# Web REactive Components (wrec)

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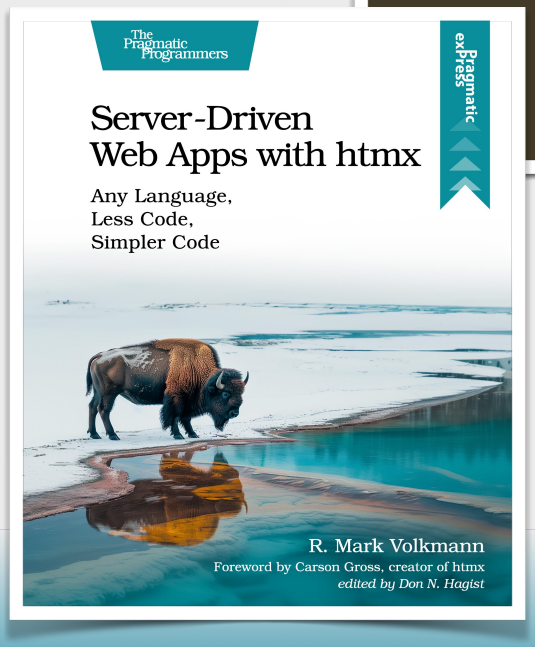
Code at https://github.com/mvolkmann/wrec-talk-code

# About Me

- Partner and Distinguished Software Engineer at Object Computing, Inc. in St. Louis, Missouri USA
- 44 years of professional software development experience
- Writer and speaker
- **Blog** at https://mvolkmann.github.io/blog/
- Author of Manning book "**Svelte ... in Action**"
- Author of Pragmatic Bookshelf book "**Server-Driven Web Apps with htmx**"
- Currently writing a book on web components

# What is wrec

- Library that simplifies development of web components
  - https://www.npmjs.com/package/wrec
- Strong focus on simplicity and reactivity
- To define a web component
  - define a class that extends **`Wrec`**
  - define properties with static property named **`property`**
  - specify scoped CSS with static property named **`css`**
  - specify HTML to render with static property named **`html`**

# Getting Started ...


- Create project directory and **`cd`** to it
- Create **`package.json`** by entering **`npm init -y`**
- Install Vite by entering **`npm i -D vite`**
- Add **`dev`** script to **`package.json`**
- Install wrec by entering **`npm i wrec`**
- Create **`hello-world.js`**

package.json

```
{
  "name": "hello-world",
  "scripts": {
    "dev": "vite"
  },
  "devDependencies": {
    "vite": "^7.3.1"
  },
  "dependencies": {
    "wrec": "^0.18.5"
  }
}
```

The **`html`** tag function enables syntax highlighing and code completion of HTML inside tagged template literals.

hello-world.js

```
import { html, Wrec } from "wrec";

class HelloWorld extends Wrec {
  static html = html`<h1>Hello, World!</h1>`;
}

HelloWorld.register();
```

# ... Getting Started

- Create **`index.html`**
- Start local server by entering **`npm run dev`**
- Browse **`localhost:5173`**

**Hello, World!**

index.html

```
<!doctype html>
<html lang="en">
  <head>
    <script type="module" src="hello-world.js"></script>
  </head>
  <body>
    <hello-world></hello-world>
  </body>
</html>
```

# Better hello-world

- Can specify **`name`** attribute

hello-world.js

```
import { css, html, Wrec } from "wrec";

class HelloWorld extends Wrec {
  static properties = {
    name: { type: String, value: "World" },
  };

  static css = css`
    h1 {
      color: blue;
    }
  `;

  static html = html`<h1>Hello, <span>this.name</span>!</h1>`;
}

HelloWorld.register();
```

```
<hello-world name="Earth"></hello-world>
```

**Hello, Earth!**

# Best hello-world

- Can specify **`color`** and **`name`** attributes

hello-world.js

```
import { css, html, Wrec } from "wrec";

class HelloWorld extends Wrec {
  static properties = {
    color: { type: String, value: "blue" },
    name: { type: String, value: "World" },
  };

  static css = css`
    h1 {
      color: this.color;
    }
  `;

  static html = html`<h1>Hello, <span>this.name</span>!</h1>`;
}

HelloWorld.register();
```

```
<hello-world color="red" name="Earth"></hello-world>
```

Hello, Earth!

