

STATE MANAGEMENT WITH REDUX

(MMT-M2020)

EXAM 17.5.

- » Open Book Exam
- » Most questions will require some coding
- » eg. implement a reducer and write a test for this reducer
- » exam will either be in moodle or MS Teams

ROADMAP

- » Task connect components with redux
- » Functional Programming continue
 - » memoization
- » Testing redux

TASK 1 (CONTAINER)

- » Try to connect your moneyTransactionCreate dropdown with users from the store



TASK 2 (CONNECT TO BACKEND)

- » Try to connect `fetchUsers` action creator
- » call action creator when the component is rendered initially



FUNCTIONAL PROGRAMMING RECAP

FUNCTIONAL PROGRAMMING - RECAP

PURE FUNCTIONS

- » A function is considered pure when:
 - » for the same input it always returns the same output
 - » it has no side effects
 - » no mutation of non-local state,

```
const add = (a, b) => a + b
```

FUNCTIONAL PROGRAMMING - RECAP

ATTRIBUTES OF PURE FUNCTIONS

- » They are idempotent
- » They offer referential transparency
 - » calls to this function can be replaced by the value without changing the programs behaviour
- » They can be memoized (or cached)
- » They can be lazy
- » They can be tested more easy

FUNCTIONAL PROGRAMMING - RECAP

IMMUTABILITY

“An immutable data structure is an object that doesn't allow us to change its value. (Remo H. Jansen)”

FUNCTIONAL PROGRAMMING - RECAP

IMMUTABLE OBJECTS IN JS

```
const immutableObject = Object.freeze({ test: 1 })
immutableObject.test = 10
console.log(immutableObject) // => { test: 1 }
```

FUNCTIONAL PROGRAMMING - RECAP

HIGHER ORDER FUNCTIONS

“A higher order function is a function that takes or returns a function.”

FUNCTIONAL PROGRAMMING - RECAP

HIGHER ORDER FUNCTIONS

```
const buildCreateUser = (dbAdapter) => {
  return (user) => {
    if (!isValid(user)) { throw new Error('User Invalid') }
    return dbAdapter.create(user)
  }
}
const createUserInPG = buildCreateUser(postgresAdapter)
const createUserInMemory = buildCreateUser(inMemoryAdapter)
```

FUNCTIONAL PROGRAMMING MEMOIZATION

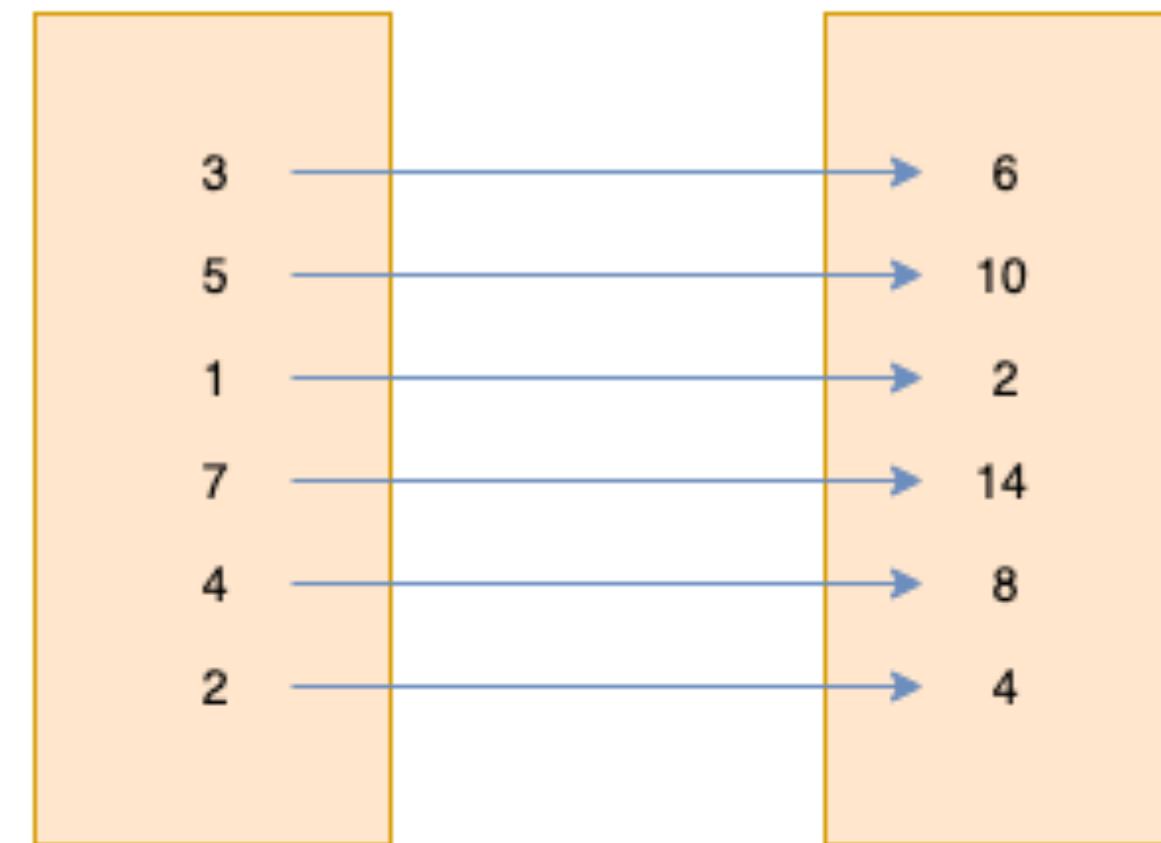
“`Memoizing' a function makes it faster by trading space for time. It does this by caching the return values of the function in a table. (<https://metacpan.org/pod/Memoize>)”

