Accessible Web Mapping Apps

ARIA, WCAG and 508 Compliance

Kelly Hutchins

Tao Zhang

Agenda

- Introduction
- Section 508 and WCAG
- Knowledge and Techniques
  - Focus
  - Semantic HTML
  - WAI-ARIA and accessible components
- Demo
- Automated Testing
- Resources

Diversity of Users

- About 15% of world population lives with some form of disability
- 1 Billion People

Forms of Disability

Visual

Motor

Auditory

Cognitive

Visual

A broad range from **no vision** (total blindness) to **limited or low vision**

Motor

Users may prefer not to use a mouse, have **RSI** (Repetitive Strain Injury), or physical **paralysis** and **limited range of motion**

Auditory

Users may be **completely deaf** or **hard of hearing**

Cognitive

A broad range including:

- Learning disabilities
- Reading disorders(**dyslexia**)
- Attention deficit disorders(**ADHD** and **autism**)

Far more users with cognitive disabilities than all the other types of disabilities combined

Benefits of Accessibility

- Accessible interfaces is about good design and coding practice
- Good accessibility is good user experience
- Accessibility will enhance design, not destroy it

Section 508 and WCAG

Section 508

- The Rehabilitation Act of 1973
- Mandates that people with disabilities have **same access to and use** of ICT (Information and Communication Technology) comparable to those without disabilities
- Products procured by government agencies must pass Section 508 requirements
- Recent refresh incoporates WCAG 2.0 Level A and AA success criteria
  - Published: Jan. 18, 2017
  - Enforcement: Jan. 18, 2018

Overview of WCAG 2.0

Principles	Success Criteria	Level A	Level AA	Level AAA
1. Perceivable	1.1 Text Alternatives	1.1.1		
	1.2 Time-based Media	1.2.1 – 1.2.3	1.2.4 – 1.2.5	1.2.6 – 1.2.9
	1.3 Adaptable	1.3.1 – 1.3.3		
	1.4 Distinguishable	1.4.1 – 1.4.2	1.4.3 – 1.4.5	1.4.6 – 1.4.9
2. Operable	2.1 Keyboard Accessible	2.1.1 – 2.1.2		2.1.3
	2.2 Enough Time	2.2.1 – 2.2.2		2.2.3 – 2.2.5
	2.3 Seizures	2.3.1		2.3.2
	2.4 Navigable	2.4.1 – 2.4.4	2.4.5 – 2.4.7	2.4.8 – 2.4.10
3. Understandable	3.1 Readable	3.1.1	3.1.2	3.1.3 – 3.1.6
	3.2 Predictable	3.2.1 – 3.2.2	3.2.3 – 3.2.4	3.2.5
	3.3 Input Assistance	3.3.1 – 3.3.2	3.3.3 – 3.3.4	3.3.5 – 3.3.6
4. Robust	4.1 Compatible	4.1.1 – 4.1.2		

Level of Conformance

- Level **A**: Sets a minimum level of accessibility and does not achieve broad accessibility for many situations.
- Level **AA**: Generally recommended for web-based information.
- Level **AAA**: W3C does not recommend be required as general policy because it is not possible to satisfy all Level AAA Success Criteria for some content.

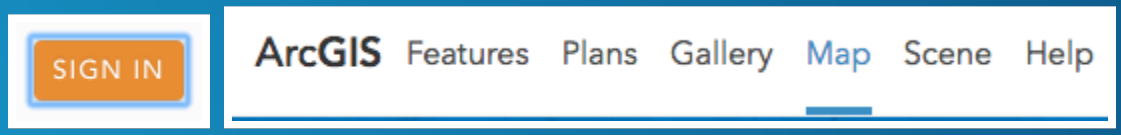
Knowledge and Techniques

- Focus
- Semantic HTML
- WAI-ARIA and accessible components

Focus

Introduction

- **Focus**: Which control on the screen currently receives input from keyboard.
- Focus ring: visual focus indicator, style depending on browser and page style.



- **Tab order**: The order in which focus proceeds forward and backward through interactive elements via Tab key.

Focusable elements

- Native interactive HTML elements are focusable:
  - Text fields, Buttons, Links, Select lists ...
- (Normally) not focusable:
  - `<p>`, `<div>`, `<span>`, `<h1>` ...
- Only focus elements that keyboard users need to interact with
- Screen reader users have ways to read focusable and non-focusable elements

Tab order matters

WCAG 1.3.2: Reading and navigation order, as determined by DOM structure, should be logical and intuitive.

