Enhancing Digital Accessibility in Higher Education

Sandeep Patil

What color is the light?

Photo by Roberto Júnior on Unsplash

Color blindness and traffic signal lights

Photo by Roberto Júnior on Unsplash

Color blindness and traffic signal lights

Source: https://www.txdot.gov/safety/traffic-signs-signals/arrow-signals.html

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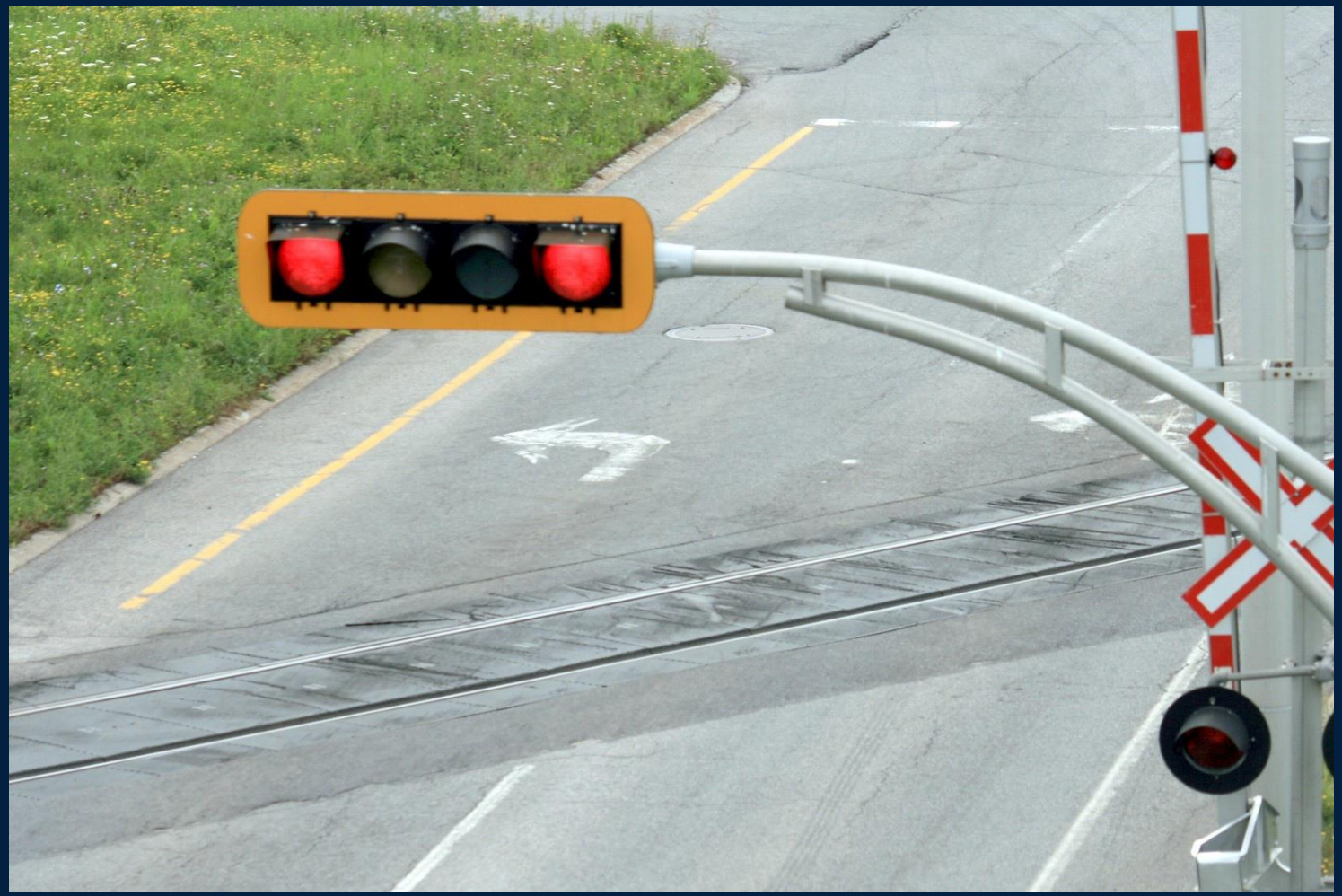
Source: https://live.staticflickr.com/3423/3868478152_3b1436f0fc_k.jpg

Color blindness and traffic signal lights



Source: https://live.staticflickr.com/3423/3868478152_3b1436f0fc_k.jpg

Digital systems can learn from this

- Accessibility isn’t an afterthought.
- It’s a design principle that makes interfaces clearer, safer, and more resilient.

By the end of this session you will

- Understand what is digital accessibility and why we need it
- Understand some best practices

Who is Sandeep Patil?

- Assistant Professor at Luleå University of Technology, Sweden
- Recognized University Teacher (Meriterad Lärare)
- Secretary at IES Technical Committee on Education in Engineering and Industrial Technologies (TC-05)
- Teaching in CS subjects, mainly programming
- Research
  - Software for Industrial Automation
  - Pedagogical topics
    - Digital accessibility
    - Personalized Learning
    - Course Development

Why this tutorial at IROS?

