Experiment 5

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Subject Name: Computer Graphics Lab **Subject Code: 22CSH-352**

1. **Aim:**

   Implement clockwise and anticlockwise rotation of a triangle about a specified point and evaluate the results.

2. **Objective:**

   To perform and visualize clockwise and anticlockwise rotations of a triangle about a specified point.

3. **Algorithm:**

   a) **To Rotate Clockwise :**

   1. Initialize Graphics Mode:-
      Detect and initialize the graphics driver and mode using initgraph().

   2. **Input Triangle Coordinates:-**
      Take user input for the three vertices *(x1,y1)(x1, y1)*(x1,y1), *(x2,y2)(x2, y2)*(x2,y2), *(x3,y3)(x3, y3)*(x3,y3).

   3. **Draw Original Triangle:-**
      Use drawpoly() to display the initial triangle.

   4. **Compute Centroid:-**
      Calculate the centroid *(xc,yc)(xc, yc)*(xc,yc) using:
      xc= x1+x2+x2 / 3, yc= y1+y2+y3 / 3

   5. **Input Rotation Angle:-**
      Accept the rotation angle from the user and convert it to radians:
      rad= angle x 3.14/180

   6. **Compute New Rotated Coordinates (Clockwise Rotation Formula):-**
      For each vertex *(X,Y)(X, Y)*(X,Y), calculate:
      X'= xc+ (X-xc) . cos(rad) + (Y-yc) . Sin(rad)
      Y'= yc- (X-xc) . sin(rad) + (Y-yc) . Cos(rad)

7. **Draw Rotated Traingle:-**
   Use drawpoly() to display the rotated triangle in a different color.

8. **Wait for User Input & Close Graphics Mode:-**
   Use getch() to pause, then closegraph() to exit.

b) <u>To Rotate Anti-clockwise:</u>

1. **Initialize Graphics Mode:-**
   Detect and initialize the graphics driver and mode using initgraph().

2. **Input Triangle Coordinates:-**
   Take user input for the three vertices (x1,y1), (x2,y2), (x3,y3).

3. **Draw Original Triangle:-**
   Use drawpoly() to display the initial triangle.

4. **Compute Centroid:-**
   Calculate the centroid (xc,yc) using:
   xc= x1+x2+x2 / 3, yc= y1+y2+y3 / 3

5. **Input Rotation Angle:-**
   Accept the rotation angle from the user and convert it to radians:
   rad= angle x 3.14/180

6. **Compute New Rotated Coordinates (Clockwise Rotation Formula):-**
   For each vertex (X,Y), calculate:
   X’= xc+ (X-xc) . cos(rad) - (Y-yc) . Sin(rad)
   Y’= yc- (X-xc) . sin(rad) + (Y-yc) . Cos(rad)

7. **Draw Rotated Traingle:-**
   Use drawpoly() to display the rotated triangle in a different color.

8. **Wait for User Input & Close Graphics Mode:-**
   Use getch() to pause, then closegraph() to exit.

4. Implementation/Code:

a.To Rotate Clockwise:

