# CSE-303: COMPUTER GRAPHICS

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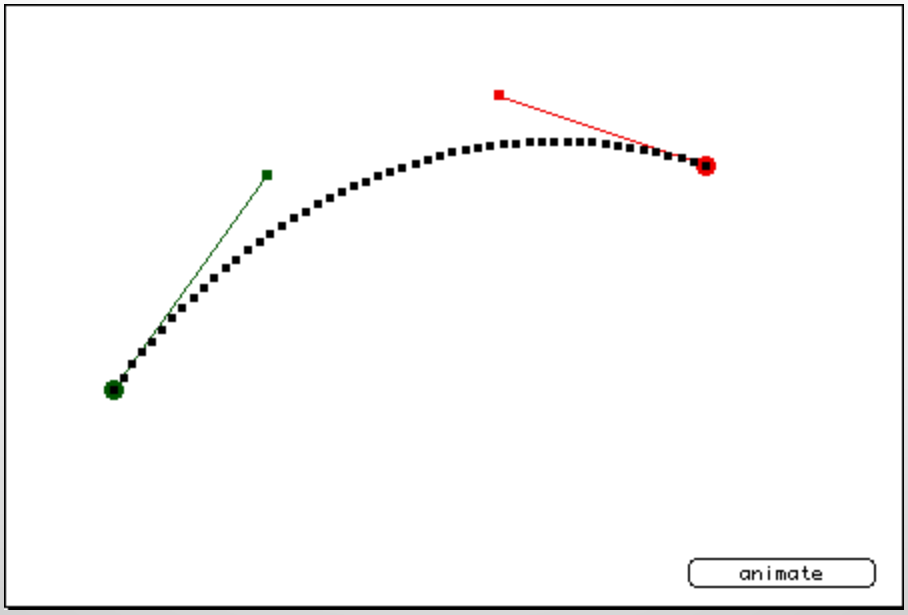
# SCAN CONVERSION IV

# CURVE GENERATION

- In computer graphics, we often need to draw different types of objects onto the screen.
- Objects are not flat all the time and we need to draw curves many times to draw an object.

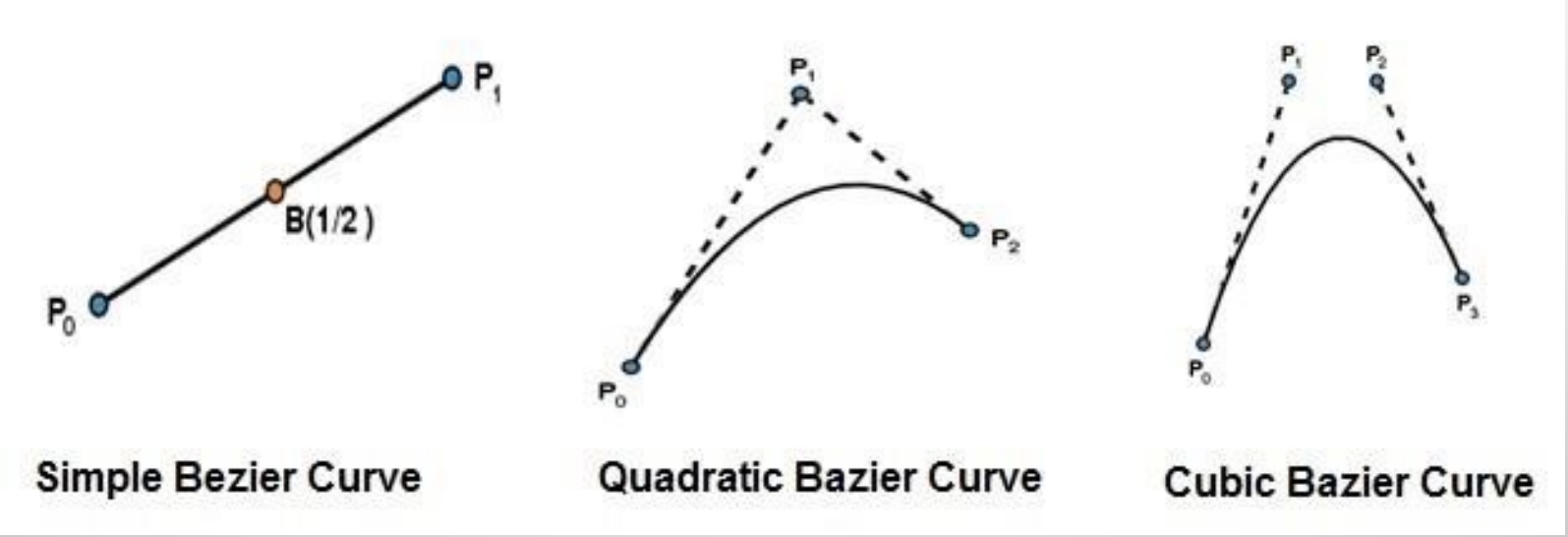
# CURVE

- A curve is an infinitely large set of points. Each point has two neighbors except  endpoints in specific direction.



