Mobile Application Programming

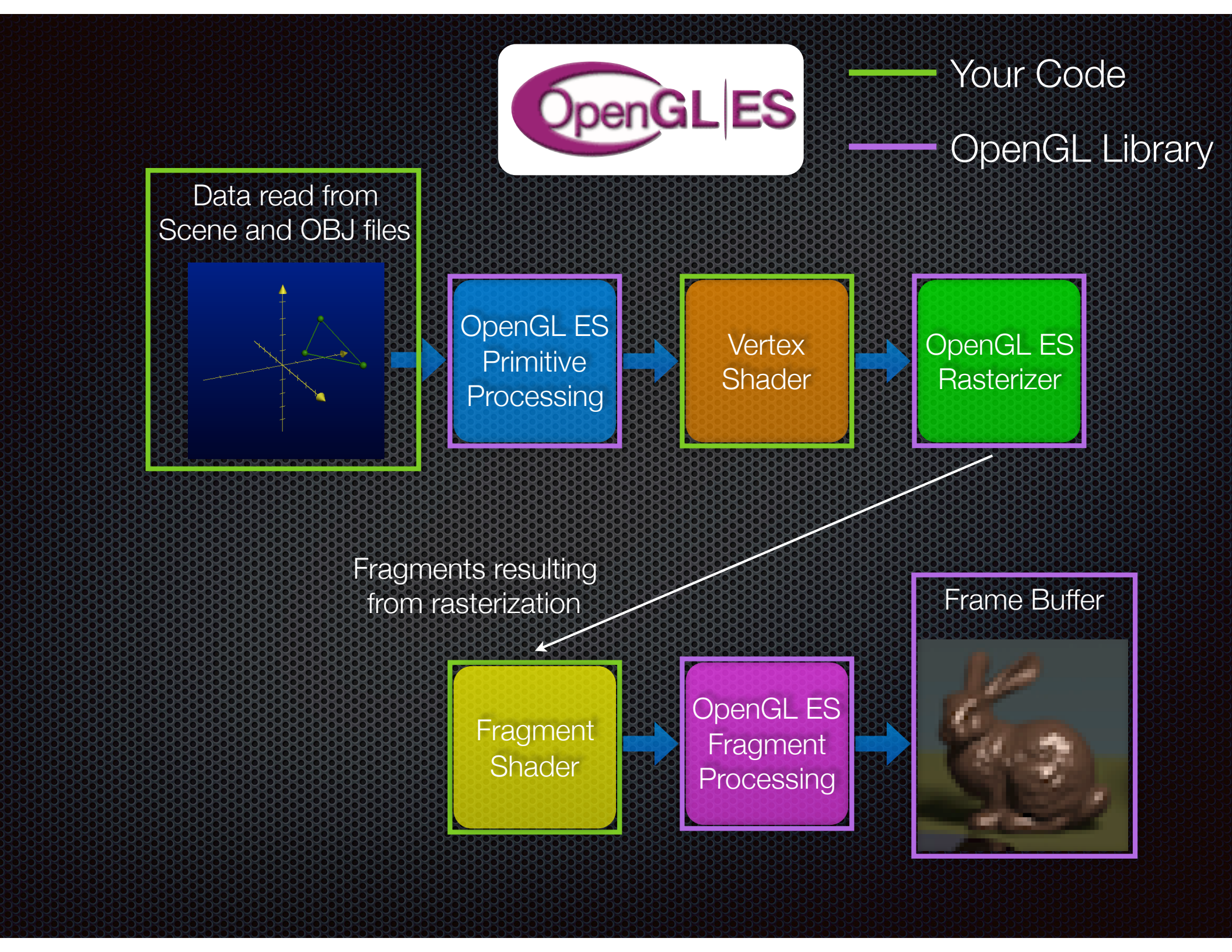
Sprites

Topics

https://www.surveymonkey.com/r/L3738YY

OpenGL Environment

- UIWindow
  - Root VC - GLKViewController
    - GLKView
      - Vertex Shader
      - Fragment Shader
      - Program
        - Uniform Variables
        - Attribute Arrays

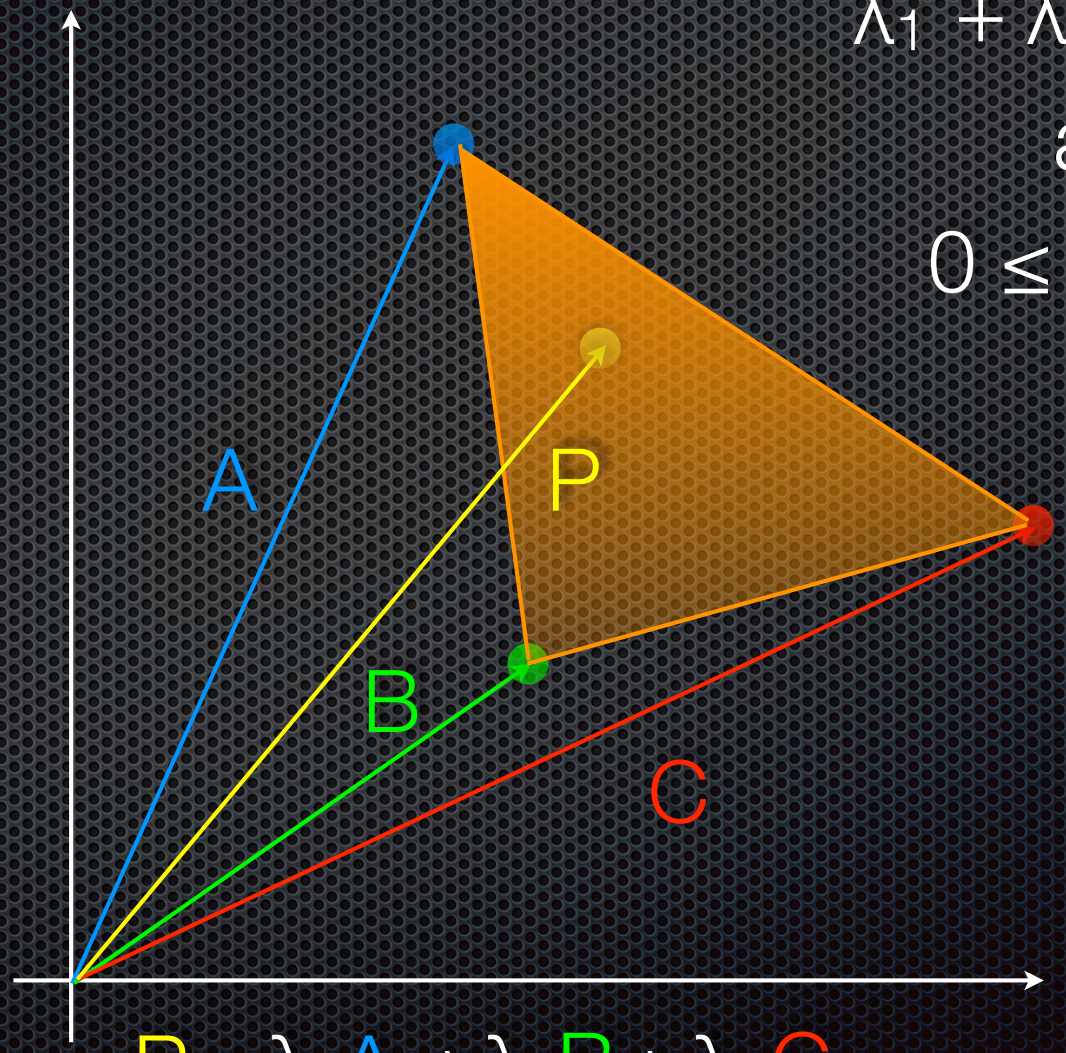

OpenGL ES
Your Code
OpenGL Library
Data read from Scene and OBJ files
OpenGL ES Primitive Processing
Vertex Shader
OpenGL ES Rasterizer
Fragments resulting from rasterization
Fragment Shader
OpenGL ES Fragment Processing
Frame Buffer

