PDF Days Europe 2025

HTML vs PDF

Where they differ, where they don't, and why it matters

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Hello!

- CTO of bfo.com
- Working with PDF since 1999
- Member W3C CSS WG
- Several PDF Association WGs

This presentation is online at

bfo.com/s/ab

HTML vs PDF? Isn't the answer obvious?

You have a business. You need to invoice customers. Which format?

HTML	PDF
Customer logs in, views their invoice online	PDF Invoice emailed to customer
Online data (hopefully) secured by you	PDF secured by the customer
Linked resources (images etc) can't change	Invoice is self contained
In ten years time, data is 404	Customer can archive, and PDF lasts forever
Tailored experience for small screens	-
-	Authenticity from digital signatures

Answer: it depends!

HTML is not for print!

> *Hachette is typesetting around 40% of their books (in the US) using HTML+CSS via Prince.*
>
> *Two of the top four New York Times Hardcover bestsellers this week were done with CSS.*

Dave Cramer, Hachette Book Group, former editor of CSS GCPM specification, email to CSS WG 9 Sep 2013

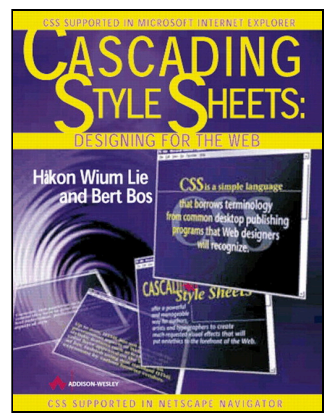
CSS was used to layout this book, published in 2005 - when IE6 ruled the web.

In 2025 only three *Layout Engines* remain that handle HTML+CSS in the browser:

Webkit (by Apple), **Blink** (by Google) or **Gecko** (by Mozilla).

For print? Engines by BFO, Prince, PDF Reactor, Antenna House, Vivliostyle,

Weasyprint, Typed.sh (that I know of). *Eight independent implementations.*



PDF is the end result!

10.1.4.10 Reflow

Where ICT is a non-web document, it shall satisfy the success criterion in Table 10.2.

Table 10.2: Document success criterion: Reflow

Content can be presented without loss of information or functionality, and without requiring scrolling in two dimensions for: • Vertical scrolling content at a width equivalent to 320 CSS pixels. • Horizontal scrolling content at a height equivalent to 256 CSS pixels. Except for parts of the content which require two-dimensional layout for usage or meaning.

ETSI EN 301 549, the European Accessibility Act

HTML+CSS is the most battle-tested document format in history.

If we are to support reflow in PDF, the most obvious approach is to convert PDF to HTML, in public or in secret. PDF/UA already takes us half-way.

> *If you love **PDF,** the law or sausages,*
> *it's best not to see either being made*

(probably not) Otto von Bismarck

Color

Color (legacy)

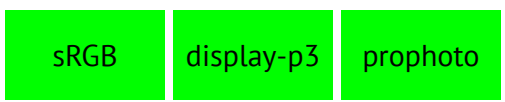
CSS	PDF
HSL, sRGB	DeviceRGB*
-	DeviceCMYK (*and subset DeviceGray*))
-	ICCBased (*also CalRGB, CalGray*)
-	Lab
-	DeviceN (*also Separation*)

* DeviceRGB may not be sRGB; sRGB may not be DeviceRGB

Color (modern?)

CSS	PDF
HWB, HSL, sRGB	DeviceRGB*
device-cmyk	DeviceCMYK (*and subset DeviceGray*))
display-p3, rec2020, prophoto, xyz, ICC	ICCBased (*also CalRGB, CalGray*)
Lab	Lab
OkLCH, OkLab, LCH	-
-	DeviceN (*also Separation*)

