

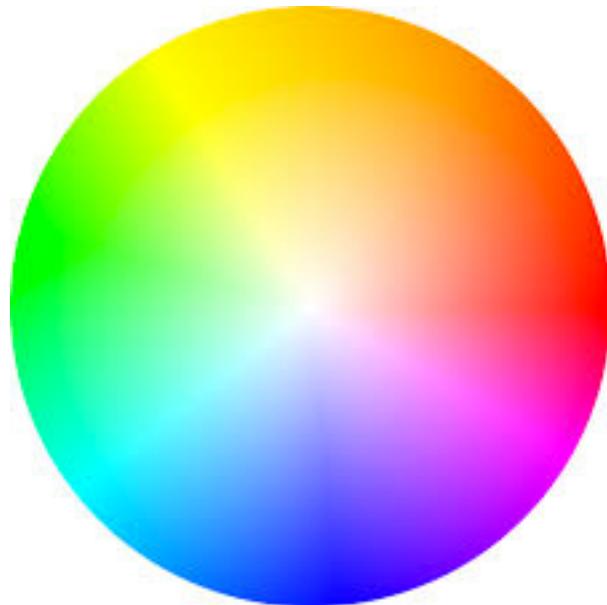


Module #5c: **Color in Visualization**



Principles

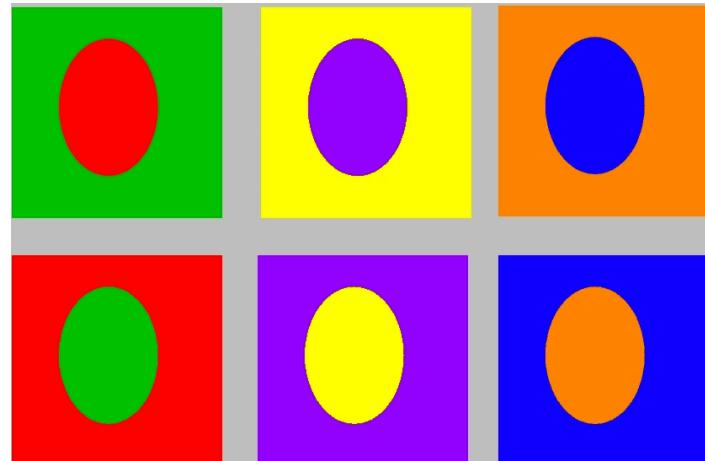
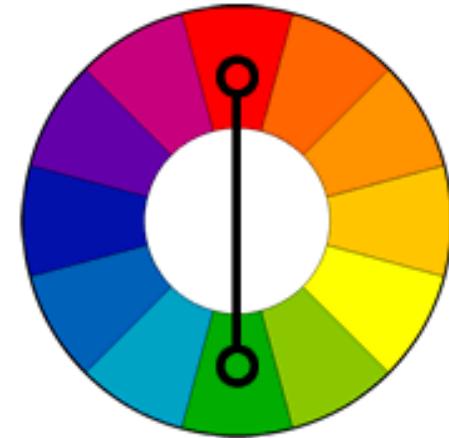
- Good design
 - 1. Focus attention using contrast (complementary colors)
 - 2. Unifies using analogy (analogous colors)





Complementary Colors

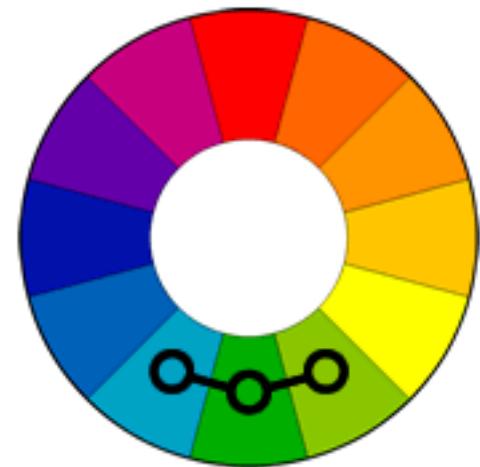
- Complementary colors:
 - are opposite each other on the color wheel (example: red and green).
 - the high contrast of complementary colors creates a vibrant look
 - **complementary colors** are bad for text





