Human-Computer Interaction

2024/2025

Lecture 8

Screen Design and Colour

Screen Design and Colour

Beatriz Sousa Santos 2025

- The screen design is an important part of the UI development

- A poor screen design may degrade user performance

- Screen layout must be carefully designed

- There are numerous guidelines (we have seen already some of them)

Screen Layout Guidelines

- Several types:

  General layout of information

  messages

  Text

  instructions

  Numbers

  Coding techniques (colour and others)

Information layout

- Include only the needed information

- Include all needed information

- Begin at the top left corner and align left (in Western culture)

- Group items according to type

- Leave plenty of white space

- Use leaders in multiple columns
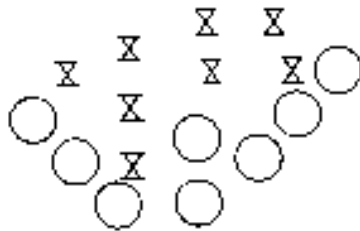
- This is related to how humans
  analyse an image

Boxes to group logical items
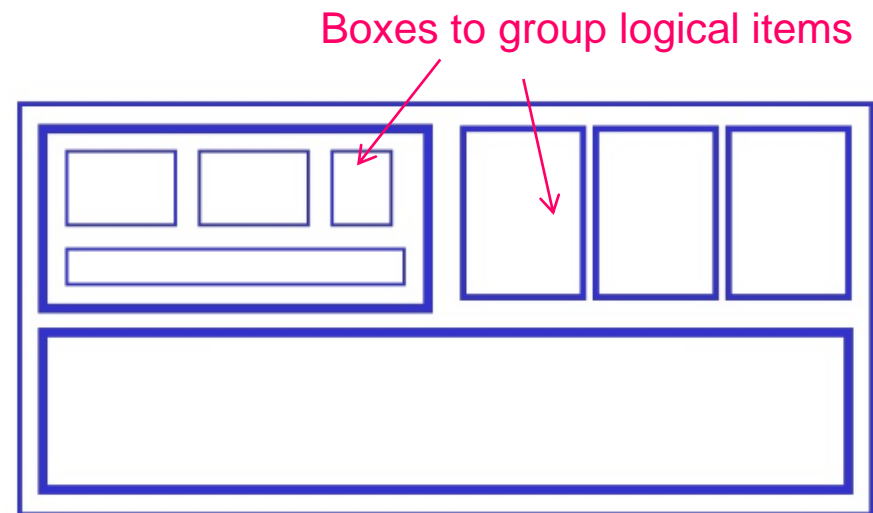
Gestalt "Laws"

Help understand how visual stimuli in a scene are perceived
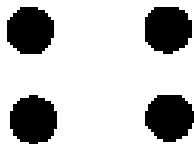
Proximity

Near stimuli are perceived as a group

Similarity

Similar stimuli tend to be grouped (may override proximity)

Closure

Stimuli tend to be grouped in complete figures

Simplicity

Ambiguous stimuli tend to be resolved Using the simplest explanation
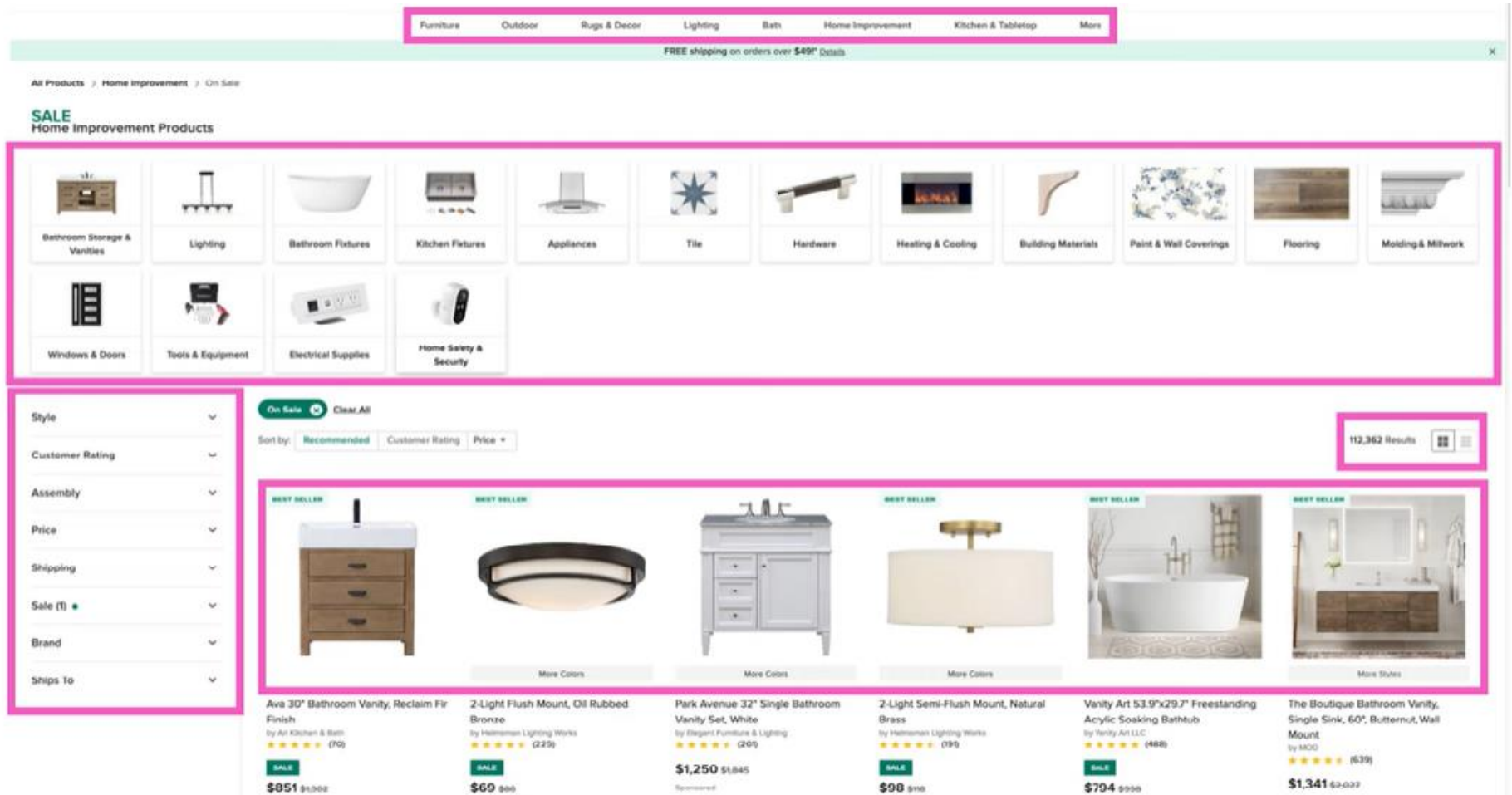
Good continuation

Stimuli tend to be grouped as to minimize variations or discontinuities

Symmetry

Regions delimited by symmetric tend to be perceived as coherent figures

What are the Gestalt Principles? | IxDF

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Gestalt Laws applied in screen layout design

The Gestalt Principles for User Interface Design (Video)
Similarity: Gestalt Principle for User Interface Design