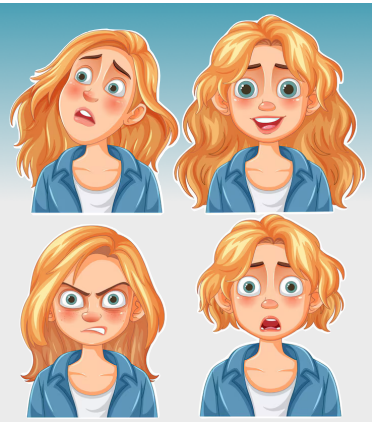
# Vanilla Version

requires much more code


hello-world.js

```
class HelloWorld extends HTMLElement {
  static get observedAttributes() {
    return ["color", "name"];
  }

  #color = "black";
  #name = "World";
  #p = document.createElement("p");

  attributeChangedCallback(name, _oldValue, newValue) {
    if (name === "color") {
      if (newValue !== this.#color) this.color = newValue;
    } else if (name === "name") {
      if (newValue !== this.#name) this.name = newValue;
    }
  }

  connectedCallback() {
    this.attachShadow({ mode: "open" });
    this.shadowRoot.replaceChildren(this.#p);
  }

  get color() {
    return this.#color;
  }

  get name() {
    return this.#name;
  }

  set color(value) {
    this.#color = value;
    this.setAttribute("color", value);
    this.#p.style.color = value;
  }

  set name(value) {
    this.#name = value;
    this.setAttribute("name", value);
    this.#p.textContent = `Hello, ${value}!`;
  }
}

customElements.define("hello-world", HelloWorld);
```

# JavaScript Expressions

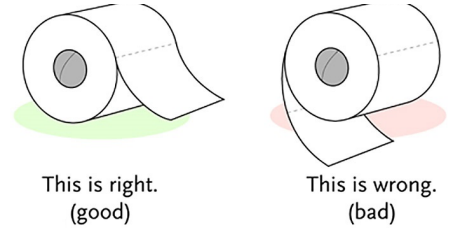


- wrec supports JavaScript expressions that refer to component properties with **`this.someName`**
- Can appear in element text content, attribute values, and CSS property values

Lit doesn't support JavaScript expressions in CSS

- Automatically updated when referenced property values change

# `this.` Controversy




- Should those JavaScript expressions be surrounded by some kind of delimiter like curly braces?
- Is searching for **`this.`*`someName`*** in plain text sufficient?
- When would plain text ever contain **`this.`** followed by a letter that is not part of a JavaScript expression?
- Answer: never
- But there is an escape mechanism
  - **`this`** followed by two periods is not treated as part of a JavaScript expression and will be replaced by **`this`** followed by a single period

# Property/Attribute Reflection

- It's automatic!
- Open DevTools and click Elements tab
- Change an attribute of a custom element
  - like **`color`** or **`name`** attribute in a **`hello-world`** element
  - updates what is rendered AND corresponding property
- Select a custom element and click Console tab
- Change properties of **`$0`**
  - for example, **`$0.name = 'Moon'`**
  - updates what is rendered AND corresponding attribute

demonstrate with hello-world project

# Secret Sauce


- The first time an instance of a given web component class is used, wrec searches all attribute values, element text content, and CSS properties for expressions matching **`this.{property-name}`** using a regular expression.
- Expressions in CSS properties are replaced by a local variable reference and a CSS variable declaration whose value is the expression is added before it.

```
h1 {
  --color: this.color;
  color: var(--color);
}
```

- A static map named **`propToExprsMap`** is created (one per **`Wrec`** subclass) whose keys are property names and whose values arrays of the expressions where they are found.
- A map named **`exprToRefsMap`** is created for each **`Wrec`** subclass instance whose keys are the expressions and whose values are arrays of references to the elements, attributes, and CSS variable declarations where they appear.
- For each property, **`Object.defineProperty`** is called to add getter and setter methods.
- When an instance property change is detected by its setter method, a list of the expressions that use the property is retrieved from **`propToExprsMap`** and new values are computed.
- Then for each expression whose value was computed, a list of all references to the expression is retrieved from **`exprToRefsMap`** and they are updated with the new value.

