COM3503/4503/6503: 3D Computer Graphics

Dr Steve Maddock

1 JOGL Version 2.x

"Java OpenGL (JOGL) is a wrapper library that allows OpenGL to be used in the Java programming language" (Wikipedia: http://en.wikipedia.org/wiki/Java_OpenGL). Version 1.x of JOGL was hosted by Sun, but, as development continued on new versions, was moved to jogamp.org (http://jogamp.org/jogl/www/). Table 1.1 gives the list of OpenGL versions. I have taken the decision to use JOGL version >= 3.x, i.e. 'modern' OpenGL, focussing on the programmable pipeline.

OpenGL versions	
1.0-1.5	Fixed function pipeline
2.0-2.1	Support for programmable shaders
3.0	Adopts deprecation model (fixed function deprecated), but retains backward compatibility
3.x	Fixed function pipeline and associated functions removed (but can be accessed using a compatibility context)
4.x	Geometry and tessellation shaders
ES 1.x	Fixed-function version (stripped down) [ES - embedded systems]
ES 2.x	Programmable shader version
Es 3.x	Geometry and tessellation shaders

Table 1. OpenGL versions (see http://jogamp.org/jogl/doc/Overview-OpenGL-Evolution-And-JOGL.html for relation to JOGL)

2 Setting up

2.1 Java

You will run your programs from the Windows command prompt. If you are on the CiCS managed desktop (in the Diamond), you need to start this using the menu system as follows:

Start > Java JDK > Command prompt with JDK

If you start a command line window in any other way, the Java compiler will not be available to you.

Once the command line window is open, you can compile Java programs using 'javac ProgName.java' and run them using 'java ProName'. To use JOGL we need to link in the relevant libraries, which is the subject of the next section.

2.2 JOGL

If you are working on a University Windows machine in the lab class, then you can make use of the zip file that I have provided which includes all that is required to use JOGL. If you are using a different platform, e.g. your own laptop, then you need to take a look at Appendix A which describes how to download everything from the jogamp website.

When you have unzipped the JOGLstarting.zip file, you will see that it creates a subfolder called jogl2 which contains two subfolders named jar and lib. (Note that jogl2 is four letters and one digit – the 4th character is the letter l, not a one.) ***Important:*** Move the jogl2 folder to U:, to become U:\jogl2.

Within each of these are platform-specific files, in this case Windows 64-bit specific files. Every time you want to compile and run a Java program that uses JOGL, you need to link to the files in the jogl2 folder. If you were the administrator of the machine, this could be done by changing the environment variables, which is what you would do on your home machine (see Appendix B). However, you are not the administrator of the managed desktop PCs. Thus you have to link them in each time you run a program.

```
set path=u:\jogl2\lib;%path%
set classpath=.;u:\jogl2\jar\jogl-all.jar;u:\jogl2\jar\gluegen-rt.jar;%classpath%
```

Figure 1: setup.bat

I have included a batch file in setupJOGL.zip called setupJOGL.bat (see Figure 1). ***Assumption*:** This assumes that you have added the jogl2 folder to your U: drive to produce U:\jogl2

When you open a command line window, check that you have setupJOGL.bat in the folder. Then, type 'setupJOGL' at the prompt. This will run the setupJOGL.bat file and will add the jogl2 lib and jar folders to the system path and classpath variables for **this** command line window only. These environment variables will persist whilst the command line window remains open. You only need to run 'setupJOGL' once when a command line window is opened.

Now you can compile and run the Java programs that have been supplied with the Week 1 exercise sheet. For example:

```
U:\com3503>javac S01.java
```

```
U:\com3503>java S01
```

(or U:\com4503 or U:\com6503, depending on which degree you are on).

Alternative:

An alternative is to add the jogl2 folder as a subfolder in the folder where you are developing your JOGL programs. Thus you might have the following folder structure

U:\com3503

U:\com3503\jogl2

The setupJOGL.bat file would be stored in the folder u:\com3503. You would then change the setupJOGL.bat file accordingly, e.g. u:\jogl2\lib would become jogl2\lib, and u:\jogl2\jar would become jogl2\jar, since they would be relative to com3503. Thus when the command prompt appears, you would first navigate to folder com3503, then run setupJOGL, then compile and run your Java programs. The important thing is that the jar and lib folders need to be set up so that they are on the classpath and path system environment variables.

3 API documentation

See the link 'API Docs […JOGL…]' at http://jogamp.org/ or go directly to http://jogamp.org/deployment/jogamp-next/javadoc/jogl/javadoc/

You will find these documents useful as you develop your OpenGL programs in Java. They give full listings of all the packages and all the OpenGL calls for each version of OpenGL.

Recommendation: Add a bookmark to these files in your favourite Web browser.

Appendix A

Downloading JOGL version 2.0

1. http://jogamp.org/
2. On the home page, scroll down to the section called 'Builds/Downloads'. Select 'Current [zip]' which will lead to a list of downloads.
3. Download jogamp-all-platforms.7z (The program 7-zip is required to 'unzip' this. If this is not available on the network, it can be downloaded from http://www.7-zip.org/.)
4. When you have unzipped this you will find a folder called 'jogamp-all-platforms'. We are interested in two of its subfolders: jar and lib.
5. Note: If you are installing this on your own machine, you will need to copy the files that are relevant for your system, e.g. Windows, 32-bit Intel or AMD, Linux or Mac.