Some simple rules for screen design

What is similar should be together

Billing details:
Name
Address: …
Credit card no
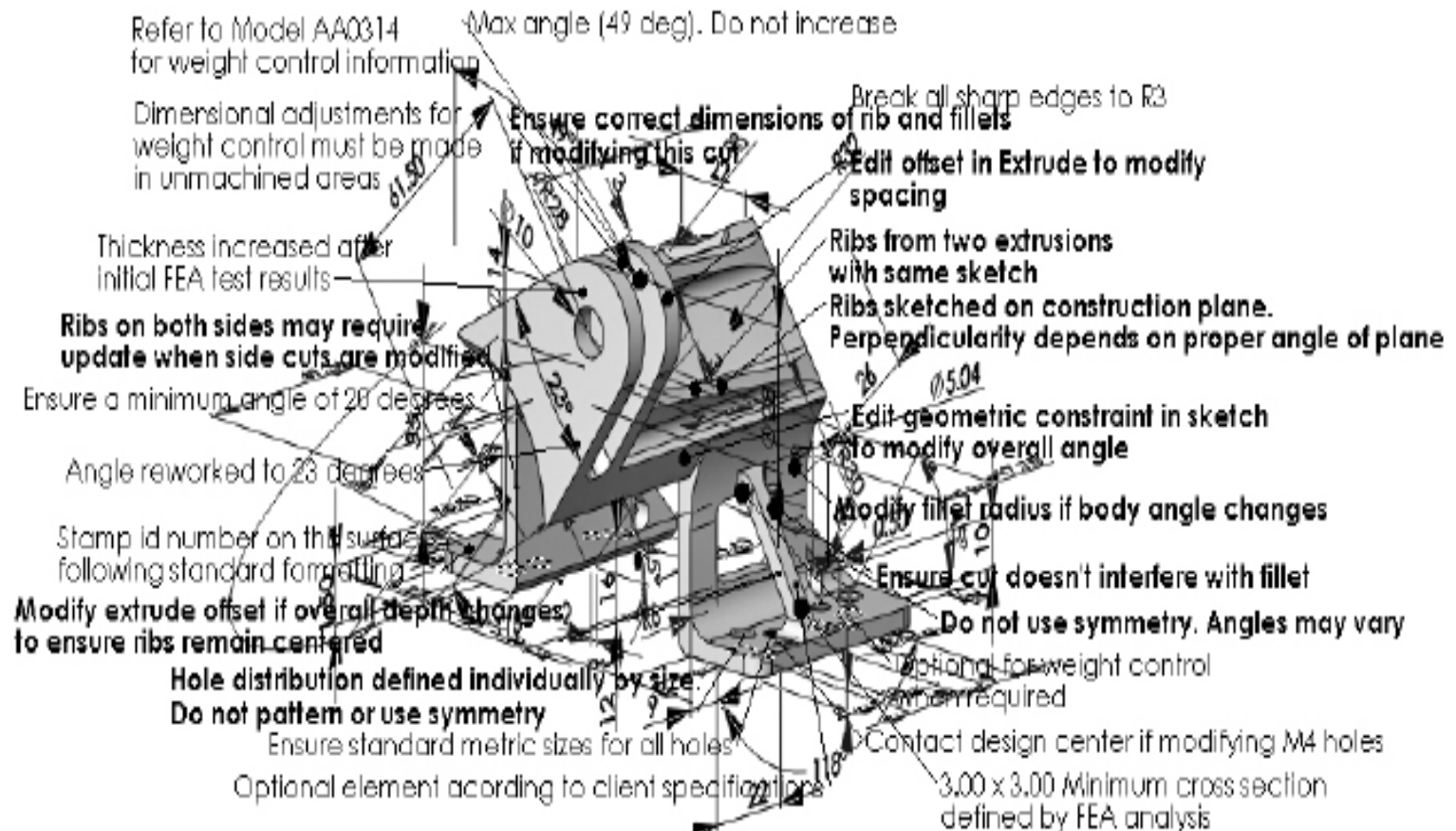
Delivery details:
Name
Address: …
Delivery time

Order details:

item	quantity	cost/item	cost
size 10 screws (boxes)	7	3.71	25.97
……	…	…	…

Include only the needed information

Avoid Visual Clutter

Text

- Avoid using only capital letters (are more difficult to read)

- Avoid text with many capital letters

- Do not use too many fonts for emphasis

- In multiple columns use leaders or greying

use fonts for emphasis
(but not too many)

ABCDEF HIJKLM
NOPQRSTUVWXYZ

Alcântara - Terra				12:36			13:06				13:36	
Campolide		12:15		12:41	12:45		13:11	13:15			13:41	13:45
Rossio		12:19			12:49			13:19				13:49
Sete Rios			12:19	12:43		12:49	13:13			13:19	13:43	
Entrecampos			12:22	12:47		12:52	13:17			13:22	13:47	
Roma - Areeiro			12:24	12:49		12:54	13:19			13:24	13:49	

Use greying

Willy Wonka and the Chocolate Factory
Winston Churchill - A Biography
Wizard of Oz
Xena - Warrior Princess

Left aligned: more readable

Willy Wonka and the Chocolate Factory
Winston Churchill - A Biography
Wizard of Oz
Xena - Warrior Princess

Right aligned: fine for effects
But more difficult to read

In multiple columns it is difficult to read across gaps:

sherbert	75
toffee	120
chocolate	35
fruit gums	27
coconut dreams	85

use leaders

sherbert ————————————————	75
toffee ————————————————	120
chocolate ————————————————	35
fruit gums ————————————————	27
coconut dreams ————————————————	85

or greying

sherbert	75
toffee	120
chocolate	35
fruit gums	27
coconut dreams	85

- Messages shall:

  - Have a detail level adequate to user knowledge and experience

  - Be specific and understandable

  - Be brief and concise

  - Be positive

  - Be helpful

Error messages

better

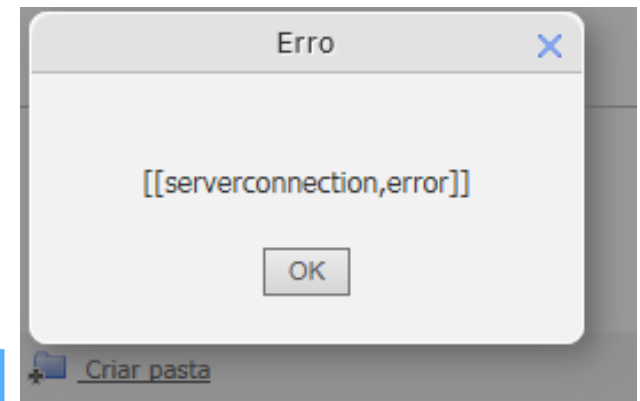|	
The processing of the text editor yielded 23 pages of output	Output 23 pages
Error in SIZE field	Error: SIZE range is 4 to 16
Cannot exit before saving file	Save file before exiting
Bad/illegal file name	Maximum file name length is 8 chars
Syntax error 1542	Unmatched left parenthesis in line 210

Too vague

Negative

Not helpful

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Examples of useless messages for users

Foxit Reader Updater

遇到不适当的参数。

OK

(Except for Chinese speaking people!)

Windows 10 Setup

Something happened

Something happened

Close

Failed to print document

Printing is not supported on this printer.

Close

Moodle:

Erro

[[serverconnection,error]]

OK

Criar pasta

presentation dates

edição

Erro

String JSON inválida

OK

neiro ...   Criar pasta
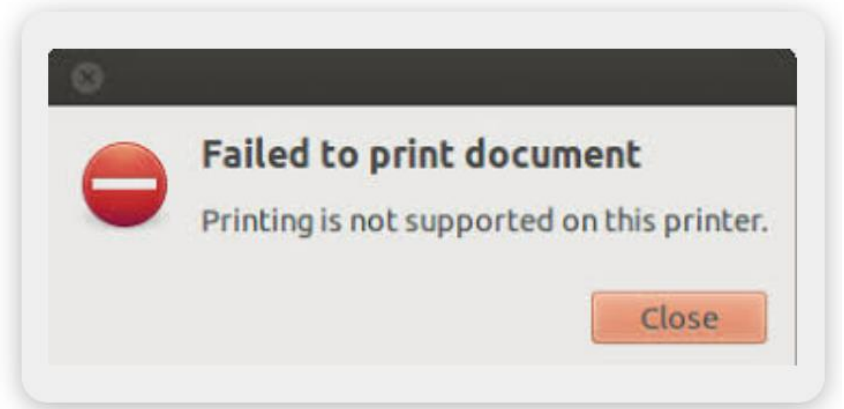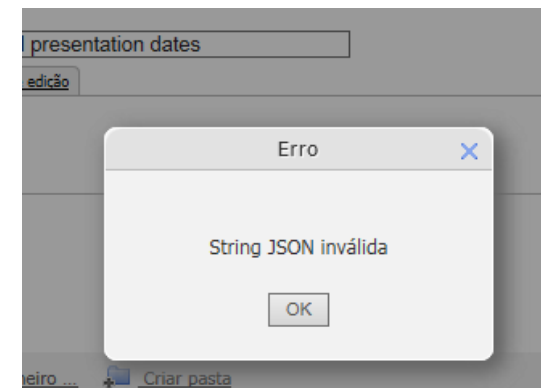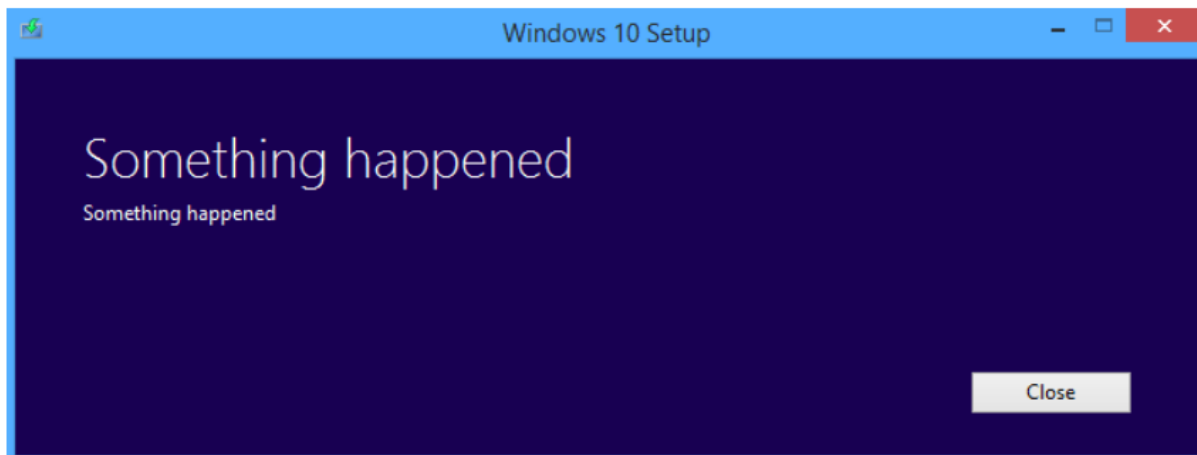
Numbers