New features in **css-color-4** as of draft in early 2021



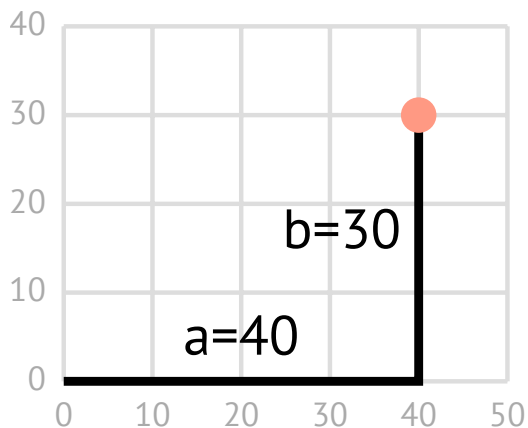
Color (modern)

CSS	PDF
HWB, HSL, sRGB	DeviceRGB*
~~device-cmyk~~	DeviceCMYK (*and subset DeviceGray)*)
display-p3, rec2020, prophoto, xyz, ~~ICC~~	ICCBased (*also CalRGB, CalGray*)
OkLCH, OkLab, LCH, Lab	Lab
-	DeviceN (*also Separation*)

- LCH, OkLCH and OkLab can *always* be mapped to Lab…
- device-cmyk and ICC postponed to **css-color-5** and unimplemented in browsers. Only in *CSS print engines*
- **XYZ is a problem in PDF** - ICC profiles of input-type XYZ are disallowed. *Very* unintuitive, will rarely be used

Alternative coordinates: HWB, HSL and LCH

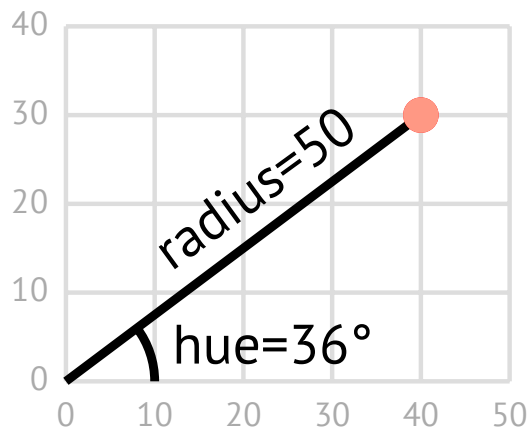
LCH and Lab are different views of the same color-space. Lab uses cartesian coordinates, LCH uses polar. HWB/HSL are roughly the same, but for sRGB.



lab(75% 40 30)

=

lch(75% 50 36deg)



Gradients

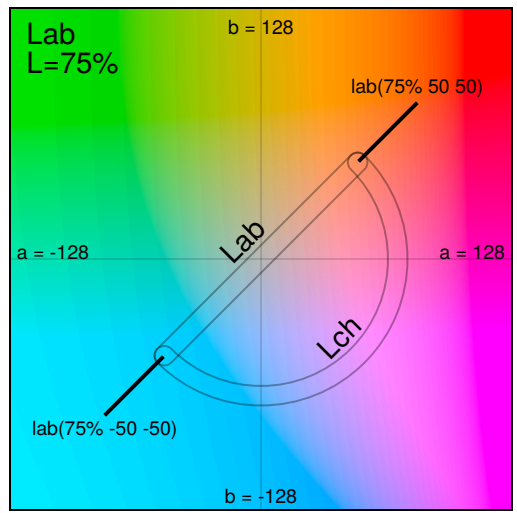
Interpolation between colors

Gradients (interpolation color-space)

linear-gradient(in **srgb** to right, lab(75% -50 -50), lab(75% 50 50))

linear-gradient(in **lab** to right, lab(75% -50 -50), lab(75% 50 50))

linear-gradient(in **lch increasing hue** to right, lab(75% -50 -50), lab(75% 50 50))



New CSS syntax for linear-gradient added in **css-images-4**, November 2021. Widely implemented

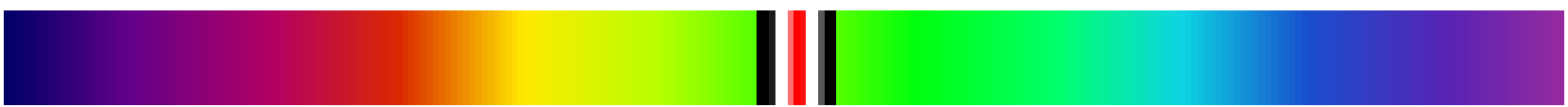
Gradients (interpolation in PDF)

PDF can simulate interpolation in LCH by using Lab, and a sampled function

Interpolation in CSS is *linear*. Interpolation in PDF is *non-linear*.

