E-Portfolio
Polymer Project

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Agenda

1. What Are Web Components
2. Why Web Components
3. Polymer Project
4. Lit-HTML Templating Library
5. Lit-Element Base Class
6. The Future Of Web Development And Polymer
7. Let‘s Build Our Own Web Components!

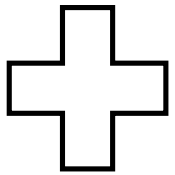
What Are Web Components?

Set Of Web Platform APIs

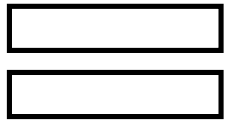
- Web Platform APIs: Global JavaScript objects available in most browsers
- Specified by World Wide Web Consortium (W3C)
- Custom, reusable, encapsulated HTML tags
- Based on four specifications

1. Custom Elements
2. Shadow DOM
3. ES6 Modules
4. HTML Templates

```
<header>
   <h1><slot></slot></h1>
   <button>Menu</button>
</header>
```



```
<my-header>Shadow DOM</my-header>
```

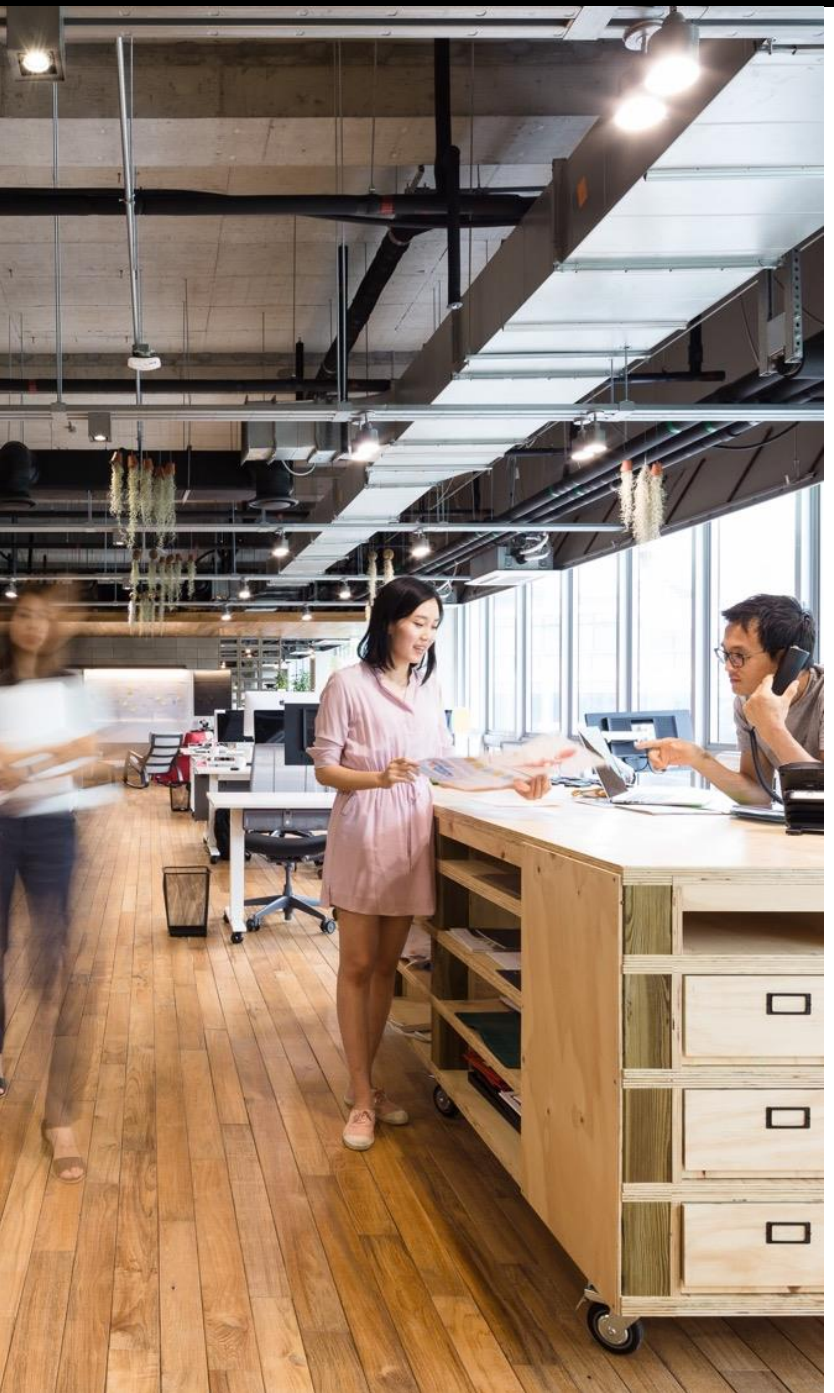


```
<my-header>
  <header>
     <h1>Shadow DOM</h1>
     <button>Menu</button>
  </header>
</my-header>
```

Lifecycle Callbacks

- connectedCallback
- disconnectedCallback
- adoptedCallback
- attributeChangedCallback

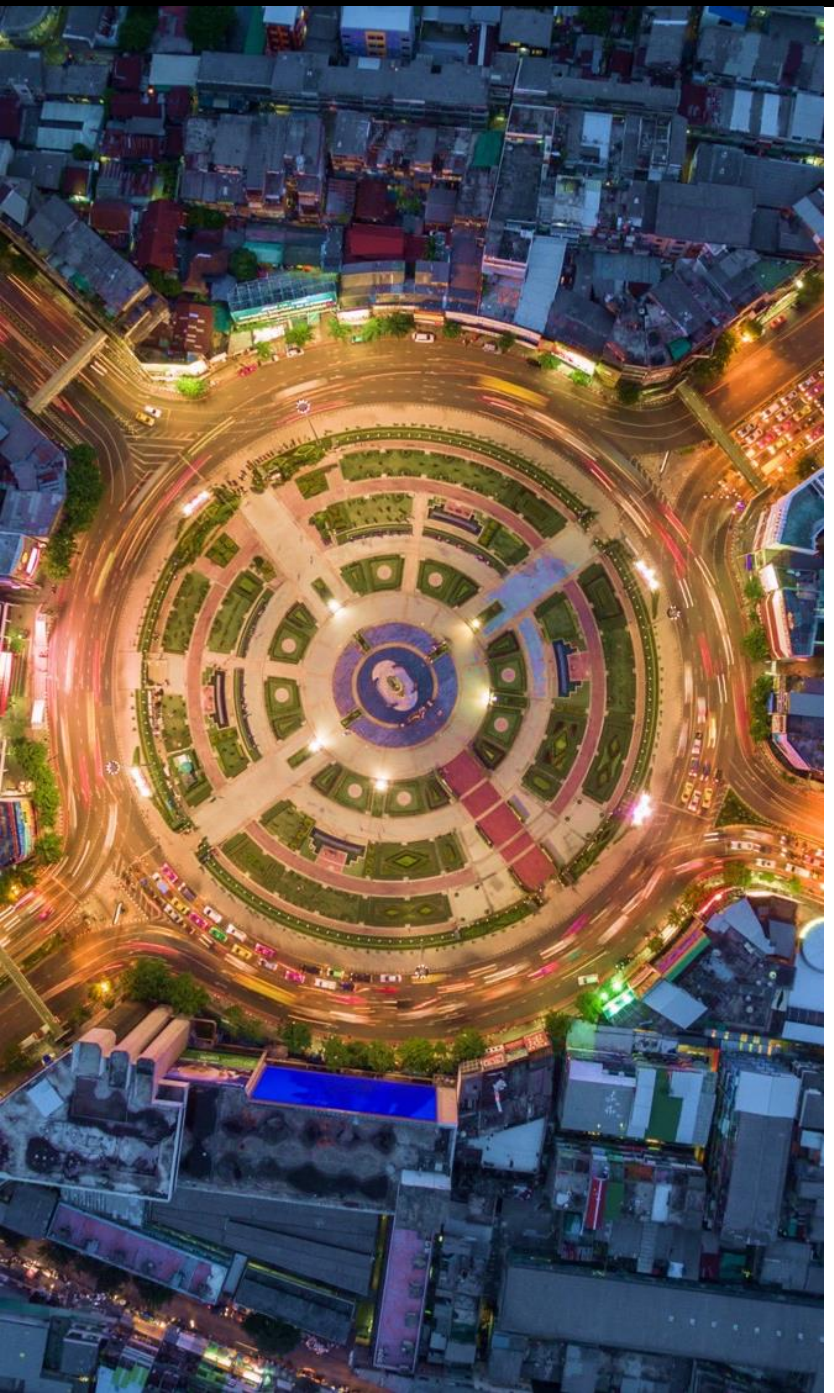
Why Web Components?



