Algorithm 3: Sceneview

Comp175: Introduction to Computer Graphics – Spring 2020

Algorithm due: **Friday February 28th** at 11:59am
Project due: **Monday March 9th** at 11:59pm

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1 Instructions

Complete this assignment only with your teammate. You may use a calculator or computer algebra system. All your answers should be given in simplest form. When a numerical answer is required, provide a reduced fraction (i.e. 1/3) or at least three decimal places (i.e. 0.333). Show all work; write your answers on this sheet. This algorithm handout is worth 3% of your final grade for the class.

2 OpenGL Commands

[$\frac{1}{2}$ **point each**] Suppose you want to apply a transformation matrix to some vertices. In what order should you use the following five OpenGL commands?

5 ____ `glEnd()`
1 ____ `glMatrixMode(GL_MODELVIEW)`
3 ____ `glBegin()`
2 ____ `glLoadMatrix()`
4 ____ `glVertex4fv()`

[$1\frac{1}{2}$ **points**] Suppose your program contained a block of code which sent vertices to OpenGL, delimited by `glBegin()` and `glEnd()`. What would be the effect of a call to `glLoadMatrix()` within this block?

glLoadMatrix() would throw an GL_INVALID_OPERATION error

3 Scenefiles

Consider the following excerpt from a scenefile.

```
<transblock>
    <translate x="0" y=".5" z="0"/>
    <scale x=".05" y="1.0" z=".05"/>
    <rotate x="1" y="0" z="0" angle="45"/>
    <object type="primitive" name="cylinder">
        <diffuse r="1" g="1" b="1"/>
    </object>
</transblock>
```

[$1\frac{1}{2}$ **points**] To transform a point on the cylinder C into the desired cylinder C', in which order would you multiply the three transformations: translate (T), rotate (R), and scale (S) to achieve the desired effect?

C' = _____ T*S*R _____ * C

1

In a previous question you described how to compose transformations within a single transformation block (trans block). When coding `Sceneview`, you will also have to compose transformations whenever there is an object tree block contained within a trans block. Consider the following contrived excerpt from a scenefile:

```
<transblock>
  <rotate x="0" y="1" z="0" angle="60"/>
  <scale x=".5" y=".5" z=".5"/>
  <object type="tree">
    <transblock>
      <translate x="0" y="2" z="0"/>
      <scale x="1" y=".5" z="1"/>
      <object type="primitive" name="sphere">
        <diffuse r="1" g="1" b="0"/>
      </object>
    </transblock>
  </object>
</transblock>
```

[$1\frac{1}{2}$ **points**] Suppose you composed the two transformations in the outer trans block, calling the result CTM1, and composed the transformations in the inner trans block, calling the result CTM2. Show the order in which you must multiply these matrices to obtain a single composite matrix with the desired effect on the sphere.

CTM1 * CTM2

so the sphere is scaled then translated to create a tree then the tree is scaled and rotated

[**1 point**] In your most efficient program design, when and how many times should you traverse the original parse tree?

You should traverse a tree once in the beginning of the program when you read in the scenefile

[**1 point**] Flattening the parse tree makes it quicker and easier to traverse when drawing the scene. What type of data structure will you use for this flattened tree?

A list of nodes to store the elements of the parse tree in the traversed order

[**1 point**] What information will you store at each of the nodes in the flattened tree? Please give valid types and descriptions of any types you are defining yourself.

Nodes will store matrices for transformations in the transblock, object type (with object characteristics such as diffuse, ambient, etc.) for objects, and global_data, camera_data, and light_data as defined in the format on this link https://cs.brown.edu/courses/cs123/docs/scenefile.pdf

4   Parse Tree

Being sure of the order in which matrices must be multiplied puts you well on your way to completing `Sceneview`. The other major hurdle is deciding how you will traverse the parse tree provided by `SceneParser`.

5   How to Submit

Hand in a PDF version of your solutions using the following command:

```
provide comp175 a3-alg
```