MEMOIZATION

- » A pure function returns for the same input the same output
- » simple mapping from value a to value b
- » after calculation is done once, a cached value could be returned

MEMOIZATION

```
fn: a -> b  
const multiplyByTwo = (number) => number * 2;
```



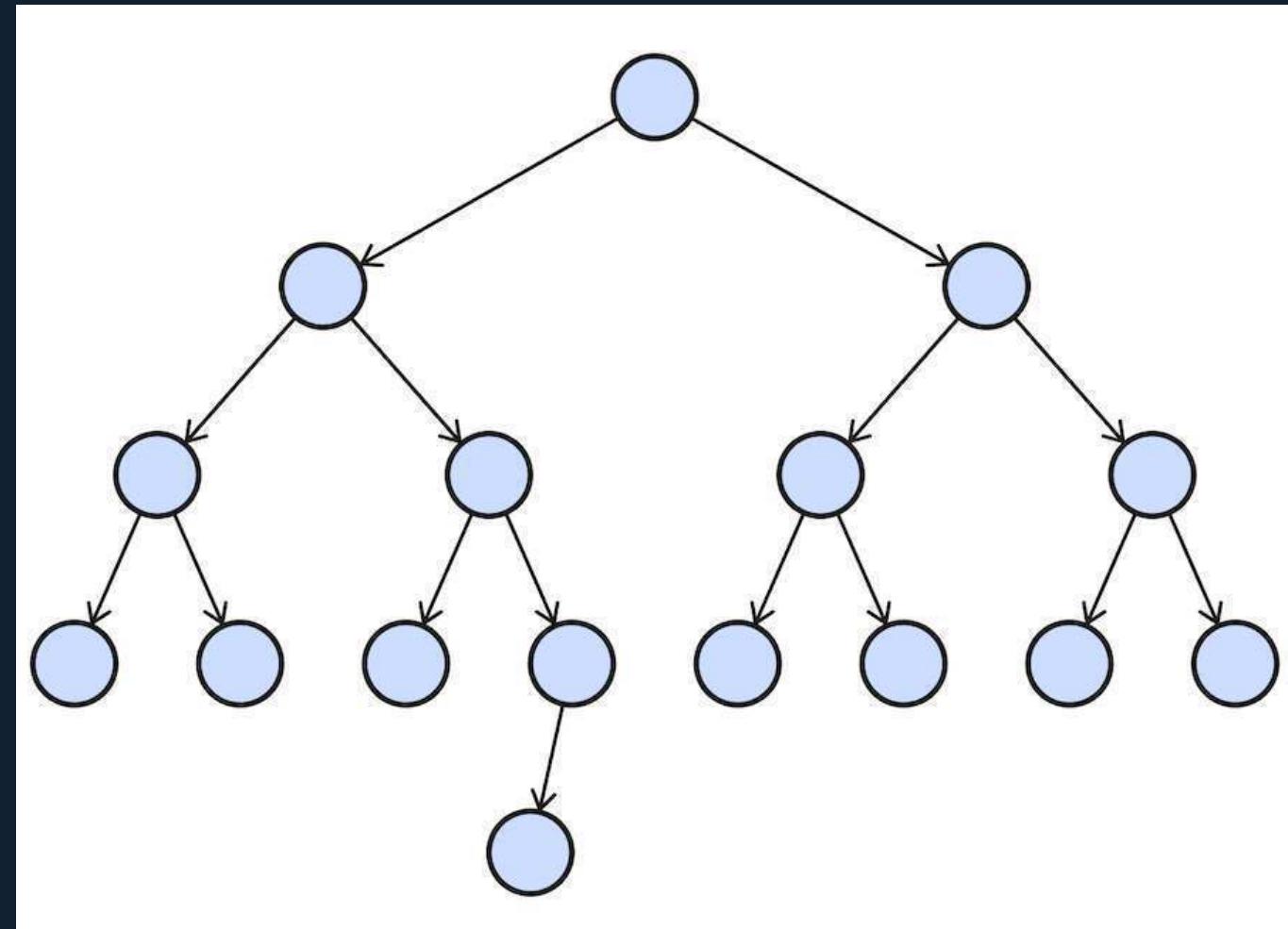
MEMOIZATION IN REACT

UNIDIRECTIONAL DATAFLOW

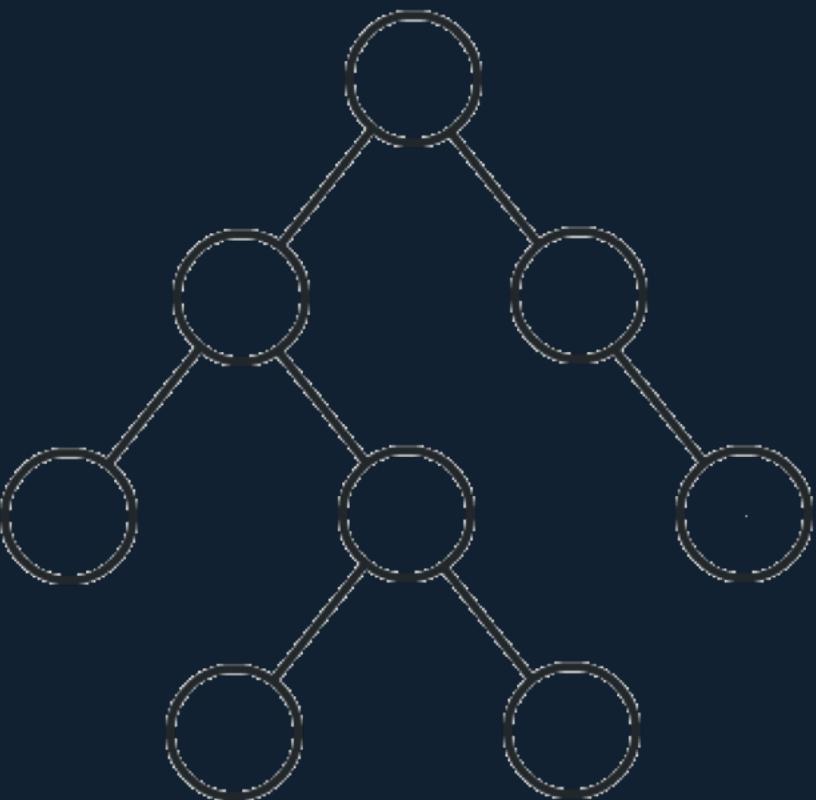
- » Props only flow from parent to children
- » Parent is responsible to update data
 - » might provide callbacks to do so
- » set state rerenders all children of component

MEMOIZATION IN REACT

- » every state change triggers a complete rerender of the subtree



MEMOIZATION IN REACT



- State changes initiated
- State changes

“Source”

MEMOIZATION IN REACT

REACT.MEMO

“React.memo() wraps a component, React memoizes the rendered output then skips unnecessary rendering. ¹”

