

Rendering on the client

Many ways "work"

- This methods SCALES over time

Similar process to server rendering!

- Have state
- Render output based on state
- Update state in response to user actions

Many variations

- Same base pattern

Example Client App

For now, let's look solely at browser JS

Imagine a list of "todo" items

Each item in the list

- Is done or not done
- Has text for the task

Consider State without Presentation

```
const todos = [  
  { task: 'Nap', done: false },  
  { task: 'Knock stuff down', done: true },  
  { task: 'Eat', done: false },  
];
```

- This is a useful coding technique in general
- Describe your data model ("shape")
 - Before writing code
- This is an array. Later we'll see an object is better

No, Seriously! Start with State

*I wish I understood earlier what you meant
about starting with state
-- Many previous students*

Start with:

- Data structure
- How it describes current state
- What changes you make to this state

What actions can a user take?

- Toggle a task done/not done
- Delete a task
- Add a task

Also "view all tasks", but we'll do that continuously

- Not really an "action"
- Doesn't change state

See How Actions are Changes to State

```
const todos = [  
  { task: 'Nap', done: false },  
  { task: 'Knock stuff down', done: true },  
  { task: 'Eat', done: false },  
];
```

- Toggle a task done/not done
- Delete a task
- Add a task

We aren't thinking about UI details yet!

Render State to View (HTML)

First pass (additions to come)

```
<ul class="todos"></ul>
```

```
const html = todos.map( todo => `- ${todo.task}</li>`  
).join('');  
  
document.querySelector('.todos').innerHTML = html;

```

Need to indicate if complete!

```
const html = todos.map( todo => {  
  const doneClass = todo.done ? "complete" : "";  
  return `  
    <li class="todo ${doneClass}">${todo.task}</li>  
  `;  
}).join('');  
  
document.querySelector('.todos').innerHTML = html;
```

```
// CSS  
.complete {  
  line-decoration: line-through;  
}
```

We write class BASED on state

- Not CHANGING class on existing HTML

Now put it together

- static `index.html`
 - Loads `styles.css`
 - Loads `todos.js` with one of
 - `<script>` with `defer` attribute in `<head>`
 - `<script>` as last child of `<body>`
 - Has the empty `<ul class="todos">`
- `todos.js`
 - Defines initial state
 - Has a `render()` function
 - Nothing magic about `render()` name
 - Calls `render()` when script loads

Changing state through events

- Action to toggle "done" on an item
 - Change the state
 - Call `render()`

What in presentation will trigger this action?

- How about clicking on the todo?

Small steps: First add click event

Worry about updating state, etc later

- Just capture the click
- `console.log()` to see it worked

One immediate problem

- `` don't exist when the script first runs
- `` are replaced each time `render()` is called
- Many `` would mean many event listeners

Solution: Event Delegation

`click` events on any ``

- Will **propagate** ("bubble") to ancestor ``

We can add just one listener on the ``

- Inspect `e.target` to see which `` was clicked
- We don't to react to clicks on the `` itself
 - Just ones on the ``s

Click Event listener

```
const listEl = document.querySelector('.todos');
listEl.addEventListener('click', (e) => {
  if( e.target.classList.contains('todo') ) {
    console.log(`click on a <li>`);
  }
});
```

Now we detect clicks

- But WHICH `` was clicked?
- Which todo item does it match to?

We can use `data-` attributes and `.dataset`

Rendering the data attribute

```
function render() {  
  const html = todos.map( (todo, index) => {  
    const doneClass = todo.done ? "complete" : "";  
    return `  
      <li  
        class="todo ${doneClass}"  
        data-index="${index}"  
      >  
        ${todo.task}  
      </li>  
    `;  
  }).join('');  
  
  document.querySelector('.todos').innerHTML = html;  
}
```

Reading the .dataset property

- The `data-` name we choose is up to us
- We use `data-index` since our state is an array
 - For objects we'd have the key
- We could call it `data-bob`
 - Terrible name, but allowed

```
const listEl = document.querySelector('.todos');
listEl.addEventListener('click', (e) => {
  if( e.target.classList.contains('todo') ) {
    const index = e.target.dataset.index;
    console.log(`click on <li> index ${index}`);
  }
});
```

Updating state and re-render

Update state

- then render()

```
const listEl = document.querySelector('.todos');
listEl.addEventListener('click', (e) => {
  if( e.target.classList.contains('todo') ) {
    const index = e.target.dataset.index;
    todos[index].done = !todos[index].done;
    render();
  }
});
```

No need to say what we are changing in output

- Follows automatically from state

Big Lessons! Ask Questions!

