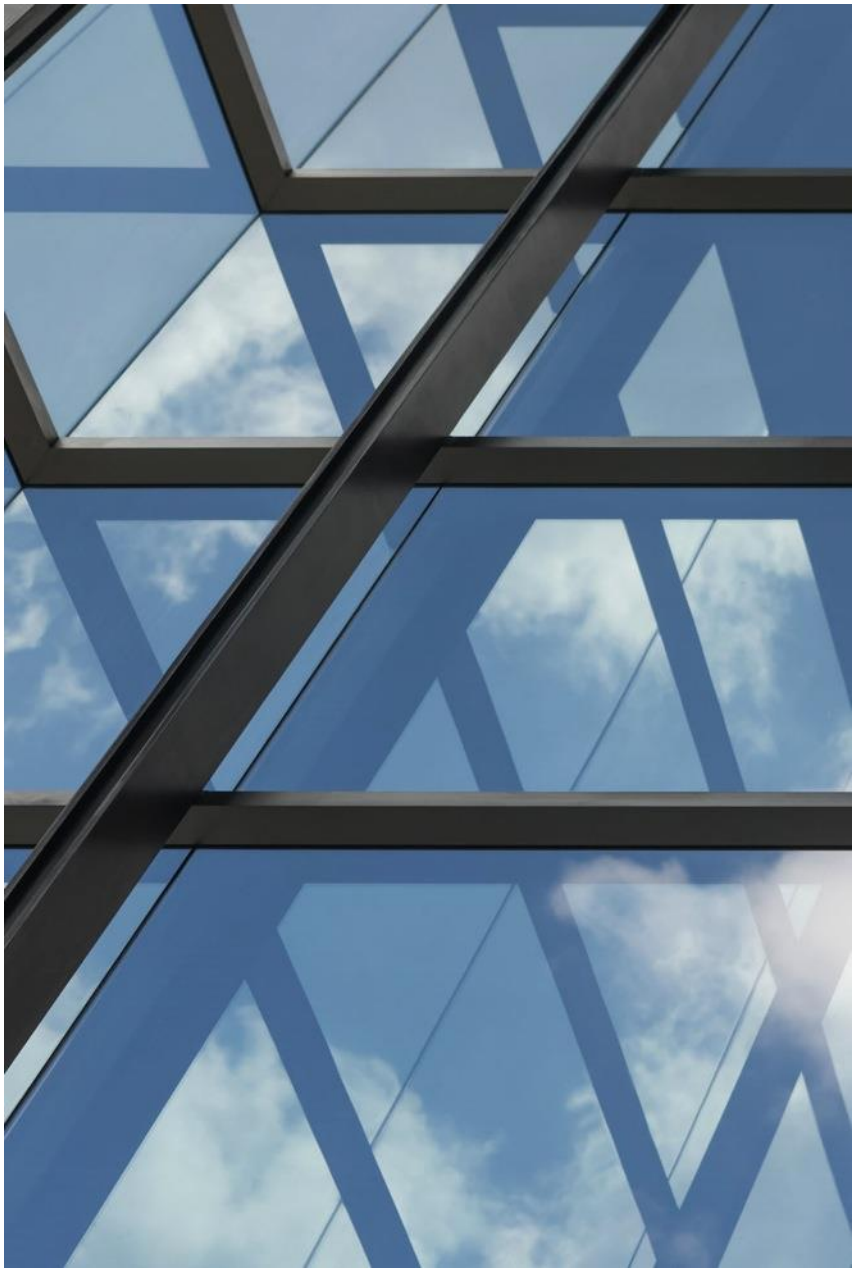
INFO3315 Human-Computer Interaction

Lecture 10 – Accessibility 1

Zhanna Sarsenbayeva



THE UNIVERSITY OF SYDNEY

Recap

- Interfaces:
  - different interface types suit different applications
- CLIs, GUIs, Post-WIMP user interfaces
- BCI, Social interfaces

Before we start, let's read the submission details

1. Demonstration

Each group is expected to have conducted a usability testing session using their prototype during **Week 12 workshop (next week)**. You must submit to Demonstration on Canvas, as a single submission, the materials that you used during the session:

- A single PDF file of your prototype and a link to their prototypes.
- A single PDF file of the task description, max THREE(3) tasks. These are the tasks that the participant will be trying to complete during the session. It must include the main task that the target user will perform to accomplish their goal of using your solution.

Before we start, let's read the submission details

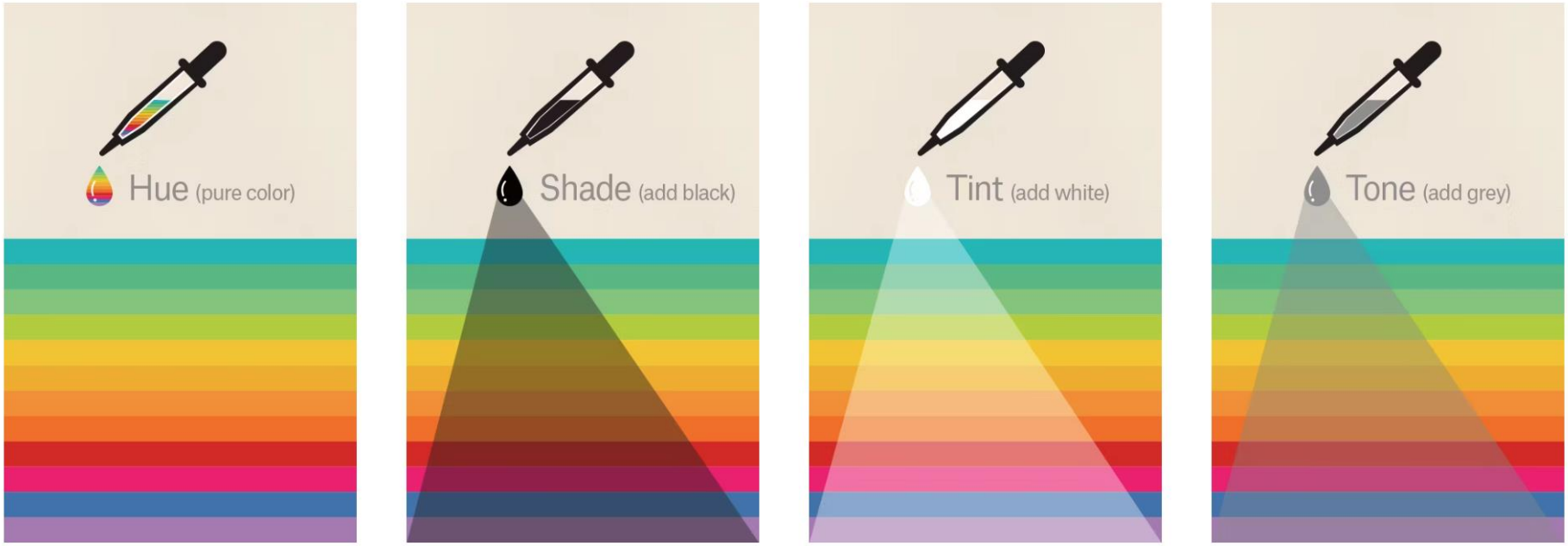
2. Poster

The poster should effectively communicate your topic or research findings. The poster should be visually engaging, well-structured, and demonstrate a clear understanding of the subject matter.