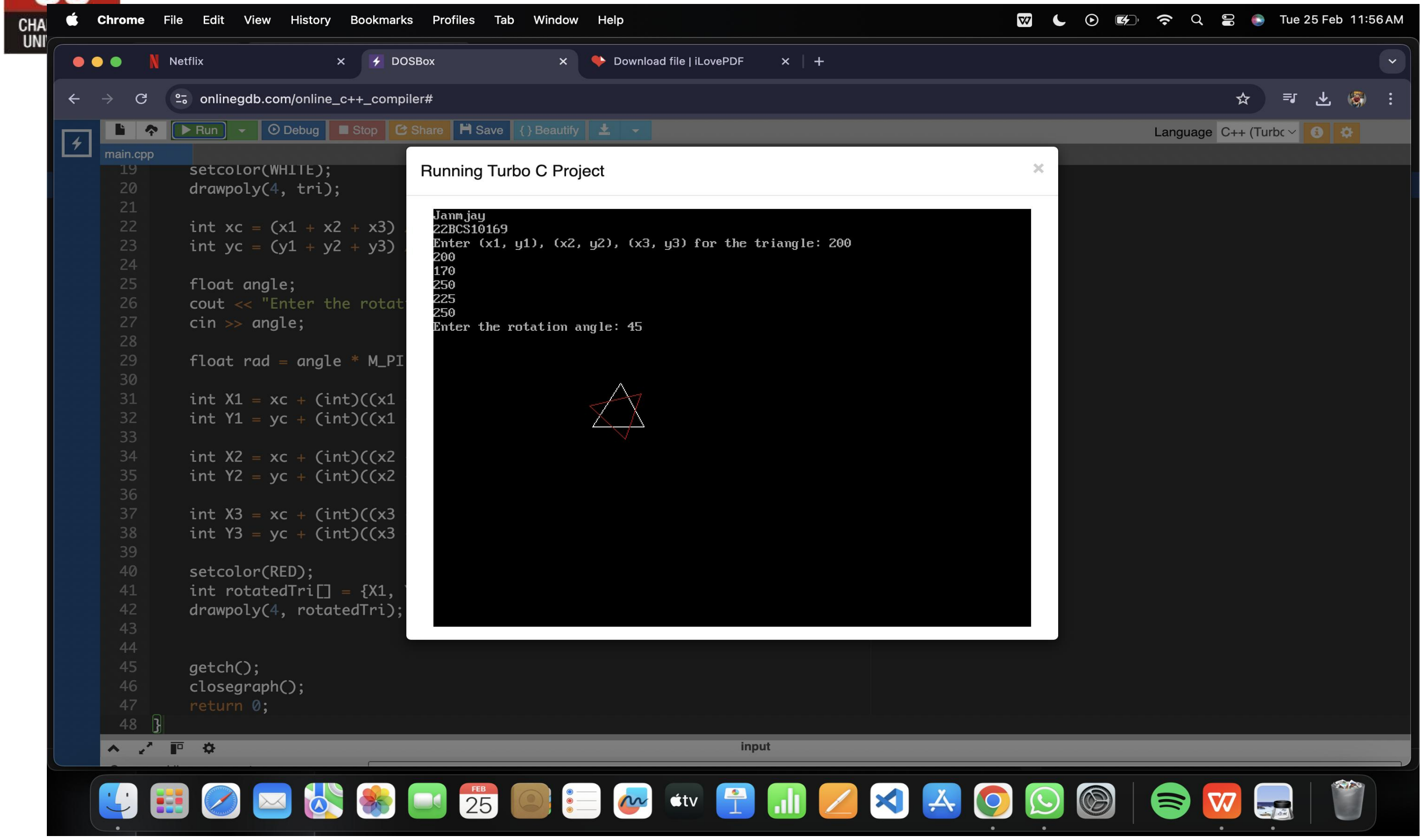
```
#include <iostream>
#include <conio.h>
#include <graphics.h>
#include <math.h>

using namespace std;
int main() {
clrscr();
int gd = DETECT, gm;
initgraph(&gd, &gm, "C:\\Turboc3\\BGI");  // Use the correct BGI path

int x1, y1, x2, y2, x3, y3;
cout << "Enter (x1, y1), (x2, y2), (x3, y3) for the triangle: ";
cin >> x1 >> y1 >> x2 >> y2 >> x3 >> y3;

int tri[] = {x1, y1, x2, y2, x3, y3, x1, y1};
setcolor(WHITE);
drawpoly(4, tri);

int xc = (x1 + x2 + x3) / 3;
int yc = (y1 + y2 + y3) / 3;

float angle;
cout << "Enter the rotation angle: ";
cin >> angle;

float rad = angle * M_PI / 180.0;

int X1 = xc + (int)((x1 - xc) * cos(rad) - (y1 - yc) * sin(rad));
int Y1 = yc + (int)((x1 - xc) * sin(rad) + (y1 - yc) * cos(rad));

int X2 = xc + (int)((x2 - xc) * cos(rad) - (y2 - yc) * sin(rad));
int Y2 = yc + (int)((x2 - xc) * sin(rad) + (y2 - yc) * cos(rad));

int X3 = xc + (int)((x3 - xc) * cos(rad) - (y3 - yc) * sin(rad));
int Y3 = yc + (int)((x3 - xc) * sin(rad) + (y3 - yc) * cos(rad));

setcolor(RED);
int rotatedTri[] = {X1, Y1, X2, Y2, X3, Y3, X1, Y1};
drawpoly(4, rotatedTri);
getch();
closegraph();
return 0;
}
```