Why Web Components?

1. Fully featured and conform
2. Encapsulated
3. Reusable and modular
4. Maintainability
5. Brand consistency
6. Framework independent

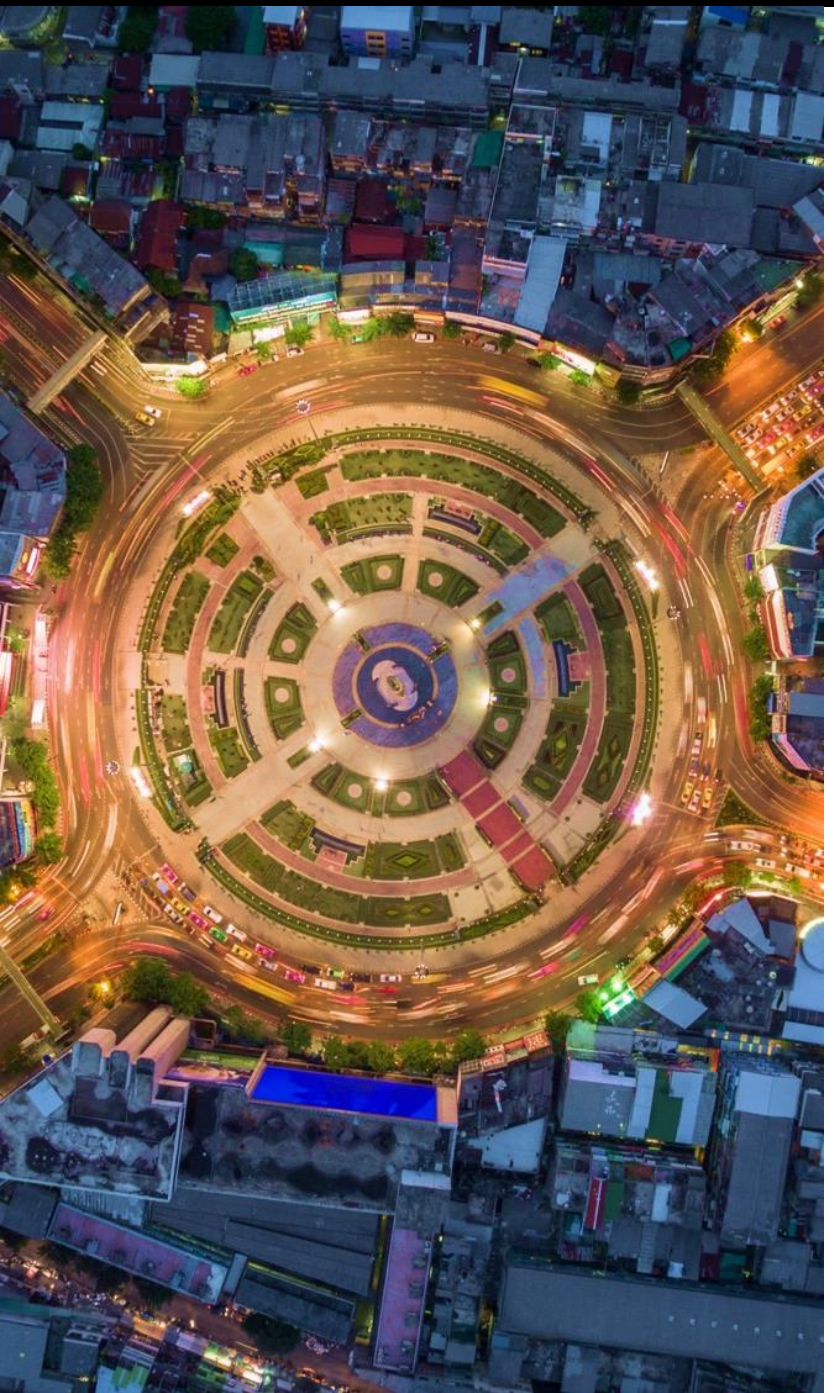

The Polymer Project



The Polymer Project

- Open-source JavaScript library for building PWAs using web components
- Developed by a team of 29 Google developers
- Used by redesigned YouTube, Netflix, IBM, …
- 3-Clause BSD license
- Main libraries:

1. Lit-html
2. Lit-element
3. PWA-starter-kit



Lit-HTML Templating Library

- Based on tagged template literals with embedded JavaScript expressions
- Express web UI as a function of data and state
- Efficient
  - Uses web platform features like html templates
  - Only re-renders updated parts of view
- Expressive
  - Use full power of JavaScript in expressions
  - Templates can be computed and passed to and from functions
  - Text content binding can contain strings, DOM nodes, nested templates, arrays and more
- Extensible/Customizable
  - Take use of several lit-html directives
  - Customizable to create own template construction kit

General Usage:

```
const myTemplate = (name) => html`<p>Hello ${name}</p>`; //Returns a TemplateResult, lit-html is lazily rendered
render(myTemplate('World'), document.body); //Replaces all content of body node
```

Attribute Binding:

```
const myTemplate2 = (data) => html`<div ?disabled=${!data.active}>Stylish text</div>`;
render(myTemplate2({active: false}), document.body);
```

Property Binding:

```
const myTemplate3 = (data) => html`<my-list .listItems=${data.items}></my-list>`;
render(myTemplate3([1,2,3]), document.body);
```

Event Handling:

```
const myTemplate4 = () => html`<button @click=${clickHandler}>Click Me!</button>`;
render(myTemplate4(() => console.log("clicked!")), document.body);
```

Composed Templates:

```
const myTemplate5 = html`<h1>Header</h1>`;
const myTemplate6 = html`${myTemplate5} <div>Here's my main page.</div>`;
render(myTemplate6(), document.body);
```

Conditional Statements:

```
html`${user.isloggedIn ? html`Welcome ${user.name}` : html`Please log in`}`;
html`${() => {
    if (user.isloggedIn)
        return html`Welcome ${user.name}`;
    return html`Please log in`;
}}`;
```

Iterative Statements:

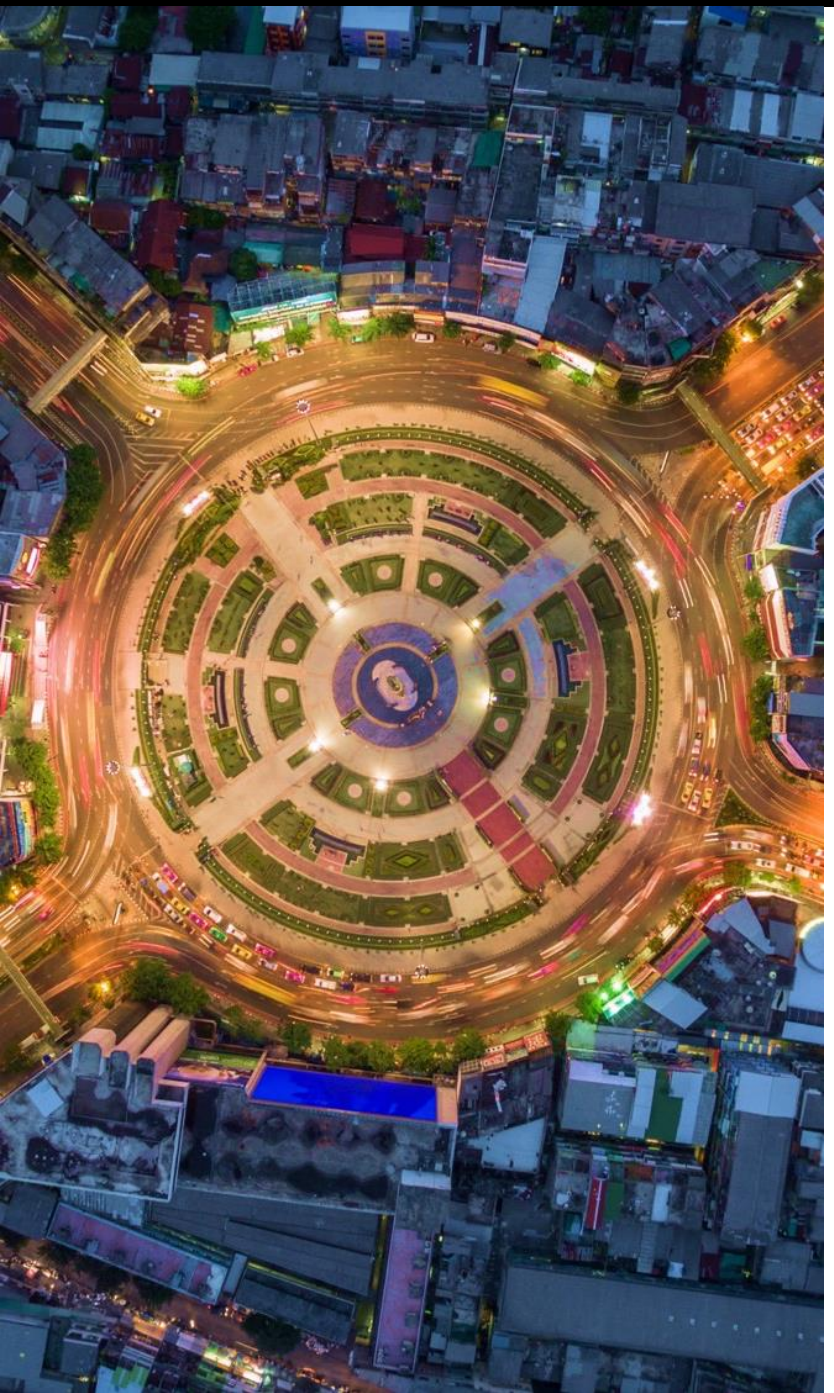
```
const items = [1,2,3];
const itemTemplates = [];

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

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

html`<ul>${repeat(items, (item) => item, (item, index) => html`<li>${index}: ${item}</li>`)}</ul>`;
```