Barycentric Coordinates

$\lambda_1 + \lambda_2 + \lambda_3 = 1$

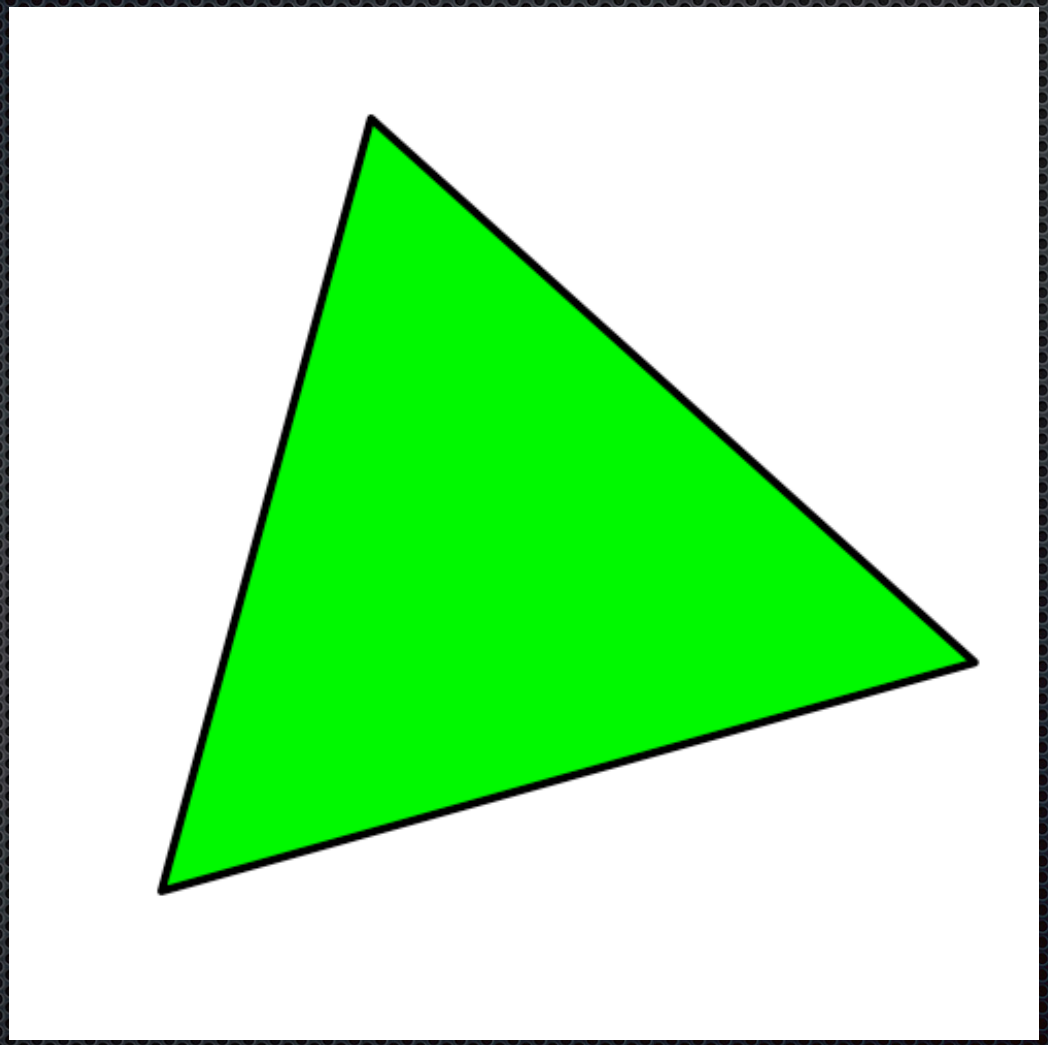
and

$0 \leq \lambda_x \leq 1$

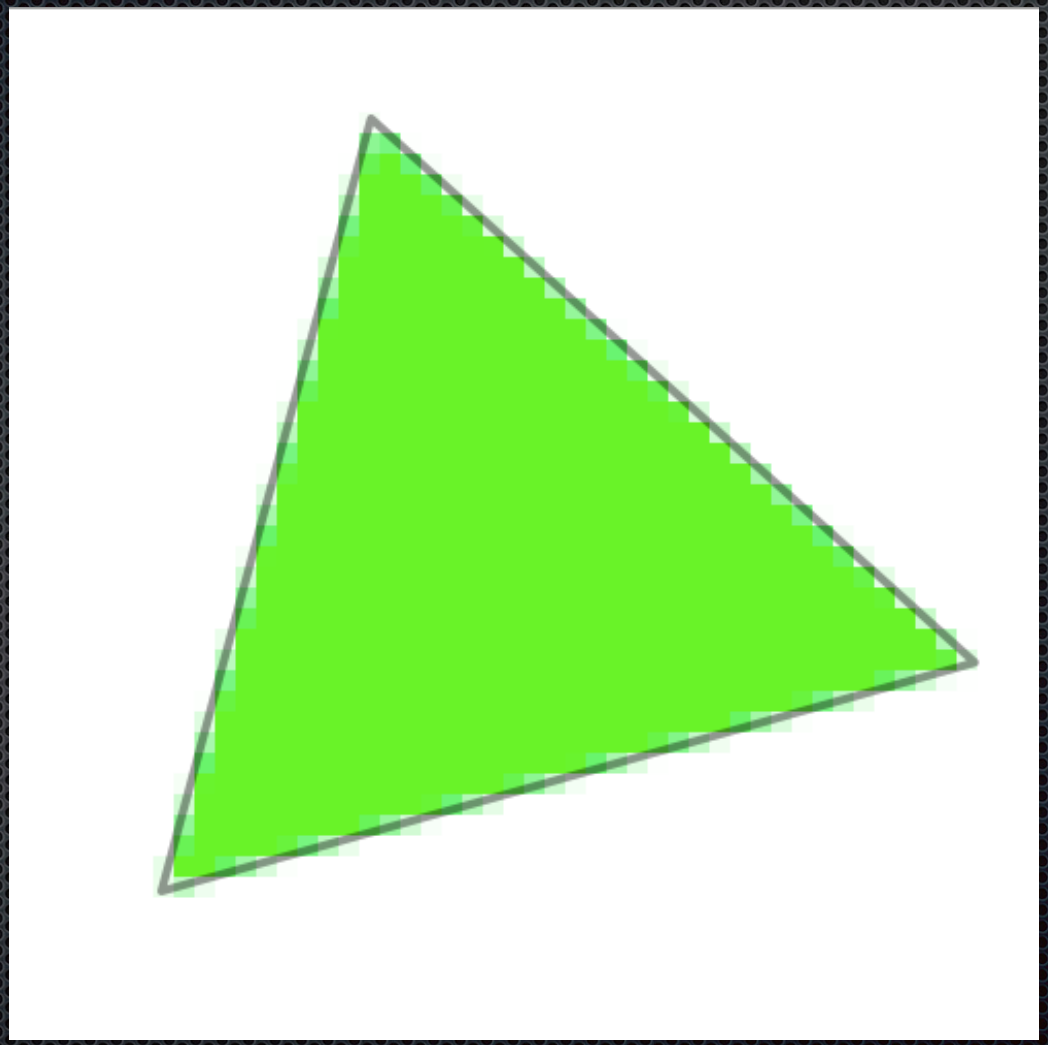


$P = \lambda_1 A + \lambda_2 B + \lambda_3 C$

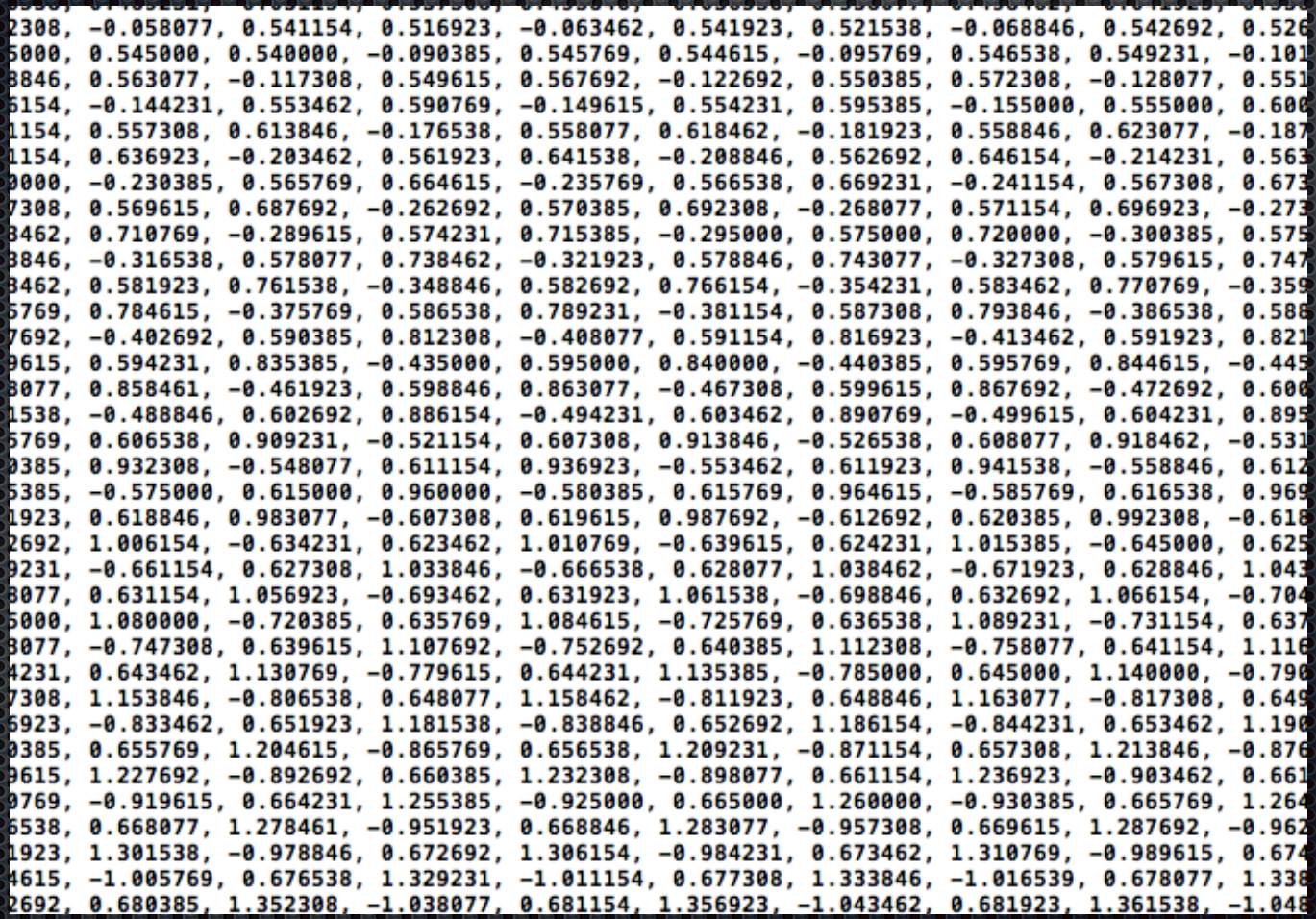
Rasterization



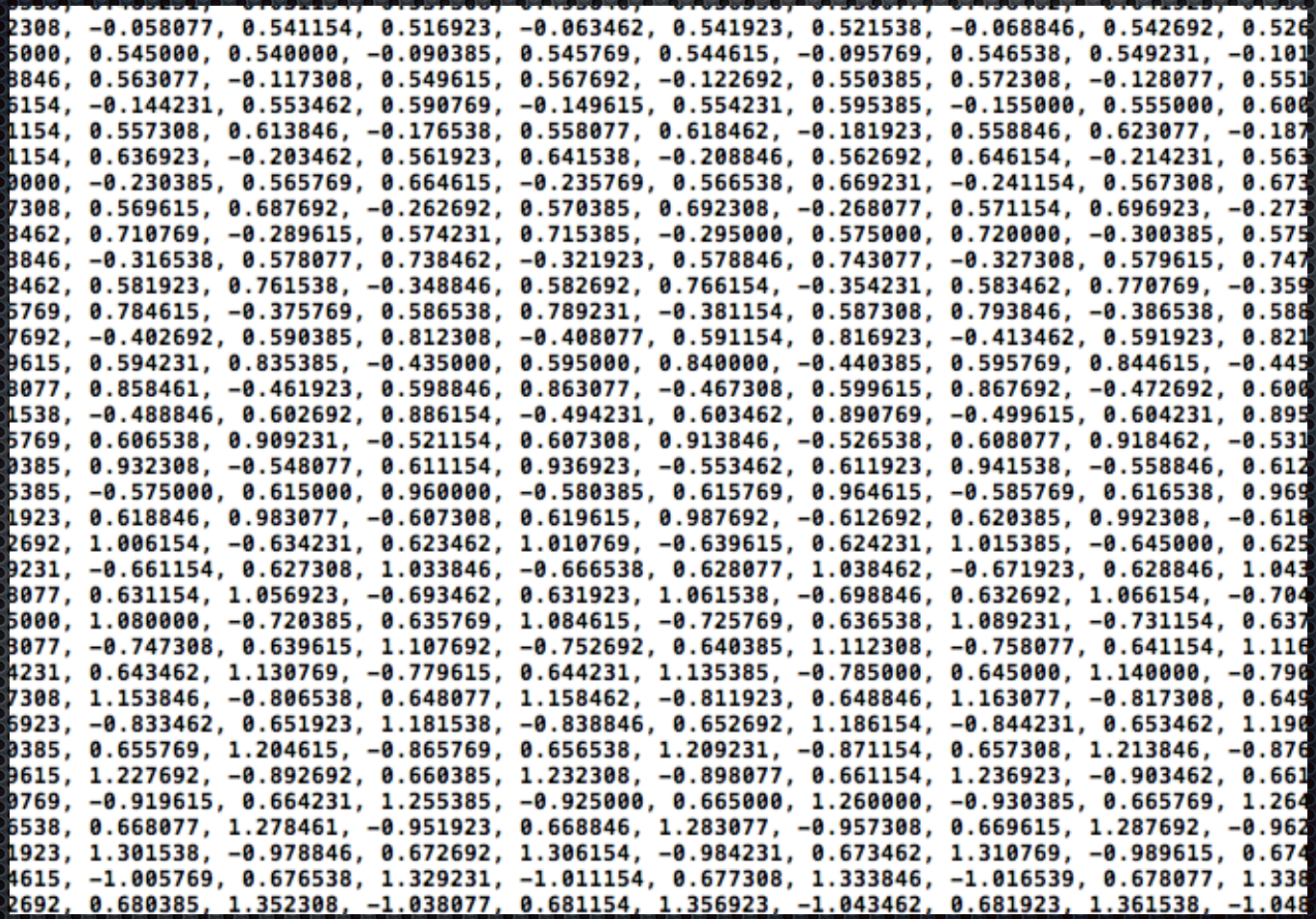
Rasterization



Barycentric Coordinates



Barycentric Coordinates



```
2308, -0.058077, 0.541154, 0.516923, -0.063462, 0.541923, 0.521538, -0.068846, 0.542692, 0.526
6000, 0.545000, 0.540000, -0.090385, 0.545769, 0.544615, -0.095769, 0.546538, 0.549231, -0.101
3846, 0.563077, -0.117308, 0.549615, 0.567692, -0.122692, 0.550385, 0.572308, -0.128077, 0.551