- Be careful changing visual position of elements on screen using CSS
- Avoid jumping around tab order

Offscreen elements

- Example: Calcite drawer pattern
- Prevent element from gaining focus when off screen

```
display:none;
visibility:hidden; /* alternative */
```

- Only allow it to be focused when user can interact with it

```
display:block;
visibility:visible; /* alternative */
```

Test

- Tab through page to see tab order doesn't disappear or jump out of logical sequence
- Make sure to hide offscreen content
- Rearrange elements' position in the DOM if necessary

Manage focus

- `tabindex="0"`: let natural DOM structure determine tab order
- `tabindex="-1"`: programmatically move focus (e.g., error message, menus, radio buttons, etc.)
- `tabindex="5"`: anti-pattern

Focus management example

Customized menu

```
<menu-list>
<!-- After the user presses the down arrow key,
focus the next available child -->
<menu-item tabindex="0">Map</menu-item>

<!-- call .focus() on this element -->
<menu-item tabindex="-1">Layer</menu-item>

<menu-item tabindex="-1">Scene</menu-item>
<menu-item tabindex="-1">Tool</menu-item>
<menu-item tabindex="-1">Data</menu-item>
</menu-list>
```

Example code

Keyboard traps

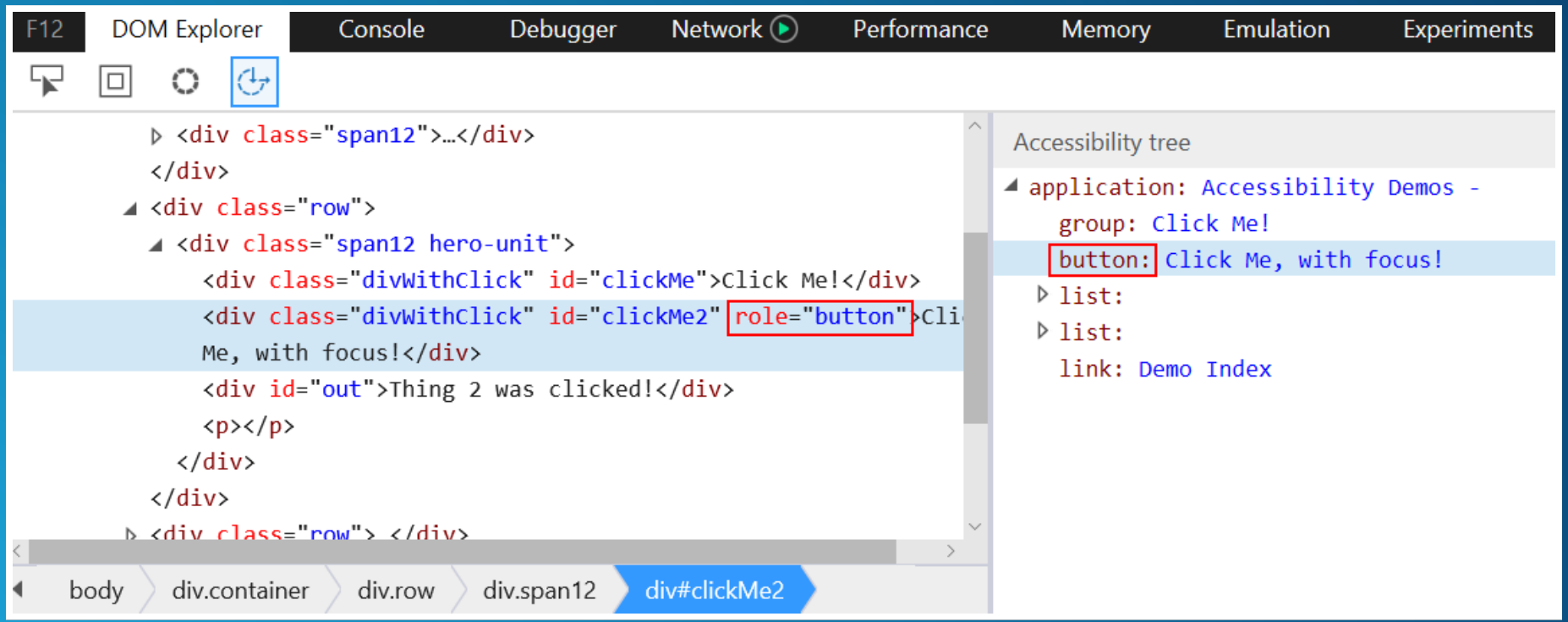
- Keyboard focus should not be locked or trapped at one particular element.
- **Temporary** keyboard trap is necessary for modal dialogs:
  - When modal is displayed: trap focus inside modal.
  - When modal is closed: restore focus to previously focused item.
  - Demo
  - Example code

