Art in "The Cloud", of Clouds

How I Learned to Stop Worrying and *Love* ShaderToy/WebGL

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The Premise

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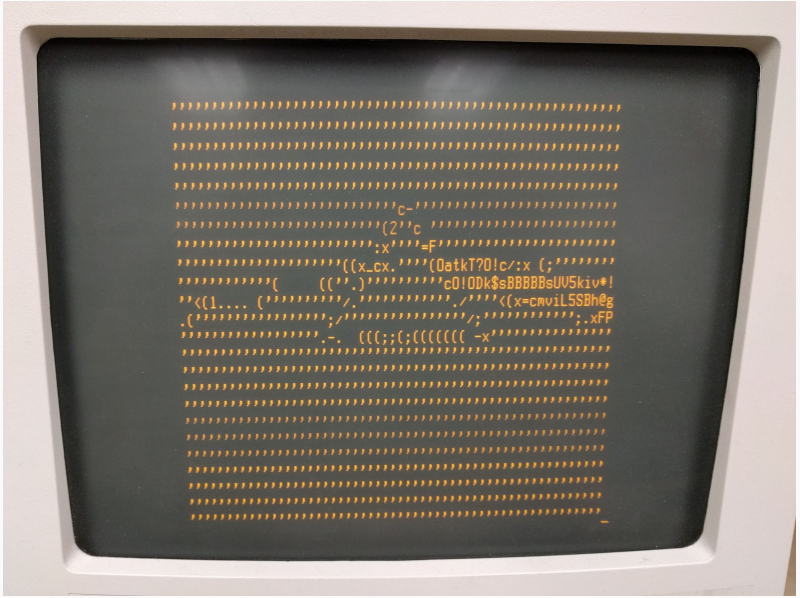
Past Renderings



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This time around...

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Project

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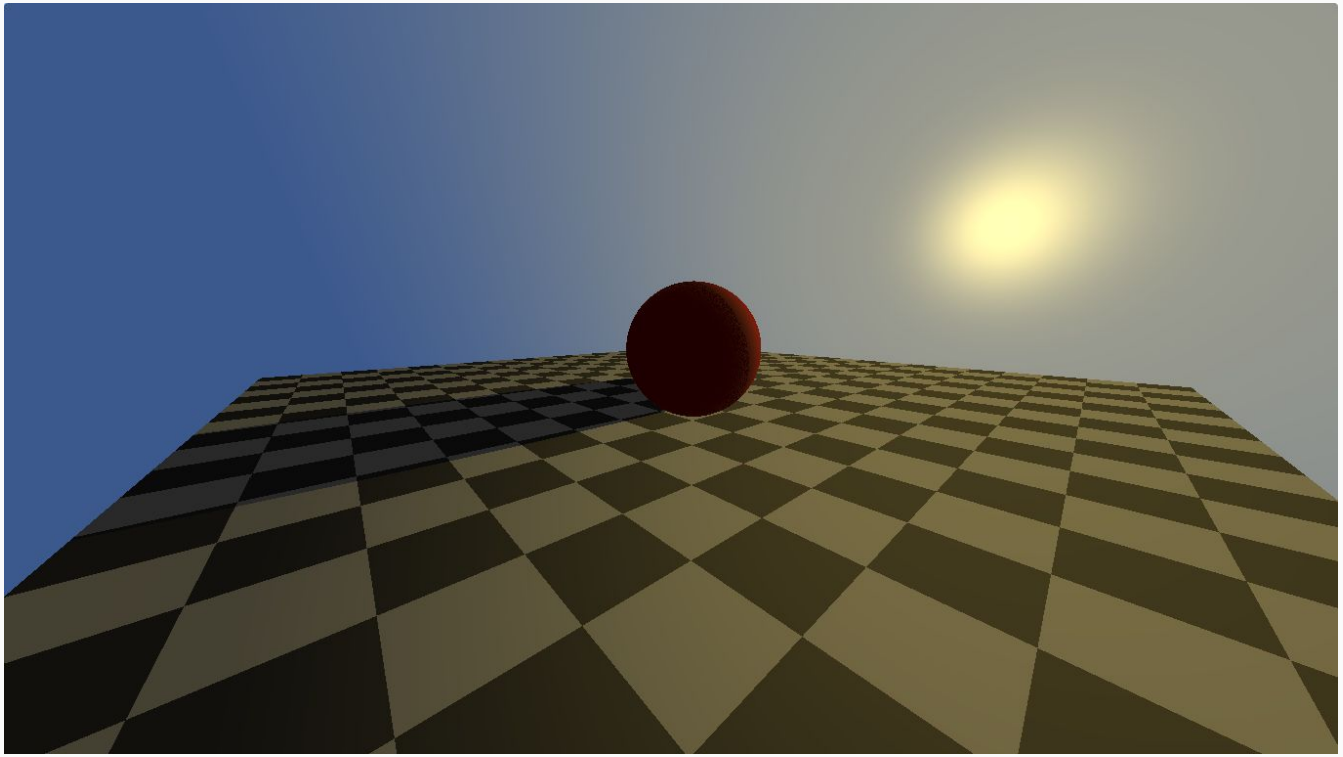
“Setting the Scene”