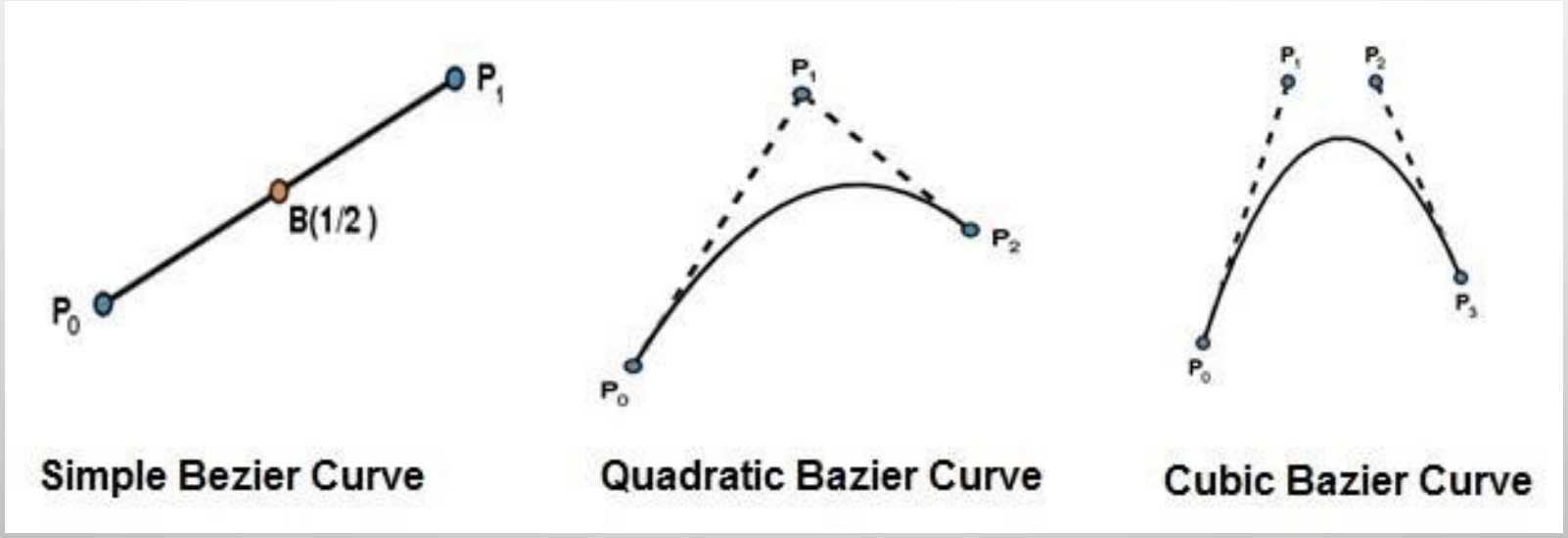
# BEZIER CURVE

- Bezier curve is discovered by the french engineer **Pierre Bézier. These curves can be generated under the control of other points.**



# BEZIER CURVE

- The simplest Bézier curve is the straight line from the point P0 to P1.
- A quadratic Bezier curve is determined by three control points.
- A cubic Bezier curve is determined by four control points.



