

Full Stack Web Development

WS2020 - BSA5 Ausgewählte Kapitel



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Smart Homes and Assistive Technologies

October 7, 2020

Outline

1 Vue.js

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Vue.js - Introduction

JavaScript Frameworks

- AngularJS
- Angular
- React
- Vue.js
- Ember.js
- ...



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Vue.js - Introduction

Evan You [1, 2]

- Born and raised in Wuxi, PRC (无锡中国).
- Recruited by Google for his work, inspired by [Chrome experiments](#), and joined the [Five program](#) during his study in the U.S.
- Started the work on [Vue.js](#) as a personal project during his work at Google Creative Labs in 2013.
- Works full-time on Vue since 2016.

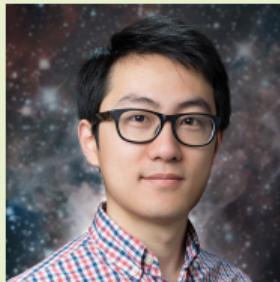


Figure 1: Evan You
(尤雨溪)



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Vue.js

- Client-side JavaScript framework
- Progressive framework
- Performant
- Lightweight (~33.30kB - `min+gzip`)
- Extensible
 - Vue Router
 - Vuex
 - Vue Server Renderer



Figure 2: Vue.js Logo

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Features



Figure 3: Vue.js Features



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Vue applications can be created in different ways. To get started, we will employ a simpler setup and add the Vue script in the <head> section, using a <script> element.

```
<script src="https://vuejs.org/js/vue.js"></script>
```

Listing 1: Adding Vue to your page.

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With the addition of this script, we can now access the class `Vue` in our scripts.

To create an application, we have to instantiate a object of this class. We have to pass a `JSON` object to the class constructor to configure the application.

```
<script>
  new Vue({
    el: "#app",
    data: {
      text: "Hello Vue!"
    }
  });
</script>
```

Listing 2: Creating a Vue application.



