# Vue Components

# Component Overview

- Components break up UI into reusable pieces
- At high level, components
  - accept input using props
  - generate DOM
  - respond to user interactions using event handling
  - produce data using events, callback functions, and Vuex state
- Rendered using a virtual DOM, just like in React
  - minimizes number of actual DOM updates performed
- Automatically updated when their data changes
  - includes changes to props, data, and state in a Vuex store (if used by component)

# Ways to Define Components

- **Single File Component (SFC)**
  - most common
  - defined in a `.vue` file that holds valid HTML
  - exports an instance definition object — described soon
  - supports scoped styles — described in "Styles" section
  - using components can assign alternate name to avoid conflicts
  - Webpack `vue-loader` processes these files
    - Vue CLI configures this by default
- `Vue.component(name, instanceDefinitionObject)`
  - much less common
  - no support for scoped styles
  - names must be unique throughout app
  - defined in a `.js` or `.vue` file
  - "can be used in the template of any root Vue instance (new Vue) created after registration" — very restrictive!

# Vue.component

NOT USED OFTEN!

- Components defined this way can only be used in the template of a root Vue instance

can use template property or `render` method

```
Vue.component('Greet', {
  name: 'Greet',
  props: {
    name: {
      type: String,
      required: true
    }
  },
  //template: '<div>Hello, {{ name }}!</div>'
  render(createElement) {
    const msg = `Hello, ${this.name}!`;
    const children = [msg];
    return createElement('div', children);
  }
});
```

# `createElement` Arguments

NOT USED OFTEN!

- Tag or component name - ex. `'div'` or `Greeting`
- Object describing attributes - optional
  - ex. `{attrs: {id: 'message'}, class: 'danger'}`
  - some attributes are treated specially such as `class`, `style`, and those for event handling
- String or array describing children - optional
  - ex. `['warning: the', otherElement, 'is too hot']`

```
Vue.component('Danger', {
  props: {
    message: {type: String, required: true}
  },
  render(createElement) {
    return createElement('div', {class: 'danger'}, this.message);
  }
});
```

Example usage:

```
<Danger message="out of memory" />
```

version using JSX instead of `createElement`

```
Vue.component('Danger', {
  props: {
    message: {type: String, required: true}
  },
  render() {
    return <div class="danger">{this.message}</div>;
  }
});
```

more on JSX at the end of this section

# SFC Layout

MOST COMMON WAY TO DEFINE COMPONENTS

- **`<template>`**
  - holds HTML that is not immediately rendered
  - later it can be cloned and added to DOM, zero or more times
  - Vue components do this for each instance
  - can use other components, interpolation, and directives
  - can include `<!-- comments -->`
- **`<script>`**
  - holds JavaScript that defines and exports an "instance definition"
  - can import things from other files
- **`<style>`**
  - holds CSS or another syntax such as Sass
  - can be scoped to the component so it doesn't affect HTML outside it

```
<template>
  ...
</template>

<script>
  ...
</script>

<style lang="scss" scoped>
  ...
</style>
```

`.vue` file containing valid HTML

# Instance Definition Objects

- `Vue.component` takes one as its second argument
  - rarely used
- SFC `script` tags export one
- Contains same properties in either case
- Most are optional
- The following slides describe them

```
{
  el: 'some-selector',
  name: 'SomeName',
  components: { ... },
  props: { ... },
  computed: { ... },
  data() {
    return { ... };
  },
  watch: { ... },
  methods: { ... },
  life-cycle-methods,
  template: 'some-template'
}
```

# `el` Property

- Typically only specified in top-level components
- Value is CSS selector string that specifies where this component should be rendered
- Example `el: '#app',`
- Alternate way to specify
  - create a new `Vue` object and call its `$mount` method
  - `main.js` in apps generated by Vue CLI does this

```
import Vue from 'vue';
import App from './App.vue';

new Vue({
  render: h => h(App)
}).$mount('#app');
```

`h` stands for "hyperscript" which is a name given to scripts that generate HTML

# `name` Property

- Component name
- Only used in SFCs
  - with `Vue.component` the name is specified in first argument
- Typically matches source file name
- If kebab-case
  - same name must be used in elements
  - ex. `'foo-bar'` → `<foo-bar>`
- If camel-case
  - element name can be kebab-case or camel-case
  - ex. `'FooBar'` → `<foo-bar>` or `<FooBar>`
- Example

```
name: 'FooBar',
```

I prefer to make components names camel-case and refer to them with camel-case which matches React convention.