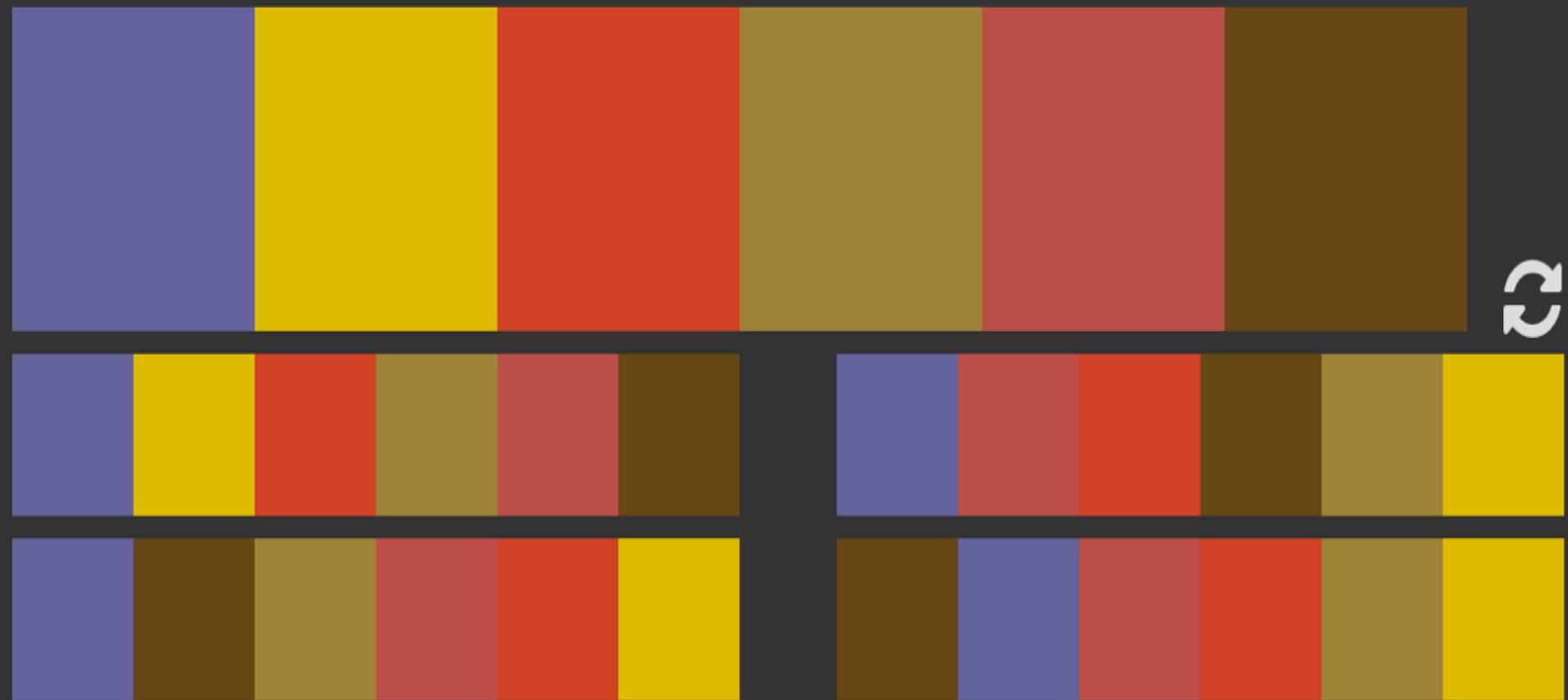
Analogous colors

- Analogous colors:
 - colors that are next to each other on the color wheel.
 - Harmonious and pleasing to the eye.
 - Choose one color to dominate, a second to support. The third color is used (along with black, white or gray) as an accent.





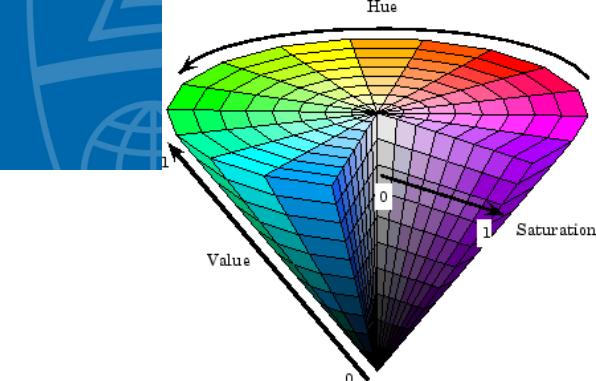
Be better than random





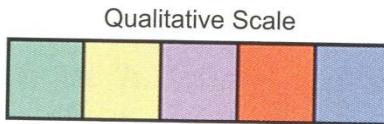
Intelligently use palette design tools

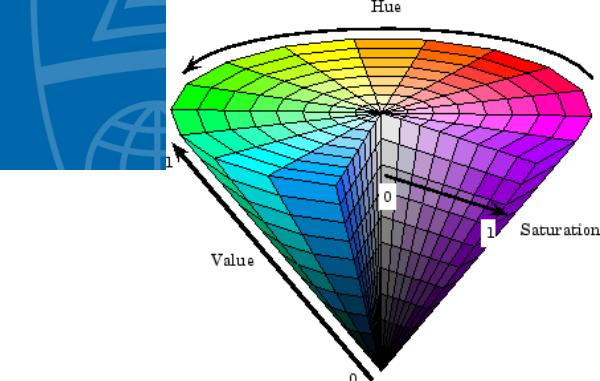




Color Palettes

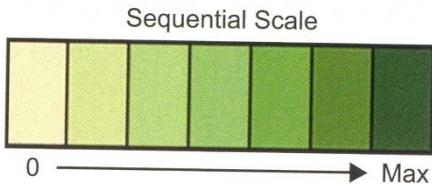
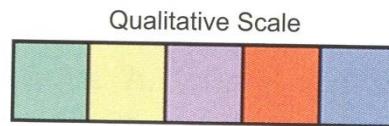
- **Qualitative** – colors don't have a perceived order
 - Same value, different hue