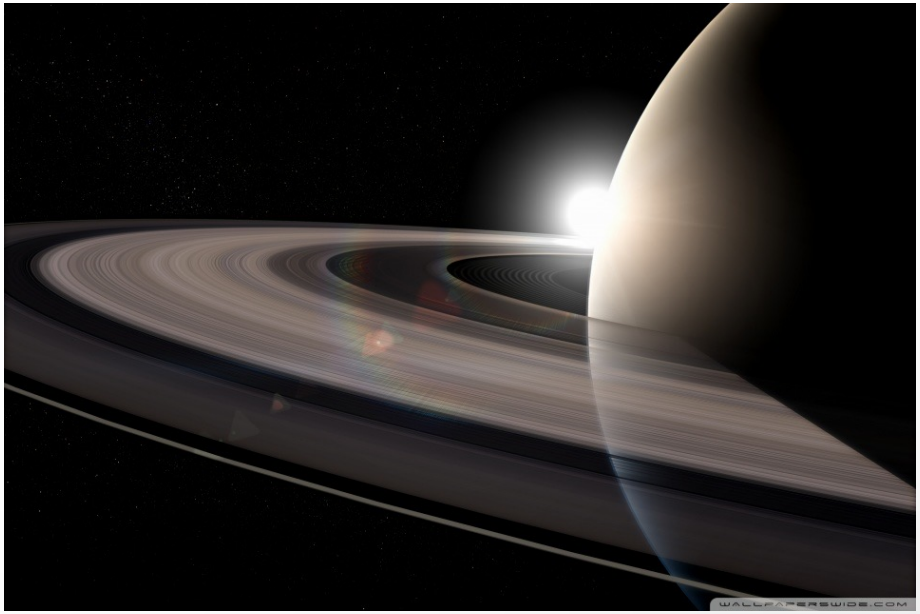
# PROPERTIES OF BEZIER CURVES

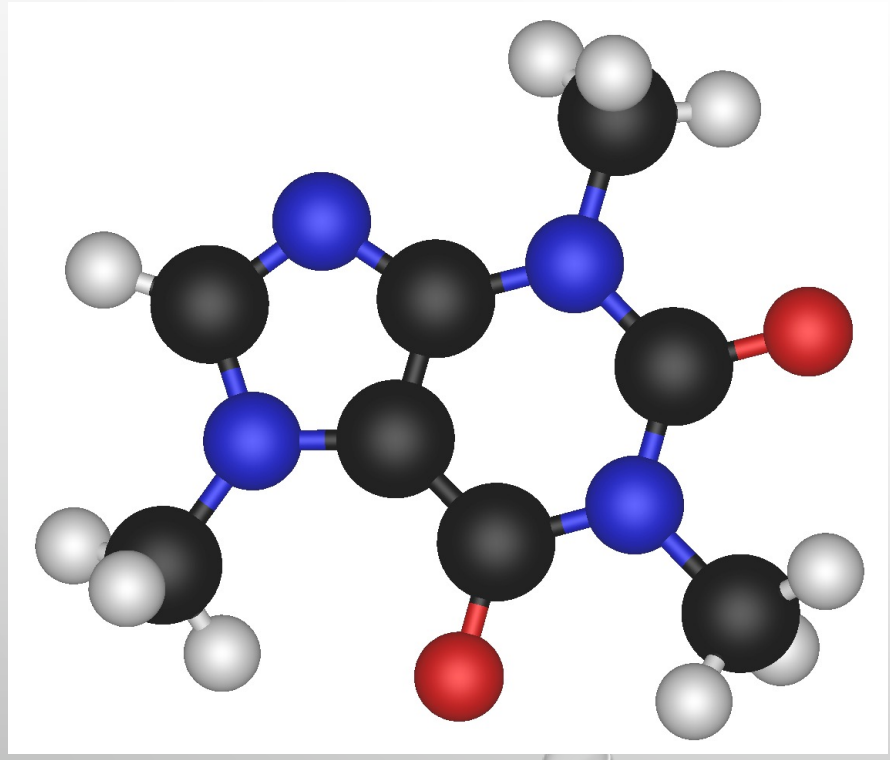
- They always pass through the first and last control points.
- The degree of the polynomial is one less that the number of defining polygon point. Therefore, for 4 control points, the degree of the polynomial is 3, i.e. Cubic polynomial.

# PROPERTIES OF BEZIER CURVES

- A Bezier curve generally follows the shape of the defining polygon.
- The direction angle of the end points is same as that of the first and last segments
- A given Bezier curve can be subdivided into two Bezier segments which join together to form a new shapes.

# FRACTALS





# FRACTALS

- Fractals are very complex pictures generated by a computer from a single formula.
- They are created using iterations.
- This means one formula is repeated with slightly different values over and over again, taking into account the results from the previous iteration.