Semantic HTML

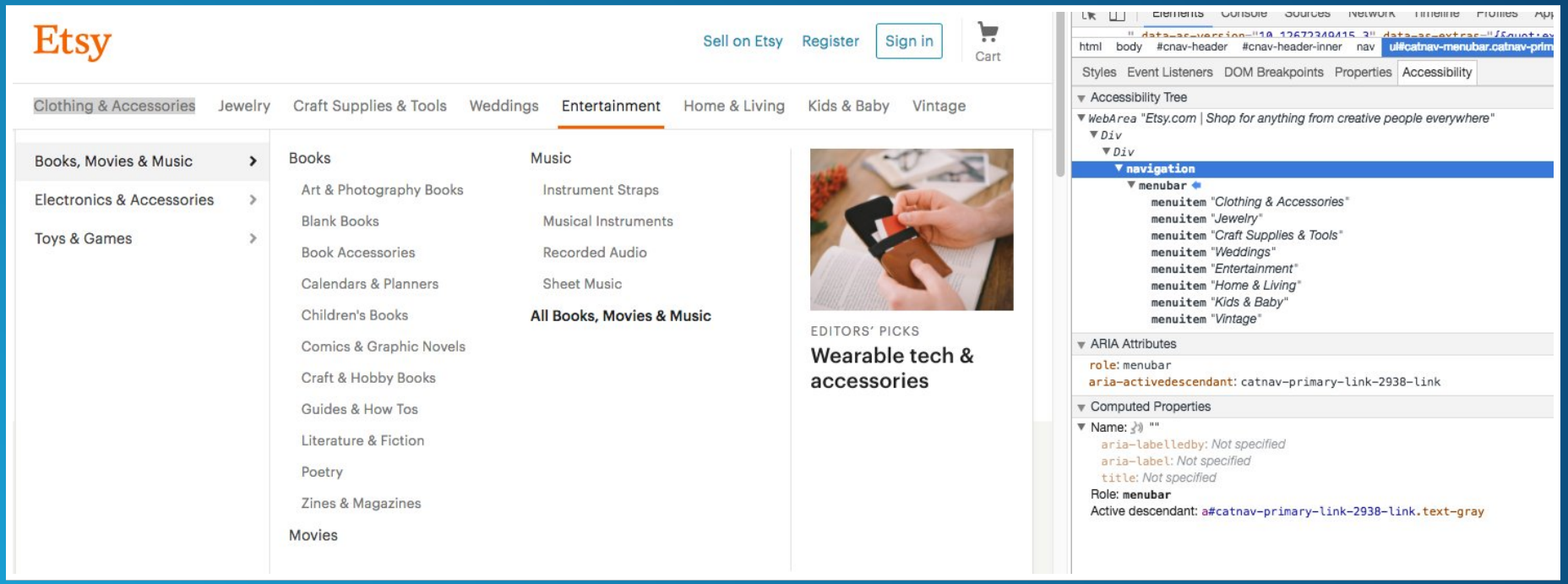
Accessibility tree

Browser's responsibility to expose accessibility tree to assistive technologies.

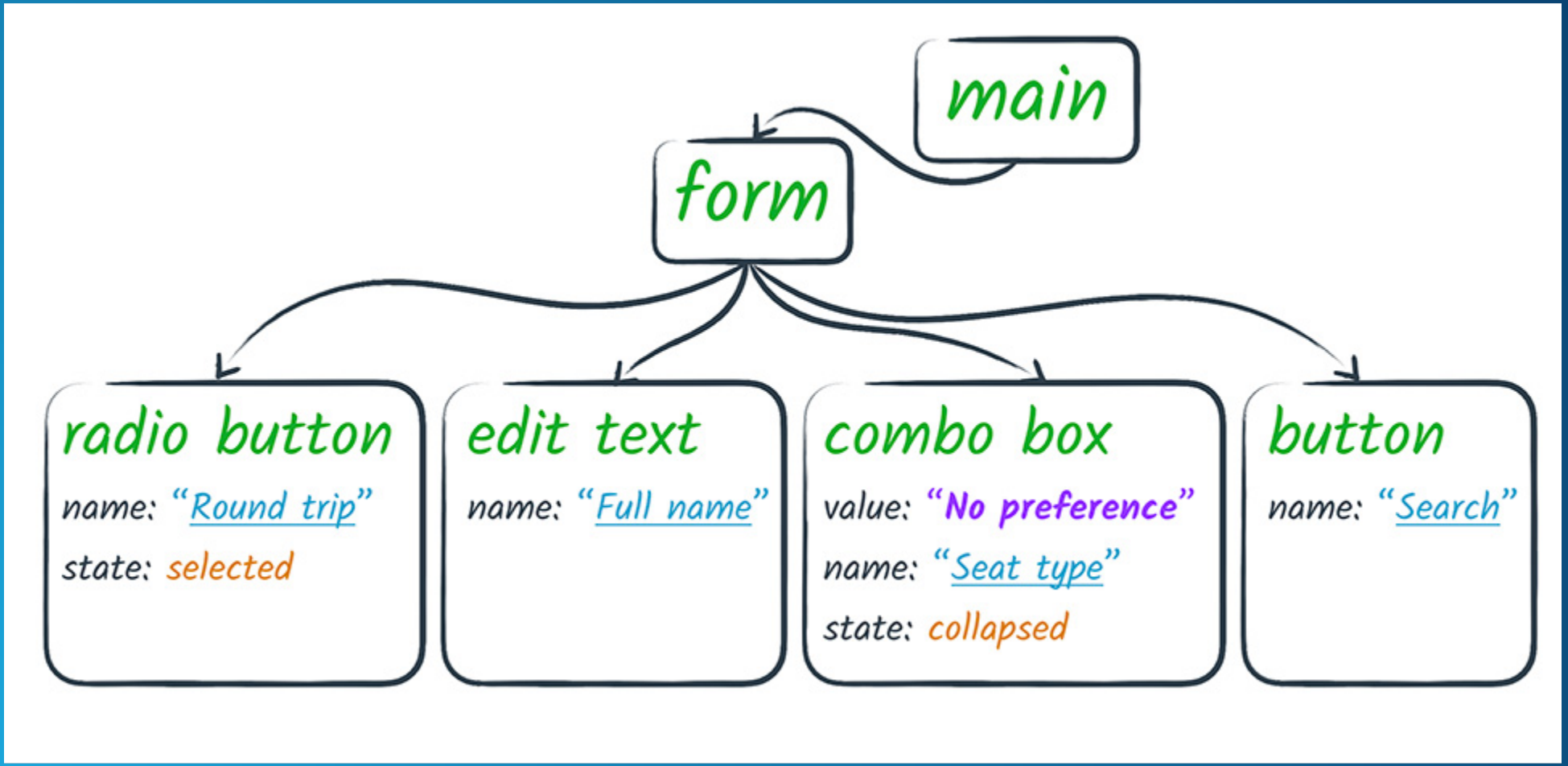
Microsoft Edge's accessibility tree view



