PUNE INSTITUTE OF COMPUTER TECHNOLOGY

IT Department

CGL Assignment 7

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Title:

Fractal Patterns

Problem Statement:

Generate fractal curves using i) Bezeir ii) Koch Curve

Theory:

A fractal is a never-ending pattern. Fractals are infinitely complex patterns that are self-similar across different scales. They are created by repeating a simple process over and over in an ongoing feedback loop. Driven by recursion, fractals are images of dynamic systems – the pictures of Chaos. Geometrically, they exist in between our familiar dimensions. Fractal patterns are extremely familiar, since nature is full of fractals. For instance: trees, rivers, coastlines, mountains, clouds, seashells, hurricanes, etc.

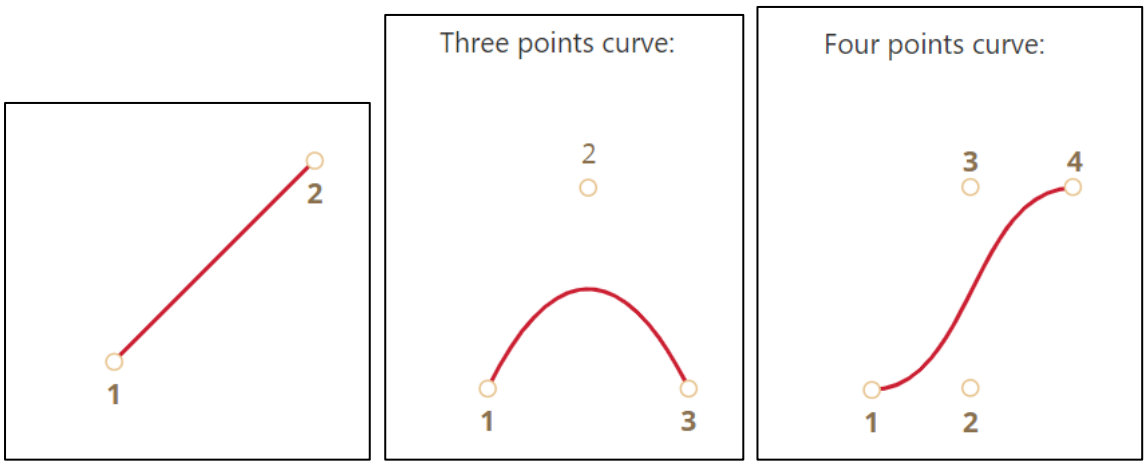
1) Bezier Curve :-

Bezier curves are used in computer graphics to draw shapes, for CSS animation and in many other places. They are a very simple thing, worth to study once and then feel comfortable in the world of vector graphics and advanced animations.

A Bezier curve is defined by control points.

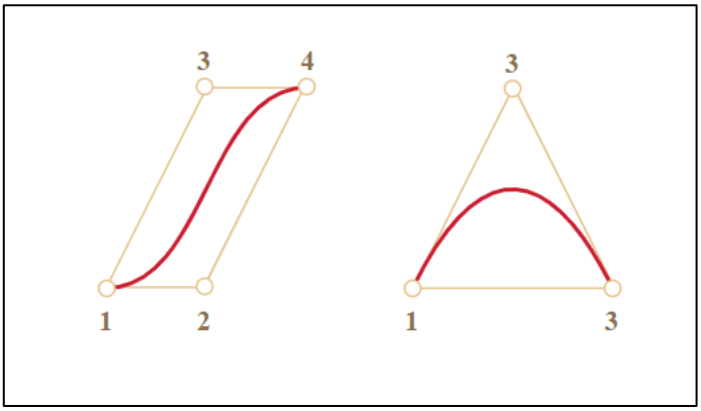
There may be 2, 3, 4 or more.

For instance, two points curves :-



If you look closely at these curves, you can immediately notice:

1. **Points are not always on curve.** That is perfectly normal, later we'll see how the curve is built.
2. **The curve order equals the number of points minus one**. For two points we have a linear curve (that is a straight line), for three points – quadratic curve (parabolic), for four points – cubic curve.
3. **A curve is always inside the convex hull of control points:**

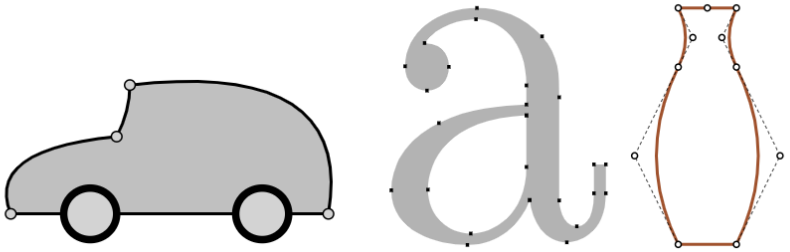


Because of that last property, in computer graphics it is possible to optimize intersection tests. If convex hulls do not intersect, then curves do not either. So, checking for the convex hulls intersection first can give a very fast "no intersection" result. Checking the intersection of convex hulls is much easier, because they are rectangles, triangles and so on (see the picture above), much simpler figures than the curve.

The main value of Bezier curves for drawing – by moving the points the curve is changing *in intuitively obvious way*.