But as both can divide gradient into many small sections*, it's the same thing.

For linear and radial gradients, **CSS and PDF are equally capable**.



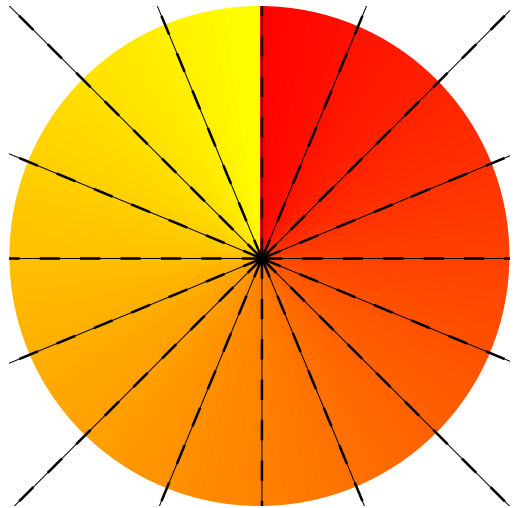
* eg take linear function, sample halfway and measure Δ*E*(CIE94). If too far, split and repeat. *De Casteljau's* algorithm.

CSS Conic Gradients

CSS has *conic gradients*, which rotate around a focus point. PDF can reproduce these accurately using a triangular mesh.

Problem: most PDF viewers incorrectly interpolate triangular meshes in DeviceRGB.

Solution: use smaller triangles, for less interpolation.



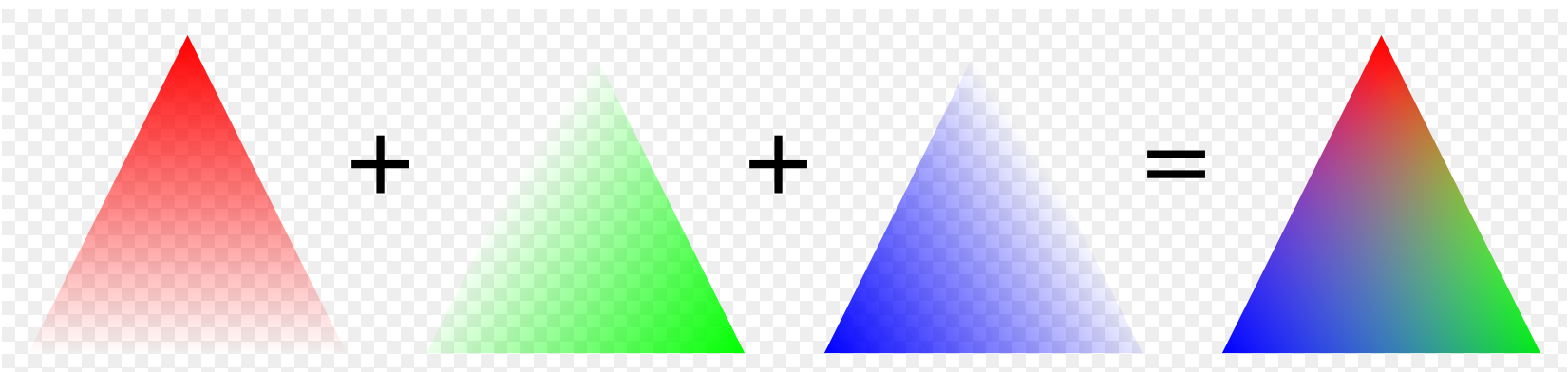
conic-gradient(in srgb, black, yellow)

PDF Mesh Gradients

PDF has *mesh gradients*, based on a lattice of triangles or patches.

No equivalent in SVG (a Coons Patch proposal never got beyond draft).

Gouraud triangles can be simulated in SVG, but it's *very* verbose.