# Form Control 2-way Bindings

Lit doesn't do this

- **`input`** & **`select`** element **`value`** attribute gets 2-way binding to a property
- Expressions that use property automatically update when value changes

```
import { css, html, Wrec } from "wrec";

class CircleCalculator extends Wrec {
  static properties = {
    radius: { type: Number, value: 0 },
  };

  static css = css`
    :host {
      font-family: sans-serif;
    }
    label {
      font-weight: bold;
    }
  `;
```

**Radius:** 1

**Circumference:** 6.283185307179586

**Area:** 3.141592653589793

```
  static html = html`
    <div>
      <label for="radius">Radius:</label>
      <input id="radius" type="number" value="this.radius" />
    </div>
    <div>
      <label for="circumference">Circumference:</label>
      <span id="circumference">2 * Math.PI * this.radius</span>
    </div>
    <div>
      <label for="area">Area:</label>
      <span id="area">Math.PI * this.radius</span>
    </div>
  `;
}

CircleCalculator.register();
```

# Disabling

- Adding **`disabled`** attribute to a wrec component instance or removing it, automatically does the same to all applicable descendant elements, even those in nested shadow DOMs
- Applicable elements include **`button`**, **`fieldset`**, **`input`**, **`select`**, and **`textarea`** elements, and also nested wrec component instances

# Parent-Child 2-way Bindings ...

- Parent components can pass their properties to child components
- Automatically creates a 2-way binding
- When child property changes,
  corresponding parent property is directly updated
  - doesn't require dispatching events from child and listening for them in parent
  - uses **`propToParentPropMap`**

# ... Parent-Child 2-Way Bindings

```
import { css, html, Wrec } from "wrec";

class ToggleButtons extends Wrec {
  static properties = {
    labels: { type: String },
    value: { type: String },
  };
  static css = css`...`;
  static html = "this.makeButtons(this.labels)";

  handleClick(event) {
    this.value = event.target.textContent.trim();
  }

  makeButtons(labels) {
    const labelArray = labels.split(",");
    return labelArray.map((label) => {
      const classExpr = `this.value === '${label}' ? 'selected' : ''`;
      return html`
        <button class="${classExpr}" onClick="handleClick">${label}</button>
      `;
    });
  }
}
ToggleButtons.register();
```

details omitted

adds event listener

```
import { html, Wrec } from "wrec";
import "./hello-world";
import "./toggle-buttons";

class MyApp extends Wrec {
  static properties = {
    color: { type: String, value: "red" },
  };
  static html = html`
    <hello-world color="this.color"></hello-world>
    <toggle-buttons
      labels="red,green,blue"
      value="this.color"
    ></toggle-buttons>
  `;
}
MyApp.register();
```

**Hello, World!**

red | green | blue

# number-slider


used later in `color-picker`

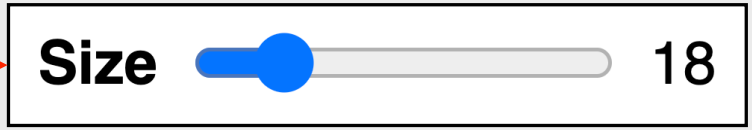
```
import { css, html, Wrec } from "wrec";

class NumberSlider extends Wrec {
  static properties = {
    label: { type: String },
    labelWidth: { type: String },
    max: { type: Number, value: 100 },
    min: { type: Number, value: 0 },
    value: { type: Number },
  };

  static css = css`...`;
```

details omitted

```
  static html = html`
    <label>this.label</label>
    <input
      type="range"
      min="this.min"
      max="this.max"
      value:input="this.value"
    />
    <span>this.value</span>
  `;
}

NumberSlider.register();
```