Styling Templates:

```
const highlightStyles = { color: 'white', backgroundColor: 'red'};
html`<div style=${styleMap(highlightStyles)}>Hi there!</div>`;

const classes = { highlight: true, enabled: true, hidden: false };
html`<div class=${classMap(classes)}>Classy text</div>`;
```

Directives:

```
const image = {alt: "description"};
html`<img src="/images/${ifDefined(image.filename)}">`;

const content = fetch('./content.txt').then(r => r.text());
html`${until(content, html`<span>Loading...</span>`)}`;

const immutableItems = ["Are","you","still","listening?"];
html`<div>${guard([immutableItems], () => immutableItems.map(item => html`${item}`))}</div>`;
```



Lit-Element Base Class

- Create
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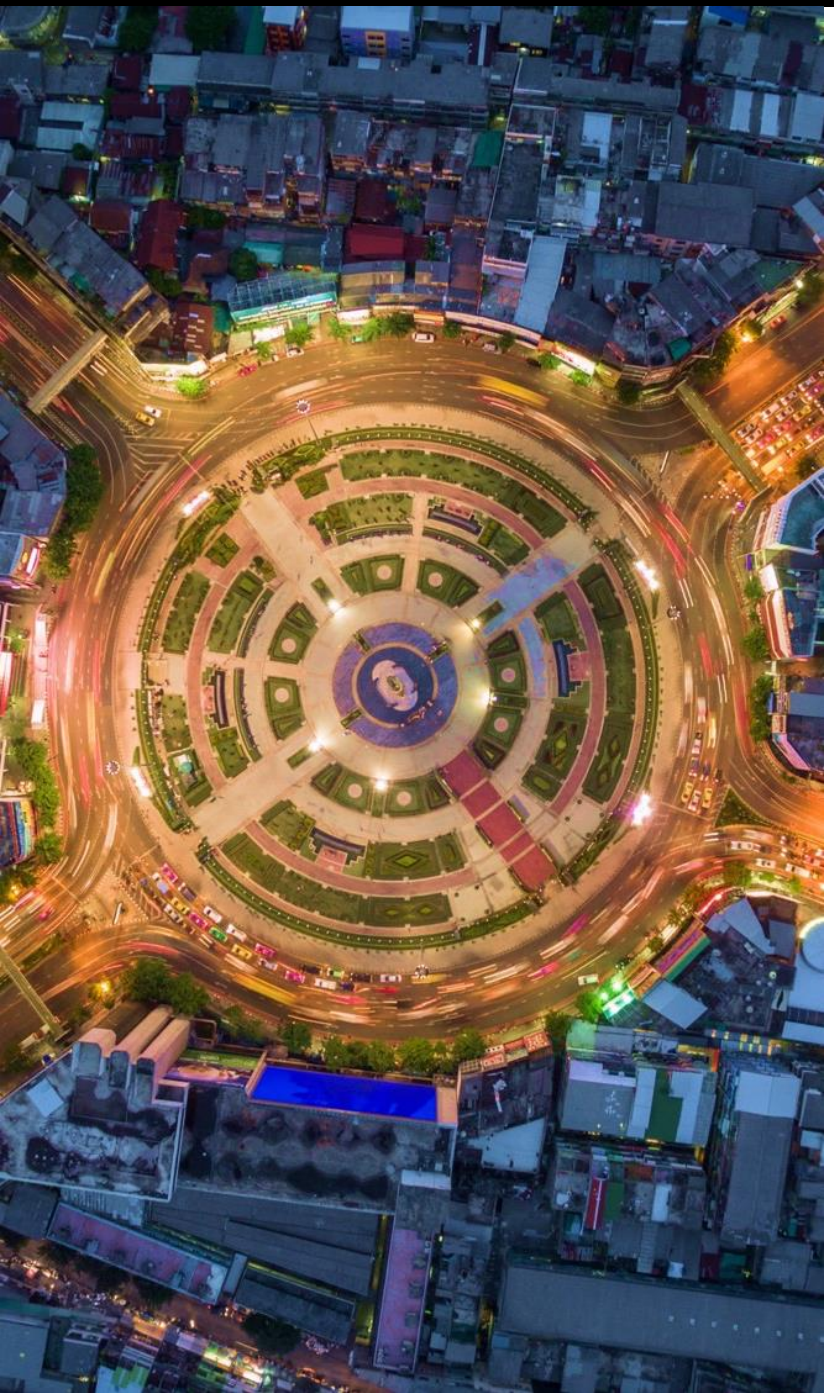
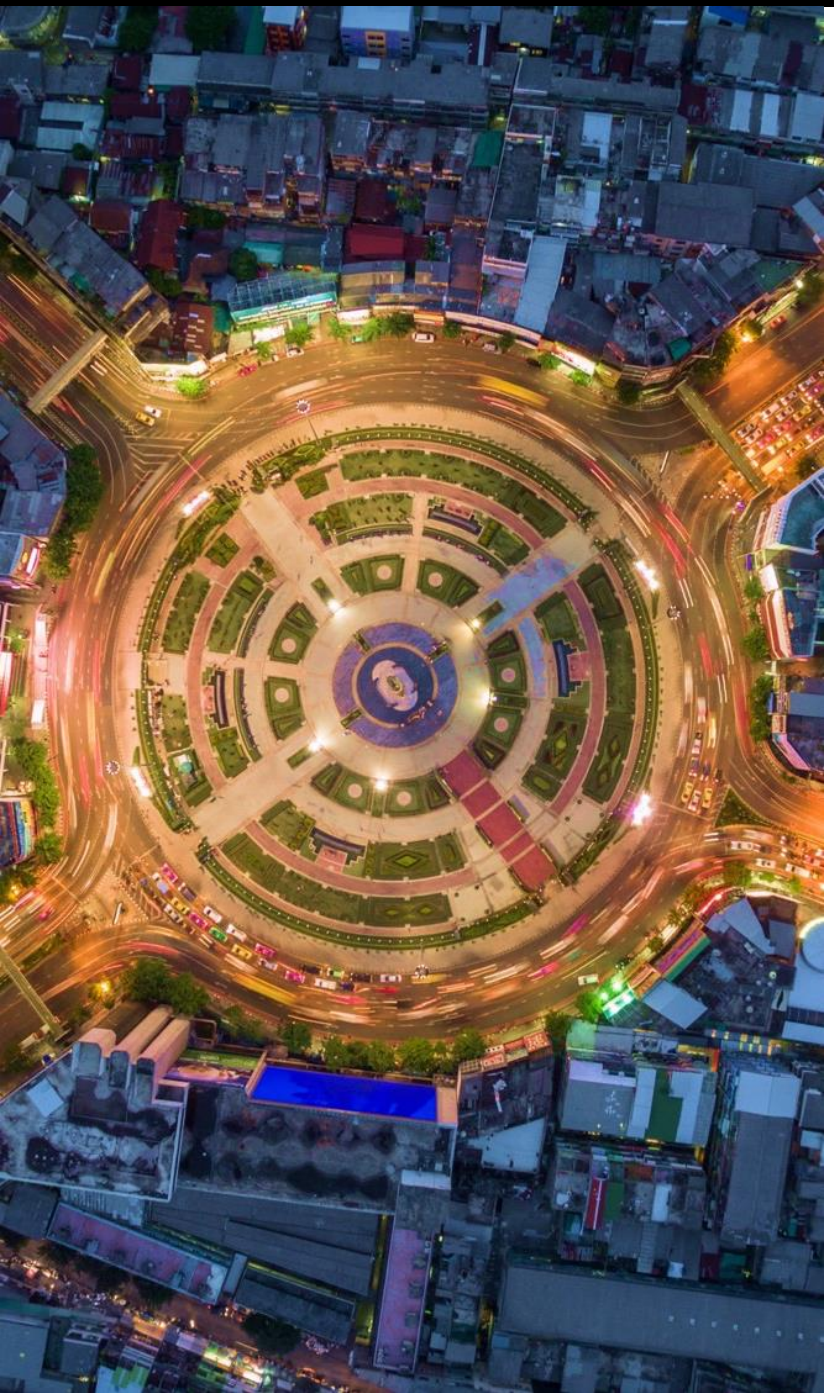
```
import { LitElement, html, css} from 'lit-element';
class HelloWorld extends LitElement {
    render() {
        return html`<p>${this.message.map(item => html`${item} `)}</p>`;
    }
    static get styles() {
        return [super.styles, css`
          p {
            font-family: Roboto;
            font-size: 30px;
            font-weight: 500;
          }
        `];
    }
    static get properties() {
        return { name: { type: String },
                 message: { type: Array } };
    }
    constructor() {
        super();
        this.name = 'Felix';
        this.message = ['Hello', this.name, '!'];
    }
}
window.customElements.define('hello-world', HelloWorld);
```