6154, -0.144231, 0.553462, 0.590769, -0.149615, 0.554231, 0.595385, -0.155000, 0.555000, 0.600
1154, 0.557308, 0.613846, -0.176538, 0.558077, 0.618462, -0.181923, 0.558846, 0.623077, -0.187
1154, 0.636923, -0.203462, 0.561923, 0.641538, -0.208846, 0.562692, 0.646154, -0.214231, 0.563
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7308, 0.569615, 0.687692, -0.262692, 0.570385, 0.692308, -0.268077, 0.571154, 0.696923, -0.273
8462, 0.710769, -0.289615, 0.574231, 0.715385, -0.295000, 0.575000, 0.720000, -0.300385, 0.575
3846, -0.316538, 0.578077, 0.738462, -0.321923, 0.578846, 0.743077, -0.327308, 0.579615, 0.747
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```

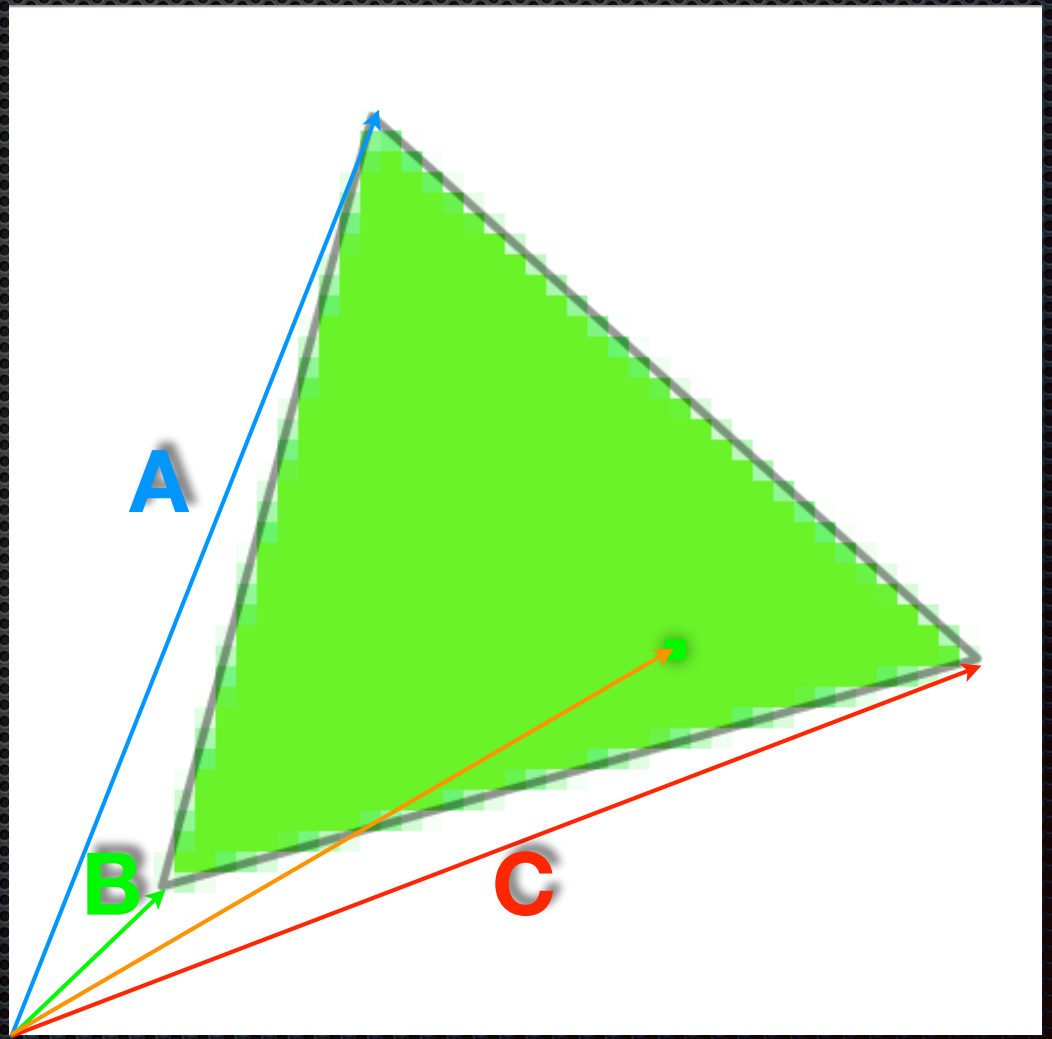
What else can we do with this data?

Barycentric Coordinates

$$\lambda_1 + \lambda_2 + \lambda_3 = 1$$

and

$$0 \leq \lambda_x \leq 1$$



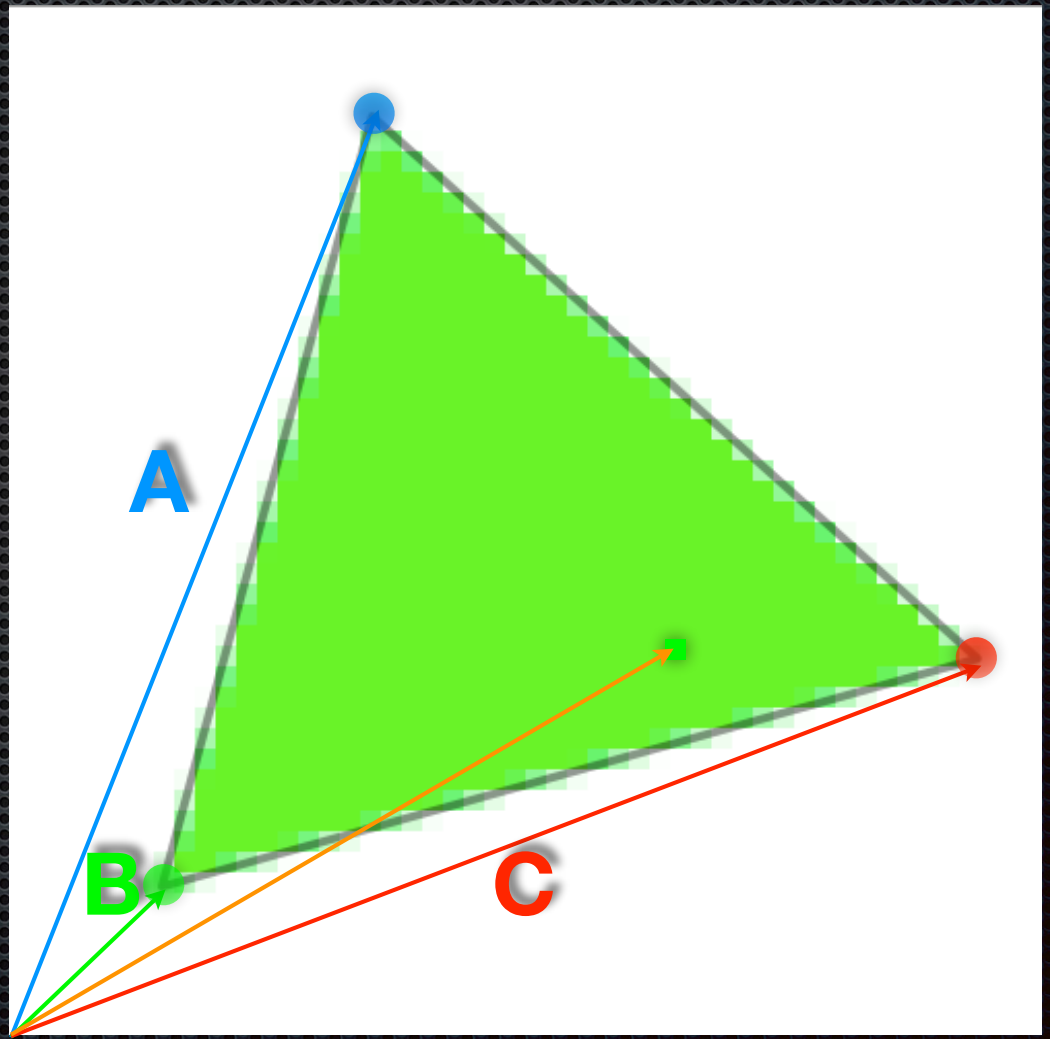
Barycentric Coordinates

$\lambda_1 + \lambda_2 + \lambda_3 = 1$

and

$0 \leq \lambda_x \leq 1$

Associate a color with each point



Barycentric Coordinates

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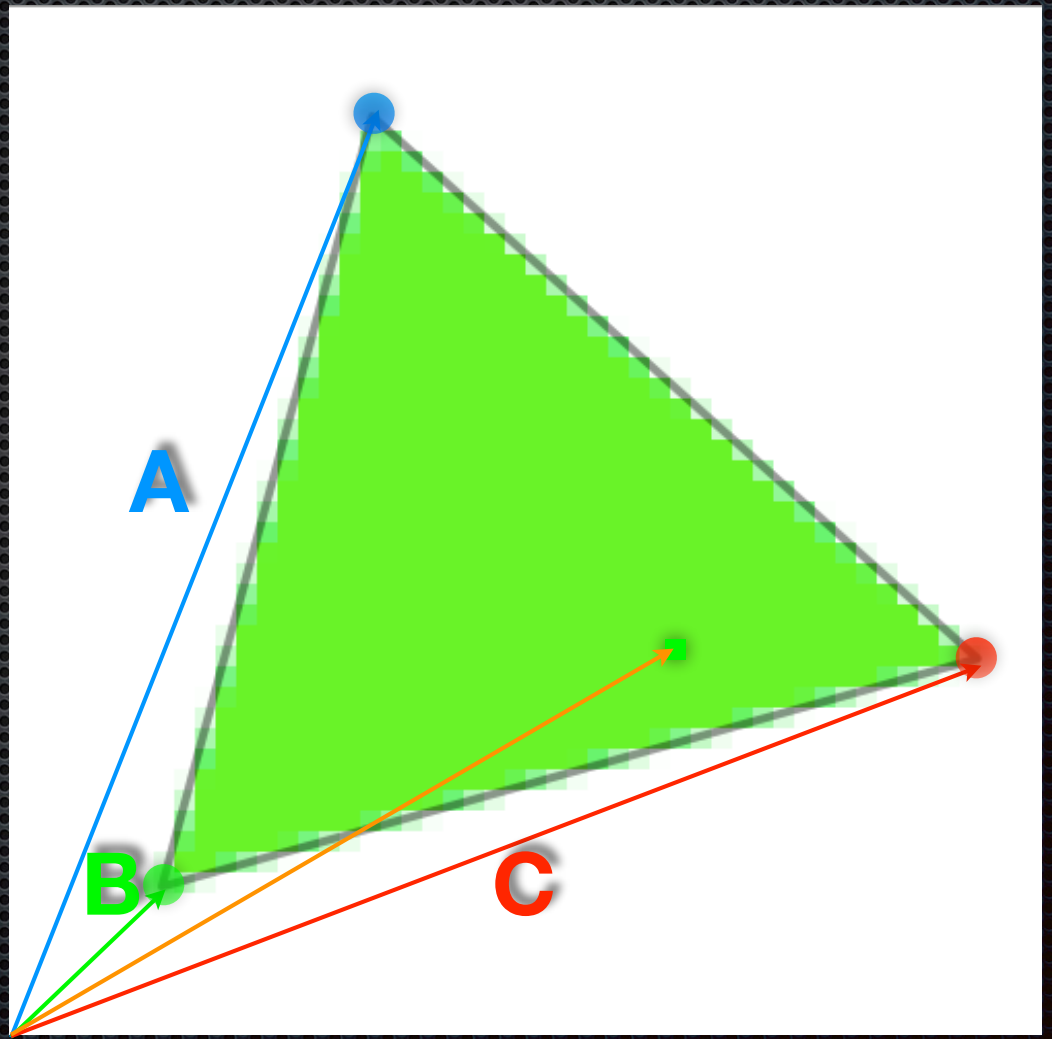
- $0 \leq \lambda_1 \leq 1$
- $0 \leq \lambda_2 \leq 1$
- $0 \leq \lambda_3 \leq 1$



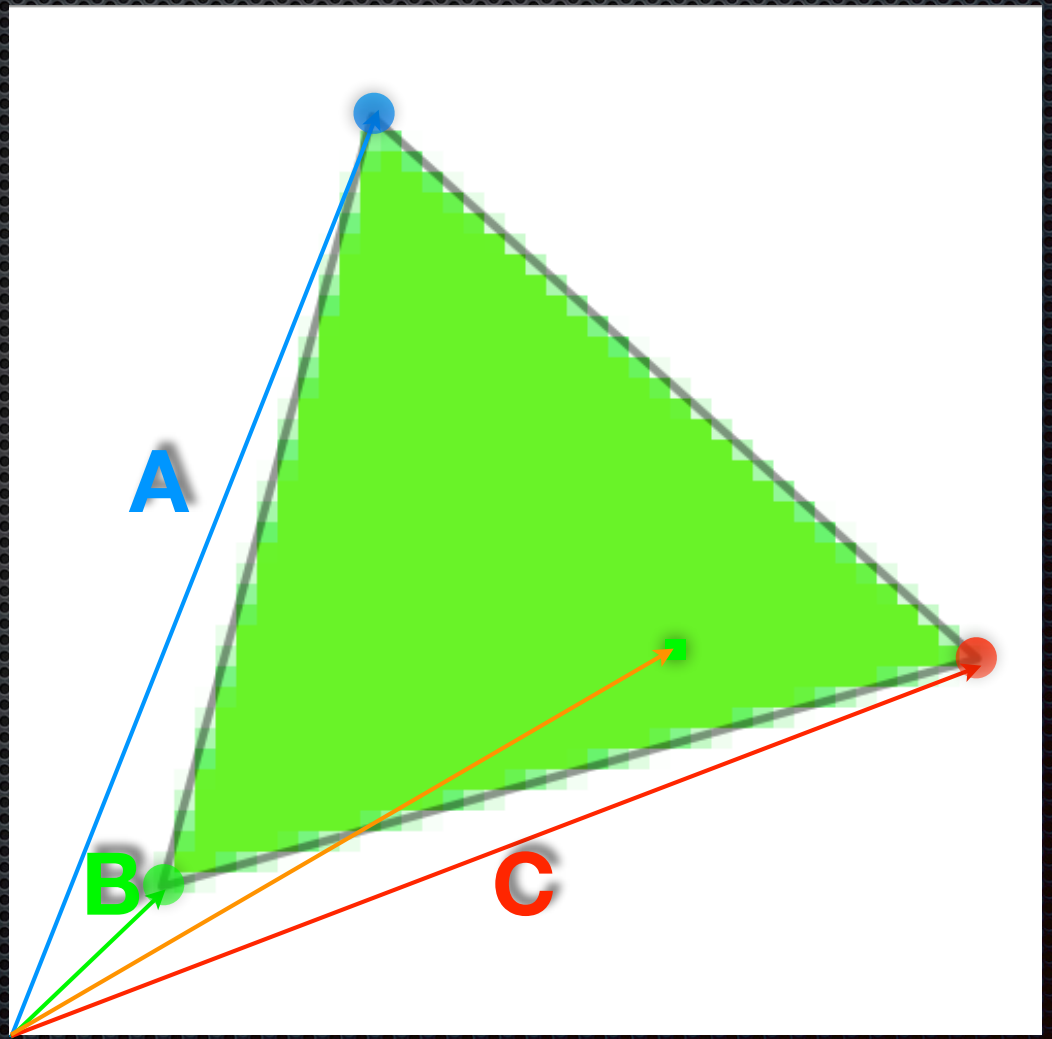
Barycentric Coordinates

$\lambda_1 + \lambda_2 + \lambda_3 = 1$