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```
1  <!DOCTYPE html>
2
3  <html>
4    <head>
5      <meta charset="utf-8" />
6      <title>Vue Setup</title>
7      <script src="https://vuejs.org/js/vue.js"></script>
8    </head>
9    <body>
10      <div id="app">{{ text }}</div>
11    </body>
12
13    <script>
14      new Vue({
15        el: "#app",
16        data: {
17          text: "Hello Vue!"
18        }
19      });
    </script>
</html>
```

Listing 3: Minimal Example



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We use the `el` property to specify what element should be used as the root element of our application. Vue interprets this parameter as a `CSS` selector to find the specified element(s) in the `DOM` of our page.

Vue then uses the specified element(s) as a *template* to create a virtual `DOM`, which is then used internally to create a new (static) `DOM`. Subsequently, Vue replaces the specified element(s) with the newly created `DOM` tree.

We can use other properties in the `JSON` object to customize our application.

In this example, we use the `data` property to specify the data of our application. We can then access the data in the (virtual) `DOM` (*template syntax*). We will explore the `data` and other properties in more detail, in the following sections.



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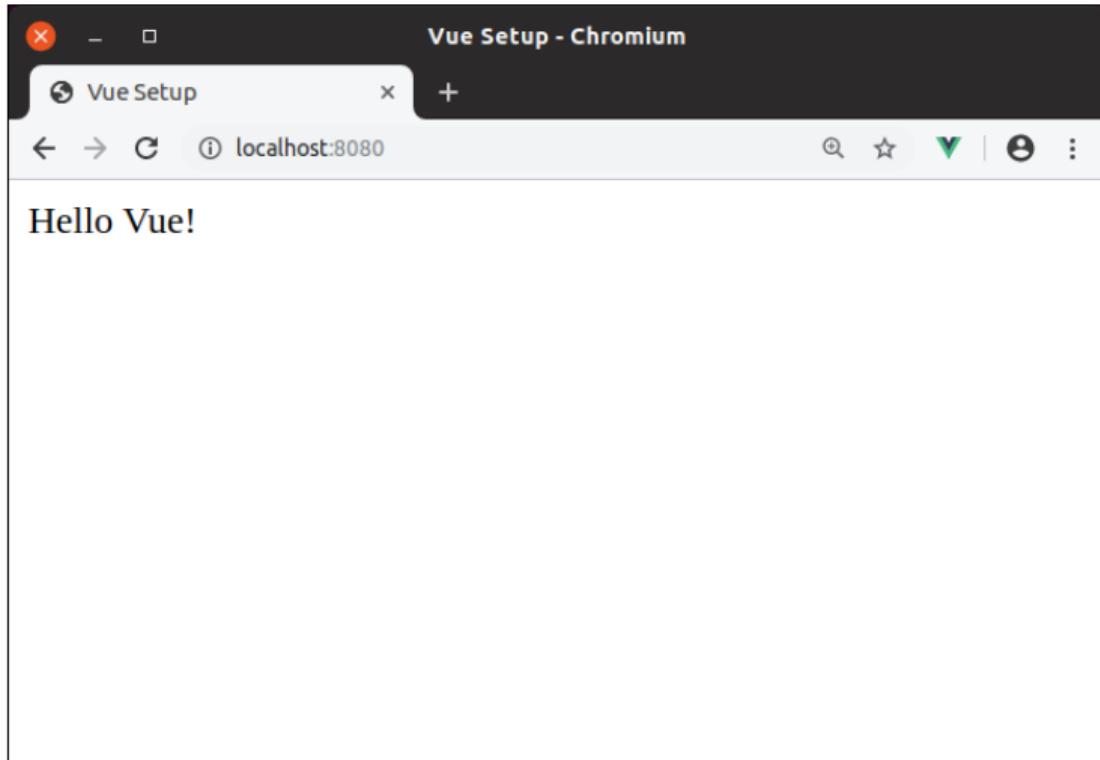


Figure 4: Minimal Example



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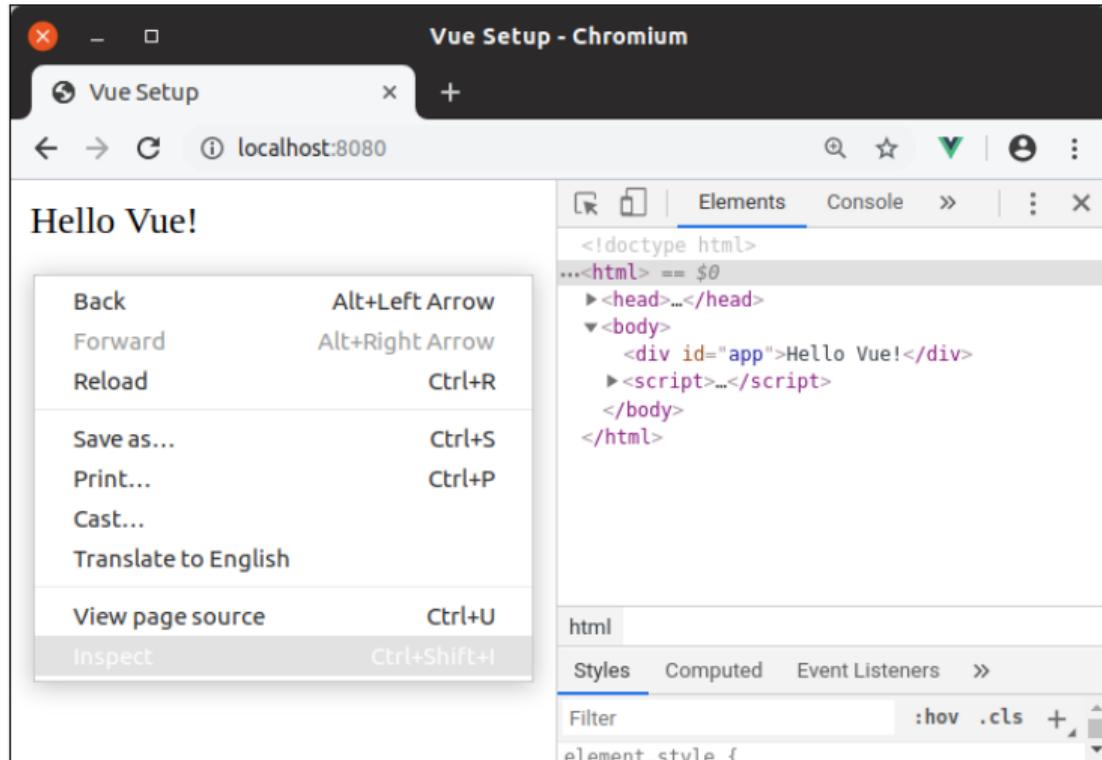


Figure 5: Chromium Developer Tools



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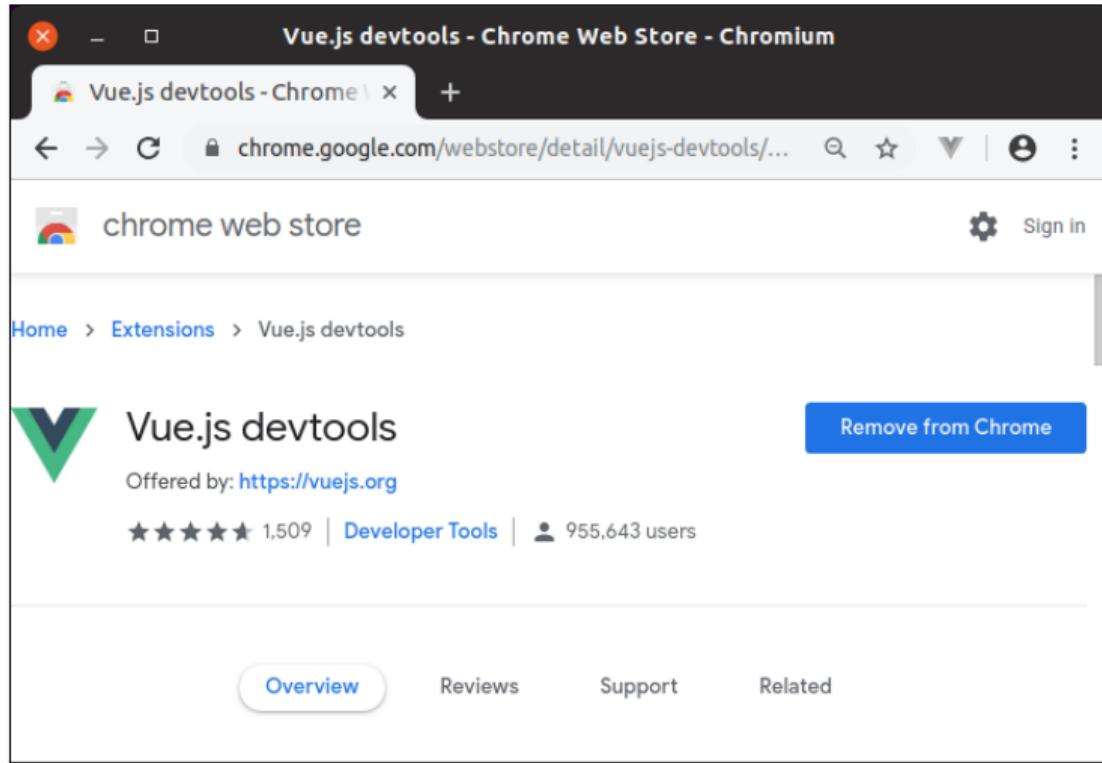


Figure 6: Chrome Vue.js Devtools



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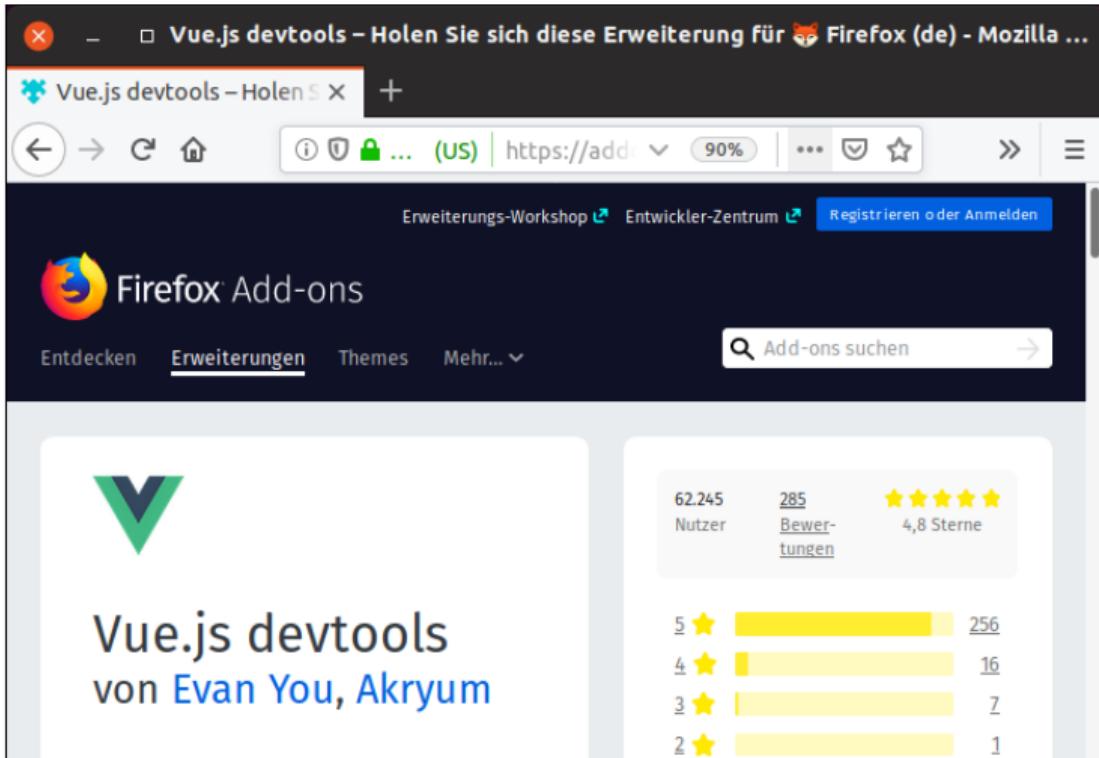


Figure 7: Firefox Vue.js Devtools



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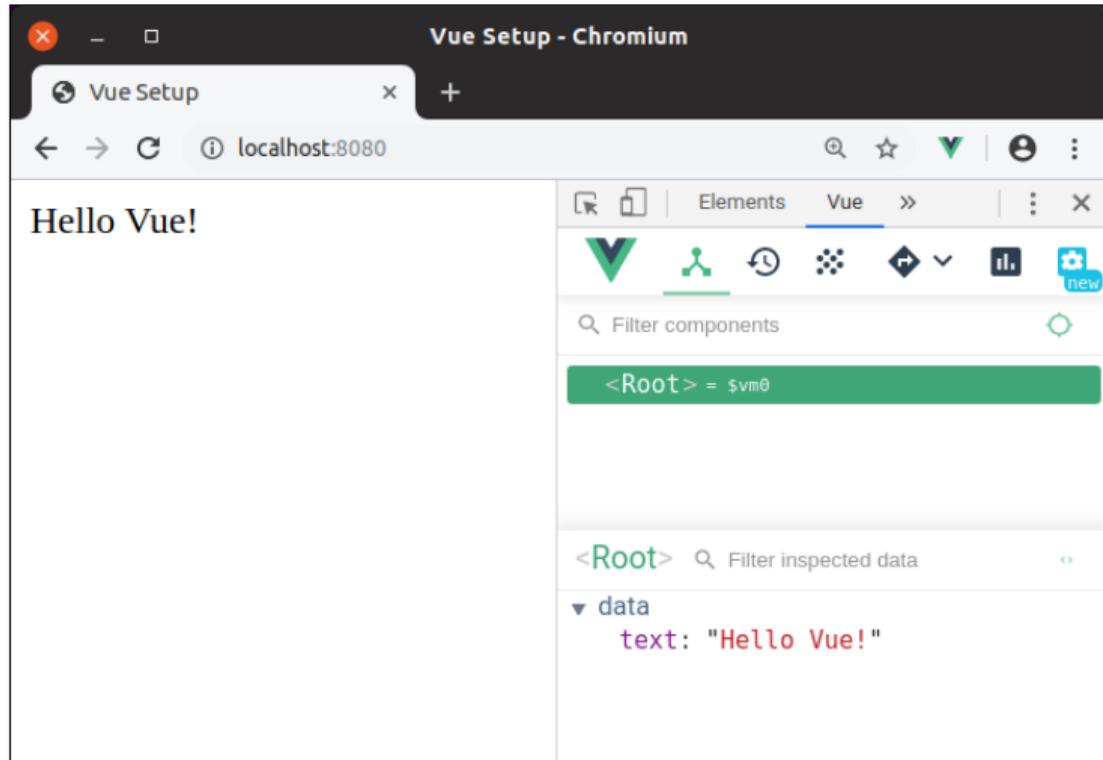


Figure 8: Chrome Vue.js Devtools - Tab



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To test our application, we can install a simple [HTTP](#) server which hosts our files.

Run the following command(s) to install the [npm](#) package `http-server` on your machine.

