CSS Color 4 in Print

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Print and CSS Color 4?

- Yes! CSS is already used extensively for print layout

- Commercial layout engines from BFO, Prince, Antenna House, RealObjects, Compart, Callas

- Open source engines from Vivliostyle, Weasyprint, AthenaPDF

- More implementations for print than for screen

- PDF has been doing color properly since 2000 (PDF 1.3)

Why should we listen to you?

- CTO of bfo.com; working with PDF since 1999

- Member of CSS Working Group, various PDF Association working groups

- Knows just enough about color to be dangerous

- We have implemented CSS Color 4 for PDF output

Let's compare: CSS Color 3

CSS	PDF
sRGB	DeviceRGB
HSL	-
	ICCBased (*also CalRGB, CalGray*)

Let's compare: CSS Color 4

CSS	PDF
sRGB	DeviceRGB
HSL	-
HWB	-
ICC (*also display-p3, rec2020, xyz etc*)	ICCBased (*also CalRGB, CalGray*)
device-cmyk	DeviceCMYK
Lab	Lab
LCH	-
-	DeviceN (*also Separation*)

Alternative coordinates: HWB, HSL and LCH

LCH and Lab are different views of the same colorspace. Lab uses cartesian coordinates, LCH uses polar. HWB/HSL are roughly the same, but for sRGB.
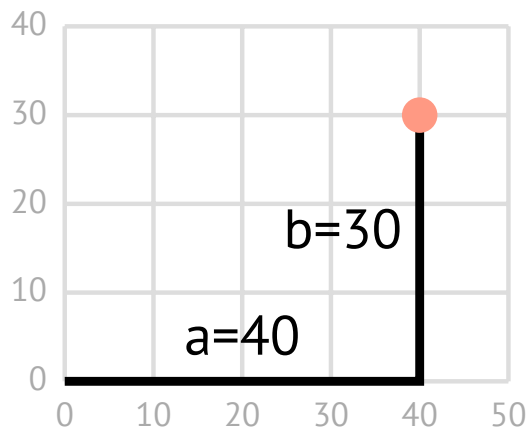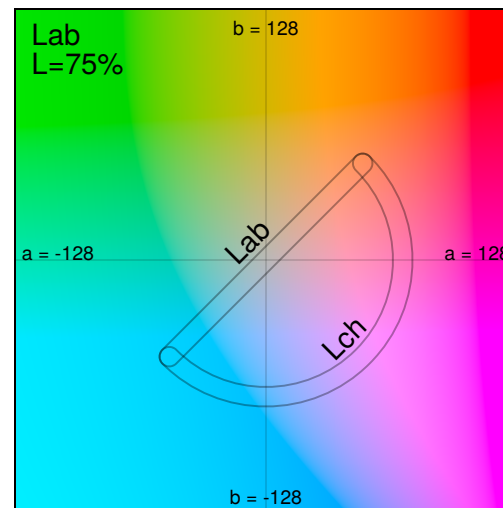
lab(75% 40 30)
=
lch(75% 50 36deg)
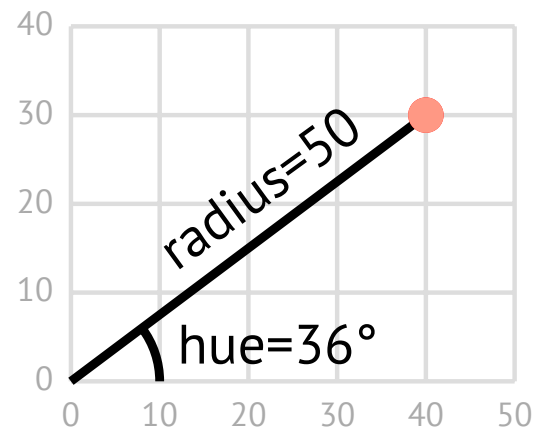
Gradients

Simply converting the endpoints from LCH to Lab is not enough. We also need to control how we interpolate.

lch(75% 70 -135deg)   lch(75% 70 45deg)

lab(75% -50 -50)   lab(75% 50 50)

Note: macOS preview may not display these gradients properly

Interpolation

In CSS, all interpolation is linear. But PDF has more choices: we can stitch functions, use sampled functions, even PostScript. So simulating an LCH gradient in Lab is easy; we just need the right function.

Many ways to do this: we make a linear function, sample it halfway and measure ΔE(CIE94). If it's too far, we split the function and repeat for each half - *De Casteljau's* algorithm. Good for simulating HSL/HWB in RGB too.

Let's recompare: CSS Color 4

CSS	PDF
sRGB	DeviceRGB
HSL	DeviceRGB
HWB	DeviceRGB
ICC (*also display-p3, rec2020, xyz etc*)	ICCBased (*also CalRGB, CalGray*)
device-cmyk	DeviceCMYK
Lab	Lab
LCH	Lab
-	DeviceN (*also Separation*)

So it's all working perfectly?

- ICC profiles of input-type Lab and XYZ are disallowed in PDF. So we can't use an "identity" XYZ ICC profile for `color(xyz n n n)`. Same for 7-color FOGRA55.

- Named Color ICC profiles also disallowed. Exceedingly rare. DeviceN/Separation colors are the better solution; Maybe css-color-*n* (for *n*≥5)?

- 2D "Coons Patch" gradients are required for CSS `conic-gradient`. But these typically interpolate in the wrong color space - sRGB or similar. The corner colors are correct; the "solution" is to use smaller patches so the interpolation matters less. Coons Patches will also be required if the proposed `<meshgradient>` is added to SVG.

Note: macOS preview may not display this gradient properly
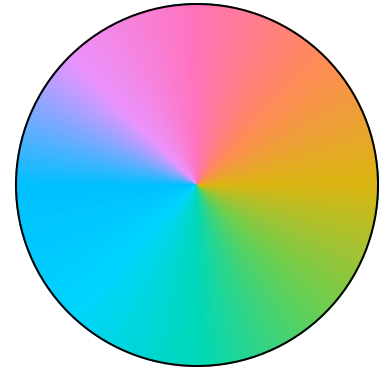
Print is mostly CMYK, ICC and Spot color

Source: "Mighty Nibus", b3ta.com, 2007

CMYK is widely supported. All commercial engines use `cmyk(0%, 22%, 5%, 0%)` ICC may be supported, in implementation-specific ways. `@color-profile` will help.

Device-independent color is required for PDF/A and PDF/UA, widely required by governments. Demand for these should help adoption.

Thank You

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https://bfo.com/misc/css-color4-presentation

https://bfo.com/misc/css-color4-presentation.pdf

(The PDF version of this presentation demonstrates all of the concepts discussed)

BFO