CSE 331
Software Design & Implementation

James Wilcox & Kevin Zatloukal

Fall 2022

Modern Web GUIs

React

- Improve modularity by allowing custom tags

```
let app = (
    <div>
      <TitleBar name=“My App”/>
      <EditPane rows=“80” />
    </div>);
```

- `TitleBar` and `EditPane` can be separate modules
  – their HTML gets substituted in these positions

React

- Custom tags implemented using classes

```
class TitleBar extends React.Component {
```

- Attributes (`name=“My App”`) passed in `props` arg
- Method `render` produces the HTML for component
- Framework joins all the HTML into one blob
  - can update in a single call to `innerHTML = …`

React Example

register-react/…

React Components

- Each React component renders into HTML elements

```
let app = (
    <div>
      <TitleBar name="My App"/>
      <EditPane rows="80" />
    </div>);
```

- React components corresponds to *portions* of the document
  - `TitleBar` is one subtree
  - `EditPane` is another subtree
  - `App` contains the two of those

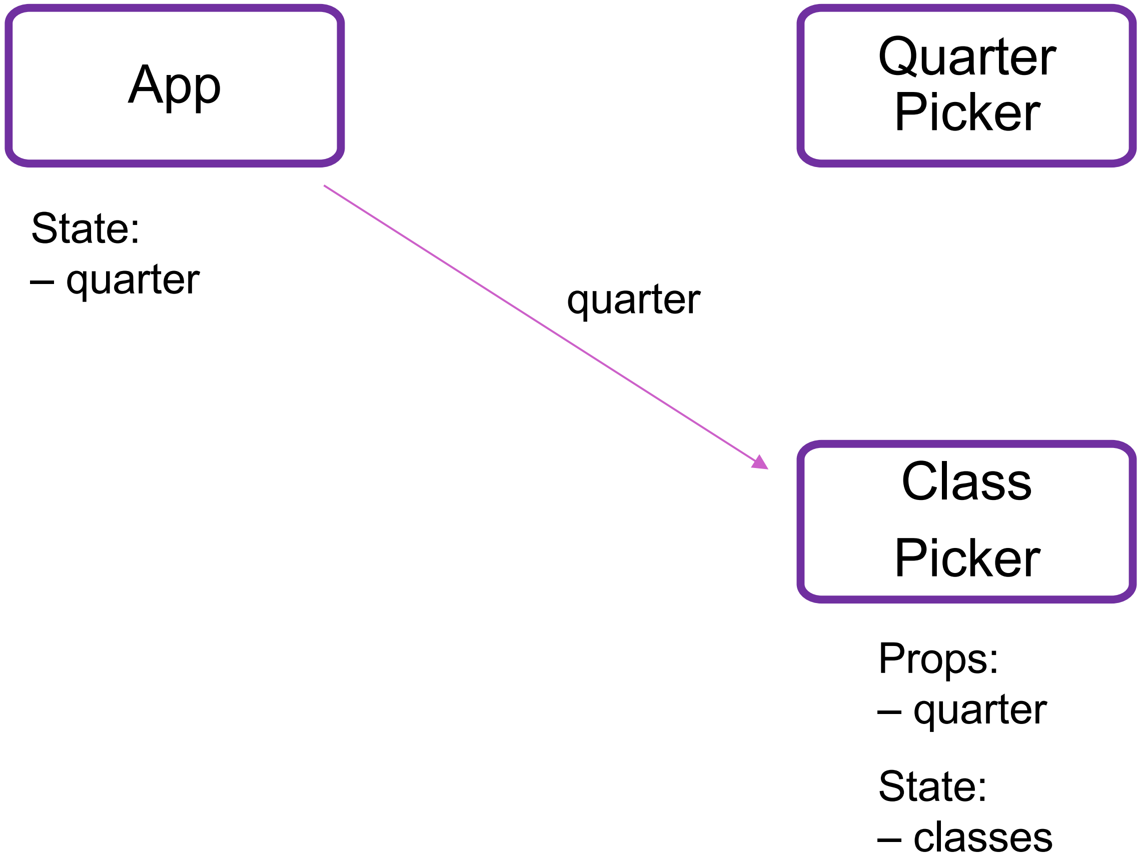
React State

- Last example was not dynamic
  - there was no model!

- Components become dynamic by maintaining state
  - stored in fields of `this.state`
  - call `this.setState({field: value})` to update

- React will respond by calling `render` again
  - will automatically update the live HTML to match
  - will only update the parts that changed