Gradients

SVG and CSS	PDF
linear, repeating-linear	linear
radial, repeating-radial	radial
conic (CSS only)	triangular mesh
expensively simulated in SVG, or bitmap	mesh (triangular, tensor patches, lookup table)

- Any CSS (or SVG) gradient can be created in PDF
- Any PDF gradient can be created in CSS or SVG, but it might be expensive
- CSS repeating gradients can be made non-repeating by duplicating segments

General Graphics

Graphics Primitives

Lines, curves and transformations are universal. Bitmaps too. Easy!

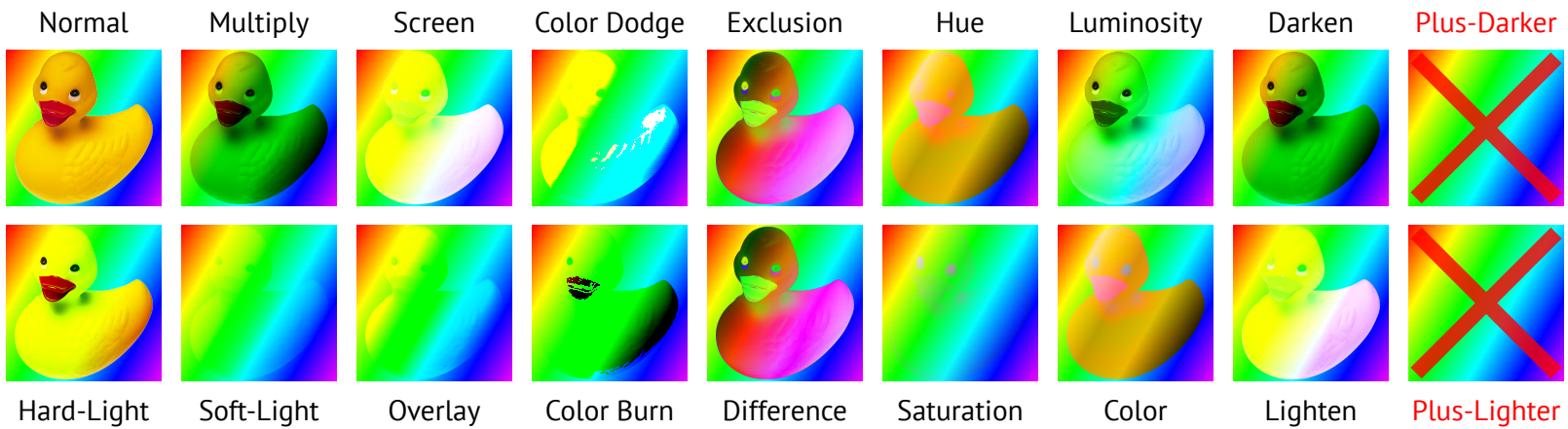
CSS `transform-style:preserve-3d` *has entered the room*

CSS transforms *anything* in 3D; graphics, text, video.

But even in 3D, a transformed line is still a line.

- vector graphics can be transformed, point by point
- text becomes vectors, with matching invisible glyphs
- gradients: linear are unchanged, others are meshed
- bitmaps have to be rebuilt, which is expensive

Blending and Compositing



CSS has the same blend modes as PDF, ***and two new ones in 2022*** *

Masking layers can be anything (in PDF), an image (in CSS; SVG image is OK)

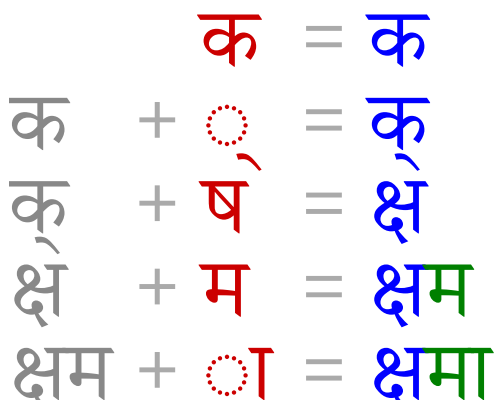
CSS blending is *only* sRGB. PDF is RGB or CMYK (+ overprint and knockout)


CSS artwork by Ben Evans
2.5kB of HTML, 198kB of CSS. No bitmaps. No SVG.
www.tinydesign.co.uk

Text and Fonts

Text

- HTML specifies Unicode *characters* (semantics)
- PDF specifies *glyphs* (appearance)
- Characters + Shaping = Glyphs. May be complex!
- Glyphs + ToUnicode (+ ActualText) = Characters



PDF often requires `ToUnicode` and sometimes requires `ActualText` to get semantic values from glyphs.