- Integers shall be right justified

- Real numbers shall be aligned by the decimal point

- Avoid unnecessary zeros (at left)

- Long numbers shall be divided in groups

Which is the largest?

532.56	627.865	
179.3	1.005763	75
256.317	382.583	120
15	2502.56	35
73.948	432.935	27
1035	2.0175	85
3.142	652.87	
497.6256	56.34	Right align integers

Align decimal points

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Numbers

Better

10 100 1000 10000	10 100 1000 10000
100.00 25.365 5432.01 1.45591	100.00 25.365 5432.01 1.45591
10:1 p.m. 002	10:02 p.m. 2
6173954686	617-395-4686

Coding techniques

Blinking

Bold

Size

Font

Underlining

Shape

Special characters and icons

Proximity

Borders

Sound

Colour

Main guideline: use parsimoniously any coding technique!

5 Important Factors of Control Room Display Wall Design

What about large screens?

Visual ergonomics: large format screens or multidisplay | GESAB

Specific problems for large displays

Designing for large screens may be different due:

Size

Viewing angle

Viewing distance

…

Screen layout for large displays: some guidelines

Take Advantage of the Extra Space:

       Show More Content

       Multi-Column Layouts

       Larger margins and fonts

Prioritize Information Hierarchy is important:

       Visual Composition

       Group Related Elements

       Ensure Reachability

Motion and Animations: slower for larger distances

Revolution in the Cockpit: Mercedes-Benz UX
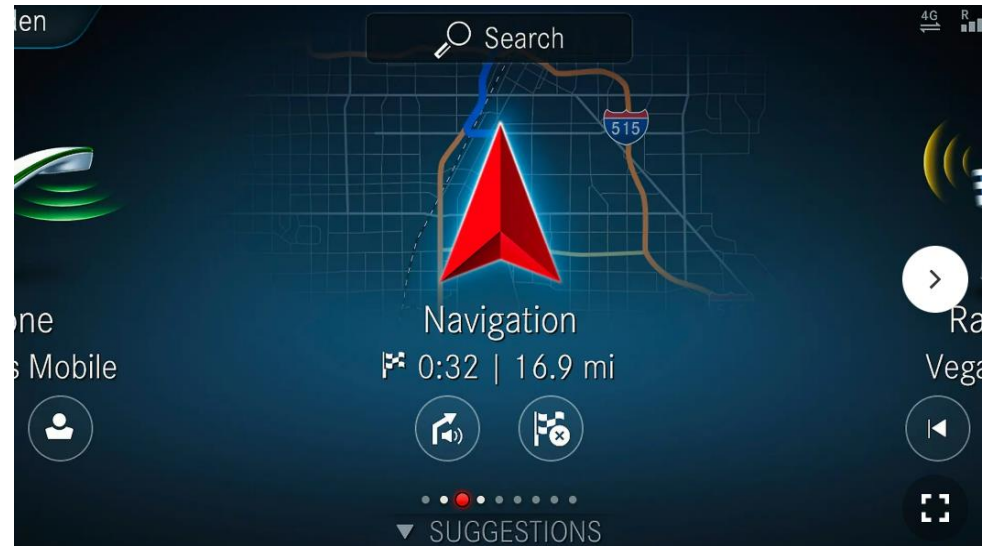
What about specific platforms?

The Role of Wearable Devices in Monitoring Health

Specific issues for different platforms: mobile

- Many guidelines are similar for mobile and desktop design, but their mobile interpretation is **much more unforgiving**

  - Context of use
  - Size of screen
  - Platform limitations

- There are guidelines for different platforms

Design & Plan | Android Developers

UI Design Dos and Don'ts - Apple Developer

Mobile UX Sharpens Usability Guidelines
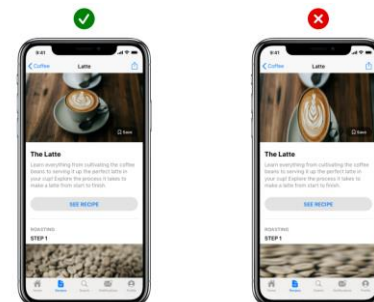
Specific issues for different platforms: wearable

Designing for wearables: some rules:

       Glanceability

       Keep it simple

       Minimalistic interface

…

Remember also:

Privacy and Wireless connectivity

Designing for wearables: 7 rules and best practicesl

A critical situation: automotive dashboards

The Tesla case:
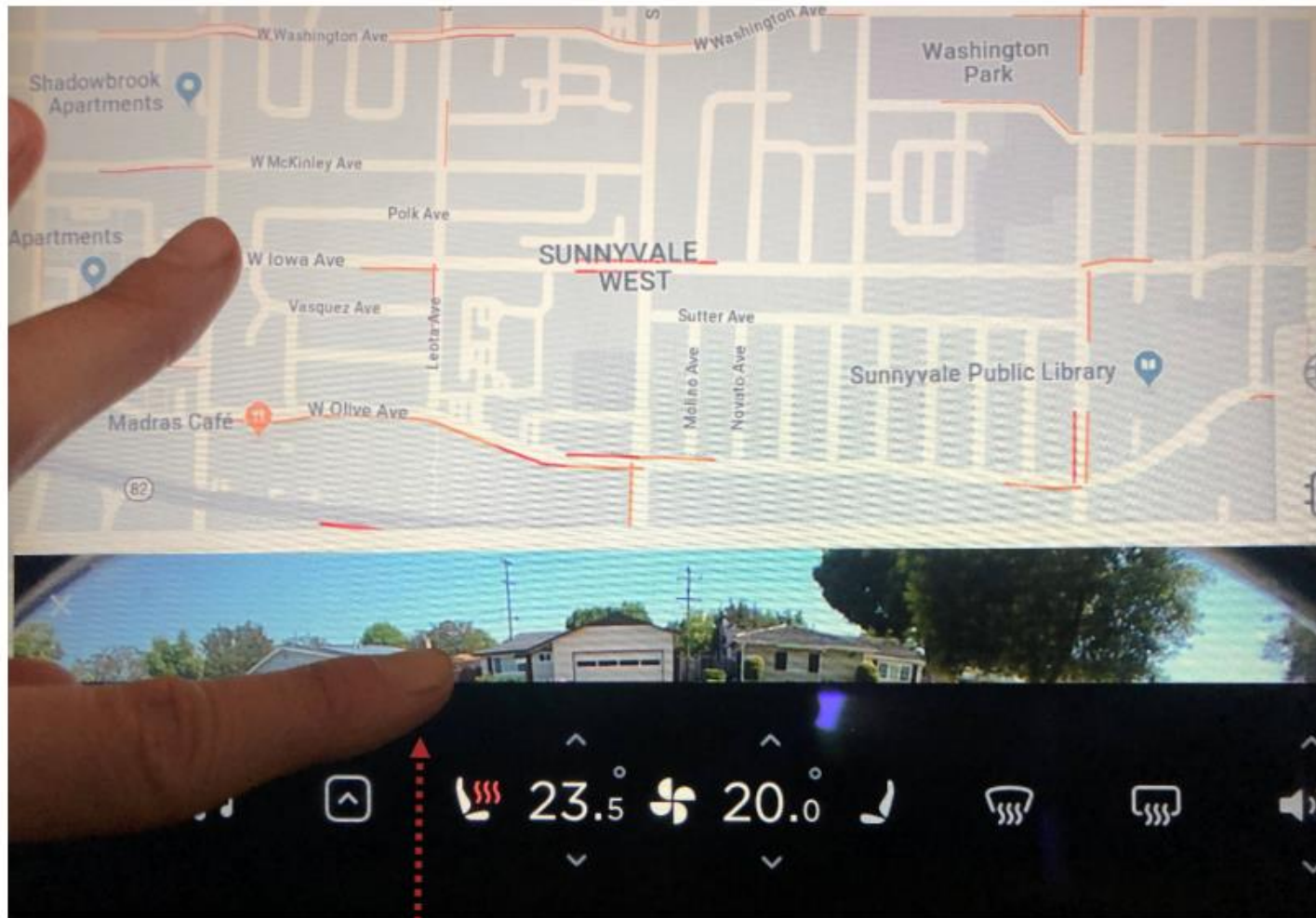
[Tesla's Touchscreen UI: A Case Study of Car-Dashboard User Interface](#)

