

Tweaking CSS3 for Hardware Acceleration

@ariyahidayat

/usr/bin/whoami

SH=PE

shapesecurity.com

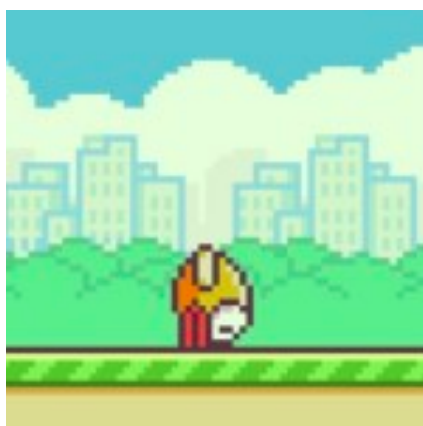


PhantomJS



Esprima





translate 3-D!



Web Page Rendering

Web Page vs Game



Predictable content/assets



Mostly text



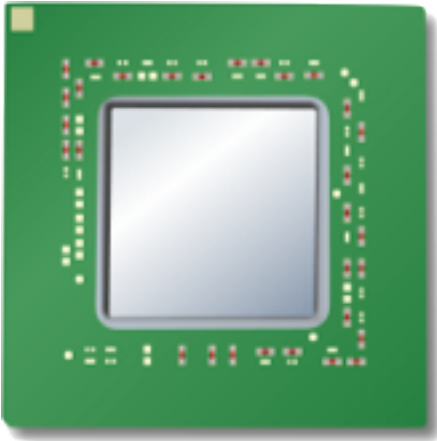
Mostly images



Initial response

immediate

Graphics Processing Unit (GPU)



“Fixed” geometry
Transformation
Textured triangles

Parallelism

Optimized for Games

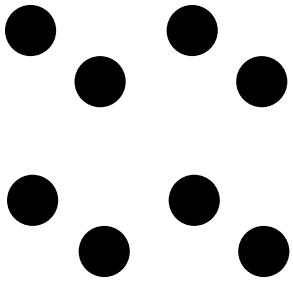


<http://epicgames.com/technology/epic-citadel>



<http://www.rage.com/>

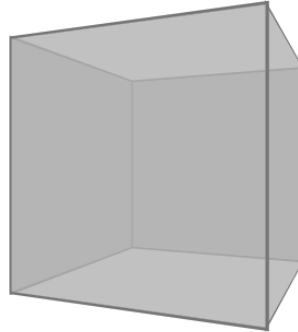
GPU Programming Workflow



Vertices



Matrix



Rendered



Textured

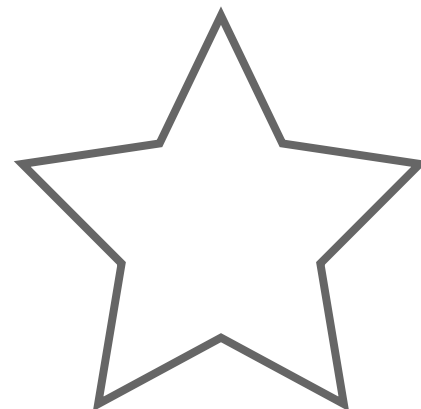
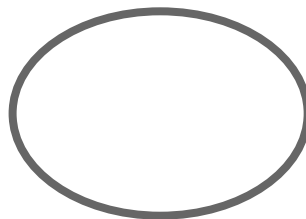
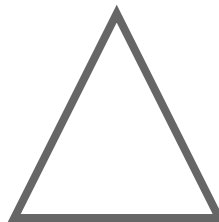
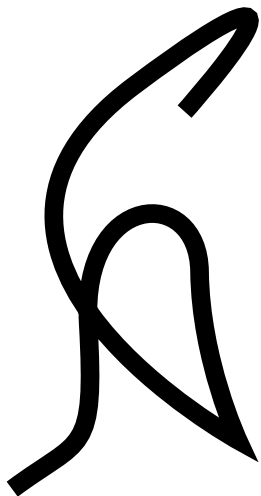
CSS 3-D

<http://bit.ly/coverflow3d>

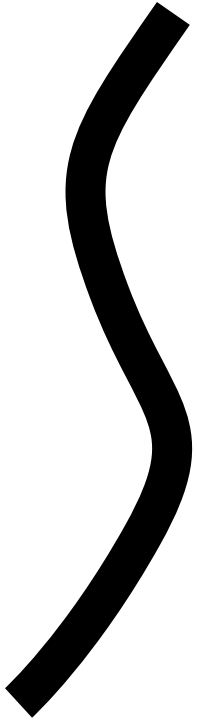


<http://ariya.ofilabs.com/2014/01/javascript-kinetic-scrolling-part-5-cover-flow-effect.html>