Lit-Element Styling

- Static styles property
  - Constructable style sheets
  - Return a single or an array of tagged template literals
- <style> element in HTML template in the render function
- External stylesheet linked to from your HTML template

- Use ***:host*** or ***:host()*** pseudo class to refer to host element of shadow root
- Use ***::slotted()*** pseudo class to refer to all light DOM children, that are inserted to the shadow DOM by a slot element
- Element selector from light DOM has priotity over *:host* selector
- Inherited CSS properties and custom CSS properties are inherited through shadow root boundaries

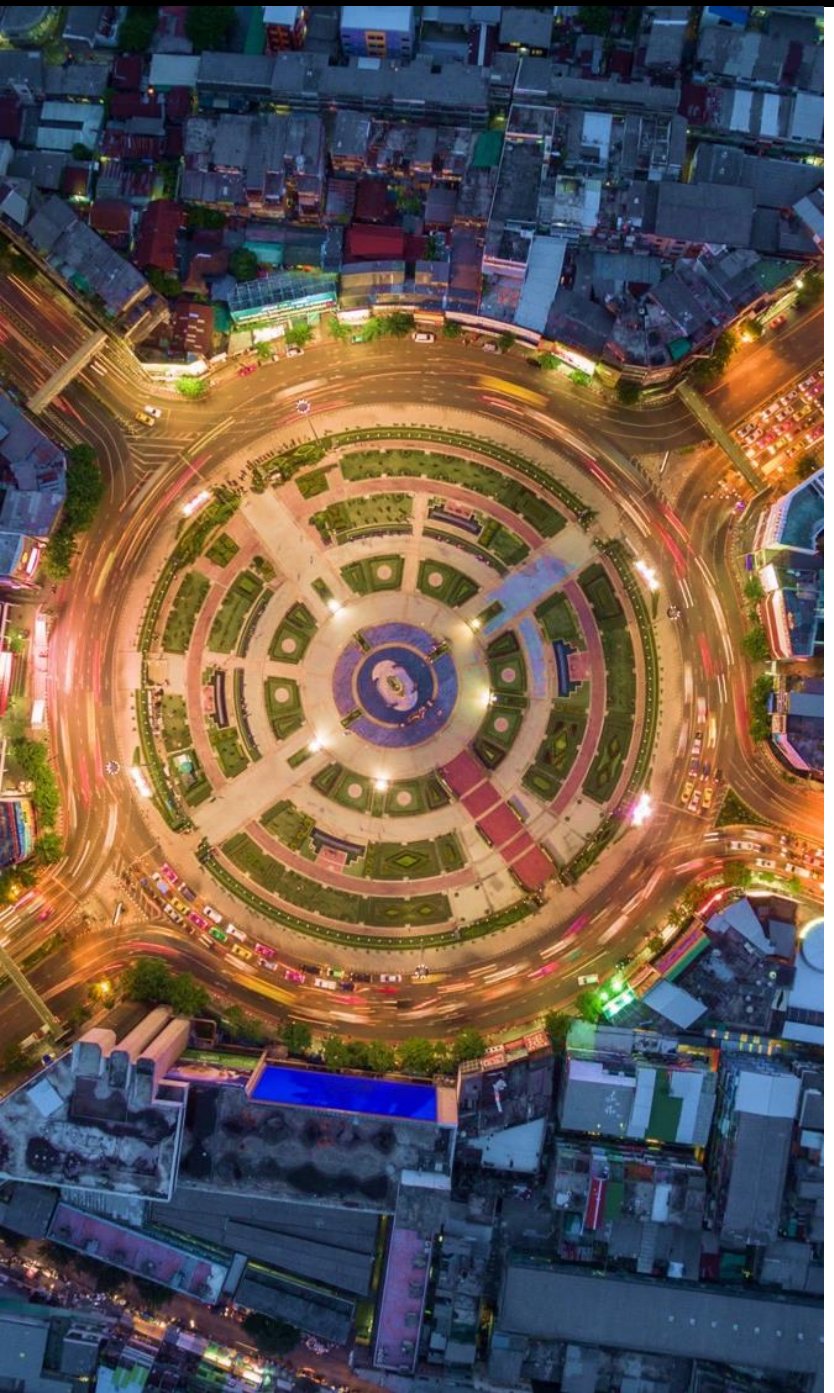


Excursus: CSS custom properties

```
<style>
  html {
    --myBackground: rgb(67, 156, 144);
  }
</style>
```

```
return [super.styles, css`
    :host {
        display: block;
        background-color: var(--myBackground, yellow);
    }
`];
```