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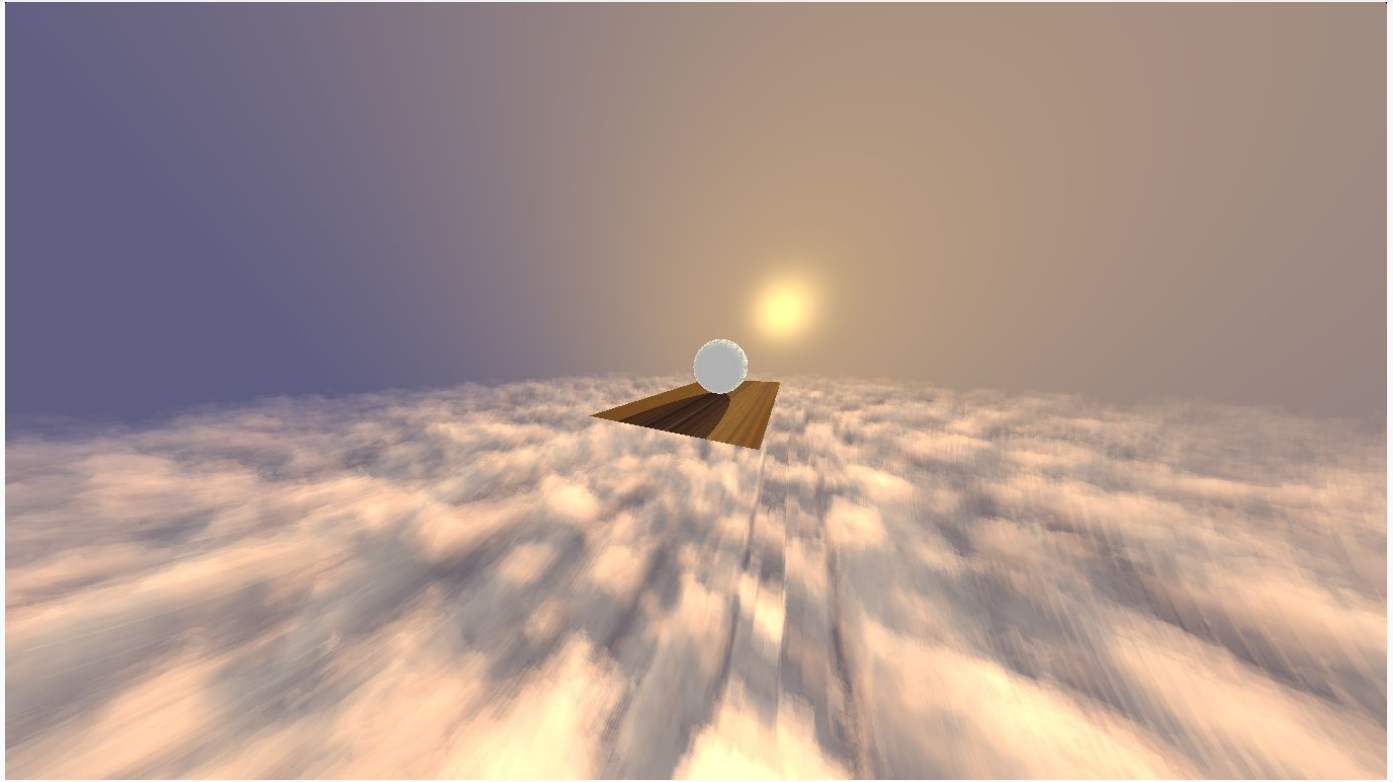
Link: https://www.shadertoy.com/view/Xdsczs

Final Image (sort of, will explain later)



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Link: https://www.shadertoy.com/view/Xdsczs

Process

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Original Plan

- Build a particle system!
  - Computationally expensive
- For a cloud, this would likely be recursive
  - “Emitter” or object that produces particles would likely need to use subdivision to “fluff-out” the cloud pattern
  - ShaderToy/GLSL does not support recursion

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Problems with the Original Plan

- Ran into way too many issues using ShaderToy early on
- WebGL is slow
  - Or more likely, my hardware is too old and cheap to use it effectively
- Bugs across multiple systems
  - More on that later