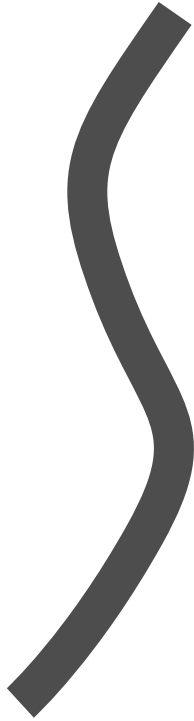
Path = Everything



Stroke = Outline



Solid



Dashed

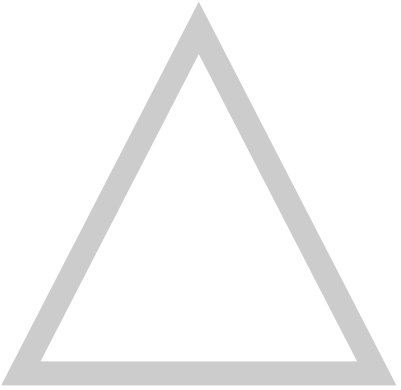


Dotted

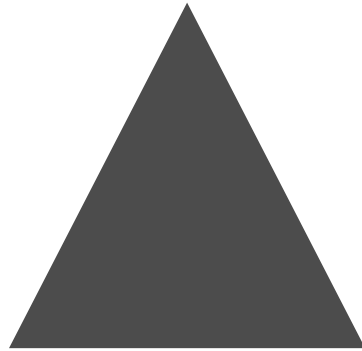


Textured

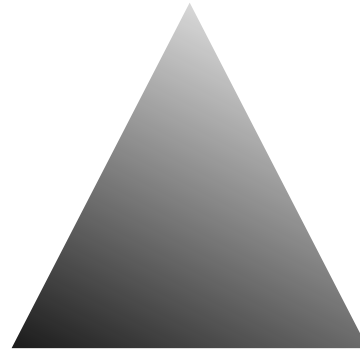
Brush = Fill