and

$0 \leq \lambda_x \leq 1$

- λ_1 = Weight 1
- λ_2 = Weight 2
- λ_3 = Weight 3



Barycentric Coordinates

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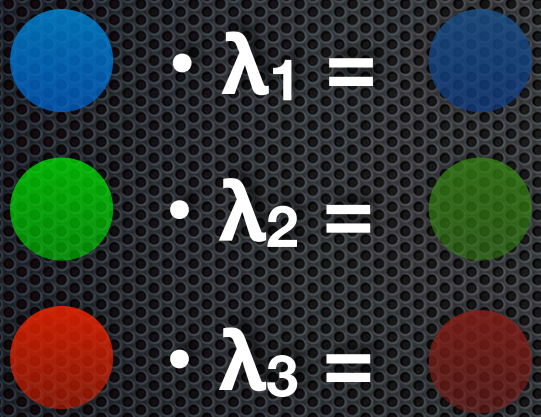
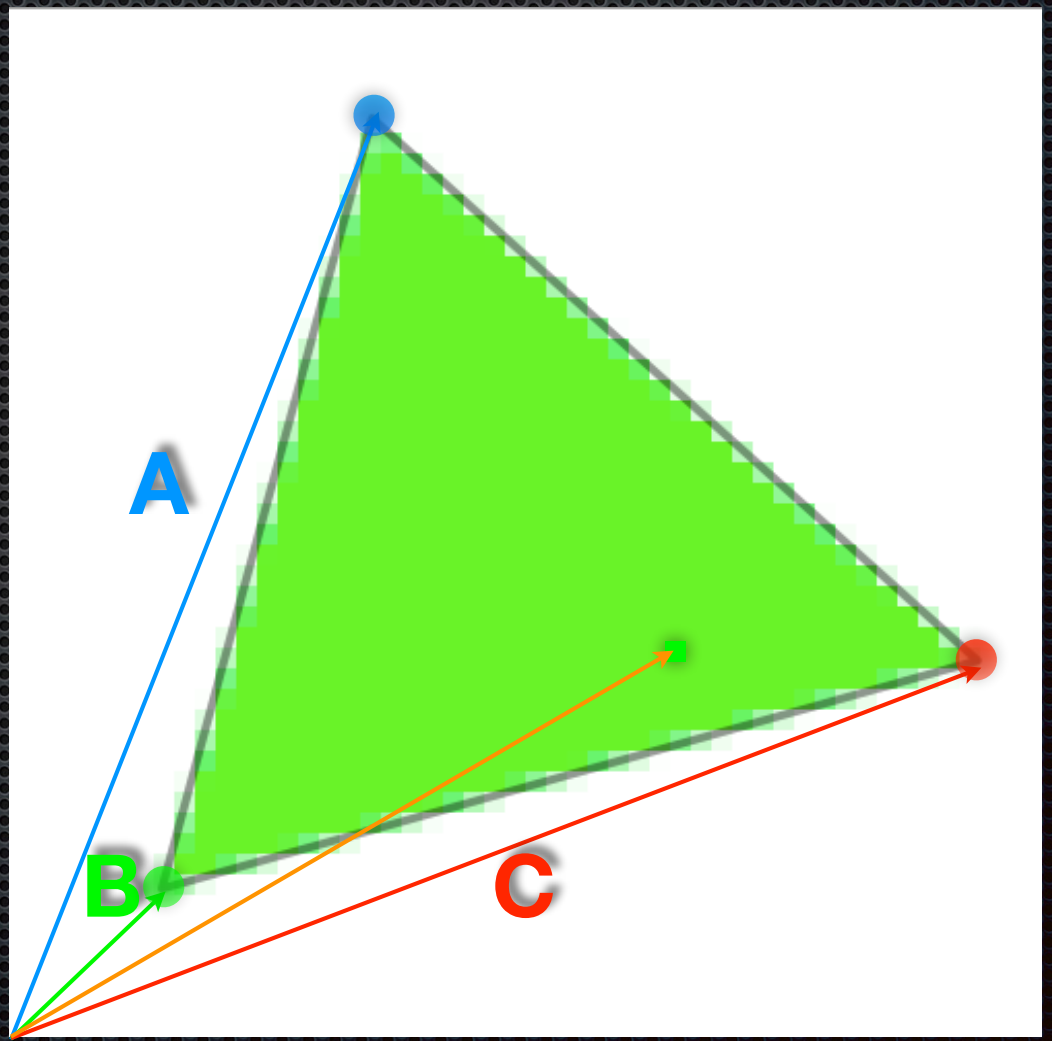
and

$0 \leq \lambda_x \leq 1$



- $\lambda_1 =$
- $\lambda_2 =$
- $\lambda_3 =$



Barycentric Coordinates

$\lambda_1 + \lambda_2 + \lambda_3 = 1$

and

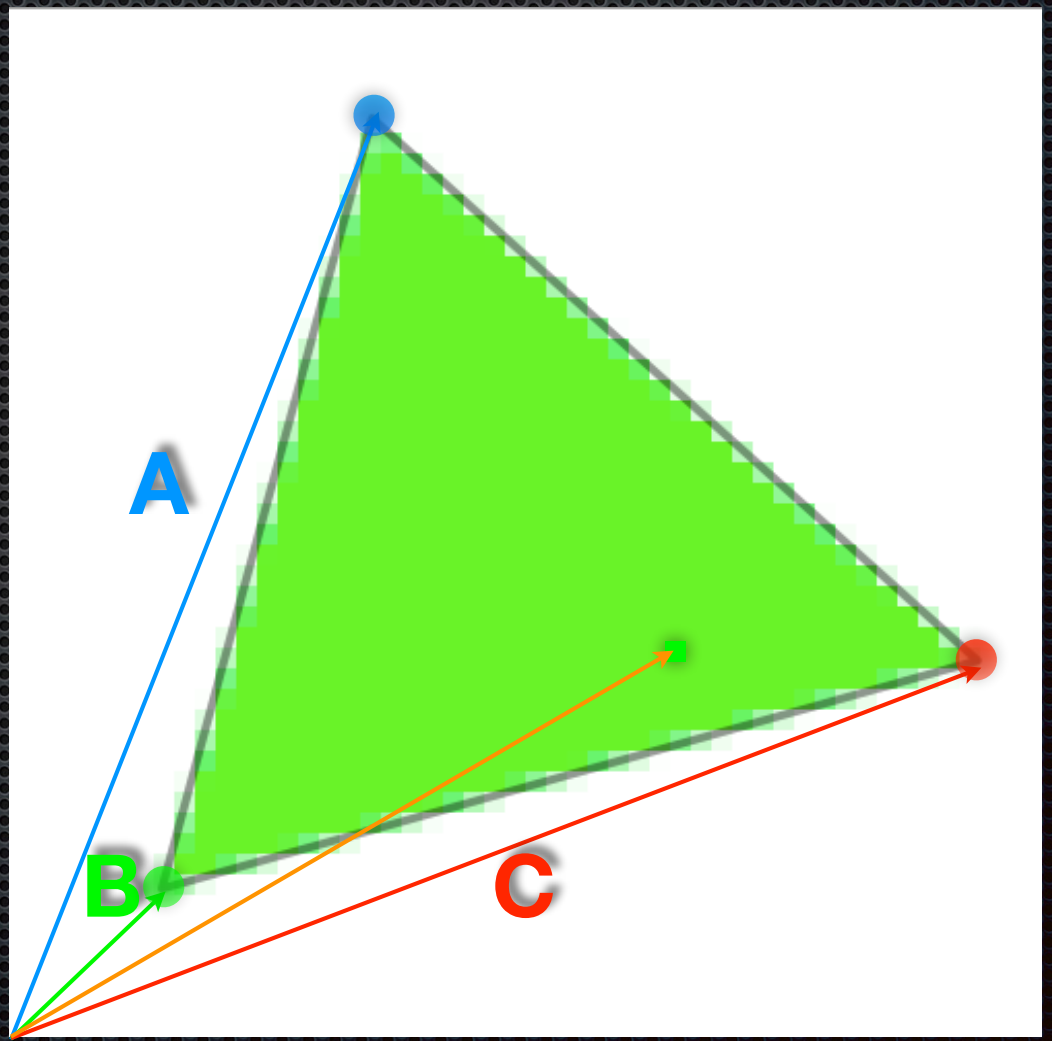
$0 \leq \lambda_x \leq 1$

$\cdot \lambda_1 +$

$\cdot \lambda_2 +$

$\cdot \lambda_3 +$

$=$



Barycentric Coordinates

$\lambda_1 + \lambda_2 + \lambda_3 = 1$

and

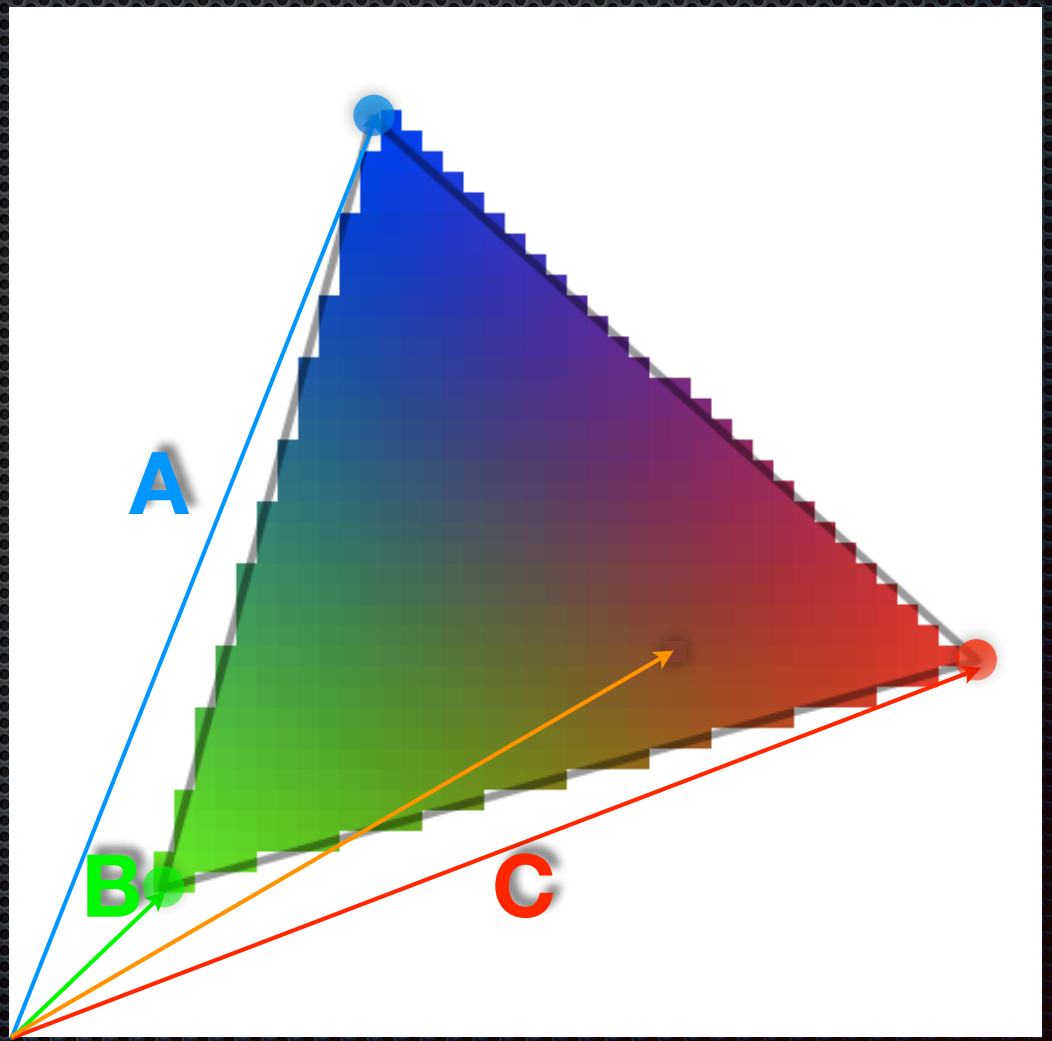
