
# Game Development in Android

Disgruntled Rats LLC

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# Overview

- Introduction
- Android Tools
- Game Development
- OpenGL ES
- Marketing
- Summary
- Questions

# Introduction

Disgruntled Rats incorporated on March 31st, 2011.

We are a small company that specializes in game development for mobile devices.

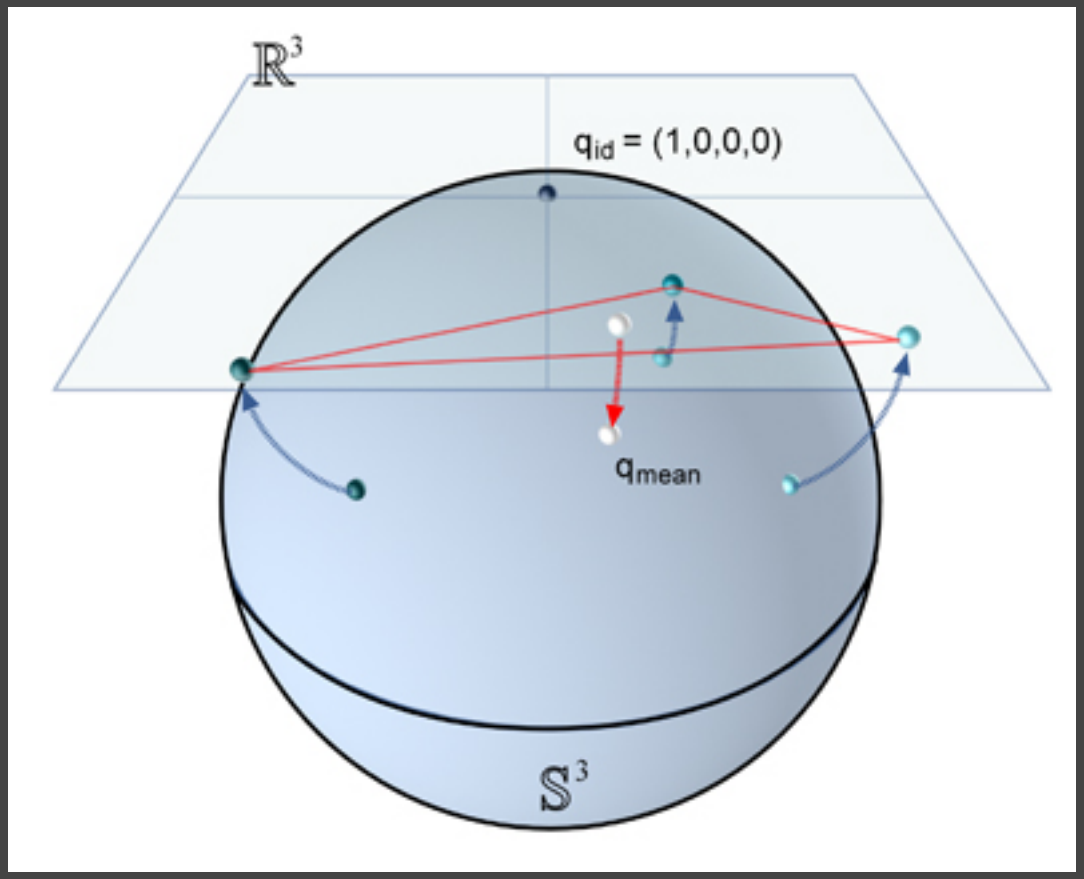
Sean Godinez - Software Engineer - Graphics and C/C++

Michael Boldischar - Software Engineer - Java and Linux

Brian Morgan - Music, Sound, Marketing, Business, and Advertising

# Question!

Who discovered quaternions and when?



# Android Tools

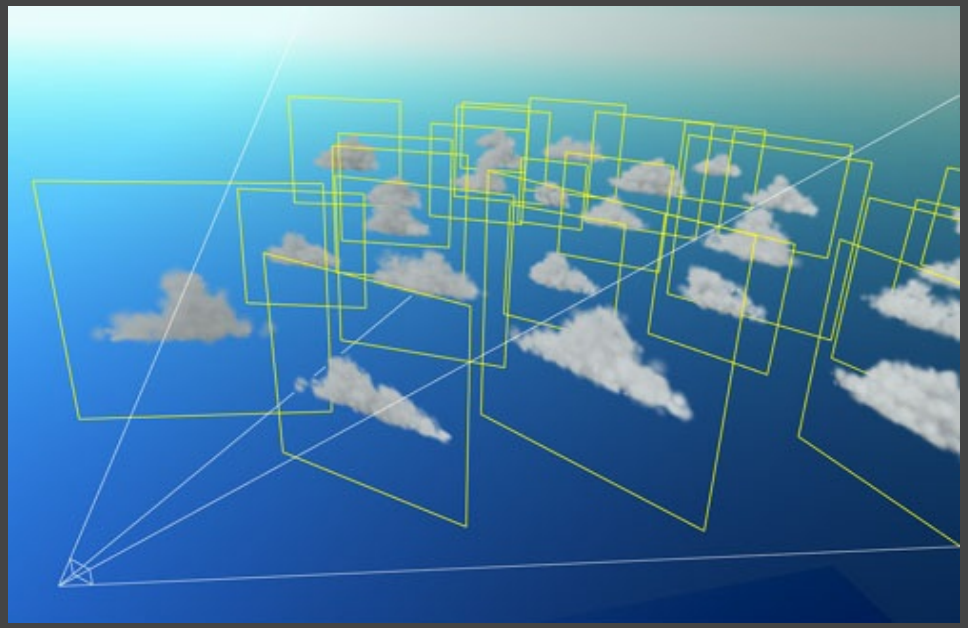
- Eclipse - Integrated Development Environment (IDE)
- ADT - Android's Eclipse Plugin
- Ant (show off our build environment)
  http://www.disgruntledrats.com/?page_id=309
  Why Ant? - Larger group projects
  The Eclipse IDE works well for one developer
  Can invoke Ant scripts from cron scripts
- Hudson - Automatic build tool
  Invokes Ant when new code is checked in
  Send emails when code doesn’t compile
- Android SDK - includes ADB
  http://developer.android.com/sdk/installing.html