# FRACTALS ARE USED IN MANY AREAS

- **Astronomy:**

For analyzing galaxies ,

Rings of saturn

- **Biology/chemistry:**

For depicting bacteria

Cultures, chemical

Reactions,

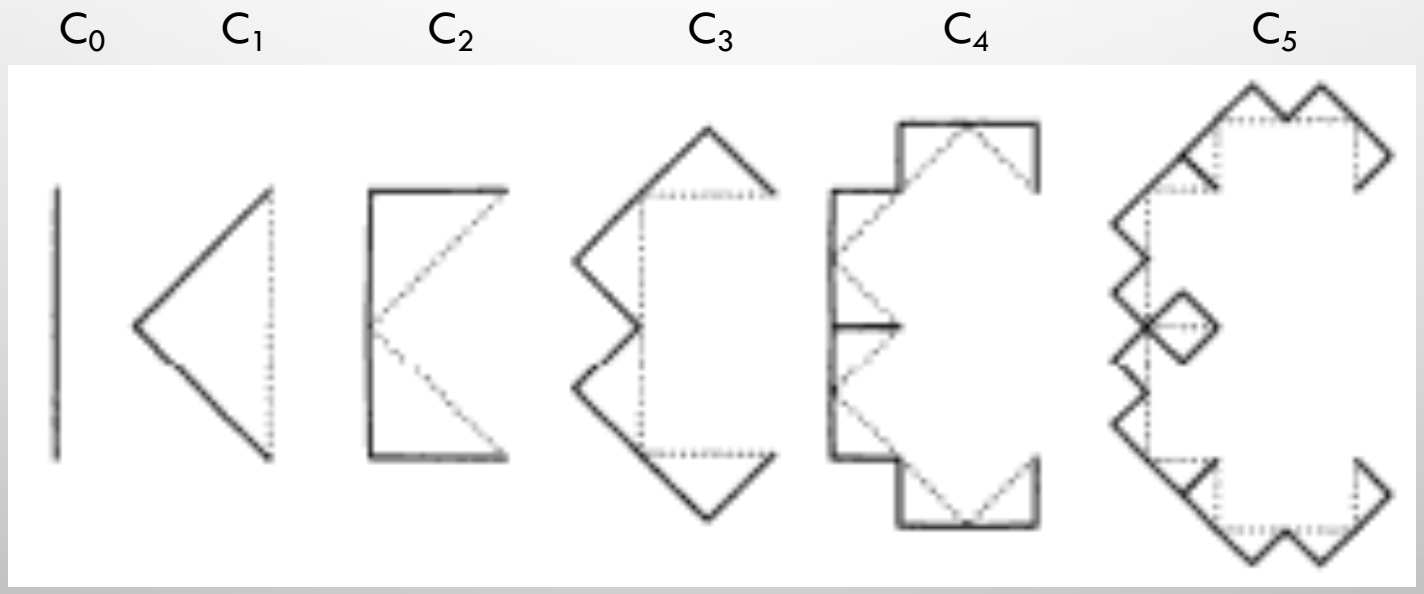
Human anatomy,

Molecules,

Plants etc

# C CURVE

- A line by itself is a first-order C curve, denited by $C_0$.
- The modification rule:
  - Replace a line by two shorter, equal length lines joining each other at a $90^0$ angle, with the original line and the two lines forming a right-angled triangle.



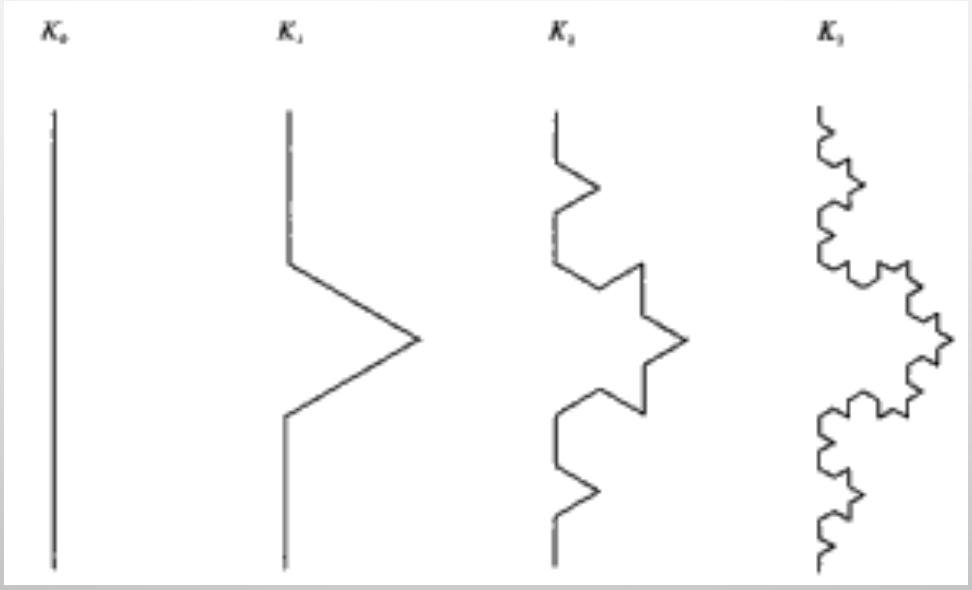
# C CURVE...

