Data Structures

Triangle

Contents:

- Find the area of triangle .
- Find the interior angles of a triangle and print them.
- Print the generated triangles.
- Writing whole program.

Finding the area of Triangle:

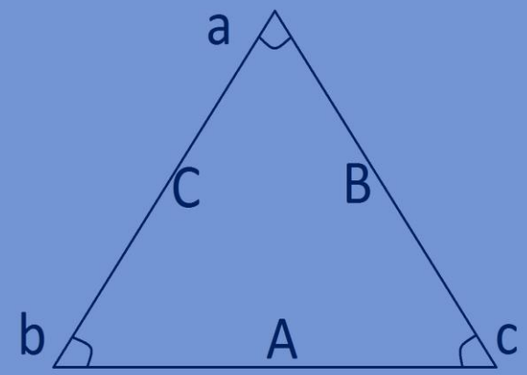
- Formulae for calculating area of triangle from Its vertices is-

  Area=1/2(x1(y2−y3)+x2(y3−y1)+x3(y1−y2))

  Here x1=t[i].a.x,y1=t[i]a.y

  X2=t[i].b.x,y2=t[i].b.y

  X3=t[i].c.x,y3=y[i].c.y




```
void computeArea(TRIANGLE*t,int n)
{
    for(int i=0;i<n;i++)
    {
        t[i].area=(1/2.0)*abs((t[i].a.x*(t[i].b.y-
t[i].c.y)+t[i].b.x*(t[i].c.y-t[i].a.y)+t[i].c.x*(t[i].a.y-t[i].b.y)));
    }
}
```

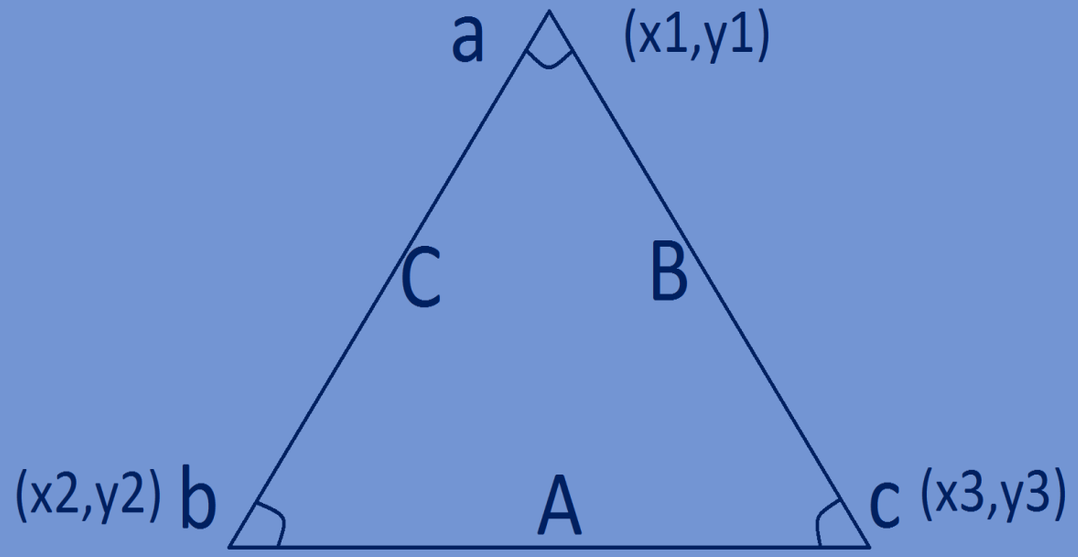
Finding the interior angles of generated triangles:

