
# REDUX

**Zsolt German**
zsolt_german@epam.com

MARCH 14, 2018

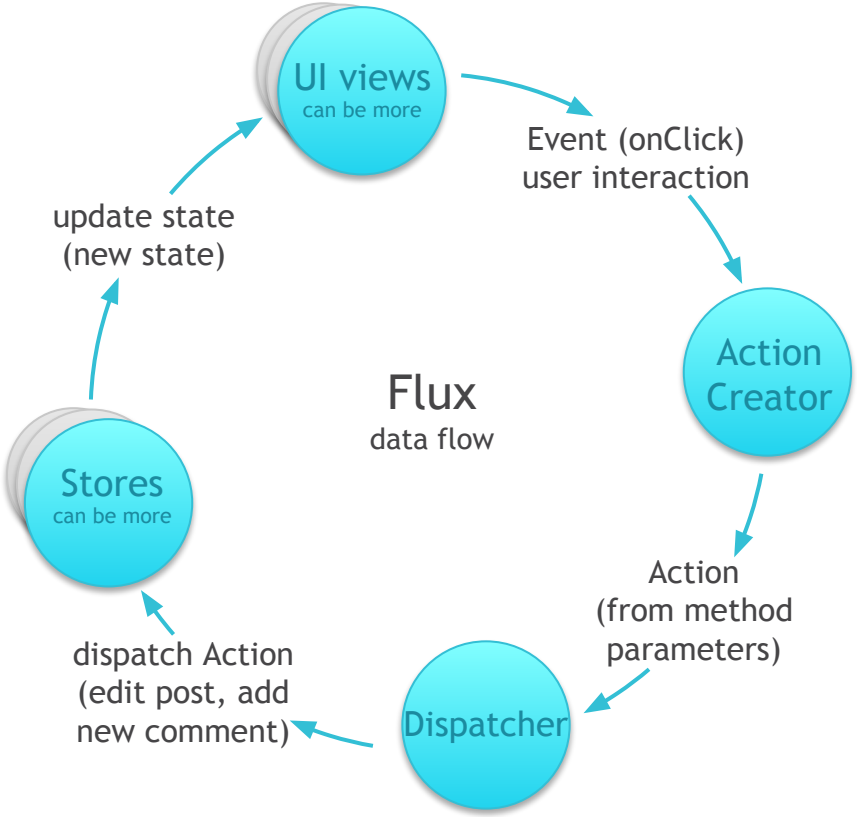
# Agenda

- About
- Basics
- Best Practices
- Usage with React
- Advanced technics


Redux
ABOUT FLUX AND REDUX
Superdry

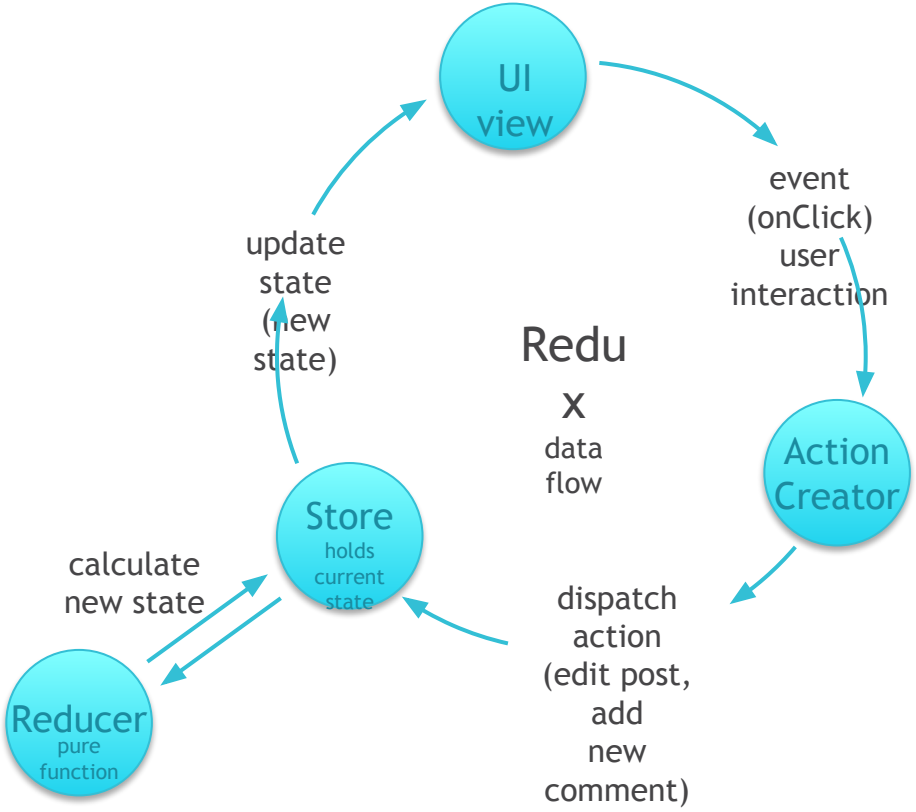
# FLUX

- Application architecture
- Pattern
- By Facebook
- Replace MVC model
- Predictable data
- Unidirectional data flow
- Complements React UI