¹ Source <https://dmitripavlutin.com/use-react-memo-wisely/>

MEMOIZATION IN REACT WITHOUT REACT.MEMO

- » react renders component in virtual DOM
- » compares result with DOM
- » when DOM differs -> DOM is updated
- » this is usually fast enough

MEMOIZATION IN REACT WITH REACT.MEMO

- » React renders component once
- » Component is cached
- » when component props didn't change
 - » cached component is returned
- » when component props did change
 - » react does a regular rerender ²

² See previous slide

MEMOIZATION IN REACT WITH REACT.MEMO

- » React.memo shallow compares props
- » with Immutable data structures this check becomes simple

```
const UserList = React.memo(({ users }) => {
//           ^^^^^^^^^^
// memoize component result on subsequent renders
  return (
    <ul>
      {users.map((user) => {
        return (<li key={user.id}>{user.name}</li>)
      })}
    </ul>
  )
})
```

MEMOIZATION IN REACT

WHEN TO USE REACT.MEMO

- » Component is a pure
 - » renders the same output for the same input
- » Component renders often
- » Your data structures are immutable
- » Component contains many sub-components
- » You have performance issues in your app

MEMOIZATION IN REACT

PITFALLS - CALLBACKS

```
function MyApp( { store, cookies } ) {
  return (
    <MemoizedLogout
      username={store.username}
      onLogout={() => cookies.clear('session')}
    />
  );
  // ^^
  // every time the component is rerendered a new
  // function is created => shallow compare fails
}
```

MEMOIZATION IN REACT

PITFALLS - CALLBACKS

```
function MyApp({ store, cookies }) {
  const onLogout = useCallback(
    () => cookies.clear('session'),
    [cookies]
  );
  // ^^^^^^
  // caches the onLogout callback until the reference
  // to cookies changes
}

return (
  <MemoizedLogout
    username={store.username}
    onLogout={onLogout}
  />
);
}
```

MEMOIZATION³

TASK - 30 MINUTES

- » Memoize the fibonacci sequence
- » Compare results with and without memoize

```
const memoize = () => {} // TODO: implement me
const fibonacci = memoize((num) => {
  if (num <= 1) return 1
  return fibonacci(num - 1) + fibonacci(num - 2)
})
```

- » helper to measure time <https://bit.ly/2UOFgAE>

³ Possible implementation will be added to the wiki

MEMOIZATION AND REDUX COMPUTING DERIVED DATA

MEMOIZATION AND REDUX

COMPUTING DERIVED DATA

```
const mapStateToProps = (state) => {
  return {
    users: state.users.filter((user) => !user.disabled)
    //
    // Array.prototype.filter always returns a new
    // array => every time the store changes redux
    // will rerender the connected component
  }
}
```

MEMOIZATION AND REDUX COMPUTING DERIVED DATA

“Reselect selectors can be used to efficiently compute derived data from the Redux store.”

MEMOIZATION AND REDUX

COMPUTING DERIVED DATA

```
const mapStateToProps = (state) => {
  return {
    users: state.users.filter((user) => !user.disabled)
    //
    // Array.prototype.filter always returns a new
    // array => every time the store changes redux
    // will rerender the connected component
  }
}
```

MEMOIZATION AND REDUX

COMPUTING DERIVED DATA

```
import { createSelector } from 'reselect'

const getUsers = (state) => state.users
const getEnabledUsers = createSelector(
  getUsers,
  (users) => users.filter((user) => !user.disabled)
// ^^^^^^
// this function is only triggered when users change
)

const mapStateToProps = (state) => {
  return {
    users: getEnabledUsers(state)
// ^^^^^^^^^^^^^^^^^^
// getEnabledUsers returns same array for the same users
  }
}
```

MEMOIZATION AND REDUX COMPOSING SELECTORS

```
const getUsers = (state) => state.users
const getEnabledUsers = createSelector(
  getUsers,
  (users) => users.filter((user) => !user.disabled)
)

const getEnabledAndActive = createSelector(
  getEnabledUsers,
  // ^^^^^^
  // reusing previous selector
  (users) => users.filter((user) => user.active)
)

const state = { users: [{ id: 1, enabled: true, active: true }] }

getEnabledAndActive(state) === getEnabledAndActive(state)
```