```
1 $~ node -v  
2 v10.16.3  
3 $~ npm -v  
4 6.9.0  
5 $~ npm install -g http-server  
6 + http-server@0.11.1  
7 added 26 packages from 28 contributors in 6.096s
```

[Listing 4:](#) Install [npm](#) module `http-server`



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To host the files inside our folder `project`, inside our *home directory*, we have to run following command(s).

```
1 $~ ls
2 Desktop  Downloads Pictures Public    Videos
3 Documents Music      project  Templates
4 $~ http-server project/
5 Starting up http-server, serving project/
6 Available on:
7   http://127.0.0.1:8080
8 Hit CTRL-C to stop the server
9 $~/project http-server .
10 Starting up http-server, serving .
11 Available on:
12   http://127.0.0.1:8080
13 Hit CTRL-C to stop the server
```

Listing 5: Host directory with `http-server`



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```
1  <!DOCTYPE html>
2
3  <html>
4    <head>
5      <meta charset="utf-8" />
6      <title>Vue Setup</title>
7      <script src="https://vuejs.org/js/vue.js"></script>
8    </head>
9    <body>
10      <div id="app">
11        <p>{{ text }}</p>
12      </div>
13    </body>
14    <script>
15      new Vue({
16        el: "#app",
17        data: {
18          text: "Hello Vue!"
19        }
20      });
21    </script>
22  </html>
```

Listing 6: Vue Instance and DOM Template.



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```
1  <!DOCTYPE html>
2
3  <html>
4    <head>
5      <meta charset="utf-8" />
6      <title>Vue Setup</title>
7      <script src="https://vuejs.org/js/vue.js"></script>
8    </head>
9    <body>
10      <div id="app">
11        <p>{{ text }}</p>
12      </div>
13    </body>
14    <script>
15      new Vue({
16        el: "#app",
17        data: {
18          text: "Hello Vue!"
19        }
20      });
21    </script>
22  </html>
```

Template



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Listing 6: Vue Instance and DOM Template.

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```
1  <!DOCTYPE html>
2
3  <html>
4    <head>
5      <meta charset="utf-8" />
6      <title>Vue Setup</title>
7      <script src="https://vuejs.org/js/vue.js"></script>
8    </head>
9    <body>
10      <div id="app">
11        <p>{{ text }}</p>
12      </div>
13    </body>
14    <script>
15      new Vue({
16        el: "#app",
17        data: {
18          text: "Hello Vue!"
19        }
20      });
21    </script>
22  </html>
```

Template

Instance



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Listing 6: Vue Instance and DOM Template.