Menti Poll

- menti.com
- Use code – 4956 8571

Accessibility Drives Innovation in Robotics Education and Research

- Inclusive design improves usability, reliability, and human–robot interaction.
- Accessible digital tools enable all learners, including those with disabilities, to engage in robotics education and research.
- Robotics can itself be a vehicle for inclusion, supporting diverse participation in STEM.
- Designing for accessibility builds more robust, adaptable interfaces, vital in human-centered systems.

Accessible Digital Tools Advance Robotics Learning and Research Dissemination

- Accessible simulation & coding platforms (e.g., ROS, Webots) can include keyboard-only, high-contrast, and screen-reader-friendly interfaces.
- Accessible research dissemination: captioned videos, tagged PDFs, and alt-text figures widen participation at conferences and in publications.
- Faculty readiness is key; training in digital accessibility enhances inclusivity in robotics and engineering education.
- The robotics community can lead by example, integrating accessibility into design, teaching, and outreach.

Get the material

- eeit.ieee-ies.org
  - Click on Workshops and Tutorials
  - Then click on Tutorial at IROS 2025
  - You will find the resources under Workshop Materials

Agenda for the Tutorial

- Introduction to Digital Accessibility
- Handson Task 1: Accessibility Audit
- Handson Task 2: Apply accessibility principles on the documents

Understanding Digital Accessibility

What is digital accessibility?

- **Digital Accessibility** is the practice of designing digital content and technologies so that **people with disabilities** can perceive, understand, navigate, and interact with them effectively.

Source:
https://www.reddit.com/r/mildlyinfuriating/comments/1exxowd/thanks_for_being_accessible/?embed_host_url=https://www.ndtv.com/offbeat/old-note-urging-differently-abled-to-come-upstairs-to-use-lift-goes-viral-sparks-outrage-online-6406089

What is digital accessibility - Key concepts

- Accessibility for Disabilities: Ensuring content is perceivable, operable, understandable, and robust for users with disabilities.
- Assistive Technologies: Compatibility with tools like screen readers, screen magnifiers, and alternative input devices.
- Standards and Guidelines: Adherence to WCAG, ADA, Section 508, etc.
  - WCAG - Web Content Accessibility Guidelines
  - ADA - The Americans with Disabilities Act
  - Section 508 - Amendment to the Rehabilitation Act of 1973

What are the 4 areas of accessibility?

- Physical
- Cognitive
- Auditory
- Visual needs.

Why is it needed?

Legality: Government regulations

- USA: section 508
  - Read more at https://www.section508.gov/
  - Part of Amendment to the Rehabilitation Act of 1973

Legality: Government regulations

- EU released guidelines and laws in 2016 European Accessibility Act
- This directive was transposed into Swedish law via the Act on Accessibility of Digital Public Services (Lag 2018:1937) in 2019. Access the English Summary
- What is the Mandate?
  - The Swedish law mandates that public authorities (including state universities) provide digital services to meet the EU directive's accessibility requirement. This means university websites, e-services, and mobile applications must conform to a common standard.

What exactly is that?

- Rights of users (students and staff)
  - The Web Accessibility Directive covers all public sector websites and apps in the EU.
  - Each website and app in the scope of the directive must provide a Feedback mechanism.
  - You have the right to send constructive feedback when you find something inaccessible.

But I am not sure what is included in the law?

- Pre-recorded videos must have captions.
- Good enough contrast between text and background is required.
- Navigation should be logical.
- Documents on public sector websites must be accessible.
- Color must be used together with something else to convey meaning.
- The website should be able to be used and navigated using the keyboard.
- Links should be easy to find and understand.
- Design must support users by showing what is clickable.
- Items on websites must survive significant magnification.
- Forms and tables must contain labels and instructions.
- And much more ...!

Universal Design for Learning

Heard about Universal Design?

- **Universal design** is a concept in which products and environments are designed to be **usable by all** people, to the greatest extent possible, without the need for adaption or specialized design.
- It is a framework for creating accessible products and environments
- The idea or motivation is by following simple rules and tips, you are creating content that is already digitally accessible.