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Plan B

- Find an example program, understand it, and build on top of it!
- ShaderToy user “iq” is one of the original developers of ShaderToy and has posted dozens of freely available examples
  - All of them, like most of ShaderToy’s features, are undocumented

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“Clouds” by iq

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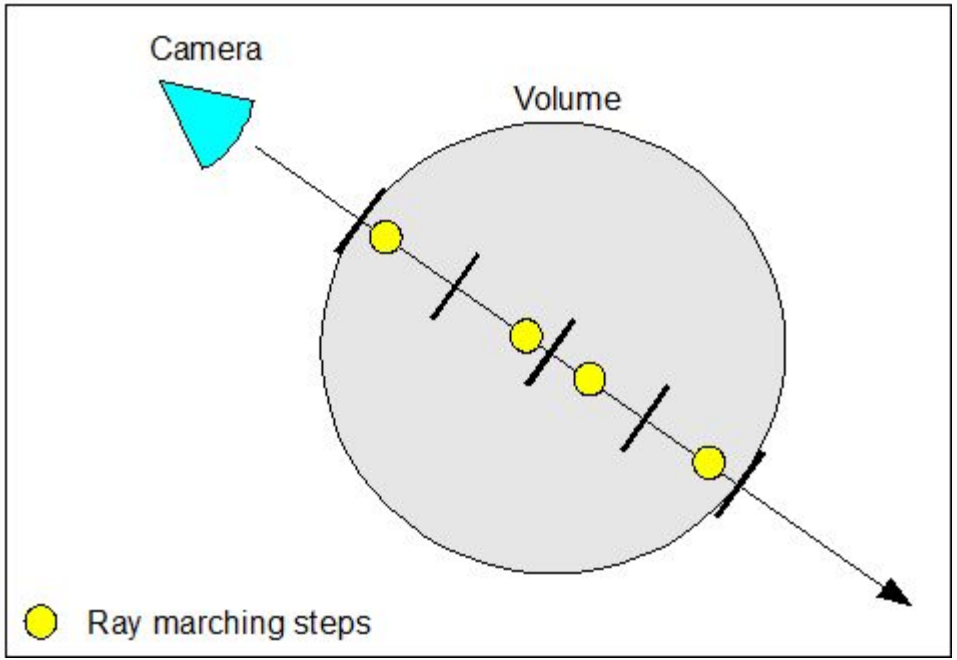
Link: https://www.shadertoy.com/view/XslGRr

Raymarching (a.k.a Ray Volume Casting)



Link: http://guerillarender.com/doc/1.4/User%20Guide_Volumes_Rendering%20Volumes.html

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Raymarching & Noise

- Cloud volume data is generated by reading in a noise texture
  - RGB values are then used to calculate position information in the cloud
- Note that the cloud map is not stored in a buffer, per se
  - The data is calculated at run-time, based on the location of the fragment coordinate being built

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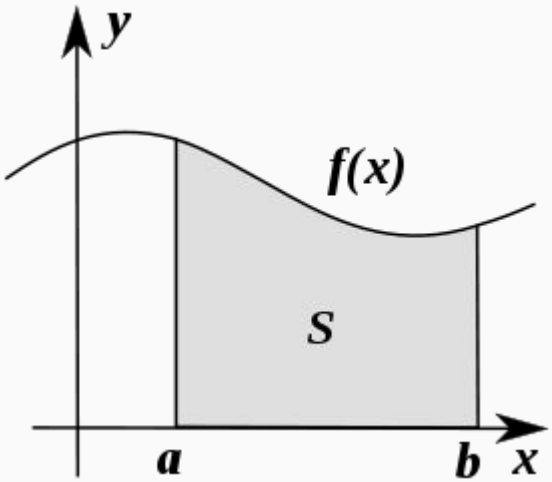
Raymarching & Noise

- To speed things up, we sub-sample this cloud mapping
  - The these sample points are then integrate to make the clouds fluffy and not jagged
- Orange highlights are created by tracing the current location of the sun to the “cloud plane”



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End Result

- A modified version of my “part 4” raytracer
  + Techniques from iq’s example
  = An interesting learning experience

- ~800 lines of GLSL, nearly ⅓ of that is documentation

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Bug Hunt

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Texture Loading Bug

- Remember, ShaderToy & WebGL run locally on the computer's GPU
- Wooden boat texture does not load completely
  - Exact display issue is system/version dependent
- Probably caused by the recent switch-over to WebGL 2.0
  - Both ShaderToy and Chrome switched to the standard within the last month