By default, updates on change events. Adding `:input` causes update on every mouse drag, not just when focus moves away.

```
<number-slider
  label="Size"
  max="48"
  min="12"
  value="this.size"
></number-slider>
```

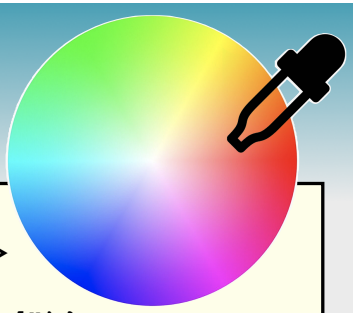



property in parent component

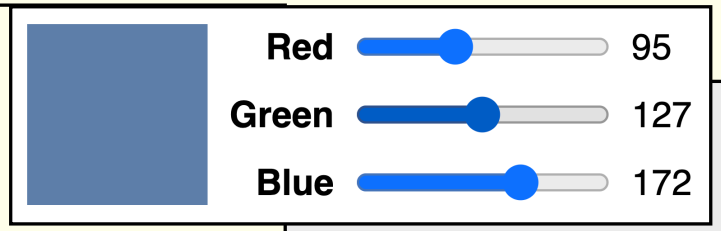
# Computed Properties

- Defined by adding **`computed`** property in property options
  - see **`color`** property on next slide
- Uses static **`propToComputedMap`**
  - tracks which computed properties to recompute after a change to a property used to compute it

# color-picker



```
import { css, html, Wrec } from "wrec";
import "./number-slider";

class ColorPicker extends Wrec {
  static properties = {
    labelWidth: { type: String, value: "3rem" },
    red: { type: Number },
    green: { type: Number },
    blue: { type: Number },
    color: {
      type: String,
      computed: "`rgb(${this.red},${this.green},${this.blue})`",
    },
  };

  static css = css`
    :host {
      display: flex;
      gap: 0.5rem;
    }
    #sliders {
      display: flex;
      flex-direction: column;
      justify-content: space-between;
    }
    #swatch {
      background-color: this.color;
      height: 5rem;
      width: 5rem;
    }
  `;

  static html = html`
    <div id="swatch"></div>
    <div id="sliders">
      ${this.makeSlider("Red")}
      ${this.makeSlider("Green")}
      ${this.makeSlider("Blue")}
    </div>
  `;

  static makeSlider(label) {
    return html`
      <number-slider
        label=${label}
        label-width="this.labelWidth"
        max="255"
        value="this.${label.toLowerCase()}"
      ></number-slider>
    `;
  }
}

ColorPicker.register();
```

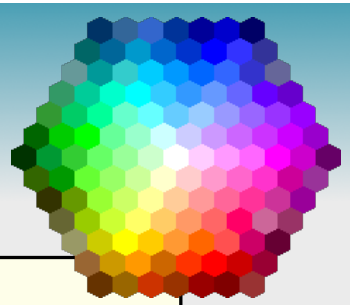


# Computed with “uses”

- Computed properties support optional **`uses`** property
  - needed when expression doesn’t reference every property needed to compute value
  - for example, the **`color`** property on previous slide can be defined like this

```
static properties = {
  ...
  color: {
    type: String,
    computed: "this.getColor()",
    uses: "red,green,blue"
  },
};

getColor() {
  return `rgb(${this.red},${this.green},${this.blue})`;
}
```