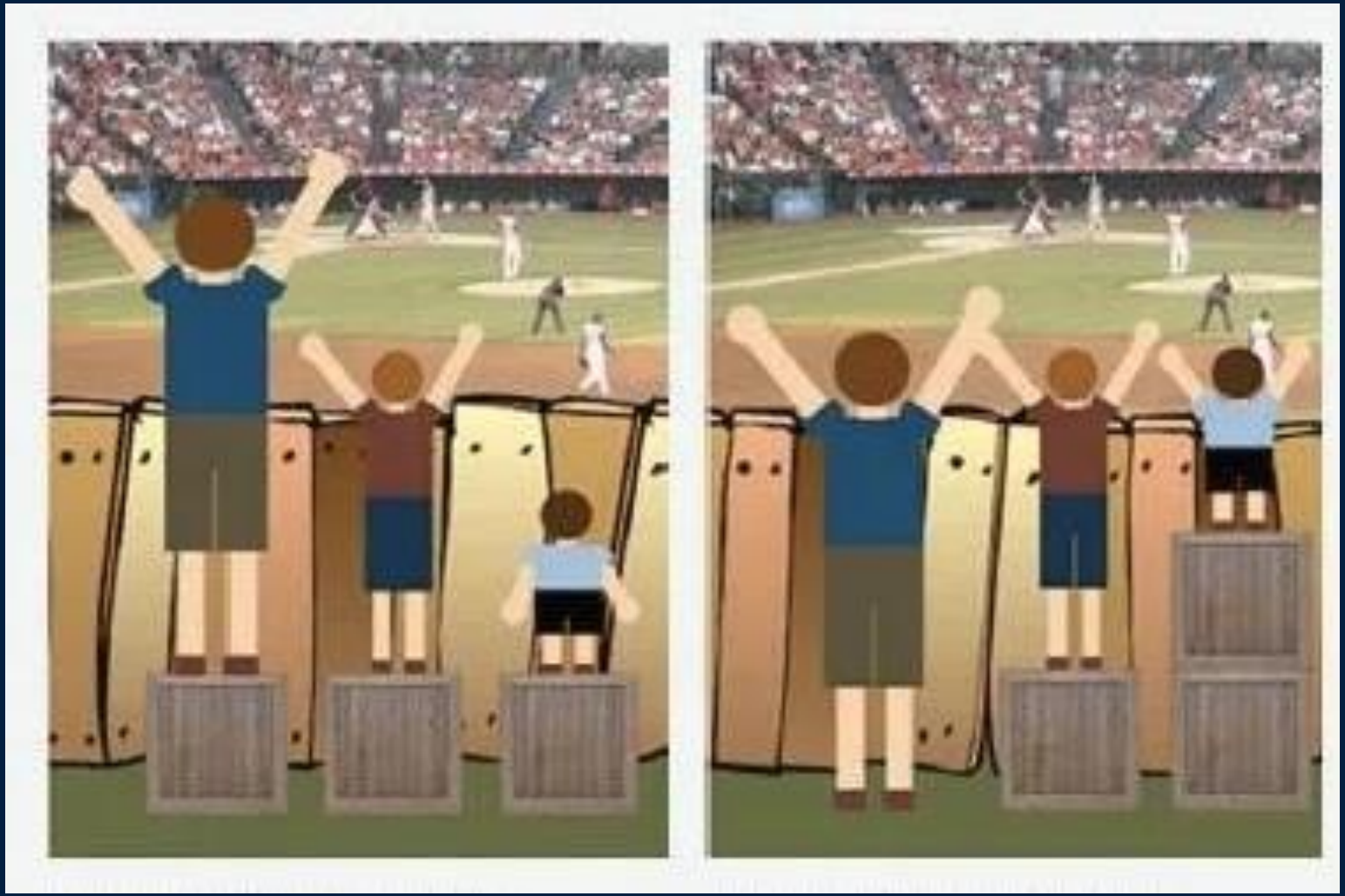
Universal Design for Learning

- Universal Design for Learning (UDL) is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn.

Equality in education

Source” https://medium.com/@CRA1G/the-evolution-of-an-accidental-meme-ddc4e139e0e4

Equity in education



Source” https://medium.com/@CRA1G/the-evolution-of-an-accidental-meme-ddc4e139e0e4

UDL addresses this equality vs equity question

Source" https://medium.com/@CRA1G/the-evolution-of-an-accidental-meme-ddc4e139e0e4

Importance and Benefits of Digital Accessibility in Education

Why Accessibility Matters in Education

- Inclusivity
  - Equal learning opportunities for all students
- Legal Compliance
  - Meeting educational regulations and standards
- Enhanced Learning Experience
  - Benefits not just students with disabilities but all learners

Benefits for Students

- Improved Access
  - Access to materials in preferred formats
- Flexibility
  - Learning at their own pace and style
- Engagement
  - Increased participation and interaction

Benefits for Educators and Institutions

- Reaching a Wider Audience
  - Potential to attract more students
- Reputation Enhancement
  - Being recognized as an inclusive institution
- Future-Proofing Content
  - Content remains relevant and usable over time

Real-World Impact - Statistics

- SCB (The Swedish Statistics Authority) estimates that about 36% of the population has some form and degree of disability. Almost 11% have more than one disability at a time
- In the 2023/24 academic year, approximately 6.2% of students in compulsory school (grundskolan) received some form of special support, equating to nearly 68,600 students.
- SCB does not have data on University enrollments, nor does UKÄ publish this in their annual report

Real World Impact – Legal cases

- Edx
  - In April 2015, EdX signed a settlement agreement to resolve a suit filed by the US Department of Justice. In the agreement EdX agreed to:
  - Ensure all their mobile applications and LMS comply with WCAG 2.0 AA Accessibility Guidelines;
  - Ensure that the CMS enables the creation and presentation of content that conforms with WCAG 2.0 AA;
  - Ensure that their mobile application or platforms do not block or interfere with any accessibility features in Course Content provided by Content Providers, including any content published in accessible formats.

Source: http://udloncampus.cast.org/page/policy_legal#1970129-02

Principles of Accessible Content

WCAG principal

- 4 principals of Web Content Accessibility Guidelines (WCAG)
  - Perceivable
  - Operable
  - Understandable
  - Robust

WCAG Principle 1 - Perceivable

- Definition: Information and user interface components must be presented to users in ways they can perceive, using their available senses.
- Key Aspects
  - Providing text alternatives for non-text content.
  - Offering alternatives for time-based media (audio and video).
  - Making content adaptable to different presentation formats.
  - Ensuring sufficient contrast and distinguishable elements.