- Pseudo-code:

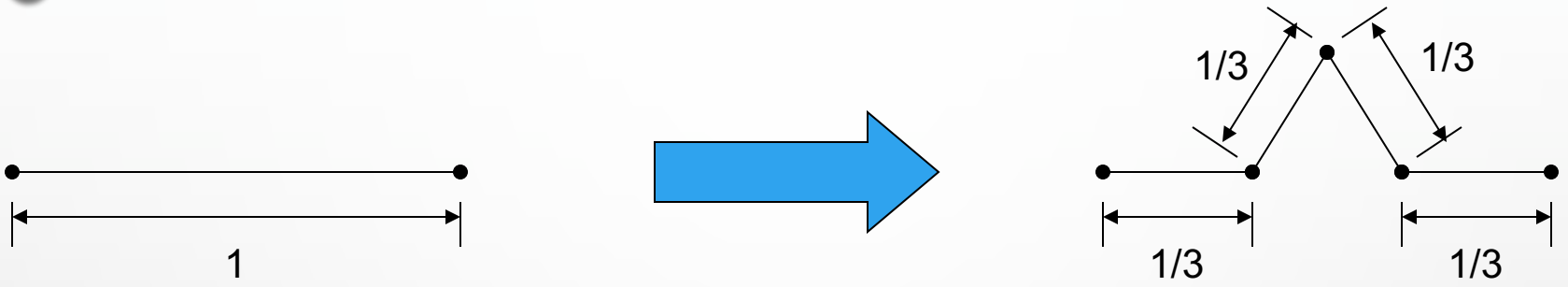
```
C-curve (float x, y, len, alpha; int n)
{
   if (n > 0) {
      len = len/sqrt(2.0);
      C-curve(x, y, len, alpha + 45, n − 1);
      x = x + len*cos(alpha + 45);
      y = y + len*sin(alpha + 45);
      C-curve(x, y, len, alpha − 45, n − 1);
   } else
      line(x, y, x + len*cos(alpha), y + len*sin(alpha));
}
```

# THE KOCH CURVE

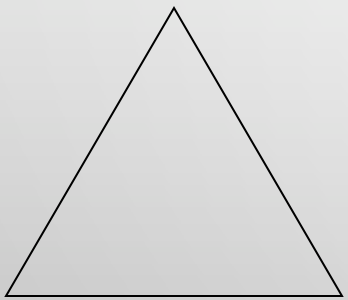
- A line by itself is a first-order Koch curve, denoted by $K_0$.
- Modification rule:
  - divide a line into three equal segments and replace the middle segment with two lines of the same length.
  - the replaced segment and the two added lines form an equilateral triangle.



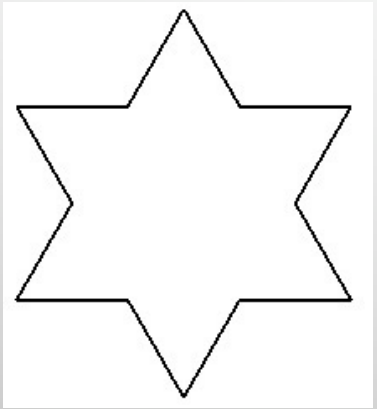
# KOCH FRACTALS (SNOWFLAKES)