"Manufacturers need to examine whether their incar display strategies … are sacrificing other critical automobile functions, particularly safety."

Interface-Driven Customer Experience: Redefining User Interface (UI) Design for Automotive Infotainment System | IEEE Journals & Magazine | IEEE Xplore

Driver's usage[b]

Primary task:
Driving
(Visual attention &
hand/foot movements)

AND

Secondary task:
Interface navigation
(Visual attention &
hand movements)

Diverted visual attention
/ Increased risks of
accidents

Colour usage
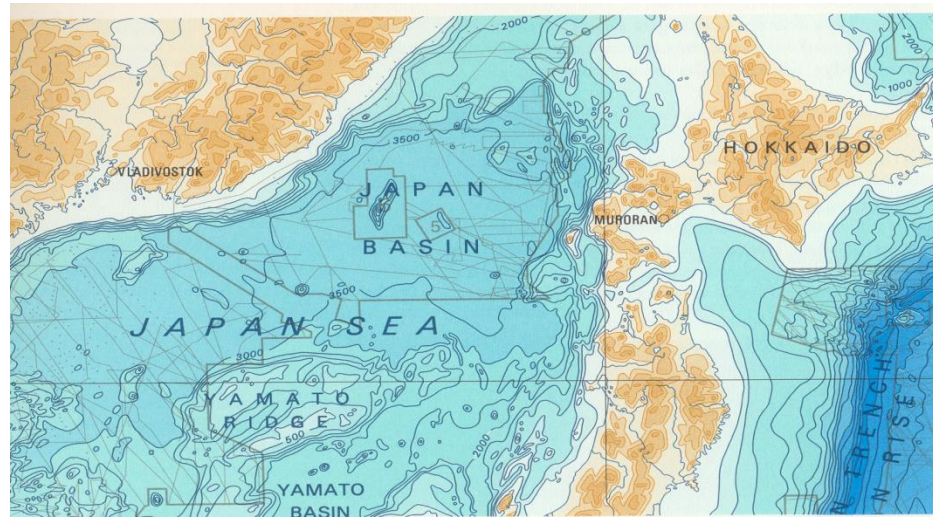
Colour

- Colour is a **complex and multidisciplinary** subject:
  - Physics
  - Physiology and psychology
  - Art and graphic design
  - Interactive systems design

- The perceived colour of an object depends on the:
  - Material characteristics
  - Illumination
  - Ambient colour
  - Human visual system
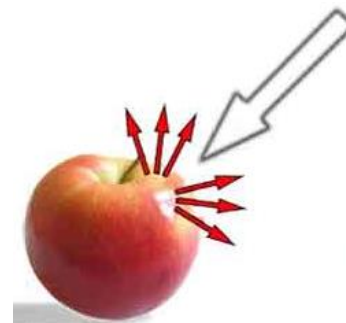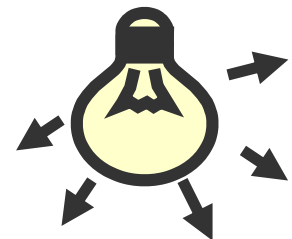
How many cherries?

(Ware, 2004)

How many cherries?

Colour may support users in many tasks!
(yet, if not properly used may make them more difficult!)

Using colour

Besides increasing realism, it may have the following **advantages**:

It may:

- Show the logical organization of the information displayed

- Ease the search in complex displays

- Represent approximate values

- Catch the attention

- Increase satisfaction

- Trigger emotions

…

However, **it may degrade user's performance** if not used properly

Guidelines for using colour

- **Use colour parsimoniously**

- Use a limited number of colours

- Firstly make it work without colour

- Use colour coherently

- Avoid using simultaneously several saturated colours

- Do not convey information solely through colour

- Make colour coding support the user task

- Make the colour coding as obvious as possible

- Take into account the cultural meaning of colours   …

Take into account the cultural meaning of colours
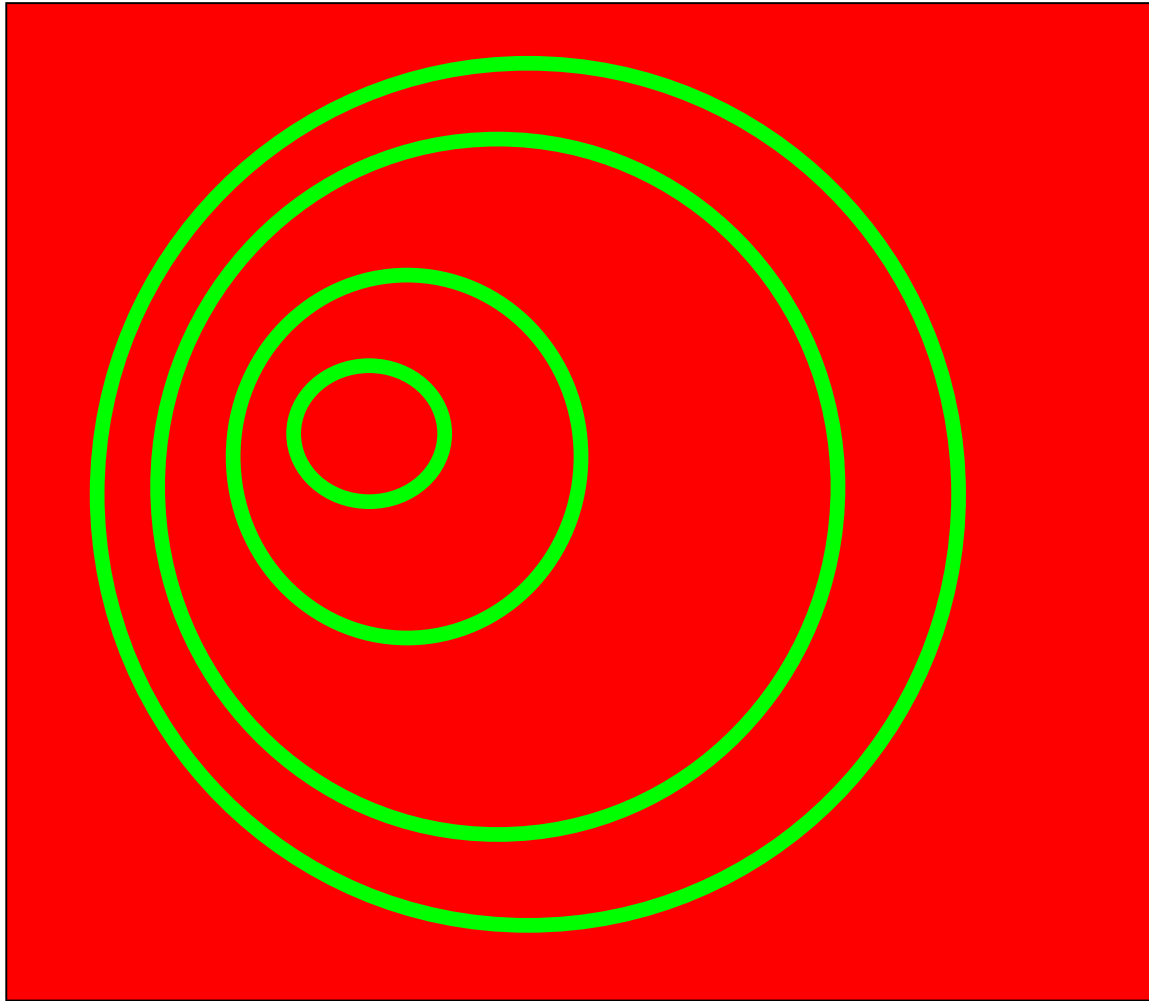
Saturated complementary colours should not be used simultaneously