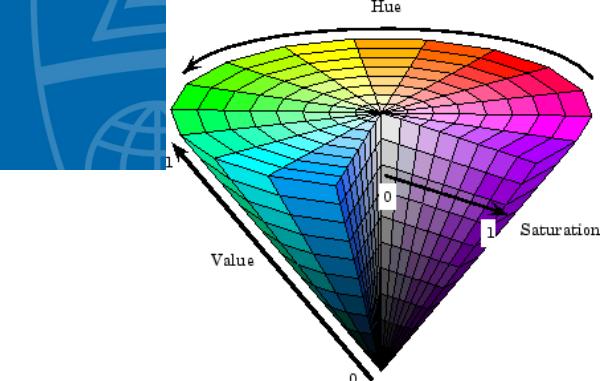




Color Palettes

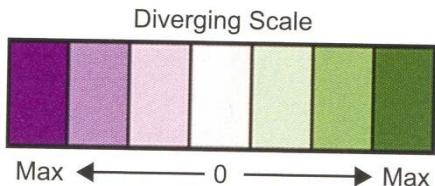
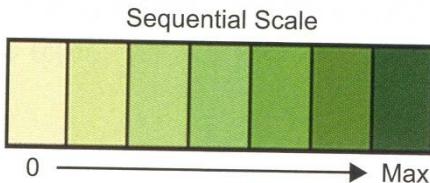
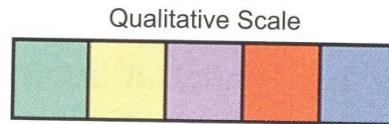
- **Qualitative** – colors don't have a perceived order
 - Same value, different hue
- **Sequential** - colors have a perceived order and perceived difference between successive colors is uniform
 - Scale in value/saturation





Color Palettes

- **Qualitative** – colors don't have a perceived order
 - Same value, different hue
- **Sequential** - colors have a perceived order and perceived difference between successive colors is uniform
 - Scale in value/saturation
- **Diverging** - two back-to-back sequential palettes starting from a common color
 - Cross fade through neutral



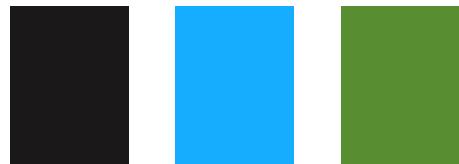


Two main types of color palettes

Continuous



Categorical (i.e., discrete)