What are you talking about?

- Alternate texts on images
- High color contrast
- Readable font
- Video with closed captions
- Video with audio descriptions

WCAG Principle 1 – Perceivable, Why is it needed?

- Cognitive Disabilities: Users with learning disabilities, dyslexia, or attention disorders may have difficulty understanding complex language or inconsistent interfaces.
- Non-Native Speakers: Simple language aids comprehension for users who are not fluent in the content's primary language.
- Overall Usability: Enhances the user experience for all by promoting clarity and predictability.

WCAG Principle 2 - Operable

- Definition: User interface components and navigation must be operable via multiple means, meaning that users can interact with them using various input methods.
- Key Aspects
  - Keyboard accessibility.
  - Providing enough time for users to read and interact with content.
  - Avoiding content that causes seizures (e.g., flashing lights).
  - Helping users navigate and find content.

What are you talking about now?

- Distinct Slide titles
- Shortened links with descriptive back-halves

WCAG Principle 2 – Operable, Why is it needed?

- Motor Disabilities: Some users cannot use a mouse and rely on keyboard navigation or alternative input devices.
- Cognitive and Neurological Conditions: Users may need additional time to process information or may be susceptible to seizures.
- Inclusive Interaction: Ensures that all users can navigate and interact with content effectively.

WCAG Principle 3 - Understandable

- Definition: Information and the operation of the user interface must be understandable and consumable, meaning users can comprehend the content and how to use the interface.
- Key Aspects
  - Clear and straightforward language.
  - Consistent navigation and functionality.
  - Providing error messages and suggestions for correction.
  - Predictable behavior of interactive elements.

Not again, what is this now?

- Clear Structure and layout
- Consistent formatting
- Effective use of images

WCAG Principle 3 – Understandable, Why is it needed?

- Cognitive Disabilities: Users with learning disabilities, dyslexia, or attention disorders may have difficulty understanding complex language or inconsistent interfaces.
- Non-Native Speakers: Simple language aids comprehension for users who are not fluent in the content's primary language.
- Overall Usability: Enhances the user experience for all by promoting clarity and predictability.

WCAG Principle 4 - Robust

- Definition: Content must be robust enough to be interpreted reliably by a wide variety of user agents, including assistive technologies.
- Key Aspects:
  - Using clean, valid HTML and code standards.
  - Ensuring compatibility with current and future user agents.
  - Providing proper markup to convey meaning and structure.

Last one I promise, please don’t leave

- Checked for accessibility
  - using accessibility checker built into PowerPoint
  - test using a screen reader
  - Manual check where possible by a user who uses assistive technology
  - Online tools

WCAG Principle 4 – Robust, Why is it needed?

- Assistive Technology Compatibility: Users rely on screen readers, magnifiers, and other tools that need well-structured content to function correctly.
- Future-Proofing Content: As technologies evolve, robust content remains accessible.
- Interoperability: Enhances the ability of different devices and software to work together.

Summary

Principle	Definition	Why It Is Needed	Examples
Perceivable	Presenting information in ways users can perceive	Allows users with sensory disabilities to receive information	Alt text for images, captions for videos, sufficient color contrast
Operable	Making interface components usable by all methods of interaction	Enables users with motor disabilities or alternative input methods to navigate and interact	Keyboard navigation, adjustable time limits, avoiding flashing content
Understandable	Ensuring content and operation are understandable	Assists users with cognitive disabilities in comprehending and using content	Clear language, consistent navigation, helpful error messages
Robust	Creating content that works with current and future technologies	Guarantees compatibility with assistive technologies and future user agents	Valid HTML, ARIA roles, avoiding deprecated technologies

Best Practices

1. Text Content - Headings and Structure

- Best Practice
  - Use proper heading levels (e.g., H1 for main titles, H2 for section headings, H3 for subsections) to organize content hierarchically.
- Why Follow This Practice
  - Improves Navigation: Proper headings allow users to understand the structure of the content and navigate efficiently.
  - Assistive Technology Compatibility: Screen readers use headings to let users jump between sections.
- Target Disabilities
  - Visual Impairments: Users relying on screen readers can navigate through headings.
  - Cognitive Disabilities: Clear structure aids comprehension for users with learning or attention difficulties.

1. Text Content - Lists and Tables

- Best Practice
  - Use built-in list functions and table structures rather than manually creating them with spaces or tabs.
- Why Follow This Practice
  - Semantic Meaning: Proper list and table elements convey meaning to assistive technologies.
  - Navigation: Users can move through list items or table cells systematically.
- Target Disabilities
  - Visual Impairments: Screen readers can announce lists and table headers accurately.
  - Motor Disabilities: Keyboard navigation is more effective with proper structures.

1. Text Content - Readable Fonts

- Best Practice
  - Use clear, sans-serif fonts (e.g., Arial, Verdana) at an adequate size (12pt or larger) with sufficient spacing.
- Why Follow This Practice
  - Enhances Legibility: Improves readability for all users, reducing eye strain.
  - Ease of Processing: Simple fonts are easier to read and process.
- Target Disabilities
  - Visual Impairments: Users with low vision benefit from clear and larger fonts.
  - Dyslexia: Simple fonts can reduce reading errors.