# color-demo ...

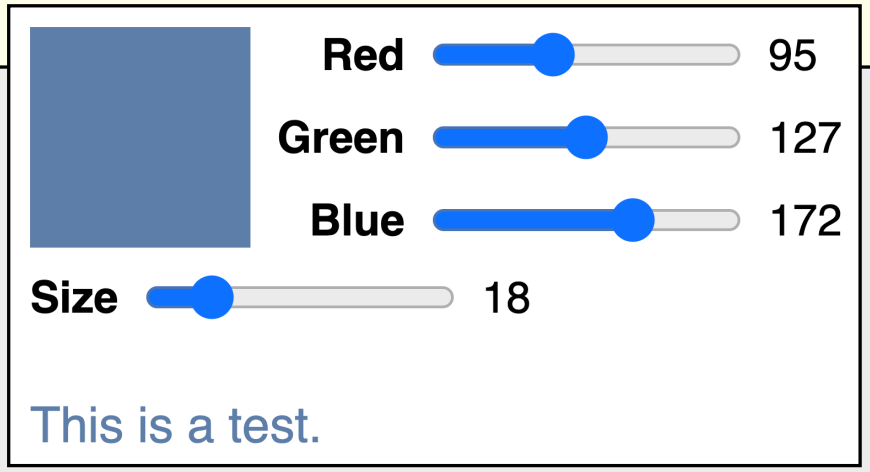


```
import { css, html, Wrec } from "wrec";
import "./color-picker";
import "./number-slider";

class ColorDemo extends Wrec {
  static properties = {
    color: { type: String },
    size: { type: Number, value: 18 },
  };

  static css = css`
    :host {
      display: flex;
      flex-direction: column;
      gap: 0.5rem;
      font-family: sans-serif;
    }
    p {
      color: this.color;
      font-size: this.size + "px";
    }
  `;
```

```
  static html = html`
    <color-picker color="this.color"></color-picker>
    <number-slider
      label="Size"
      max="48"
      min="12"
      name="size"
      value="this.size"
    ></number-slider>
    <p>This is a test.</p>
  `;
}

ColorDemo.register();
```

# ... color-demo


```
<!doctype html>
<html lang="en">
  <head>
    <script src="color-demo.js" type="module"></script>
  </head>
  <body>
    <color-demo></color-demo>
  </body>
</html>
```



# Event Dispatching ...

- Can opt into having change events dispatched when a property changes
- Just add **`dispatch: true`** to property description

```
static properties = {
  value: {type: String, dispatch: true}
};
```

- Events have **`detail`** property
  whose value is an object with properties
  **`tagName`**, **`property`**, **`oldValue`**, and **`value`**

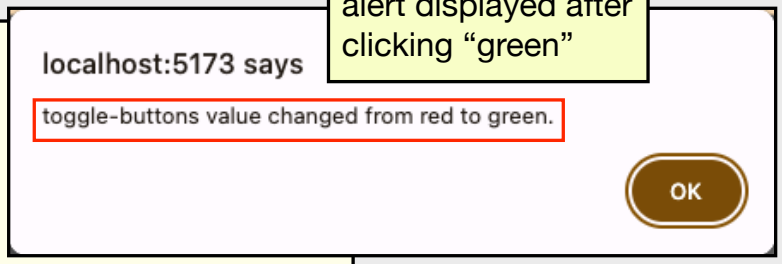
custom element name

# Event Dispatching

```
class ToggleButtons extends Wrec {
  static properties = {
    labels: { type: String },
    value: { type: String, dispatch: true },
  };
  ...
}
```

change

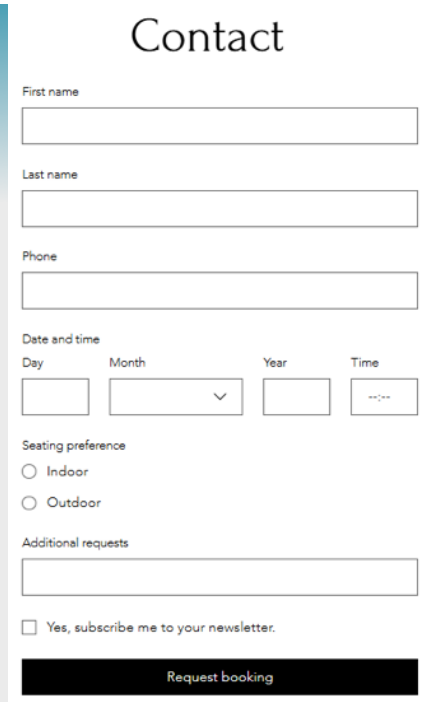

alert displayed after clicking “green”