# Sprites

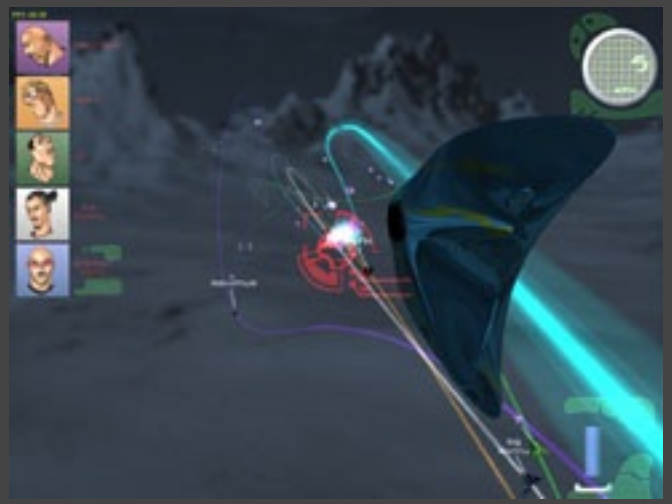
A sprite is a texture mapped to a quad.  They can be animated by updating their position / texture coordinates over time.

- Basic
  - Plants, grass, signs, etc
- Axial
  - LOD Technique for far off mountains, castles, etc
- Screen-Aligned
  - HUDs
  - Text
- View Point
  - Point Sprites => Particle Effects
  - Clouds

# World-Oriented Sprites



# Screen-Aligned & Axial Sprites



# Sound

We developed a sample sound project that builds and deploys with Ant.
Follow the following link to our website to get started :
http://www.disgruntledrats.com/?page_id=545

Let's read some code!

# 3D Models - Data Formats

Data Formats

- Text-based
  - Pros - easy to parse
  - Cons - bloated model files
- Binary
  - Pros - very compact, tightly packed data
  - Cons - harder to parse, have you tried byte shifting in Java lately?

# 3D Models - File Types

What are some of the file types?

- 3DS - Autodesk 3DS Max (.3ds)
  - Pros - de-facto standard for modelling, hierarchical data
  - Cons - all meshes are made from triangles, closed standard
- COLLADA
  - Pros - open standard for transferring model data
  - Cons -very complex, lots of elements and relationships, would take a long time to fully implement a parser, 3D Studio Max exports lose some animation data
- Milkshape, SketchUp, X3D, etc...

# Question!

Who's hotter than J-WOWW?

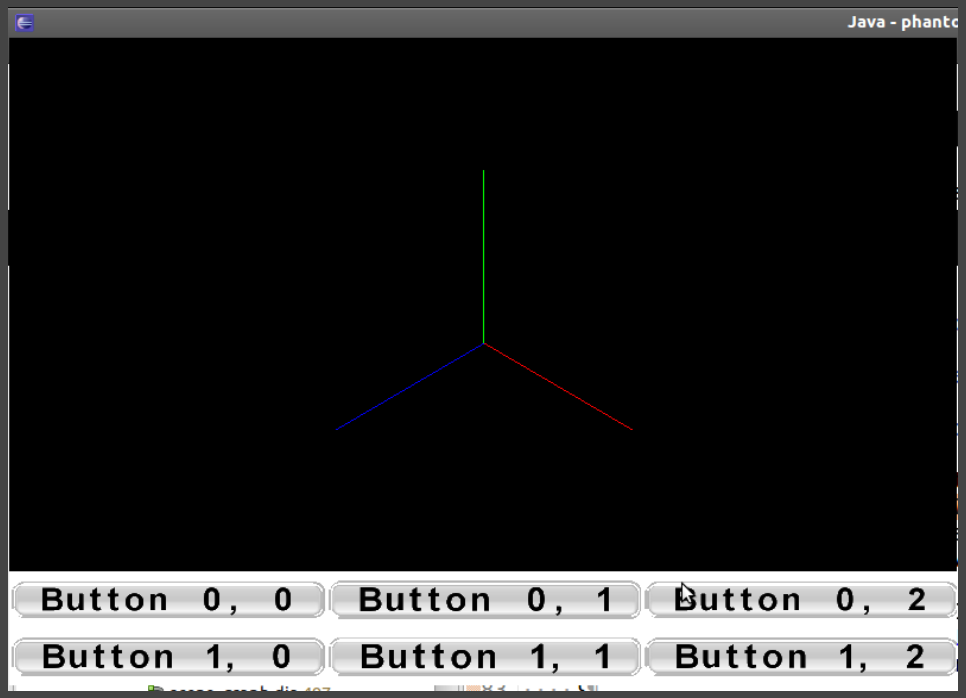
# AI & Physics

- AI Behaviors
  - Seek and Evade
  - Cohesion and Separation
  - Alignment
- A-Star & Dijkstra Search Algorithms

- Classical Mechanics
  - Position and its derivatives
  - Force

# In Game User Interfaces

- Standard Android UI and widgets
  - Pros - Library is already written for you!
  - Cons -None
- Build Your Own - Orthographic Sprites, Font Textures, or Font Algorithms
  - Pros - Build it once, apply it anywhere in a game (e.g. a newspaper, quests, etc...)!
  - Cons - Time consuming process, fonts are not trivial



# Version Checking

You should check which version of OpenGL ES is supported by the current device.

```
  /**
   * Checks to see if the OS supports the given version of OpenGL ES.
   * @param version
   *          the version to check against in hex
   * @return
   *          true if the version is supported by the OS, otherwise false
   */
  private static boolean supportsOpenGlEsVersion(int version) {
      ActivityManager activityManager = (ActivityManager)
              activity.getSystemService(Activity.ACTIVITY_SERVICE);
      int foundVersion
              = activityManager.getDeviceConfigurationInfo().reqGlEsVersion;
      System.out.println("OpenGL ES version found: " + foundVersion);
      return foundVersion >= version;
  }
```

# Question!

Who would win in a fight and why?

Gordan Freeman

Chuck Norris

# Brass Tacks - Vertices

What are they?

- "A point is represented by a set of floating-point numbers called a vertex" - OpenGL Red Book

How do we get all the data associated with vertexes to the GPU?

Remember these calls?

```
glBegin(GL_TRIANGLES);                  // Drawing Using Triangles
    glVertex3f( 0.0f, 1.0f, 0.0f);      // Top
    glVertex3f(-1.0f,-1.0f, 0.0f);      // Bottom Left
    glVertex3f( 1.0f,-1.0f, 0.0f);      // Bottom Right
glEnd();                                // Finished Drawing The Triangle
```

Why are they a bad idea on a mobile device?