1. Text Content – Demo / Example

2. Images – Alt Text

- Best Practice
  - Provide descriptive alternative text (alt text) for all meaningful images.
- Why Follow This Practice
  - Conveys Information: Allows users who cannot see images to understand their content and function.
  - SEO Benefits: Improves search engine indexing.
- Target Disabilities
  - Blindness or Low Vision: Screen readers read alt text aloud.
  - Cognitive Disabilities: Descriptions can aid understanding.

2. Images – Complex Images

- Best Practice
  - Offer detailed descriptions for charts, graphs, and diagrams, either as captions or linked descriptions.
- Why Follow This Practice
  - Accessibility of Data: Ensures that complex visual data is accessible to those who can't see it.
  - Comprehension: Aids in understanding complex information.
- Target Disabilities
  - Visual Impairments: Provides access to visual data.
  - Color Blindness: Users who can't distinguish colors can understand content through descriptions.

2. Images – Demo / Example

2. Images – Demo / Example

3. Multimedia - Videos

- Best Practice
  - Include synchronized captions and provide transcripts for all video content.
- Why Follow This Practice
  - Access to Audio Information: Captions convey spoken words and sounds.
  - Multilingual Support: Helps non-native speakers understand content.
- Target Disabilities
  - Deaf or Hard of Hearing: Provides access to auditory information.
  - Auditory Processing Disorders: Reading captions can enhance comprehension.

3. Multimedia – Audio Content

- Best Practice
  - Provide transcripts for audio-only content like podcasts.
- Why Follow This Practice
  - Alternative Format: Allows users to access content in text form.
  - Searchability: Text can be searched and referenced easily.
- Target Disabilities
  - Deaf or Hard of Hearing: Access to content without relying on hearing.
  - Cognitive Disabilities: Some users prefer reading to listening.

3. Multimedia – Avoid Auto Play

- Best Practice
  - Do not set audio or video content to play automatically upon page load.
- Why Follow This Practice
  - User Control: Prevents unexpected sounds that can startle or disorient users.
  - Bandwidth Considerations: Reduces unnecessary data usage.
- Target Disabilities
  - Cognitive Disabilities: Prevents confusion and sensory overload.
  - Anxiety Disorders: Reduces stress from unexpected stimuli.

3. Multimedia – Demo / Example

4. Color and Contrast – Hight Contrast Ratios

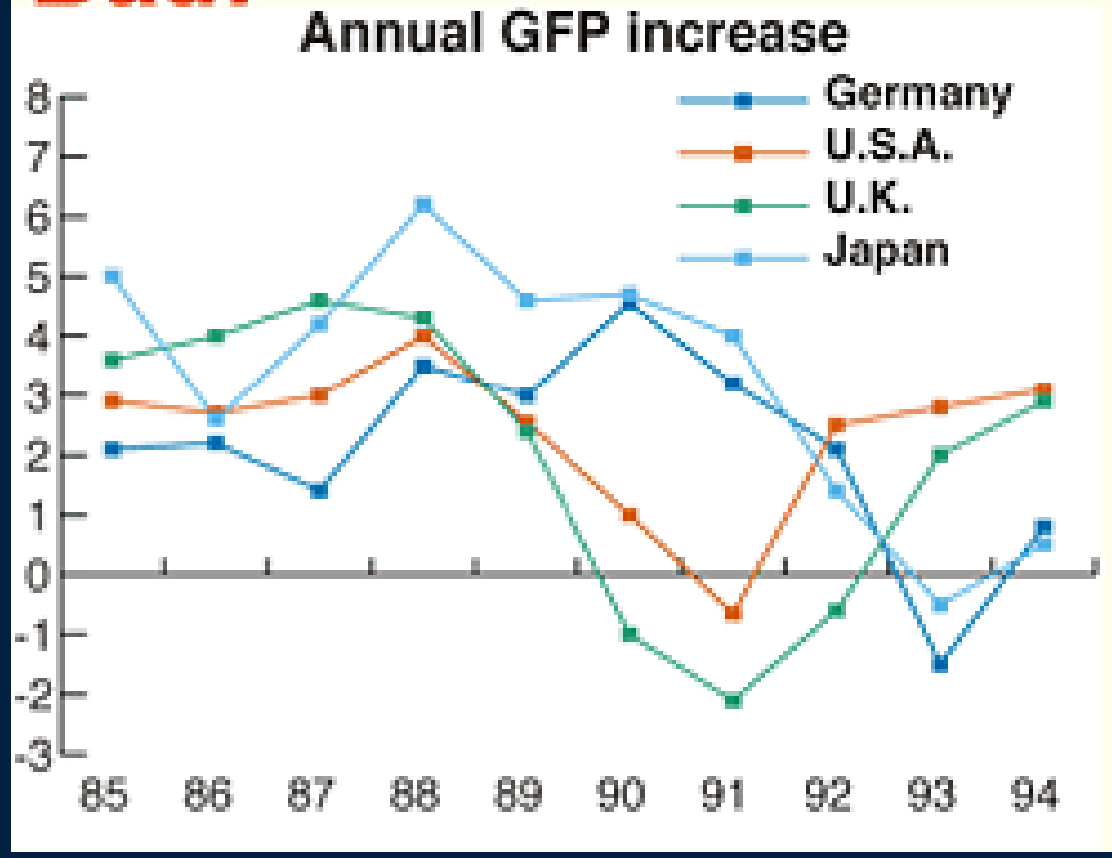
- Best Practice
  - Ensure text and background colors have sufficient contrast (minimum ratio of 4.5:1 as per WCAG).
  - 7:1 is the recommended
- Why Follow This Practice
  - Readability: Improves legibility of text, especially in low-light conditions.
  - Eye Strain Reduction: Eases reading over extended periods.
- Target Disabilities:
  - Low Vision: Enhances Readability for users with visual impairments.
  - Color Vision Deficiency: Helps users who have difficulty distinguishing colors.