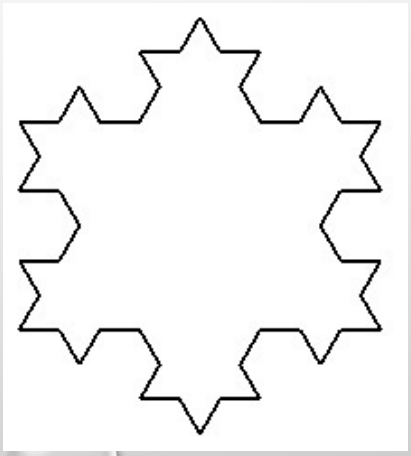

Generator



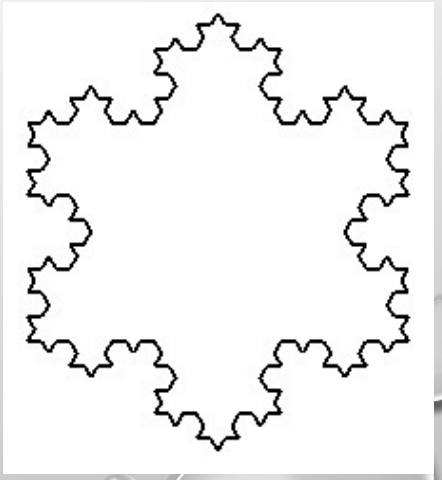
Iteration 0



Iteration 1

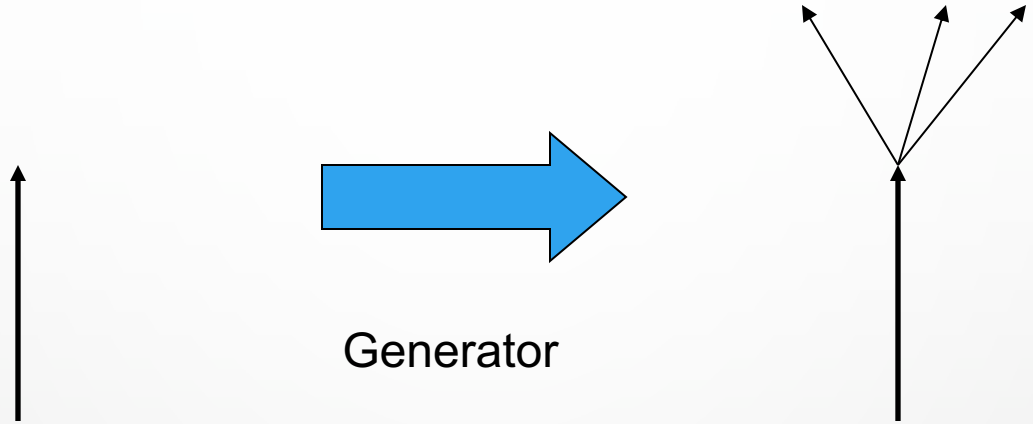


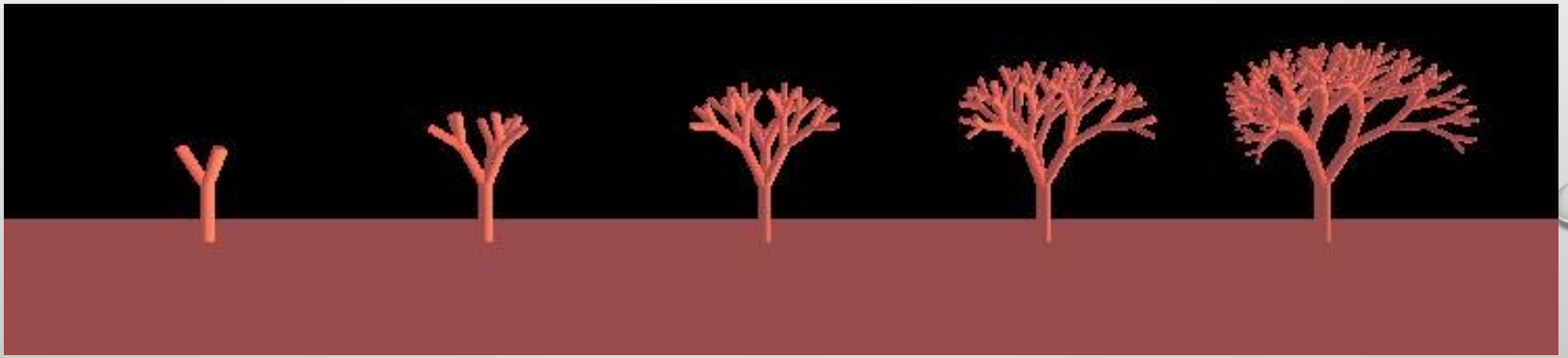
Iteration 2