Continuous scale types

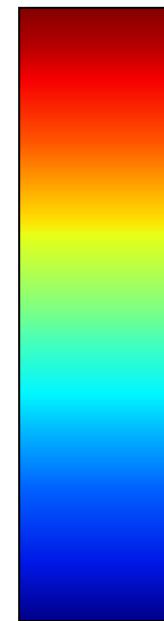
Sequential



Diverging



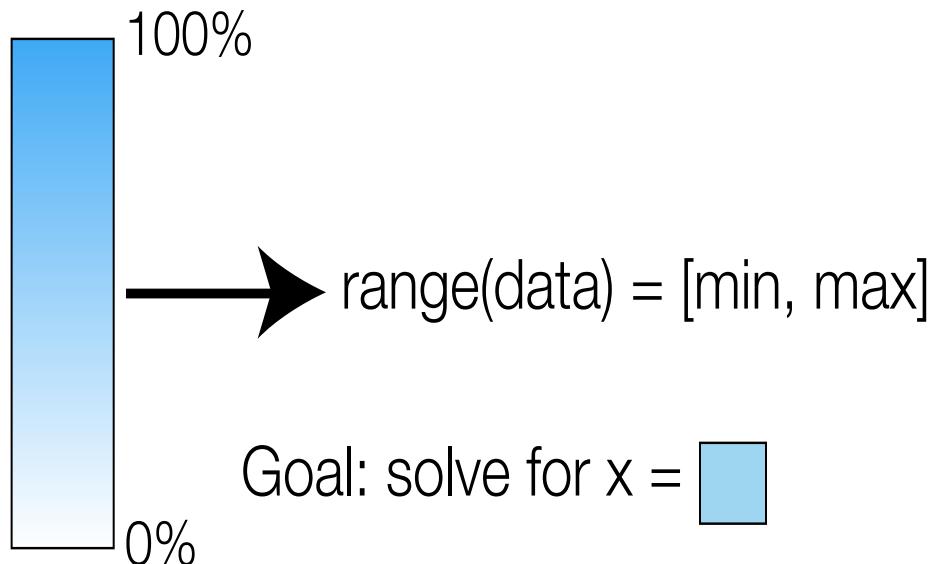
Rainbow



Difference purposes

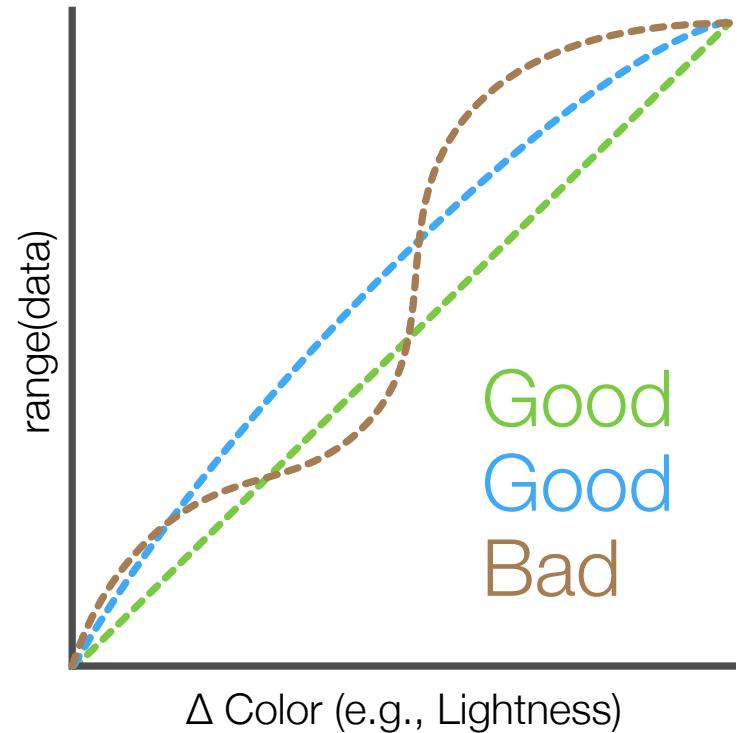
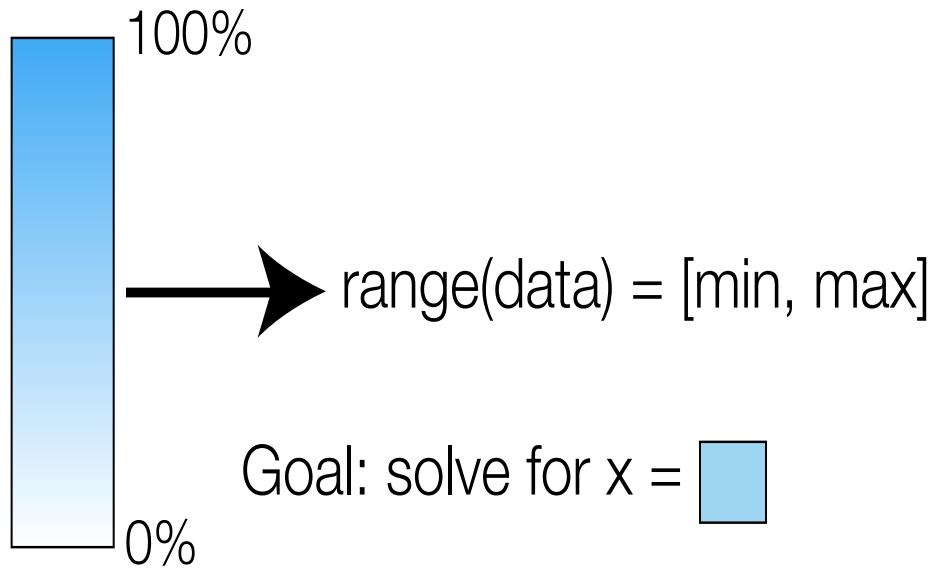


Continuous color palettes





Continuous color palettes



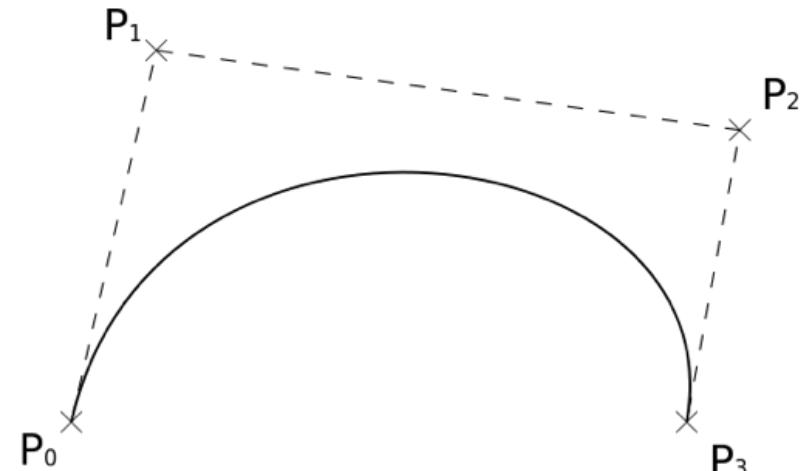
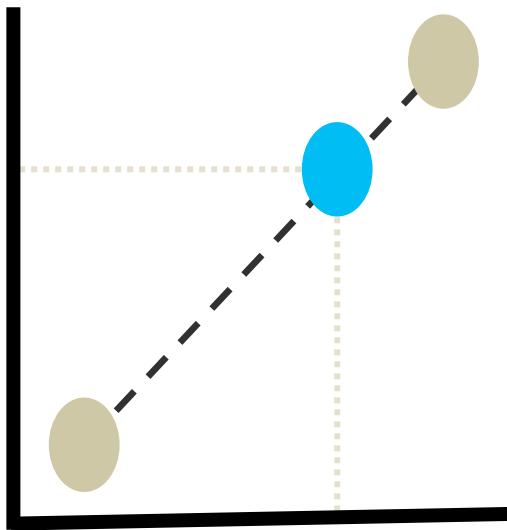


