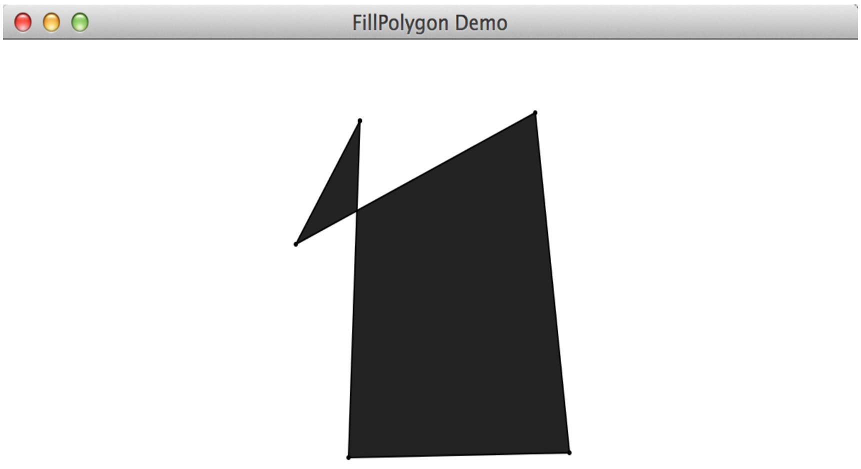
JDK1.6

How to run

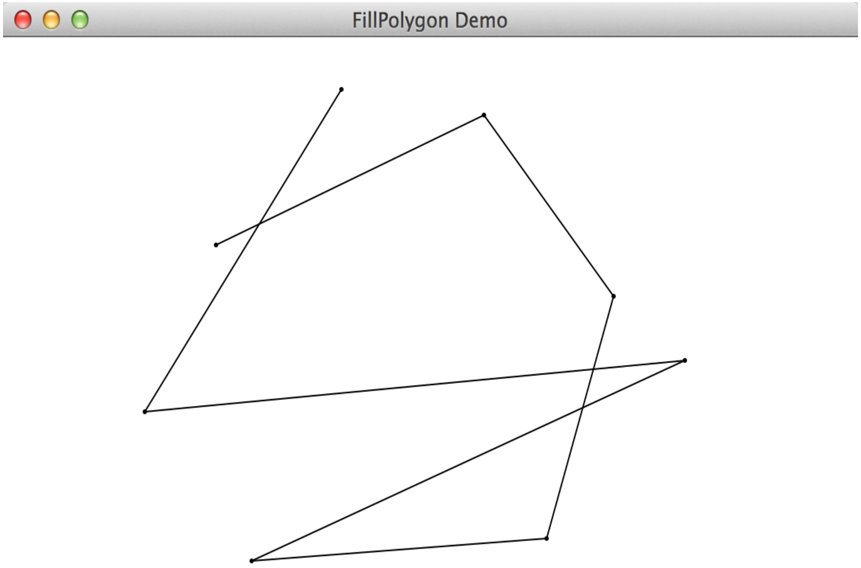
```
git clone https://github.com/whimsycwd/GemetoryPJ.git
mvn clean compile
mvn exec:java -Dexec.mainClass="base.FillPolygon"   # 多边形填充
mvn exec:java -Dexec.mainClass="bonus.Cube"         # 3D立方体投影
```