TESTING REDUX

TESTING RECAP



TESTING RECAP

FAKE OBJECTS

- » Objects have a working implementation
 - » but take some shortcuts
 - » eg. `inMemoryDatabases` instead of persistent DB
- » example `fake-local-storage`

TESTING RECAP

STUB OBJECTS

- » Predefined return values for testing
- » Instead of calling the real API we return a value for testing
- » Examples:
 - » retrieving geolocation in tests
 - » testing edge cases (eg.: database throws OutOfMemory exception)

TESTING RECAP

SPY OBJECTS

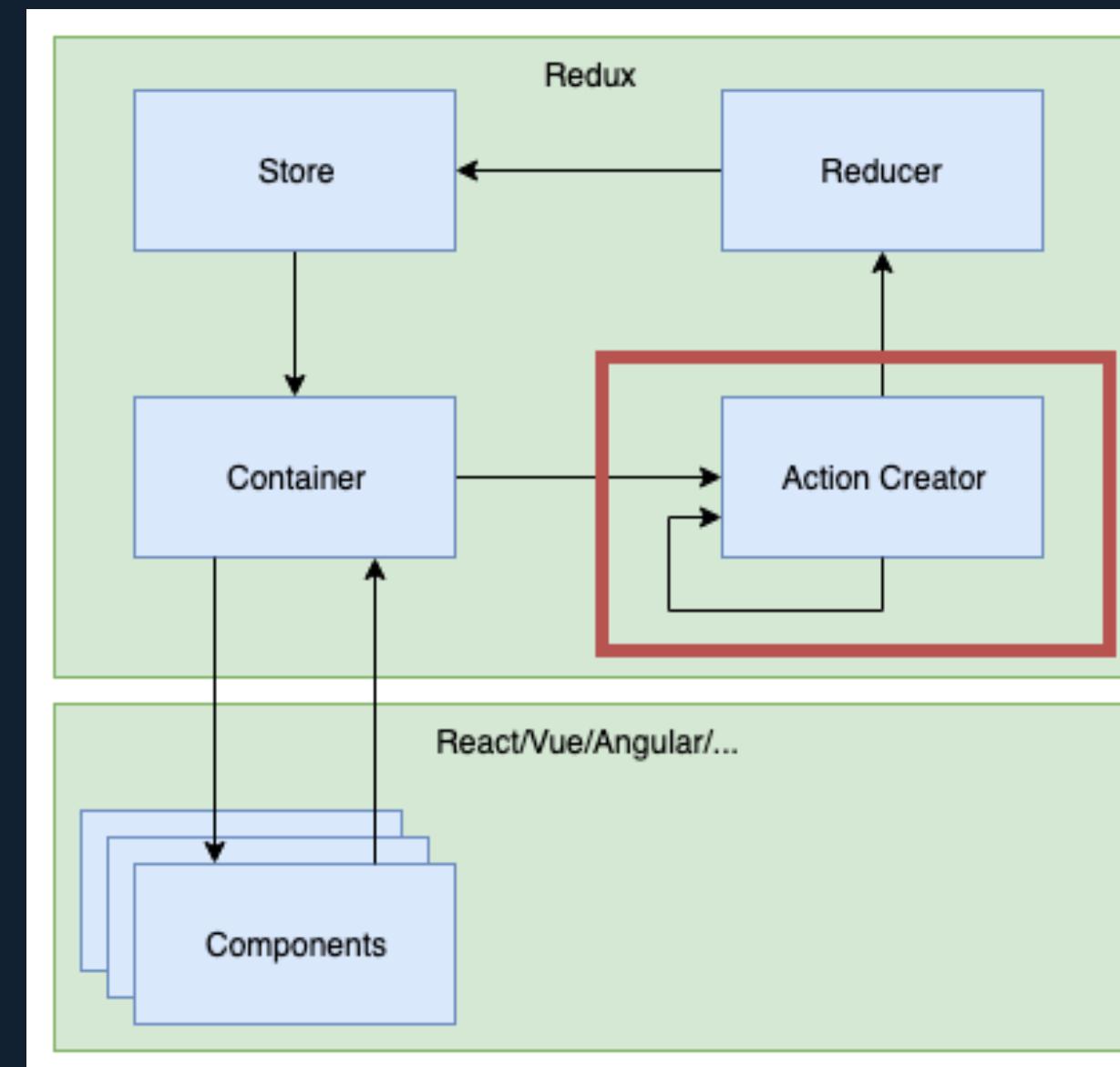
- » Are stubs that also record the way they were called
- » Used to verify side effects (eg. E-Mail sending)

```
it('sends an email on sign up', () => {
  const username = 'username'
  const password = 'password'

  const sendEmail = jest.fn() // create a spy
  const signUp = signUp(username, password, { sendEmail })

  expect(sendEmail).toHaveBeenCalledWith(username, password);
  // ^^^^^^^^^^^^^^^^^^^^^^
  // verify that the spy has been called
})
```