Small spots of colour on a neutral background enhance relevant information

- Do not expect to perceive order from colour

  (Borland, Taylor II, 2007)
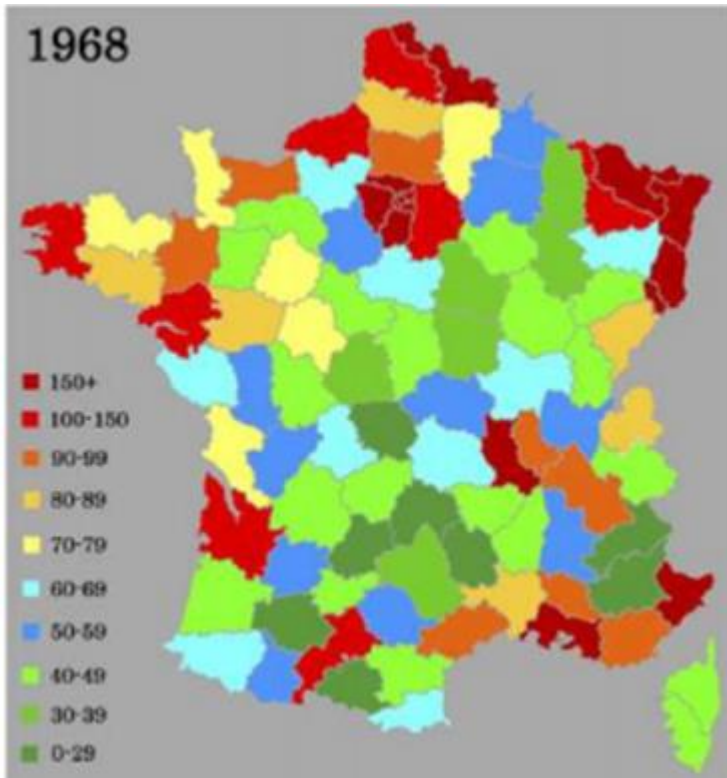

(a)

(b)
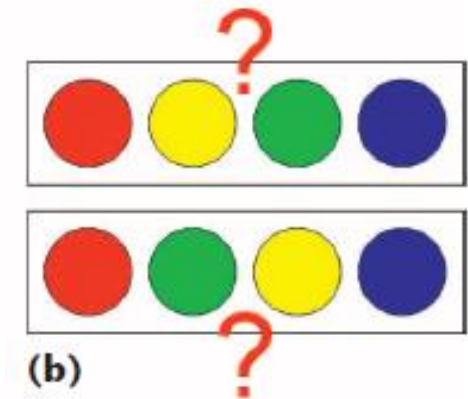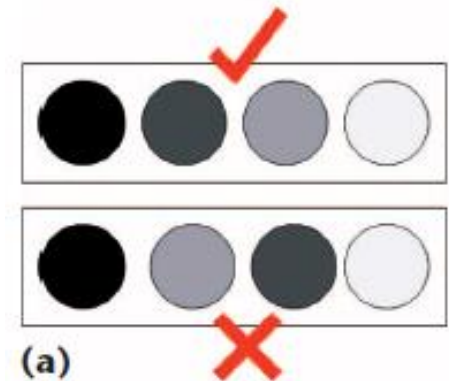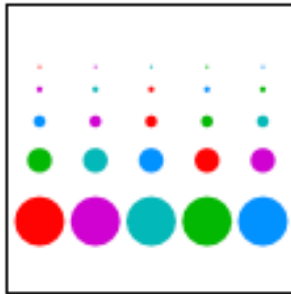
Don't use colour coding on small elements
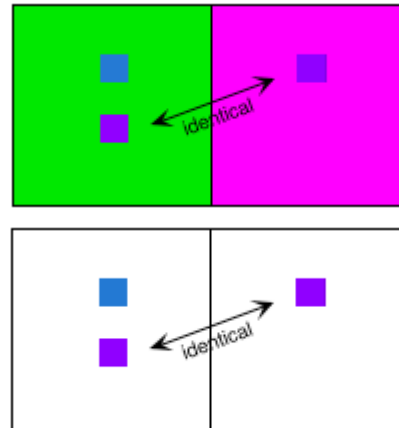
Use neutral gray surrounds where colour judgments are critical.

Colour may not help or even **make it more difficult**!

A **B**
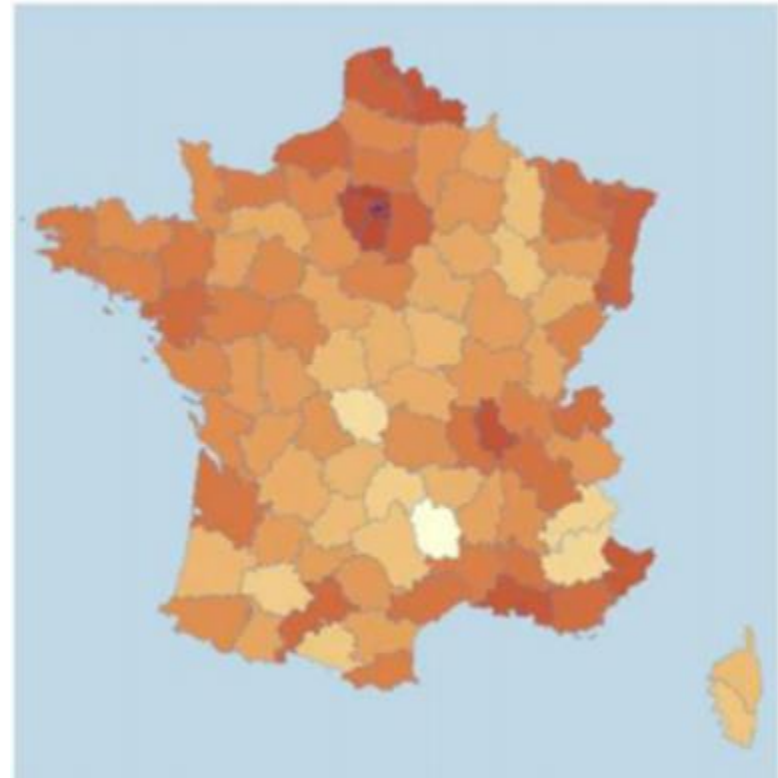
A- no preattentive association that allows efficiently determine the values (Kirk, 2012)

B- a single hue and a sequential colour scheme representing values in an immediately understandable way