- Format: A2 conference-style poster (portrait or landscape)
- File type: Submit as a single PDF file (printing can be done as 1 A2 paper, or splitting it into several A4 papers (tiling)

Accessibility – Colour

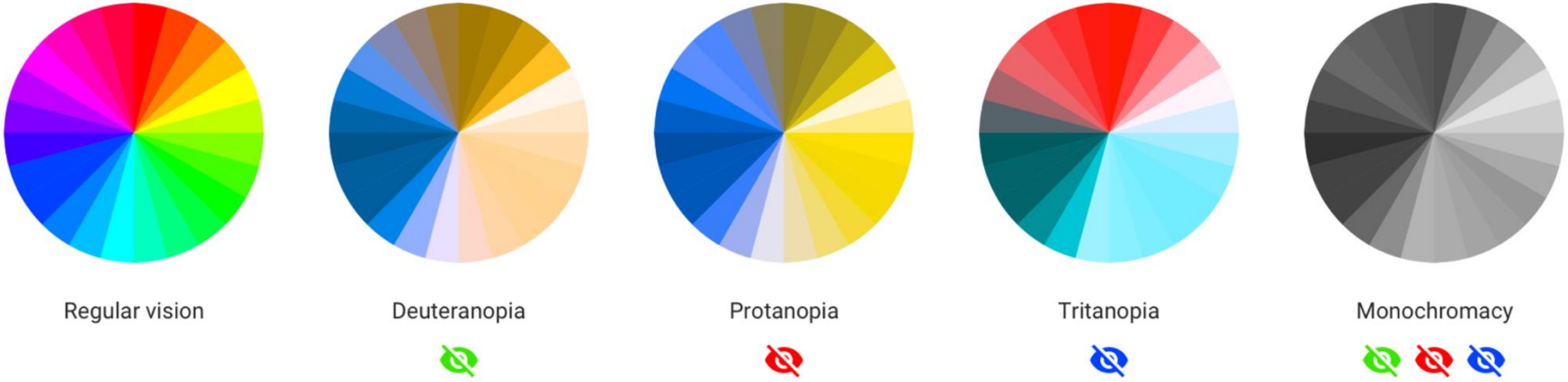
- Valuable for screen design
  - Performance ++
  - Affect ++
  - Attention ++



Colour challenges

- ~2.2 bln people globally are affected with some type of visual impairments
- Challenging if information is portrayed by colour alone
- Accessibility of colours differentiates between good and bad designs
- Colour accessibility - designing digital content ensuring it can be used effectively by people with various forms of colour-vision deficiency

Types of colour blindness



Colour-blindness

Widely stated prevalence is for **Europeans**

~ 8% of men, 0.5% women

Birch, Jennifer. "Worldwide prevalence of red-green color deficiency." *JOSA A* 29, no. 3 (2012): 313-320.

Colour-blindness

Table 2. Prevalence of Red-Green Color Deficiency Determined with the Ishihara Plates in European Caucasian Populations That Included over 5000 Men [7,8,22,23]

Country Author and Date	Men			Women		
	Number Examined	Number of Color Deficient	%	Number Examined	Number Color Deficient	%
Norway (Waaler 1927)	9049	725	8.01	9072	40	0.44
Germany (Schmidt 1936)[a]	6863	532	7.75	5604	20	0.36
France (Kherumian and Pickford 1959)	6635	594	8.95	6990	35	0.50
Greece (Koliopoulos *et al.* 1976)	21231	1687	7.95	8754	37	0.42
Germany (Feig and Ropers 1978)	5565	434	7.80	—	—	—

[a]Reported by Kherumian and Pickford 1959 [7].

Table 6. Prevalence of Red-Ggreen Color Deficiency in Chinese Populations Determined with the Ishihara Plates (NB: place names are in Mandarin) [3,4,6,7,19,20,21]

Location and Date	Authors	Men		Women	
		Number Examined	%	Number Examined	%
Peiping and Chengtu 1932	Chang[a]	2279	6.5	1132	1.7
Chengtu 1934	Kilburn and Beh	1115	6.3	—	—
Kweiyang 1942	Fang and Lui[a]	7333	5.6	3001	1.5
Chengtu 1950	Chan and Mao	7542	5.0	3519	0.7
Chinkiang 1952	Yu[a]	4045	4.6	2685	1.0
Canton 1953	Chan *et al.*	7815	4.0	3549	0.4
Peking 1958	Yang *et al.*	7285	5.2	5786	0.5

[a]Reported by Chan and Mao 1950 [4].

Table 7. Prevalence of Red-Green Color Deficiency in Taiwan, Korea, and Singapore [9,19,21]

Country and Date	Authors	Screening Test	Men		Women	
			Number Examined	%	Number Examined	%
Taiwan 1968	Chang[a]	Ishihara	8050	5.3	4342	0.2
Korea 1967	Yung *et al.* [a]	Ishihara	5521	4.2	7071	0.2
Korea 1989	Kim *et al.*	HRR	4678	5.9	4760	0.4
Singapore 1980	Ahmad and Chai					
Chinese		Ishihara	19459	4.6	—	—
Malay		Ishihara	4364	4.6	—	—

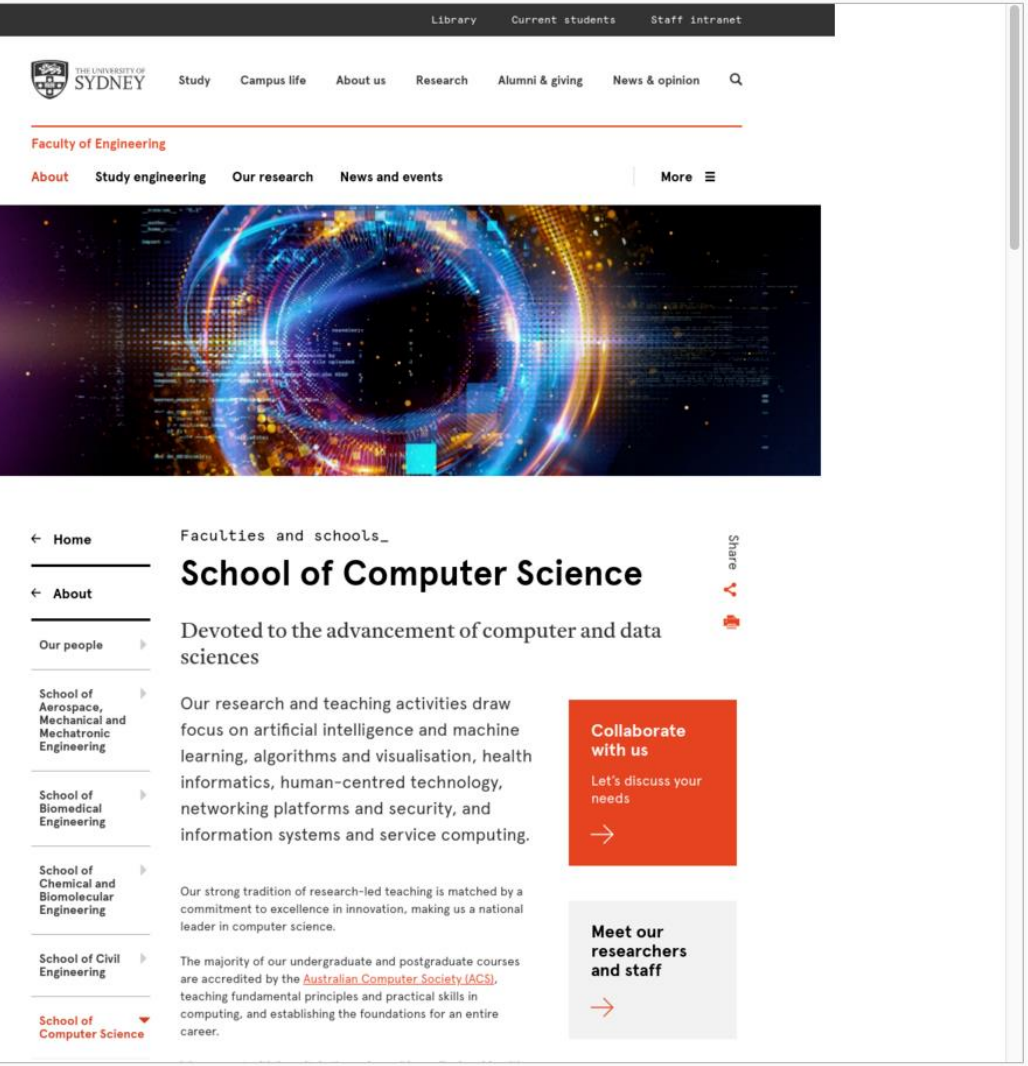
[a]Reported by Iinuma and Handa 1972 [19].