TESTING REDUX ACTION CREATORS



TESTING REDUX ACTION CREATORS

```
// A simple action creator we'd like to test
export const fetchUsers = () => async (dispatch) => {
  const userResponse = await window.fetch('http://localhost:3001/users')
  //
  // window.fetch is not available in node and would do a query
  // against the backend. We'd like to avoid calling our BE
  .then(response) => response.json()

  dispatch({ type: 'users/fetched', payload: userResponse })
}
```

TESTING REDUX ACTION CREATORS

```
// fakeFetch.js

// in order to test the action creator without the backend
// we implement a very minimal fake for fetch
export const buildSuccessFullFakeFetch = (response) => {
  return jest.fn().mockReturnValue(Promise.resolve({
    json: () => Promise.resolve(response)
  }))
}
```

TESTING REDUX ACTION CREATORS

```
// A simple action creator we'd like to test
export const fetchUsers = () => async (dispatch, _, { fetch }) => {
//                                         ^^^^^^
// instead of using window.fetch we pass our as dependency to
// our action creator. In our test we can provide the fake fetch
const userResponse = await fetch('http://localhost:3001/users')
  .then(response) => response.json()

  dispatch({ type: 'users/fetched', payload: userResponse })
}
```

TESTING REDUX ACTION CREATORS

```
// store.js
const store = createStore(
  rootReducer,
  compose(
    applyMiddleware(thunk.withExtraArgument({ fetch: window.fetch })),
    // ^^^^^^^^^^^^^^^^^^
    // provide a real fetch object for being used in the browser
    // this argument is now being passed to every action creator

    // ... other middlewares
  )
)
```

TESTING REDUX ACTION CREATORS

```
describe('fetchUsers', () => {
  it('dispatches users/fetched action', async () => {
    const users = [{"id": 1, "name": "Sepp"}, /* ... */]
    const dispatch = jest.fn() // spy on calls to dispatch

    const fetch = buildFakeResponse(users)
    // create our fake with the predefined list of users

    await fetchUsers()(dispatch, undefined, { fetch })
    // call our action creator

    expect(dispatch).toHaveBeenCalledWith(1, {
      type: 'users/fetched',
      payload: users
    })
    // verify that the desired action got dispatched
  })
})
```