- `render()` replaces HTML
 - Based on current state
 - NOT on what just happened
- We have **one listener** for *any* click
 - Using **Event Propagation** is **Event Delegation**
 - Must exclude wrong event sources
- Click Handler reads `e.target` to connect to state
 - We used a `.dataset` property
- We update state, not HTML
 - `render()` updates HTML
- `render()` doesn't know what just happened!

Render uses State, not Event

"What is the score?"

"Cats 42, Dogs 0"

- Getting Score is based on state
 - Not events
 - Can ask anytime, not just in reaction to event
- Scoring a point changes the state
- Someone new asking score gets new score

Deleting an item

- Same principle
 - Detect which item to delete
 - Update state
 - Call render()
- But how are we indicating a delete?

Let's add an "X" in the list

- Many options
- Let's add a button in the HTML
 - Can change appearance with CSS

Rendering the delete button

```
const html = todos.map( (todo, index) => {  
  const doneClass = todo.done ? "complete" : "";  
  return `  
    <li>  
      <span class="todo ${doneClass}" data-index="${index}">  
        ${todo.task}  
      </span>  
      <button  
        data-index="${index}" class="delete" type="button">  
        X  
      </button>  
    </li>  
  `;  
}).join('');
```

- Extra `` not needed, but cleaner
- No overlapping functionality

Handling the click to delete

```
const listEl = document.querySelector('.todos');
listEl.addEventListener('click', (e) => {
  if( e.target.classList.contains('todo') ) {
    // ...
    return; // ADDED
  }
  if( e.target.classList.contains('delete') ) {
    const index = e.target.dataset.index;
    todos.splice(index, 1);
    render();
    return;
  }
});
```

Why the `return`?

Here using same click event listener

- Could be separate

Change didn't add much complexity

Because our render() uses the state

- Not connected to the action we are taking
- Actions just change state
- Our concerns (rendering vs handling action)
 - Separation of Concerns
- Our render doesn't KNOW what happened
- Our actions don't know how it renders
 - Principle of Least Knowledge
 - (in general, not the OOP version)

Getting the Data to add

- We need a form (or at least an input)
- Todo Task
- We will assume "done" as false
- Form/input does not need to be rerendered
 - Always there regardless of state

HTML for input

```
<label>
  New Task
  <input class="new-task">
</label>
<button type="button">Add</button>
```

- No `<form>` is allowed
 - No `name` attribute
 - No `submit` event
 - No auto "submit on enter"
 - Can use `click` and `keyup/input`
- We are REQUIRING Javascript for this
 - Always consider if that is right choice

HTML with form

```
<form action="" class="add-task">
  <label>
    New Task
    <input class="new-task">
  </label>
  <button type="submit">Add</button>
</form>
```

- Need to preventDefault on `submit` event
 - Auto "submit on enter" behavior
 - Don't use click/input/keyup events
- Still requires Javascript
 - Unless we have an action on backend
- `<form>` never submits, but semantically better

Adding event for adding tasks

```
const addFormEl = document.querySelector('.add-task');
addFormEl.addEventListener('submit', (e) => {
  e.preventDefault();

  const task = document.querySelector('.new-task').value;
  todos.push({ task, done: false });
  render();
});
```

Almost feels too easy now

- User takes action
- Update state
- render()

Only complication is not re-rendering elements that have listeners

What if it was more complex?

What if...

- Bulk of HTML could be "replaced"?
- Including the list and the add form?
- Let's add a toggle
 - Option 1: See todo list and add task form
 - Option 2: See a picture of a cat

Changing page contents

Two major approaches:

- All content on page, some set to `display: none;`
 - Best to do this with classes
 - **Do not use `style` attribute**
 - Lots of tutorials and examples will!
 - It works, but makes code hard to change
- Render only the current HTML content
 - But keep the state to recreate as needed

Option: Hiding Content

Pros

- Don't need to juggle event listeners
- Showing/Hiding is fairly easy
 - As long as you define the classes

Cons

- Render gets messier since it has ALL the HTML
- Styling can have impacts from all the HTML
- Debugging can be annoying
 - Lots of hidden elements but still in HTML

Option: Conditional Render

Pros

- HTML and CSS stay "clean"
- Once changes made
 - Can easily scale for more

Cons

- Have to move event listeners to ancestor
- Have to expand and break up render

Choosing which Option

Personally

- "Hiding" only for the most trivial of content
- "Conditional Rendering" most of the time
 - Always will be another added feature

