Towards richer colors in Chromium

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W3C Workshop on Wide Color Gamut
and High Dynamic Range for the Web
April–May 2021

Hello!

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Color on the Web

There is increasing interest in adding support for wider color gamuts and other color functionalities to different elements in the Web platform.

For example:

- *"Unlocking Colors" (bkardell.com)*
- *"LCH colors in CSS: what, why, and how?" (lea.verou.me)*
- "Color managing canvas contents": *github.com/WICG/canvas-color-space*
- This workshop :)

This talk will focus specifically on adding support in Chromium
for richer colors defined in HTML and CSS.

CSS Color

CSS Color Module 4 (*drafts.csswg.org/css-color*)

- `color()`: specify a color in a particular colorspace
  - `srgb, display-p3, a98-rgb, prophoto-rgb, rec2020, xyz, lab, etc.`
- `lab()`, `lch()`: define colors in the CIE L*a*b* space
- pick the interpolation colorspace for gradients, filters, transitions…
- detailed conversion algorithms, etc.

Next iteration: CSS Color 5

Having colors outside of the sRGB gamut opens up questions about consistency and interoperability between the different elements of the Web platform.

- Related: *TAG review of lab(), lch()*

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Chromium

Free SW base of Chrome, Edge, and others (chromium.org)

Web engine: Blink

Implements Web Platform standards:

Web content → pixels on the screen

Builds structures to update the rendering efficiently

Multiplatform graphics library: Skia (*skia.org*) SKIA

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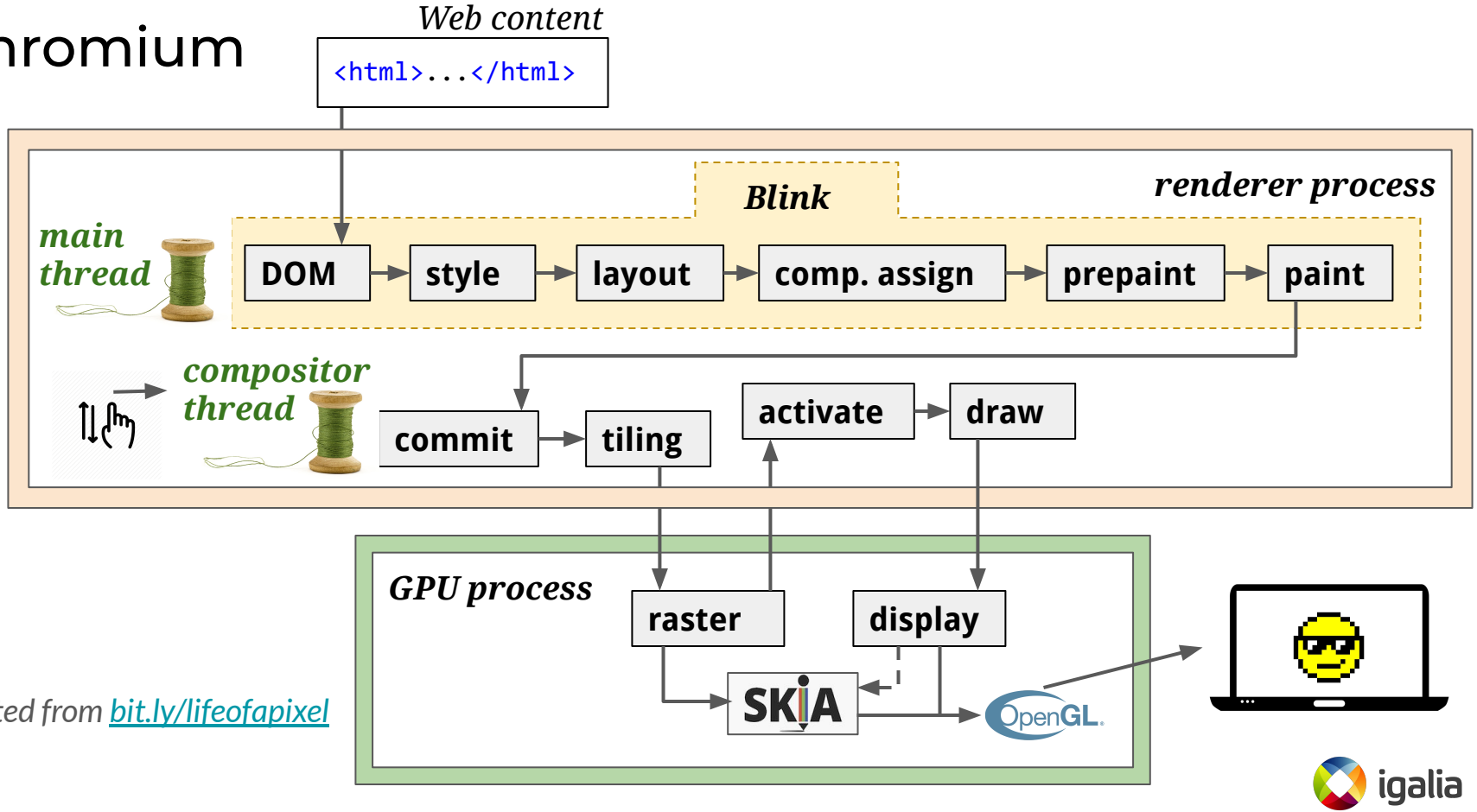
Chromium