b. To Rotate Anti-Clockwise:

```
 #include <iostream.h>
 #include <conio.h>
 #include <graphics.h>
 #include <math.h>

 void main()
 { clrscr();
 // Initialize graphics mode
 int gd = DETECT, gm;
 initgraph(&gd, &gm, "C:\\Turboc3\\BGI");

 // Input triangle coordinates
 int x1, y1, x2, y2, x3, y3;
 cout << "Enter (x1, y1), (x2, y2), (x3, y3) for the triangle: ";
 cin >> x1 >> y1 >> x2 >> y2 >> x3 >> y3;


// Draw original triangle
 int tri[] = {x1, y1, x2, y2, x3, y3, x1, y1};
 setcolor(WHITE);
 drawpoly(4, tri);

 // Compute centroid
 int xc = (x1 + x2 + x3) / 3;
 int yc = (y1 + y2 + y3) / 3;

 // Input rotation angle
 float angle;
 cout << "Enter the rotation angle: ";
 cin >> angle;

 // Convert angle to radians
 float rad = angle * M_PI / 180;

 // Compute new rotated coordinates (Anti-clockwise rotation formula)
 int X1 = xc + (int)((x1 - xc) * cos(rad) - (y1 - yc) * sin(rad));
int Y1 = yc + (int)((x1 - xc) * sin(rad) + (y1 - yc) * cos(rad));

int X2 = xc + (int)((x2 - xc) * cos(rad) - (y2 - yc) * sin(rad));
int Y2 = yc + (int)((x2 - xc) * sin(rad) + (y2 - yc) * cos(rad));

int X3 = xc + (int)((x3 - xc) * cos(rad) - (y3 - yc) * sin(rad));
int Y3 = yc + (int)((x3 - xc) * sin(rad) + (y3 - yc) * cos(rad));

// Draw rotated triangle
setcolor(BLUE);
int rotatedTri[] = {X1, Y1, X2, Y2, X3, Y3, X1, Y1};
drawpoly(4, rotatedTri);

getch();
closegraph();
}
```