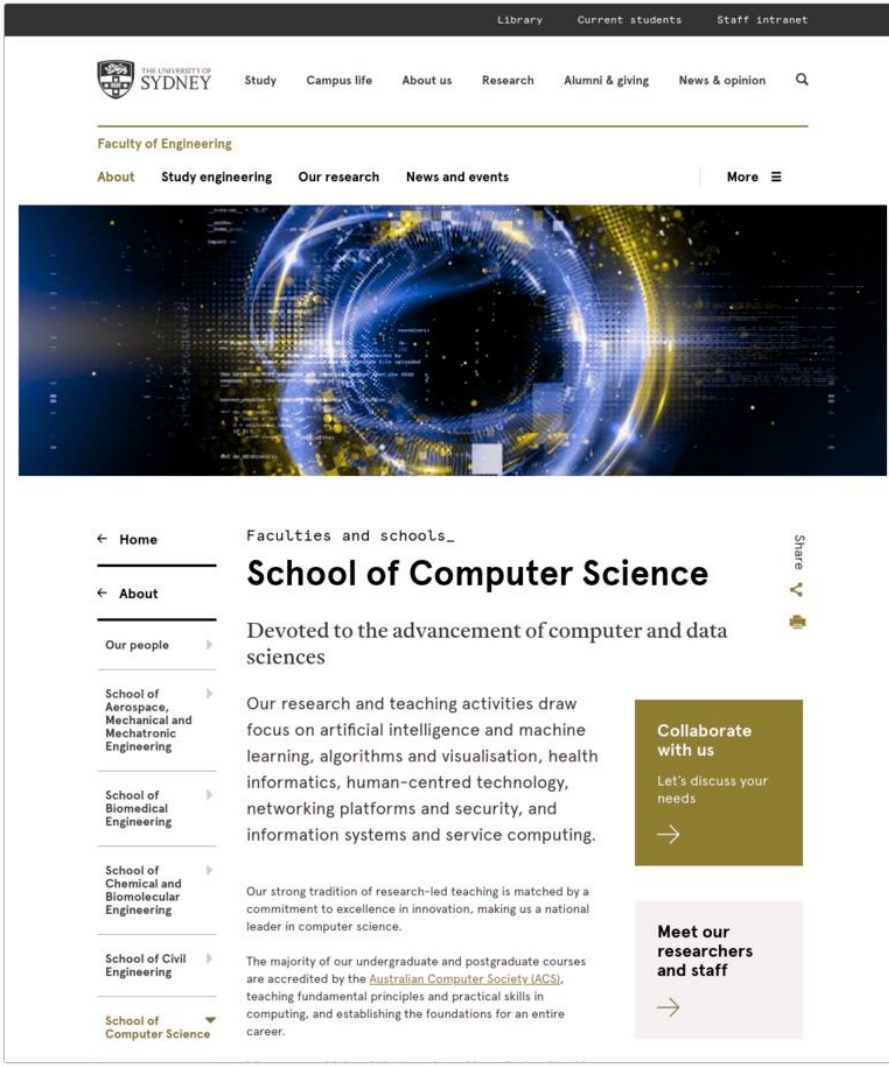
Key challenge – Designer is not the user





Colour-blindness simulator:
https://www.color-blindness.com/coblis-color-blindness-simulator/


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News and events
More
Home
About
Our people
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School of Chemical and Biomolecular Engineering
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Devoted to the advancement of computer and data sciences
Our research and teaching activities draw focus on artificial intelligence and machine learning, algorithms and visualisation, health informatics, human-centred technology, networking platforms and security, and information systems and service computing.
Our strong tradition of research-led teaching is matched by a commitment to excellence in innovation, making us a national leader in computer science.
The majority of our undergraduate and postgraduate courses are accredited by the Australian Computer Society (ACS), teaching fundamental principles and practical skills in computing, and establishing the foundations for an entire career.
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Devoted to the advancement of computer and data sciences
Our research and teaching activities draw focus on artificial intelligence and machine learning, algorithms and visualisation, health informatics, human-centred technology, networking platforms and security, and information systems and service computing.
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The majority of our undergraduate and postgraduate courses are accredited by the Australian Computer Society (ACS), teaching fundamental principles and practical skills in computing, and establishing the foundations for an entire career.
Collaborate with us
Let's discuss your needs
Meet our researchers and staff
Share

Ready

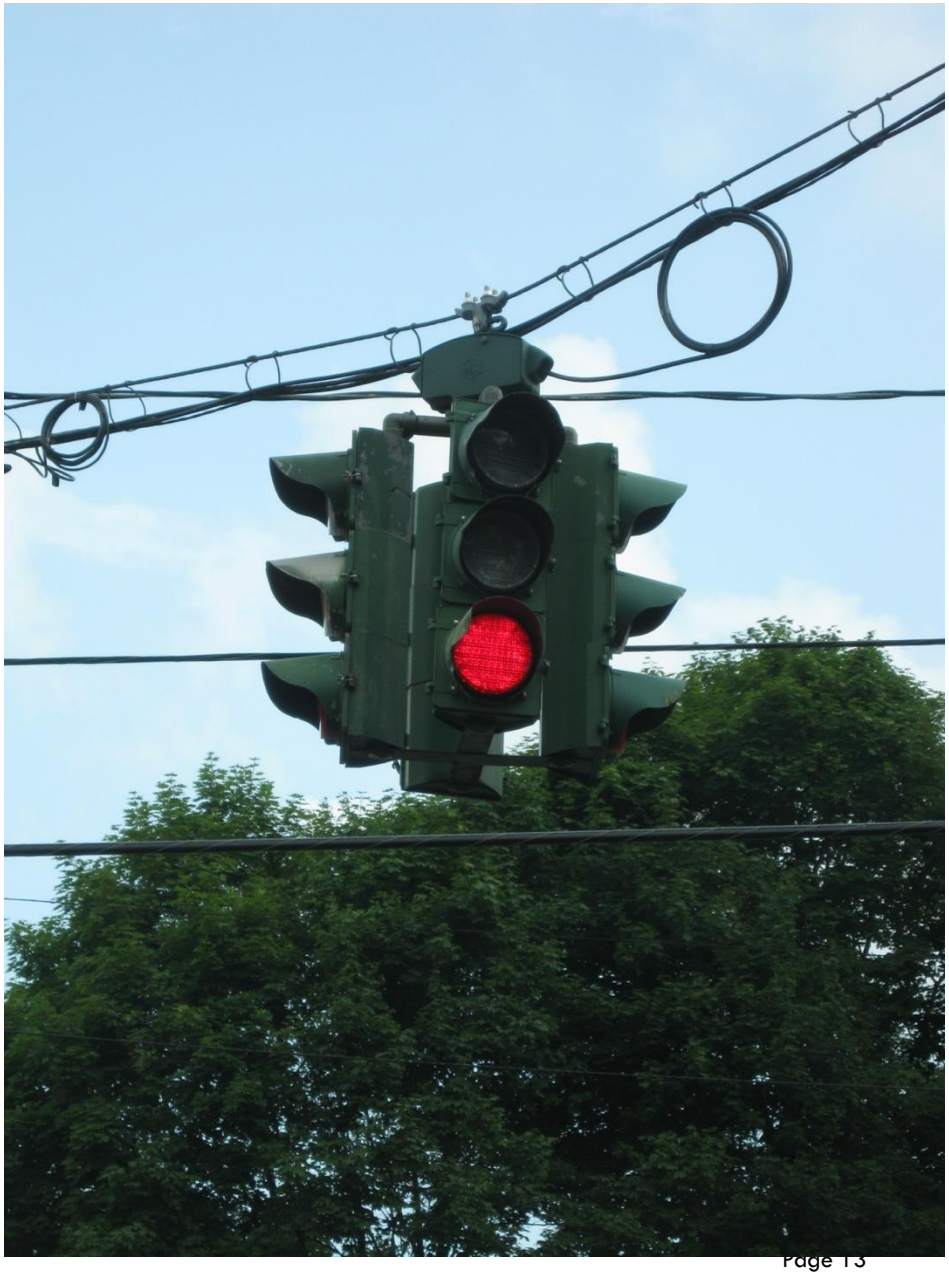
Tools to test interfaces for colour-blindness