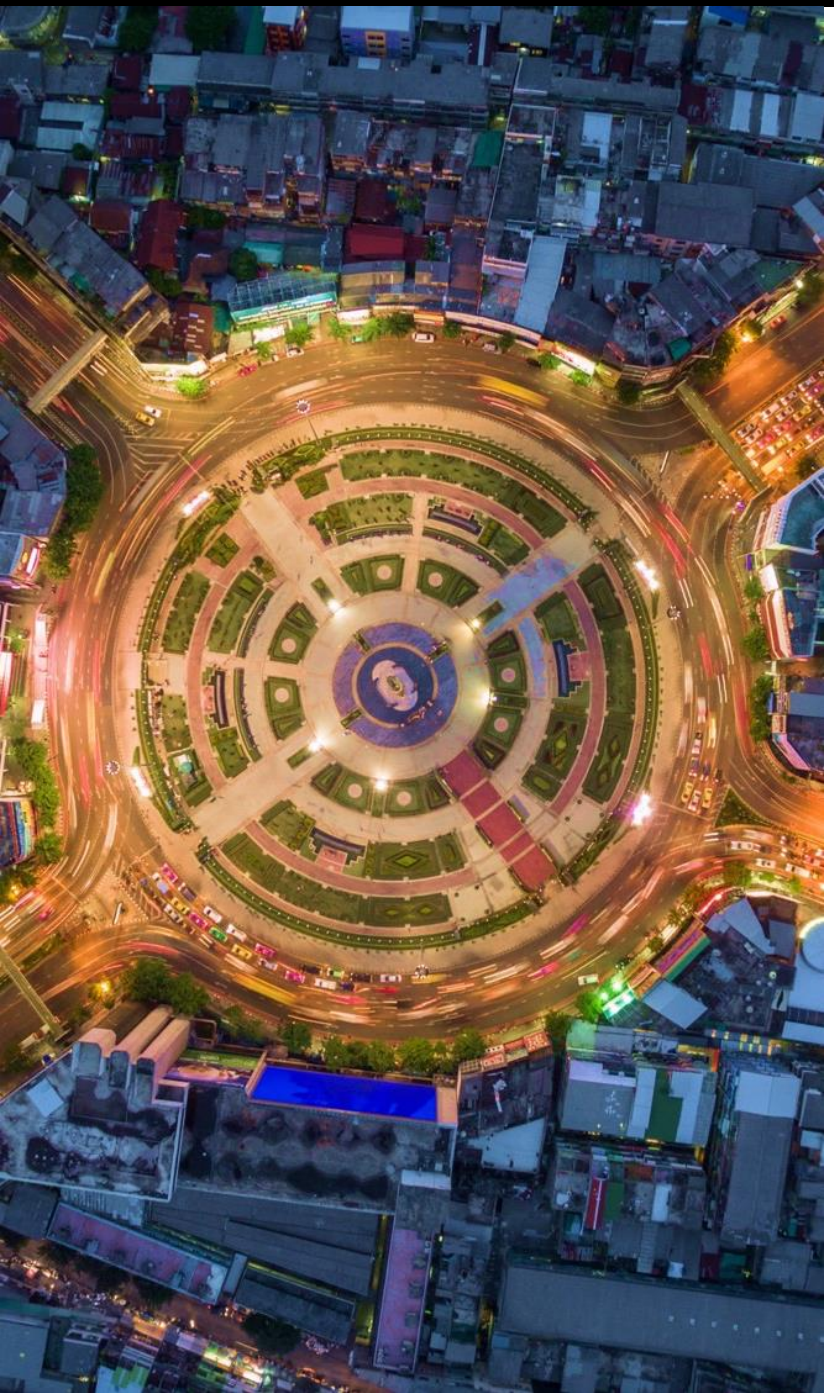
⇨ **Implement theming**



Lit-Element Properties

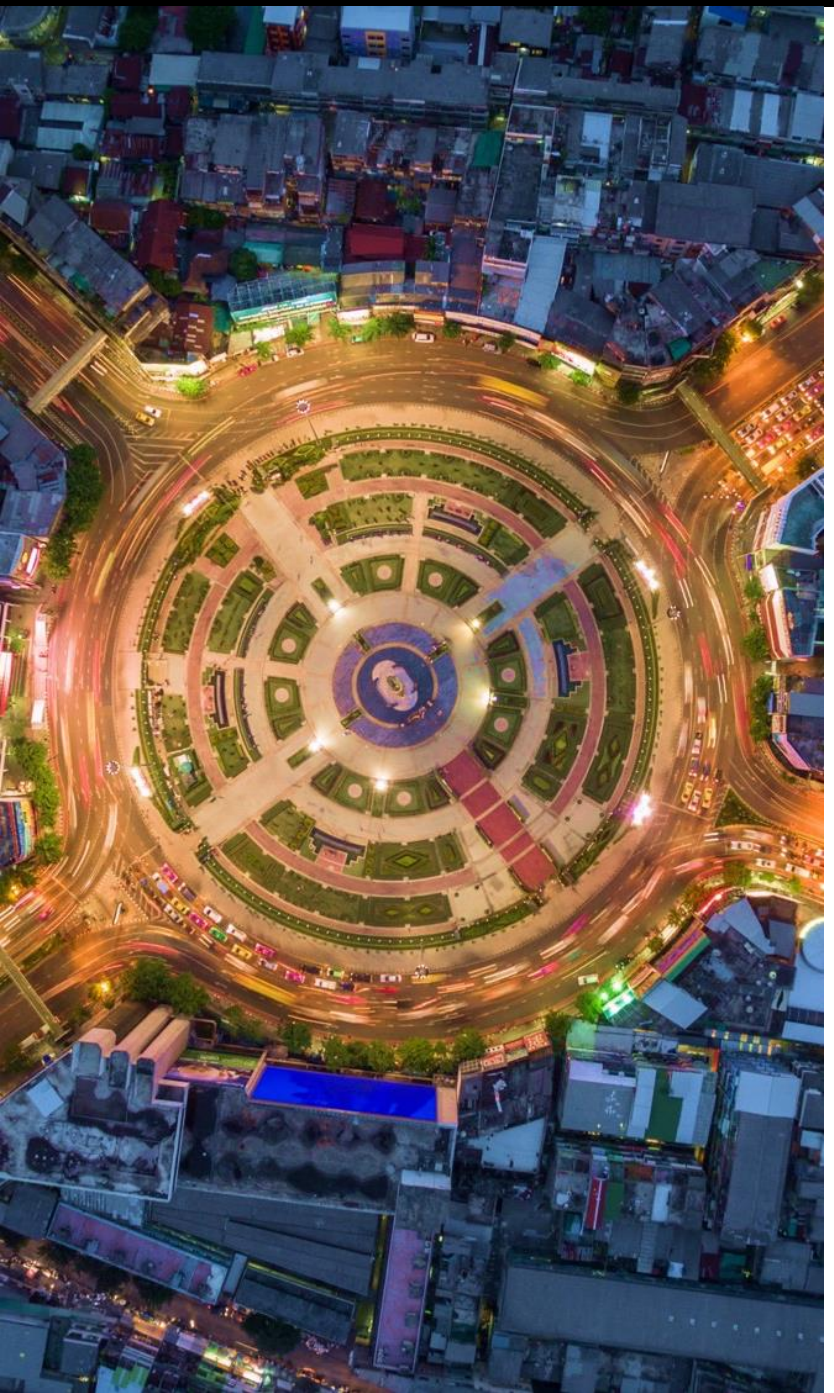
- Property options
  - **type**: Use Lit-Element's default attribute converter
  - **noAccessor**: Whether to set up a default property accessor
  - **hasChanged**: Specify what constitutes a property change
  - **converter**: Convert between properties and attributes
  - **attribute**: Configure observed attributes
  - **reflect**: Configure reflected attributes
- Properties declared in *static get properties*
- Properties initialized in constructor
- Properties can set through markup attributes

  ⇨ Conversion needed



Lit-Element Type Custom Converter

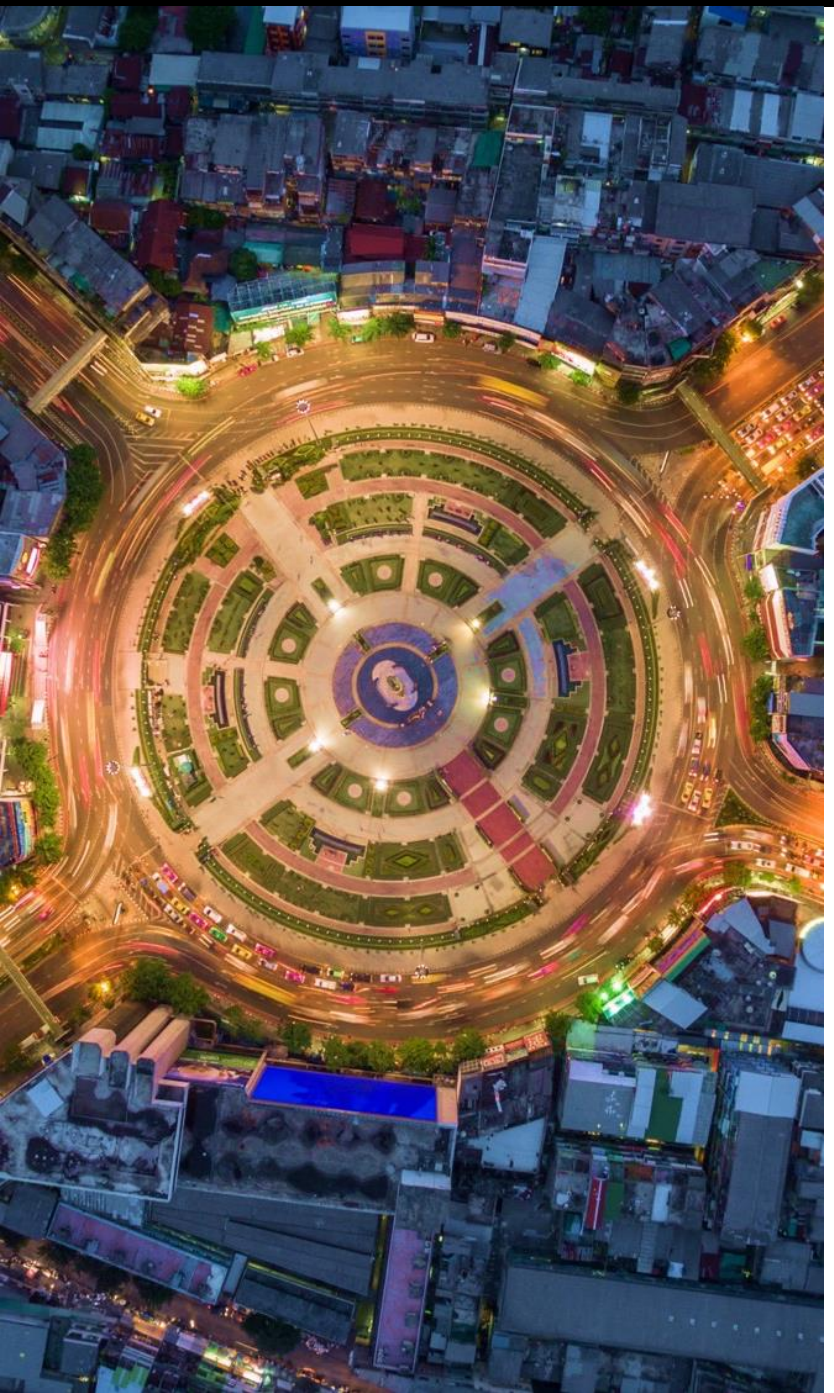
```
prop1: { type: Number,
          converter: {
               fromAttribute: (value, type) => {
                    // `value` is a string
                    // Convert it to a value of type `type` and return it
                    return type(value);
               },
               toAttribute: (value, type) => {
                    // `value` is of type `type`
                    // Convert it to a string and return it
                   return value.toString();
               }
          }
        },
prop2: { type: Object,
         converter: (value, type) => {
              // `value` is a string
              // Convert it to a value of type `type` and return it
              return type(value);
         }
}
```



