Web Components

Custom Elements, Shadow DOM, Templates, lit-html

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Web Components

Web Platform API

What are Web Components?

- Web components are a set of **web platform APIs** that allow you to create:
  - Custom, reusable, **encapsulated HTML tags** to use in web pages and web apps
- Custom web components **benefits**:
  - Will work across **modern browsers**
  - Can be used with any JavaScript **library** or **framework** that works with HTML

Web Components - Specification

- Web Components are based on **four** main specifications:
  - Custom Elements – lays the foundation of **designing** and using **new** types of **DOM elements**
  - Shadow DOM – defines how to use **encapsulated** style and markup
  - ES Modules – import/export
  - HTML Template – declare **fragments of markup** that go unused on page load, but are instantiated later

Creating Web Components

Shadow DOM

Defining HTML Elements

- Use JavaScript to define a new HTML element and its tag with the **customElements** global

```
class AppRoot extends HTMLElement {...}

window.customElements.define('app-root', AppRoot);
```

- To use the new tag

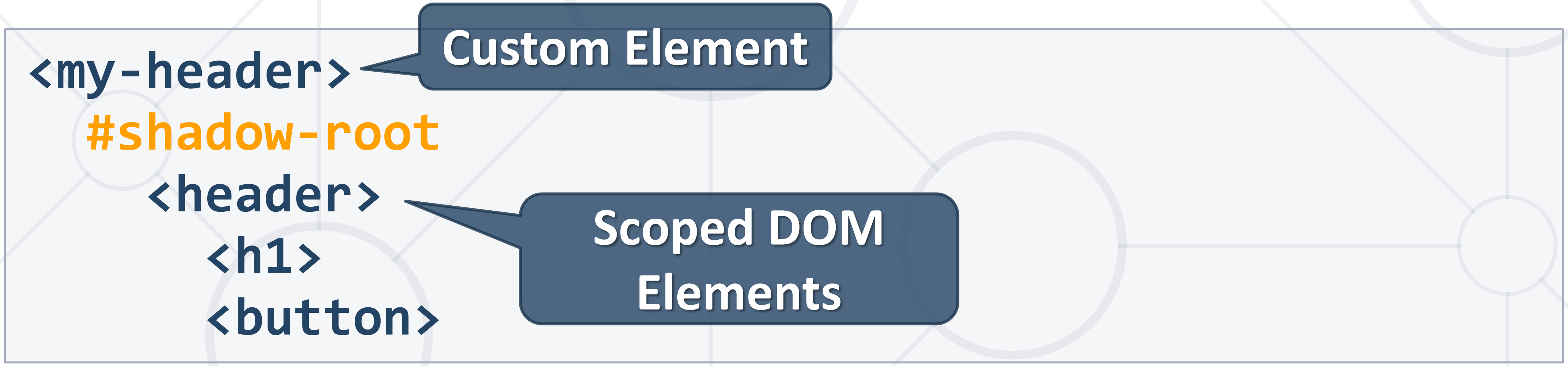
```
<app-root></app-root>
```

Shadow DOM

- Shadow DOM is a new DOM feature that helps you build components
  - You can think of shadow DOM as a **scoped subtree** inside your element
- Shadow DOM lets you place the children in a scoped subtree, so document-level CSS **can't restyle** it
- The **shadow root** is the top of the shadow tree

Shadow DOM Example

- Consider a header component that includes a **page title** and a **menu button**
- The subtree below shadow root is called a shadow tree:



```
<my-header>
  #shadow-root
    <header>
      <h1>
      <button>
```

Shadow Root & Host

- The shadow root is the top of the shadow tree
- The element that the tree is attached to (**<my-header>**) is called the shadow host
  - Has a property called **shadowRoot** that refers to the shadow root
- The shadow root has a **host** property that identifies its host element

Adding a Shadow Tree

- You can add a shadow tree to an element imperatively by calling **attachShadow**:

```
let div = document.createElement('div');

let shadowRoot = div.attachShadow({mode: 'closed'});

shadowRoot.innerHTML = '<h1>Hello Shadow DOM</h1>';
```