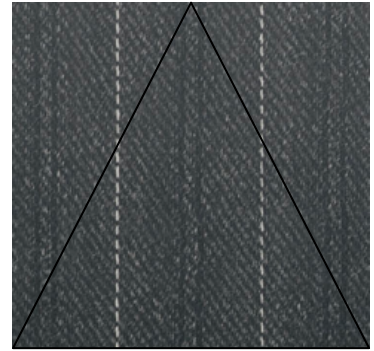
None



Solid



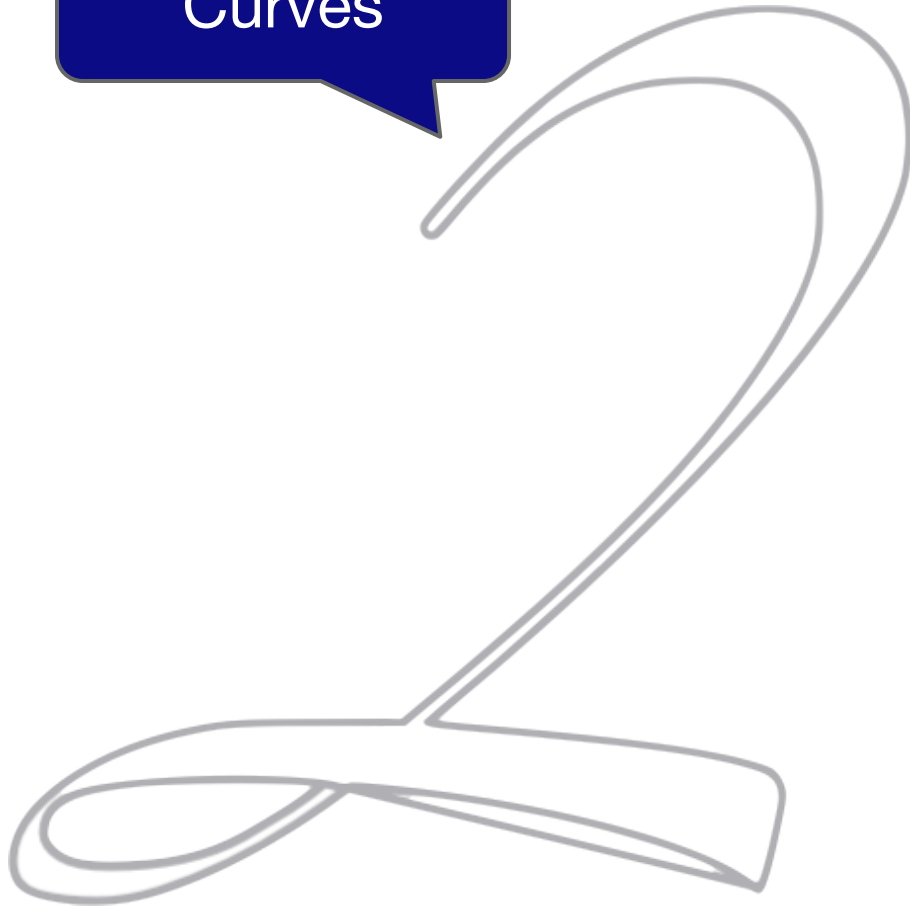
Gradient



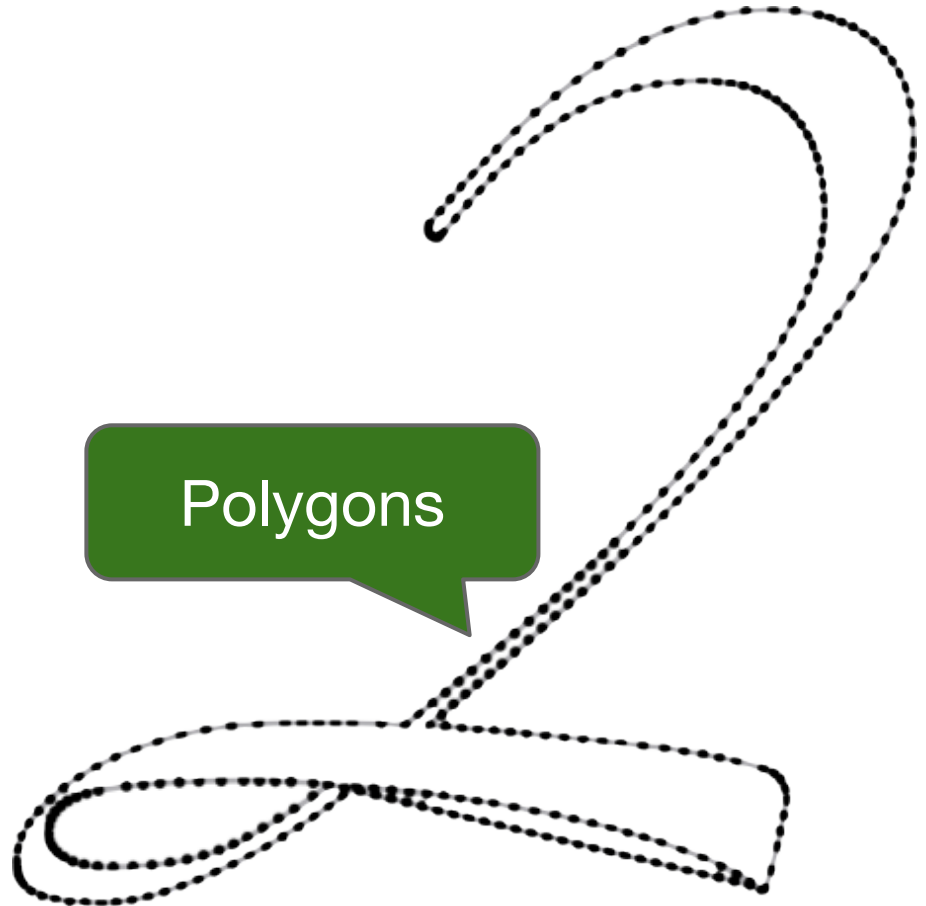
Textured

Path Approximation

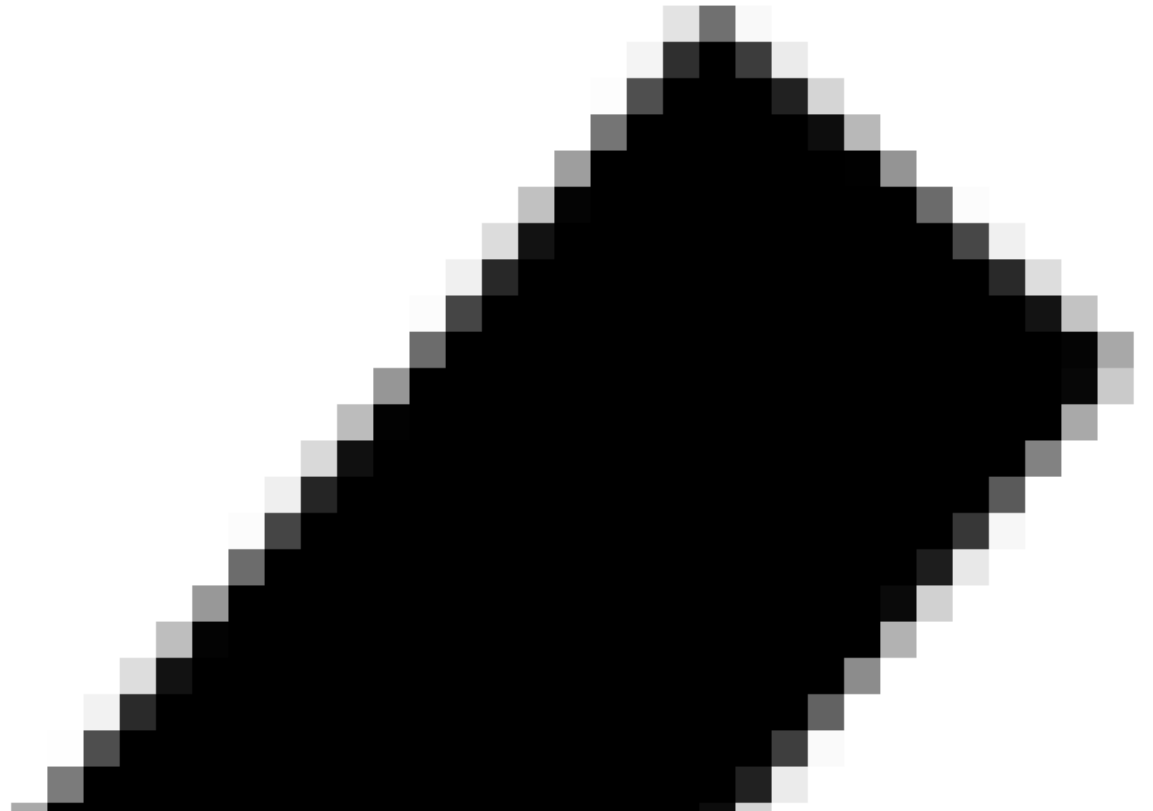
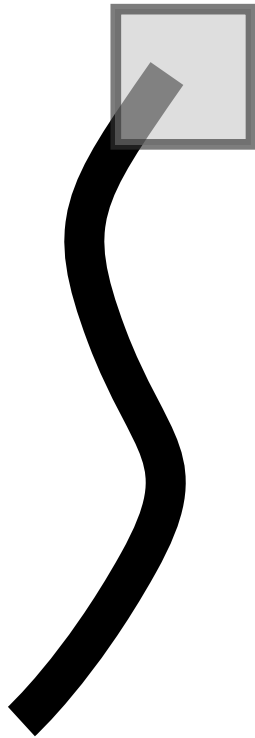
Curves