Linear Interpolation

Given 2+ points, get a **y** value for a given **x**

OR

Solve for **x**

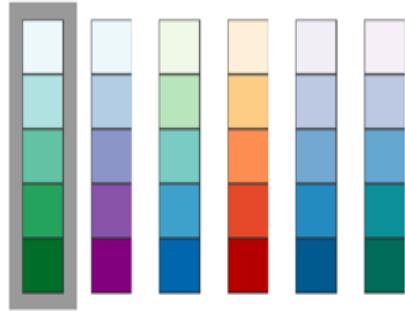




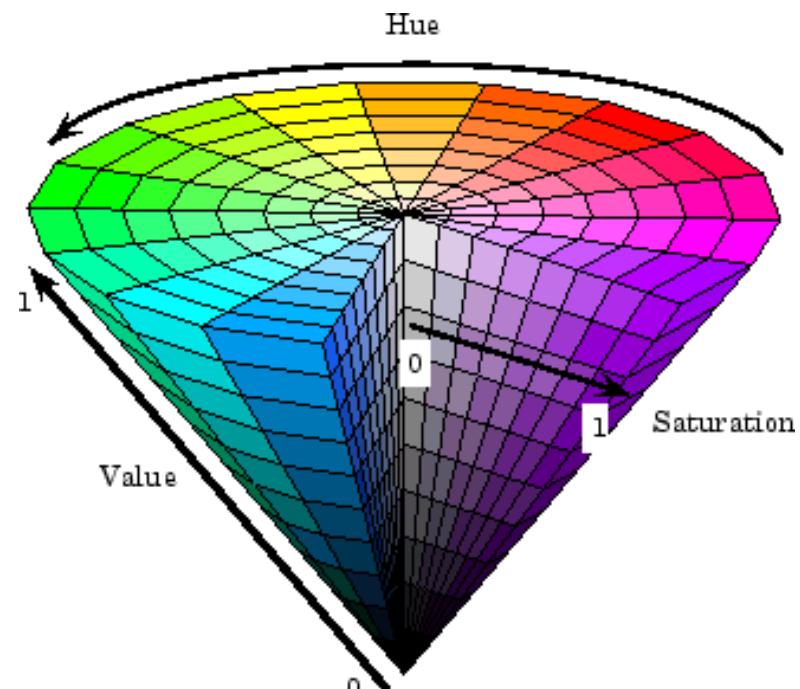
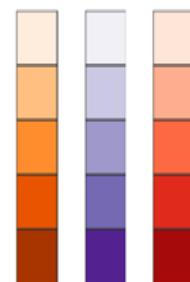
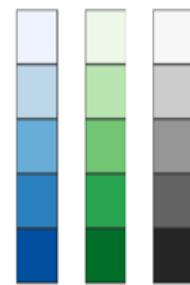
Design strategies for sequential scales

- Best to primarily vary value or saturation
- Only small changes in hue

Multi-hue:



Single hue:



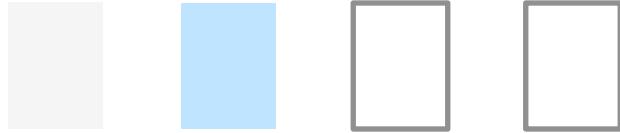


Sequential palette example

Step 1: pick a color you want to represent the scale's maximum

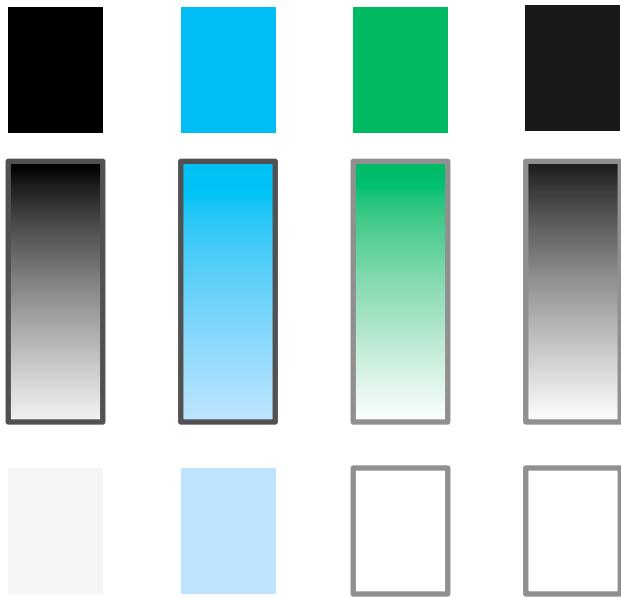
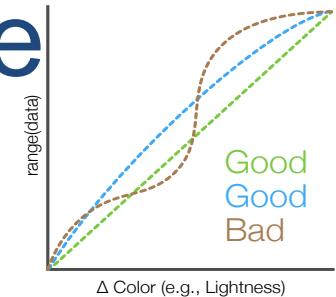