# Vertex Buffers and Textures

What is the best way to pack data?

- It depends.

The Goal: Switch between buffers as little as possible during rendering.

Separate buffers for vertex, normal, texture data: Tradeoff between simplicity and performance.

Let's read some code!
http://www.disgruntledrats.com/?page_id=545

# Transformations

- Right Hand Rule vs Left Hand Rule
- Column Vector vs Row Vector
- Column Major vs Row Major
- Translation
- Rotation
- Scale
- 4x4 Transformation Matrix
- Rotation about arbitrary axis
- Quaternions
- Inverting Matrices
- Transpose of an Inverted Matrix
- Transformations in a Scene Graph
- OpenGL ES 2.0 does NOT have matrix stack
- Check out our website for a tutorial on scene graphs

# 4x4 Transformation Matrix

- Translation $\begin{bmatrix} 1 & 0 & 0 & dx \\ 0 & 1 & 0 & dy \\ 0 & 0 & 1 & dz \\ 0 & 0 & 0 & 1 \end{bmatrix}$

- Scaling $\begin{bmatrix} s_x & 0 & 0 & 0 \\ 0 & s_y & 0 & 0 \\ 0 & 0 & s_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

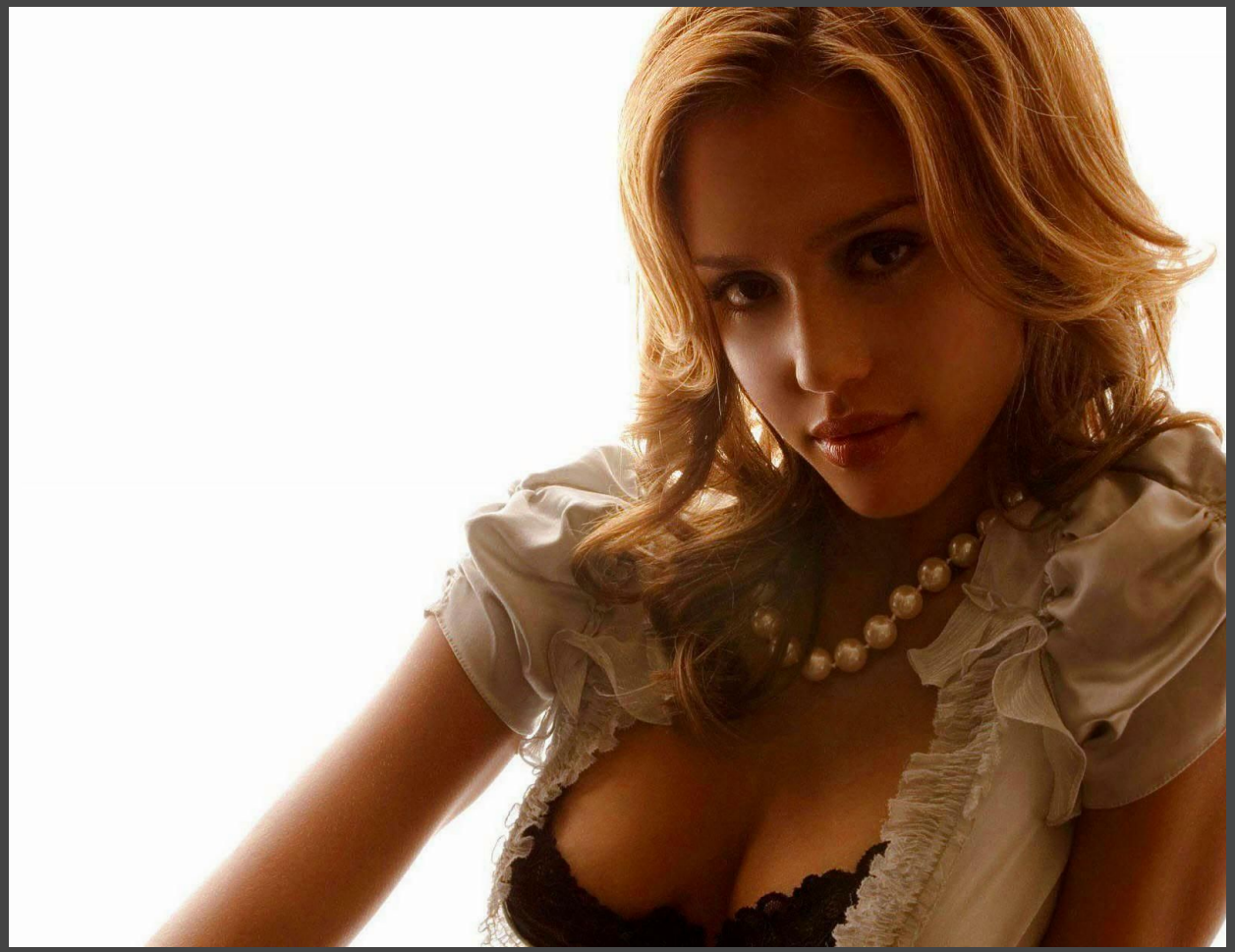
- Rotation about X-axis $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

- Rotation about Y-axis $\begin{bmatrix} \cos\theta & 0 & \sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

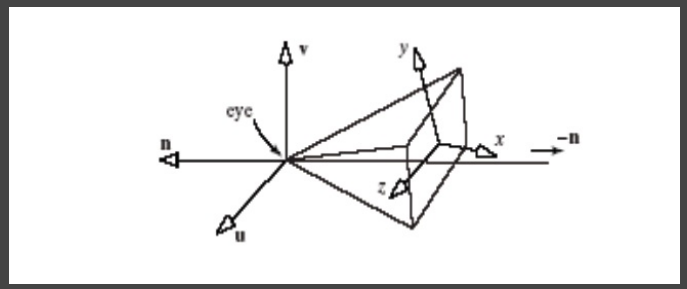
- Rotation about Z-axis $\begin{bmatrix} \cos\theta & -\sin\theta & 0 & 0 \\ \sin\theta & \cos\theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

# Question!

Who's hotter than Jessica Alba?



