CS3451 — Fall 2008 — Q04 NAME: Grade: out of 20

No need for detailed pseudocode or formulae. Answer each question with a short sentence or two in plain English describing at a high level the algorithm that you would implement to solve the problem. Problems are in two dimensions. Use figures if they help.

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1) <4 points> Test whether a polyloop P is oriented clockwise. (We assume that P does not self-cross.)

Sign of signed area is positive

OR

Left-most vertex is a right turn.

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2) <4 points> Four-point refinement of a polyloop P.

For each quadruple of consecutive vertices (A,B,C,D) associate a new vertex M with the edge (B,C) where

M = S(A(A,D), 9/8, A(B,C)), where A() returns the average of two points and S(A,s,B) returns A +sAB.

Then insert all these vertices. This doubles the number of vertices.

Repeating this converges to a smooth interpolating curve.

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3) <4 points> Test whether two triangles (faces, not just borders) intersect.

I interpret this question as: Test whether two closed triangles interfere (i.e. have a common point).

For each edge E of triangle T, for each edge E' of triangle T' if E intersect E', return true.

(Edge/edge intersection returns true when edges cross or when the a vertex of one is in the other.)

// That is not enough, since one triangle may be inside the other… hence:

For one vertex V of T (resp T') if V in T' (resp T) return true. You do not need to test all the vertices, just one per triangle.

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4) <4 points> Test whether a point q lies inside a polygon P.

Shoot ray R from q that avoids all vertices of P. If R hits an odd number of edges of P, return true

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5) <4 points> Compute the convex hull of a polyloop P.

Keep removing concave vertices one by one when their removal is safe: i.e., it does not produce a self-intersection.

Removing vertex B in sequence A, B, C is safe when the triangle (A,B,C) contains no other vertex.

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5) <4 points> (Bonus question) Advantages (+) and drawbacks (–) of a cubic B-spline subdivision over the four-point subdivision.

+ B-spline is smoother (C^2) .Four-point is only C^1 and may exhibit abrupt changes of curvature (infinite jerk).

+ B-spline is a series of spans that each have a representation as a parametric cubic (four-point does not).

- B-spline is not interpolating (does not go through vertices).