adapted from bit.ly/lifeofapixel

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Color in Chromium

Color management (ICC), `@media (color-gamut: p3)`, color profiles in images, etc.

But no support yet for using wider colorspaces in individual Web elements:

- Blink parses and stores CSS colors in a 32-bit RGBA format: 8 bits per channel
  - `RGBA32` and `Color` in `third_party/blink/renderer/platform/graphics/color.h`
- Skia uses a similar 32-bit RBGA to handle and raster those colors
  - `SkColor` in `third_party/skia/include/core/SkColor.h`
- Throughout the Chromium render pipeline, colors are stored in 32 bit sRGBA; this limits the precision and richness of the colors that can be displayed.

Color in Skia

Skia does support high precision colors (four floats, RGBA structure)

- `SkRGBA4f` and `SkColor4f` in `third_party/skia/include/core/SkColor.h`
- Much of Skia's API (colors, gradients…) can take a colorspace and one or more high-precision colors.

Skia colorspace = transfer function + gamut

- `third_party/skia/include/core/SkColorSpace.h`
- transfer function: `SRGB, 2Dot2, Linear, Rec2020, PQ, HLG`
- gamut: `SRGB, AdobeRGB, DisplayP3, Rec2020, XYZ`

See more: *Color Correct Skia*, *Skia Color Management*

If we could get the rich color information defined in the Web sources all the way to Skia at the end of the pipeline, we would be able to paint those colors correctly.

Color in WebKit

High precision representation of colors: four float values and a colorspace.

- `WebCore/platform/graphics/Color.h`
- `WebCore/platform/graphics/ColorComponents.h`
- `WebCore/platform/graphics/ColorSpace.h`

`A98RGB, DisplayP3, LCH, Lab, LinearSRGB, ProPhotoRGB, Rec2020, SRGB, XYZ_D50`

Rich color features already in WebKit:

- Images: *"Improving Color on the Web"*,
- `Display-P3` gamut: *"Wide Gamut Color in CSS with Display-P3"*
- `lab()`, `lch()`, `color(lab ...)`: *bug #205675* *bug #220684*
- `color-contrast()`: *bug #2225230*
- etc.

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In conclusion

The first step to richer CSS colors in Chromium is to add a way to represent high-precision colors and colorspaces throughout the rendering pipeline, so they can be correctly painted in hardware supporting wider color gamuts.

Once that is in place, it would be possible to start working on the features added by the CSS Color spec: `lab()`, `lch()`, interpolation colorspaces, etc.

Thank you!

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