- https://www.toptal.com/designers/colorfilter/ visited Mar 2024
- https://www.tpgi.com/color-contrast-checker/ visited Sep 2024
- https://webaim.org/resources/contrastchecker/ visited Sep 2024
- https://www.figma.com/community/plugin/748533339900865323/contrast visited Sep 2024
- … And many more

Conventions and colour

- By Doug Kerr - Flickr: Tipperary Hill - Syracuse, New York, CC BY-SA 2.0,

  https://commons.wikimedia.org/w/index.php?curid=12449391



Contrast

- Color contrast is the difference in luminance or brightness between two colors used in a design, typically between the foreground and background. The greater the contrast between these two elements, the easier it is to distinguish and read the content.

Contrast and readability (legibility)

- Make sure the text stands out clearly from the background in both color and brightness.

- If there isn't enough contrast between the text and the background, the text may look blurry or have a glowing effect, making it hard to read and causing eye strain

Good: Black (#000000) text on a cyan (#00FFFF) background.	Very good: Black (#000000) text on a yellow (#FFFF00) background.	Good: Black (#000000) text on a pale thalo yellow green (#99FF99) background.	**Good: White (#FFFFFF) text on a blue (#0000FF) background.**

Problems with Blue

- Just two percent of all retinal cones detect blue
- The eye brings blue into focus in front of rather than on the retina
- Visual acuity for the blue range of the spectrum is poor and it decreases with age
- User performance in symbol identification is poorer with blue symbols than with symbols of any other color
- So, avoid using dark or highly saturated shades of blue for text
- Also avoid fine lines on a black or other dark background
- Also, avoid text or symbols consisting of fine lines in highly saturated blue hues on a white

Contrast and readability (legibility)

- Visual acuity reduced for violet end of spectrum
- Insensitivity to blue increases with age
- With normal light, we see mid-spectrum colours best (ie green, yellow)
- Reds appear closer than blues
- Warm colours appear larger than cool colours
- eg red larger than blue
- Blooming effect
- Light colours on dark backgrounds appear larger
- Colours distant on spectrum require refocusing
- Illumination matters too

Contrast and readability (legibility)

Excellent: Black (#000000) text on a white background.	Excellent: Kashmir green (#003300) text on a white background.	Excellent: Midnight blue (#000033) text on a white background.	Excellent: Burnt umber (#330000) text on a white background.
Good: Charcoal gray (#333333) text on a white background.	Excellent: Peruvian turquoise (#003333) text on a white background.	Excellent: Deep purple (#330033) text on a white background.	Excellent: Raw umber (#333300) text on a white background.
Good: Slate (#333366) text on a white background.	Very good: Forest green (#006600) text on a white background.	Good: Navy blue (#000066) text on a white background.	Good: Deep burnt sienna (#660000) text on a white background.
Good: Indigo blue (#330066) text on a white background.	Very good: Viridian green (#006633) text on a white background.	Good: Prussian blue (#003366) text on a white background.	Good: Deep burgundy (#660033) text on a white background.

Very good: Yellow (#FFFF00) text on a black background.	Very good: Green (#00FF00) text on a black background.	Very good: Cyan (#00FFFF) text on a black background.	Very good: Magenta (#FF00FF) text on a black background.

Blooming - light text on dark background seems larger

Light text on a dark background

Dark text on a light background

Colour and Accessibility

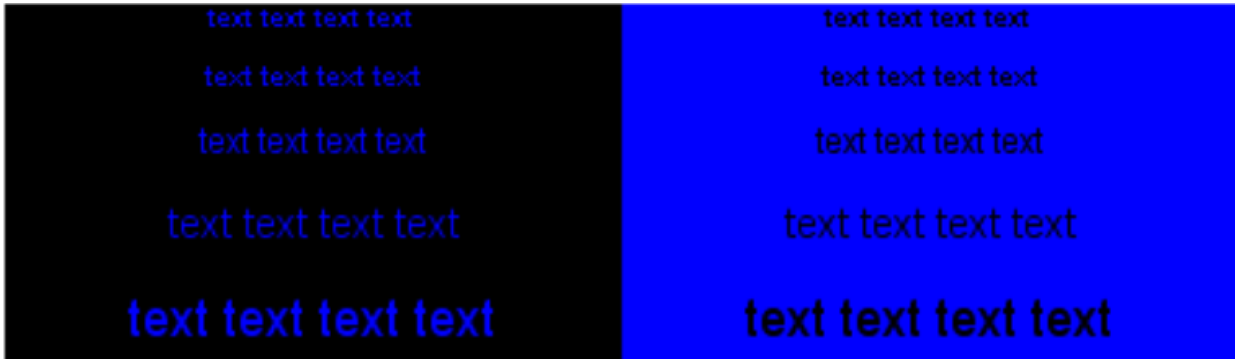
- Colour contrast and accessible colours impact the usability and inclusivity of the digital content
  - An appropriate colour contrast ensures web elements are easily distinguishable hence improves legibility
  - Using accessible colours ensures that users with varying colour-blindness can engage with the digital content

Colour and Accessibility

- Using accessible colours is not only best design practice but also a legal requirement.
- Accessibility laws worldwide mandate accessible color usage, including:
  - Americans with Disabilities Act (ADA)
  - European Accessibility Act (EAA)
  - Accessibility for Ontarians with Disabilities Act (AODA)
  - Web Content Accessibility Guidelines (WCAG)

