

Math 155B — Computer Graphics — Spring 2020
Homework #7 — Due Tuesday, May 12, 11:00pm
Hand in via Gradescope

1. A degree three B-spline curve $\mathbf{q}(u)$ has knot vector $0, 0, 0, 0, 1, 2, 3, 3, 4, 4, 4, 4$ with 12 knots. It has 8 control points \mathbf{p}_0 – \mathbf{p}_7 .
 - a. What is the knot vector for $\mathbf{q}'(u)$ as a degree two B-spline? How many control points does it have?
 - b. Give formulas for $\mathbf{q}'(0)$, $\mathbf{q}'(3)$ and $\mathbf{q}'(4)$ in terms of the \mathbf{p}_i 's. [Hint: This should not require extensive computation.]
 - c. Give a formula for $\mathbf{q}''(2)$ in terms of the \mathbf{p}_i 's.
 - d. Is it possible that $\mathbf{q}''(u)$ is discontinuous at $u = 2$. At $u = 3$?
2. What new material properties are used in (basic) ray tracing that were not already used in the Phong local lighting model? Give a short (one sentence at most) description of each one. Can they have separate values for red, green and blue?
3. Answer the following multiple choice—true/false questions a.-i. about geometry shaders. Answer the cases under the assumption that the shader program has a geometry shader. We may not have covered all these topics explicitly, but answer according to what would make the most sense in terms of how geometry shaders work.
 - a. A geometry shader can take as inputs any one of points, lines, line strips, triangles, triangle fans, or triangle strips.
 - b. A geometry shader that takes lines as inputs can output triangle strips. (*True/False*)
 - c. The only way a geometry shader can output a triangle fan is to output it as multiple triangle strips. (*True/False*)
 - d. The input primitives to a geometry shader can be which of the following types: points, lines, line strips, line adjacencies, triangles, triangle fans, triangle strips, triangle adjacencies?
 - e. The output primitives from a geometry shader can be which of the following types: points, lines, line strips, line adjacencies, triangles, triangle fans, triangle strips, triangle adjacencies?
 - f. A geometry shader can change the value of a uniform variable. (*True/False*)
 - g. A geometry shader can access all vertex attributes, even vertex attributes that the vertex shader did not copy into “out” variables. (*True/False*)

- h. The vertices output by the geometry shader might be processed by a vertex shader before being sent to the fragment shader.
 - i. The fragment shader's "in" variables can be used to receive values directly from both the vertex shader and the geometry shader.
4. Give a full acknowledgement of assistance. This includes anyone, any written source, any web site, etc., that helped you; and anyone you helped.