# `components` Property

- List of other components used by this one
- Omit if no other components are used
- Value is object where
  keys are component names and
  values are components
- Example
  - suppose components **`Foo`** and **`Bar`** are used

```
components: {Foo: Foo, Bar: Bar},
```

  - or using ES6 object shorthand

```
components: {Foo, Bar},
```

- Ability to choose names by which components will be referenced
  - important when there are name conflicts because it allows
    use of multiple components that happen to have the same name

# `props` Property ...

- Object or array describing props this component accepts
- Allows parent components to pass data to child components
- When value is an array
  - just a list of prop names; bypasses type checking

```
props: ['age', 'name'],
```

- When value is an object
  - keys are prop names
  - values are either a type or another object
  - object properties are
    - `type` - JavaScript type name (ex. `String`) or custom class name (ex. `Person`)
    - `default` - optional default value that matches type
    - `required` - optional boolean

```
props: {age: Number, name: String},
```

```
props: {
  name: {
    type: String,
    required: true
  },
  age: {
    type: Number,
    default: 0
  }
},
```

supported JS classes include `Boolean`, `Number`, `String`, `Symbol`, `Date`, `Function`, `Object`, and `Array`

# ... `props` Property ...

- For more fine-grained validation of a prop value add `validator` method
- Example

```
const isNumber = value => typeof value === 'number';
const isString = value => typeof value === 'string';
...

  props: {
    person: {
      type: Object,
      required: true,
      validator(person) {
        const {name, age} = person;
        return isString(name) && isNumber(age);
      }
    }
  }
```

# ... `props` Property

- Prop values are passed in from parent components using attributes
- Can be any kind of value
  - including functions defined in parent component that child component can call
- When prop values change
  - component is updated rather than creating a new instance
  - `beforeUpdate` and `updated` lifecycle methods are invoked
- Camel-cased prop names must be written in kebab-case in HTML
  - example: `fooBar` prop in HTML would be
    `<SomeComponent foo-bar="some-value" />`
  - of course using single-word prop names avoids this issue

# computed Property

- Object describing props that are computed based on other props and data
- Defines methods whose names are prop names and return prop value
- Results are cached and only recomputed when data they depend on changes
- Makes them more efficient that implementing a method that returns the same computed value
  - defining instance methods is described later in this section
- Example

```
computed: {
  fullName() {
    return this.firstName + ' ' + this.lastName;
  }

  // Works, but verbose.
  //fullName: function () {
  //  return this.firstName + ' ' + this.lastName;
  //}

  // Does not work because it uses wrong "this" value.
  //fullName: () => this.firstName + ' ' + this.lastName
}
```

# `data` Property ...

- Value is a function that returns an object containing data specific to each component instance
  - allows each instance to maintain its own data
  - similar to "state" in React
- In returned object
  - keys are data names
  - values are initial values which can be changed later
- **`v-model`** directives refer to data property names
- Example

```
data() {
  return {
    email: '@gmail.com',
    rating: 10,
    car: {
      make: '',
      model: '',
      year: new Date().getFullYear()
    }
  };
},
```

**`v-model`** directive, described in "Templates" section, provides two-way data binding between a form input and a **`data`** property

# ... `data` Property ...

- Outputs error if set to an object instead of a function
  - "error: data property in component must be a function"
- Changes to data are watched by Vue
- Some JavaScript approaches to modifying data aren't seen by Vue, so other techniques must be used
  - details on next slide

# ... `data` Property ...

- Primitive values
  - set with `this.property = value;`
  - delete with `this.property = null;`
- Object values
  - can assign a new object
  - can set a property
    - if initially present use `this.someObj.property = value;`
    - if not use `this.$set(this.someObj, property, value);`
  - delete a property with `this.$delete(this.someObj, property);`
- Array values
  - can assign a new array
  - set an element with `this.$set(this.someArray, index, value);`
  - delete an element in two ways
    - 1) assign result of `Array` `slice` or `splice` method to `this.someArray`
    - 2) `this.$delete(this.someArray, index);`

# … `data` Property

- Sometimes desirable to set data based on a prop value and update it whenever a new prop value is passed in
- One way to achieve this
  - prop name is `foo` and data name is `fooData`

```
props: {
  foo: {
    type: String,
    required: true
  }
},
data() {
  return {
    fooData: this.foo // captures initial value
  };
},
watch: {
  foo(newValue) {
    this.fooData = newValue; // captures updates
  }
},
```