Examples of guidelines about colour

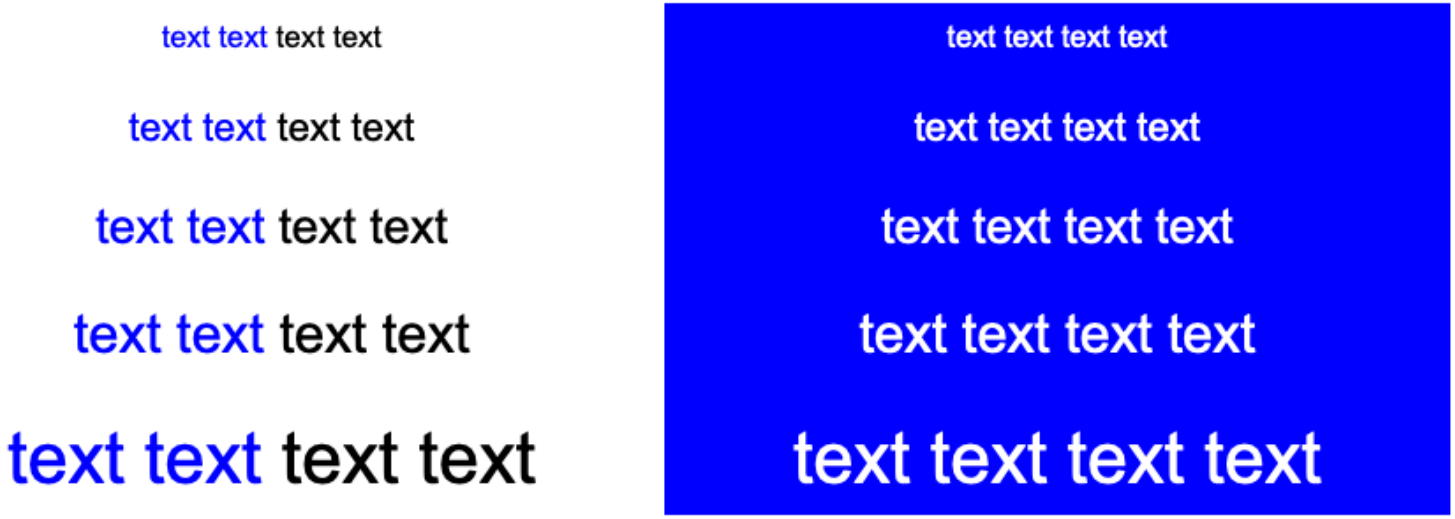
- Pure blue shall not be used on a dark background for text, thin lines, or high resolution information. …
- 8.6.2.2.7 Blue. Blue should not be used as the foreground color if resolution of fine details is required.
- The blue/black combinations in the two panels above are difficult to read, especially at the smallest sizes.



- https://colorusage.arc.nasa.gov/guidelines_0.php

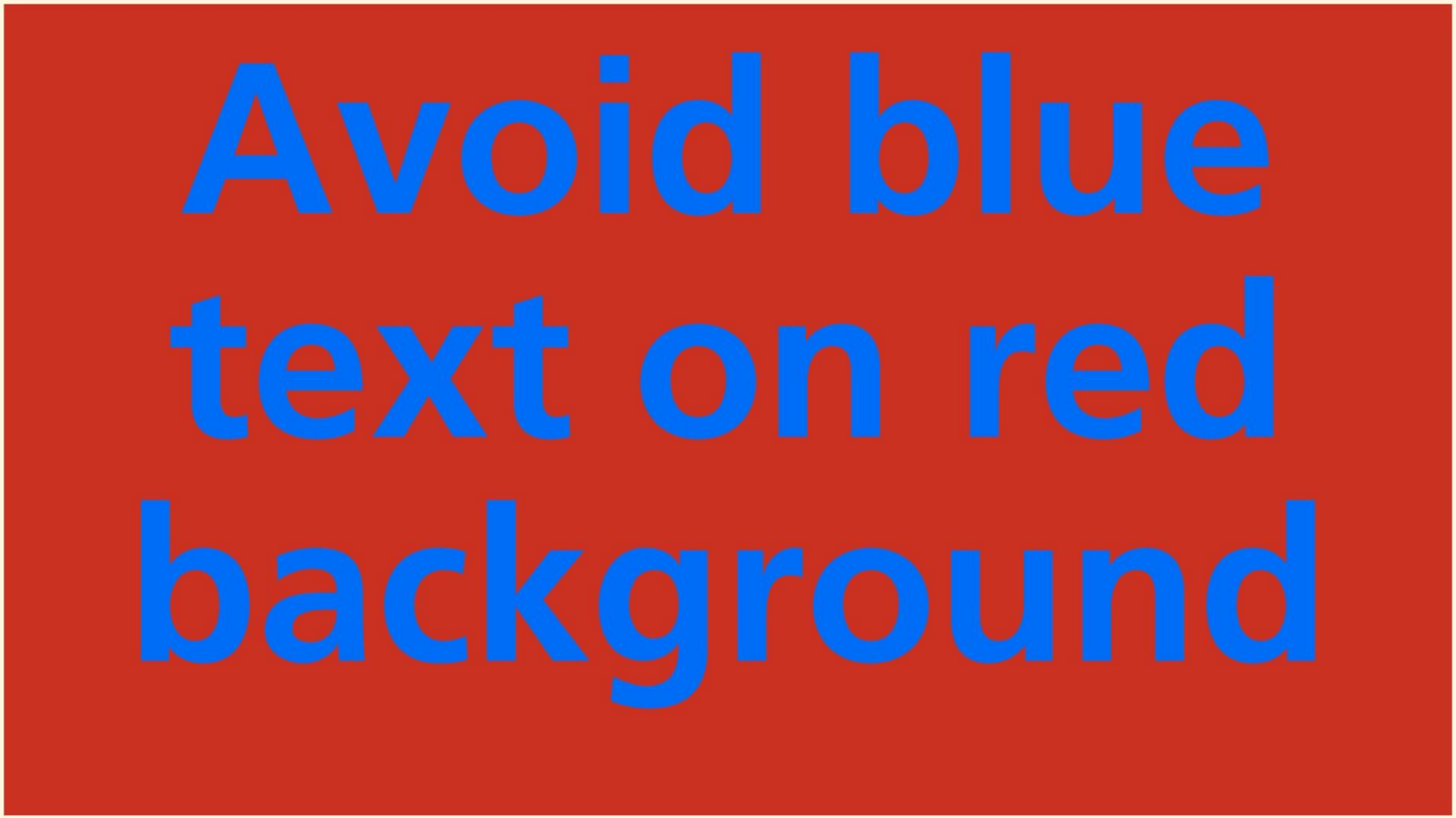
Examples of guidelines about colour

- Blue can be used in most contexts if care is taken to achieve adequate luminance contrast. This can be done in a number of ways. Instead of blue on black or vice versa one can substitute white (or some other high luminance color) for the black. In the next figure the small blue text on the white background is nearly as legible as the black text:
- https://colorusage.arc.nasa.gov/blue_2.php



More examples from NASA

- Use no more than six colors to label graphic elements.
- Use colors in conformity with cultural conventions.
- Use color coding consistently across displays and pages
- Use color coding redundantly with other graphic dimensions.
- Don't use color coding on small graphic elements


Avoid blue
text on red
background

Tog principles

- Any time you use colour to convey information in the interface, you should also use clear, secondary cues to convey the information to those who cannot see the colours presented
- Test your site to see what colour-blind individuals see
- Do not avoid colour in the interface just because not every user can see every colour.
- Do not strip away or overwhelm colour cues in the interface because of a passing graphic-design fad.