Step 2: pick a neutral color you want to represent the min

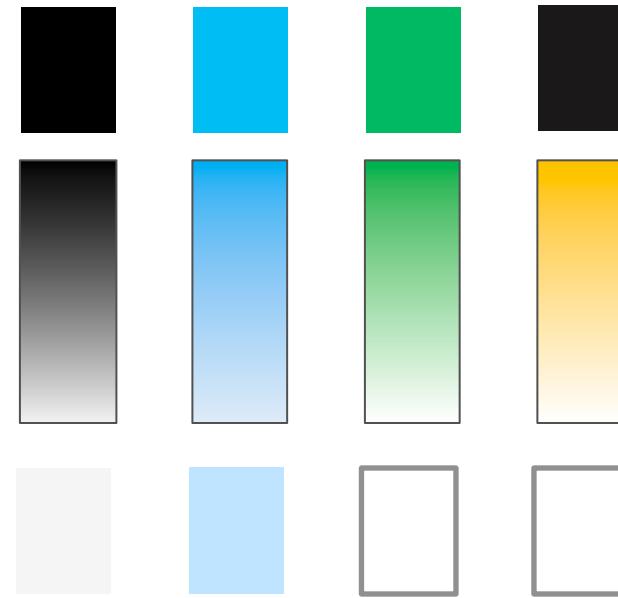


Sequential palette example

Step 3: interpolate between the two points



RGB



CIE Lab

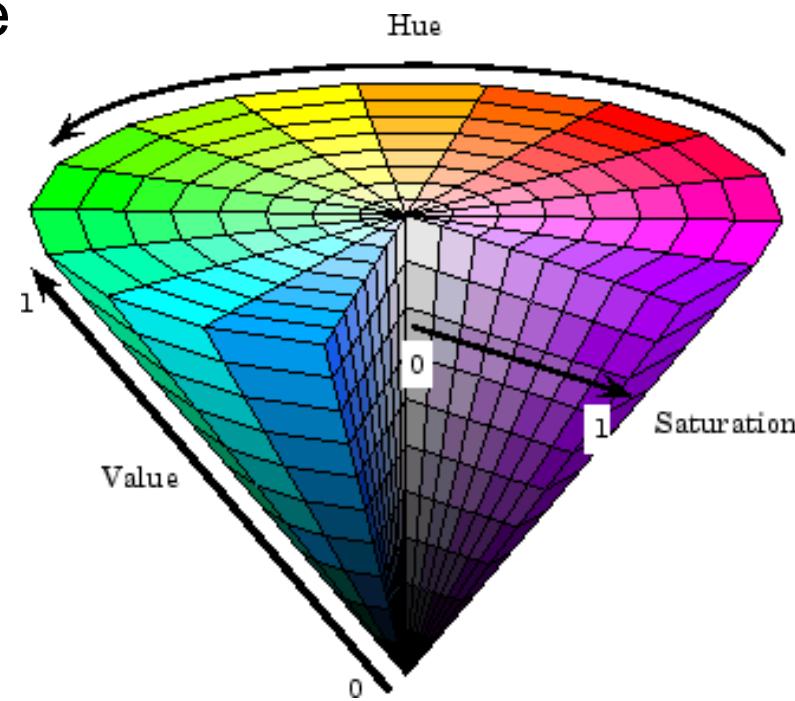
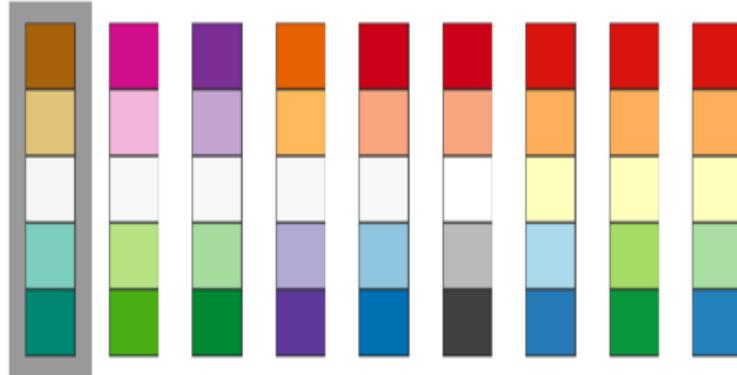


Design strategies for diverging scales

Endpoints should have same/similar
value + saturation

Focus on changing saturation + hue

Neutral = 0'ish saturation





Continuous scale types

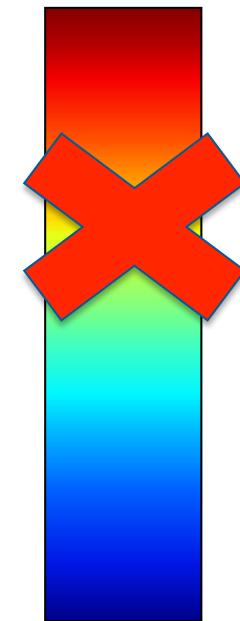
Sequential



Diverging



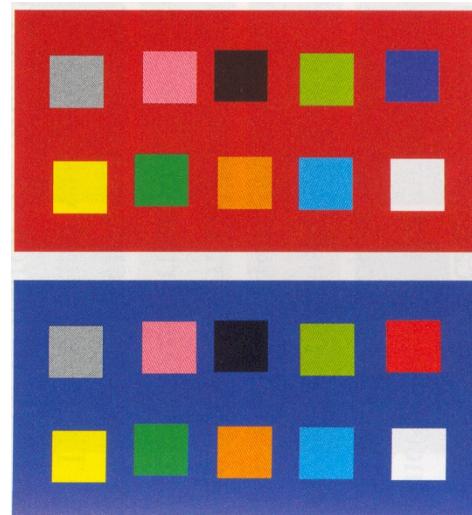
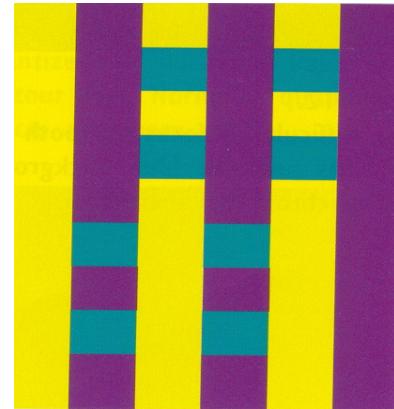
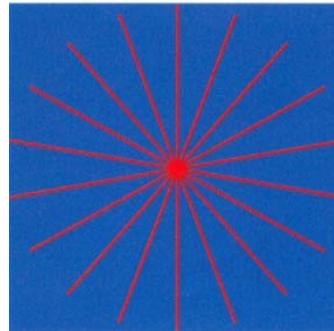
Rainbow