$0 \leq \lambda_x \leq 1$

$\cdot \lambda_1 +$

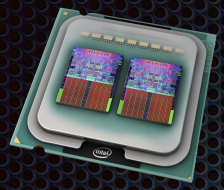
$\cdot \lambda_2 +$

$\cdot \lambda_3 +$

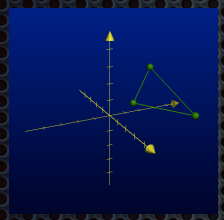
$=$



Interpolation Program



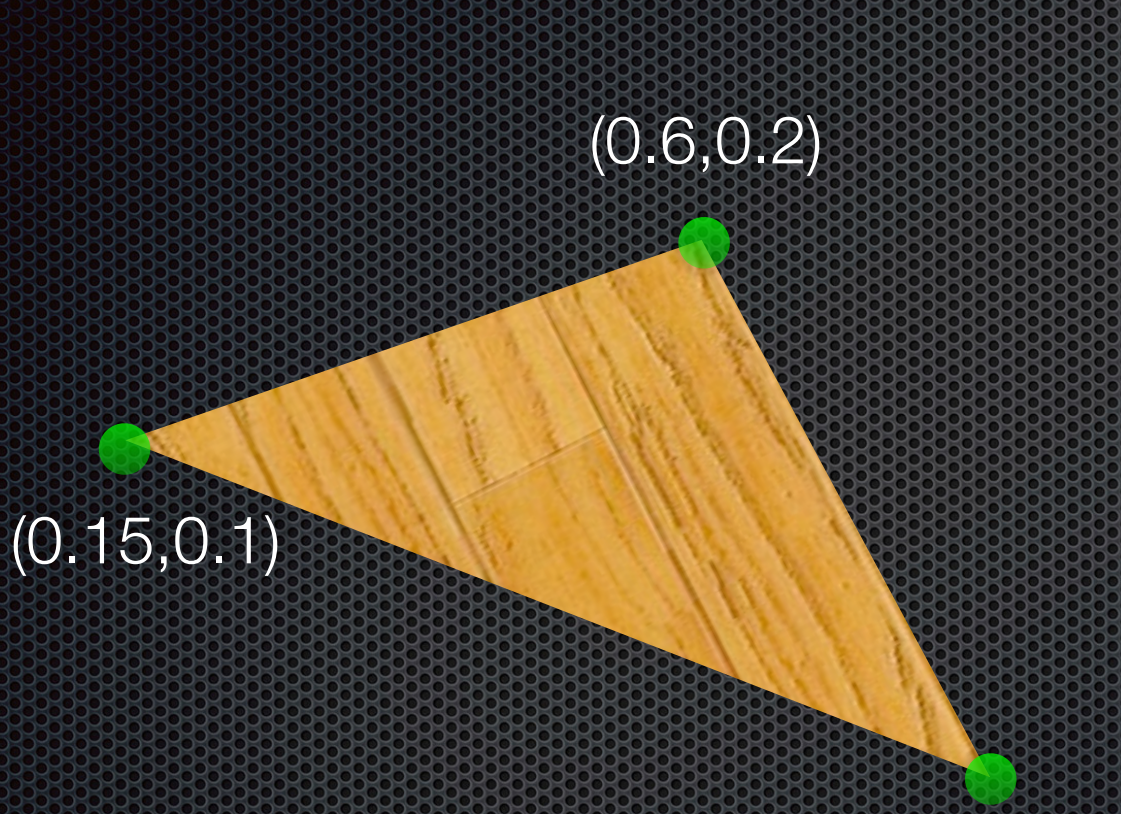
```
glUseProgram(_program) // positions array has 6 floats between -1.0 -> 1.0
glVertexAttribPointer(10, 2, GLenum(GL_FLOAT), GLboolean(FALSE), 0, positions)
glVertexAttribPointer(11, 4, GLenum(GL_FLOAT), GLboolean(FALSE), 0, colors)
glUniform2f(glGetUniformLocation(_program, "translate"), 0.4, -0.2)
glDrawArrays(GLenum(GL_TRIANGLES), 0, 3) // colors array is 12 floats 0.0 -> 1.0
```

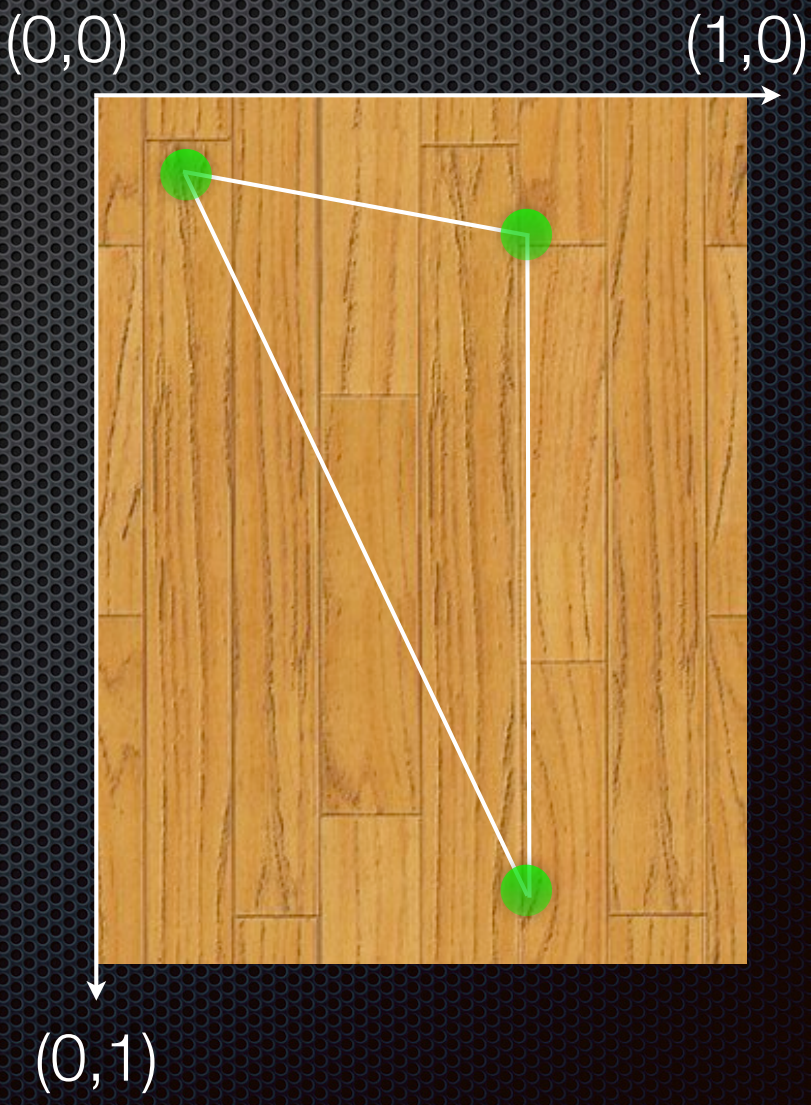


