CS 779, Winter 2020
Assignment 8

1. (10 pts) Write an evaluator for tensor product Bézier patches. Extend this evaluator to a tesselator (e.g., chop the patch up into a set of triangles). Your program should output triangled in `s3d` format. Use your program to tessellate the following test cases:
   - tensorproduct
   - teapot
2. (15 pts) Write an evaluator for triangular Bézier patches. Extend this evaluator to a tesselator (e.g., chop it up into a set of triangles). Your program should output triangles in `s3d` format. Use your program to tesselate the following test cases:
   - patch
   - ball
   - ball2
   - doughnut

The datasets for the first question can be found in
http://www.student.cs/∼cs779/Data/Rectangular/
and for the second question in
http://www.student.cs/∼cs779/Data/Triangular/
You should tell me where to find the `s3d` files you created for the above data sets.

You can view `s3d` triangles by using `cglv` on Linux.

See
http://www.student.cs/˜cs779/Documentation/{patch,s3d}
for documentation on the patch format and the `s3d` file format.

Your tesselations should have both position and normals for each sample point.

Optional Questions

The following question is optional. You might want to look at it, and think about them briefly. Do it and submit it if you want — I'll mark it if you do, and it won't hurt your grade. In fact, it might help your grade: if you do this question and miss points on the other questions on this assignment, I will use these to boost your score on this assignment up to 100%.

1. (10 pts) Given: a grid of points $P_{i,j}$ together with first and second derivatives at the points. Construct: a piecewise bi$-n$ic surface that interpolates the position, first derivatives, and second derivatives at the grid of points. Each patch should interpolate the data at four of the grid points ($P_{i,j}, P_{i+1,j}, P_{i,j+1}, P_{i+1,j+1}$). Further, adjacent patches should meet with C^2 continuity.

(a) (3 points) Prove that it is not possible in general to find a solution to this problem using bicubic patches.

(b) (2 points) What degree patch would be required to solve the problem as stated? What problem arises with such a solution?

(c) (5 points) Assuming C^2 continuity between adjacent patches and the use of bicubic patches are the most important components of the problem (i.e., you have to satisfy these constraints), how much data (e.g., position, first derivatives, and/or second derivatives) can you interpolate at the grid of points? Outline how such a construction would work.

(Hint: Consider solving the problem using bicubic B-splines.)