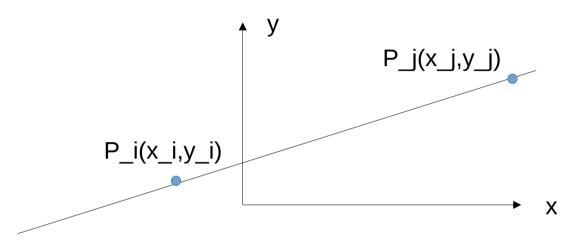
Introduction to 2D Vector Graphics



Direction vector d(x,y) = (dx, dy), which is defined as

$$d(x,y) = P_i(x_i,y_i) - P_j(x_j,y_j) \dots (1)$$
$$= (x_i - x_j, y_i - y_j) \dots (1-1)$$

Now the vector form equation for the straight line:

$$P(x,y) = P_i(x_i,y_i) + alpha * (P_i(x_i,y_i) - P_j(x_j,y_j))$$
... (2)

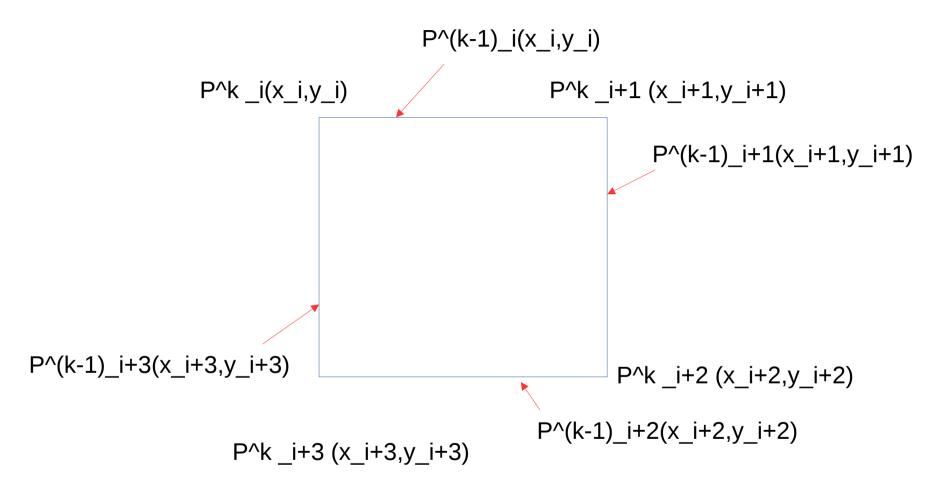
Note:

(1) for alpha = 0 and 1 equation (2) returns $P(x,y) = P_i(x_i, y_i), P(x,y) = P_j(x_j, y_j);$

Based on the above vector form equation, generate screen savers and trees. (Reference: H. Li, IEEE Transactions on Education)



2D Vector Graphics to Create Rotating Pattern



From equation (1), we can derive the following equation

$$P^k(x,y) = P^k(k-1)_i(x_i,y_i) + alpha * (P^k(k-1)_i(x_i,y_i) - P^k(k-1)_j(x_j,y_j)) ... (3)$$

Choose alpha = 0.8

2D Rotating Pattern Technique

I have created an algorithm to summarize the rotating pattern technique:

Defining a polygon with a set of vertices $\{(x_i, y_i)|i=1, 2, \dots, k\}$, one can use a vector formula to describe an object reduction and rotation as:

$$(x_i^{l+1}, y_i^{l+1}) = (x_i^l, y_i^l) + \mu(x_{i+1}^l - x_i^l, y_{i+1}^l - y_i^l)$$
(1)

where the subscript i is used to denote each vertex of a given object, $i=1,2,\cdots,k$. If i=k and i+1>k, then i+1=1. The superscript l is used to denote the level of iteration. The constant μ is defined as $0 \le \mu \le 1$, which is used to define the rate of reduction. For example, if $\mu=0.5$ then each side of the object is reduced to half. This μ is also related to the direction of the rotation. For μ less than 0.5, the rotation is toward the current reference point (x_i^l, y_i^l) , otherwise the rotation is away from the current point. Equation (1) is, in fact, derived directly from a vector addition. Let us assume $\overline{a} = (x_i^l, y_i^l)$, $\overline{b} = (x_{i+1}^l - x_i^l, y_{i+1}^l - y_i^l)$, and $\overline{a}' = (x_i^{l+1}, y_i^{l+1})$, then (1) can be written as $\overline{a}' = \overline{a} + \mu(\overline{b} - \overline{a})$ for vertices i and i+1 with reduction at level l. Following

the argument above, μ can also be expanded to the range greater than 1 to produce magnification.

Reference:

Three-Dimensional Computer Graphics
Using EGA or VGA Card

By H. Li