Chrome Canary's accessibility tree view



Shows how website is interpreted by assistive technologies and how accessible data are provided.



- Assistive technologies simulate and relay user interactions like click and key press to accessibility tree.
- As developers, we need to:
  - Express the semantics of page correctly.
  - Specify accessible names and descriptions.
  - Make sure important elements have correct accessible roles, states, and properties.

Semantics in native HTML

- Most HTML elements have implicit semantics (**role** and **state**).
- Native HTML elements work predictably across browsers
  - Take advantage of this!

Example:

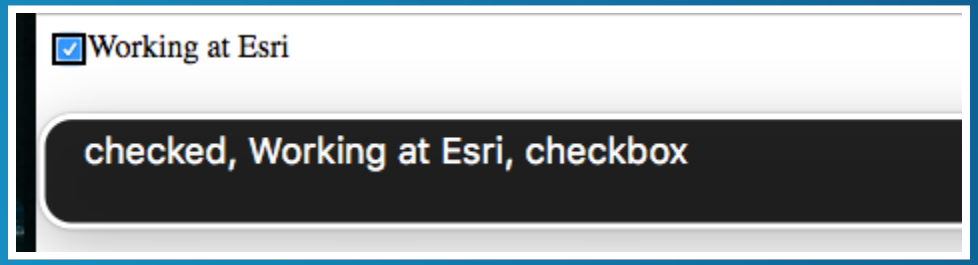
```
<a href="http://www.esri.com">Esri Homepage</a>
```

- Role="link"
- Accessible name="Esri Homepage"
- State="focusable"

Example:

```
<label><input type="checkbox" checked>Working at E
```

- Role="checkbox"
- Accessible name="Working at Esri"
- State="focusable checked"



Keyboard

- Native interactive HTML elements receive keyboard focus:
  - `<a>`, `<button>`, `<input>`...
- Tab order follows DOM order of interactive elements
- Interactive elements have expected interactions:
  - Link: click, tap, or Enter key
  - Button: click, tap, Enter key, or Space key
  - Input: click, tap, or Enter key

Neutral semantics

- Some HTML elements do not convey semantics (role or state)
  - `<div>This is a block area</div>`
  - `<span>This is an inline area</span>`

If the element is interactive, we need to do extra work:

- Make it **focusable**: `tabindex="0"`
- Receive **keyboard events**: Enter, Space
- **Name**: explicit label (`label`) or implicit text (`aria-label`, `aria-labelledby`)
- **Role**
- **States** and **properties**