TESTING REDUX ACTION CREATORS

```
describe('fetchUsers', () => {
  it('dispatches users/fetched action', async () => {
    const users = [{"id": 1, "name": "Sepp"}, /* ... */]
    const dispatch = jest.fn()
    //          ^^^^^^^^^^
    // spy on calls to dispatch

    const fetch = buildFakeResponse(users)
    // create our fake with the predefined list of users

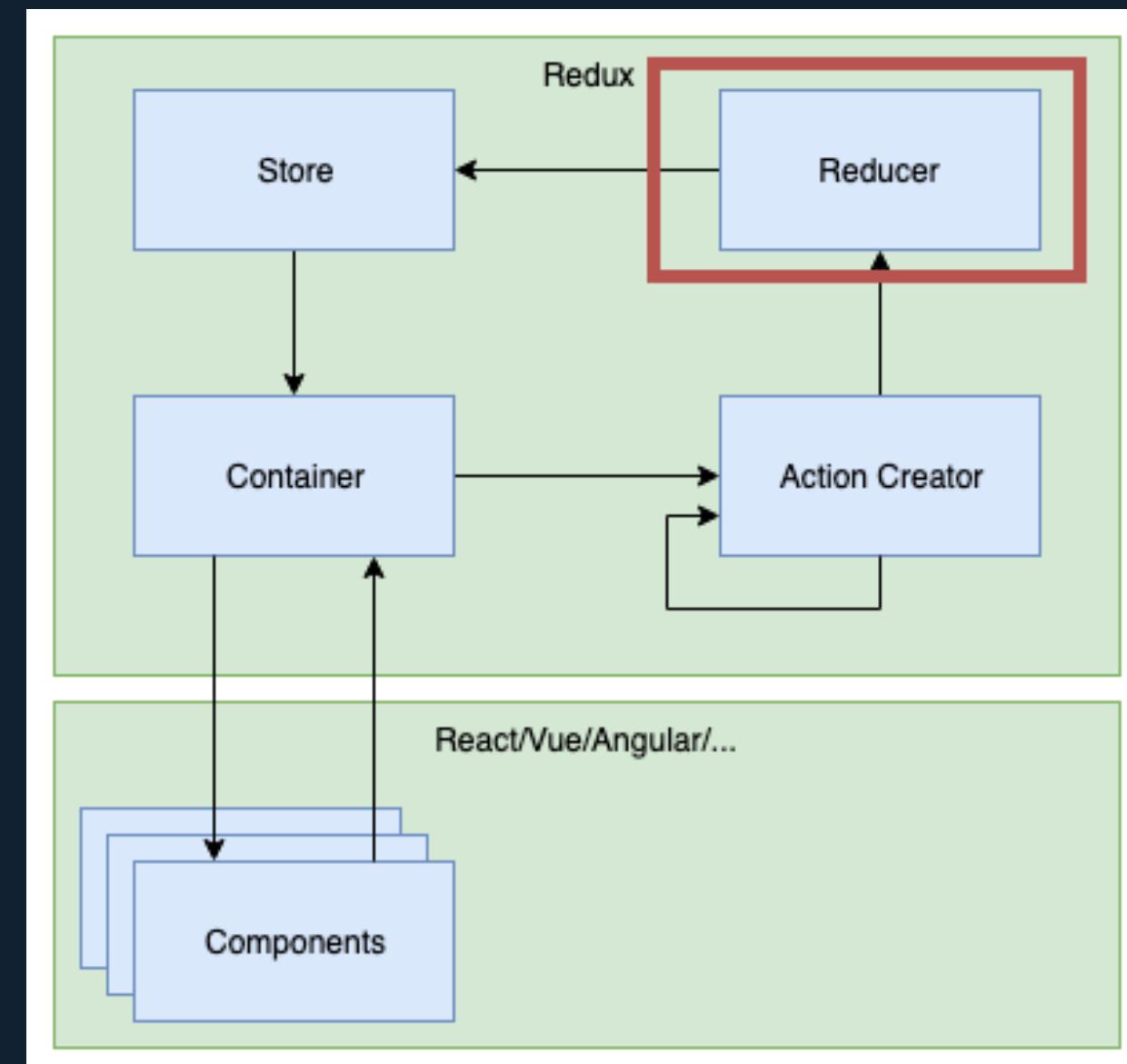
    await fetchUsers()(dispatch, undefined, { fetch })
    // call our action creator

    expect(dispatch).toHaveBeenCalledWith(1, {
      type: 'users/fetched',
      payload: users
    })
    // verify that the desired action got dispatched
  })
})
```

TESTING REDUX TASK

- » build a `fetchUser` action creator
- » write tests for the action creator
- » adapt redux thunk to use `window.fetch`

TESTING REDUX REDUCERS



TESTING REDUX REDUCERS

```
// user/reducer.js

const initialState = []
export const userReducer = (currentState = initialState, action) => {
  switch (action.type) {
    case 'users/fetched':
      return uniqueBy('id', [...currentState, ...action.payload])
    default:
      return currentState
  }
}
```

