

NOTE: The written portion of the assignment must be handed in during class on the due date. All code can be emailed to the TA by 10PM on Oct. 6, 2014.

Problem 1

Suppose a 3x3 image has the following intensity values. For the sake of simplicity, assume this is a grayscale image (i.e. only a single channel exists).

50	122	178
78	97	150
35	115	184

(A)

Compute the image gradient $\vec{\nabla}I$ at the center pixel using the discrete approximation from class. Show all work for full credit.

(B)

Compute the magnitude of the image gradient $||\vec{\nabla}I||$ at the center pixel. Show all work for full credit.

(C)

We can also compute the gradient direction as follows

$$\theta = \tan^{-1} \left(\frac{\partial f / \partial y}{\partial f / \partial x} \right)$$

Explain why this gives the gradient direction and compute the gradient direction at the center pixel of the sample image showing your work.

Problem 2

For this written assignment problem, you'll write a small program that you submit to the TA. The purpose of this question is to get you familiar with the Qt library. We'll also start on this assignment problem in class. You should start with the **simple_commandline_CMSC427.zip** template code. Your solution must use the following classes from Qt: QFile, QTextStream, QString, QStringList, and QVector and QMap.

Your program must accept a single command line parameter, the name of an input file. The input file specifies a set of triangles where vertices are stored separately and triangles are specified by the corresponding vertex ids. If the line starts with a "v" you store a vertex with a given integer id and an x,y position.

```
v <int id> <float x position> <float y position>
v <int id> <float x position> <float y position>
```

If a line starts with “trivid” you should store a triangle with the given vertex ids.

```
trivid <string triangle id> <vertex id1> <vertex id2> <vertex id 3>
```

Once you’ve read this file in, output a stream of triangles (to standard out e.g. printf or cout) using this data as follows in sorted order of the string triangle id.

```
tri <x1> <y1> <x2> <y2> <x3> <y3>
tri <x1> <y1> <x2> <y2> <x3> <y3>
```

Note that triangles may share vertices, but the stream must just be a series of triangles where the vertices are specified by floats.

When you’re done you must email the TA a .ZIP file containing only the following files: **cmssc427.cpp**, **cmssc427.hpp**, and **cmssc427.pro**. You will only modify cmssc427.cpp.

The .ZIP file must be named as follows:

```
[your last name]_[your first name]_Written2_QtFirst.zip
```

For full credit, your program must perform correctly on a few test inputs. A sample file of inputs has been included in the .ZIP file for your own testing. You can assume that we will not introduce any malicious input, therefore you do not have to worry about coding for input that has the wrong format, other than what is specified above.

Problem 3

For this written assignment question, you’ll write another small program that you will submit to the TA. The purpose of this question is to give you the chance to modify your first vertex shader as well as send geometry to OpenGL for the first time. We will start on this problem in class as well.

You should start with the **CMSC427_minimalGL_2D.zip** template code. You will need to make the following modifications to the simple 2D OpenGL program in the template:

- Modify the vertex shader so triangles oscillate in the x **and** y direction.
- If the 2-key is pressed, two solid colored triangles (each a different color) appear and oscillate.
- If the 3-key is pressed, three solid colored triangles (each a different color) appear and oscillate.

When you’re done you must email the TA a .ZIP file containing the following files: **GLview.cpp**, **GLview.hpp**, **cmssc427.cpp**, **cmssc427.hpp**, **cmssc427.pro**, **cmssc427.ui**, **resources.qrc**, **simple.fsh**, **simple.vsh**. You should have only modified **GLview.cpp** and **GLview.hpp** and **simple.vsh**. The .ZIP file must be named as follows:

```
[your last name]_[your first name]_Written2_GLfirst.zip
```