Graphics B-Exam Winter 1997

1. (a) Write down a formula for *linear interpolation.*
   (b) Give 4 examples of algorithms in Computer Graphics where linear interpolation plays a key role. For each algorithm, explain briefly where amd how linear interpolation is applied.
   (c) Using formulas or equations, describe how incremental calculations can be applied to speed up linear interpolation. Give examples of how incremental calculations are applied in 2 of the algorithms you discussed in part b.
2. (a) Describe the HLS color model. in particular, clarify the meanings of the terms "Hue", "Saturation", and "Luminescence", and explaine how the values of these parameters are specified in the HLS color model.
   (b) Describe the CIE color model. Explain in particular:
      i. How color and intensity are described in this model.
      ii. What is unusual about the primary colors in this model?
      iii. What is the reason for the choice of such unusual primary colors?
      iv. How is the dominant color specified in this model?
      v. How are the complementary colors defined in this model?
3. Consider the fractal depicted below in Figure 1.
   (a) Write a turtle program to draw this fractal.
   (b) What transformations would you apply to generate this fractal using an iterated function system (IFS)?
   (c) What is the fractal dimension of this fractal (black) curve?
   (d) What percentage of the area of the outer triangle is contained in all the white triangles?

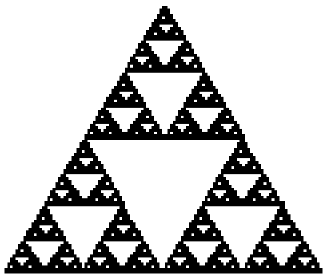

Figure 1 Fractal

4. Define a collection of degree n bivariate polynomials $B_{ij}(s,t)$ by setting:

$B_{ij}(s,t) = \binom{n}{ij} s^i t^j (1-s-t)^{n-i-j} \qquad i,j \geq 0, i+j \leq n$

$\binom{n}{ij} = \frac{n!}{\{i!j!(n-i-j)!\}}$

Let $\{P_{ij}\}$, $i,j \geq 0$, $i+j \leq n$, be a triangular array of control points and define a triangular surface $B(s,t)$ by setting

$B(s,t) = \sum_{ij} B_{ij}(s,t) P_{ij} \quad (s,t) \in \Delta = \{(s,t) \mid s,t \geq 0 \text{ and } s+t \leq 1\}$

(see Figure 2)

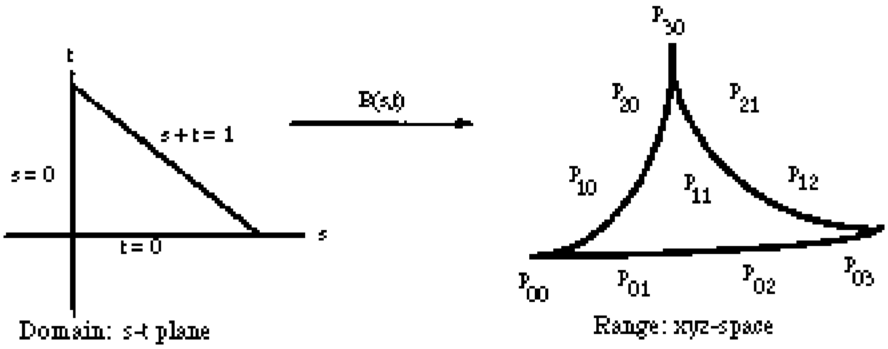

Figure 2 A cubic triangular patch

(a) Determine which control points P_{ij} are interpolated by $B(s,t)$.

(b) Describe the boundary curves of the surface $B(s,t)$.

(c) Does the surface $B(s,t)$ lie in the convex hull of its control points?