TESTING REDUX REDUCERS

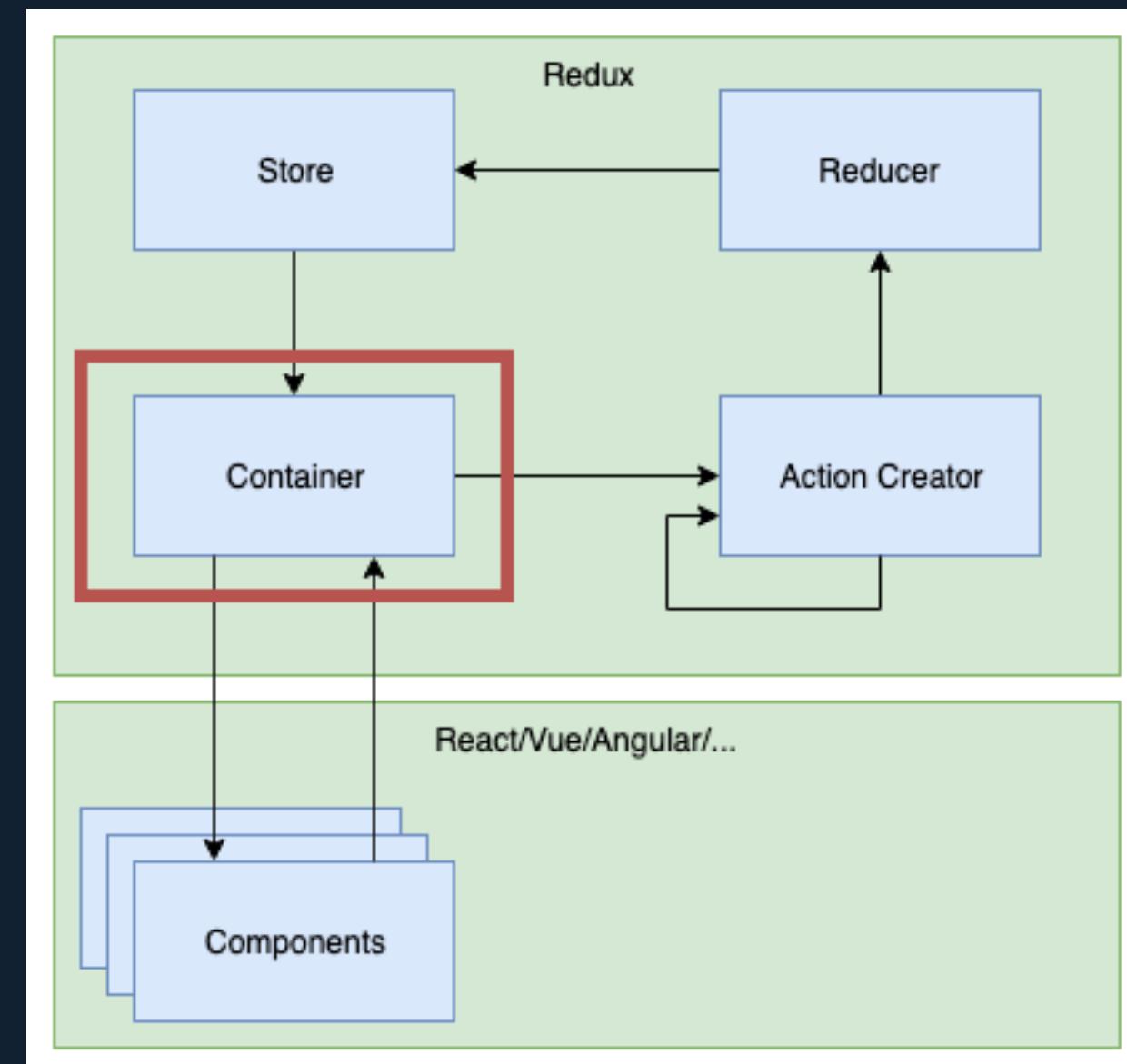
```
// user/reducer.spec.js

it('when user with same id already exists, does not add user twice', () => {
  const user = { id: 1, name: 'Sepp' }
  const action = { type: 'users/fetched', payload: [user] }
  const state = [user]
  // build a previous state which already contains the user

  const nextState = userReducer(state, action) // call the reducer

  expect(nextState).toEqual(state) // verify that the states are equal
})
```

TESTING REDUX CONTAINER



TESTING REDUX MAPSTATETOPROPS

- » is a simple function and can be tested similar to reducers

HOMEWORK (DUE DATE 2.5.)

see wiki

FEEDBACK

- » Questions: tmayrhofer.lba@fh-salzburg.ac.at
- » <https://de.surveymonkey.com/r/8TW92LL>