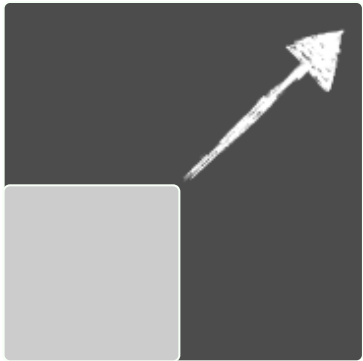
Polygons



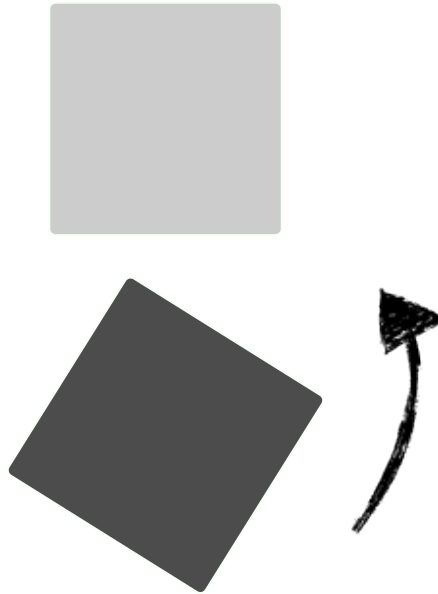
Antialiasing



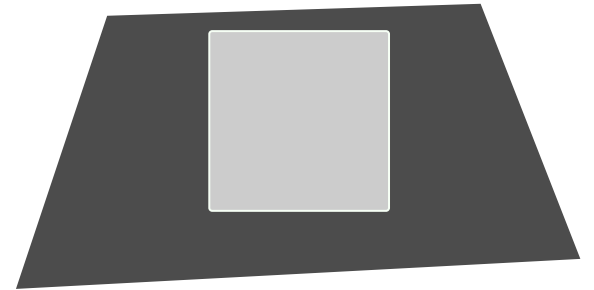
Transformation



Scaling



Rotation



Perspective

Physical Limitations

Memory

Can't store too much stuff

Speed

CPU is faster for some operations

Bandwidth

Data transfer can be the bottleneck

Power

Electrons always need energy

Animation Mechanics

Fluid Animation

1

At the beginning, push as **many resources** as possible to the GPU

2

During the animation, **minimize** the interaction between CPU-GPU

Rendering Styles

At the beginning

Draw the shape
onto a buffer

For every animation tick...

Draw the shape at (x, y)
 $x = x + 10$

Blit the buffer at (x,y)
 $x = x + 10$

Immediate

Retained

Compositing Process

Initialization

“Hey, this is good stuff. **Cache** it as texture #42.”



Animation step

“Apply **[operation]** to texture #42.”



DOM Element = Layer



Compositing: “Logical” 3-D



Efficient Compositing

Easy

Opacity
Transformation
Filter

“Hardware
accelerated”

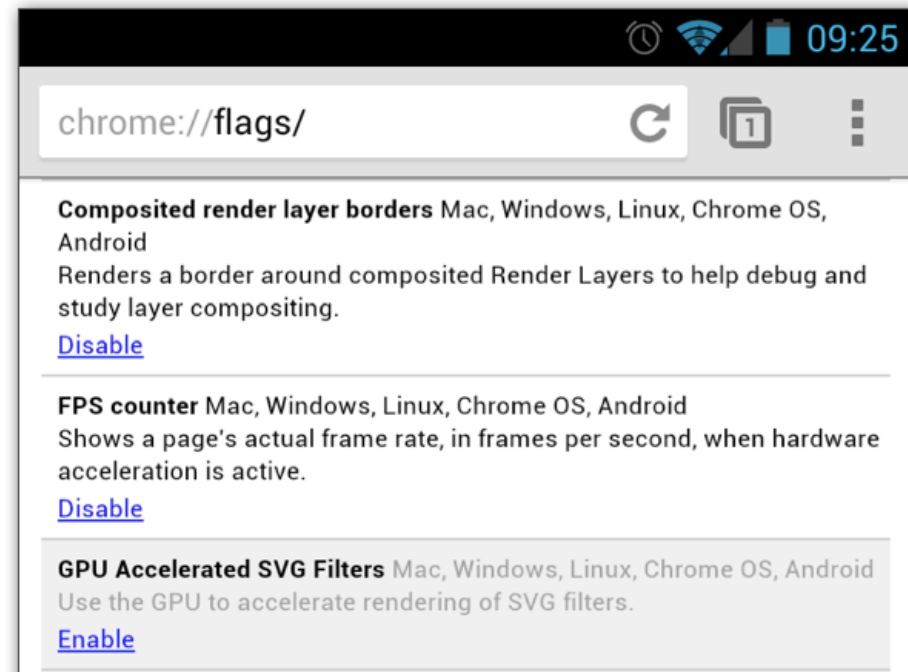
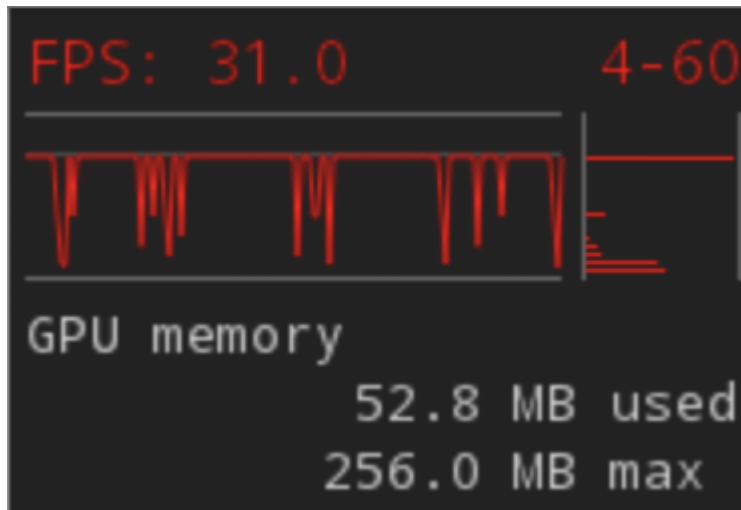
Hard

Everything else!