Vue - Basics

With the `el` property of the configuration object, passed to the class constructor (`Vue()`), we can use `CSS` selectors to specify what *templates* should be processed by the Vue *instance*.

Inside the *template* we can employ Vue's *template syntax* to reference `data` and `methods` of our Vue instance.

Even though, the example is pretty simple and straightforward, Vue does a lot of work in the background. Vue's `data` property and the `DOM` are now linked together, which results in immediate updates of the `DOM` when changing the used properties.



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Reactivity

To test the *reactivity* of our application, we can save a reference to our Vue instance and change the property manually using the browser's console.

```
13 <script>  
14   const app = new Vue({  
15     el: "#app",  
16     data: {  
17       text: "Hello Vue!"  
18     }  
19   });  
20 </script>
```

Listing 7: Saving a reference to the Vue instance.



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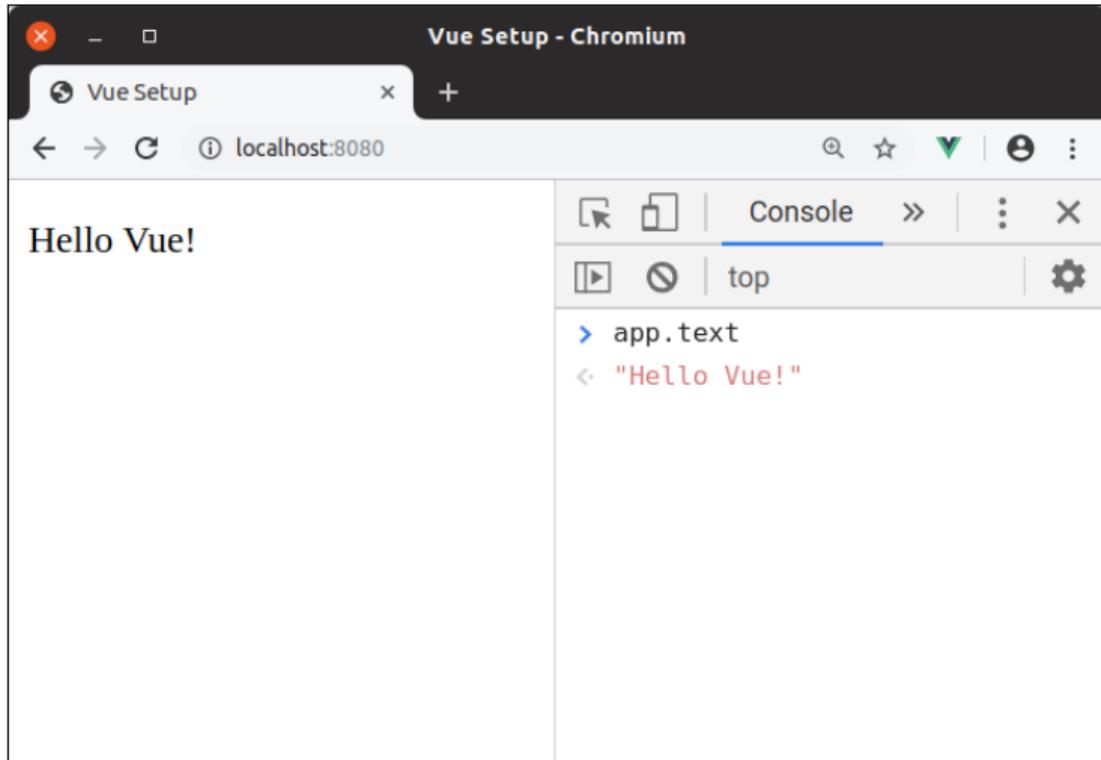


Figure 9: Changing properties of the Vue instance.