Colour scales: Qualitative colour scales to distinguish items or groups

Okabe Ito

ColorBrewer Dark2

ggplot2 hue

Colours are chosen to be clearly distinct
and not stand out relative to others

Fundamentals of Data Visualization
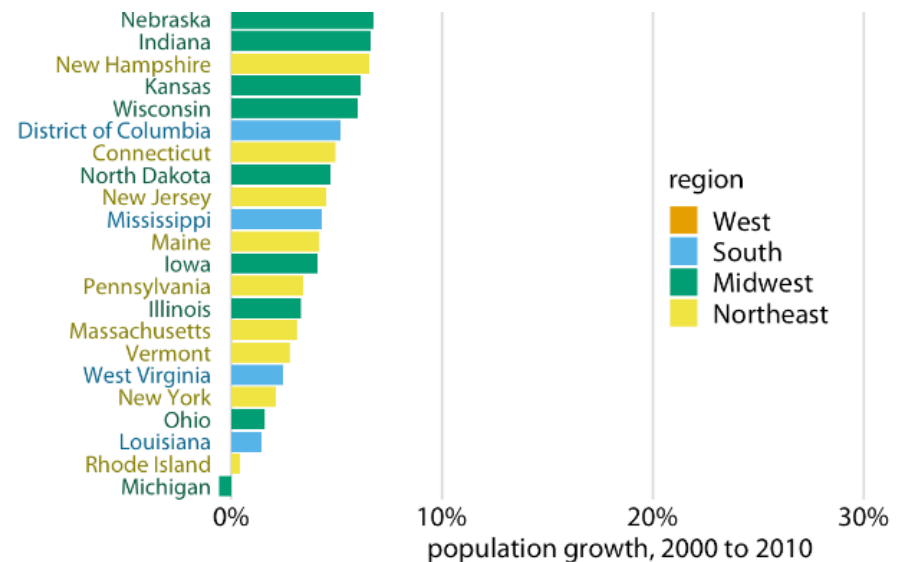
Sequential colour scales to represent quantitative values

ColorBrewer Blues

Heat

CARTO Earth

Blue-Red

monochrome

diverging

colours should indicate which values are larger or smaller, and how distant two specific values are from each other, may be monochrome, diverging …

Fundamentals of Data Visualization

Colour Vision deficiencies

- ≈ 8% of men and 1% of women have some type of colour vision deficiency

- Generally it is genetic (associated to the X chromosome)

- Common deficiencies are explained by the lack of cones (colour sensor cells in the retina) sensitive to the long and medium λ (dicromacies)):
  - Protanopia (LW – "Red" cone)
  - Deuteranopia (MW – "Green" cone) (Daltonism)

- There are three types of inherited deficiencies:
  - Monocromacy (disorder or lack of all colour sensitivity)
  - Dicromacy (disorder or lack of one type of cone)
  - Anomalous Tricromacy (disorder in cones)

Rainbow colours as viewed by people suffering from colour vision deficiencies

The colors of the rainbow as viewed by a person with no color vision deficiencies.

The colors of the rainbow as viewed by a person with protanopia.

The colors of the rainbow as viewed by a person with deuteranopia.

The colors of the rainbow as viewed by a person with tritanopia.
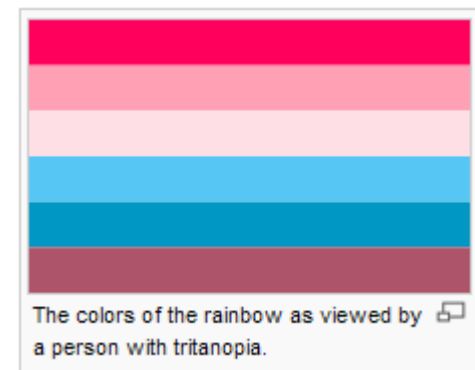
Color blindness - Wikipedia

Simulating colour vision deficiencies

Original image as seen
by a normal observer

As seen by a deuteranope
(daltonic)

Daltonize.org

Simulating colour vision deficiencies
Ishihara-2

Green-Blind/Deuteranopia

As seen by an observer with a colour vision deficiency:

Original image as seen by a normal observer

Red-Blind/Protanopia

Blue-Blind/Tritanopia

colour Blindness Simulator - Coblis
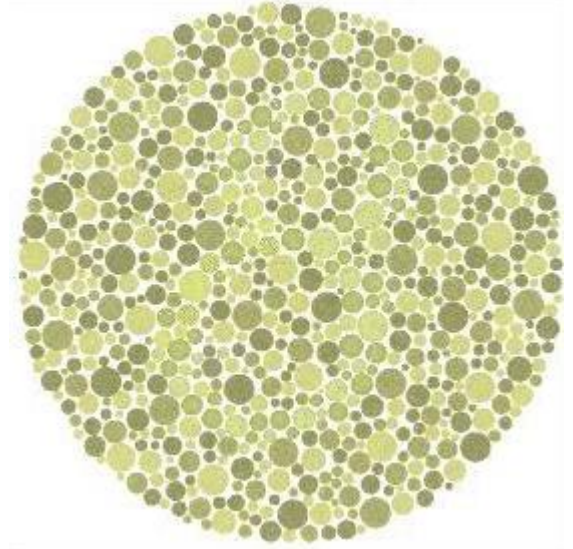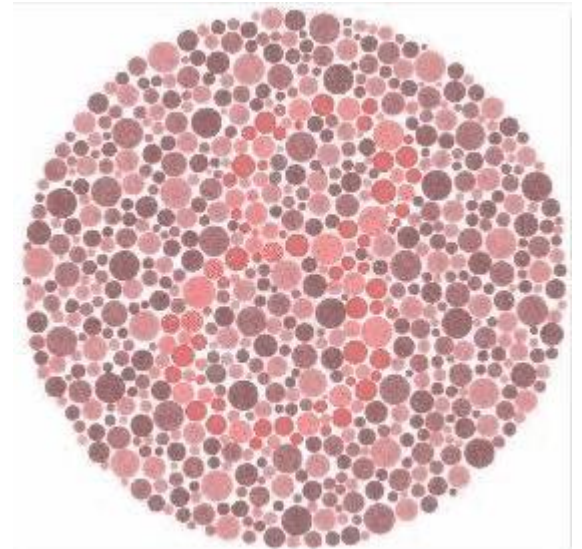
The elements within these sets look identical to deuteranopes, the most common kind of dichromat:

Set A

Set B
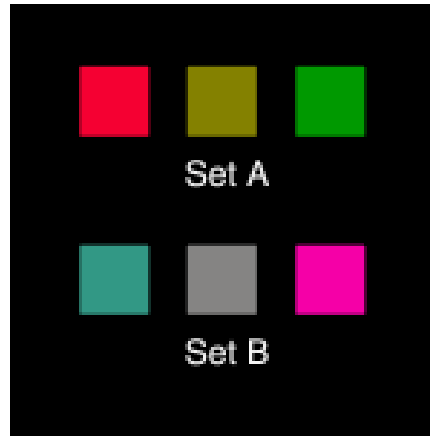
"Make it right in black and white": this will work even without colour

These can be discriminated on the basis of non-color differences:

Set A

Set B
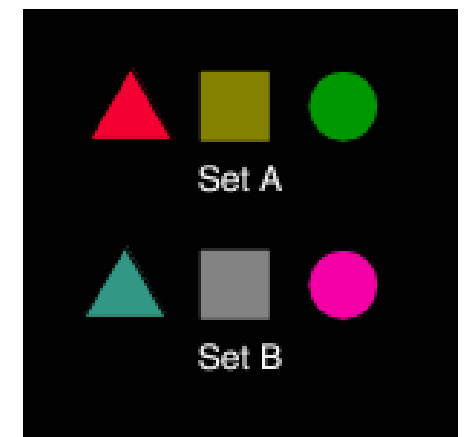
How can we describe colour experience?