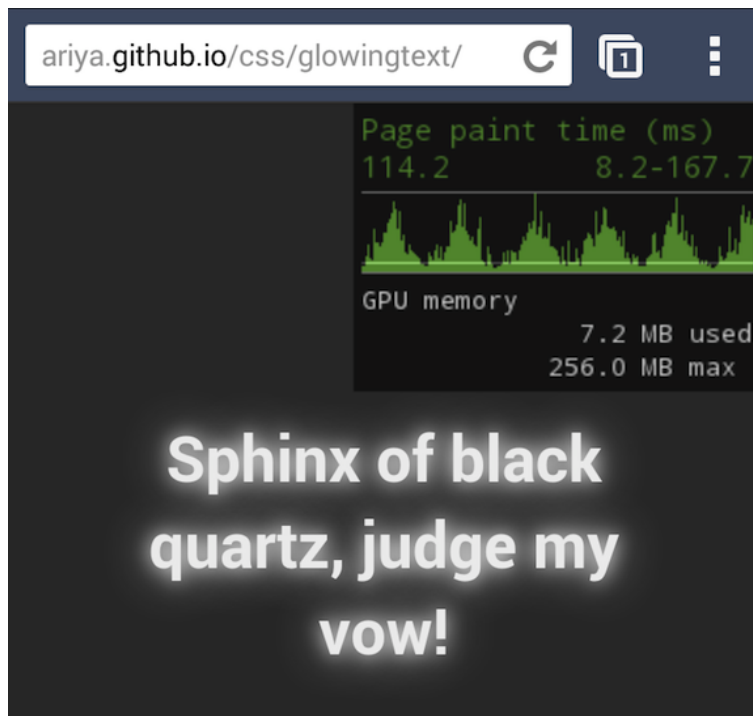
Tools & Examples

Frame Rate HUD in Chrome

chrome://flags



Continuous Painting in Chrome



Page paint time (ms)
for every single frame

Debugging in Chrome

chrome://flags

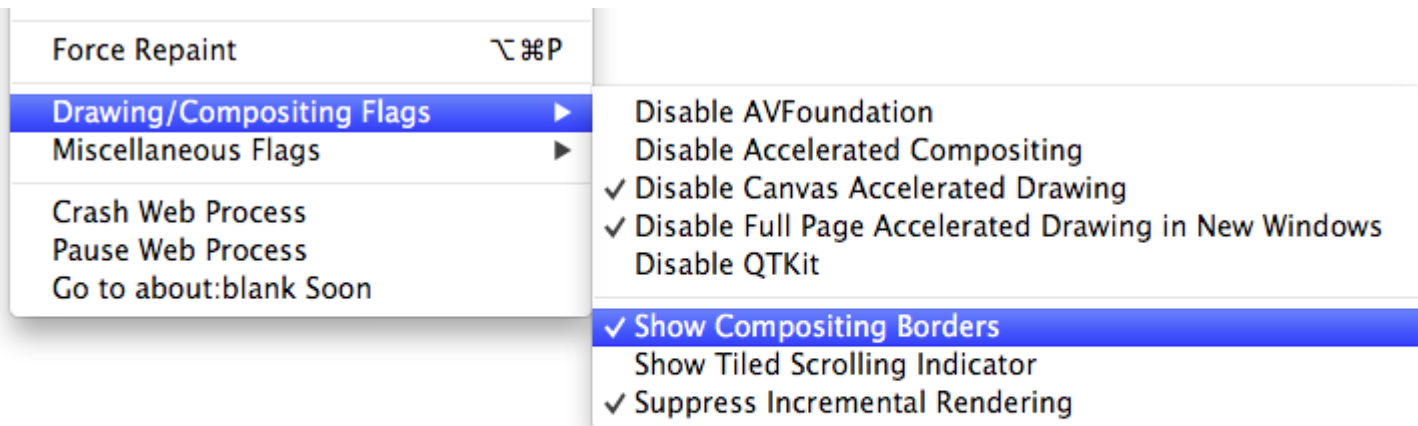


chrome://flags/#composited-layer-borders

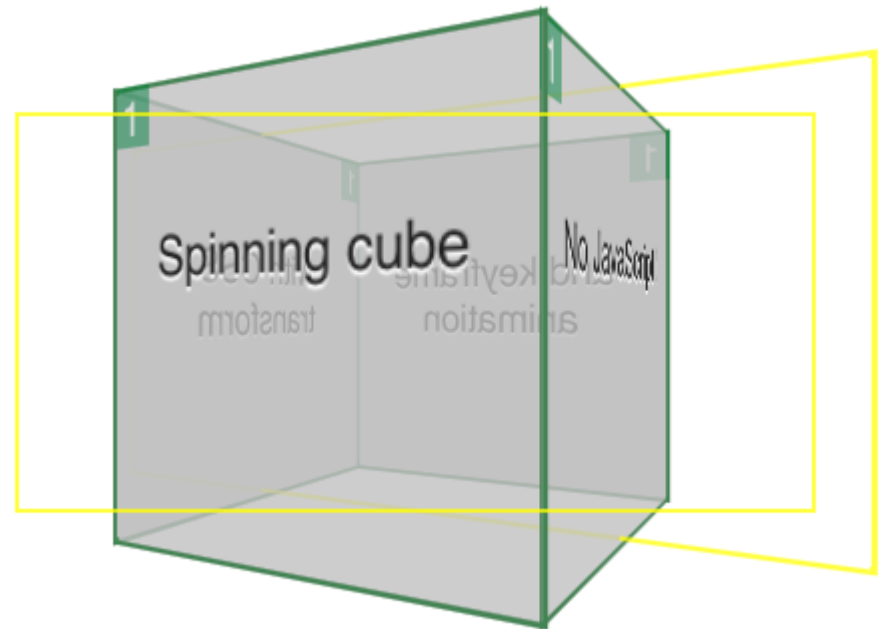
Composited render layer borders Mac, Windows, Linux, Chrome OS, Android
Renders a border around composited Render Layers to help debug and study layer compositing. [#composited-layer-borders](#)
[Enable](#)

Debugging in Safari

```
defaults write com.apple.Safari IncludeInternalDebugMenu 1
```