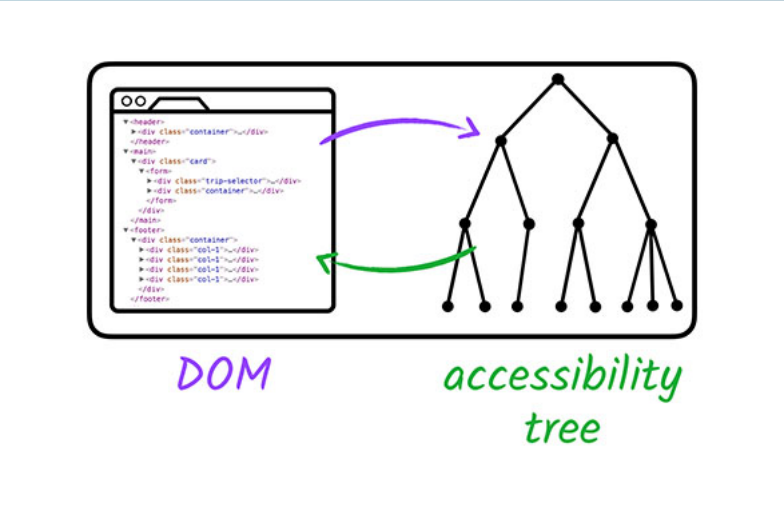
WAI-ARIA

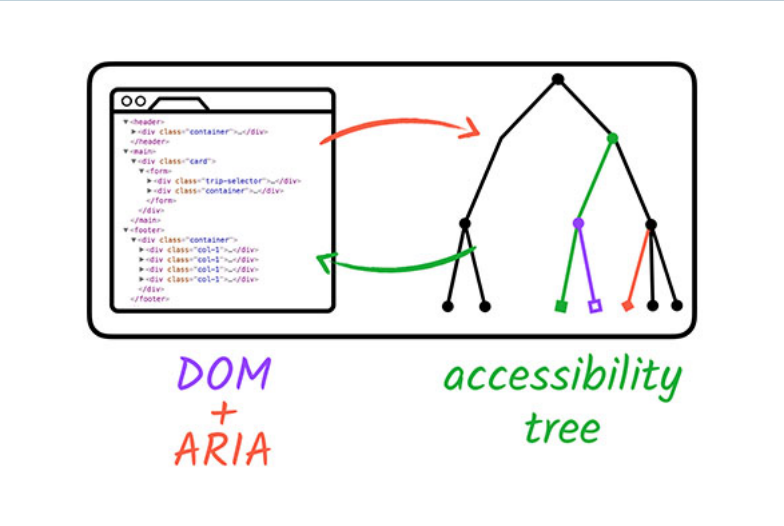
Why need ARIA

- Use Native HTML semantics whenever possible
- Certain semantics and design patterns make it impossible to use native HTML semantics.
- Example: a pop-up menu, no standard HTML element
- Example: a semantic characteristic "the user needs to know about this as soon as possible"

What is WAI-ARIA

- Specification for increasing accessibility of custom elements
- Allows developers to modify and augment accessibility tree from standard DOM





ARIA doesn't augment any of the element's inherent behavior:

- Focusable
- Keyboard event listeners

Custom behaviors still need to be implemented

ARIA attributes

- **Roles**: meaning of an element
  - `tooltip`, `tablist`, `search`
- **Properties**: relationships and functions
  - `aria-required`, `aria-controls`
  - `aria-label`, `aria-labelledby`
- **States**: current interaction states
  - `aria-checked`, `aria-expanded`, `aria-hidden`

An ARIA example

```
<li tabindex="0" class="checkbox" checked>
    Show premium content
</li>
```

- Sighted users see a checkbox as a result of CSS `class="checkbox"`.
- Screen reader users will not know this is meant to be a checkbox.

An ARIA example

```
<li tabindex="0" class="checkbox" role="checkbox"
aria-checked="true">
    Show premium content
</li>
```

Screen reader will report this as a checkbox.

Roles

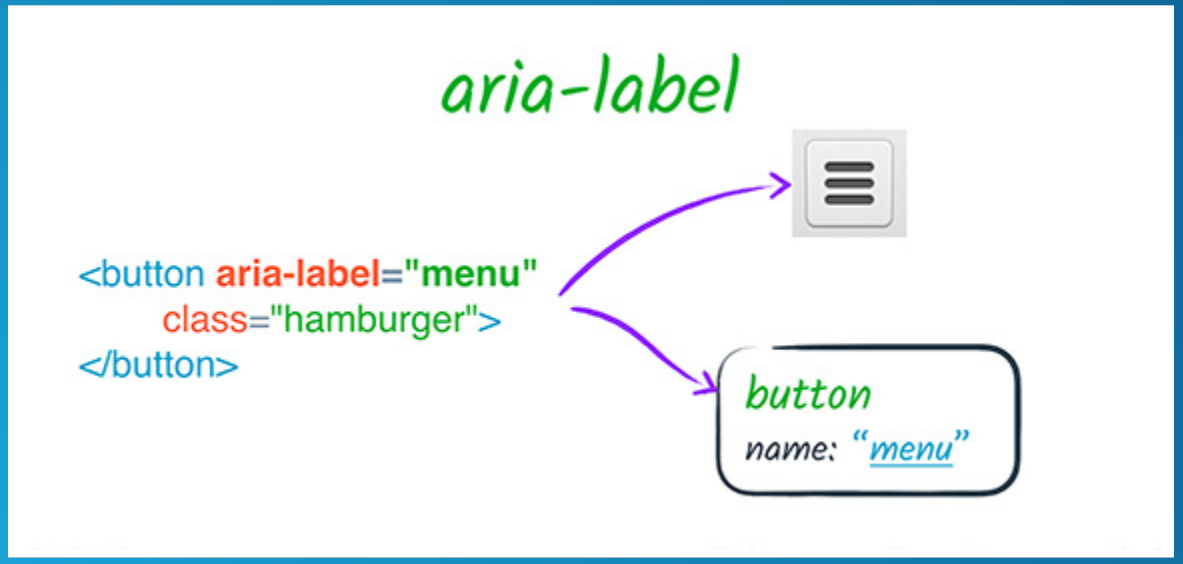
- Landmarks
  - `banner`: The main header of a page; typically assigned to a header element.
  - `contentinfo`: A collection of metadata, copyright information and the like.
  - `main`: the main content of a document.
  - `navigation`: A collection of links for navigation.