- https://asktog.com/atc/principles-of-interaction-design/ visited Mar 2024

More…

- With black foreground, use cyan, magenta, white
- Ensure contrast in hue and brightness of fore- and background

- Allow users to control colour coding
- Use colour consistently across system
- Use other (redundant) cues as well
- Avoid saturated blue for small text and thin lines

Colour is valuable but complex

- … your reading about cultural, national, gender differences

Meanings associated with colours

Color	China	Japan	Egypt	France	United States
Red	Happiness	Anger Danger	Death	Aristocracy	Danger Stop
Blue	Heavens Clouds	Villainy	Virtue Faith Truth	Freedom Peace	Masculine
Green	Ming Dynasty Heavens	Future Youth Energy	Fertility Strength	Criminality	Safety Go
Yellow	Birth Wealth Power	Grace Nobility	Happiness Prosperity	Temporary	Cowardice Temporary
White	Death Purity	Death	Joy	Neutrality	Purity

Barber, W., & Badre, A. (1998, June). Culturability: The merging of culture and usability. In *Proceedings of the 4th Conference on Human Factors and the Web* (Vol. 7, No. 4, pp. 1-10). Citing The Color-Culture Chart below illustrates some of the different meanings (Boor & Russo, 1993).

Colour is valuable but complex

- Need to be careful when using it

In-class quiz week 10

What can we do about colour-blindness?

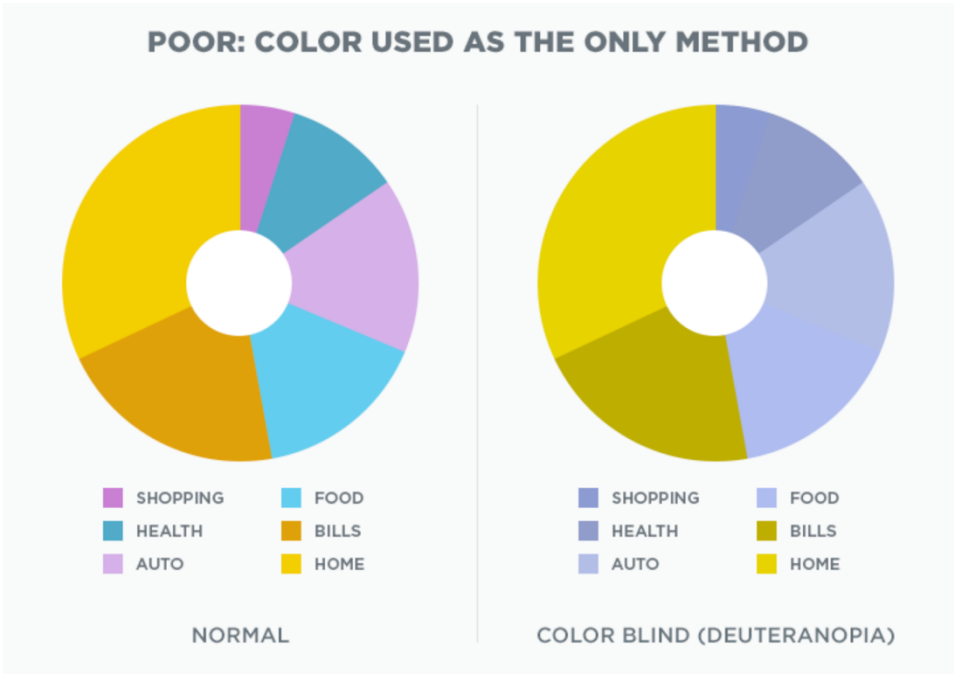
- Be aware!
- Design in black and white and add colour sparingly
- What else?
- **Include more than just colour-hue to code differences, such as brightness and additional interface differences such as outlines**

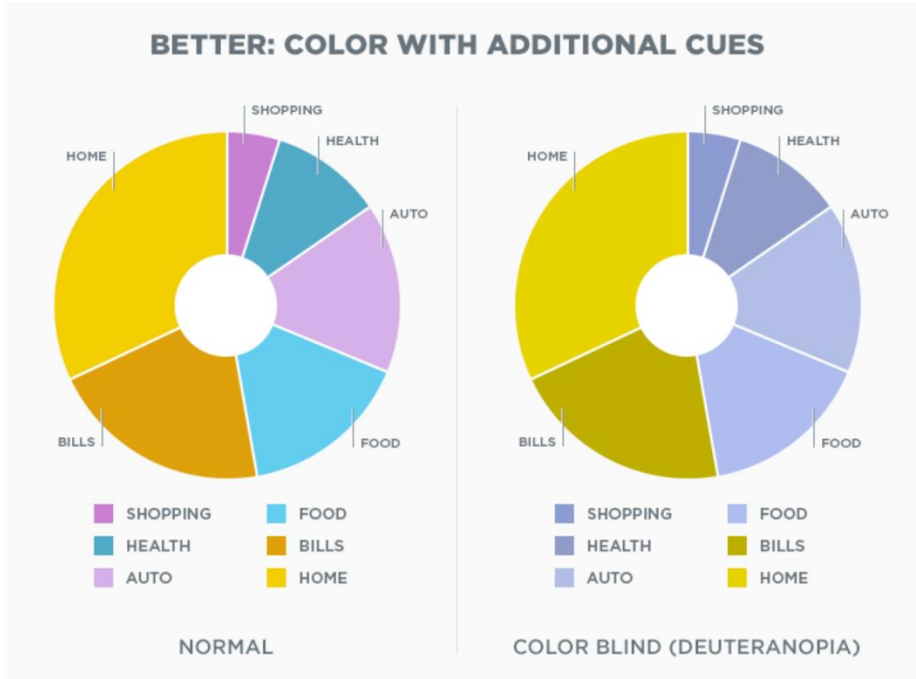
Some examples of ways to help people with colour blindness