Lit-Element Properties

- Lit-Element creates for all properties an observed attribute (name is lowercased property name)
- Use *attribute* property option to define an own name
- Set *attribute* property option to false if it should not be observed
- **Accessors:**
  - LitElement generates a property accessor for all declared properties
  - Use this.<accessor name> to invoke accessor

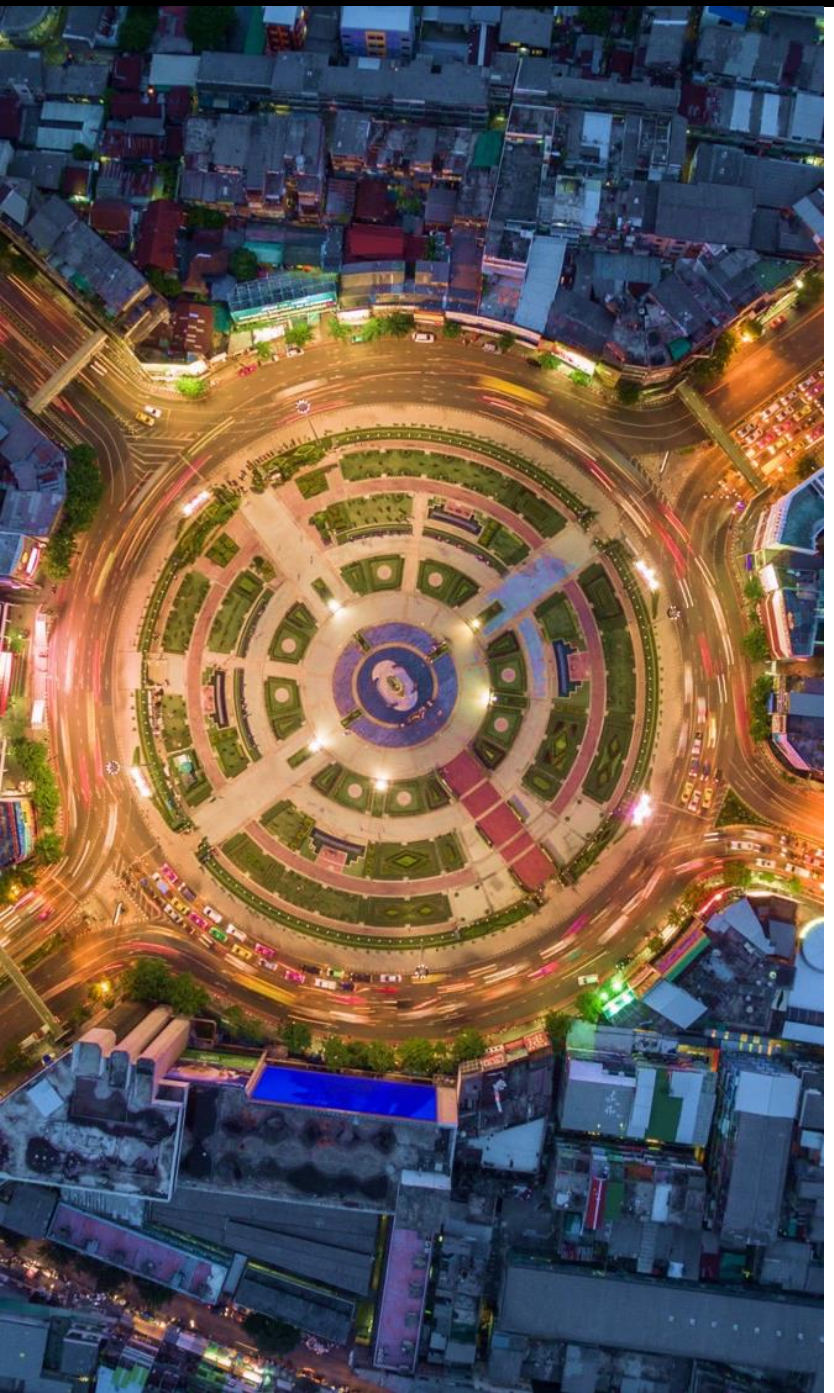
```
set prop1(value) {
    const oldValue = this.prop1;
    console.log("Changed property to " + value);
    // Implement setter logic here...
    this.requestUpdate('myProp', oldValue);
}
get prop1() {

}
```



Lit-Element Properties

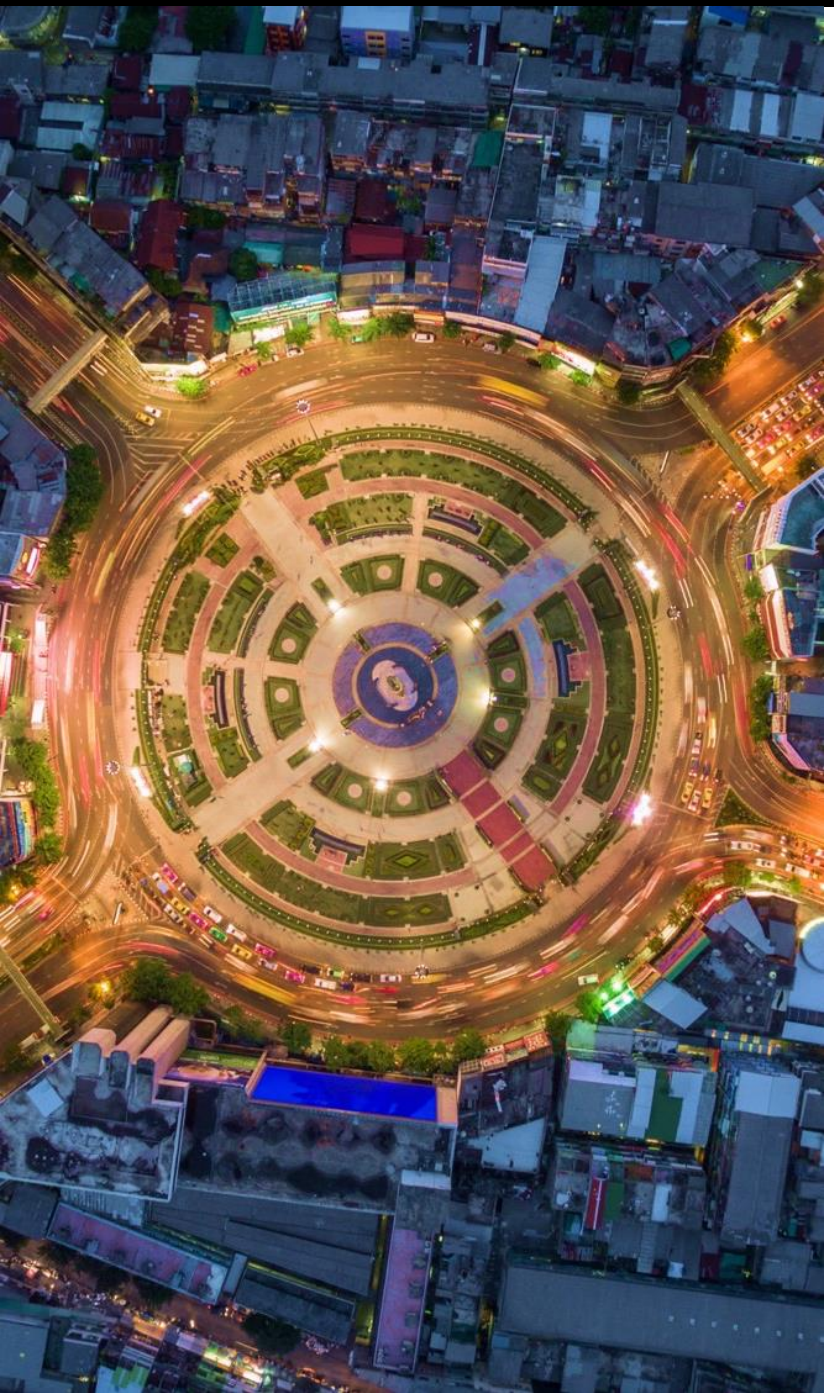
- hasChanged:
  - Specifies whether *update()* should be called or not

```
prop1: { type: Number,
         hasChanged(newVal, oldVal) {
                  return newVal > oldVal;
         },
```