Iteration 3

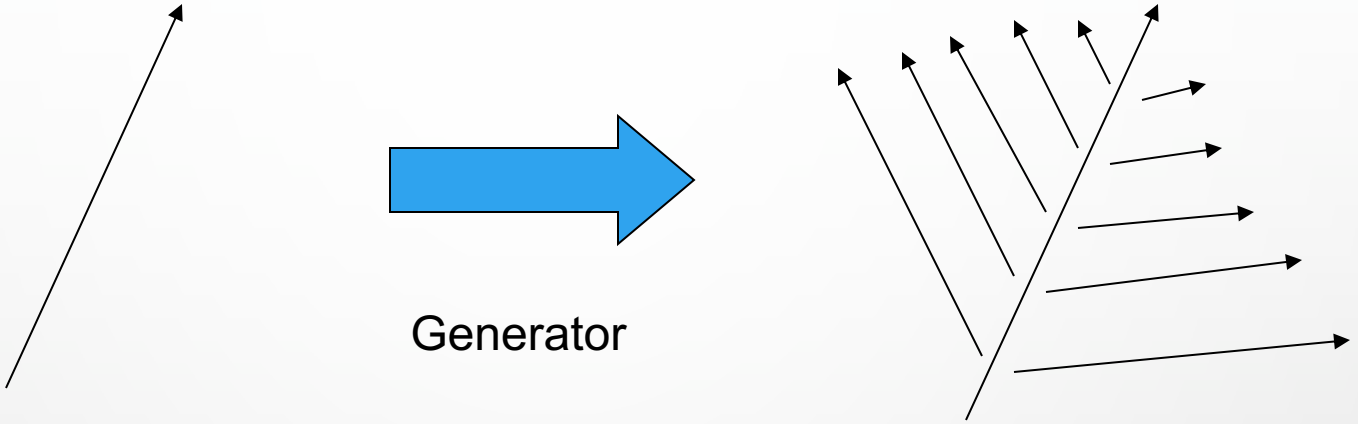
# FRACTAL TREE

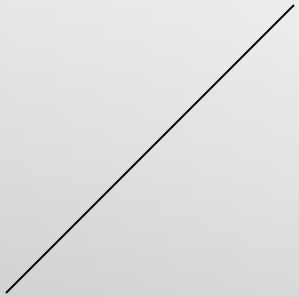


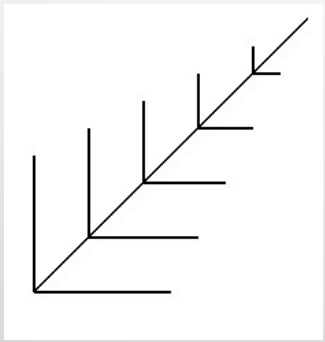
Iteration 1 Iteration 2 Iteration 3 Iteration 4 Iteration 5