- Colour perception happens in the mind due to light properties

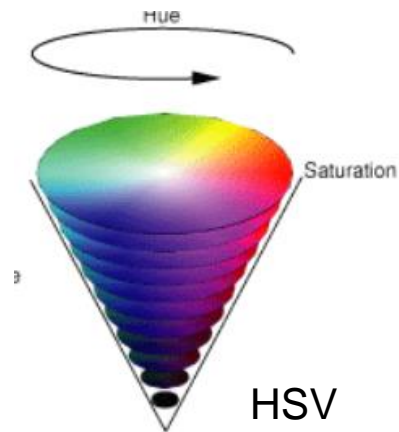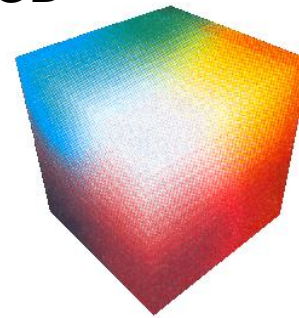- Different colour descriptions are necessary for:

light stimuli	**colour sensations**
external (physical)	$\longrightarrow$	subjective (mental)
photometry, colourimetry	colour attributes
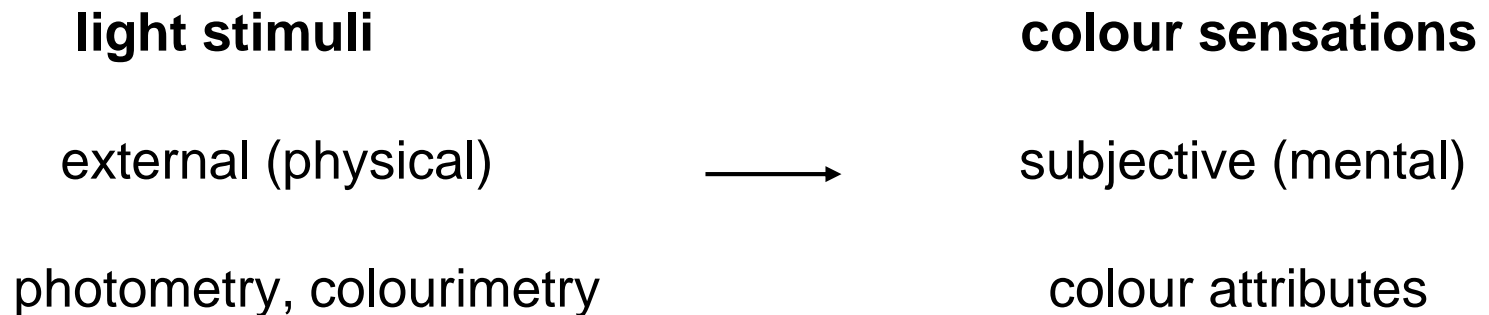
- **Colour models** allow describing colour objectively (very important in may situations)
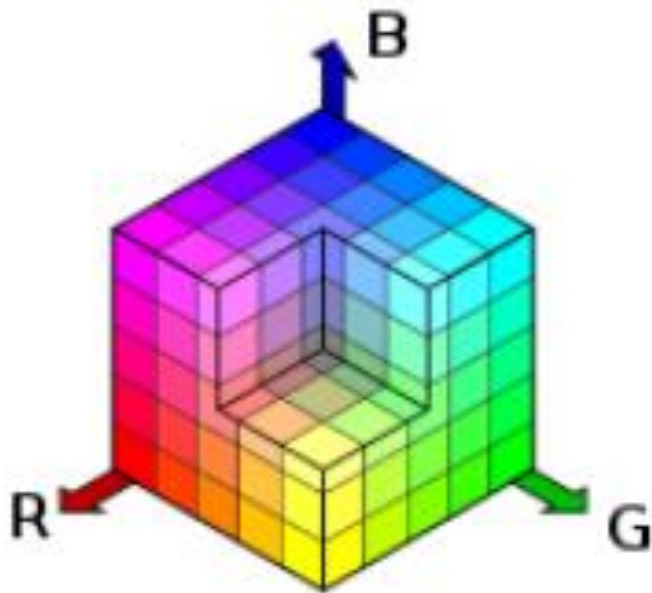
Colour Models

HLS

RGB

HSV
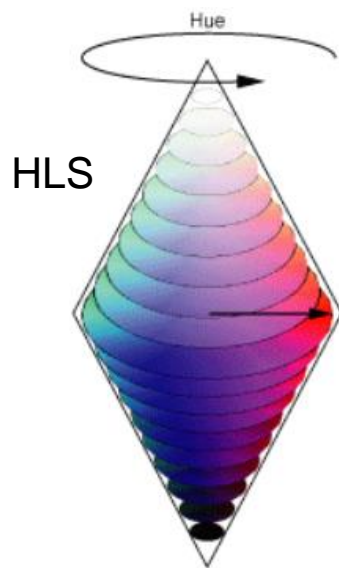
- Objects are perceived as having a colour depending on the spectrum of the reflected light (or emitted)

- But different spectra may induce similar colour sensations

- It is important to be able to describe colour objectively

- There are to types of colour production systems:

    - Additive (e.g.: monitors, TV sets, projectors)$\rightarrow$ RGB

    - Subtractive (e.g.: printers) $\rightarrow$ CMY

- **RGB** and **CMY** are **H/W oriented** colour models not adequate for users

- There are more colour models …

The RGB colour model:

The **RGB colour model** is
an additive colour model in
which red, green, and blue light (the
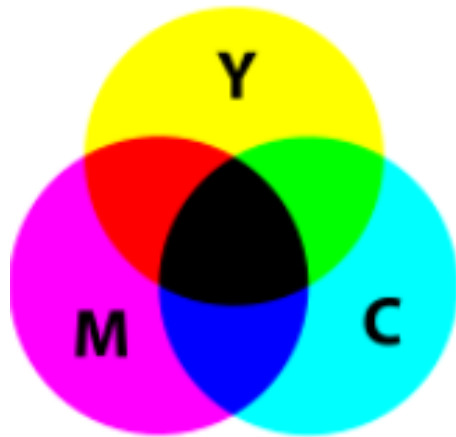primary colours) are added to reproduce a
broad array of colours.

The colour space is a cube in a Cartesian
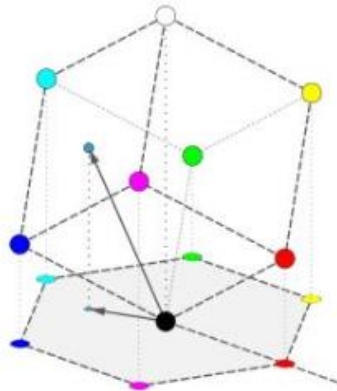coordinate system

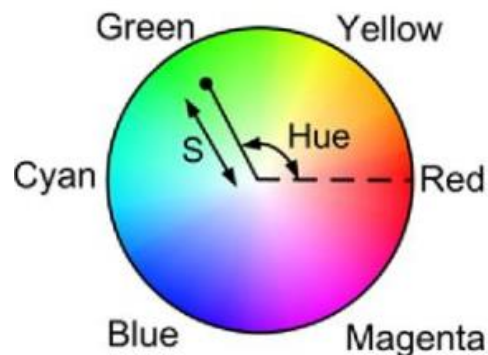White -> 1, 1, 1

Black -> 0, 0, 0

RGB colour model - Wikipedia

The **CMY colour model** is
a subtractive colour model in
which cyan, magenta, and yellow (the
primary colours) are subtracted from white to
reproduce a broad array of colours.

The colour space is also a cube in a
Cartesian coordinate system

White -> 0, 0, 0
Black -> 1, 1, 1

There are other models **more adequate to colour specification by the users**:
- **HSV**
- **HLS**

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- Humans describe colour based on 4 **psychophysical variables** related to physical variables:

  - **Hue** – the degree to which is similar to or different from stimuli that are described as red, green, blue, and yellow

  - **Saturation** – related to the amount of achromatic light

  - **Lightness** – related to the objects reflectance (for reflecting objects)

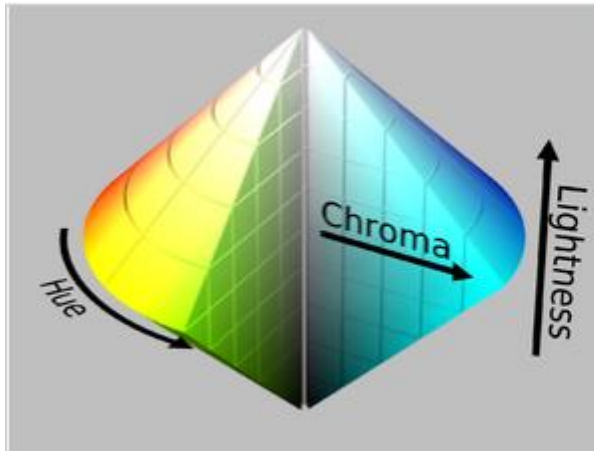 - **Brightness** – for light emitting objects