Lit-Element Events

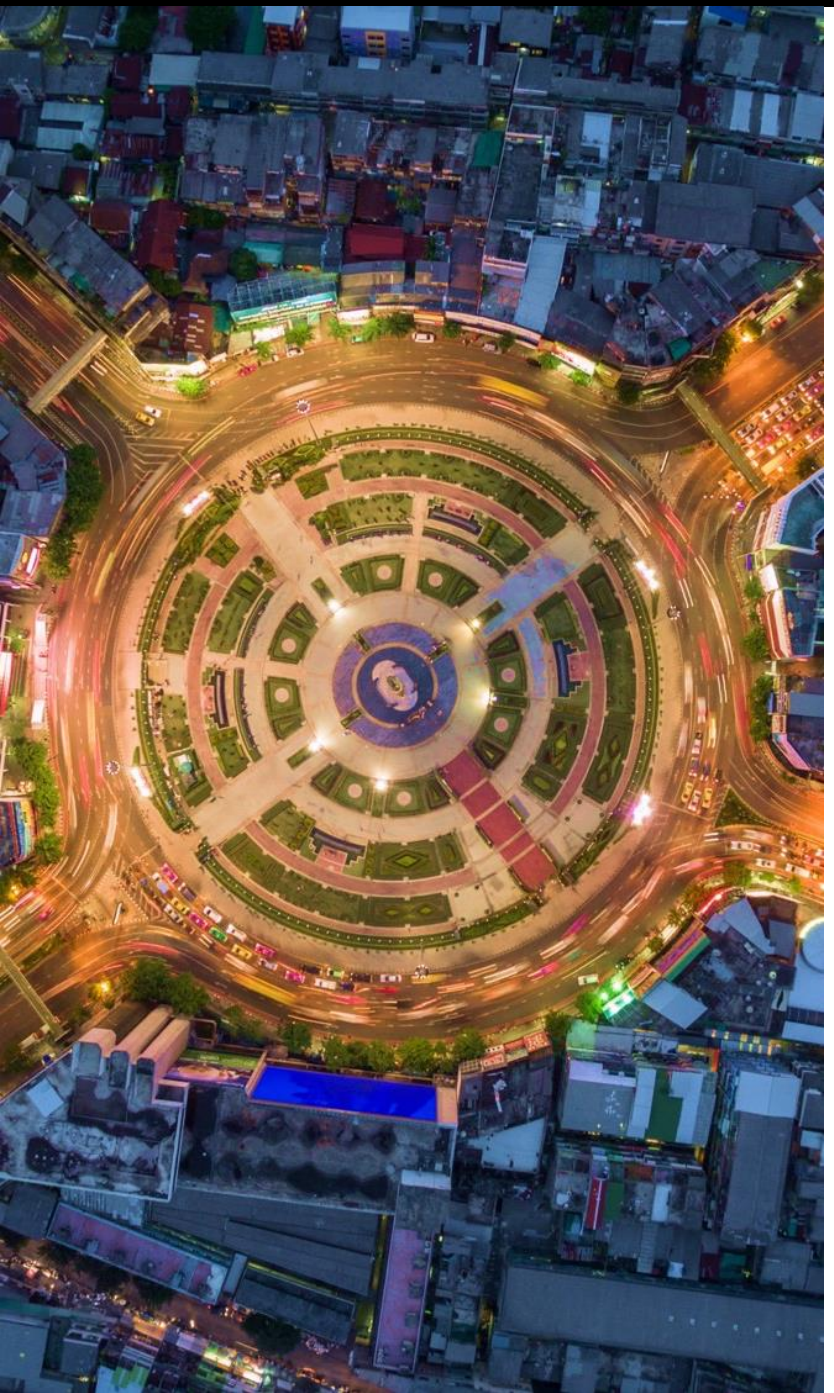
- Where to set event handlers?
  - *@event* binding in HTML template
  - *.addEventListener* in constructor
  - *firstUpdated* lifecycle callback
  - *connectedCallback* lifecycle callback
- Custom events bubble through shadow DOM boundaries if *bubble* and *composed* flag is set to true
- Event targets are set to the custom element
- Actual event origin can be found in *composedPath* property



Lit-Element Lifecycle

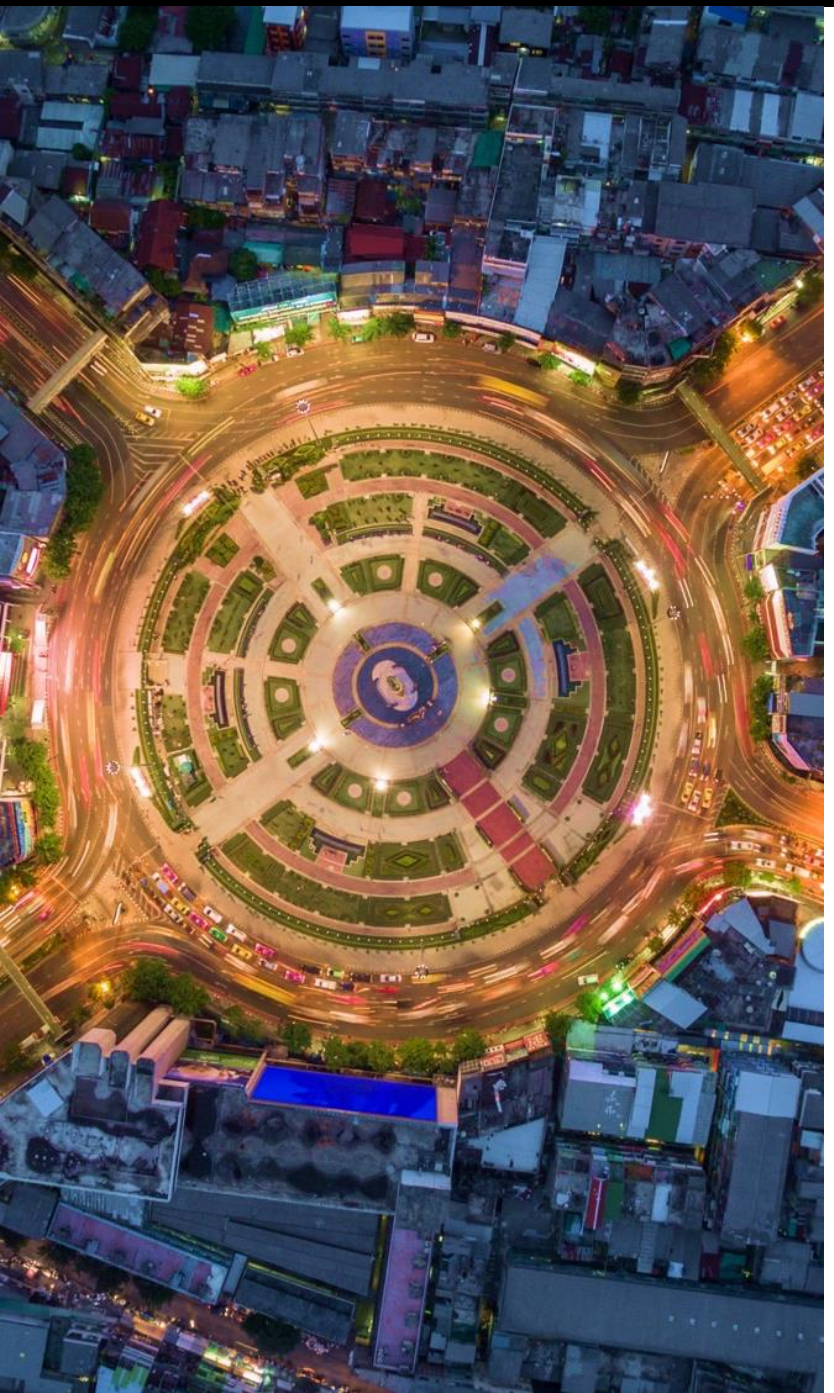
1. someProperty.hasChanged
2. requestUpdate
3. performUpdate
4. shouldUpdate
5. update
6. render
7. firstUpdated
8. updated
9. updateComplete