- Adding additional coding as well as the colour

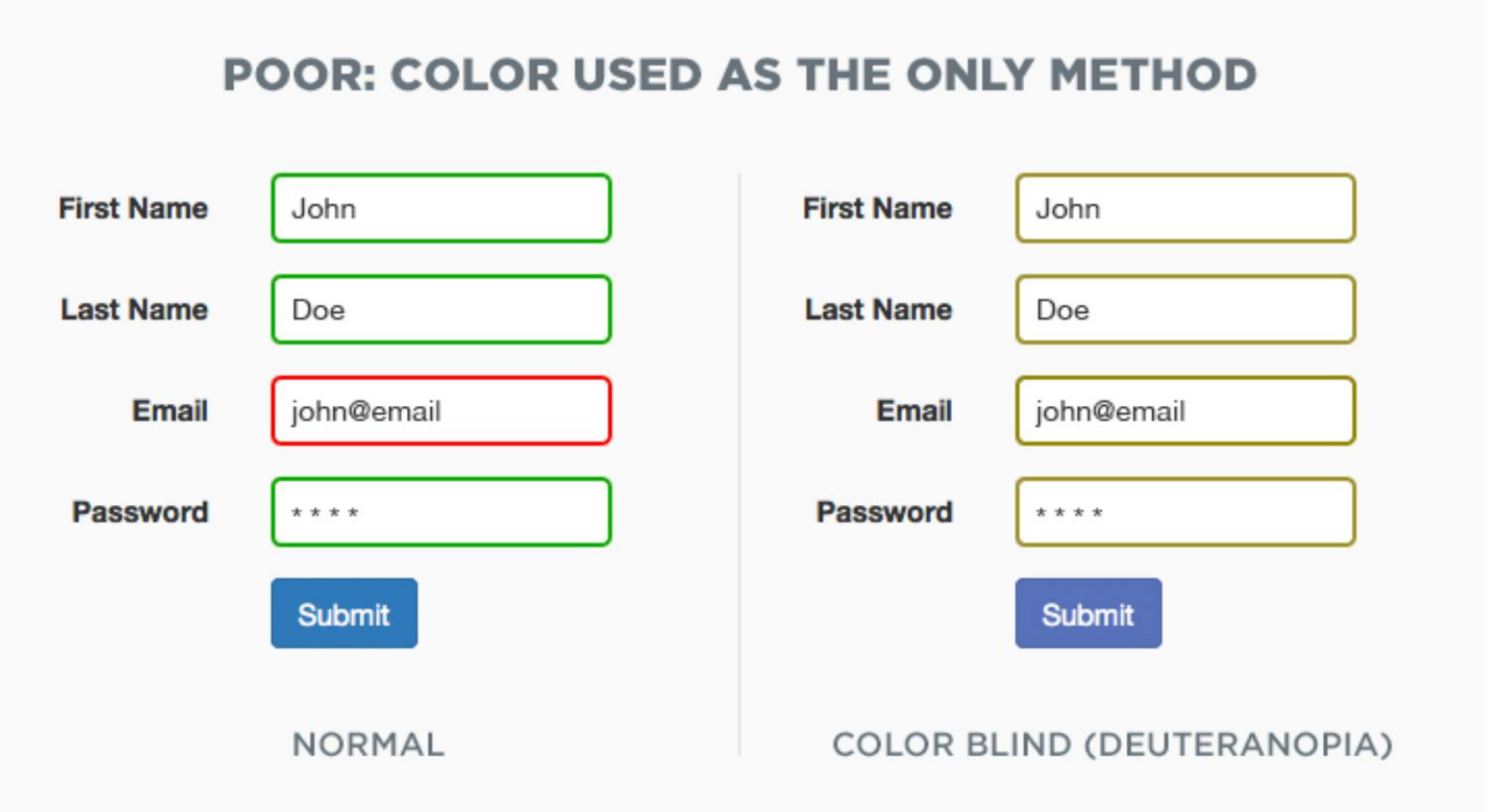
Poor design

Much Better design

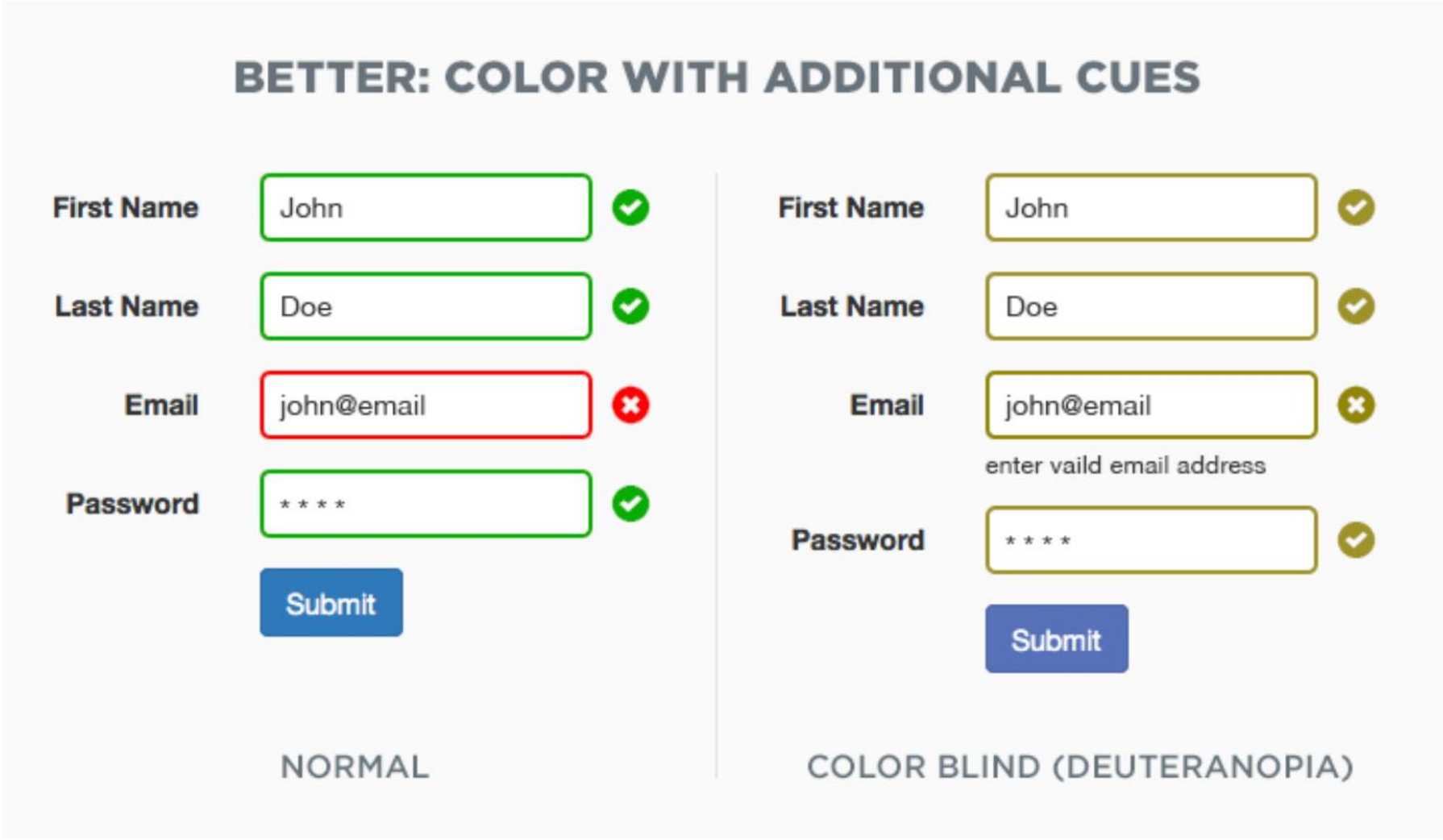




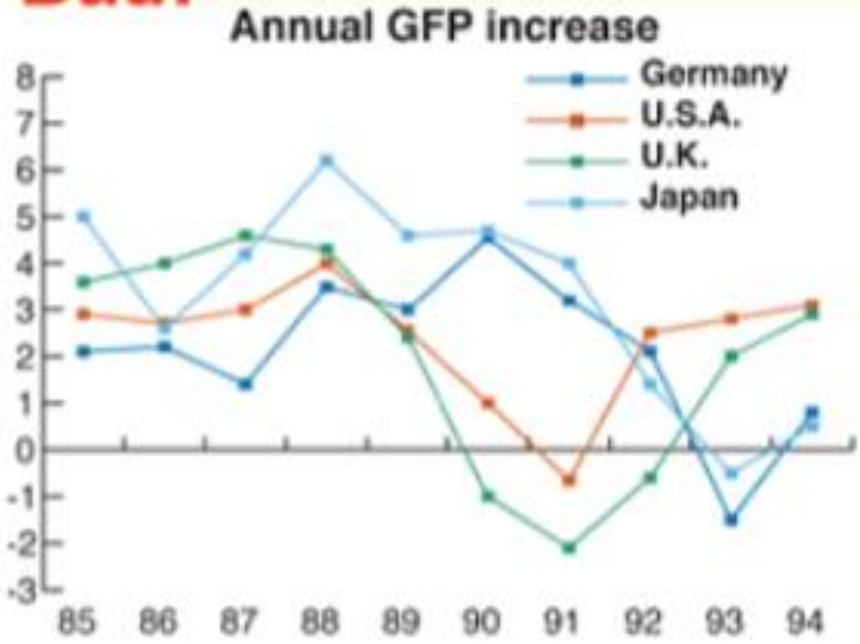
What can you do to improve this?