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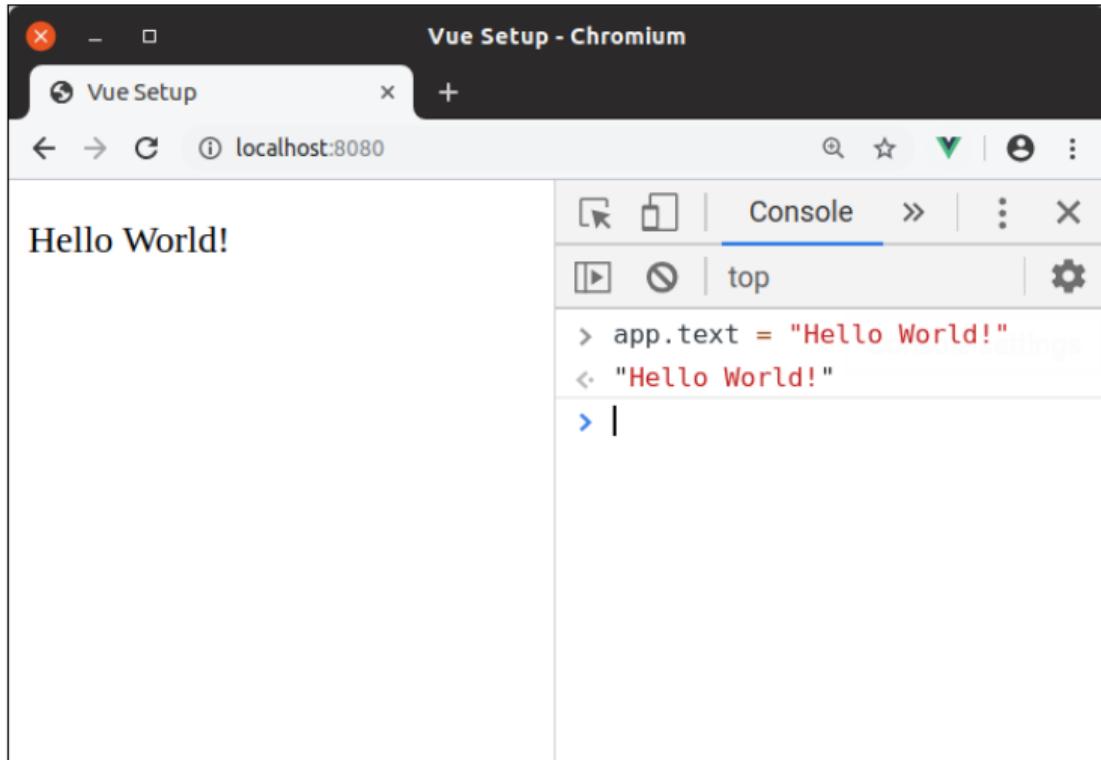


Figure 9: Changing properties of the Vue instance.



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The `data` property is used to store the data of our application. It will be used by Vue to create getters and setters from the properties inside of it.

```
14      data: {  
15        text: "Hello Vue!"  
16      },
```

Listing 8: The `data` property of the `JSON` (configuration) object.

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Vue - Data and Methods

We can then access the data (e.g., `text`)

- Inside the template, using *Interpolation* or *String Interpolation*.
- Inside the Vue instance, using a (virtual) `this` reference.
- Using a reference to the Vue instance, either by
 - Vue's internal properties, that is
 - ▶ `app.$data.text` or
 - ▶ `app._data.text`
 - Generated getters and setters, that is `app.text`



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```
9 <div id="app">{{ text }}</div>
```

Listing 9: (String) Interpolation inside the template.

```
12 const app = new Vue({  
13   el: "#app",  
14   data: {  
15     text: "Hello Vue!"  
16   },  
17   methods: {  
18     hello() {  
19       console.log(this.text);  
20     }  
21   }  
22});
```

Listing 10: Accessing data inside the Vue instance.

```
23 console.log(app.text); // Generated getters and setters  
24 console.log(app.$data.text); // Vue's internal properties
```

Listing 11: Accessing the data with a reference to the Vue instance.



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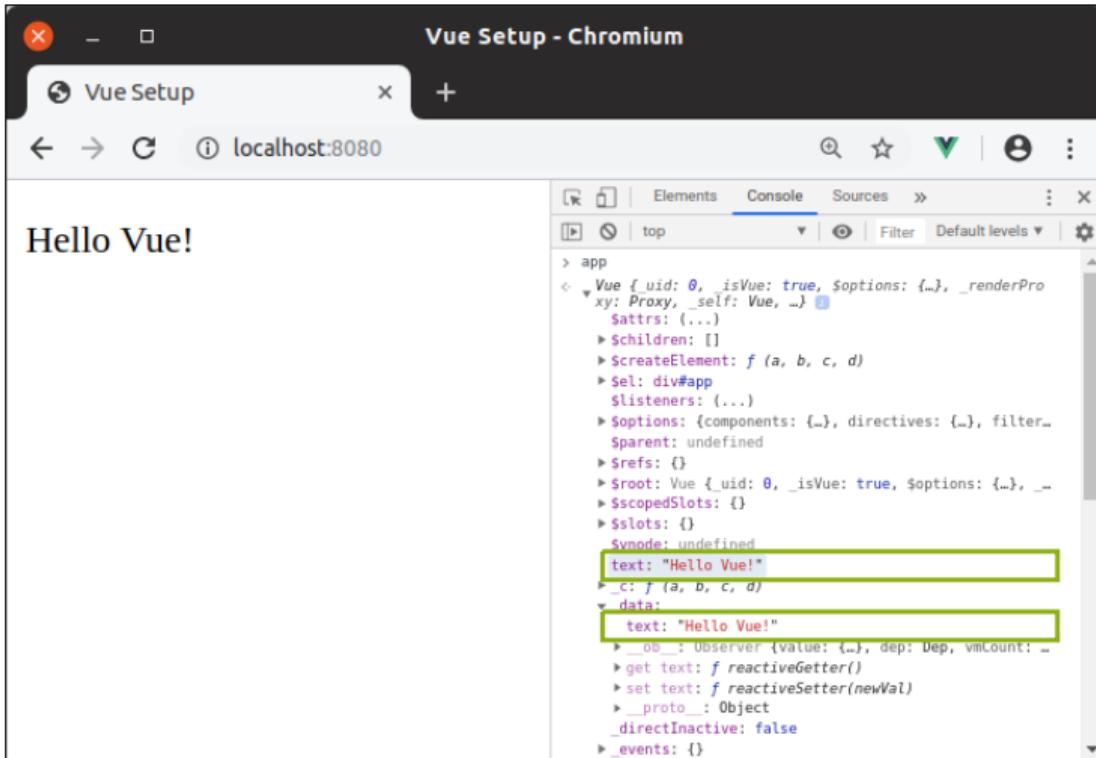
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The screenshot shows a browser window titled "Vue Setup - Chromium" displaying the URL "localhost:8080". The page content says "Hello Vue!". Below the browser is the Chrome DevTools interface, specifically the "Console" tab. The console output shows the internal structure of a Vue instance named "app". The "text" property under the "data" object is highlighted with a yellow box, and its value "Hello Vue!" is also highlighted with a yellow box. The "text" property is defined as a reactive getter and setter.