Layout tables are stripped from fonts. Editing a form field? Replace font. 😢

Fonts

OpenType	PDF
TrueType outlines	TrueType
CFF outlines	CFF
Bitmaps: SBIX and CDBT	Type3
SVG color fonts	Type3
COLR v0 color fonts	Type3
COLR v1 color fonts	Type3… with some effort

WOFF and WOFF2 are just OpenType, PDF's Type1 can convert to CFF

Variable **Fonts**

TrueType or OpenType (CFF). Not supported in PDF, but it is ~~easy~~ possible to convert a particular variation to a *static* version of the same font.

The resulting PDF may have many fonts; thats OK.

If the font is not embedded, we have to choose the variation from its name. Adobe Technical Note #5902 make this predictable (in theory).

In practice? Just embed the font!

optical sizing in "Fraunces"

sRGB

Color Fonts 😎

- Bitmaps
- SVG (from Adobe/Mozilla). One major flaw: not invented at Google
- COLR (from Microsoft/Google) - layers (v0), gradients and layer blending (v1)

COLR v1 uses *Porter-Duff* blending. Can be simulated in PDF with masks.

We can convert *any* COLR v1 font to PDF Type3 font without rasterizing.

Color Fonts 😎

CSS can override individual colors in fonts,

including with non-sRGB colors.

In theory we could have CMYK color fonts!

sRGB

display-p3

prophoto

Palette entries are only referenced by number.

Too awkward to be useful.

```
@font-face {
  font-family: "Segui";
  src: url("seguiemj.ttf");
}
@font-palette-values --fp1 {
  font-family: "Segui";
  override-colors: 43 rgb(0 100% 0);
}
@font-palette-values --fp2 {
  font-family: "Segui";
  override-colors: 43 color(display-p3 0 1 0)
}
@font-palette-values --fp3 {
  font-family: "Segui";
  override-colors: 43 color(prophoto-rgb 0 1 0)
}
.srgb {
  font-family: "Segui";
  font-palette: --fp1;
}
.display-p3 {
  font-family: "Segui";
  font-palette: --fp2;
}
.prophoto {
  font-family: "Segui";
  font-palette: --fp3;
}
```

Text and Fonts: conclusion

Every aspect of OpenType 1.9 can be represented in PDF content streams.

To make this look easy, PDF creation tools have to work hard.

Accessibility
Forms
Metadata

Structure ☞ Accessibility

HTML *is* tags, so is always structured. Tags are required for layout so many have no semantic purpose (e.g. twenty-deep nested elements).

PDF tags are not required, and are often left out. Result can be "glyph salad". Separation of layout and structure means no *need* to add non-semantic tags.

PDF documents never change. HTML is dynamic, which causes problems.

typical HTML > typical PDF

good PDF ⩾ good HTML

Structure ☞ Accessibility

CSS `background-image` is not accessible.

WCAG says it's “designed for decorative purposes”.

The internet doesn't care, and CSS is convenient.

But an image on a PDF page *must* be tagged!

Backgrounds and borders too. If it marks the page, it must be categorised as *real content* or an *artifact*. It's machine-checkable; no avoiding it.

```
<img src="ducky.png">
```

```
<div class="ducky">
```

```
div.ducky {
 background: url("ducky.png");
 -bfo-pdf-tag: "Figure"
 -bfo-pdf-tag-include: background;
}
```

Metadata

HTML can contain graphs of `[subject, predicate, object]` triples as RDFa, Microdata or JSON+LD. These can (theoretically) represent anything.

PDF has XMP: like RDF/XML but can only represent a tree not a graph.

The `subject` is the PDF object the XMP is attached to.