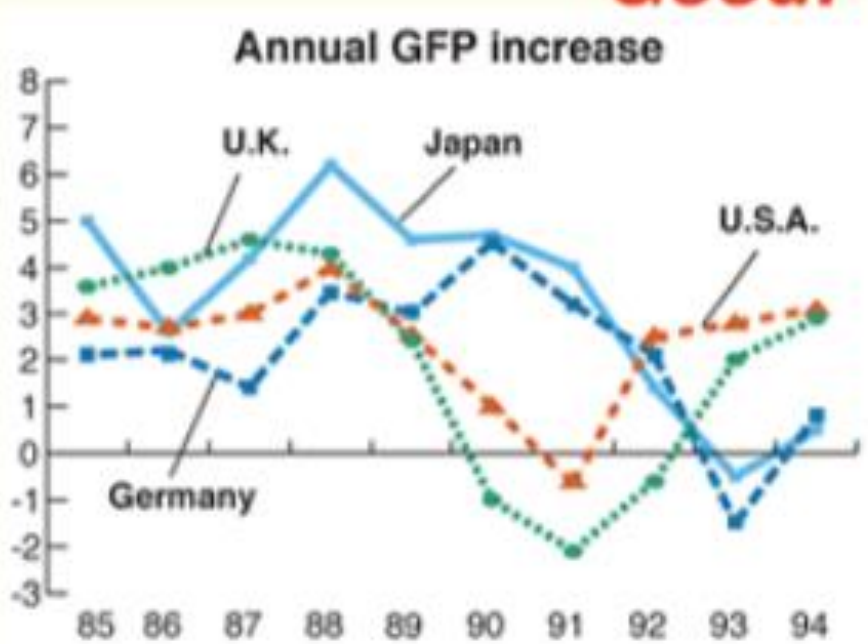
Better


BETTER: COLOR WITH ADDITIONAL CUES
First Name
John
Last Name
Doe
Email
john@email
Password
* * * *
Submit
NORMAL
First Name
John
Last Name
Doe
Email
john@email
enter vaild email address
Password
* * * *
Submit
COLOR BLIND (DEUTERANOPIA)

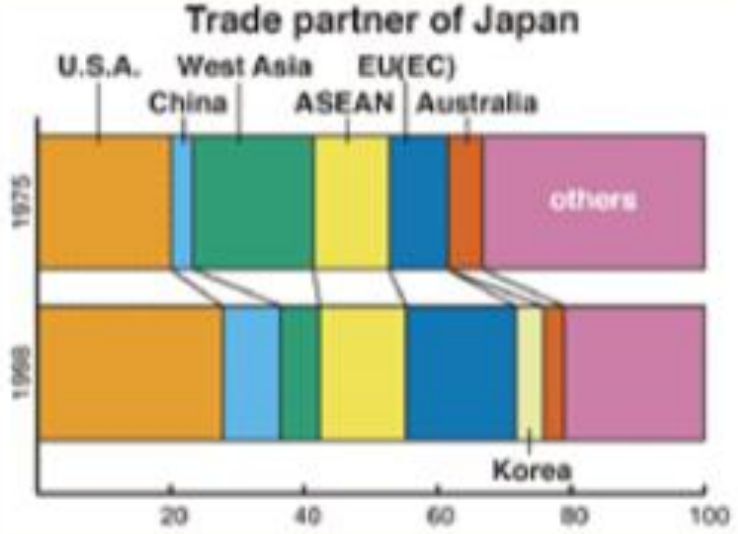
Bad!


Annual GFP increase
Germany
U.S.A.
U.K.
Japan
8
7
6
5
4
3
2
1
0
-1
-2
-3
85
86
87
88
89
90
91
92
93
94

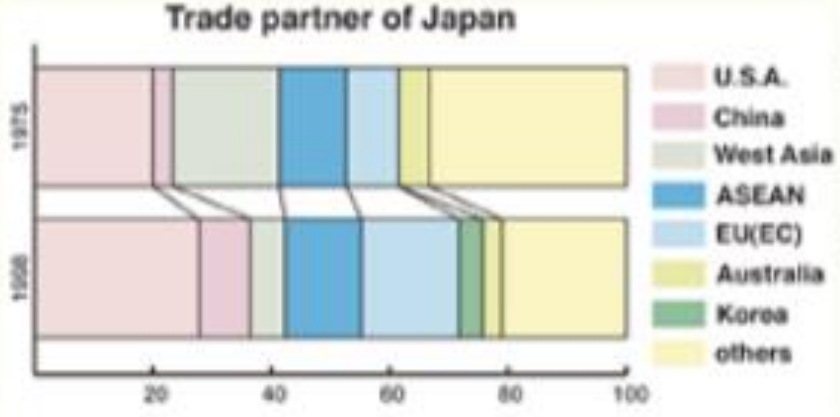
Good!

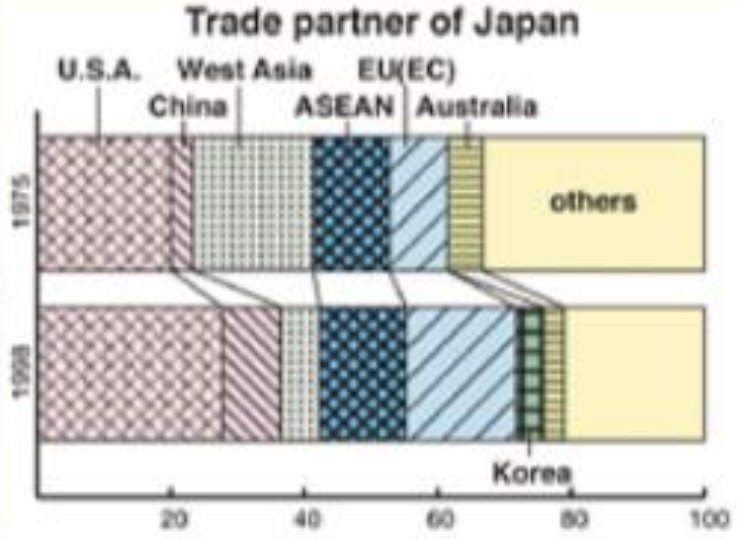

Annual GFP increase
U.K.
Japan
U.S.A.
Germany
8
7
6
5
4
3
2
1
0
-1
-2
-3
85
86
87
88
89
90
91
92
93
94

Good!


Trade partner of Japan
U.S.A.
West Asia
EU(EC)
China
ASEAN
Australia
1975
1998
others
Korea
20
40
60
80
100

Bad!


Trade partner of Japan
1975
1998
U.S.A.
China
West Asia
ASEAN
EU(EC)
Australia
Korea
others
20
40
60
80
100


Trade partner of Japan
U.S.A.
West Asia
EU(EC)
China
ASEAN
Australia
1975
1998
others
Korea
20
40
60
80
100

Colour and Accessibility

- Accessible colours ensure usability for all users, regardless of visual abilities.
- A proper colour palette makes a site easy to read and navigate, especially for those with visual impairments, colour blindness, or other disabilities.
- Accessible colours benefit users without disabilities, such as:
  - Older adults with age-related vision changes.
  - People using low-resolution screens.
  - Situational disabilities (e.g., bright sunlight or dimly lit environments) are addressed through an accessible colour scheme with adequate contrast.
- Accessible colours enhance usability and create a more inclusive online environment for everyone to engage with content.

Colour and Accessibility – Best practices

- Summary:
- High contrast: Ensure a high contrast ratio between text and background for better visibility
- Avoid relying solely on color:
  - Use text labels, patterns, or icons to differentiate elements in addition to color
- Accessible color palettes
  - Use color schemes that remain distinguishable for people with color vision deficiencies, avoiding combinations like red and green.

References

https://www.audioeye.com/post/accessible-colors/
https://asktog.com/atc/principles-of-interaction-design/