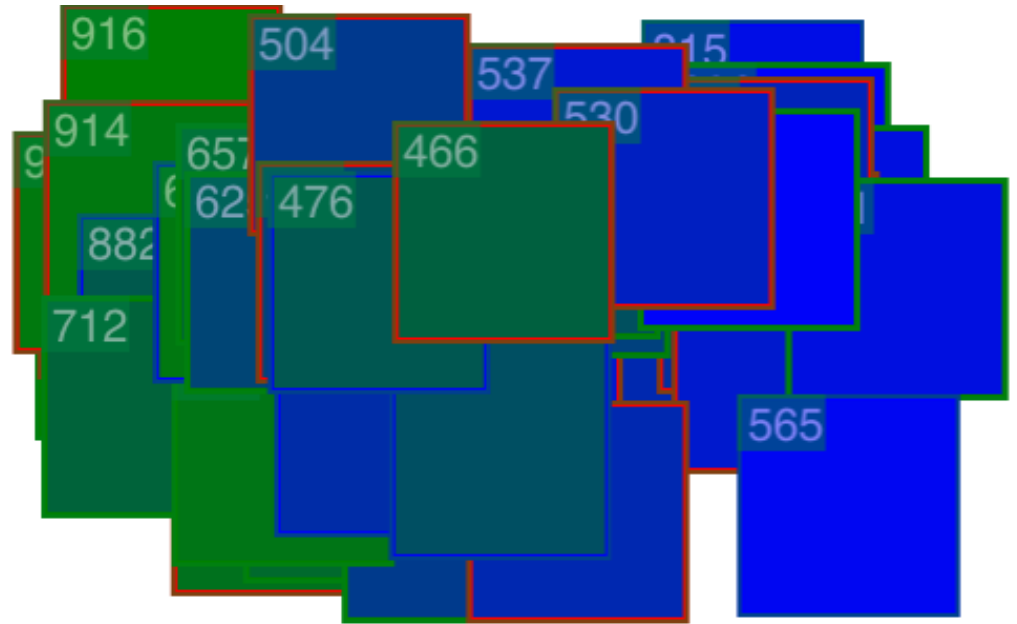
Compositing Indicator



Continuous Upload = Disaster

translate3d

???

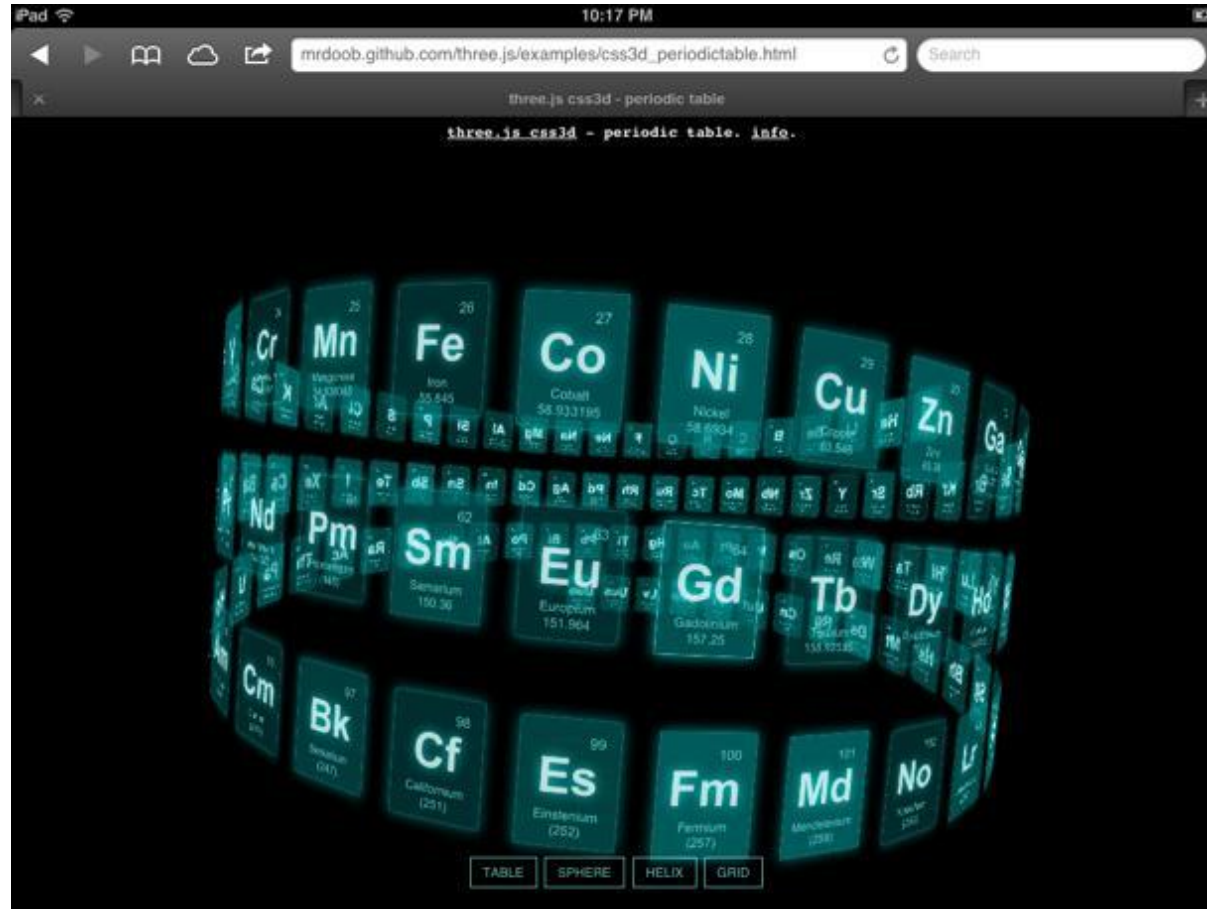


<http://codepen.io/ariya/full/xuwgy>

Transformation & Opacity



three.js Periodic Table



http://mrdoob.github.com/three.js/examples/css3d_periodictable.html

Montage MovieShow



<http://montagejs.github.com/montage/samples/popcorn/>

Filter

The screenshot displays the CSS FilterLab web application. On the left is a dark-themed control panel with the title "CSS FilterLab" and a "Experiment" button. Below the title are two filter categories: "grayscale" and "drop-shadow". The "grayscale" filter has an "amount" slider set to 50. The "drop-shadow" filter has sliders for "offset_x" (3.37), "offset_y" (5), and "radius" (3.88). Below these is a "Color" section with a checkerboard pattern and the hex code "#000000". At the bottom of the control panel are "flood_color" sliders for red (r), green (g), blue (b), and alpha (a), all set to 0. On the right is a preview area showing a webpage titled "The Graphical Web". The webpage has a dark background with stylized illustrations of a yellow creature with a crown and a blue creature. The text on the webpage reads: "The Graphical Web", "The Graphical Web is not a mythical place. It's a place where HTML, CSS & JS are supercharged with powers that extend their abilities to amaze.", and "CSS Filters is a small step for web design, a giant leap for the web. [Learn more!](#)". Above the preview area are buttons for "Default", "Save as Preset", "Tweet", "Share", "What are CSS Custom Filters?", and "Help".

