A Very Quick Introduction of OpenGL Shading Language (GLSL)

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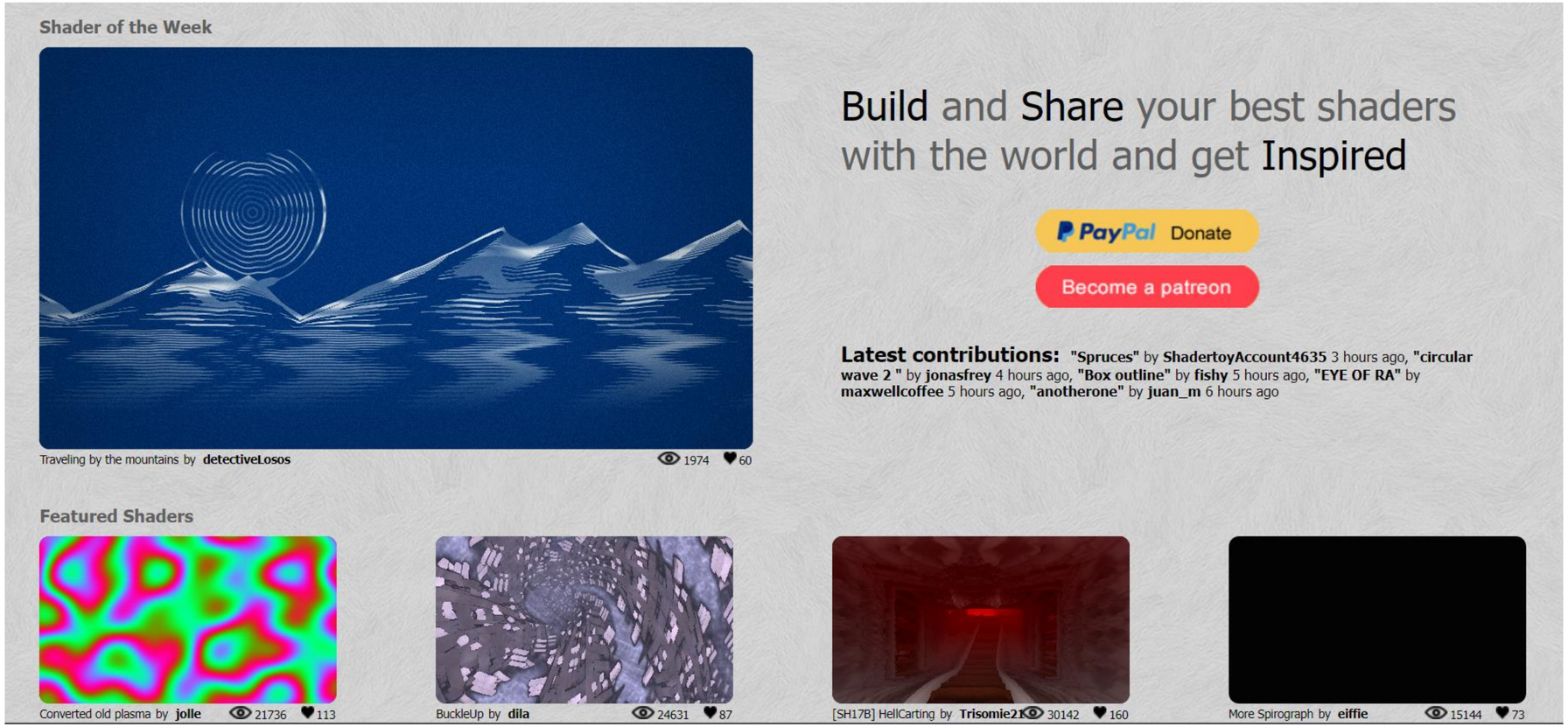
Many slides from Ed Angel and Dave Shreiner for SIGGRAPH 2013 course notes

ShaderToy



https://www.shadertoy.com/

GLSL Data Types

- Scalar types: `float, int, bool`
- Vector types: `vec2, vec3, vec4`
  `ivec2, ivec3, ivec4`
  `bvec2, bvec3, bvec4`
- Matrix types: `mat2, mat3, mat4`
- Texture sampling: `sampler1D, sampler2D, sampler3D, samplerCube`
- C++ Style Constructors

```
vec3 a = vec3(1.0, 2.0, 3.0);
```

Operators

- Standard C/C++ arithmetic and logic operators
  - and: `&&`
  - or: `||`
  - not: `!`
  - equality: `==`
  - inequality: `!=`
  - conditional operator: `? :`

  (Read the GLSL reference for more)

- Overloaded operators for matrix and vector operations

```
mat4 m;
vec4 a, b, c;

b = a*m;
c = m*a;
```

Components and Swizzling

- Access vector components using either:
  - [ ] (c-style array indexing, with index number starting from 0)
  - `xyzw`, `rgba` or `stpq` (named components)

- For example:

```
vec3 v;
v[1], v.y, v.g, v.t
```

 - all refer to the same element

- Component swizzling:

```
vec3 a, b;
a.xy = b.yx;
```

Qualifiers

- `in`, `out`
  - Copy vertex attributes and other variable into and out of shaders

```
in  vec2 texCoord;
out vec4 color;
```

- `uniform`
  - shader-constant variable from application

```
uniform float time;
uniform vec4 rotation;
```

Functions

- Built in
  - Arithmetic: `sqrt`, `pow`, `abs`
  - Trigonometric: `sin`, `asin`
    - `Take angle as put`
  - Graphical: `length`, `reflect`
- (Read the GLSL reference for more)

Built-in Variables

- `gl_Position`
  - (required) output position from vertex shader
- `gl_FragCoord`
  - input fragment position
- `gl_FragDepth`
  - input depth value in fragment shader

A Simple Vertex Shader

```
#version 430

in vec4 vPosition;
in vec4 vColor;

out vec4 color;

void main()
{
    color = vColor;
    gl_Position = vPosition;
}
```

The Simplest Fragment Shader

```
#version 430

in vec4 color;

out vec4 fColor; // fragment's final color

void main()
{
   fColor = color;
}
```

Starter Code

- Live Demo
- Practice: Let's start!