# Redux

- State management library
- Inspired by Flux
- Tiny library
- Small dependency
  (just using a polyfill)
- Use with React, Angular, etc.
- Centralized Store

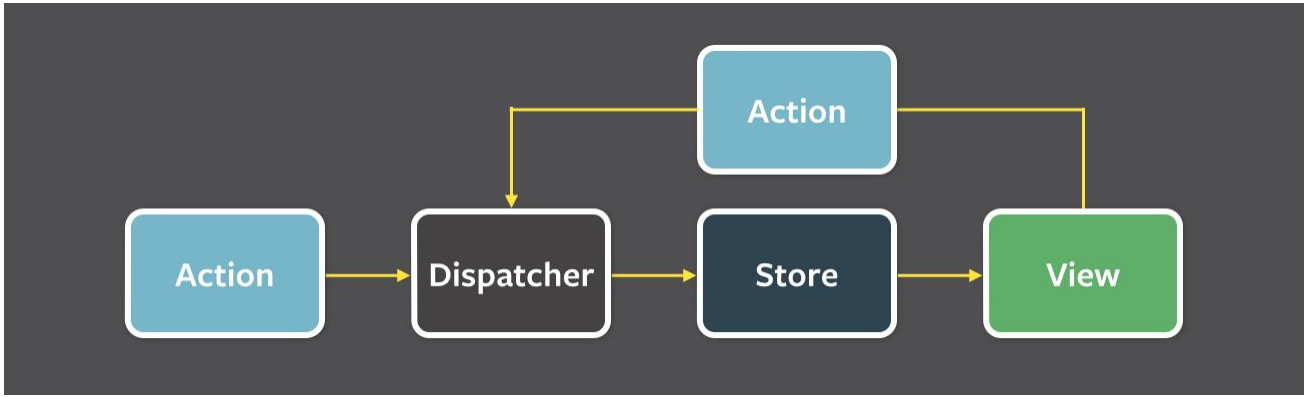


# Three Principles

1. **Single source of truth**
   - **Store** saves a single state tree
   - Easy debug and inspection
   - Undo/redo became trivial
2. **State is read-only**
   - **Actions** describe what happened
   - Changes are centralized
   - Easy log, serialize, replay
3. **Changes made with pure functions**
   - **Reducer** transforms the state tree
   - New state, no mutation
   - Code splitting, reusability


Redux
BASICS
Superdry

# Redux



# Install and Import Redux

- Install Redux as development dependency
- Import functions where you use them

**Install Redux with npm**

```
npm install --save redux
```

**Import Redux in code**

```
import { createStore } from 'redux';
```

# Design State Shape

- **All** app state
- **Single** object
- Keep **minimal**

- ***Store*** provide

## State examples

```
// Example when user logged out
{
  logged: false,
  username: ''
}
```

```
// Example when user logged in
{
  logged: true,
  username: 'username'
}
```

# Store

- Holds app state

- ***createStore()***: init Store
- ***.getState()***: get state
- ***.dispatch()***: “update” state
- ***.subscribe()***: register listener

- Unregister listener via *callback* (that ***.subscribe()*** returned)

./index.js

```
import { createStore } from 'redux';
import reducer from './reducers/authentication';

// Create store
export const store = createStore(reducer);




// Subscribe state changes
const unreg = store.subscribe(() => {
  // Get actual state
  console.log(store.getState())
});


// Dispatch actions
store.dispatch({ type: 'LOGIN', username: 'username' });
store.dispatch({ type: 'LOGOUT' });


// Unsubscribe listener
unreg();
```

# Actions

- Plain **objects**
- **Payloads** of information

## Action examples

```
// Example when user logs in
{
  type: 'LOGIN',
  username: 'username'
}


// Example when user logs out
{
  type: 'LOGOUT'
}
```

# Reducers

- Specify **state change**
- **Pure** function:
  - No mutation
  - No side effect
- **Returns** new state object
- **Default** returns previous state

./reducers/authentication.js

```
const initState = { logged: false, username: '' };

const auth = (state = initState, action) => {
  switch (action.type) {
    case 'LOGIN':
      return Object.assign({}, state, {
        logged: true,
        username: action.username
      });
    case 'LOGOUT':
      return Object.assign({}, state, {
        logged: false,
        username: ''
      });
    default:
      return state;
  }
};

export default auth;
```


Redux

# BEST PRACTICES

Redux

# ACTION CREATORS

# Action Types and Action Creators

- Keep all **action types** in a separate file
  - All existing actions in one place
- Create **action creators**
  - More verbose code

actions/actionTypes.js

```
// Authentication
export const LOGIN = 'LOGIN';
export const LOGOUT = 'LOGOUT';

// User management
export const USER_ADD = 'USER_ADD';
export const USER_DELETE = 'USER_DELETE';
```

actions/authentication.js

```
import { LOGIN, LOGOUT } from './actionTypes';

export const login = (username) => ({
  type: LOGIN,
  username
});

export const logout = () => ({
  type: LOGOUT
});
```