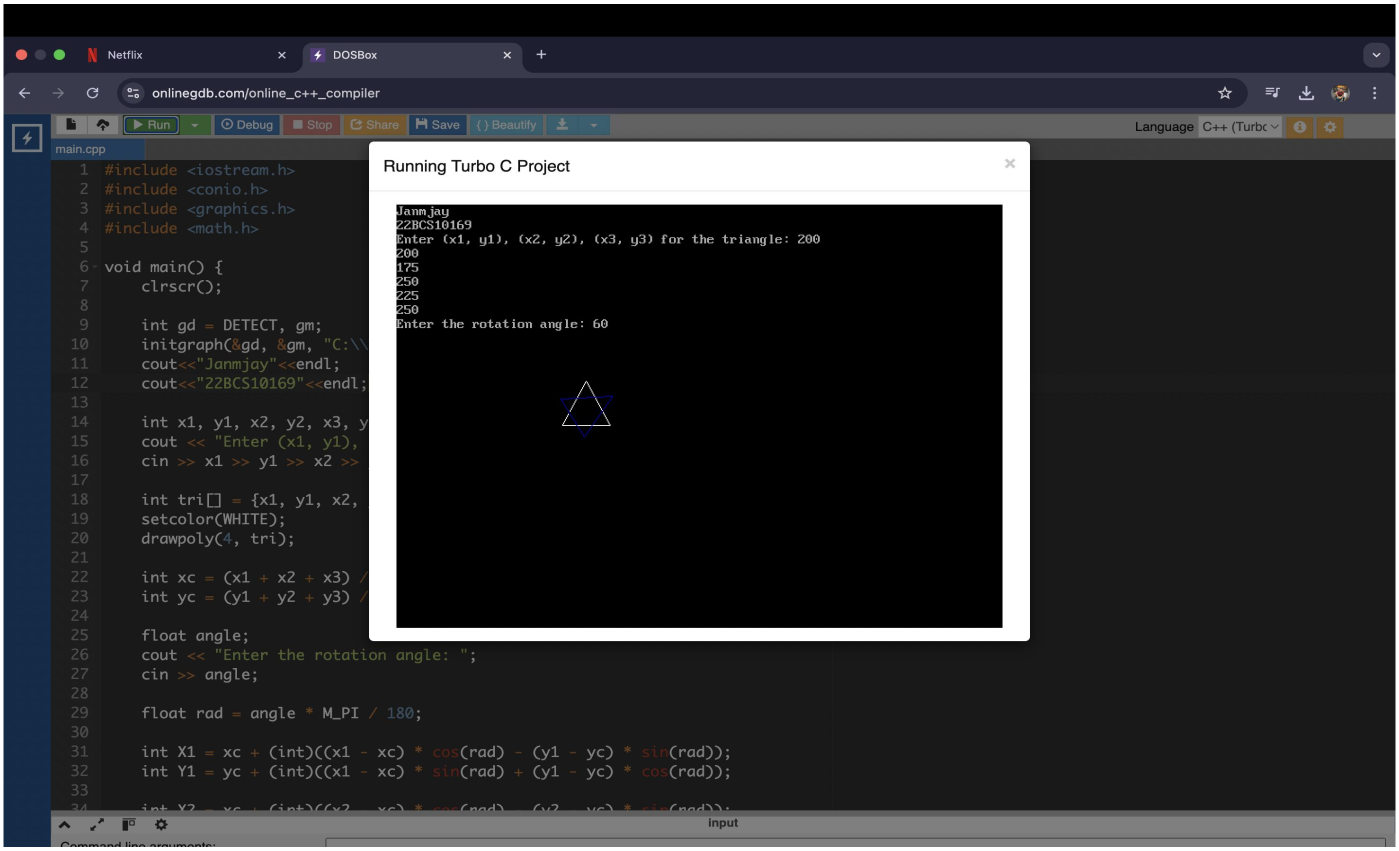
Output :-

Output:



```
    setcolor(WHITE);
    drawpoly(4, tri);

    int xc = (x1 + x2 + x3)
    int yc = (y1 + y2 + y3)

    float angle;
    cout << "Enter the rotat
    cin >> angle;

    float rad = angle * M_PI

    int X1 = xc + (int)((x1
    int Y1 = yc + (int)((x1

    int X2 = xc + (int)((x2
    int Y2 = yc + (int)((x2

    int X3 = xc + (int)((x3
    int Y3 = yc + (int)((x3

    setcolor(RED);
    int rotatedTri[] = {X1,
    drawpoly(4, rotatedTri);


    getch();
    closegraph();
    return 0;
}
```

```
Janmjay
22BCS10169
Enter (x1, y1), (x2, y2), (x3, y3) for the triangle: 200
200
170
250
225
250
Enter the rotation angle: 45
```



```
#include <iostream.h>
#include <conio.h>
#include <graphics.h>
#include <math.h>

void main() {
    clrscr();

    int gd = DETECT, gm;
    initgraph(&gd, &gm, "C:\\
    cout<<"Janmjay"<<endl;
    cout<<"22BCS10169"<<endl;

    int x1, y1, x2, y2, x3, y
    cout << "Enter (x1, y1),
    cin >> x1 >> y1 >> x2 >>

    int tri[] = {x1, y1, x2,
    setcolor(WHITE);
    drawpoly(4, tri);

    int xc = (x1 + x2 + x3) /
    int yc = (y1 + y2 + y3) /

    float angle;
    cout << "Enter the rotation angle: ";
    cin >> angle;

    float rad = angle * M_PI / 180;

    int X1 = xc + (int)((x1 - xc) * cos(rad) - (y1 - yc) * sin(rad));
    int Y1 = yc + (int)((x1 - xc) * sin(rad) + (y1 - yc) * cos(rad));
```

```
Janmjay
22BCS10169
Enter (x1, y1), (x2, y2), (x3, y3) for the triangle: 200
200
175
250
225
250
Enter the rotation angle: 60
```

5. Learning Outcomes:-

- Learned how **rotation transformation** works in computer graphics using **trigonometric functions** (sin, cos).
- Explored the difference between **clockwise** and **anti-clockwise** rotation by modifying the **sine term signs** in the rotation formula.
- Understood the importance of **centroid (xc, yc)** in rotating a shape **around its center** rather than the origin.
- Gained hands-on experience in using **C++ graphics.h** library functions like initgraph(), drawpoly(), and setcolor() for visual representation.
- Learned the necessity of converting **degrees to radians** using the formula:
  rad= angle x 3.14/180