`watch` is described in two more slides

# When to use `this.`

- Instance definition object **`props`**, **`data`**, and **`computed`** all define properties on the component instance
- Templates access them without **`this.`** prefix
- Methods must use **`this.`** prefix

```
<template>
  <div>
    Hello, {{ name }} ({{ initials }})!<br />
    Today is {{ date }}.
  </div>
</template>
<script>
export default {
  name: 'Greet2',
  props: {
    name: {
      type: String,
      required: true
    }
  },
  computed: {
    initials() {
      return this.name.split(' ')
        .map(part => part[0].toUpperCase())
        .join('');
    }
  },
  data() {
    return {
      date: new Date().toDateString()
    }
  }
};
</script>
```

example: `'Sat Mar 09 2019'`

# `watch` Property

- Object where
  keys are names of data to be watched and
  values are functions to execute when value changes
- These functions are passed new and old values
- To watch for deep changes in an object or array,
  use an object for the value with
  **`deep`** and **`handler`** properties
  - **`deep`** is a boolean that must be set to **`true`**
  - **`handler`** is a function that is invoked with new and old values when anything in watched object changes
- If goal is only to compute new property values based on changes to watched props,
  use **`computed`** properties instead of **`watch`**

```
props: {
  user: {
    type: Object,
    required: true
  }
},
watch: {
  //user(newUser) {
  //  console.log(newUser);
  //}
  user: {
    deep: true,
    handler(newUser) {
      console.log(newUser);
    }
  }
},
```

A

B

**Approach A** works if new object is assigned to **`user`** prop, but not if properties inside existing object are changed.
**Approach B** works when a new object is assigned AND when properties inside existing object are changed.

# `methods` Property

- Value is an object that defines component methods
- Primarily used for event handling
  - example
```
<button @click="handleClick">Do It</button>
```
- Inside these methods, `this` refers to a component instance
- Lifecycle methods are defined at top of instance definition object, not here
  - more on these later
- Example

```
methods: {
  handleClick() {
    // handle the click
  },
  handleSubmit() {
    // handle the submit
  }
},
```

# Reactive Properties

- Vue component properties are reactive
  - includes **`props`**, **`data`**, and **`computed`**
  - DOM updates are triggered when methods change their values

# Lifecycle Methods

- Described in "Lifecycle" section

# `template` Property

- String of HTML to be rendered
- Alternative to **`<template>`** element
- Fine for small amounts of HTML, but **`<template>`** is preferred for large amounts
- Example

```
template: '<div>Email: {{ email }}</div>',
```

- To spread across multiple lines, surround with backticks

```
template: `
  <div>
    Email: {{ email }}
  </div>
`,
```

- Does not support JSX
  - use **render** method on next slide for that
- Requires **`runtimeCompiler`** option

vue.config.js

```
module.exports = {
  runtimeCompiler: true
};
```

# `render` Method ...

- Alternative to **`template`** property and **`<template>`** element
- Supports using JavaScript to determine content instead of Vue template directives
  - like in React
- Passed **`createElement`** function
- Return result of **`createElement`** call or JSX more details on JSX later
  - many find JSX more readable than calls to **`createElement`**
- Examples
  - **`ColorList`** component on next slide renders a list of color names in three ways
  - in this case, using a **`<template>`** element or **`template`** property are the best options

# ... `render` Method ...

```
export default {
  name: 'ColorList',
  props: {
    colors: {
      type: Array,
      required: true
    }
  },
  template: `
    <div>
      <div v-for="color of colors">{{ color }}</div>
    </div>
  `,
  render(h) {
    const children = this.colors.map(
      color => h('div', color));
    return h('div', children);
  },
  render() {
    return (
      <div>
        {this.colors.map(color => <div>{color}</div>)}
      </div>
    );
  }
}
```

**using template**
remove `render` methods

**using render with `createElement`**
remove `template` and other `render` method

**using render with JSX**
remove `template` and other `render` method

can only use one of these `render` methods

`h` is common alias for `createElement` function
stands for **hyperscript** which is a "script that generates HTML structures"

# ... `render` Method

- SFCs that use a `render` method instead of an HTML template can still include a `<style>` element
- If no CSS is needed
  - file extension can be changed from `.vue` to `.js`
  - `<script>` start and end tags can be removed
  - works because in this case Vue build tooling is not needed

# JSX ...

- Stands for "JavaScript XML"
- XML syntax for generating DOM
- Can be returned by a `render` method
  - or by methods the `render` method calls
- Alternative to using a template
- Requires a Babel plugin
  - projects created by Vue CLI have this configured by default
- Most Vue developers prefer to not use JSX

```
<script>
export default {
  name: 'Greeting',
  props: {
    name: {
      type: String,
      required: true
    }
  },
  render() {
    return (
      <div class="greeting">
        Hello, {this.name}!
      </div>
    );
  }
};
</script>
```

JSX

# ... JSX ...

- Vue template vs. JSX syntax differences
  - interpolation `{{ }}` → `{ }`
  - Vue directives → interpolation containing JavaScript expressions
  - **`v-if`** → ternary inside `{ }`
  - **`v-for`** → **`map`** method inside `{ }`
  - **`v-model`** → custom event handling that updates a **`data`** property