Hot to Operate

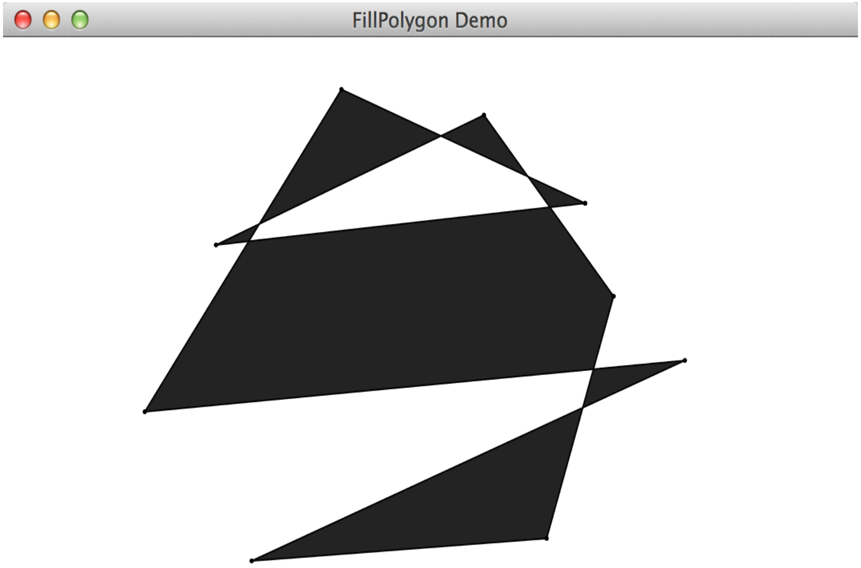
多边形填充



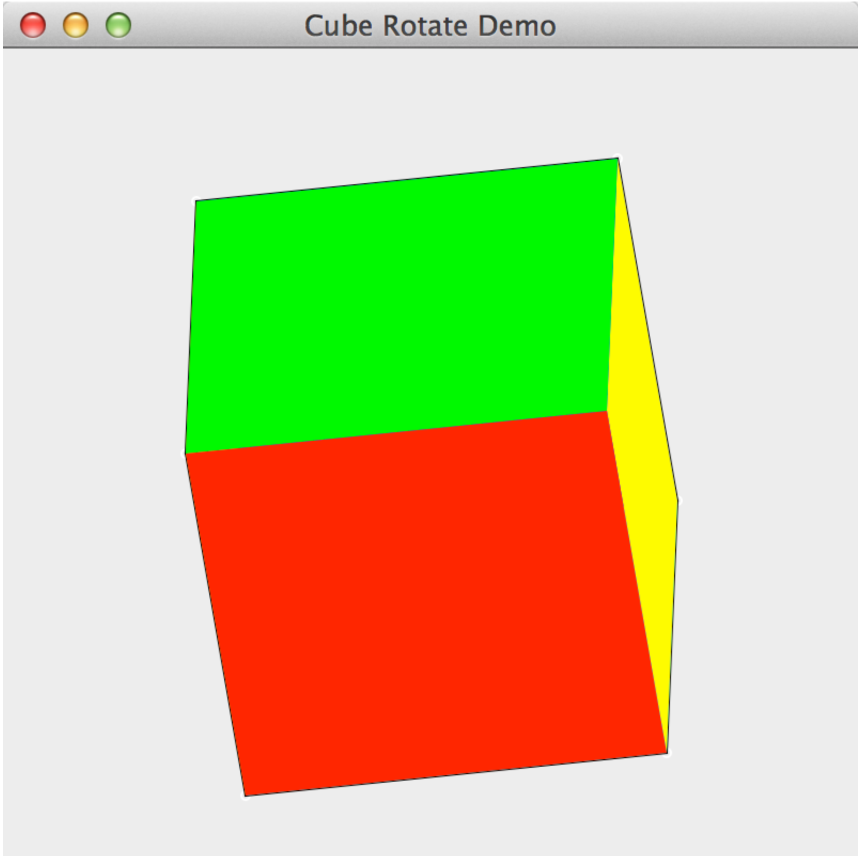
1. 鼠标点击n个点
2. 最后一个点双击
3. 这n个点组成的的多边形内部被染色



示例:



3D立方体投影



- `w` and `s` : Pitch
- `a` and `d` : Yaw
- `q` and `e` : Roll

实现算法

多边形填充

1. 跨立实验判断线段相交

```
    public double cross(Point a, Point b, Point c) {
    return (double) (b.x - a.x) * (c.y - a.y) - (double) (b.y - a.y)
* (c.x - a.x);
 }
 public int sign(double value) {
     if (value > 1e-8) return 1;
     if (value < -1e-8) return -1;
     return 0;

 }
 public boolean intersection(Point a, Point b, Point c, Point d) {
     if (sign(cross(a,b,c)) * sign(cross(a, b, d)) > 0) return false;
     if (sign(cross(c,d,a)) * sign(cross(c,d,b)) > 0)  return false;
     return true;
 }
```

