CS 557 Winter 2001
Cubic NURBS Project
Due: Friday, 9 March 2001

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Add to your CPLOT package the capability of plotting cubic periodic NURBS (non-uniform rational B-spline) curves. Note that in a cubic periodic B-Spline, each edge of the control polygon corresponds to exactly one Bézier curve. In this project, the knot information will not be given as a knot vector, but rather each edge of the control polygon will be assigned a *knot interval* d_i that indicates the parameter interval for the underlying Bézier curve.

Implement the following commands:

STBS

n, m

$x_0,\ y_0,\ w_0,\ d_0$

$x_1,\ y_1,\ w_1,\ d_1$

$x_2,\ y_2,\ w_2,\ d_2$

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$x_{m-1},\ y_{m-1},\ w_{m-1},\ d_{m-1}$

STBS stores a cubic periodic NURB.
n is the NURB number;
m is the number of control points;
$x_i,\ y_i,\ w_i$ are the control points, and weights. d_i is the knot interval for the Bézier curve that corresponds to control polygon edge $\mathbf{P}_i$—$\mathbf{P}_{(i+1)\%m}$.

PNCP

$n,\ rad$

Plot the control polygon for NURB n, using control point radius rad. If $rad == 0$, don't plot the control points, just the control polygon.

N2BZ

n, i, k

For B-spline n, find the control points and weights for the Bézier curve whose knot interval is d_i. Store that Bézier curve in curve #k.

PNUR

n

Plot NURB n.

IKNO

$n,\ i,\ t$

Insert a knot into NURB n. Store in NURB m. Do this by splitting knot interval d_i into two intervals: $t * d_i$ and $(1-t) * d_i$. Of course, $0 \leq t \leq 1$.

CORN
n, m

Perform a "corner-cutting" operation on NURB n. Store the result in NURB m. Corner-cutting means to cut each knot interval in half.

Hand in plots illustrating the following, each in a seperate viewport.

1. Define a uniform cubic periodic polynomial B-spline with four control points that form a square (call it NURB 1). Plot NURB 1 and its control points.

2. For NURB 1, perform a corner cut and plot the new control polygon. In a separate viewport, perform a second corner cut and plot the control polygon. Perform a third and fourth corner cut and plot the control polygons in separate viewports.

3. Plot NURB 1 and its control points. In the same viewport, plot the control points of the four Bézier curves that make up NURB 1.

4. Define a periodic NURB that has six control points. Call it NURB 2, Plot the NURB and its control polygon. Define another NURB equivalent to NURB 2 except that one control point is moved to a different position. Plot this NURB and its control polygon on top of NURB 2.

5. Define a circle as a periodic cubic NURB. Plot the control polygon. Perform a corner cut operation and plot the new control polygon. Perform a second corner cut operation and plot the new control polygon. Perform a third corner cut operation and plot the new control polygon. In all cases, set the control point radius to zero.

6. Define a cubic periodic NURB using a five sided control polygon. Plot the NURB along with its control polygon. Insert enough knots so that a control point lies on Bézier curve #3 at $t = .5$ on that curve.