# ... JSX

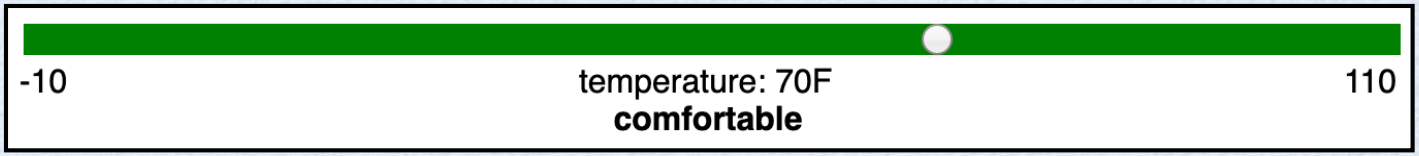
- Example of **render** method that returns JSX and uses a method call to get more JSX

```
<script>
export default {
  name: 'ColorList',
  data() {
    return {
      colors: ['red', 'green', 'blue']
    };
  },
  methods: {
    getItems() {
      return this.colors.map(color => <li>{color}</li>);
    }
  },
  render() {
    return <ul>{this.getItems()}</ul>;
  },

};
</script>
```

# Exercise ...

- Build a **`Temperature`** component in my-project created earlier




  - renders a slider using **`<input type="range">`**
  - accepts many props
    - **`min`** and **`max`** are the minimum and maximum allowed temperatures
    - **`cold`** is the temperature where all values at or below are considered cold
    - **`hot`** is the temperature where all values at or above are considered hot
    - **`temperature`** is the current temperature
  - emits a **`change`** event when slider is moved
  - displays current value
  - displays evaluation of cold, comfortable, or hot
- All the code is provided so the focus is on gaining experience working with Vue
  - also, some topics haven't been covered yet
- After writing the code, verify that it works

# ... Exercise ...

- Create **`src/components/Temperature.vue`**
- **`template`** section of **`Temperature.vue`**

```
<template>
  <div class="temperature">
    <input
      :min="min"
      :max="max"
      :style="{backgroundColor: color}"
      :value="value"
      @input="handleInput"
      type="range"
    />
    <div class="labels">
      <div>{{ min }}</div>
      <div>temperature: {{ value }}F</div>
      <div>{{ max }}</div>
    </div>
    <div class="evaluation">{{ evaluation }}</div>
  </div>
</template>
```

**`min`** and **`max`** are props that are passed in

**`color`** is a computed prop

**`value`** is a data value

**`handleInput`** is a method

**`evaluation`** is a computed prop

# … Exercise …

- **`script`** section of **`Temperature.vue`**

```
<script>
export default {
  name: 'Temperature',
  props: {
    cold: {
      type: Number,
      required: true
    },
    hot: {
      type: Number,
      required: true
    },
    max: {
      type: Number,
      default: 100
    },
    min: {
      type: Number,
      default: 0
    },
    temperature: {
      type: Number,
      default: 0
    }
  },
  data() {
    return {
      value: this.temperature
    };
  },
  computed: {
    color() {
      return this.evaluation === 'cold'
        ? 'blue'
        : this.evaluation === 'hot'
        ? 'red'
        : 'green';
    },
    evaluation() {
      return this.value <= this.cold
        ? 'cold'
        : this.value >= this.hot
        ? 'hot'
        : 'comfortable';
    }
  },
  methods: {
    handleInput(event) {
      this.value = Number(event.target.value);
      this.$emit('change', this.value);
    }
  }
};
</script>
```

initial value is the temperature that is passed in via a prop

`event.target.value` is a string

parent components can listen for the event emitted here

# … Exercise …

- **`style`** section of **`Temperature.vue`**

```
<style scoped>
.evaluation {
  display: flex;
  font-weight: bold;
  justify-content: center;
}

input {
  appearance: none;
  background-color: gray;
  width: 100%;
}

.labels {
  display: flex;
  justify-content: space-between;
}

.temperature {
  width: 100%;
}
</style>
```

styles are scoped to **`Temperature`** component

using flexbox for layout

necessary to change background color

using flexbox for layout

# … Exercise

- Modify **`App.vue`** to use **`Temperature`** component

```
<script>
import Temperature from './components/Temperature.vue';

export default {
  name: 'App',
  components: {
    Temperature
  },
  data() {
    return {
      temperature: 70
    };
  },
  methods: {
    temperatureChange(t) {
      this.temperature = t;
      console.log(
        'App.vue temperatureChange: this.temperature =',
        this.temperature
      );
    }
  }
};
</script>
```

at top of file

```
<template>
  <div id="app">
    <Temperature
      :min="-10"
      :max="110"
      :cold="30"
      :hot="90"
      :temperature="temperature"
      @change="temperatureChange"
    />
  </div>
</template>
```