Computer Graphics | Zoran Popovi}
CSE 457 | Autumn 1999

Homework 4

Received: Wed, Nov. 17
Due: Mon, Nov. 29

DIRECTIONS

Please provide short written answers to the questions in the space provided. If you require extra space, you may staple additional pages to the back of your assignment. Feel free to talk over the problems with classmates, but please answer the questions on your own.

NAME: ___________________________________

Problem 1. **(16 Points)**

Fill out the following table describing properties of the listed curves.

	C2 continuous?	Local control?	Interpolates control points?	Within convex hull of control points?
Bezier				
B-spline				
C2 interpolating				
Catmull-Rom				

Problem 2. **(3 points each) TRUE/FALSE Justify each answer.**

a) Every Bezier curve is a spline.

b) Every spline is a Bezier curve.

c) Every third order Bezier curve can be broken up into two other third order Bezier curves.

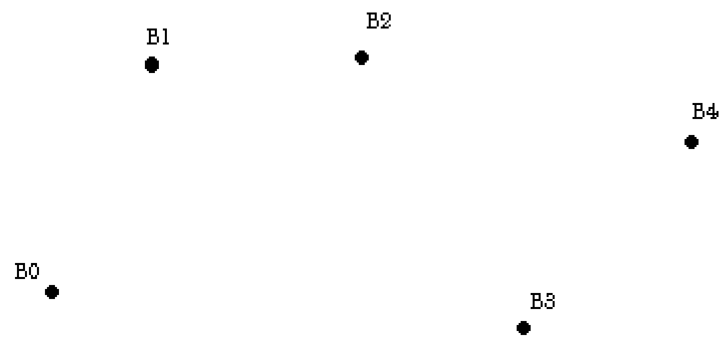
d) Every C2 continuous spline is also C1 continuous

e) A Bezier curve with n control points has n+1 degrees of freedom

f) None of the splines we considered in class have all of the following: local control, C2 continuity and interpolation of control points.

Problem 3. (25 points)

The points $\{B_0, B_1, B_2, B_3\}$ below are de Boor points for a cubic B-spline. Construct, as carefully as you can on the diagram below, the two sets of Bezier control points $\{V_0, V_1, V_2, V_3\}$ and $\{W_0, W_1, W_2, W_3\}$ corresponding to the curve. Do not repeat the endpoints.



Problem 4. (16 points)

Spline surfaces can be used to represent landscapes. However, if the surface is subdivided evenly across the entire landscape, there can be too many triangles on screen at once (i.e. we won't get interactive frame rates).

To combat this problem, people employ "level of detail" techniques. Using Bezier surfaces and the recursive subdivision algorithm, we can stop subdivision at an arbitrary level based on some criteria. List two possible criteria for deciding when to stop subdividing surfaces. Explain your reasoning.

Problem 5. (25 points)

We described Bezier tensor product surface as follows. Given a matrix **G** of control points P_{ij}, i,j = 0, …., we construct a surface $S_1(u, v)$ by treating the **rows** of **G** as control points for Bezier curves $C_0(u)$, …, $C_n(u)$, and then treating curves $C_0(u)$,…, $C_n(u)$ as control points for Bezier curves parameterized by v.

a) (4 points) For a Bezier tensor product surface, which control points does the surface interpolate?

b) (5 points) Which Bezier curves does the surface interpolate?

c) (16 points) Is the surface $S_1(u,v)$, $0 <= u <= 1$, $0 <= v <= 1$, the same as the surface $S_2(u,v)$, generated by using the **columns** of **G** as control points for Bezier curves $C_0(u)$,…, $C_n(u)$, and then treating $C_0(u)$,…, $C_n(u)$, as control points for Bezier curves parameterized by v? Justify your answer.

Extra Credit

Suppose the equations relating the Hermite geometry to the Bezier geometry were of the form $R_1 = \beta(P_2\text{-}P_1)$, $R_4 = \beta(P_4\text{-}P_3)$. Consider the four equally spaced Bezier control points P_1=(0,0), P_2=(1,0), P_3=(2,0), P_4=(3,0). Show that, for the parametric curve Q(t) to have constant velocity from P_1 to P_4, the coefficient β must be equal to 3.