Don't use rainbow colormaps

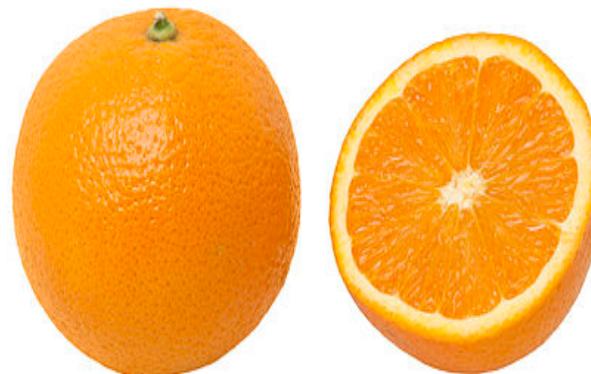
Avoid Color on Color

- Simultaneous contrast
- Depth of field varies with wavelength
 - Low intensity leads to vibrating edges
- Low density of S cones
 - Avoid blue edges



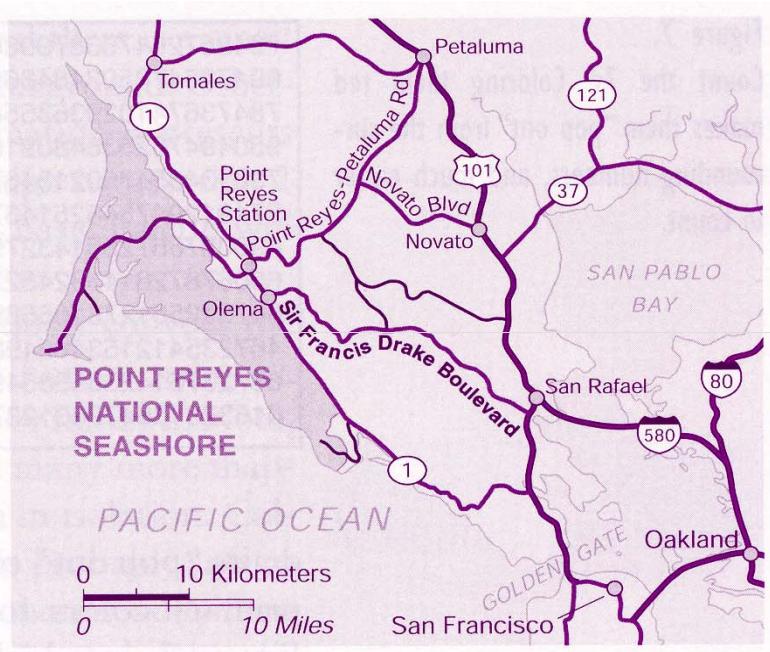
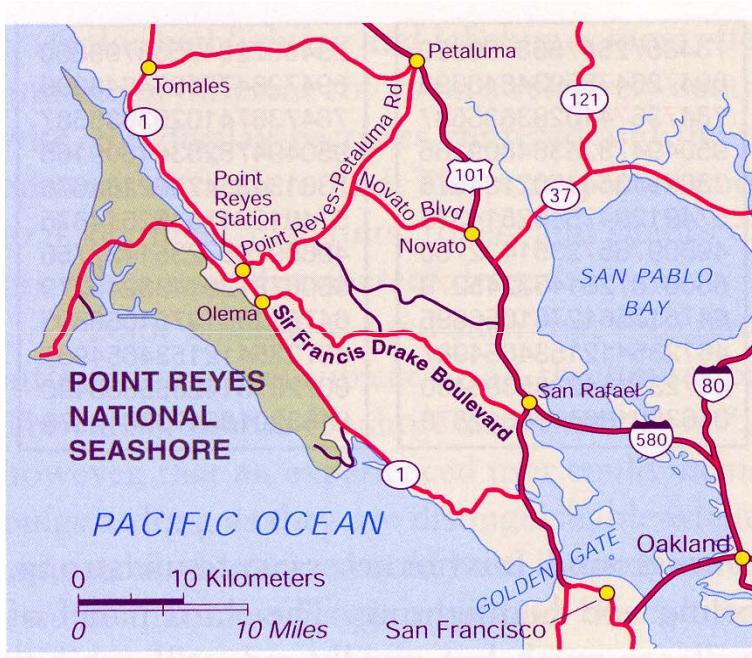


Color-semantic association





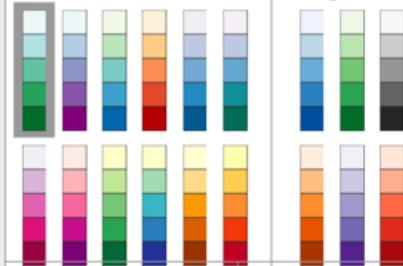
Color to Labels



Color Selection Tools

Number of data classes: 3

Nature of your data:
 sequential diverging qualitative

Pick a color scheme:
Multi-hue: 
Single hue: 

