Lab 2 - Polygon Fill

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Update history:

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1. Introduction

In this course, you will implement some of the 2D drawing routines we have been discussing in class. This will help improve your understanding of these algorithms.

This assignment involves polygon filling. You will implement the scanline polygon fill algorithm discussed in class. You have the option of doing this assignment in C, or C++.

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2. Programming Environment

As with the line drawing assignment, the programming environment that you will use for this assignment is a set of simple modules with implementations in C and C++. You are free to use any of the implementations. The modules include:

- `Buffers` - a support module providing OpenGL vertex and element buffer support.
- `Canvas` - a simple 2D canvas that allows the ability to set a pixel.
- `Rasterizer` - a module that implements rasterization algorithms
- `ShaderSetup` - a support module that handles shader program compilation

and linking.

- `fillMain` - the main function for the application.
- `shader.vert`, `shader.frag` - simple GLSL 1.50 shaders.
- `alt.vert`, `alt.frag` - simple GLSL 1.20 shaders.

The C version includes a module named `FloatVector` which provides an extensible vector holding floating-point values. Both the C and C++ versions include a file named `header.mak` for use with the `gmakemake` program on our systems to create a `Makefile` to simplify compilation and linking of the program.

See the *Supplied Files* section (below) for details on how to download the framework.

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3. Routine to Implement

You will need to modify the `Rasterizer` module. For this assignment, you will need to complete the method `drawPolygon()` using the scanline fill algorithm discussed in class. (You are free to use whichever version of the algorithm - all-integer or floating-point - seems appropriate to you.)

In your implementation, you need only make use of the method `setPixel()` on the `Canvas` object (which is part of the `Rasterizer`) holding the pixels being drawn.

The prototype for the `drawPolygon()` method varies a bit between languages

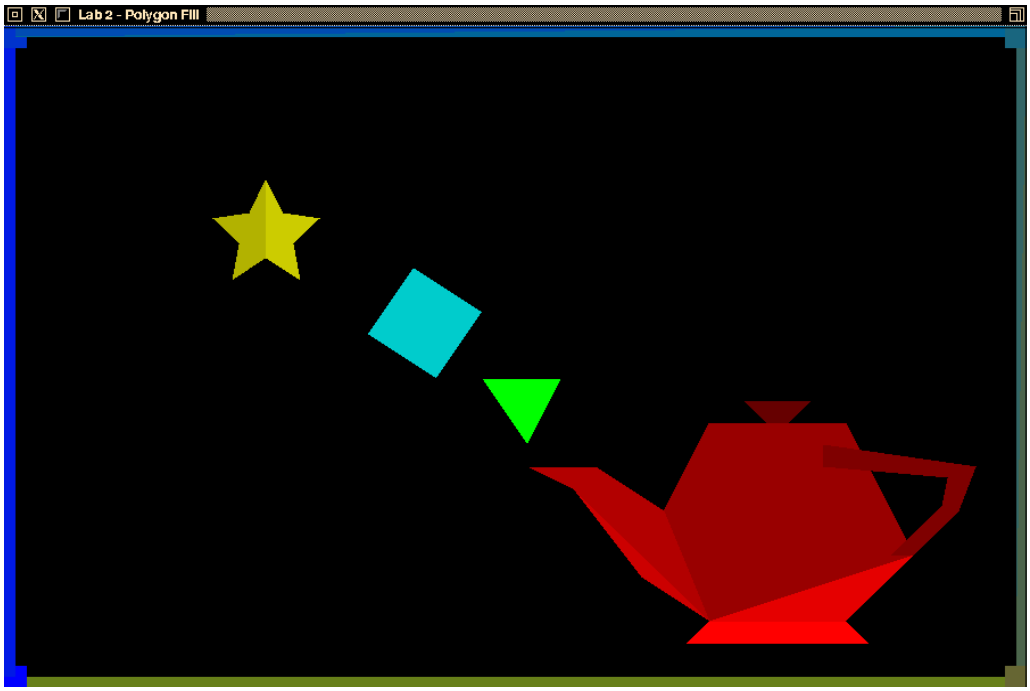
C:
```
void drawPolygon( int n, const int x[], const int y[], Rasterizer
*R );
```

C++:
```
void drawPolygon( int n, const int x[], const int y[] );
```

Where `x` and `y` are arrays containing the coordinates of the polygon to be drawn, and `n` is the number of vertices in the polygon (and, as such, indicates the size of the two coordinate arrays).

You are free to add additional members, methods, and data structures to `Rasterizer` as you see fit; however, you cannot modify the `Canvas` module or the `fillMain` driver program.

Here is the drawing that will be produced by the `fillMain` program:



With the exception of the green triangle and the blue quad, all other objects (including the borders) are drawn as multiple polygons. Furthermore, each polygon is drawn using a different color to make it easier to identify problem areas in your implementation. See the `fillMain` driver program for full details on the various shapes.