4. Color and Contrast – Avoid Color Alone

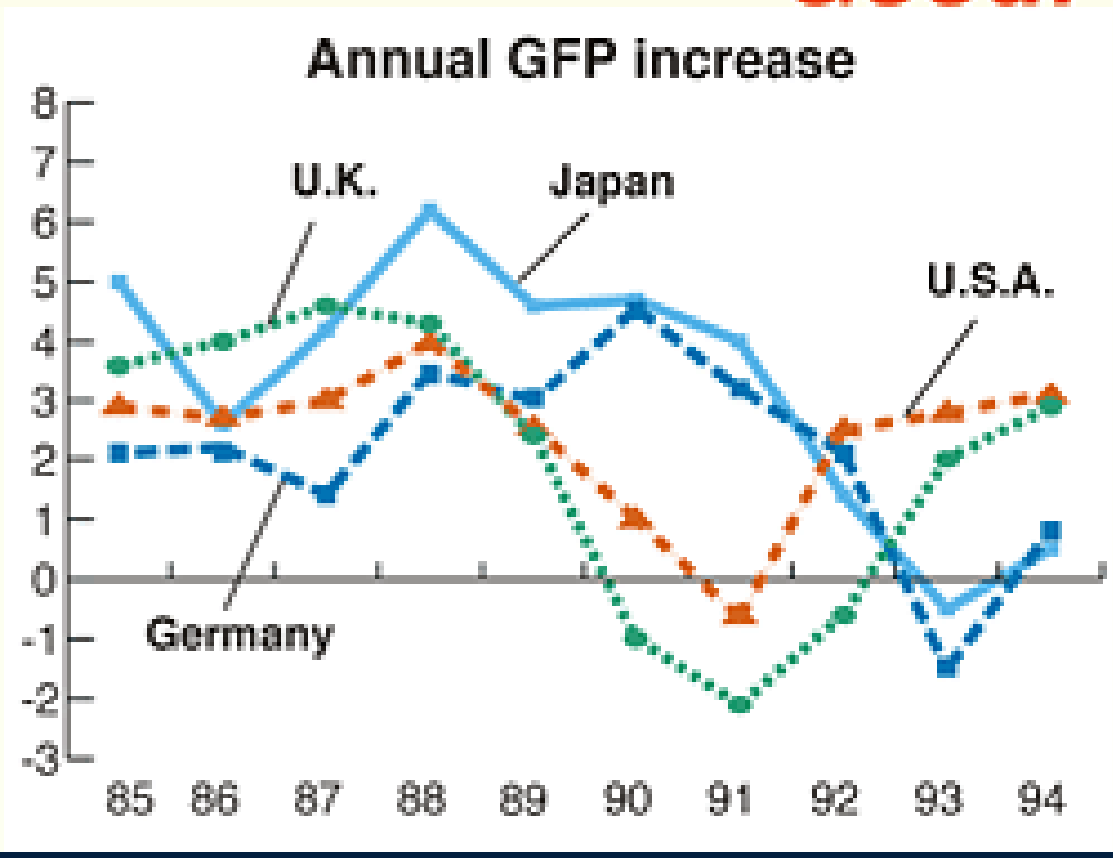
- Best Practice
  - Do not rely solely on color to convey information; use text labels or patterns in addition.
  - Available ✅ and Sold Out ❌ next to the items.
- Why Follow This Practice
  - Inclusivity: Ensures information is accessible to those who cannot perceive color differences.
  - Clarity: Reduces misinterpretation of content.
- Target Disabilities
  - Color Blindness: Users who cannot distinguish certain colors.
  - Visual Impairments: Users with difficulty perceiving color contrasts.

4. Color and Contrast – Demo/Example

Bad!