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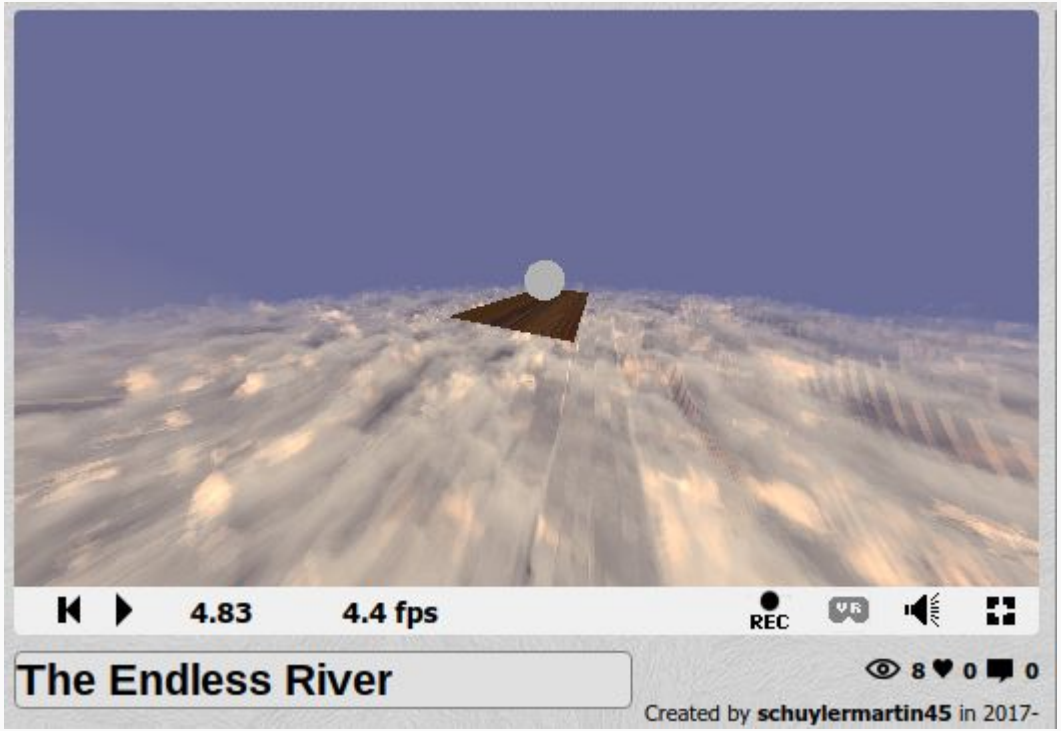
Chrome OS, Integrated Graphics: Everything's "Fine"



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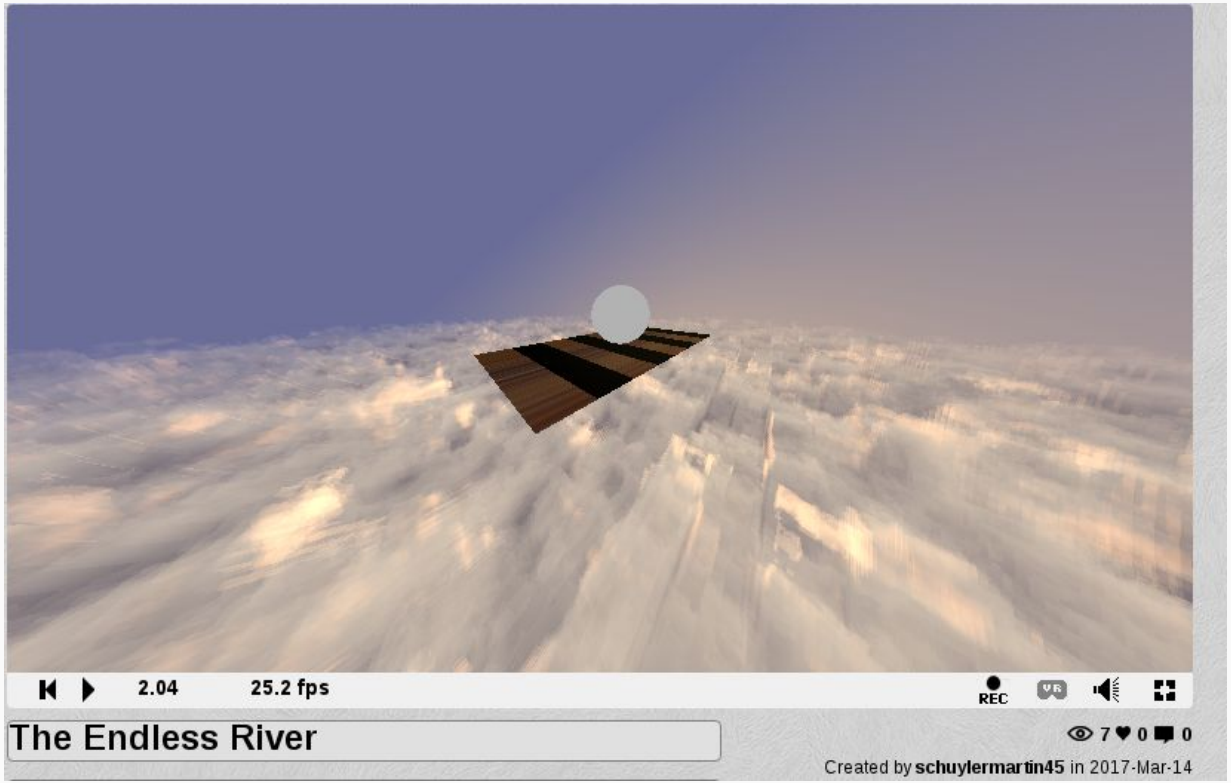
Link: https://www.shadertoy.com/view/Xdsczs

