**Computer Graphics and Applications – Final – FALL 2018**

A template Visual Studio project can be found at

<https://github.com/leventalbayrak/Levent_Development/tree/master/graphics_examples/opengl_texture/>

Feel free to use this solution as a starting point for your project.

**Goal**

Demonstrate understanding of fundamental OpenGL concepts: matrices, transforms, vertex and fragment shaders, vertex arrays, vertex and index buffer objects.

**Requirements**

Create a “cloud” of textured 3D cubesthat are spinning around themselves and a pivot point (see code example) lit from a light source.

Shading calculations must be done inside **the fragment shader**.

There are plenty of tutorials online:

<https://learnopengl.com/Lighting/Basic-Lighting>

<https://www.opengl.org/sdk/docs/tutorials/ClockworkCoders/lighting.php>

**Submission**

Upload your entire project to your github repository, add leventalbayrak as a collaborator.

A short gif animation of your program (place it inside your project folder).

Submit the URL of repository and the collaboration invitation link to blackboard.

Your project must run right out of the package (make sure to test it out by cloning/downloading your repository to a new folder, double click the solution file and compile and run the program)

**Grading**

Code/Program fulfills requirements – 80pts

Project runs by downloading the repository and double clicking the solution – 10pts

Gif animation – 10 pts

Bonus: Bump mapping – 50pts

You can use a bump map texture (grayscale image which represents height information) along with your color texture to create bumps and wrinkles on the cubes. You can utilize this extra information in your light calculations to create interesting materials/textures.

<https://en.wikipedia.org/wiki/Bump_mapping>