Could be **open** or **closed**

First Component: Example

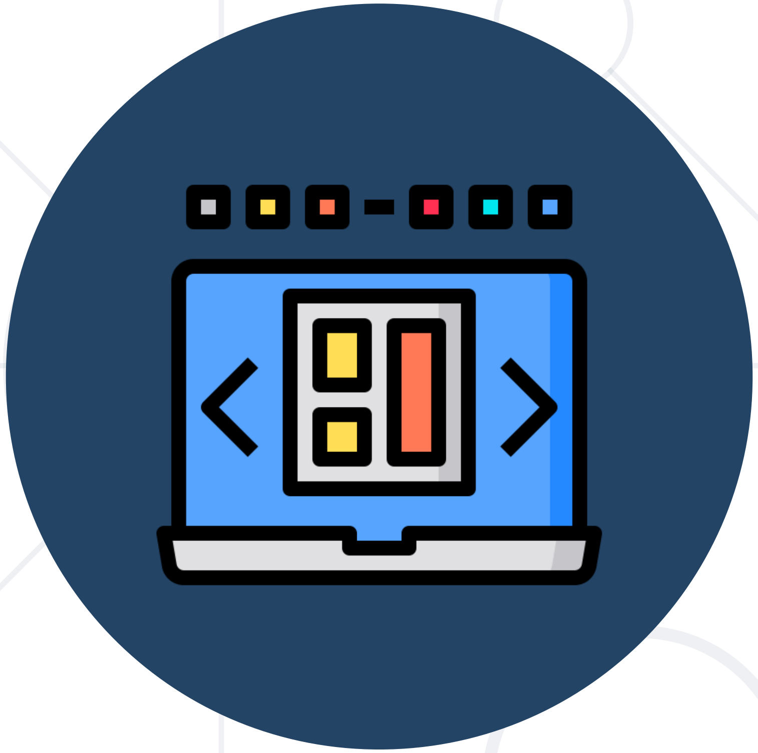
```
class AppRoot extends HTMLElement {
    constructor() {
        super();

        const root = this.attachShadow({ mode: 'closed' });

        const div = document.createElement('div');
        div.innerHTML = '<h1>Hello Shadow DOM</h1>';

        root.appendChild(div);
    }
}

customElements.define('app-root', AppRoot);
```



HTML Templates

Creating Templates & Passing Slots

The Template Tag

- The **<template>** tag is used as a container to hold some HTML content hidden from the user when the page loads
- The content inside **<template>** can be rendered later with a JavaScript

```
<template>
  <div class="container">
     <h1>App Root Name</h1>
  </div>
</template>
```

Template: Example

- `<app-root></app-root>`

```
const template = document.createElement('template');
const div = document.createElement('div');
const h1 = document.createElement('h1');
h1.textContent = this.getAttribute('app-name');
div.appendChild(h1);
template.innerHTML = div.innerHTML;

root.appendChild(template.content.cloneNode(true));
```

Retrieve passed attribute

Node **deep** cloning

Slots & Named Slots

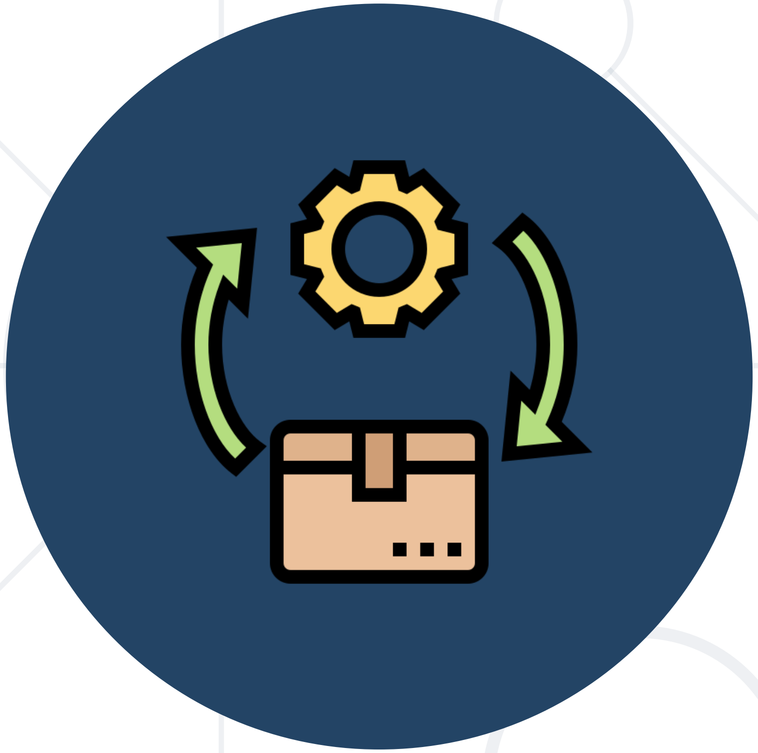
- The HTML **<slot>** element is a placeholder inside a web component that you can fill with your own markup
- This lets you create **separate DOM trees** and present them together
- A named slot is a **<slot>** element with a **name attribute**