Implementing Conditional Rendering

- Expand State
 - Track what to show
- Shift event listeners
 - Common ancestor element
 - Check target of events
- Refactor `render()`
 - Check state for what to show
 - Specific `render()`-like for parts

Expanded State

```
const state = {  
  todos: [  
    // ...  
  ],  
  page: 'todos',  
};
```

- Doesn't NEED to be one object
- ...but can help organize
- ...can pass all state or sub-portion as/if needed
- `page` as a string?
 - Allows for expansion
 - Can define enum-like

State with Enum-like

```
const PAGES = {  
  TODOS: 'todos',  
  CAT: 'cat',  
};  
  
const state = {  
  todos: [  
    // ...  
  ],  
  page: PAGES.TODOS,  
};
```

- Makes typos easier to find
- IDE can help fill in

Shifting the Listeners

Wrap page in an element that will not be replaced

```
<div id="app"></div>
```

```
const appEl = document.querySelector('#app');
appEl.addEventListener('submit', (e) => {
  if ( e.target.classList.contains('add-task') ) {
    // code for adding task
  }
  render();
});
appEl.addEventListener('click', (e) => {
  if ( e.target.classList.contains('todo') ) {
    // code for task done toggle
  }
  if ( e.target.classList.contains('delete') ) {
    // code for deleting task
  }
  render();
});
```

Breaking up render()

```
function render() {  
  if(state.page === PAGES.TODO) {  
    renderTodos();  
  }  
  if(state.page === PAGES.CAT) {  
    renderCat();  
  }  
}
```

Another approach

```
const renderFor = {  
  [PAGES.TODO]: renderTodos,  
  [PAGES.CAT]: renderCat,  
};  
  
function render() {  
  renderFor[state.page]();  
}
```

- Pro: Less `if()` "noise"
- Con: Can't easily pass values

Use whatever style works best

renderTodos ()

```
function renderTodos() {  
  const listHtml = state.todos.map( (todo, index) => {  
    // Same as before  
  }).join('');  
  
  appEl.innerHTML = `  
    <ul class="todos">  
      ${listHtml}  
    </ul>  
    <form action="" class="add-task">  
      <label>  
        New Task  
        <input class="new-task">  
      </label>  
      <button type="submit">Add</button>  
    </form>  
  `;  
}
```

renderCat()

```
function renderCat() {  
  appEl.innerHTML = `  
      
  `;  
}
```


Changing the page

- Specific button classes OR just one with data

Add to `renderTodos()`

```
<button type="button" class="page" data-target="cat">  
  Go to Cat  
</button>
```

Add to `renderCat()`

```
<button type="button" class="page" data-target="todos">  
  Go to Todos  
</button>
```

Add to listeners

```
if (e.target.classList.contains('page')) {  
  state.page = e.target.dataset.target;  
}
```

Further cleanup?

- split out some functions
 - those functions not shown

```
function renderTodos() {  
  const listHtml = generateTodoHtml(state.todos);  
  const addTaskHtml = generateAddTaskHtml();  
  const navigateHtml = generateNavigateHtml(state);  
  
  appEl.innerHTML = `  
    <ul class="todos">  
      ${listHtml}  
    </ul>  
  
    ${addTaskHtml}  
    ${navigateHtml}  
  `;  
}
```

These are just one way of organizing details

- Key lesson
 - **separate state changes and rendering**
 - Render html based on state
 - Allows you to generate HTML for any state
 - Without knowing what triggered render
 - Minimizes complexity; Allows easy change
 - Listeners unimpacted by HTML changes

You may notice js file is getting large and cumbersome

- We will address that soon!

Additional, more complex changes

- Change "done" to checkbox
 - Should have a label
- Add ability to edit text
 - Edit trigger?
 - Conditionally text vs input
 - Button to save changed text

Summary: Render Loop

- Have state
- Render based on state
- User actions update state
 - Rerender using new state
- That's all of it

Rendering based on state

- Generate HTML based on state
 - Including what classes are on elements
- Replace original HTML with new HTML
- NOT: Changing a class on an element
- NOT: Changing style attributes on an element

Pros/Cons of State-Render Loop

- PRO: State always update to date
- PRO: Can just re-render
 - Reduces cognitive requirements
- CON: Lots of redundant replacement
 - Fixed when we get to React
- CON: Re-render can lose typing in form fields
 - Fixed when we get to React
 - Could fix with more work
 - Putting in-progress typing into state