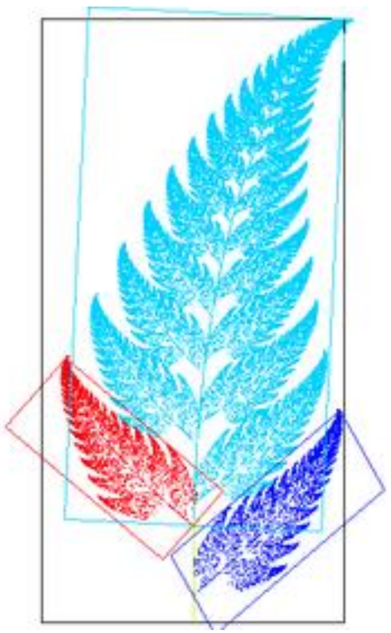
affine

- allowing for or preserving parallel relationships.

Affine w r to maths

- An **affine** function is a function composed of a linear function + a constant and its graph is a straight line. The general equation for an **affine** function in 1D is: $y = Ax + c$.
  An **affine** function demonstrates an **affine** transformation which is equivalent to a linear transformation followed by a translation.

- In Euclidean geometry, an affine transformation, or an affinity (from the Latin, affinis, "connected with"), is a geometric transformation that preserves lines and parallelism (but not necessarily distances and angles).



- In an affine space, there is no distinguished point that serves as an origin.
- Hence, no vector has a fixed origin and no vector can be uniquely associated to a point.
- In an affine space, there are instead displacement vectors, also called translation vectors or simply translations, between two points of the space.

Linear Interpolation of two points

- $P = A(1 - t) + Bt$
- **linear interpolation** between the points *A* and *B*.
- That is, the *x*-component $P_x(t)$ provides a value that is fraction *t* of the way between the value A_x and B_x,
- Similarly for the *y*-component (and in 3D the *z*-component).
- *lerp*()
- In one dimension, *lerp*(*a*, *b*, *t*) provides a number that is the fraction *t* of the way from *a* to *b*

```
float lerp(float a, float b, float t)
{
      return a + (b - a) * t;  // return a float
}
```

- **Example**
  Let A = (4, 9) and B = (3, 7). Then Tween(A, B, t) returns the point (4 - t, 9 - 2t), so that Tween(A, B, 0.4) returns (3.6, 8.1).

Tweening for Art and Animation.

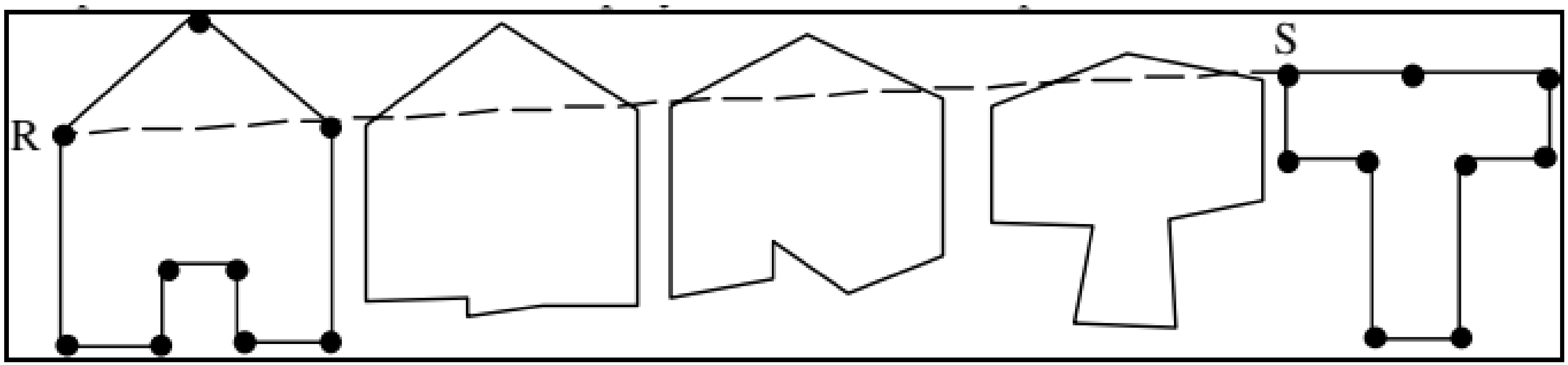
- One figure being “tweened” into another

- It’s simplest if the two figures are polylines (or families of polylines) based on the same number of points.

- Suppose the first figure, *A*, is based on the polyline with points *A*i , and the second polyline, *B*, is based on points *B*i, for *i* = 0, . . . , *n*-1. We can form the polyline *P*(*t*), called the "tween at *t*", by forming the points:

$$P_i(t) = (1 - t)\,A_i + t\,B_i$$

- a succession of values for t between 0 and 1, say, *t* = 0, 0.1, 0.2, ..., 0.9, 1.0, we see that this polyline begins with the shape of *A* and ends with the shape of *B*, but in between it is a blend of the two shapes.
- For *t* = 0.25, for instance, point *P*i(.25) of the tween is 25% of the way from *A* to *B*



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Application of Tweening

- Tweening is used in the film industry to reduce the cost of producing animations such as cartoons.

- In earlier days an artist had to draw 24 pictures for each second of film, because movies display 24 frames per second. With the assistance of a computer, however, an artist need draw only the first and final pictures, called **key-frames**, in certain sequences and let the others be generated automatically.

Quadratic and cubic tweening, and Bezier Curves