Roles

- Widgets
  - `alert`
  - `dialog`
  - `data grid`
  - `tab`
  - `tablist`
  - `tabpanel`

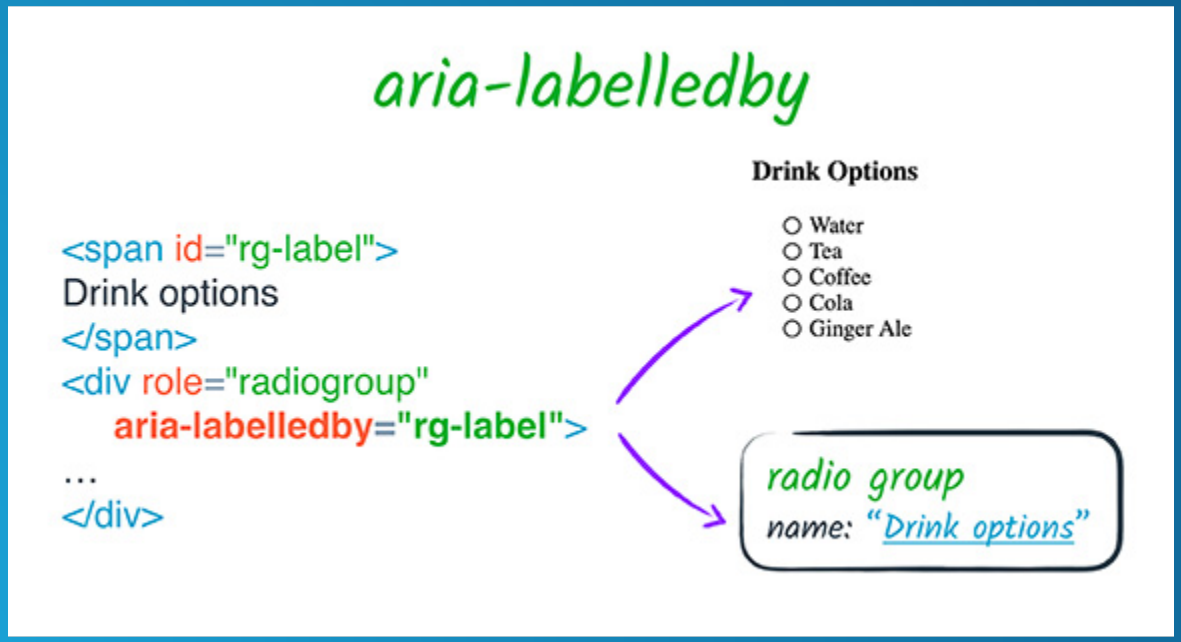
Labels

- `aria-label`
- Specifies a string as accessible label
- Overrides native labeling



Labels

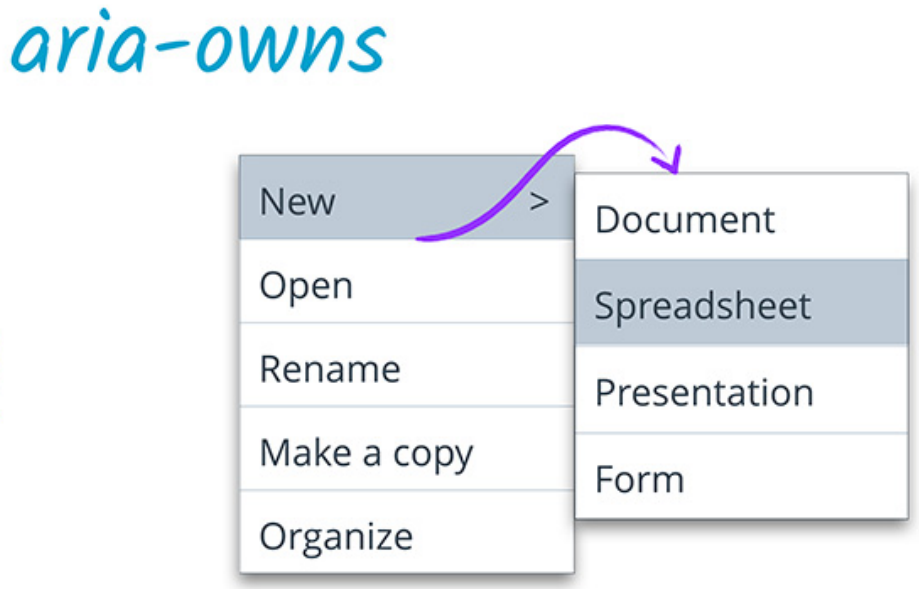
- `aria-labelledby`
  - Specifies `id` of another DOM element (or a list of `id`)
  - Overrides all other name sources
  - Applicable to any element, not just labelable elements
  - Can specify visually hidden elements