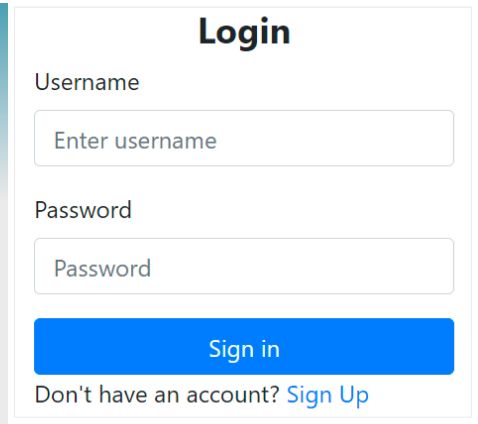

```
<!doctype html>
<html lang="en">
  <head>
    <script type="module" src="toggle-buttons.js"></script>
    <script type="module">
      const tb = document.querySelector('toggle-buttons');
      tb.addEventListener('change', e => {
        const {tagName, property, oldValue, value} = e.detail;
        alert(`${tagName} ${property} changed from ${oldValue} to ${value}.`);
      });
    </script>
  </head>
  <body>
    <toggle-buttons labels="red,green,blue" value="red"></toggle-buttons>
  </body>
</html>
```

# Forms ...

- When form control elements are nested in a form element, their values are automatically included in **`form`** submisssions
  - includes **`input`**, **`select`**, and **`textarea`** elements
- Instances of web components can also contribute to form submissions
  - add **`static formAssociated = true;`**
  - to contribute single value in property named **`value`**, specify name to submit with instance **`name`** attribute
    - just like in form control elements
  - to contribute multiple values, specify mappings from property names to names to submit with **`form-assoc`** attribute



# ... Forms




- Example
  - in **`number-slider.js`** and **`color-picker.js`**, add **`static formAssociated = true;`**
  - in parent component, add following where
    - **`number-slider`** **`value`** property is used for form data property **`score`**
    - **`color-picker`** properties **`red`**, **`green`**, and **`blue`** are used for form data properties **`r`**, **`g`**, and **`b`**

Duplicating this in vanilla web components is far more complicated.
It requires implementing the methods **`formAssociatedCallback`** and **`formResetCallback`**.
It also requires creating a **`FormData`** object, calling **`this.attachInternals`**, and calling **`setFormValue`**.

```
<form method="post" action="/save-game">
  <number-slider label="Score" name="score"></number-slider>
  <color-picker form-assoc="red: r, green: g, blue: b"></color-picker>
  <button type="reset">Reset</button>
  <button type="submit">Submit</button>
</form>
```

# State ...

- **`WrecState`** class maps state properites to wrec component properties
  - changing either updates the other to keep them in sync
- Optionally persists to **`localStorage`**
  - supports page refreshes without losing data
- Removes need for prop drilling
- Example uses
  - **`hello-world`** component (shown earlier)
  - **`labeled-input`** component

```
import { css, html, Wrec } from "wrec";

class LabeledInput extends Wrec {
  static properties = {
    id: { type: String, required: true },
    label: { type: String, required: true },
    name: { type: String },
    value: { type: String },
  };
  static css = css`
    div {
      display: flex;
      align-items: center;
      gap: 0.5rem;
    }
  `;
  static html = html`
    <div>
      <label for="this.id">this.label</label>
      <input
        id="this.id"
        name="this.name"
        type="text"
        value="this.value"
      />
    </div>
  `;
}

LabeledInput.register();
```

# ... State ...

```
<!doctype html>
<html lang="en">
  <head>
    <style>
      body {
        font-family: sans-serif;
        padding: 1rem;
      }
    </style>
  </head>
  <body>
    <labeled-input
      id="name"
      label="Name"
    ></labeled-input>
    <hello-world></hello-world>
    <button>Reset</button>
  </body>
</html>
```

```
<script type="module">
  import { WrecState } from "wrec";
  import "./hello-world.js";
  import "./labeled-input.js";

  const state = new WrecState("demo", false, { name: "World" });

  const li =
    document.querySelector("labeled-input");
  li.useState(state, { name: "value" });

  const hw =
    document.querySelector("hello-world");
  hw.useState(state);

  const button = document.querySelector("button");
  button.addEventListener("click", () => {
    state.name = "World";
  });
</script>
```