- From law of cosines we have

  $C^{\wedge 2} = A^{\wedge 2} + B^{\wedge 2} - 2AB\cos(c)$

  $B^{\wedge 2} = A^{\wedge 2} + C^{\wedge 2} - 2AC\cos(b)$

  $\cos(a) = B^{\wedge 2} + C^{\wedge 2} - A^{\wedge 2} / 2BC$



- $A=\sqrt{((x3-x2)^2+(y3-y2)^2)}$

  $B=\sqrt{((x3-x1)^2+(y3-y1)^2)}$

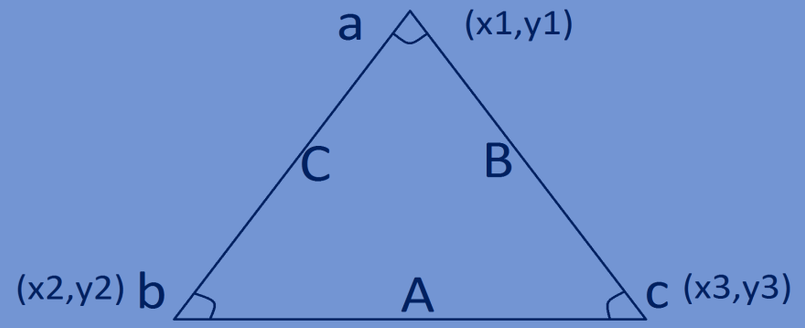
  $C=\sqrt{((x2-x1)^2+(y2-y1)^2)}$

  Here x1=t[i].a.x,y1=t[i]a.y

  X2=t[i].b.x,y2=t[i].b.y

  X3=t[i].c.x,y3=y[i].c.y

- $\cos(b) = A^{\wedge 2} + C^{\wedge 2} - B^{\wedge 2} / 2AC$
- $\cos(c) = A^{\wedge 2} + B^{\wedge 2} - C^{\wedge 2} / 2AC$
- $\cos(a) = B^{\wedge 2} + C^{\wedge 2} - A^{\wedge 2} / 2BC$




```
void findPrintInAngles(TRIANGLE *t, int n) {
    float cosA1,cosA2,cosA3;
    float a1,a2,a3;
    int i;
    for(i=0; i<n; i++) {
        a1=sqrt(pow((t[i].b.x-t[i].c.x),2)+pow((t[i].b.y-t[i].c.y),2));
        a2=sqrt(pow((t[i].c.x-t[i].a.x),2)+pow((t[i].c.y-t[i].a.y),2));
        a3=sqrt(pow((t[i].a.x-t[i].b.x),2)+pow((t[i].a.y-t[i].b.y),2));
        float num1=((pow(a2,2))+(pow(a3,2))-(pow(a1,2)));float den=(2*a2*a3);
        cosA1=num1/den;
        float num2=((pow(a3,2))+(pow(a1,2))-(pow(a2,2)));float den2=(2*a1*a3);
        cosA2=num2/den2;
        float num3=((pow(a1,2))+(pow(a2,2))-(pow(a3,2)));float den3=(2*a1*a2);
        cosA3=num3/den3;
        printf("The Angles Of A Triangle Are: %f ,%f ,%f degrees
\n",(acos(cosA1)*57.295),(acos(cosA2)*57.295),(acos(cosA3)*57.295));
    }
}
```

Printing the generated triangle coordinates and the area of generated triangle:

```
void printTriangles(TRIANGLE *t, int n)
{
    for(int i=0;i<n;i++)
    {
        printf("(%f,%f),",t[i].a.x,t[i].a.y);
        printf("(%f,%f),",t[i].b.x,t[i].b.y);
        printf("(%f,%f)",t[i].c.x,t[i].c.y);
        printf("    Area is:%f\n",t[i].area);
    }
}
```

Complete program:

```
#include <stdio.h>
#include<stdlib.h>
#include<time.h>
#include<math.h>

//vertex structure
typedef struct{
   float x;
   float y;
}point;

//triangle structure
typedef struct{
    point a;
    point b;
    point c;
    float area;
}TRIANGLE;

TRIANGLE* genTriangles(int n) {
    srand(time(NULL));
    TRIANGLE *t;
    t=(TRIANGLE*) malloc((n)*sizeof(TRIANGLE));
    for(int i=0;i<n;i++) {
        t[i].a.x=rand()%30+10;
        t[i].a.y=rand()%30+10;
```

```
        t[i].b.x=rand()%30+10;
        t[i].b.y=rand()%30+10;

        t[i].c.x=rand()%30+10;
        t[i].c.y=rand()%30+10;
    }
    return t;
}
void computeArea(TRIANGLE*t,int n) {
    for(int i=0;i<n;i++) {
        t[i].area=(1/2.0)*abs((t[i].a.x*(t[i].b.y-t[i].c.y)+t[i].b.x*(t[i].c.y-
t[i].a.y)+t[i].c.x*(t[i].a.y-t[i].b.y)));
    }
}
void printTriangles(TRIANGLE *t, int n)
{
    for(int i=0;i<n;i++)
    {
        printf("(%f,%f),",t[i].a.x,t[i].a.y);
        printf("(%f,%f),",t[i].b.x,t[i].b.y);
        printf("(%f,%f)",t[i].c.x,t[i].c.y);
        printf("    Area is:%f\n",t[i].area);
    }
}
void findPrintInAngles(TRIANGLE *t, int n) {
    float cosA1,cosA2,cosA3;
    float a1,a2,a3;
    int i;
    for(i=0; i<n; i++) {
```

```
        a1=sqrt(pow((t[i].b.x-t[i].c.x),2)+pow((t[i].b.y-t[i].c.y),2));
        a2=sqrt(pow((t[i].c.x-t[i].a.x),2)+pow((t[i].c.y-t[i].a.y),2));
        a3=sqrt(pow((t[i].a.x-t[i].b.x),2)+pow((t[i].a.y-t[i].b.y),2));
        float num1=((pow(a2,2))+(pow(a3,2))-(pow(a1,2)));float den=(2*a2*a3);
        cosA1=num1/den;
        float num2=((pow(a3,2))+(pow(a1,2))-(pow(a2,2)));float den2=(2*a1*a3);
        cosA2=num2/den2;
        float num3=((pow(a1,2))+(pow(a2,2))-(pow(a3,2)));float den3=(2*a1*a2);
        cosA3=num3/den3;
        printf("The Angles Of A Triangle Are: %f, %f ,%f
degrees\n",(acos(cosA1)*57.295),(acos(cosA2)*57.295),(acos(cosA3)*57.295));
    }
}

int main(){
    int n=5;
    TRIANGLE *t;
    t=genTriangles(n);
    computeArea(t,n);
    printTriangles(t,n);
    findPrintInAngles(t,n);
}
```

```
(35.000000,36.000000),(37.000000,28.000000),(38.000000,31.000000)   Area is:7.000000
(35.000000,35.000000),(38.000000,10.000000),(32.000000,11.000000)   Area is:73.500000
(18.000000,28.000000),(28.000000,32.000000),(33.000000,11.000000)   Area is:115.000000
The Angles Of A Triangle Are: 16.927287, 32.470751 ,130.599516 degrees
The Angles Of A Triangle Are: 13.967602, 73.693895 ,92.336058 degrees
The Angles Of A Triangle Are: 70.376782, 81.589982 ,28.030791 degrees
```