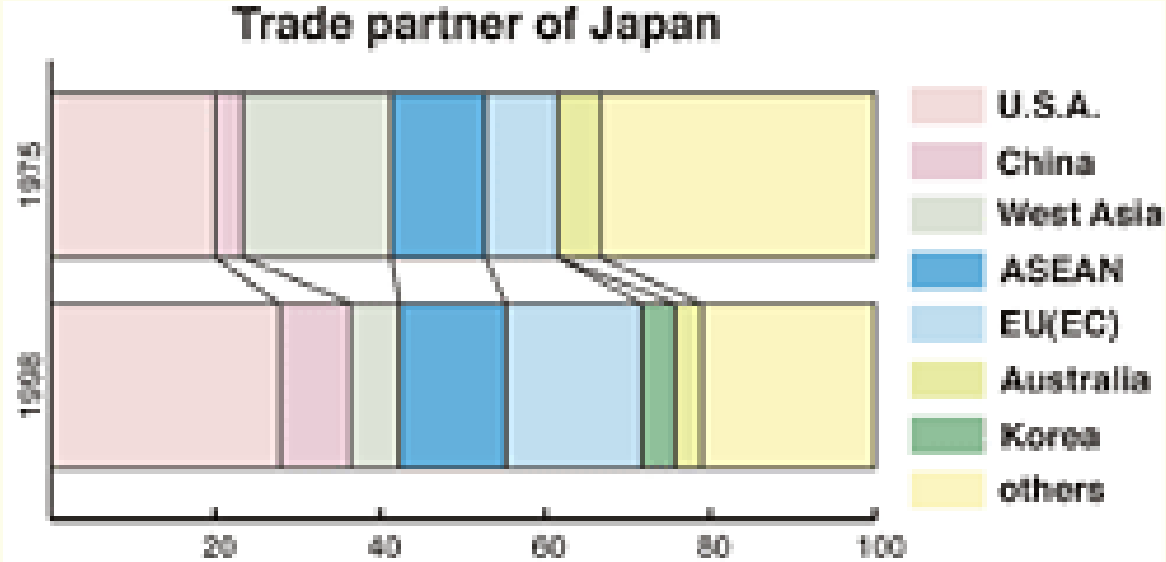
Good!



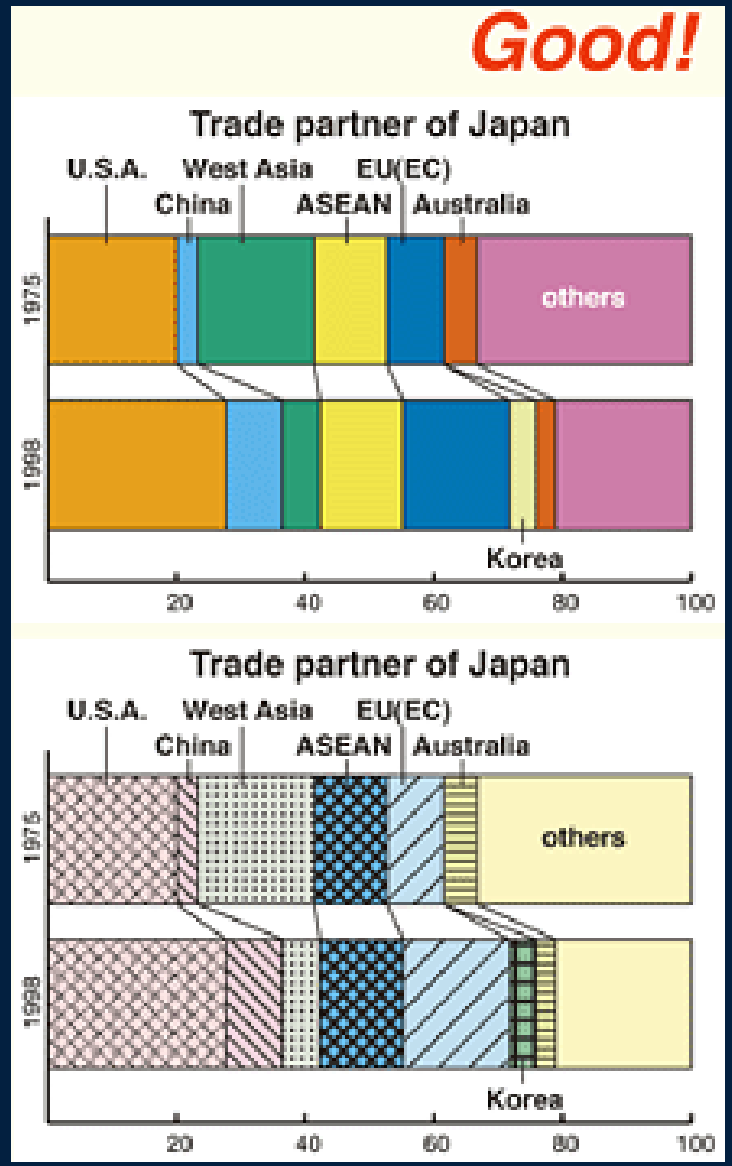
Source: https://jfly.uni-koeln.de/color/

4. Color and Contrast – Demo/Example

Bad!



Good!



Source: https://jfly.uni-koeln.de/color/

6. Navigation and Interactivity - Consistent Navigation

- Best Practice
  - Maintain the same navigation menus and placement across all pages.
- Why Follow This Practice
  - Predictability: Users know where to find navigation elements.
  - Efficiency: Reduces the learning curve for navigating content.
- Target Disabilities
  - Cognitive Disabilities: Aids memory and reduces confusion.
  - Autism Spectrum Disorders: Predictability can reduce anxiety.

5. Navigation and Interactivity - Keyboard Accessibility

- Best Practice
  - Ensure all interactive elements can be used with keyboard navigation (e.g., tabbing through links, activating buttons with 'Enter' or 'Space’).
- Why Follow This Practice
  - Alternative Input Methods: Supports users who cannot use a mouse.
  - Assistive Technology Compatibility: Many assistive devices emulate keyboard input.
- Target Disabilities
  - Motor Disabilities: Users with limited fine motor skills.
  - Visual Impairments: Screen reader users often rely on keyboard navigation.