```
> app
<  ▶ Vue {_uid: 0, _isVue: true, $options: {}, _renderPro
  ▶ xy: Proxy, _self: Vue, ...} ⓘ
    ▶ $attrs: {...}
    ▶ $children: []
    ▶ $createElement: f (a, b, c, d)
    ▶ $el: div#app
    ▶ $listeners: {...}
    ▶ $options: {components: {}, directives: {}, filter: ..., sparent: undefined}
    ▶ $refs: {}
    ▶ $root: Vue {_uid: 0, _isVue: true, $options: {}, _renderPro
      ▶ $scopedSlots: {}
      ▶ $slots: {}
      ▶ $vnode: undefined
      ▶ text: "Hello Vue!"}
    ▶ _c: f (a, b, c, d)
    ▶ _data:
      ▶ text: "Hello Vue!"
        ▶ _ob_ : Observer {value: ..., dep: Dep, vmCount: ...}
        ▶ get text: f reactiveGetter()
        ▶ set text: f reactiveSetter(newVal)
        ▶ __proto__: Object
        ▶ _directInactive: false
        ▶ _events: {}
```

Figure 10: Getters and setters of the Vue instance.



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The `methods` property is used to define methods to be mixed into the Vue instance.

All methods (except *arrow functions*) have their `this` context automatically bound to the Vue instance (by Vue).

```
18  methods: {
19    sayHello() {
20      return "Hello!";
21    },
22    sayText() {
23      // `this` is a reference to the Vue instance,
24      // not the JSON configuration object.
25      return this.text;
26    },
27    logText() {
28      console.log(this.sayHello());
29    }
30  }
```

Listing 12: The `methods` property of the `JSON` (configuration) object.



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We can then access the methods (e.g., `sayHello`)

- Inside the template, using *Interpolation* or *String Interpolation*.
- Inside the Vue instance, using a (virtual) `this` reference.
- Using a reference to the Vue instance, either by
 - Vue's internal properties, that is
 - ▶ `app.$methods.sayHello()` or
 - ▶ `app._methods.sayHello()`
 - Generated methods, that is `app.sayHello()`



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```
9   <div id="app">{{ sayHello() }}</div>
10  <div id="app">{{ sayText() }}</div>
```

Listing 13: (String) Interpolation inside the template.

```
32 console.log(app.sayHello());
33 console.log(app.sayText());
34 app.logHello();
```

Listing 14: Accessing the methods with a reference to the Vue instance.

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```
13 const app = new Vue({  
14   el: "#app",  
15   data: {  
16     text: "Hello Vue!"  
17   },  
18   methods: {  
19     sayHello() {  
20       return "Hello!";  
21     },  
22     sayText() {  
23       // `this` is a reference to the Vue instance,  
24       // not the JSON configuration object.  
25       return this.text;  
26     },  
27     logText() {  
28       console.log(this.sayHello());  
29     }  
30   }  
31});
```

Listing 15: Accessing methods inside the Vue instance.



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The `computed` property is used to cache computed results of our application.

```
27     computed: {
28       reverseText: function() {
29         return this.text
30           .split("")
31           .reverse()
32           .join("");
33     }
34   },
```

Listing 16: The `computed` property of the JSON (configuration) object.



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The in-template expressions we saw before, are very convenient.

However, they are meant for simple operations and should not be used to create complex expressions, as they bloat the code and are hard to maintain.