After some practice it becomes obvious how to place points to get the needed curve. And by connecting several curves we can get practically anything.

Here are some examples:



2) Koch Curve :-

What is Koch Curve?

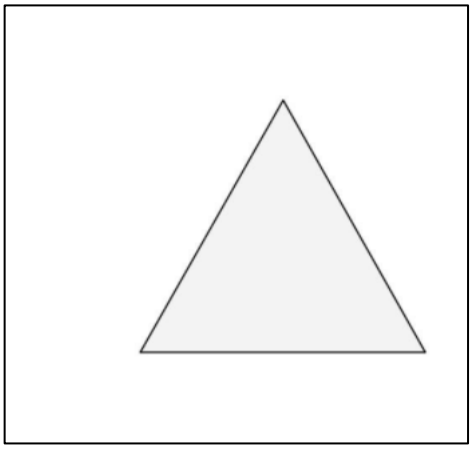
The Koch snowflake (also known as the Koch curve, Koch star, or Koch island) is a mathematical curve and one of the earliest fractal curves to have been described. It is based on the Koch curve, which appeared in a 1904 paper titled “On a continuous curve without tangents, constructible from elementary geometry” by the Swedish mathematician Helge von Koch.

The progression for the area of the snowflake converges to 8/5 times the area of the original triangle, while the progression for the snowflake’s perimeter diverges to infinity. Consequently, the snowflake has a finite area bounded by an infinitely long line.

Algorithm :-

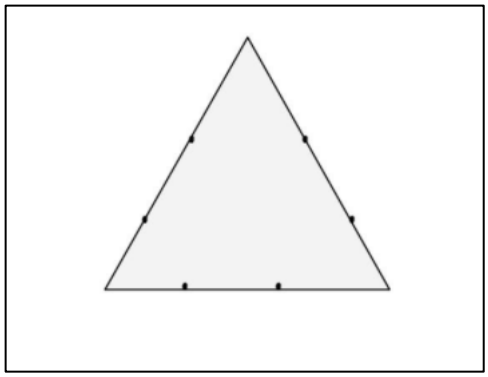
Step1:

Draw an equilateral triangle. You can draw it with a compass or protractor, or just eyeball it if you do not want to spend too much time drawing the snowflake. It’s best if the length of the sides is divisible by 3, because of the nature of this fractal. This will become clear in the next few steps.



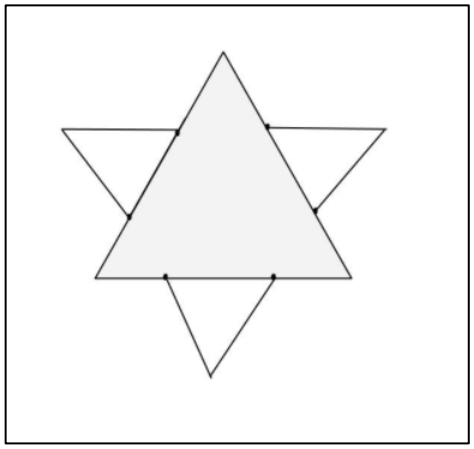
Step2:

Divide each side in three equal parts. This is why it is handy to have the sides divisible by three.



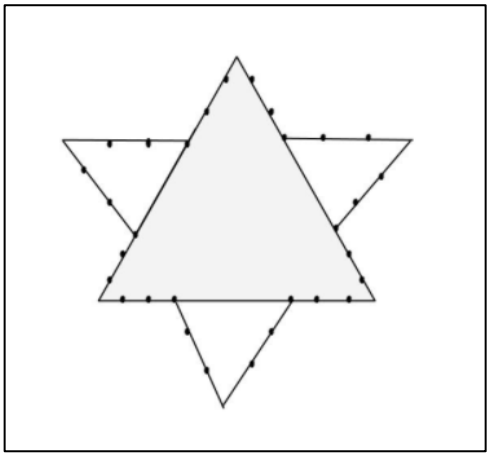
Step3:

Draw an equilateral triangle on each middle part. Measure the length of the middle third to know the length of the sides of these new triangles.



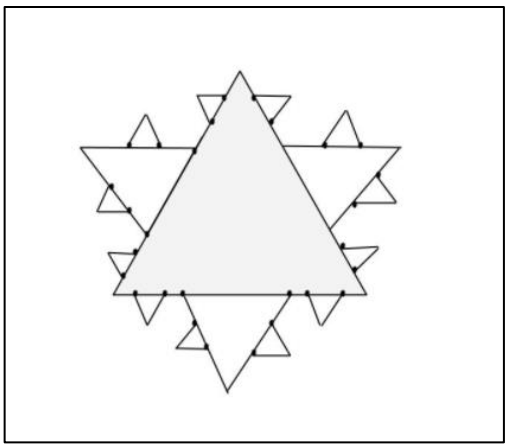
Step4:

Divide each outer side into thirds. You can see the 2nd generation of triangles covers a bit of the first. These three line segments shouldn't be parted in three.



Step5:

- Draw an equilateral triangle on each middle part.
- Note how you draw each next generation of parts that are one 3rd of the mast one.



Conclusion:

Successfully implemented Koch Curve & Bezeir Curve.