Relationships

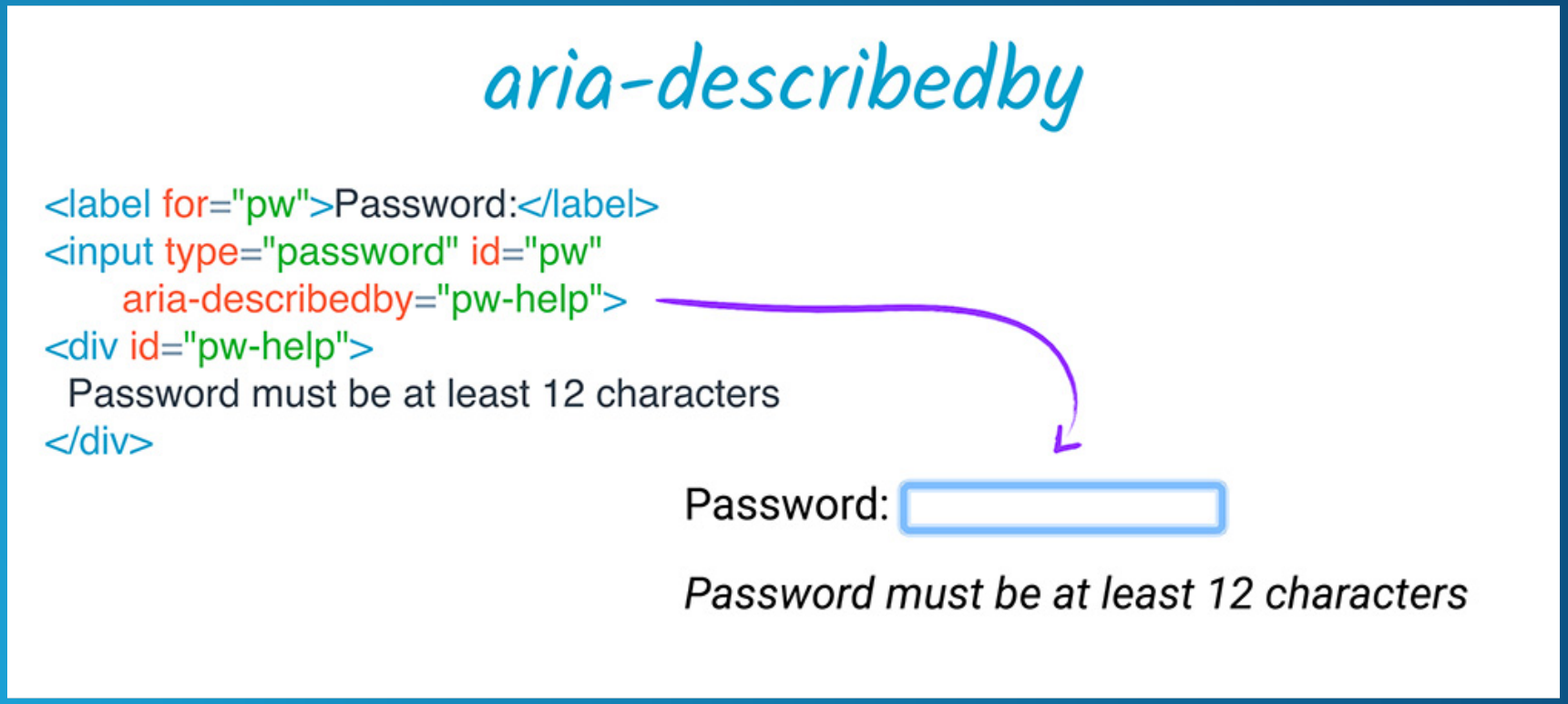
- `aria-owns`
  - Indicates an element should be treated as parent of another separate DOM element

```
<div role="menu">
  <div role="menuitem"
      aria-haspopup="true">
    New
  </div>
  <div aria-owns="submenu">
  </div>
  <!-- more items… -->
</div> <!-- menu -->
<div role="menu" id="submenu">
  <div role="menuitem">
    Document
  </div>
  <!-- more items… -->
</div> <!-- submenu -->
```



Relationships

- `aria-describedby`
  - Provides accessible description for an element
  - References elements in the DOM separated from current element



Relationships

- `aria-controls`
  - Indicates an element "controls" another element in interaction

```
<div role="scrollbar" aria-controls="main"></div>
<div id="main">
. . .
</div>
```

Hide elements

- Elements explicitly hidden from the DOM will not be included in accessibility tree

```
[hidden] {
  display: none; /*not rendered, no space allocated */
}
[invisible] {
  visibility: hidden; /*rendered, space allocated*/
}
```

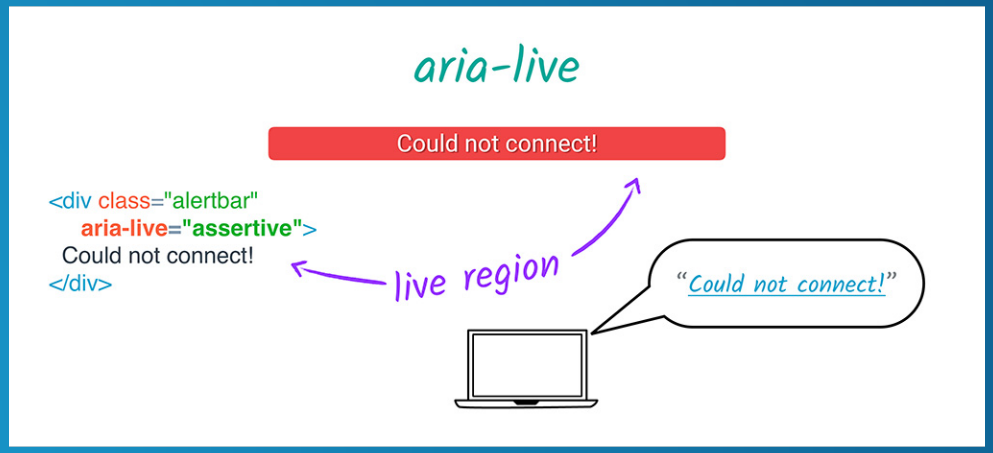
- Elements not visually rendered but not explicitly hidden is still included in accessibility tree.

```
/* Screen reader only*/
.sr-only {
  position: absolute;
  left: -10000px;
  width: 1px;
  height: 1px;
  overflow: hidden;
}
```

- `aria-hidden`
  - Excludes content from assistive technology that is not visually hidden.
  - Removes current element and all of its descendants from the accessibility tree.