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4. Supplied Files

The programming framework for this assignment is available as a ZIP archive. You can either download the `lab2.zip`, archive directly, or retrieve it by executing the command

```
get  cscix10  lab2
```

on any CS Ubuntu® system.

The ZIP archive contains a folder named `lab2`; under that are subfolders `c` and `c++` which contain the obvious things. In the C and C++ folders you'll find a file named `header.mak`, for use on the CS systems to help you generate a `Makefile` that will compile and link your program with the libraries used by the framework. See the contents of `header.mak` for details on how to do this. There is also a subfolder named `misc` which contains a shellscript named `compmac` for use on Mac systems.

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5. What to Submit

Your routines will be tested using a set of driver programs; some of them may be different from the driver found in the framework archive. Submit ***only*** your modified `Rasterizer` module and any other supporting code you write - do not submit the driver program or other source code from the framework. If you have additional supporting code (e.g., data structures or classes), you may either put them in the `Rasterizer` source files or submit them as additional source files.

If you are working in C++, your implementation must be in a file named `Rasterizer.cpp`. If your implementation requires making changes to the `Rasterizer.h` file (e.g., you have added data members or member functions to the class declaration), you should submit that file along with `Rasterizer.cpp`. If you make changes to the `header.mak` file, you may submit your modified file as well.

Similarly, if you are working in C, your implementation must be in a file named `Rasterizer.c`. Again, if your implementation requires making changes to the `Rasterizer.h` file, you should submit that file along with `Rasterizer.c`. If you make changes to the `header.mak` file, you may submit your modified file as well.

If you have not submitted anything to the grader account yet this semester, you will need to register your account. Do this with the command

```
try  grd-x10  register  /dev/null
```

and answer the question about your section number based on the schedule that will be displayed.

Turn in only your implementation file(s) described above and an optional `README` file using this command:

```
try  grd-x10  lab2  Rasterizer.X  optional_files
```

where *X* is the correct suffix for your code.

The 'try' scripts will reject submissions that attempt to turn in more than the required and optional files listed above.

If you are working in C or C++, you may optionally submit a modified `header.mak` file and/or a modified `Rasterizer.h` file. The modified `header.mak` should be based on the version found in the ZIP archive. If you do not submit one or both of these files, the 'try' scripts will use the versions provided with the framework.

The minimum acceptance test is that your code must be complete - that is, it must compile and link cleanly when submitted. Submissions *will not be accepted* if they fail to compile and link cleanly. (Warning messages from the compiler are acceptable, but not fatal errors.)

Finally, you can verify that your submission was archived with the command

```
try  -q  grd-x10  lab2
```

This command will tell you whether or not an archive exists, and if so, what files submitted by you are in it.

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6. Grading

Your grade will be based on your implementation of the required routine and its usability with the supplied test programs.

The lists of situations to be checked in your submission (see below) is not exhaustive; the tests run during grading may include other combinations. You may want to modify the test program you are given to cover a wide range of input situations.

`drawPolygon` Implementation	40 points
right triangles	
other triangles	
convex figures - rectangles/quads	
other convex figures	
concave figures - one concave side	
concave figures - more than one concave side	
complicated concave figures (e.g., star)	
Other Considerations	10 points
documentation	
Grade	_____ / 50

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7. Notes

Java applets are available online to help you visualize polygon filling.

You are guaranteed that the dimensions of the drawing window will be 900x600 pixels.

The elements of the `x[]` and `y[]` arrays are paired up; that is, vertex 0 is `(x[0],y[0])`, vertex 1 is `(x[1],y[1])`, etc. You are guaranteed that there will be `n` coordinates in each array. You are also guaranteed that the vertices given to `drawPolygon()` are listed in order around the circumference of the polygon (that is, adjacent vertices in the arrays form one edge of the polygon, with the final edge connecting the last vertex to the first vertex); however, the list may be in

either clockwise or counter-clockwise order.

It is common knowledge that code for the scanline fill algorithm is freely available on the Internet and in textbooks. You are free to use these references as a guide, but please do not simply cut and paste code from any of these sources.

Refer back to the "Hello, OpenGL!" programming assignment for information about obtaining and installing GLUT and/or GLEW libraries.

Don't wait until the last minute to submit things! You may, in fact, want to submit even a partially-working solution as you work on it - there is no penalty for making multiple submissions, and this will help ensure that you get *something* submitted for this assignment.

Do not make any changes to the function prototypes. This means that your implementations must match the prototypes exactly in terms of number, types, and order of parameters. The reason for this is that the test programs assume that your implementations match those prototypes; if you make changes, there will be compilation errors, and even if the test programs link, they almost certainly won't execute correctly (which means you'll lose substantial amounts of credit for incorrect program performance).