```
attribute vec2 position;
attribute vec4 color;
uniform vec2 translate;
varying vec4 colorInterpolated;
void main()
{
    gl_Position = vec4(
        position.x + translate.x, position.y + translate.y, 0.0, 1.0);
    colorInterpolated = color; // color data interpolated by rasterizer
}
```

```
varying highp vec4 colorInterpolated;
void main()
{
    gl_FragColor = colorInterpolated;
}
```

Texture Coordinates



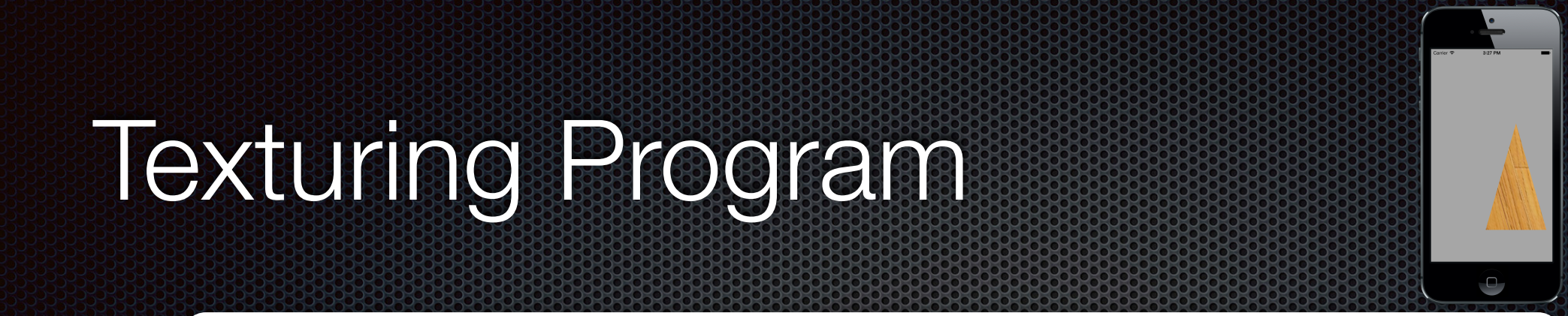


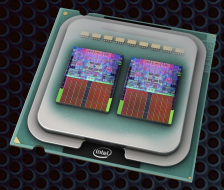
Setting Up Texturing