Named Slots: Example

- Omit the passing of the attribute:

```
<app-root>
  <h1 slot="title">My App Name</h1>
</app-root>
```

```
const appRootTemplate = html`
    <div>
        <slot name="title"></slot>
    </div>
`
```



Component Lifecycle

Handling Certain Events

Component Lifecycle

- Web Components have their own **lifecycle**
- The following events happen in a Web Component's lifecycle:
  - Element is **inserted** into the DOM
  - Updates when UI **event** is **triggered**
  - Element **deleted** from the DOM
- There are **callback functions** that capture these lifecycle events and let us handle them accordingly

Lifecycle Hooks

- The following **lifecycle hooks** are in a web component:
  - constructor()
  - connectedCallback()
  - disconnectedCallback()
  - attributeChangedCallback()
  - adoptedCallback()

Example: constructor()

- The **`constructor()`** is called when the web component is **created**
- It's called when we create the **shadow DOM** and it's used for setting up listeners and **initialize** a component's **state**

```
this._root = this.attachShadow({ mode: 'closed' });

this.state = {
  title: this.getAttribute('app-title')
}
```

Example: connectedCallback()

- This is called when an element is **added** to the DOM
- It means that we can safely **set attributes**, **fetch resources**, run set up code or **render templates**

```
connectedCallback() {
   // load some data using fetch or axios
}
```

Example: disconnectedCallback()

- This is called when the element is **removed** from the DOM
- Therefore, it's an ideal place to add **cleanup logic** and to free up resources

```
disconnectedCallback() {
    // clear timers or intervals
}
```

Example: attributeChangedCallback()

- In this callback, we can get the **value** of the **attributes** as they're assigned in the code
- We can add a `static get observedAttributes()` hook to define what attribute values we observe:

```
static get observedAttributes() {
  return ['app-title', 'foo', 'bar']
}
```

Example: attributeChangedCallback()

- The callback receives **three** parameters:

```
attributeChangedCallback(name, oldValue, newValue) {
  console.log(`${name}'s value has been changed
     from ${oldValue} to ${newValue}`);
}
```

Extending Native HTML Elements

Extending HTML Elements

- Custom elements allows you to **extend existing** (native) HTML elements as well as other custom elements
- If you aren't happy with the regular `<button>` element, for example, you can override it
- **NOTE:** This feature is **not supported** in WebKit *(August 2022)*

Example: Extending Button

- Extend the native element, and add a third parameter to the define method:

```
class FancyButton extends HTMLButtonElement {
    constructor() {
        self = super();
        self.textContent = 'Custom Button';
    }
}
customElements.define('fancy-button', FancyButton,
      { extends: 'button' }
);
```

Example: Extending Button

- After that add the **"is" attribute** and the name of the custom button element:

```
<button is="fancy-button">
</button>
```

- This should render a button with text content **"Custom Button"**

Lit-html

Creating templates with ease

What is lit-html?