Setting up to use JOGL version 2.0

1. Create a folder called jogl2 in your c: drive, i.e. `c:\jogl2` (Putting the folder at the top level of your c: drive makes the path short. In fact, you could name it whatever you like and put it wherever you like, as long as you then adapt the following explanation.)
2. Copy the complete jar folder (from wherever you unzipped it when you downloaded the jogamp-all-platforms' file) into the jogl2 folder, so as to create c:\jogl2\jar. (Note: some of the files are not needed, but it is simpler to just copy everything.)
3. Create a folder called lib in jogl2.
4. From the jogamp-all-platforms folder, open the lib folder. Within that folder open the windows-amd64 folder (yes even if you are on an intel machine!!). Then copy all the .dll files from here into c:\jogl2\lib. (Note: if you are working on a different platform, you need to copy the dll files in the folder that relates to the platform you are working on, e.g. linux-*.)
5. There are a lot of files in c:\jogl2\jar. The relevant ones are `jogl-all.jar` and `gluegen-rt.jar` (and some of the `jogl-all-natives.*` files depending on which platform you are working on). These need to be made available for compilation purposes. In addition the c:\jogl2\lib needs to be made available when compiling, as this folder contains the dll files for JOGL.
6. You can now move to the folder where you will develop your Java programs that use JOGL
7. Using a text editor (such as Notepad), create a file called setupJOGL.bat , which contains the two lines shown in Figure 1.

```
set path=c:\jogl2\lib;%path%
set classpath=.;c:\jogl2\jar\jogl-all.jar;c:\jogl2\jar\gluegen-rt.jar;%classpath%
```

Figure 1: setup.bat

Each of these set commands is on a single line in the batch file. Do not add extra new lines. Also, there is only a blank space character after the word 'set'. Do not add in any extra blank spaces anywhere else on a line. Each entry in a set command should be separated by a semi-colon and

no extra spaces. Make sure the command includes `jogl-all.jar` and `gluegen-rt.jar`. The '–' is important in both these names.
There is an 'environment variable' called path (i.e. a persistent system variable), which the system uses to locate files when the user issues commands. Thus when you type javac to compile a java program or java to run a java program, the system can make use of any files in the lib folder. The string "%path%" means that the existing contents of the path variable are also included on the path.
Likewise classpath is an environment variable. Note the '.' at the start of the classpath list is important, as it indicates the current folder (whichever folder you are in).

8. Now, every time you start a command tool (Windows: Start, All Programs, Accessories, Command Prompt) you will need to navigate to the folder where setupJOGL.bat is stored (e.g. com3503 or com4503 or com6503 or myjoglprograms or wherever you do your java program development and run it:

```
c:\com3503>setup
```

This will then set up the required environment variables (path and classpath). You are then ready to compile and run java programs that make use of JOGL.

```
c:\com3503>javac MyProg.java
c:\com3503>java MyProg
```

9. (Note: You can clean up the lib and jar folders if you wish by deleting all the joal.* and jocl.* files as these are not required. Other files can also be deleted from the jar folder depending on which platform you are working on. For example, if you are working on the windows desktop, then all you need are the following: gluegen.jar, gluegen-rt.jar, gluegen-rt-natives-windows-amd64.jar, gluegen-rt-natives-windows-i586.jar, jogl-all.jar, jogl-all-natives-windows-amd64.jar, jogl-all-natives-windows-i586.jar)

Appendix B

Using permanent environment variables on your own personal windows PC

1. You need administrator privileges to set up permanent environment variables.
2. In Windows, the environment variables can be accessed by opening Windows Settings and typing 'Environment Variables' into the search area. This will launch a window where the 'Environment Variables…' button (see Figure 2) can be selected.
   In the User Variables section, check for an existing variable called CLASSPATH. If this does not exist, then create a new entry. Select the classpath variable and edit it. Add the full path for each of the previously mentioned jar files:
   `.;c:\jogl2\jar\jogl-all.jar; c:\jogl2\jar\gluegen-rt.jar`
   (Note: It is the user environment variables that you are editing. The user environment variables are automatically appended to the system environment variables by the system. If you are the administrator of your machine, you could also edit the system variables if you wish. Note also that the drive name on your machine may be different to C:, so adapt the above list accordingly.)

3. The lib folder also needs to be made available when compiling, as this folder contains the dll files for JOGL (for the Windows platform). Navigate to the environment variables again. This time, change (or add) a user variable called PATH. Add the full path of the lib folder to this path variable:
   `c:\jogl2\lib`
   (Note that your drive name on your machine may be different to C:)

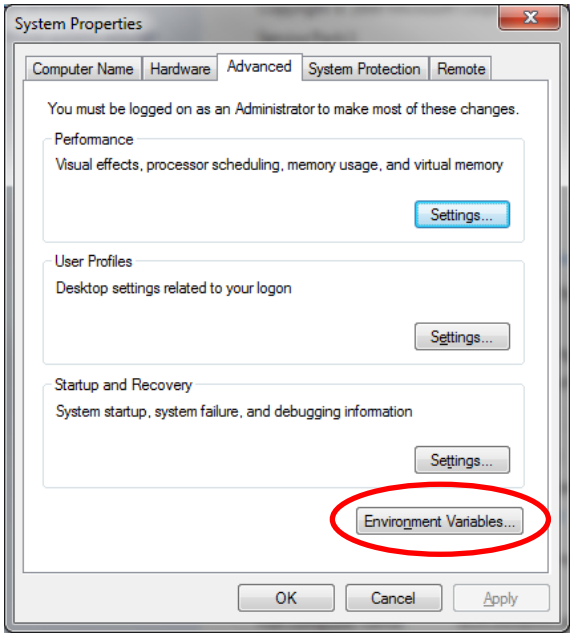

Figure 2: Screenshot for Advanced System Settings