Fedora 24, Nvidia 650Ti: Texture Doesn’t Load



Link: https://www.shadertoy.com/view/Xdsczs

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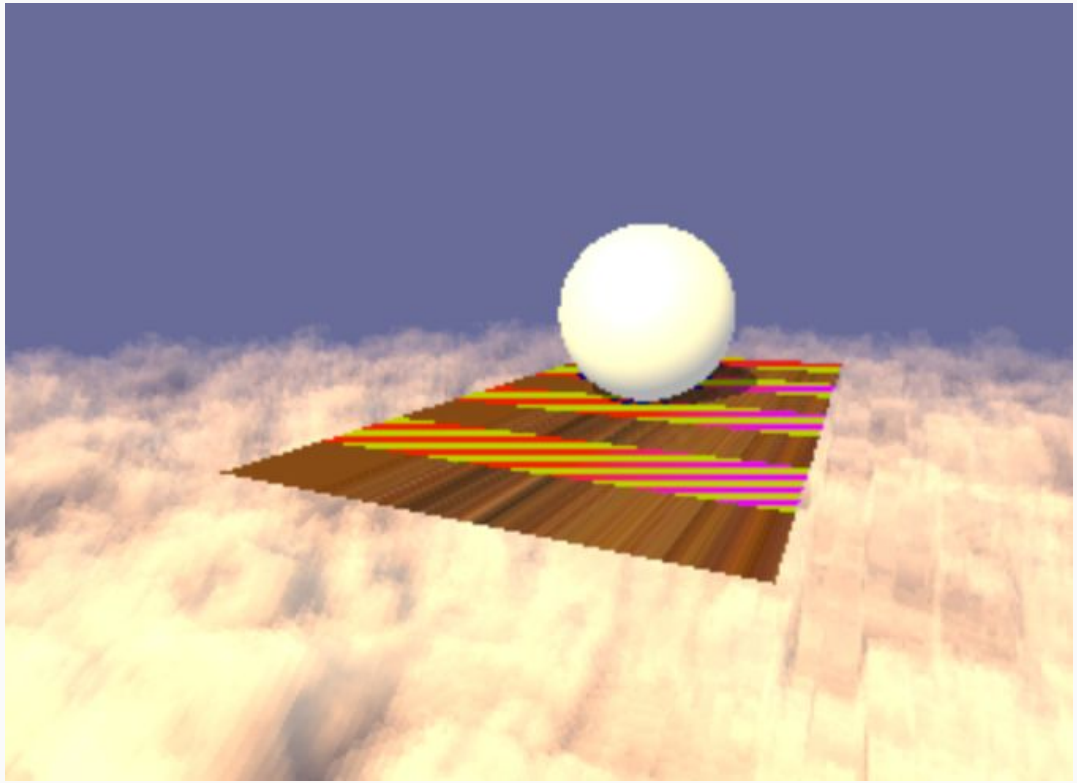
Macbook Pro: Even Worse