Only show:
 colorblind safe
 print friendly
 photocopy safe

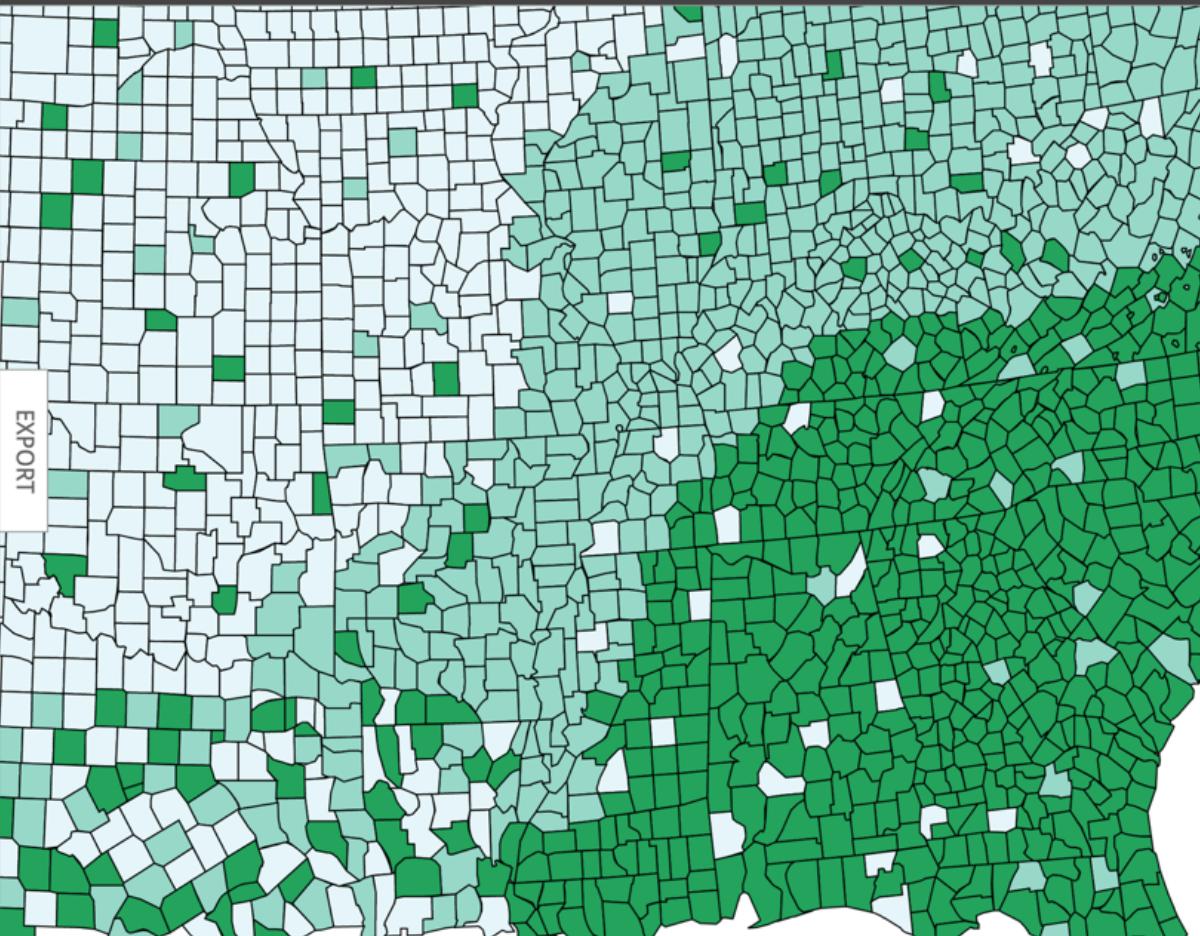
Context:
 roads
 cities
 borders

Background:
 solid color 
 terrain 

color transparency 

how to use | updates | downloads | credits

COLORBREWER 2.0
color advice for cartography



3-class BuGn

EXPORT

HEX

#e5f5f9
#99d8c9
#2ca25f

Color Selection Tools

The screenshot shows the COLOURlovers website interface. At the top, there's a navigation bar with links for 'Browse', 'Community', 'Channels', 'Trends', and 'Tools'. A search bar and a 'Create' button are also at the top. The main content area features a section titled 'Explore Over a Million Color Palettes' with a sub-section for 'Browse Palettes'. This section displays several color palettes with names like 'Breathe', 'jumpy', 'Blue Plate Cupcake', 'A Touch Of Rust', 'scott and alex', 'imjustmessingbynaw', 'Sedium in the Fall', and 'whats up!!'. Each palette card includes a small preview, the number of 'LOVES' and 'COMMENTS', and a 'Search' button. To the right, there's a sidebar titled 'RECENT PALETTE COMMENTS' showing posts from users like 'illiwud' and 'syork' with their respective palette cards.



Colorblindness tools

The screenshot shows the paletton.com website interface. At the top, there's a navigation bar with 'paletton.com' and links for 'UNDO', 'REDO', 'RESET', 'RANDOMIZE...', and 'MORE INFO'. Below the navigation is a color wheel with various color swatches. A 'Triad (3-colors)' section is visible above the wheel. On the left, there are buttons for 'Hue: 358° opposite' and 'Dist: 66° default: 30°'. At the bottom of the wheel, it says 'Base RGB: A7383D' and 'Fine Tune...'. To the right of the wheel is a preview area showing a grid of colored squares. A warning icon at the bottom right indicates 'Simulation active: Deutanopia (1 % of men)'. The bottom navigation bar includes 'COLORS', 'PRESETS', 'PREVIEW', 'EXAMPLES...', and 'TABLES / EXPORT...'.

Color Oracle

Design for the Color Impaired

Color Oracle is a free color blindness simulator for Window, Mac and Linux. It takes the guesswork out of designing for color blindness by showing you in real time what people with common color vision impairments will see.

Color Oracle applies a full screen color filter to art you are designing – independently of the software in use. Eight percent of all males are affected by color vision impairment – make sure that your graphical work is readable by the widest possible audience.

Read this article for more information: [Color Design for the Color Vision Impaired](#)

Authors

Programming: Bernhard Jenny, Oregon State University.
Ideas, testing and icon: Nathaniel Vaughn Kelso, Stamen Design, San Francisco.



Summary

- Color theory
- Color spaces (RGB, HSI/HSV, L*a*b*)
- Don't use rainbow colormap
- Be careful with diverging continuous scale design



JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

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