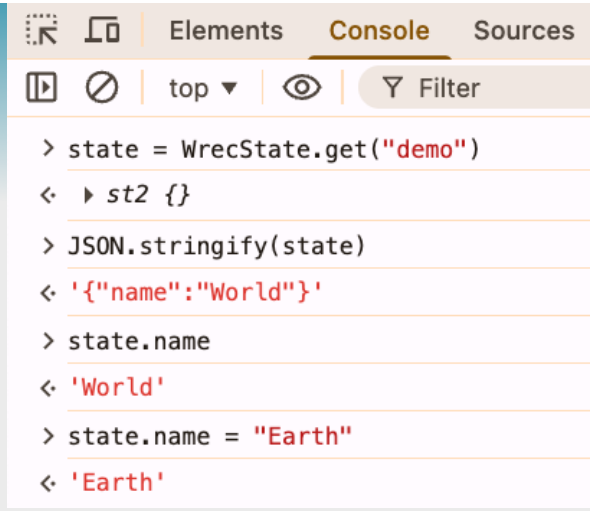
specifies whether state should be presisted to localStorage

maps state **name** property to **labeled-input value** property

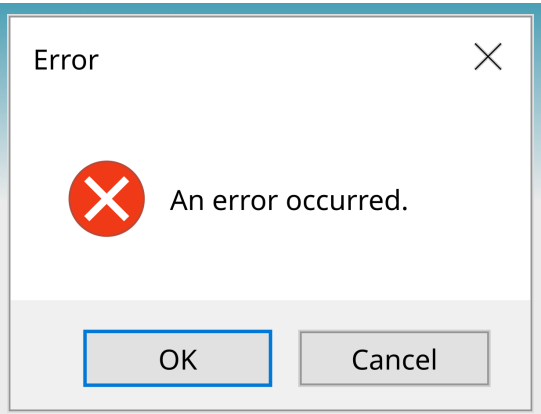
maps state **name** property to **hello-world name** property

# ... State

- State can be accessed, inspected, and modified from any code and from DevTools console
- To get reference to state object, enter `state = WrecState.get("demo")`
- To see all properties in state object, enter `JSON.stringify(state)`
- To see value of **`name`** property, enter `state.name`
  - outputs “World”
- To change value of **`name`** property, enter `state.name = "Earth"`
  - updates **`hello-world`** and **`labeled-input`** components



# Error Checking




- wrec checks for many kinds of errors and throws an **`Error`** when they are found
- Look for messages in DevTools console
- Kinds of errors detected include
  - attribute names in web component instances with no matching property declaration
  - attribute values with type that differs from declared property type
  - event handling function names that don't match a method name in web component
  - expressions in attribute values or element text content that reference undeclared web component properties
  - expressions in element text content that do not evaluate to a string or number

# Tests


- wrec has an extensive set of Playwright tests
- To run the tests
  - clone **`wrec`** repository
  - cd to **`wrec`** directory
  - Enter **`npm install`**
  - To run headless
    - enter **`npm run test`**
  - To run interactive
    - enter **`npm run testui`**
    - click right pointing triangle

# wrec Resources


- **Blog page**
  - https://mvolkmann.github.io/blog/wrec
- **npm package**
  - https://www.npmjs.com/package/wrec
- **GitHub repository**
  - https://github.com/mvolkmann/wrec
  - view and create issues here
- **Support email**
  - r.mark.volkmann@gmail.com

# wrec Benefits


- Simplies creating web components
- More reactivity than Lit components
  - DOM updates when properties change
  - automatic 2-way bindings between attributes and properties
  - automatic 2-way bindings between properties and form controls
  - reactive CSS through JS expressions in CSS property values
  - syncing changes between parent and child components without dispatching events and listening for them
    - but can automatically dispatch **`change`** events when properties change
  - computed properties
- Simplifies contributing data to form submissions
- Simplifies sharing state between components