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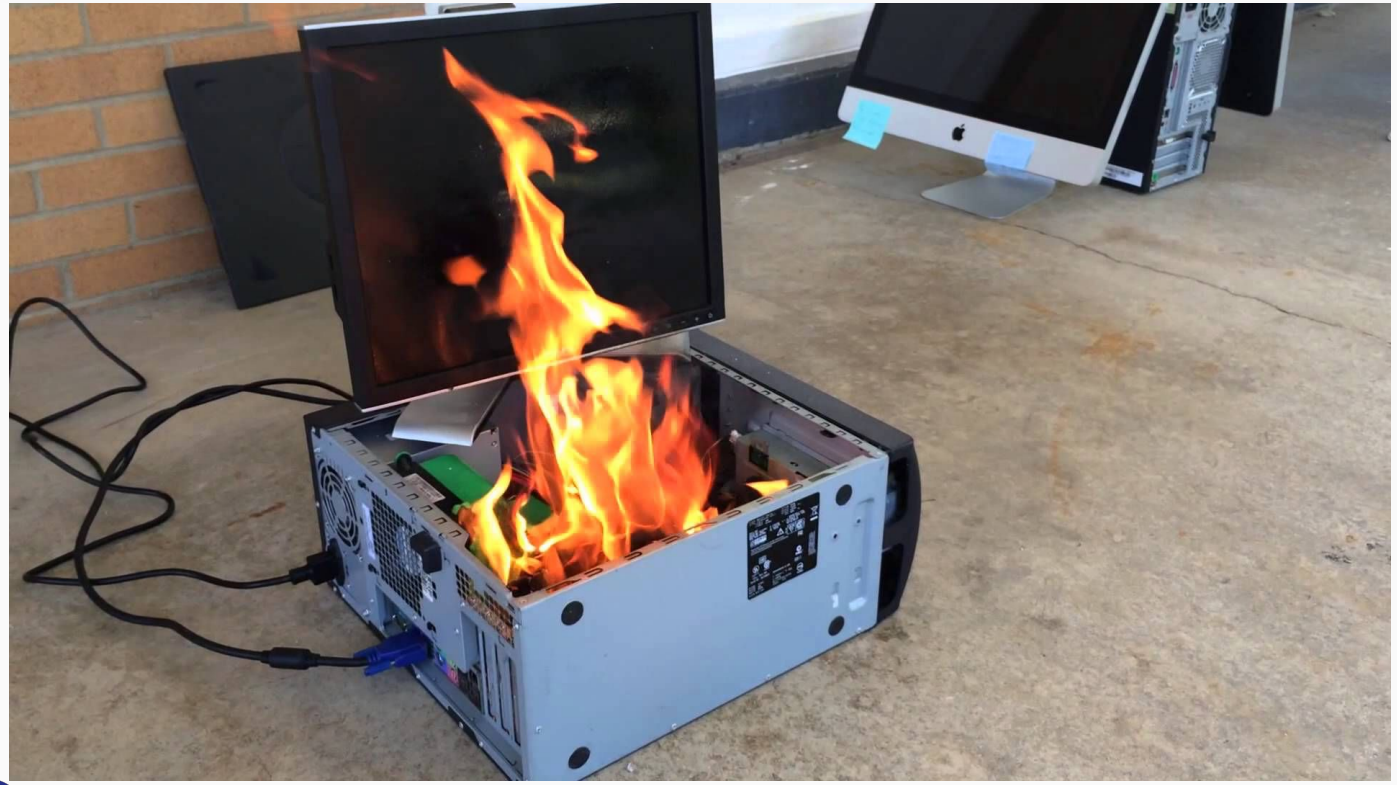
Link: https://www.shadertoy.com/view/Xdsczs

Fedora 24, Firefox: Game Over, Man



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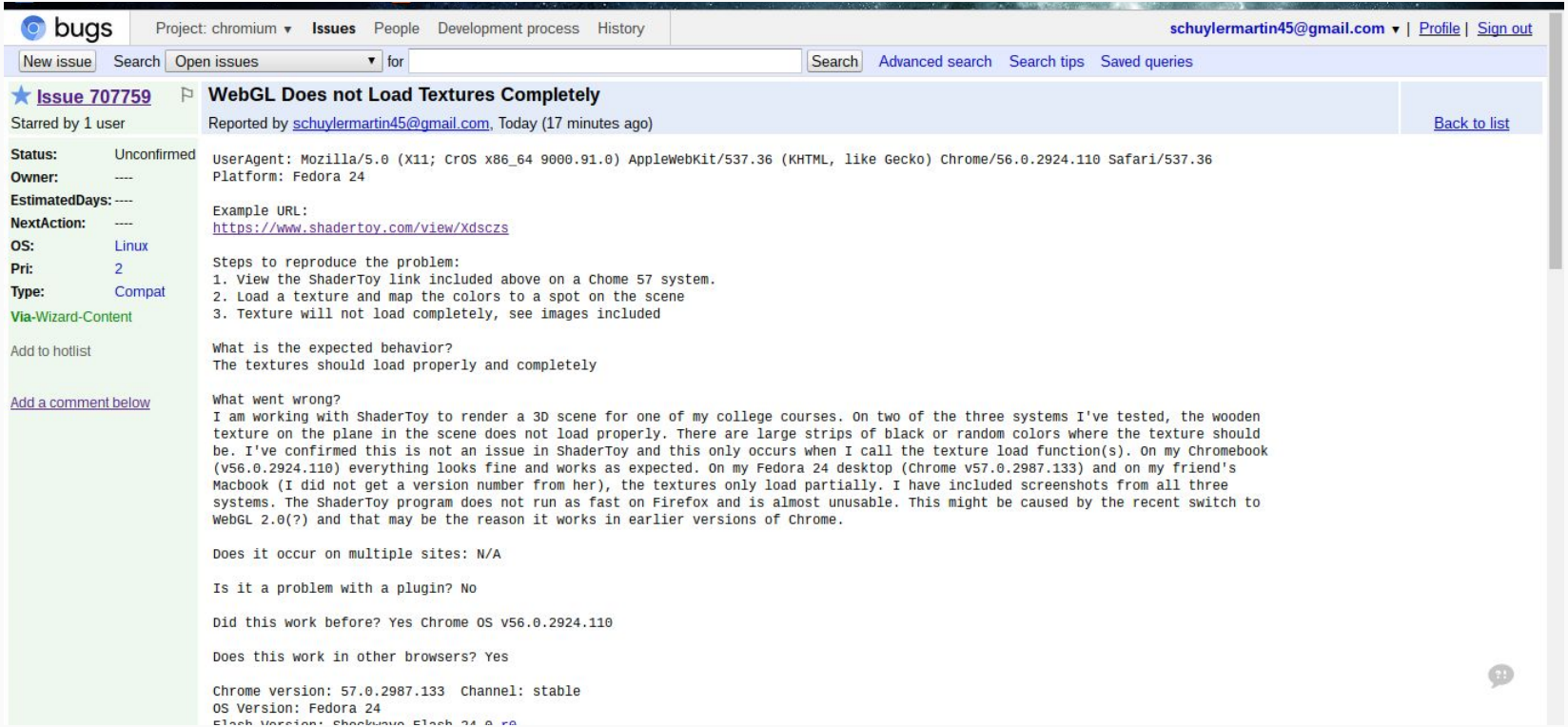
Link: https://www.shadertoy.com/view/Xdsczs