Structure of Example React App



Example 5

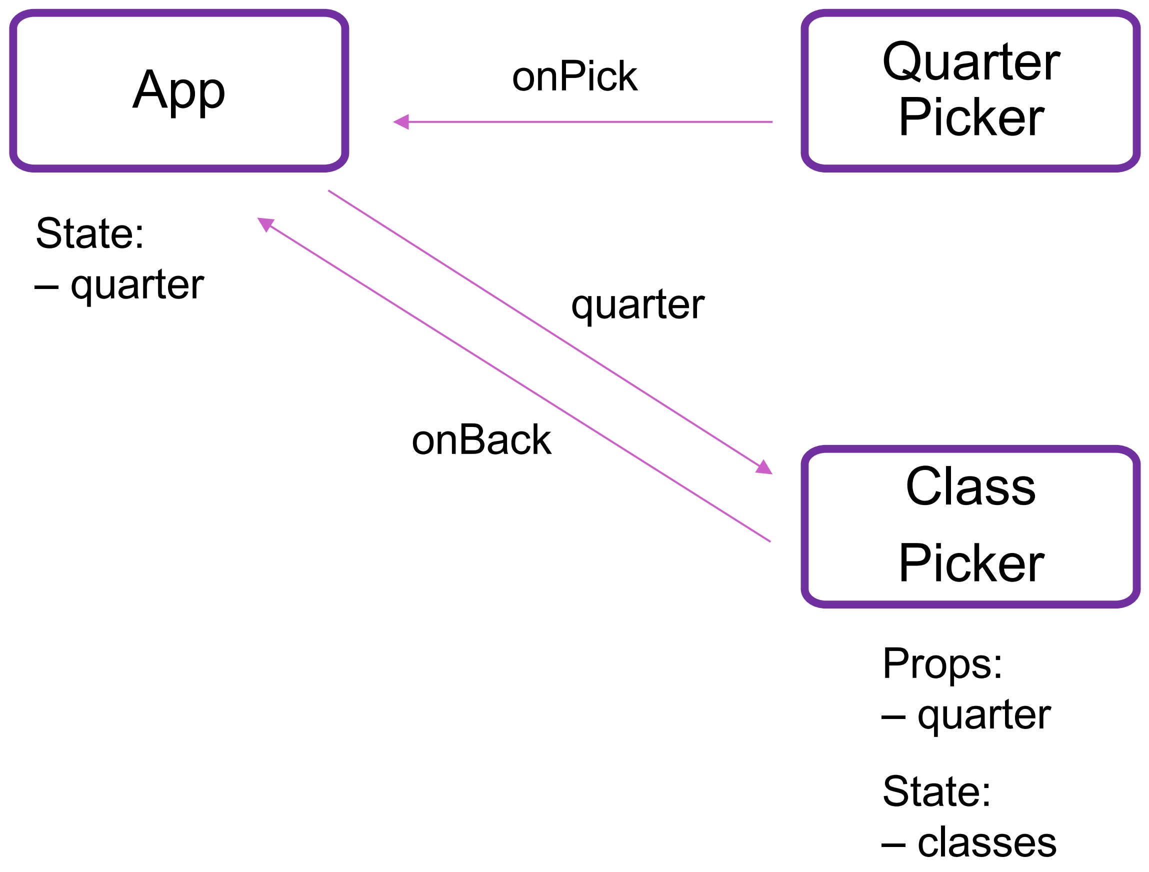
register-react2/…

React State

- Custom tag also has its own events

- Updating data in a parent:
  - sends parent component new data via event
  - parent updates state with `setState`
  - React calls parent’s `render` to get new HTML
    - result can include new children
    - result can include changes to child props

Structure of Example React App



Splitting the Model

- State should exist in the **lowest common parent** of all the components that need it
  - sent down to children via *props*

- Children change it via *events*
  - sent up to the parent so it can change its state

- Parent’s render creates new children with new props

Remaining Problems

- ~~Code is extremely **verbose**~~
  - ~~can be improved using Lambdas~~
- ~~Code is *not sufficiently* **modular**~~
  - ~~one JS mixes data, display, interaction~~
- ~~**Too much work** involved with laying out elements~~
- ~~Poor **tool support**~~
  - ~~No compile-time types~~
  - ~~HTML is created in strings!~~

Event Listener Gotchas

- Recall the issue with "`this`" in JavaScript.
  - **do not** write `onClick={this.handleClick}`

- Three ways to do this properly:

  1. `onClick={(e) => this.handleClick(e)}`
  2. `onClick={this.handleClick.bind(this)}`
  3. Make `handleClick` a field rather than a method:

     ```
     handleClick: (e) => { … };
     ```

     Then `this.handleClick` is okay.

React setState Gotchas

- `setState` does not update state instantly:

```
// this.state.x is 2
this.setState({x: 3});
console.log(this.state.x); // still 2!
```

- Update occurs after the event finishes processing
  - `setState` adds a new event to the queue
  - work is performed when that event is processed

- React can batch together multiple updates

Other React Gotchas

- State must store all data necessary to generate the exact UI on the screen
  - react may call `render` at any time
  - must produce identical UI

- Any state in the HTML components must be mirrored in the React component’s state
  - e.g., every text field’s `value` must be part of some React component’s state
  - render produces

```
<input type=“text” value={…}>
```

Other React Gotchas

- `render` should not have side-effects
  - only *read* `this.state` in render

- Never modify `this.state`
  - use `this.setState` instead

- Never modify `this.props`
  - read-only information about parent's state

- Not following these rules may introduce bugs that will be hard to catch!

React Performance

- React re-computes the tree of HTML on state change
  - can compute a “diff” vs last version to get changes

- Surprisingly, this is not slow!
  - slow part is calls into browser methods
  - pure-JS parts are very fast in modern browsers
  - processing HTML strings is also incredibly fast

React Tools

- Use of compilers etc. means new tool set

- `npm` does much of the work for us
  - installs third-party libraries
  - runs the compiler(s)