# Camera



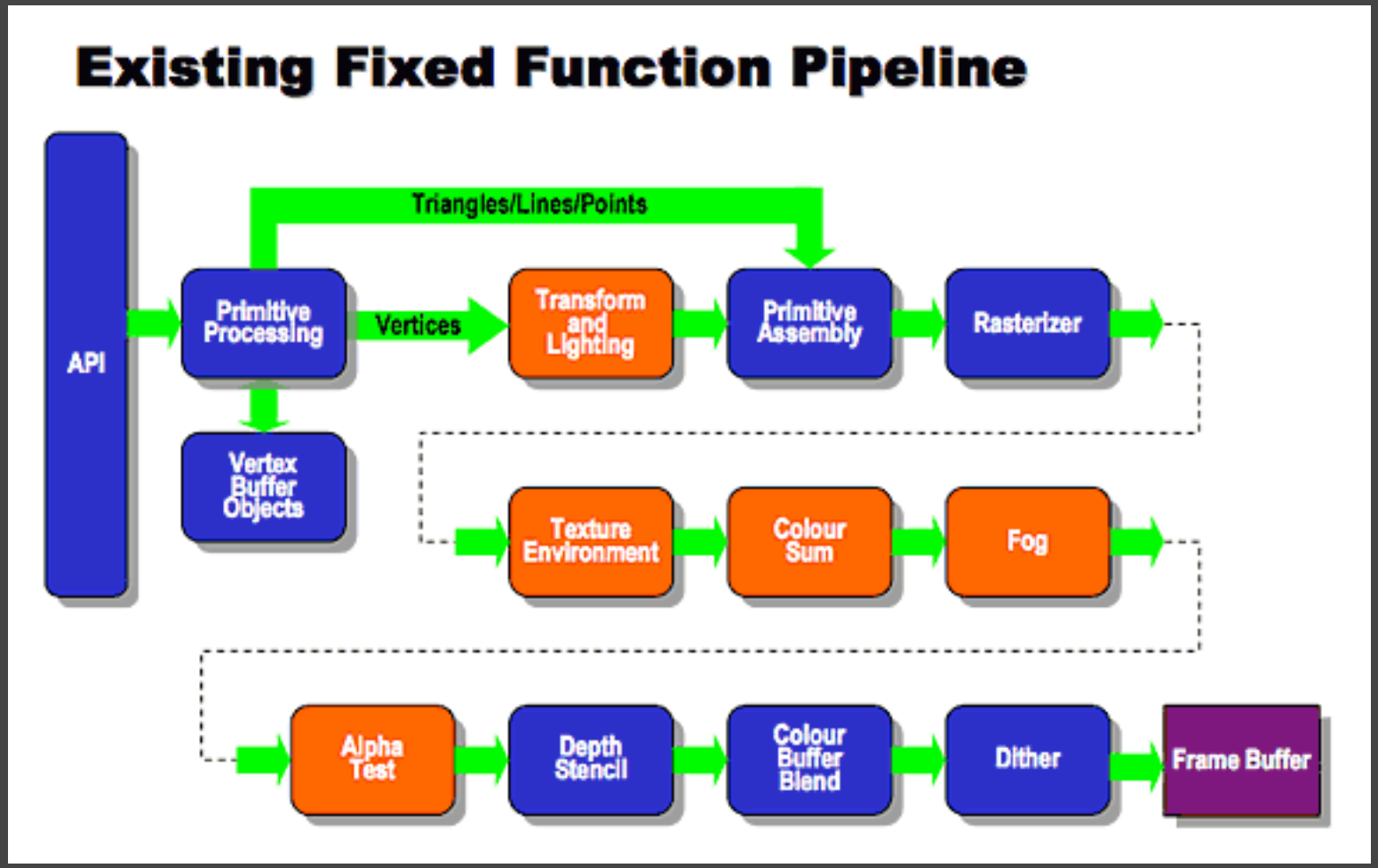

- Projections (Orthographic, Perspective, Isometric)
- Constraints on Calculating Axis (Up x View)
- View Matrix transforms from World Space to Eye Space
  - rotates (u,v,n) to align with world (x,y,z)
  - translates to origin

$$V = \begin{pmatrix} u_x & u_y & u_z & 0 \\ v_x & v_y & v_z & 0 \\ n_x & n_y & n_z & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 & -e_x \\ 0 & 1 & 0 & -e_y \\ 0 & 0 & 1 & -e_z \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

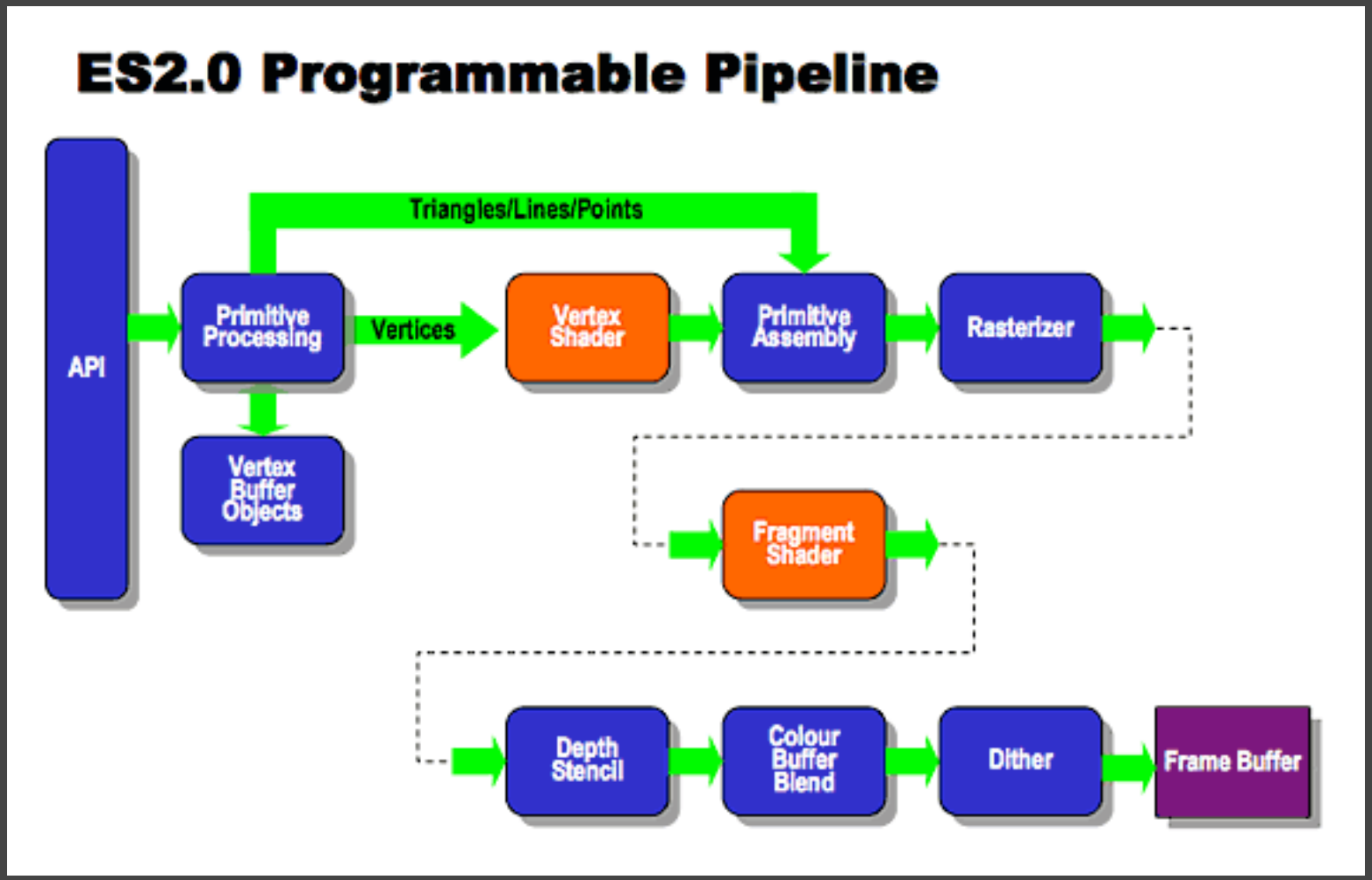
$$\mathbf{V} = \begin{pmatrix} \mathbf{u}_x & \mathbf{u}_y & \mathbf{u}_z & \mathbf{d}_x \\ \mathbf{v}_x & \mathbf{v}_y & \mathbf{v}_z & \mathbf{d}_y \\ \mathbf{n}_x & \mathbf{n}_y & \mathbf{n}_z & \mathbf{d}_z \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