→ Update lifecycle only in response to a property change



Use a web component

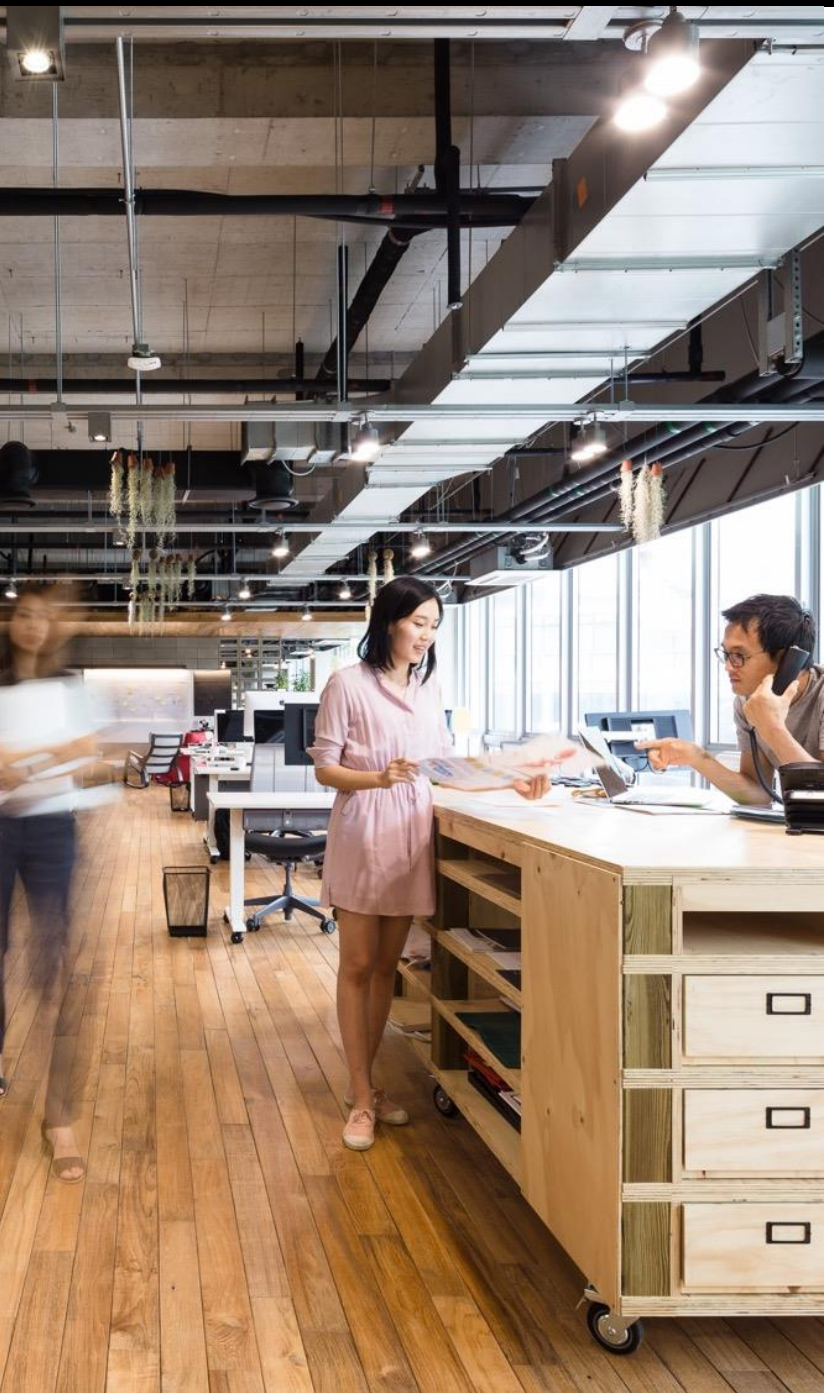
```
<head>
    <script src="./path-to/custom-elements-es5-loader.js"></script>
    <script src="path-to/webcomponents-loader.js" defer></script>
    <script type="module">
        window.WebComponents = window.WebComponents || {
            waitFor(cb){ addEventListener('WebComponentsReady', cb) }
        }

        WebComponents.waitFor(async () => {
            import('./path-to/some-element.js');
        });
    </script>
</head>
<body>
<some-element></some-element>
</body>
```



Use TypeScript decorators

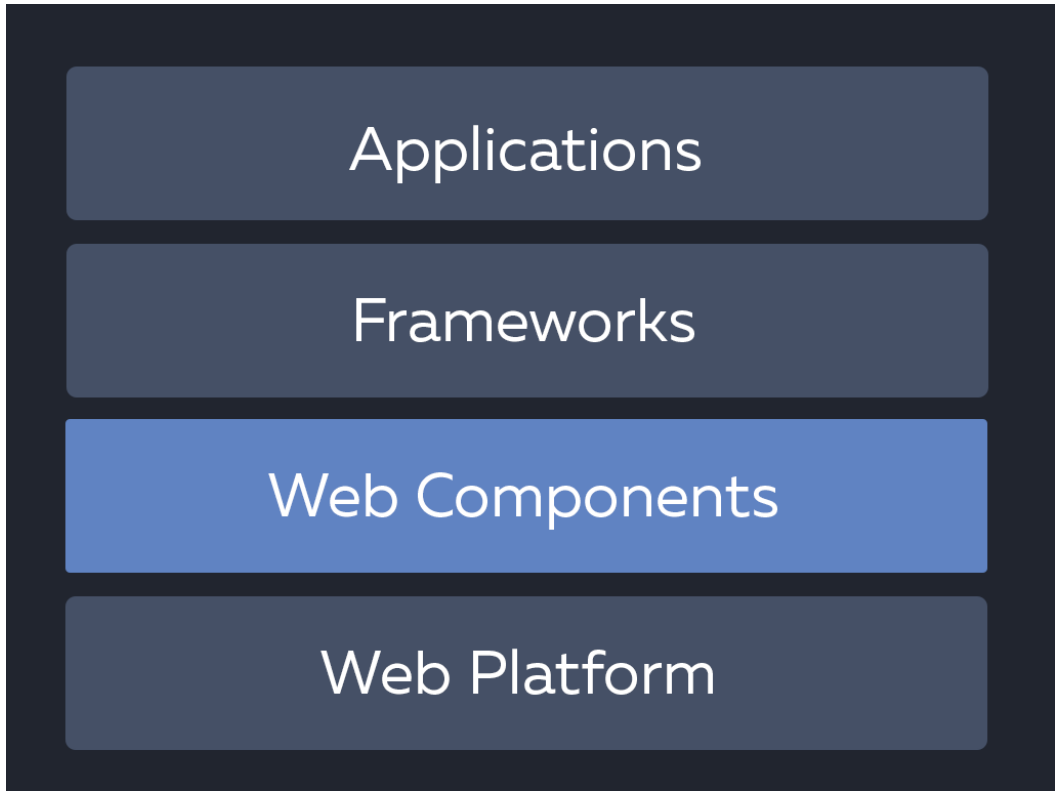
```
import { LitElement, html, customElement, property } from 'lit-element';

@customElement('my-element')
export class MyElement extends LitElement {
    @property({type : String})  prop1 = 'Hello World';
    @property({type : Array})   prop2 = [1,2,3];
    @property({type : Object})  prop3= { subprop: 'prop 3 subprop value' };

    render() {
        return html`
      <p>prop1: ${this.prop1}</p>
      <p>prop2[0]:</p>${this.prop2[0]}</p>
      <p>prop3.subprop: ${this.prop3.subprop}</p>
    `;
    }
}
customElements.define('my-element', MyElement);
```

Future Of Web Development And Polymer



Future Of Web Development And Polymer

- Check out the PWA starter kit!



References

Web components:

Web Components Introduction

Web Components Specification

Web Components Usage

Web Components Best Practices

Polymer:

Polymer Project

Polymer Comparison To Other Frameworks

Get your components!

WebComponents

Vaadin

Material Web Components

UI5 Web Components

CustomElements.IO

Thank You.

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