<http://html.adobe.com/webstandards/csscustomfilters/cssfilterlab/>

Photon CSS Lighting



<http://photon.attasi.com/>

FPS View



<http://www.keithclark.co.uk/labs/css3-fps-new/>

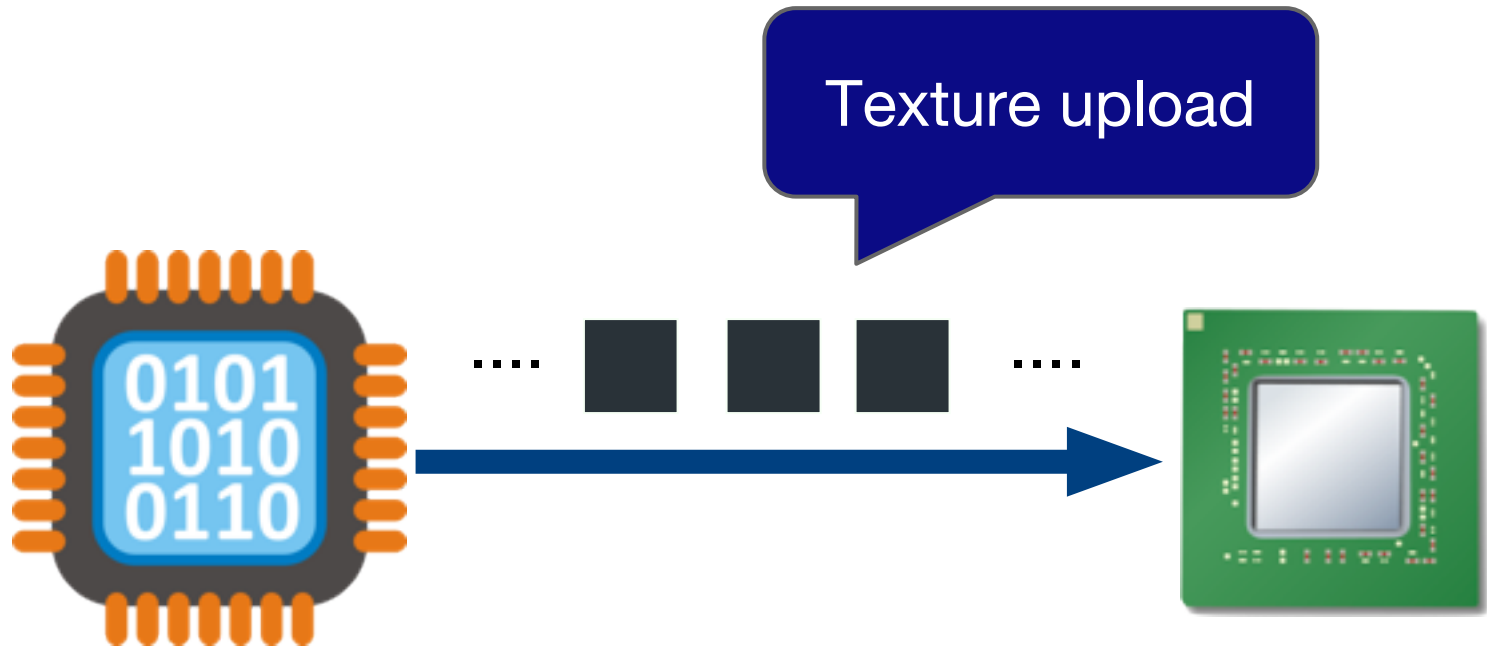
I can haz some HACKS

Traffic Congestion



Speed vs Traffic Condition

Avoid Overcapacity



Think of GPU like a **cache**

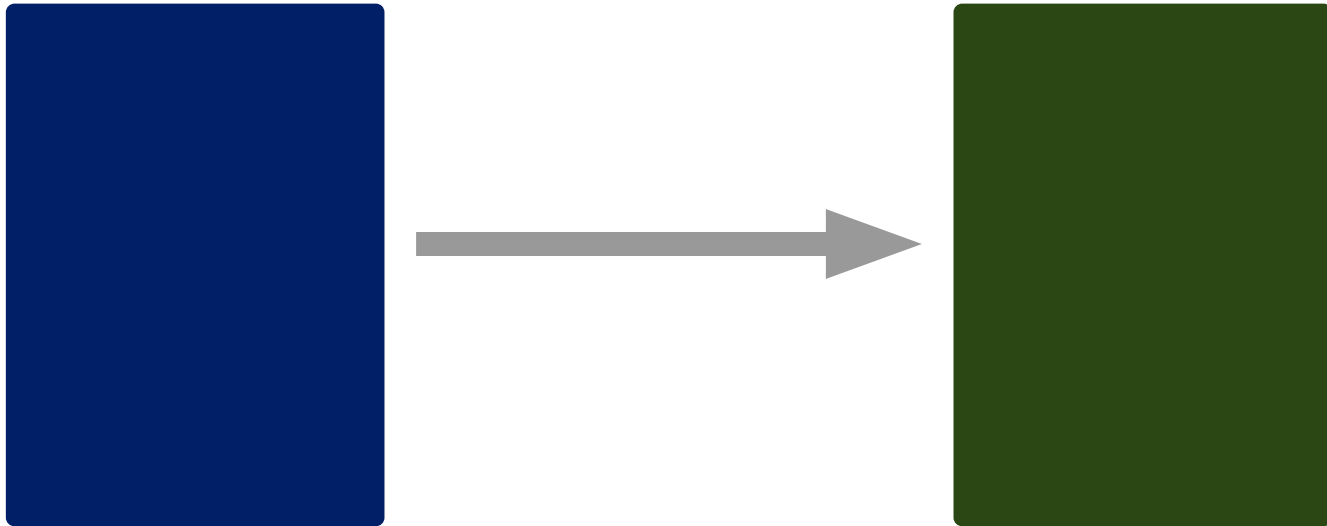
Prepare & Reuse

Hide the poster (=layer) offscreen



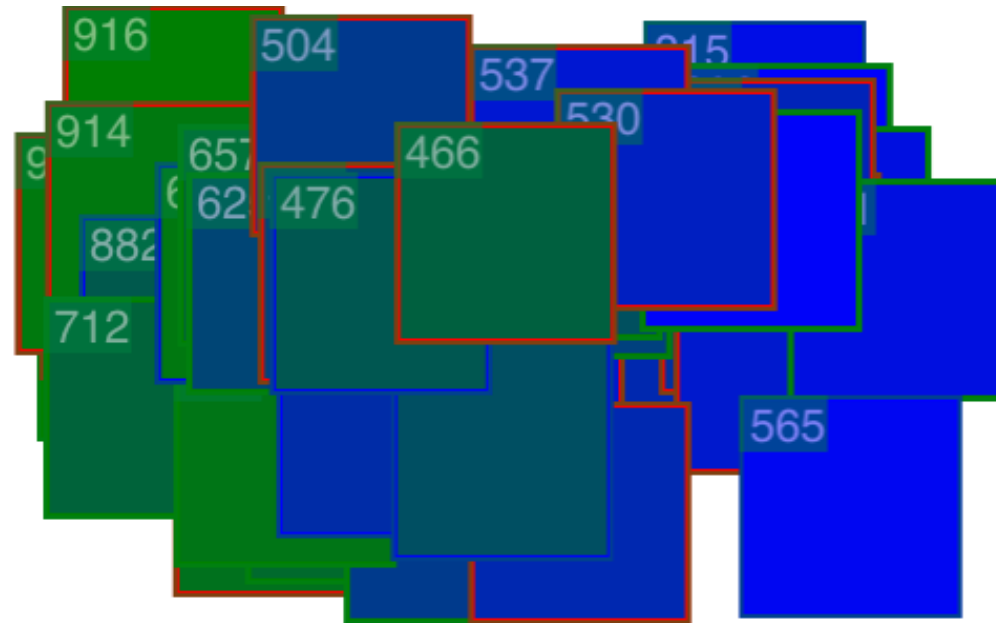
<http://montagejs.github.com/montage/samples/popcorn/>

Color Transition