Update elements

- `role="alert"`
- `aria-live`
  - Marks element as "live region" in which updates should be communicated to users immediately.
  - `aria-live="polite"`: alert user when screen reader has finished current action
  - `aria-live="assertive"`: interrupt current action and alert user immediately



ARIA best practices

1. Do not change native semantics, unless you *really* have to.

- Example: A developer wants to implement a heading which is also a button.
- Don't do this:

```
<h2 role="button">heading button</h2>
```

- Do this:

```
<h2><button>heading button</button></h2>
```

2. All interactive ARIA elements must be usable with keyboard.

- The elements should respond to standard key strokes.
  - Example: If using `role="button"`, add `tabindex="0"` and support Enter and Space actions.
- The user must be able to navigate and perform actions using keyboard.
  - Example: If allowing clicking through data grid, support navigating grid cells using keyboard.

3. Do not use `role="presentation"` or `aria-hidden="true"` on a visible and focusable element.

- This will result in focusing on "nothing".
- Don't do these:

```
<button role="presentation">Press me</button>
<button aria-hidden="true">Press me</button>
```

4. All interactive elements must have an accessible label or name.

Do this:

```
<label>
        Email
        <input type="text" placeholder="name@exam
</label>
```

Create Accessible Web Components

ARIA Design Patterns

W3C Working Draft

TABLE OF CONTENTS

WAI-ARIA Authoring Practices 1.1

W3C Working Draft 17 March 2016

This version:
http://www.w3.org/TR/2016/WD-wai-aria-practices-1.1-20160317/

Latest published version:
http://www.w3.org/TR/wai-aria-practices-1.1/

Latest editor's draft:
http://w3c.github.io/aria/practices/aria-practices.html

Previous version:
http://www.w3.org/TR/2015/WD-wai-aria-practices-1.1-20151119/

Editors:
Matt King, Facebook, mck@fb.com
James Nurthen, Oracle Corporation, james.nurthen@oracle.com
Michael Cooper, W3C, cooper@w3.org
Michiel Bijl, The Paciello Group, mbijl@paciellogroup.com
Joseph Scheuhammer, Inclusive Design Research Centre, OCAD University (Previous Editor)
Lisa Pappas, SAS (Previous Editor)
Rich Schwerdtfeger, IBM Corporation (Previous Editor)

Abstract

This document provides readers with an understanding of how to use *WAI-ARIA 1.1* [WAI-ARIA] to create accessible rich internet applications. It describes considerations that might not be evident to most authors from the WAI-ARIA specification alone and recommends approaches to make widgets, navigation, and behaviors accessible using WAI-ARIA roles, states, and properties. This document is directed primarily to Web application developers, but the guidance is also useful for user agent and assistive technology developers.

This document is part of the WAI-ARIA suite described in the WAI-ARIA Overview

Accessible Map

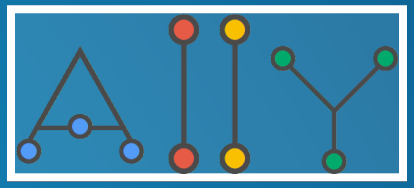
- For low-vision users:
  - Color contrast
  - Color blindness
  - Scaling and images of text
- For non-sighted users:
  - Alternative text for map's core information
  - Accessibility in Google Maps

Demo: Common Accessibility Issues

- Text alternatives
- Semantic HTML
- Tab order and focus
- Color
- Label

Automated Testing

A11Y command-line tool



by Addy Osmani

```
npm install -g a11y
a11y www.esri.com > audit.txt
```

A11Y module usage

`a11y(URL, callback)` accepts a string as input and takes a callback providing a reports object with the accessibility audit for the supplied URL.

```
var a11y = require('a11y');
a11y('esri.com', function (err, reports) {
        var output = JSON.parse(reports);
        var audit = output.audit; //a11y formatte
        var report = output.report;
        //Chrome devtools accessibility audit for
        reports.audit.forEach(function (el) {
                // result will be PASS, FAIL or N
                if (el.result === 'FAIL') {
                // el.heading
                // el.severity
                // el.elements
                }
        });
```

axe-core

Accessibility engine for automated Web UI testing by dequelabs:

```
npm install axe-core --save-dev
```

```
<script src="node_modules/axe-core/axe.min.js"></s
<!-- Normal page content ... -->
<script>
        axe.run(function (err, results) {
                if (err) throw err;
                ok(results.violations.length === (
                        'Should be no accessibili
                // complete the async call
        });
</script>
```

Resources

- W3C-WCAG 2.0
- Interpretation of success criteria
- WAI-ARIA Authoring Practices 1.1
- egghead.io course: Start Building Accessible Web Applications Today
- a11y
- axe-core
- Browser plugin:
  - aXe
  - Chrome Accessibility Developer Tools
- Some of the diagrams are adapted from Google Developers: Web Fundamentals