- Simple, modern, safe, small and fast **HTML templating library** for JavaScript
- Lets you write HTML templates in JavaScript using **template literals** with embedded JavaScript expressions
- Identifies the **static** and **dynamic parts** of your templates so it can efficiently **update** just the changed portions

Getting Started

- Installation:

```
npm install lit-html
```

- To use lit-html, import it via a path:

```
<script type="module">
  import { html, render }
     from './node_modules/lit-html/lit-html.js';
  ...
</script>
```

Path to main file (use live-server to start)

Rendering a Template

- lit-html has two main APIs:
  - The **html template tag** used to write templates.
  - The **render()** function used to render a template to a DOM container

```
const appRootTemplate = // Same as previous template
```

```
render(
    appRootTemplate(this.state), this._root,
    { host: this }
);
```

Template **event context**

Tag Functions / Tagged Templates

- A tagged template is a **function call** that uses a **template literal** from which to get its arguments

```
// Tag Function Call
greet`I'm ${name}. I'm ${age} years old.`
```

- Create a greet function and just log the arguments:

```
function greet() {
    console.log(arguments[0]); // array
    console.log(arguments[1]); // name
    console.log(arguments[2]); // age
}
```

Attribute Binding

- In addition to using expressions in the text content of a node, you can bind them to a node's attribute and property values, too:

```
const myTemplate = (data) => html`<div
    class=${data.cssClass}>Stylish text.</div>`
```

- Use the **?** prefix for a **boolean** attribute binding:

```
const myTemplate = (data) => html`<div
    ?disabled=${!data.active}>Stylish text.</div>`
```

Property Binding

- You can also bind to a **node's JavaScript properties** using the **. prefix** and the property name:

```
const myTemplate = (data) => html`<input
     .value=${data.value}></input>`;
```

- You can use property bindings to **pass** complex data **down** the tree to subcomponents:

```
const myTemplate = (data) => html`<my-list
     .listItems=${data.items}></my-list>`;
```

Handling Events

- Templates can also include declarative event listeners
- An event listener looks like an attribute binding, but with the **prefix @** followed by an **event name**:

```
const appRootTemplate = (ctx) => html`
    <div>
        <h1 @click=${ctx.handleClick}>${ctx.title}</h1>
    </div>
`
```

Conditional Statements

- lit-html has **no built-in control-flow** constructs. Instead you use normal JavaScript expressions and statements:

```
html`
  ${user.isloggedIn
      ? html`Welcome ${user.name}`
      : html`Please log in`
  }
`;
```

List Rendering

- To render lists, you can use **Array.map** to transform a list of data into a list of templates:

```
html`
  <ul>
    ${items.map((item) => html`<li>${item}</li>`)}
  </ul>
`;
```

Directives: classes and classMap

- The **classMap directive** lets you set a **group of classes** based on an object:

```
import { classMap } from './node_modules/lit-
html/directives/class-map.js';

const itemTemplate = (item) => {
  const classes = { selected: item.selected };
  return html`<div class="menu-item
     ${classMap(classes)}">Classy text</div>`;
}
```

Directives: styles and styleMap

- You can use the **styleMap directive** to set **inline styles** on an element in the template:

```
import { styleMap } from './node_modules/lit-
    html/directives/style-map.js';

const styles = {
 color: myTextColor,
 backgroundColor: highlight ? myHighlightColor :
    myBackgroundColor
};

html`<div style=${styleMap(styles)}>Hi there!</div>`;
```

Directives: repeat

- Repeats a **series of values** generated from an iterable, and **updates** those items **efficiently** when the iterable changes:

```
import { repeat } from './node_modules/lit-
    html/directives/repeat';

const myTemplate = () => html`
  <ul>
    ${repeat(items, (i) => i.id, (i, index) => html`
      <li>${index}: ${i.name}</li>`)}
  </ul>
`;
```

Additional Libraries

- Here are some additional libraries you can try out:
  - Hybrids - a UI library for creating Web Components with simple and functional API
  - Lit Element - uses lit-html to render into the element's shadow DOM and adds API to help manage element properties and attributes
  - Polymer - provides a set of features for creating custom elements
  - Stencil - an open-source compiler that generates standard-compliant web components

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