Bug Report!



bugs Project: chromium ▾ **Issues** People Development process History schuylermartin45@gmail.com ▾ | Profile | Sign out

New issue Search Open issues ▾ for Search Advanced search Search tips Saved queries

Issue 707759

Starred by 1 user

Status: Unconfirmed
Owner: ----
EstimatedDays: ----
NextAction: ----
OS: Linux
Pri: 2
Type: Compat
Via-Wizard-Content

Add to hotlist

Add a comment below

WebGL Does not Load Textures Completely

Reported by schuylermartin45@gmail.com, Today (17 minutes ago)

Back to list

```
UserAgent: Mozilla/5.0 (X11; CrOS x86_64 9000.91.0) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/56.0.2924.110 Safari/537.36
Platform: Fedora 24

Example URL:
https://www.shadertoy.com/view/Xdsczs

Steps to reproduce the problem:
1. View the ShaderToy link included above on a Chome 57 system.
2. Load a texture and map the colors to a spot on the scene
3. Texture will not load completely, see images included

What is the expected behavior?
The textures should load properly and completely

What went wrong?
I am working with ShaderToy to render a 3D scene for one of my college courses. On two of the three systems I've tested, the wooden
texture on the plane in the scene does not load properly. There are large strips of black or random colors where the texture should
be. I've confirmed this is not an issue in ShaderToy and this only occurs when I call the texture load function(s). On my Chromebook
(v56.0.2924.110) everything looks fine and works as expected. On my Fedora 24 desktop (Chrome v57.0.2987.133) and on my friend's
Macbook (I did not get a version number from her), the textures only load partially. I have included screenshots from all three
systems. The ShaderToy program does not run as fast on Firefox and is almost unusable. This might be caused by the recent switch to
WebGL 2.0(?) and that may be the reason it works in earlier versions of Chrome.

Does it occur on multiple sites: N/A

Is it a problem with a plugin? No

Did this work before? Yes Chrome OS v56.0.2924.110

Does this work in other browsers? Yes

Chrome version: 57.0.2987.133  Channel: stable
OS Version: Fedora 24
Flash Version: Shockwave Flash 24.0 r0
```