where **d** = (-**e**·**u**, -**e**·**v**, -**e**·**n**)

# OpenGL 1.x Graphics Pipeline

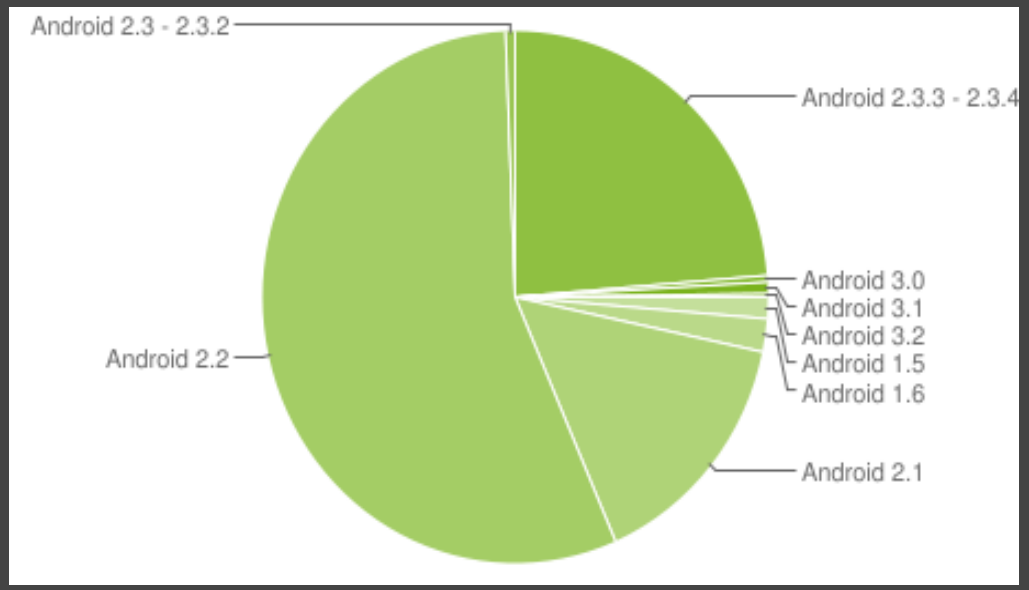


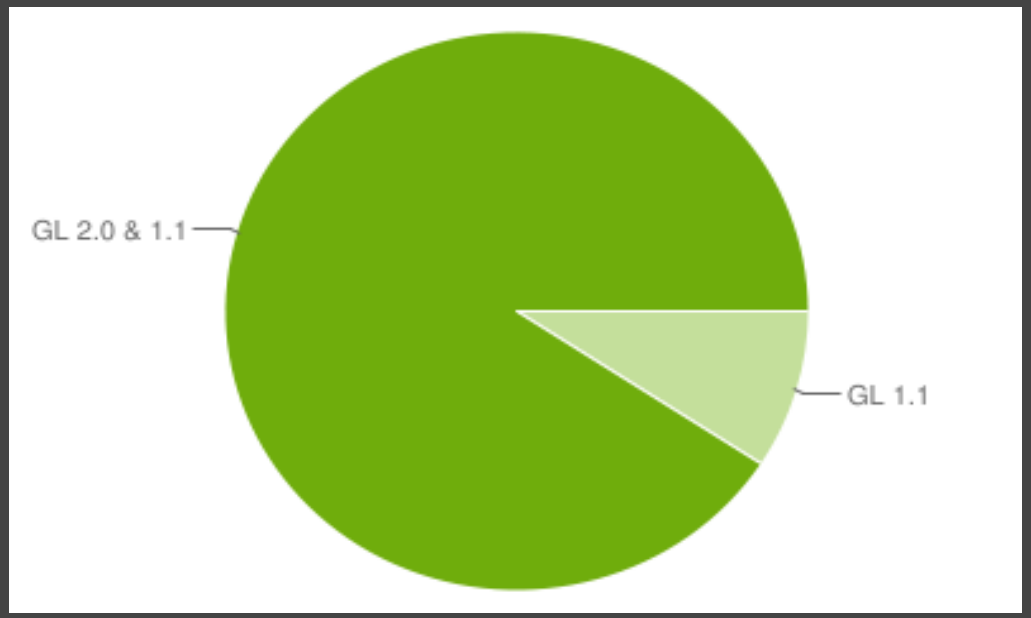
# OpenGL 2.0 Graphics Pipeline



# Other Considerations for OpenGL ES 1.0 versus 2.0

- Android Support
  - OpenGL ES 1.0 Supported since Android 1.0
  - OpenGL ES 2.0 Supported since Android 2.2
- 80% of devices now support Android 2.2 or greater
- 90% support 2.0
- More devices are supporting OpenGL ES 2.0 every day



# Question!

What was the name of the end boss in World of Warcraft's Molten Core?