Hue - Wikipedia
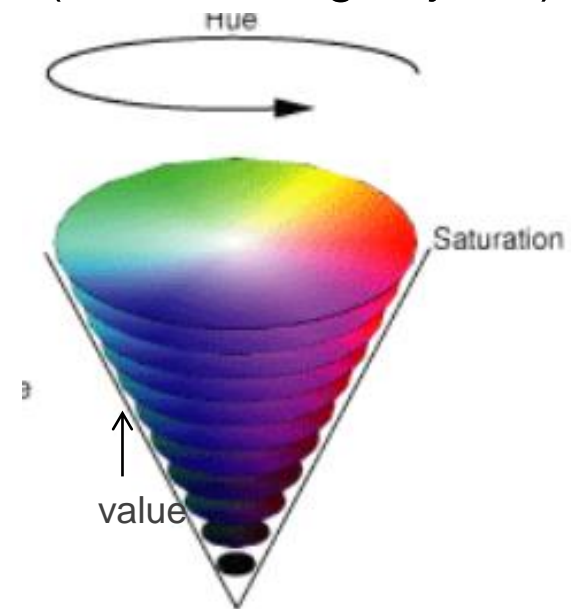
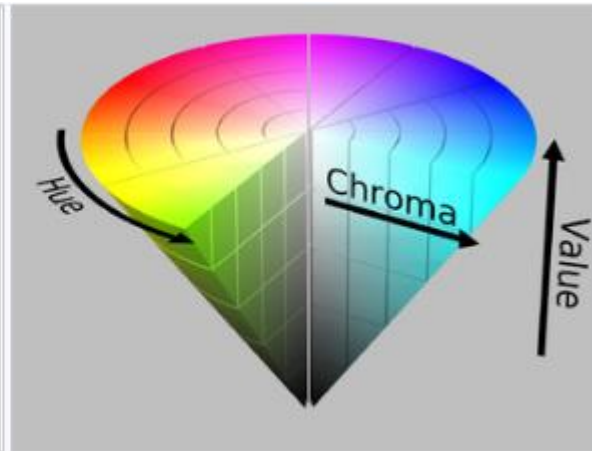- Two colour models more adequate for the users to select colour: HLS and HSV

Both use cylindrical coordinates, hue and saturation

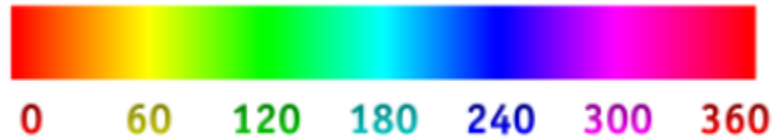HLS: more adequate to print   HSV: more adequate to screens

HLS   HSV

HSL and HSV – Wikipedia
colour models and colour spaces - Programming Design Systems
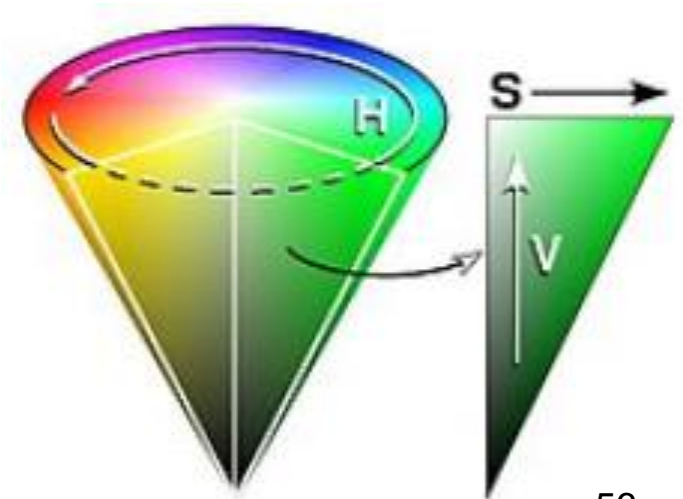
55

- HSV colour model:

  - Hue

  - Saturation – related to the amount of achromatic light

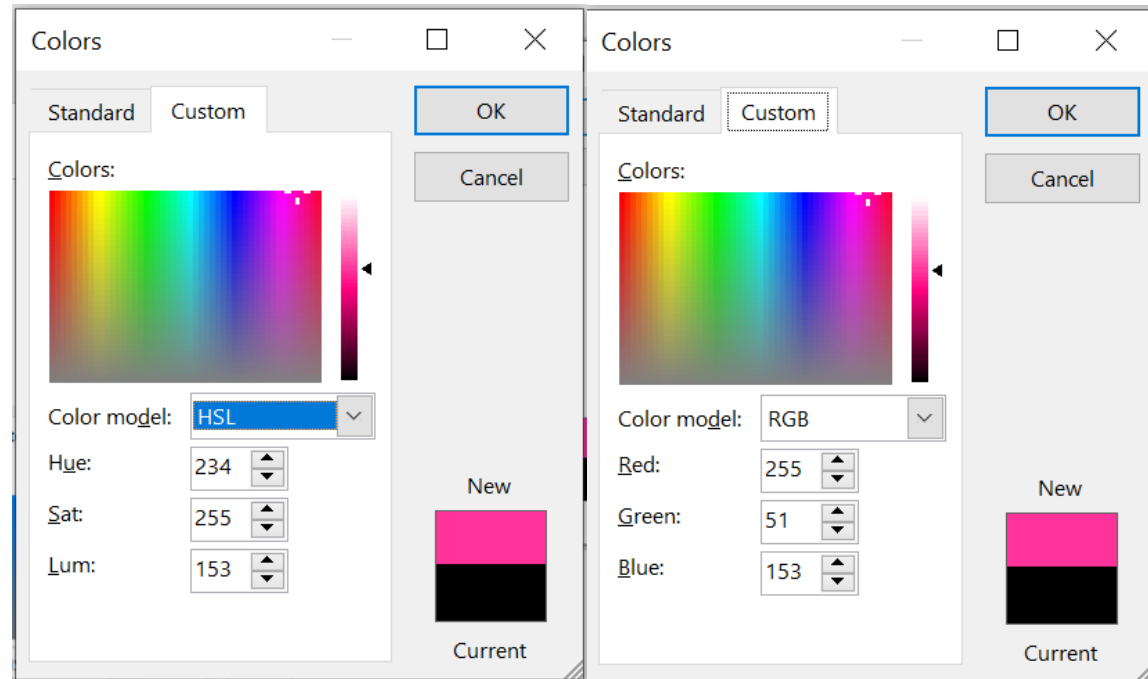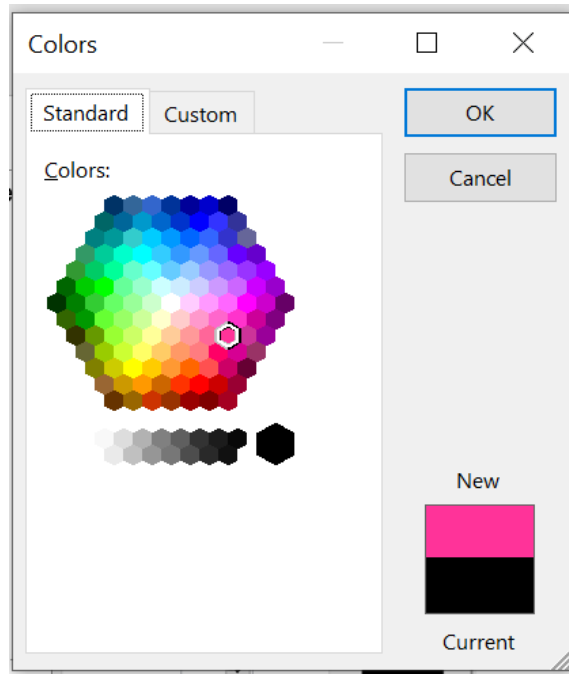 - Value - controls the brightness: 0% - pure black   100% - pure white

  Uses cylindrical coordinates

  HSL colour model (video) |
  colour science | Khan Academy

  colour models and colour spaces - Programming
  Design Systems

- To let the user select a colour:

Bibliography and links

J. Tidwell, A. Valencia, C. Brewer, Designing Interfaces: Patterns for Effective Interaction Design, 3rd edition, O'Reilly, 2020

Designing Interfaces, 3rd Edition[Book]

C. Wilke, Fundamentals of Data Visualization, O'Reilly, 2019 (Chap. 19)

19. Common Pitfalls of colour Use - Fundamentals of Data Visualization [Book]

What is User Interface (UI) Design? | IxDF

Designing for iOS | Apple Developer Documentation

Design & Plan | Android Developers

colour Guidelines, Standards, and Requirements