# FRACTAL FERN

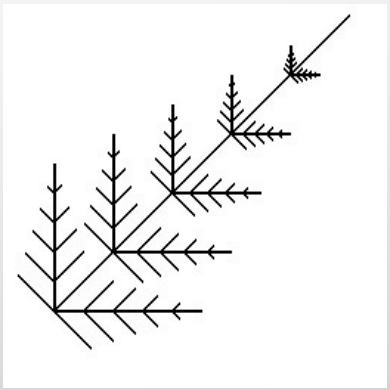


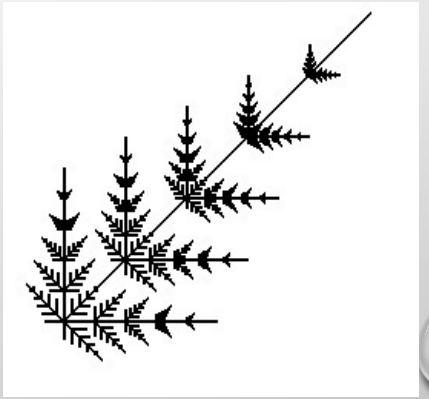
Iteration 0



Iteration 1

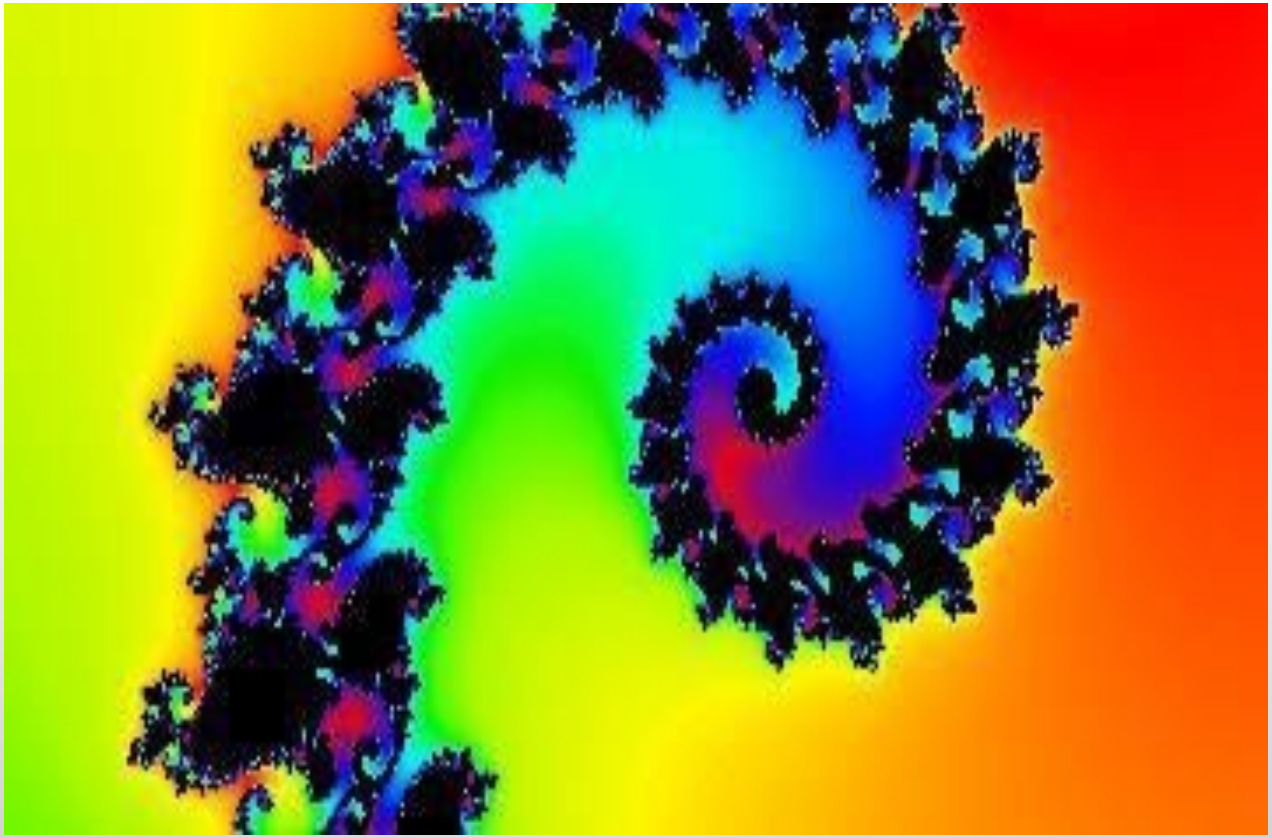


Iteration 2



Iteration 3

# FRACTALS



# GENERATION OF FRACTALS

Fractals can be generated by repeating the same shape over and over again as shown in the following figure. In figure (a) shows an equilateral triangle.

Fig: (a)

# FRACTALS

In figure (b), we can see that the triangle is repeated to create a star-like shape.

Fig: (b)

# FRACTALS

In figure (c), we can see that the star shape in figure (b) is repeated again and again to create a new shape.

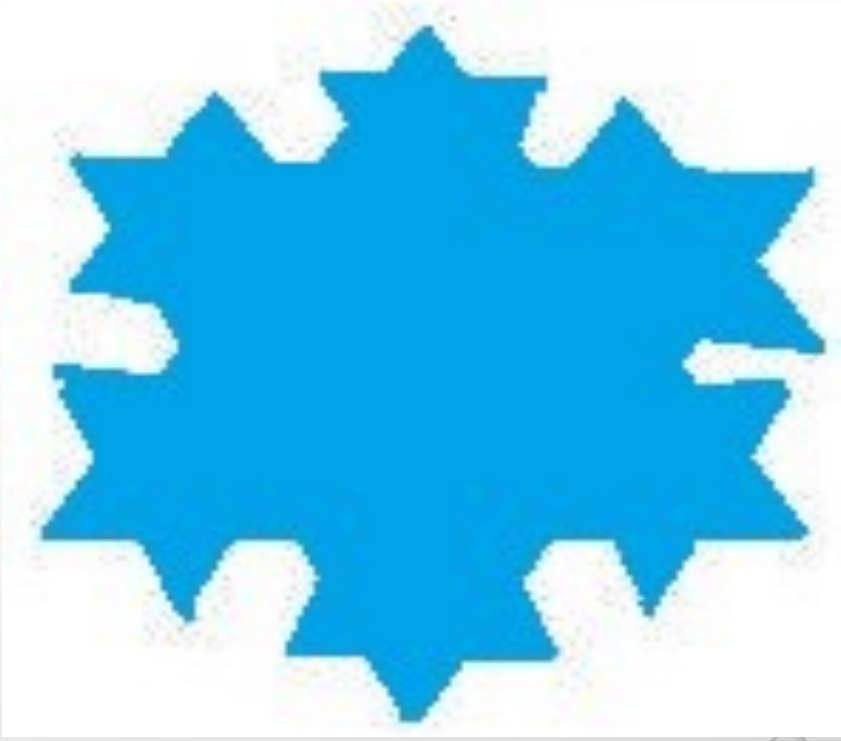


Fig: (c)