# Vertex Shader

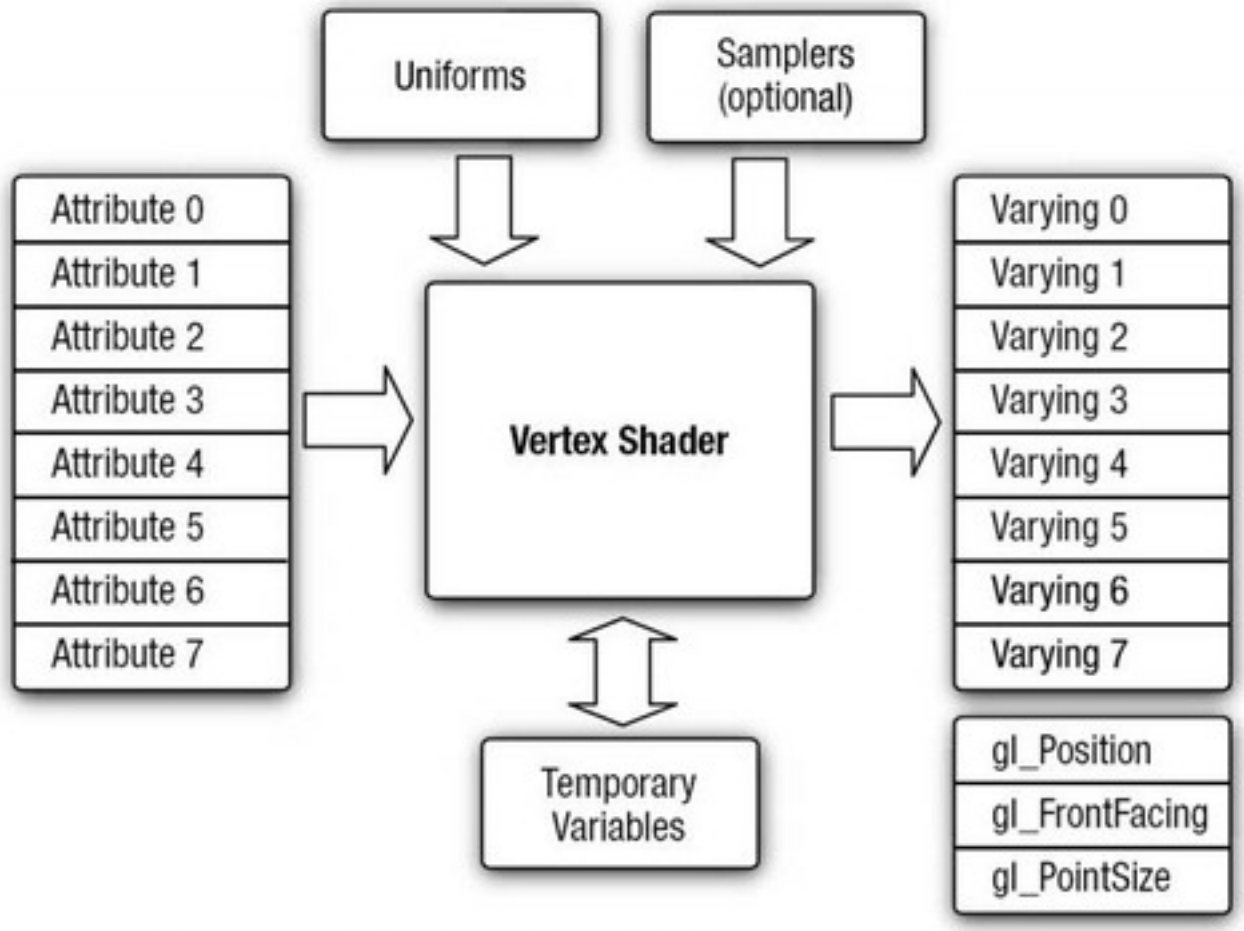



**Figure 1-2** OpenGL ES 2.0 Vertex Shader

# Primitive Assembly

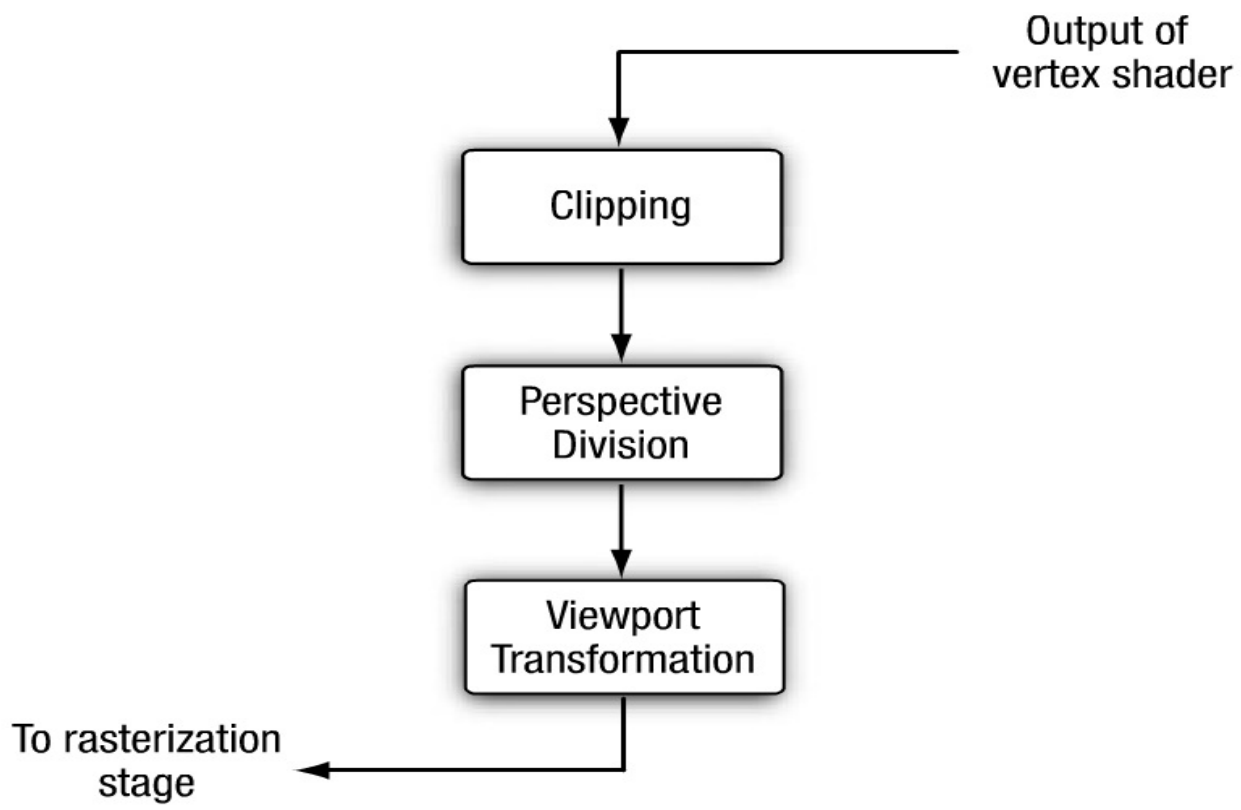



**Figure 7-6** OpenGL ES Primitive Assembly Stage

# Rasterization

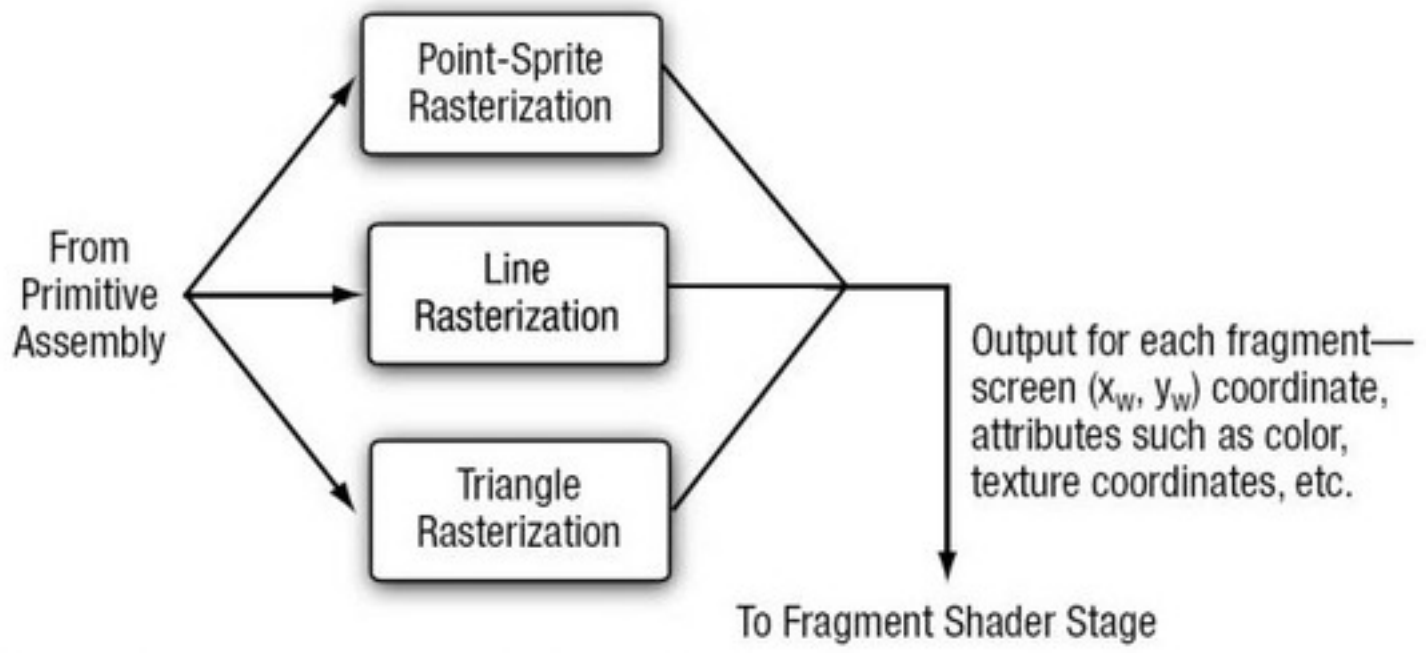



**Figure 1-3** OpenGL ES 2.0 Rasterization Stage

# Fragment Shader

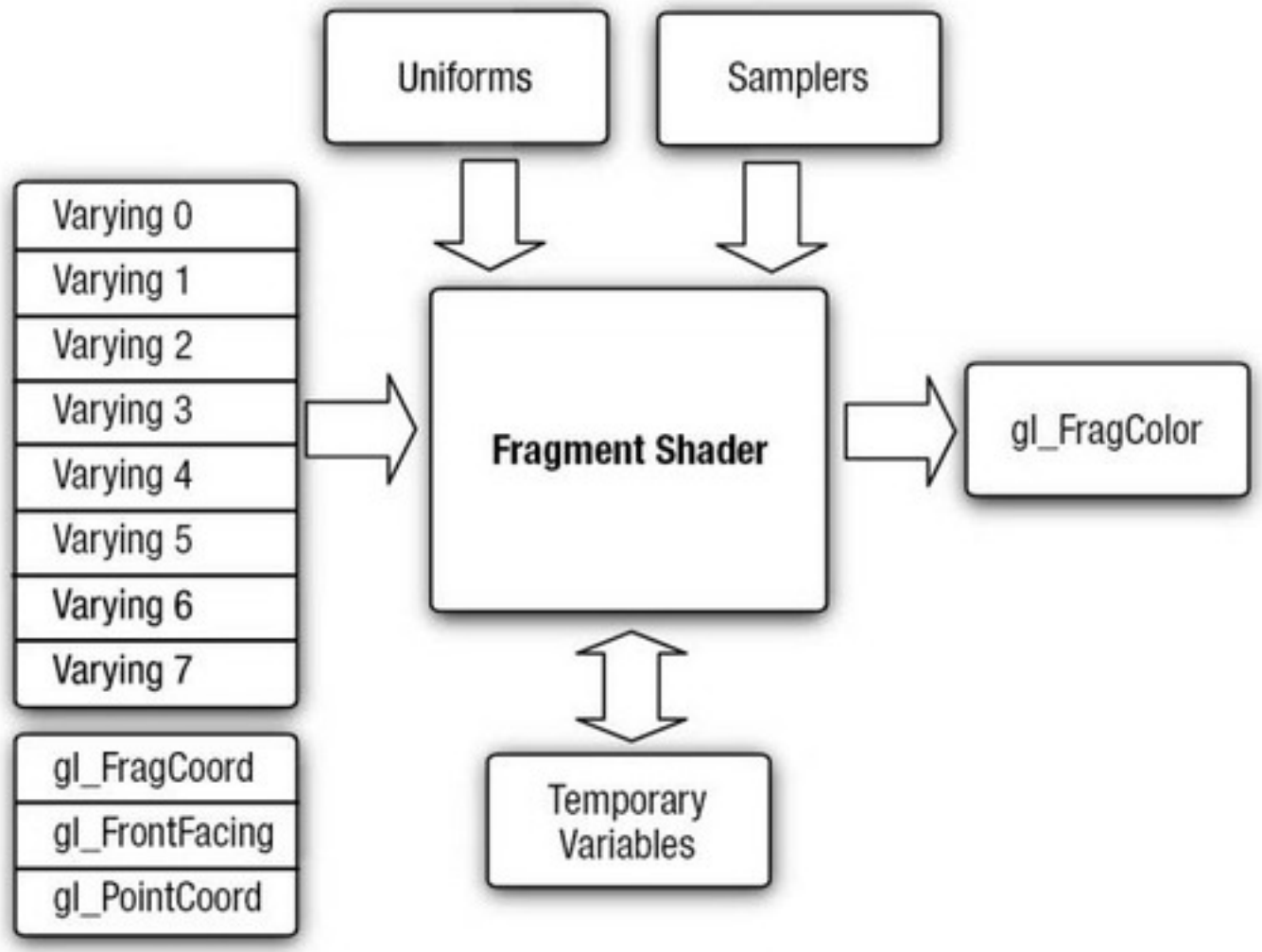



**Figure 1-4** OpenGL ES 2.0 Fragment Shader

# Per-Fragment Operations

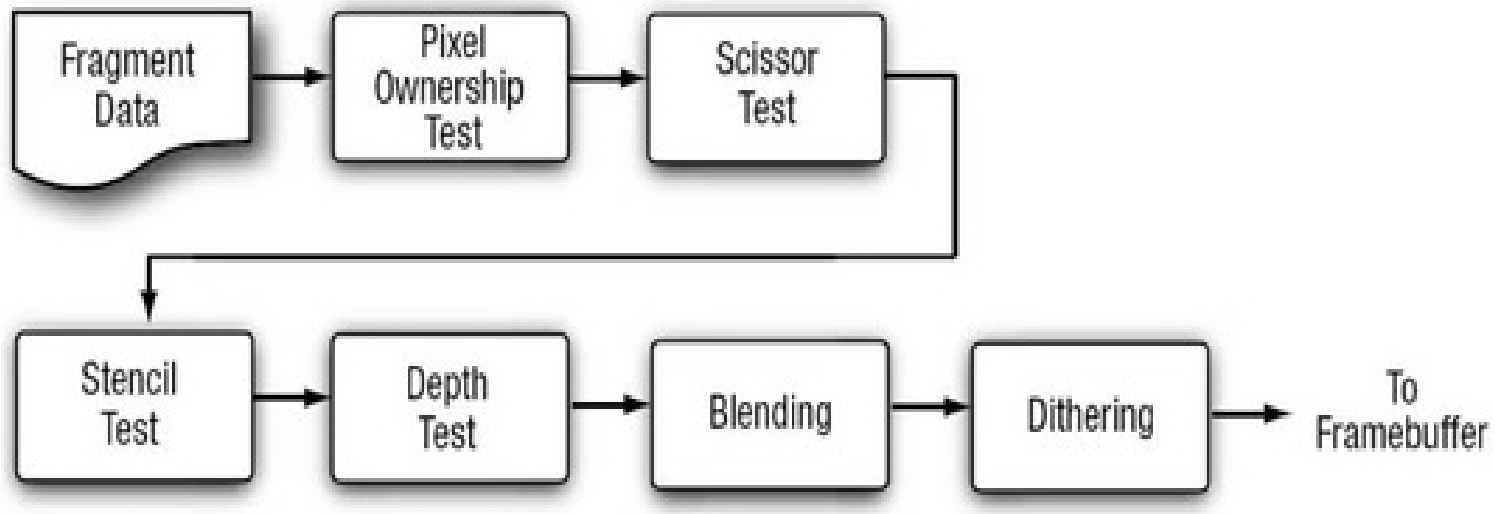



**Figure 1-5** OpenGL ES 2.0 Per-Fragment Operations

# Shaders in Android

Google does not currently have an Android emulator that supports OpenGL ES 2.0, but nVidia does!