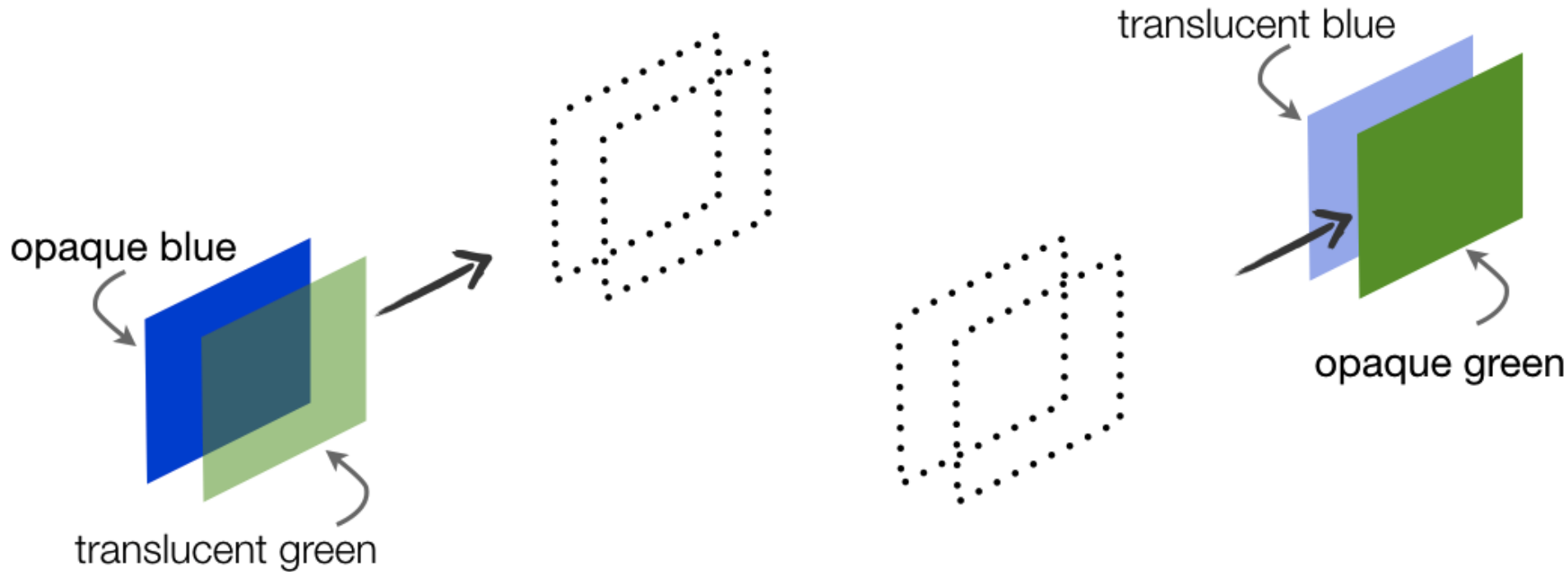
```
@keyframes box {  
    0% { transform: background-color: blue; }  
    100% { transform: background-color: green; }  
}
```

Disastrous Layer Upload



<http://codepen.io/ariya/full/xuwgy>

Transition Trick



Final Words

**With great power
comes great responsibility.**

- Batman



No Silver Bullet



- Use CSS3 **animation & transition**
- Be advised of **texture uploads**
- *Never* assume, always **measure**

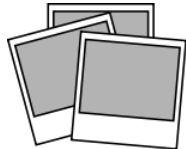
Thank You



@ariyahidayat



ariya.ofilabs.com/highlights



speakerdeck.com/ariya