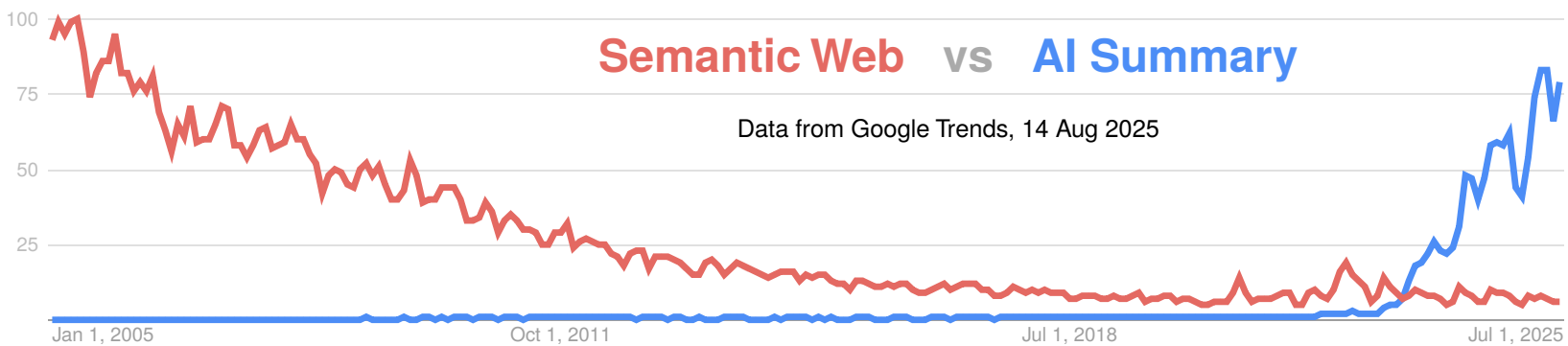
A PDF file can have multiple XMP objects, but they're all isolated.

PDF metadata is unable to represent every concept in HTML metadata.

Metadata

Does it matter? Maybe not. Metadata is rarely consumed directly by humans so errors (in content or schema) go unnoticed. Errors are *very* common.

Opinion



Forms

HTML	PDF
Dynamic Elements	
<input type="text | search | password | ...">	Text ("Tx")
<textarea>	Text ("Tx")
<select>, <input type="text" list="...">	Choice ("Ch")
<input type="date | color | time | file | ...">	-
Static Elements	
<button>	Button ("Btn")
<input type="radio">	Button ("Btn")
<input type="checkbox">	Button ("Btn")
-	Signature ("Sig")

Forms (Dynamic Fields)

HTML text fields can only have a single style - they are not "rich" - but they can be styled like document text.

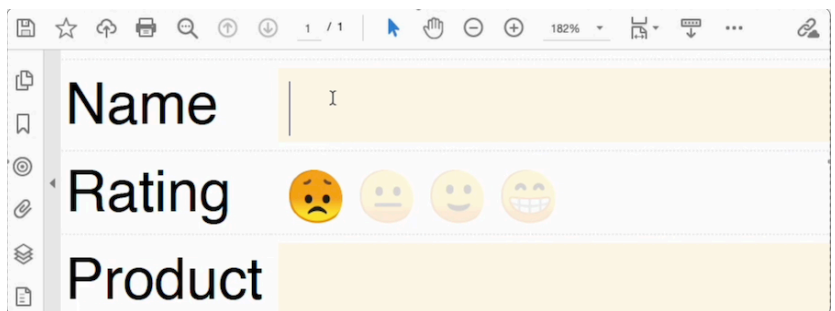
PDF text fields *can* mix normal, bold and italic, but styling is almost completely done by the viewer. "Early Layout" of text means fonts are usually ignored when editing, and it's impossible to control line-height, padding etc.

Dynamic fields are probably the biggest capability gap between HTML and PDF

Forms (Static Fields)

HTML button fields can be styled, although it requires CSS "hacks" for radio-buttons and checkboxes.

PDF button fields can be styled too! Even press and rollover images are defined, although support is very poor.