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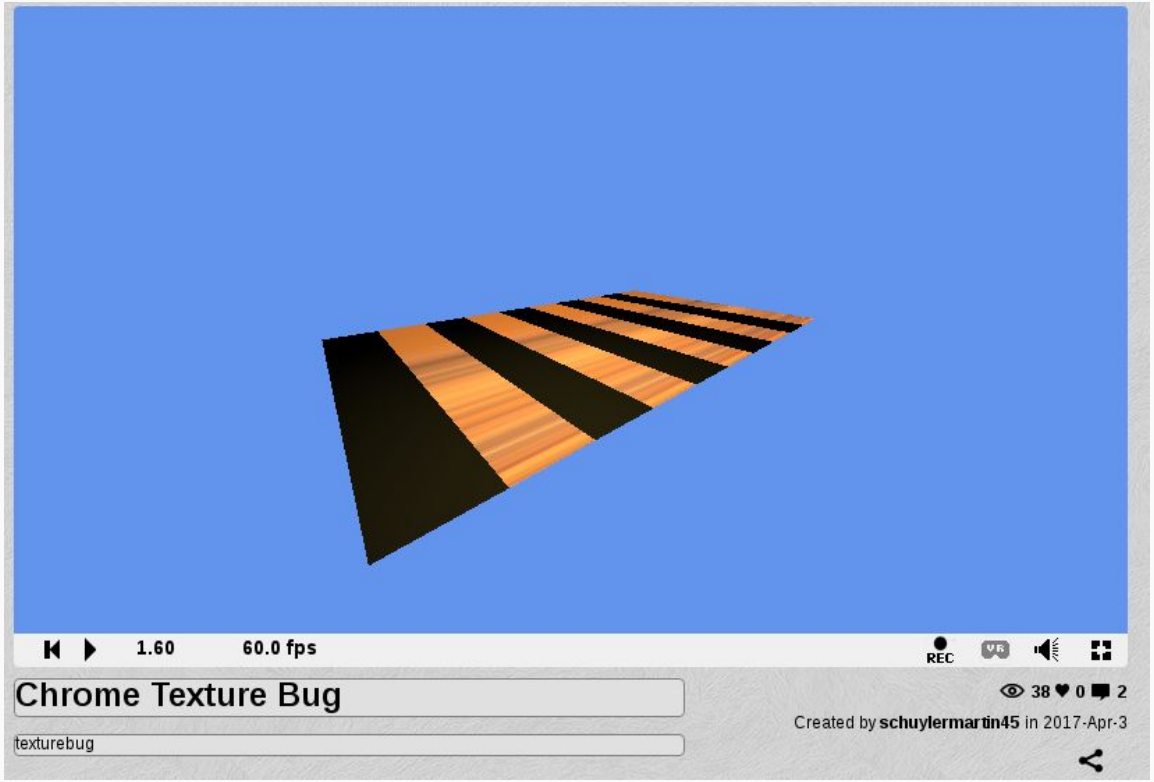
Link: https://bugs.chromium.org/p/chromium/issues/detail?id=707759

So I tried helping the cause



Link:https://www.shadertoy.com/view/4dSyRw

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And then somebody showed me the light...

iq, 2017-Apr-3
The problem is line phong 216. Half the times obj_clr is not initialized to anything, so black is assumed in some systems.

```
202 ** Calculates the color of something, based on the Phong illumination model
203 **
204 ** @param pl Plane placeholder object
205 ** @param lights Array of lights in the scene
206 ** @param int_pt Intersection point, seen by the camera
207 ** @param n Normal to that intersection point
208 ** @return Color of point to shade
209 */
210 vec3 calc_phong(Plane pl, Light light, vec3 int_pt, vec3 n)
211 {
212     // retrieve the values based on the object type
213     vec3 obj_clr, obj_spec;
214     Phong obj_ph;
215
216     if (mod(int_pt.x, 2.0) > 1.0)
217         obj_clr = pl.clr0;
218     obj_spec = pl.spec;
219     obj_ph = pl.ph;
220
```

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Link:https://www.shadertoy.com/view/4dSyRw

Video Clip

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Animations & Interactivity

- Clouds move across the sky
- Sun “orbits” around the scene
- User can move around the scene by “click-and-drag”
- Rendition of Pink Floyd’s *Sorrow* (from SoundCloud) plays in the background

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Video (ShaderToy didn’t capture the audio)

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Link: https://www.shadertoy.com/view/Xdsczs

Conclusions

- ShaderToy is a cool tool and allows lots of smart and talented people to create really cool work
- The open communities I talked to were very nice and helpful in debugging my issue
- I need a new desktop to render this stuff

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Sources

[1] ShaderToy Cloud Example, https://www.shadertoy.com/view/XslGRr
[2] Raymarching Resource, https://en.wikipedia.org/wiki/Volume_ray_casting
[3] Image content comes from freely available online resources
[4] Album Artwork and Music come from Pink Floyd
[5] Diagrams and Code Snippets by Schuyler Martin, unless otherwise noted
[6] HSC Logo created by Kailey Martin
[7] The kind folks on both the ShaderToy comments and the Chromium support team

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Special Thanks

[1] Prof. Warren Carithers - Advisor
Warren, taught me almost everything I know about Systems Programming and Computer Graphics. Without him, none of this would be possible.

[2] Prof. Sean Strout - Mentor
Sean is a close friend of mine and initially sparked a lot of my interest in becoming a C wizard.

[3] Prof. Thomas Kinsman - Mentor
Thomas has taught me how to think creatively with visual problems

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Questions?

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