```
// Setup texturing
var woodTextureInfo: GLKTextureInfo = GLKTextureLoader.textureWithCGImage(
    UIImage(named: "texture")?.CGImage, options: nil, error: nil)
// ...
glBindTexture(GLenum(GL_TEXTURE_2D), woodTextureInfo.name)
```

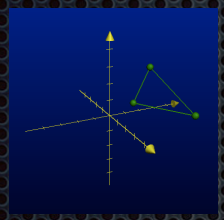
MUCH easier than it used to be!

Texturing Program





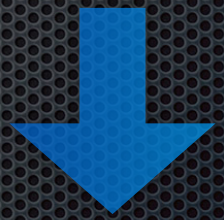
```
glUseProgram(_program) // positions array has 6 floats between -1.0 -> 1.0
glVertexAttribPointer(10, 2, GLenum(GL_FLOAT), GLboolean(FALSE), 0, positions)
glVertexAttribPointer(11, 2, GLenum(GL_FLOAT), GLboolean(FALSE), 0, texCoords)
glUniform2f(glGetUniformLocation(_program, "translate"), 0.4, -0.2)
glBindTexture(GLenum(GL_TEXTURE_2D), _woodTextureInfo.name)
glDrawArrays(GL_TRIANGLES, 0, 3) // texCoords array has 6 floats 0.0 -> 1.0
```



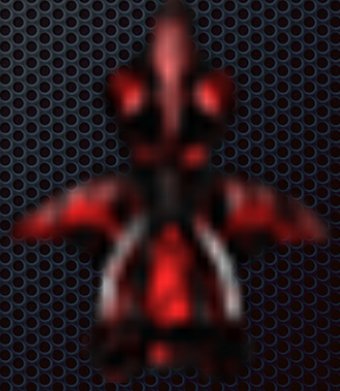
```
attribute vec2 position;
attribute vec2 textureCoordinate;
uniform vec2 translate;
varying vec2 textureCoordinateInterpolated;
void main()
{
    gl_Position = vec4(
        position.x + translate.x, position.y + translate.y, 0.0, 1.0);
    textureCoordinateInterpolated = textureCoordinate; // interpolated
}
```

```
varying highp vec4 varyingTextureCoordinate;
uniform sampler2D textureUnit;
void main()
{ gl_FragColor = texture2D(textureUnit, varyingTextureCoordinate); }
```

Alpha Blending



```
glEnable(GL_BLEND)
glBlendFunc(GL_SRC_ALPHA,
  GL_ONE_MINUS_SRC_ALPHA)
```



Sprites

Sprites

Texture

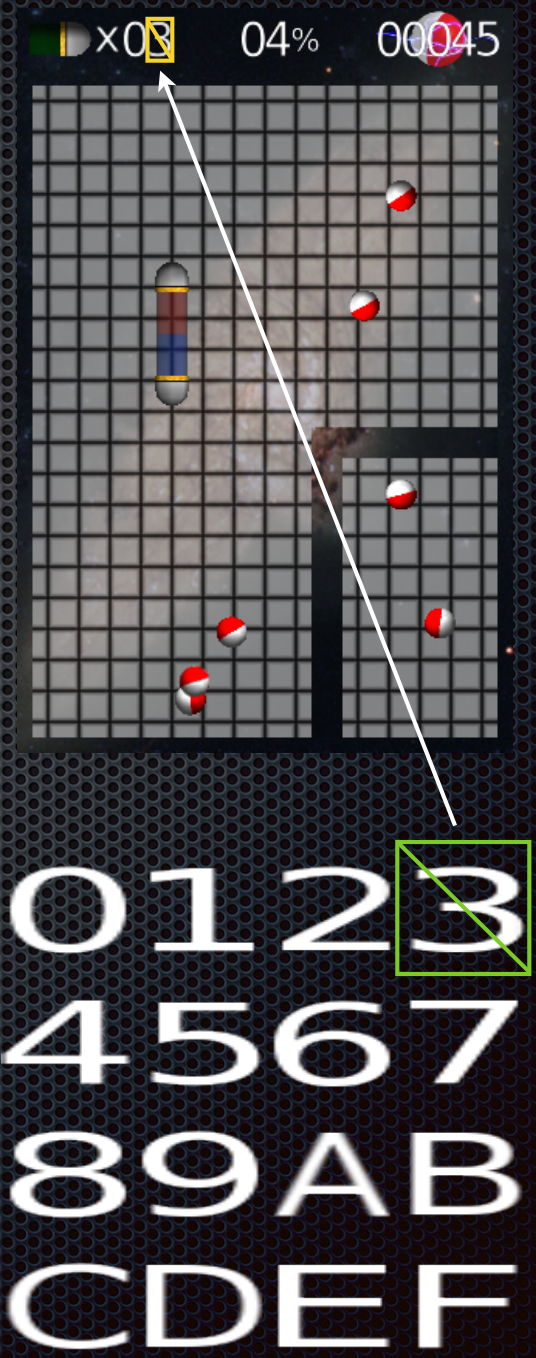
Sprite

Continuous Sprite

Special Sprite

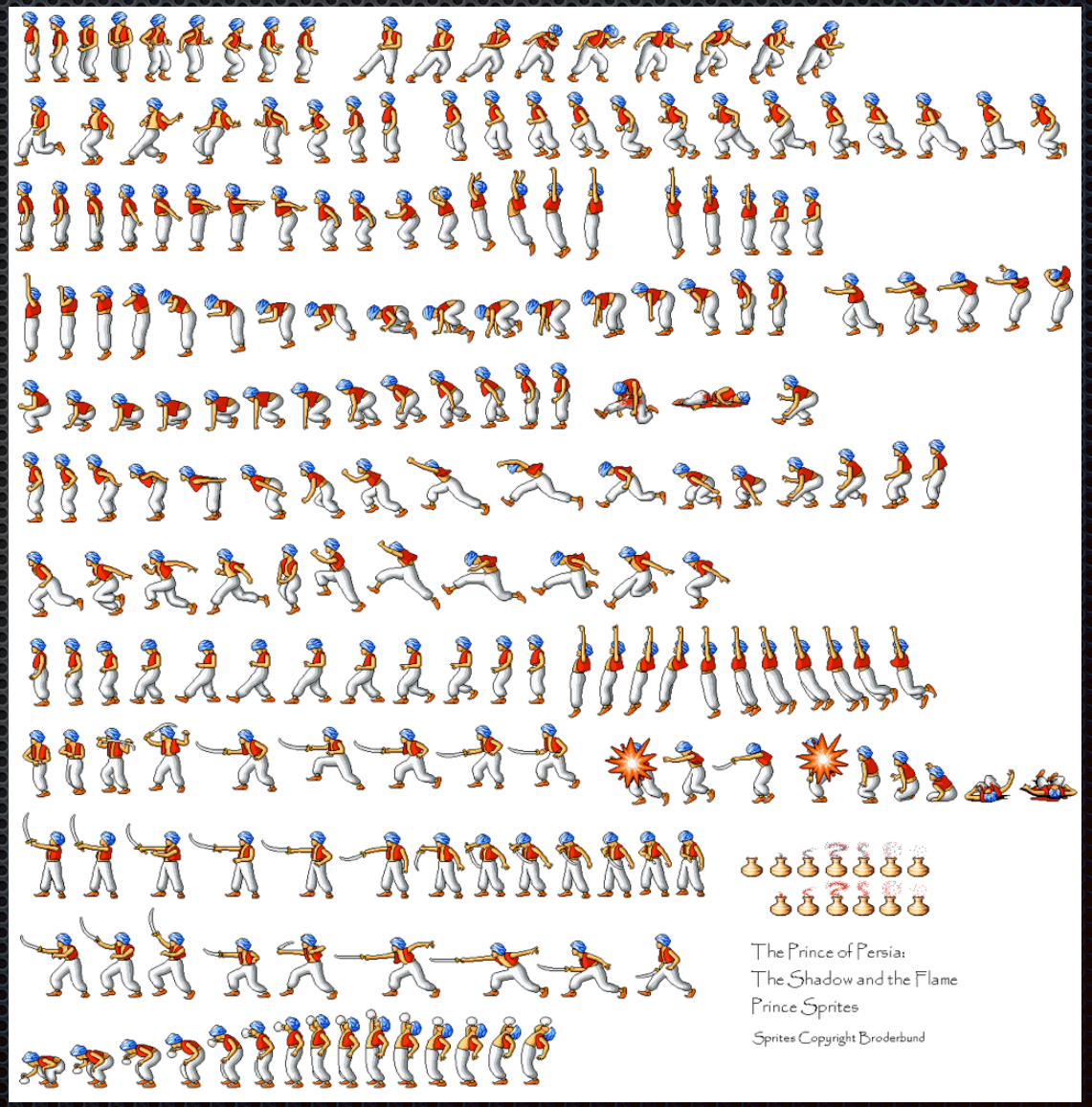
Sprites

- Built by texturing a quad (2 triangles)
  - Geometry
    - Translation, Rotation, Scale
  - Texture
    - Bound Texture
    - Texture Coordinates
    - (Optional) Texture Matrix



Sprite - One Implementation

- Sprite
  - Position (x,y)
  - Rotation (ϴ)
  - Size (width, height)
  - Animation
- Animation
  - Texture
  - Tile Rect & Time List



Sprite - One Implementation

- Sprite
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- Animation
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