5. Navigation and Interactivity - Descriptive Links

- Best Practice
  - Use clear and specific link text that indicates the destination or function (e.g., "Download Report," "View Case Study").
- Why Follow This Practice
  - Clarity: Users understand what will happen when they activate the link.
  - Navigation Efficiency: Assists in scanning content for relevant links.
- Target Disabilities
  - Cognitive Disabilities: Reduces ambiguity and confusion.
  - Screen Reader Users: Can navigate links more effectively.

5. Navigation and Interactivity – Demo / Example

- Hyperlinks
  - Click here to go to the LTU website.
  - Navigate to the Lulea University of Technology Website
  - Visit https://www.ltu.se for more details
- Use URL Shorteners, But Make the Back-Half Descriptive

Instead of

- ❌ bit.ly/2Af3XyZ
- ❌ tinyurl.com/y6p8b99x

Use:

- ✅ bit.ly/AccessibilityGuide
- ✅ tinyurl.com/SwedenWebAccessibility

How to?

1. Document Accessibility - Use Accessibility Features

- Best Practice
  - Utilize built-in accessibility features when creating documents (e.g., styles in Word, slide templates in PowerPoint).
- Why Follow This Practice
  - Structured Content: Ensures documents have a logical reading order.
  - Assistive Technology Compatibility: Enhances usability with screen readers.
- Target Disabilities
  - Visual Impairments: Proper structure aids navigation with assistive technologies.
  - Learning Disabilities: Consistent formatting improves comprehension.

1. Document Accessibility - Accessibility Checker Tools

- Best Practice
  - Use built-in accessibility checkers (e.g., in Microsoft Office, Adobe Acrobat) to identify and fix issues.
- Why Follow This Practice
  - Error Detection: Helps catch common accessibility problems.
  - Education: Teaches creators about accessibility considerations.

2. Testing and Validation – Manual Testing

- Best Practice
  - Personally test content using assistive technologies (e.g., navigate with a keyboard, use a screen reader).
- Why Follow This Practice
  - User Perspective: Gain insight into the actual user experience.
  - Identify Issues: Catch problems automated tools may miss.

2. Testing and Validation – Automated Tools

- Best Practice
  - Employ automated accessibility evaluation tools (e.g., WAVE, Axe) to scan for compliance issues.
- Why Follow This Practice
  - Efficiency: Quickly identify widespread issues.
  - Compliance Assurance: Helps ensure adherence to standards like WCAG.

2. Testing and Validation – User Feedback

- Best Practice
  - Encourage feedback from users with disabilities to improve accessibility.
- Why Follow This Practice
  - Real-World Input: Users can provide insights that testing may not reveal.
  - Continuous Improvement: Adapt to new challenges and needs.

3. Continuous Improvement – Stay Updated

- Best Practice
  - Keep abreast of updates to accessibility guidelines and best practices (e.g., WCAG updates).
- Why Follow This Practice
  - Relevance: Ensure content remains accessible as standards evolve.
  - Innovation: Adopt new techniques that enhance accessibility.

4. Continuous Improvement – Training and Resources

- Best Practice
  - Engage in ongoing training and share accessibility resources with your team.
- Why Follow This Practice
  - Skill Enhancement: Builds expertise in creating accessible content.
  - Culture of Accessibility: Fosters an inclusive mindset.

4. Continuous Improvement – Institutional Policies

- Best Practice
  - Develop and enforce institutional policies that prioritize accessibility.
- Why Follow This Practice
  - Consistency: Ensures all content meets accessibility standards.
  - Accountability: Establishes clear responsibilities.

Summary

- Download the Resource guide by Sarah Mercier.

Interactive Task 1: Accessibility Audit

Goals

- Find issues in the document or
- Find issues in a web page

Audit

- Analyze this Word document at the Accessible University demo website
- Analyze this PowerPoint document at the Accessible University demo website

Interactive Task 2: Fix the document

Goals

- Use some best practices your learned today to fix the document

Fix the three documents from last session

- Fix this Word document at the Accessible University demo website
- Fix this PowerPoint document at the Accessible University demo website

Next steps

Get certified

- Interested to get certified?
- Here is an edX course
  - https://www.edx.org/learn/web-accessibility/the-world-wide-web-consortium-w3c-introduction-to-web-accessibility
  - HPC links from LTU – very brief
    - The link to the english version of the guide:
      - https://ltu.instante.se/HPC/Kurser/improve-accessibility-in-your-teaching/content/index.html#/
    - Link to the swedish version of the guide:
      - https://ltu.instante.se/HPC/Kurser/gor-din-undervisning-mer-tillganglig/content/index.html#/
- Certification from the International Association of Accessibility Professionals (IAAP)
  - https://www.accessibilityassociation.org/s/certification
  - https://www.accessibilityassociation.org/s/certified-professional

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- Sarah Mercier talk at the Adobe Learning Summit 2024
- IEEE Industrial Electronics Society (IES)
- Luleå University of Technology.
- Last but not least
  - You all, thank you for taking an interest in this topic

One Last Thing – Please give your feedback

https://forms.office.com/e/dBHKY7U9NK


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