2. 针对每个像素, 采用射线法, 奇数个与多边形相交的点则为内部点. ``` private void fill() {

```
Point sp = new Point(9998, 9999);

int n = nodes.size();

for (int i = 0; i < WIDTH; ++i) {
    for (int j = 0; j < HEIGHT; ++j) {
        int intersectionNumber = 0;
        for (int k = 0; k < nodes.size(); ++k) {
            if (intersection(nodes.get(k), nodes.get((k + 1) % n), new
Point(i,j), sp)) {
                ++intersectionNumber;
            }
        }

        if (intersectionNumber % 2 == 1) {
            Graphics g = p.getGraphics();
            g.drawLine(i, j, i, j);
        }
    }
}
```

```

# 3D立方体投影

1. 图形旋转参考P371, 右手系旋转的方式

```
        // rotate along axis X
```
```

```
}
```

```
double [][] matrixAlpha = new double[4][4];
matrixAlpha[0][0] = 1;
matrixAlpha[1][1] = Math.cos(alpha);
matrixAlpha[1][2] = Math.sin(alpha);
matrixAlpha[2][1] = -Math.sin(alpha);
matrixAlpha[2][2] = Math.cos(alpha);
matrixAlpha[3][3] = 1;


// rotate along axis Y;
double [][] matrixBeta = new double[4][4];
matrixBeta[0][0] = Math.cos(beta);
matrixBeta[0][2] = -Math.sin(beta);
matrixBeta[1][1] = 1;
matrixBeta[2][0] = Math.sin(beta);
matrixBeta[2][2] = Math.cos(beta);
matrixBeta[3][3] = 1;

double [][] matrixGamma = new double[4][4];
matrixGamma[0][0] = Math.cos(gamma);
matrixGamma[0][1] = Math.sin(gamma);
matrixGamma[1][0] = -Math.sin(gamma);
matrixGamma[1][1] = Math.cos(gamma);
matrixGamma[2][2] = 1;
matrixGamma[3][3] = 1;




g.setColor(Color.white);
g.clearRect(p.getX(), p.getY(), p.getWidth(), p.getHeight());


Point3D [] points2 = new Point3D[8];
for (int i = 0; i < 8; ++i) {
    double [] row = new double[4];
    row[0] = points[i].getX();
    row[1] = points[i].getY();
    row[2] = points[i].getZ();
    row[3] = 1;

    row = multiply(row, matrixAlpha);
    row = multiply(row, matrixBeta);
    row = multiply(row, matrixGamma);

    points2[i] = new Point3D(row[0], row[1], row[2]);

    drawDot(g, row[0], row[1]);

}
```

2. 面染色采用 P497 画家算法, 先对平面的Z重心进行排序, 由远及近进行染色.

```
      // fill in color
    double [] center = new double[6];

    for (int i = 0; i < 6; ++i) {
        center[i] = avg(points2, facet[i]);
    }

    int [] idx = new int[6];
    for (int i = 0; i < 6; ++i) {
        idx[i] = i;
    }

    for (int i = 0; i < 6; ++i) {
        for (int j = i+1; j < 6; ++j) {
            if (center[idx[i]] > center[idx[j]]) {
                int t = idx[i];
                idx[i] = idx[j];
                idx[j] = t;
            }
        }
    }

    for (int i = 0; i < 6; ++i) {
        Polygon polygon = new Polygon();
        for (int j = 0; j < 4; ++j) {
            int nodeId = facet[idx[i]][j];
            polygon.addPoint(transform(points2[nodeId].getX()),
transform(points2[nodeId].getY()));
        }

        g.setColor(penColor[idx[i]]);
        g.fillPolygon(polygon);
    }
```

遇到的困难

1. Point3D类属于javafx包, 不是标准包, 最终改为自定义的类
2. 图形渲染闪烁问题, 从AWT转化为Swing, 用其框架自动的Double-Buffering来避免闪烁问题, 其中在画图的时候应传递同一个Graphics 否则会导致画布刷新, 从而展示不出新的东西.

参考文献

1. http://docs.oracle.com/javase/tutorial/extra/fullscreen/doublebuf.html

2. http://www.cnblogs.com/muding/archive/2013/02/19/3031447.html
3. http://www.vineetmanohar.com/2009/11/3-ways-to-run-java-main-from-maven/
4. http://mojo.codehaus.org/exec-maven-plugin/
5. http://www.ibm.com/developerworks/cn/java/l-java3d/