Colours in CSS

I lub CSS. And I lub colours.
And you all dun wanna speak at Talk.CSS.
You tell me how???
https://github.com/SingaporeCSS/talk.css/issues/1
I wrote a thing last year.

Where did CSS named colours come from?
You should read this thing to hear from a professional.

Ask an expert: Why is CSS...the way it is?
Whiteness and all grey Colours between white and black, may be compounded of Colours, and the whiteness of the Sun’s Light is compounded of all the primary Colours mix’d in a due Proportion.

-Sir Issac Newton, Opticks (Prop. V Theor. IV.)
Colour

Perceived according to the wavelength of the light which strikes the eye
Trichromat spectral sensitivity

General diagram, individual profiles will vary
Colour space

The resultant set of colours when a colour model is associated with a precise description of how components are to be interpreted.

Concept seems to have been developed by Hermann Grassmann.

Grassmann published his theory of how colours mix in 1853. Colour can be represented as a convex cone in the 3D linear space.
Colour Gamut

The portion of the colour space that can be represented or reproduced

Generally specified on the hue-saturation plane

When a colour **cannot** be expressed within a particular colour model, it is **out of gamut**

_English translation of Theorie der Pigmente von grösster Leuchtkraft_ by Erwin Schrödinger

As of now, a device that can reproduce the entire visible colour space remains an unrealised goal within the engineering of colour displays and printing processes
Chromaticity

An objective specification of the quality of a colour regardless of its luminance

Consists of two independent parameters, often specified as hue (h) and colourfulness (s)

Allows for representation via polar coordinates with respect to a white point of a display
Light is either emitted or reflected.
CMYK colour model

For colour creation in **printing** and **film**

Uses the subtractive primary colours of pigment (**Cyan**, **Magenta**, **Yellow**, **Key** (black))

**Magenta** on the X-axis, **Cyan** on the Y-axis, **Yellow** on the Z-axis

_starts_ with white, and variable amounts of dye _subtracts_ some colours from light leaving others, _cyan_ absorbs **red**, _magenta_ absorbs **green**, _yellow_ absorbs **blue**
**RGB colour model**

All light-emitting displays would use an additive colour model

RGB is device-dependent, thus an RGB value will not define the same colour across devices without some kind of colour management

A colour is expressed by indicating how much of each of the red, green, and blue is included in numerical terms

For computers, component values are stored as integer values ranging from 0 to 255, which is the range an 8-bit byte can offer
Colours in CSS1

5.3 Color and background properties

`color` to describe the text colour of an element

`background-color` to describe the background colour of an element

Colour can either be a keyword or a numerical RGB specification

Hex codes are simply RGB colours in the hexadecimal notation
#42355e

\[ \theta \rightarrow 255 \]
\[ \theta \rightarrow \text{FF} \quad (15 \times 16 + 15) \]
David DeSandro, dotCSS 2018
transparent

Was there from the beginning and is the initial value of `background-color`

CSS2 allowed its use in `border-color`

CSS3 allowed its use in all elements that accepted a colour value

Computes to `rgba(0, 0, 0, 0)`
The sRGB colour space

sRGB (standard Red Green Blue) is an RGB color space created by HP and Microsoft for monitors, printers and the Web.

Original document: A Standard Default Color Space for the Internet - sRGB

Colours in CSS were first specified in RGB.

Even though there were better systems, RGB was “good enough” at the time.
Colour Naming System (CNS)

A systematic notation for named colours for computer applications using English terms created by Berk, Brownston and Kaufman in 1982

Uses ten colour names: red, orange, brown, yellow, green, blue, purple, white, grey and black

Base colour names can be combined or prefixed with modifiers

5 lightness terms, 4 saturation terms and 31 hue terms combine to produce 620 chromatic colour names

Not meant for computation, rather, a mechanism for naming colour literals and constants
CNS expressed in Backus-Naur form

```
named-color  ::=  gray-color  |  chromatic-color

gray-color   ::=  'black'  |  'white'  |  lightness  gray
gray         ::=  'gray'  |  'grey'

chromatic-color  ::=  [  tint  |  shade  ]  hue  |  [  lightness  |  saturation  ]?  hue
  tint          ::=  'whitish'  |  'pale'  |  'brilliant'  |  'vivid'
  shade         ::=  'blackish'  |  'dim'  |  'deep'  |  'vivid'
  saturation    ::=  'grayish'  |  'moderate'  |  'strong'  |  'vivid'
  lightness     ::=  'moderate'  |  'very'?  [  'dark'  |  'light'  ]
  hue           ::=  splash-color?  base-color  |  base-color  '-'  base-color
  base-color    ::=  'red'  |  'orange'  |  'brown'  |  'yellow'  |  'green'  |  'blue'  |  'purple'
  splash-color  ::=  'reddish'  |  'orangish'  |  'brownish'  |  'yellowish'  |  'greenish'  |  'bluish'  |  'purplish'
```
Named colours

Based on the X11 colours

Supported in Mosaic and Netscape Navigator because both ran in X Windows System

Chris Lilley lost the fight to use names from the Colour Naming System (CNS)

The path of least resistance was chosen \_(ツ)_/\
Colour wheels

An abstract illustrative organisation of colour hues around a circle to show the relationships between them
When the eye sees a colour it is immediately excited and it is its nature, spontaneously and of necessity, at once to produce another, which with the original colour, comprehends the whole chromatic scale.

Johann Wolfgang von Goethe, Theory of Colours, Part VI, Completeness and Harmony
Munsell colour system

Created by Professor Albert H. Munsell

A colour space that specifies colours based on three properties of colour: hue, chroma and value

The first system which separated hue, value and chroma into perceptually uniform and independent dimensions

Munsell was the first person to illustrate colours systematically in three-dimensional space
CIELAB colour space

Defined by the *International Commission on Illumination* (CIE) in 1976
Also known as LAB, for lightness, green/red and blue/yellow respectively
CIELAB gamut includes both the gamuts for RGB and CMYK
Meant to approximate human vision and aspires to perceptual uniformity
Needed more data per pixel to obtain the same precision as RGB or CMYK
HSL colours

An alternative representation of the RGB colour model, utilising a cylindrical geometry, hue being the angular dimension, saturation along the radial direction and lightness from top to bottom.

Based on the organisation and conceptualisation of colours in human vision.

Conversion from RGB was fast enough to run in real time on 1970s hardware.

HSL was added to CSS in 2002 from the desire to have some sort of hue wheel system.

Fast forward to today, its disadvantages (non-perceptual uniformity being a key one) are flaring their head.
Hue is unitless as degrees is implicit, Saturation and Lightness are in percentages
Moar colour formats

CSS Color Module Level 4

HWB colours (hue, whiteness, blackness)
Lab colours (lightness, green/red (a-axis), blue/yellow (b-axis))
LCH colours (lightness, chroma, hue)

`gray()` function
Badly-drawn visualisations

Lab axes

L and hue
Moar colour functions

CSS Color Module Level 5

color-mix()

mix-color(peru lightgoldenrod 40%)

color-contrast()

color-contrast(purple, chartreuse, firebrick, ghostwhite)
/* ghostwhite wins with a ratio of 8.9 */

color-adjust()

color-adjust(darkslategrey lightness(-20%));
Bunch of resources on colour...

- Complete Text of Opticks
- Experiments show hummingbirds see colors you’ve never dreamed of
- Ask an expert: Why is CSS...the way it is?
- “Tomato” versus “#FF6347”—the tragicomic history of CSS color names
- Where did CSS named colours come from?
- What is the color of a blank page?
- Complete Text of Goethe's Theory of Colours
- The CNS Color Naming System
kthxbye