http://developer.nvidia.com/tegra-resources#tools

Android Triangle Demo:
http://developer.android.com/resources/samples/ApiDemos/src/com/example/android/apis/graphics/GLES20TriangleRenderer.html

# Question!

What is the game engine in the new Battlefield 3 FPS?

# Marketing

# Summary

- Game development is challenging.  Lots of math.
- No one is hotter than Jessica Alba.
- You are probably excited to get home.

# References


- Google Android SDK
- OpenGL ES 2.0 Programming Guide
- Real-Time Rendering,  3rd Edition
- University of Minnesota, CSCI 5107/5108
- Android Versions
  - http://developer.android.com/resources/dashboard/platform-versions.html
  - http://developer.android.com/guide/topics/graphics/opengl.html
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- Before vertex buffers
  - http://nehe.gamedev.net/tutorial/your_first_polygon/13002/

# References Continued


- WOW Picture
  - http://www.wowwiki.com/Ragnaros_%28tactics%29
- Gordan Freeman
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- Chuck Norris
  - http://www.amirmosadegh.com/wp-content/uploads/2008/09/chuck_norris_0021.jpg
- Jessica Alba
  - http://wallpaperpassion.com/upload/1236/jessica-alba-wallpaper.jpg
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- Battlefield 3
  - http://videogames.techfresh.net/battlefield-3-gameplay-trailer/

# Questions?