```
10  <p>  
11    {{  
12      text  
13      .split("")  
14      .reverse()  
15      .join("")  
16    }}  
17  </p>
```

Listing 17: Using instance data for a complex expression.



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To avoid issues resulting from more complex computation and expressions of our application data, we can declare a computed property (e.g. `reverseText`).

```
27     computed: {
28       reverseText: function() {
29         return this.text
30           .split("")
31           .reverse()
32           .join("");
33     }
34   },
```

Listing 18: Defining a computed property.

```
18 <p>{{ reverseText }}</p>
```

Listing 19: Using computed properties in the template.



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Actually, we could achieve the same results with a function inside the `methods` property.

```
35   methods: {  
36     reverseText() {  
37       return this.text  
38         .split("")  
39         .reverse()  
40         .join("");  
41     }  
42   }
```

Listing 20: Defining a method instead of a computed property.

The difference, however, is that computed properties are cached on their (reactive) dependencies. A computed property will only be re-evaluated when its dependencies have changed.



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The following computed property will never update, because `Date.now()` is not a reactive dependency.

```
27     computed: {  
28       now: function() {  
29         return Date.now();  
30       }  
31     }
```

Listing 21: Computed property without reactive dependencies.

In comparison, a method invocation will *always* run the function whenever a re-render happens. Computed properties allow us to cache the results of potentially expensive computations on our application data. Whenever the dependencies of a properties changes, Vue will re-evaluate all dependent properties.

We can access computed properties the same way we access our application data (cf. Page 28)



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Computed properties are by default getter-only, but we can provide a setter in case we need one.

```
27      computed: {
28        fullName: {
29          get: function() {
30            // Template String, same as
31            // this.firstname + " " + this.lastName
32            return `${this.firstName} ${this.lastName}`;
33          },
34          set: function(newName) {
35            const names = newName.split(" ");
36            this.firstName = names[0];
37            this.lastName = names[names.length - 1];
38          }
39        }
40      }
```

Listing 22: Computed property getter and setter.



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Instead of using computed properties to tell Vue to re-evaluate our data, we can use a more generic way to observe our data changes.

Consider following example.

```
14  data: {
15    firstName: "Foo",
16    lastName: "Bar",
17    fullName: "Foo Bar"
18  },
19  watch: {
20    firstName: function(val) {
21      this.fullName = val + " " + this.lastName;
22    },
23    lastName: function(val) {
24      this.fullName = this.firstName + " " + val;
25    }
26  }
```

Listing 23: The `watch` property of the JSON (configuration) object.



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We can achieve the same result, with computed properties.

```
14  data: {  
15    firstName: "Foo",  
16    lastName: "Bar"  
17  },  
18  computed: {  
19    fullName: function() {  
20      return this.firstName + " " + this.lastName;  
21    }  
22  }
```

Listing 24: Same functionality with computed properties (cmp. Listing 23).

Compared to the previous example (Listing 23), using computed properties is less imperative and less repetitive.



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While computed properties are more appropriate in most cases, there are times when a custom watcher is necessary.

For instance, you might want to delay the execution of an update for a specific time, due to an expensive computation.

```
8 <body>
9   <div id="app">
10    <p>
11      Ask a yes/no question:
12      <input v-model="question" />
13    </p>
14    <p>{{ answer }}</p>
15  </div>
16 </body>
17 <script src="https://.../axios.min.js"></script>
18 <script src="https://.../lodash.min.js"></script>
```

Listing 25: Advanced watcher example.



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```
20 new Vue({  
21   el: "#app",  
22   data: {  
23     question: "",  
24     answer:  
25       "I cannot give you an answer " +  
26       "until you ask a question!"  
27   },  
28   watch: {  
29     // whenever question changes, this function will run  
30     question: function(newQuestion, oldQuestion) {  
31       this.answer = "Waiting for you to stop typing...";  
32       this.debouncedGetAnswer();  
33     }  
34   },  
35   created: function() {  
36     this.debouncedGetAnswer =  
37       _.debounce(this.getAnswer, 500);  
38   },
```

Listing 25: Advanced watcher example.



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```
39   methods: {
40     getAnswer: function() {
41       if (this.question.indexOf("?") === -1) {
42         this.answer =
43           "Questions usually contain a question mark. ;-)";
44         return;
45       }
46       this.answer = "Thinking...";
47       var vm = this;
48       axios
49         .get("https://yesno.wtf/api")
50         .then(function(response) {
51           vm.answer =
52             _.capitalize(response.data.answer);
53         })
54         .catch(function(error) {
55           vm.answer =
56             "Error! Could not reach the API. " + error;
57         });
58     }
59   }
```

Listing 25: Advanced watcher example.



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CSS Cascading Stylesheets

DOM Document Object Model

HTTP Hypertext Transfer Protocol

JSON JavaScript Object Notation

npm Node Package Manager

PRC People's Republic of China

U.S. United States

Acronyms

References

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