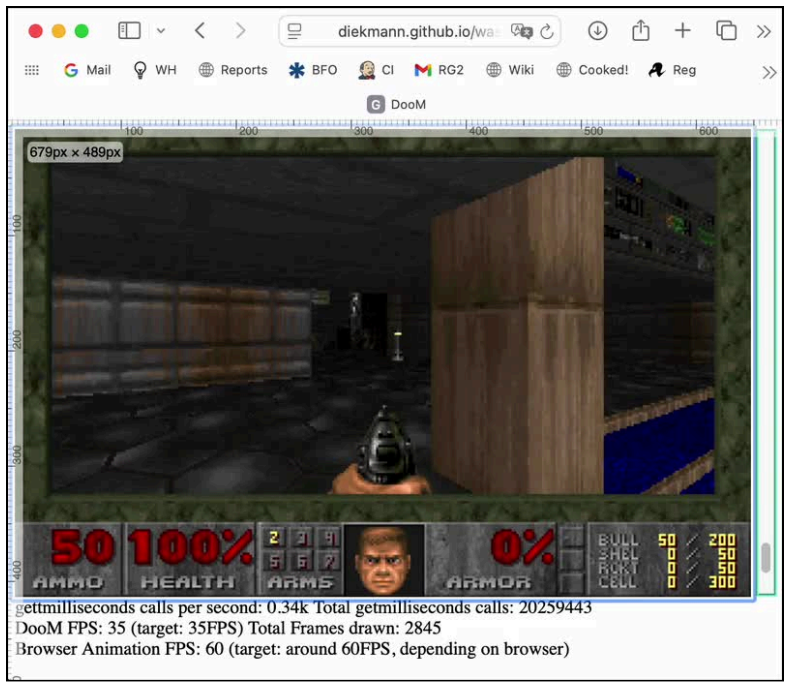
Digital signatures

A PDF file is a fixed, self-contained thing so it can be digitally signed.

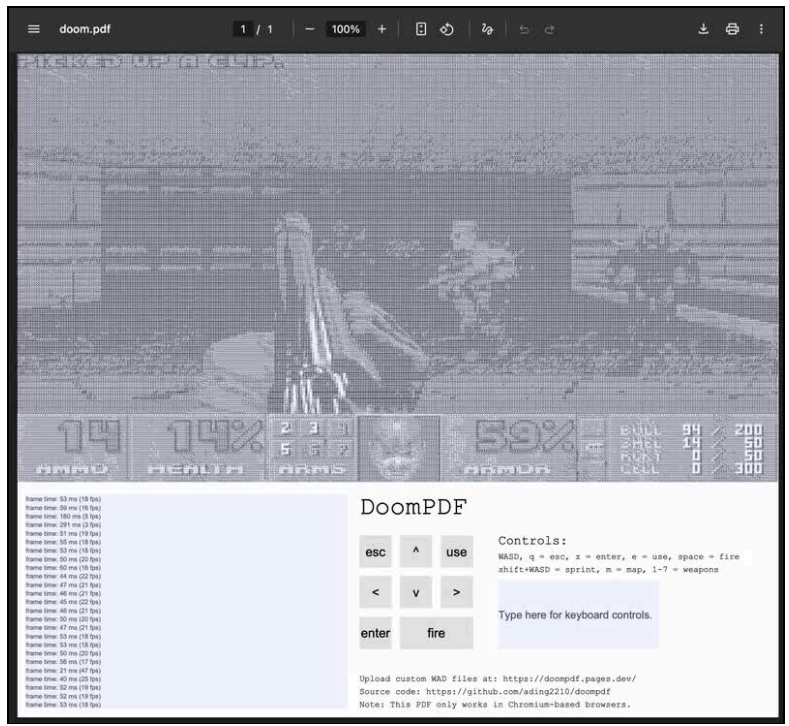
HTML is a dynamic collection of many resources from different sources.

Zip them and sign the zip? It's not the same.

Yes, but can they both play Doom?



https://diekmann.github.io/wasm-fizzbuzz/doom/



https://doompdf.pages.dev/doom.pdf

Thank You

bfo.com/s/ab

Slides created in HTML and CSS with shwr.me

Converted to PDF/UA with BFO Publisher: publisher.bfo.com

Both HTML and PDF demonstrate the concepts discussed.

No bitmaps!