# Generate Action Creator

- You can generate action creators with factories
- You can use libraries for that like ***redux-act*** or ***redux-actions***

actions/todo.js with action creator factory

```
function makeActionCreator(type, ...argNames) {
  return function (...args) {
    let action = { type };
    argNames.forEach((arg, index) => {
      action[argNames[index]] = args[index];
    })
    return action;
  }
}
```

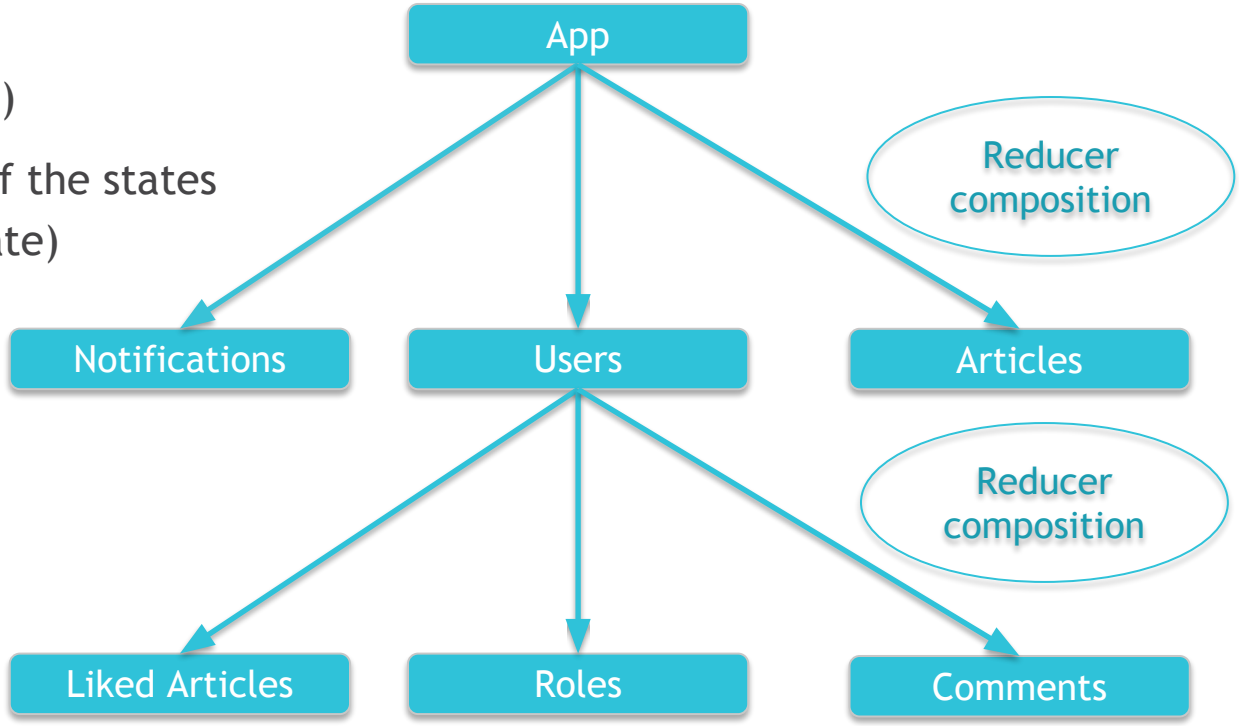
```
export const addTodo =
  makeActionCreator(ADD_TODO, 'text');
export const editTodo =
  makeActionCreator(EDIT_TODO, 'id', 'text');
export const toggleTodo =
  makeActionCreator(TOGGLE_TODO, 'id');
export const removeTodo =
  makeActionCreator(REMOVE_TODO, 'id');
```

Redux

# REDUCERS

# Reducer Composition

- App state has hierarchy (properties of properties)
- Write reducers on part of the states (reducer state != app state)
- Combine them (down to up)



# Splitting Reducers

- When fields are independent
- Reducer composition with: ***combineReducers()***
- Reducers could split into files
- ***state*** is not the app state!

reducers/notifications.js

```
export const notifications = (state = 0, action) => {
  switch (action.type) {
    case SET_NOTIFICATIONS:
      return action.notifications;
    default:
      return state;
  }
};
```

reducer.js

```
import notifications from 'reducers/notifications.js';
import users from 'reducers/users.js';
import articlesReducer from 'reducers/articlesReducer.js';

export const reducer = combineReducers({
  notifications,
  users,
  articles: articlesReducer
});
```

Redux

# MIDDLEWARE

# Middleware

There can be several middleware entities, each performing its own useful role in an Application

Middleware is a *curried* function which receives current store, next middleware in the chain, and current action
They are connected during the creation of store:

```
const logMiddleware = store => next => action => {
    console.log(action);
    next(action);
};
```

# Redux Thunk

```
const INCREMENT_COUNTER = 'INCREMENT_COUNTER';

function increment() {
  return {
    type: INCREMENT_COUNTER
  };
}

function incrementAsync() {
  return dispatch => {
    setTimeout(() => {
      // Yay! Can invoke sync or async actions with `dispatch`
      dispatch(increment());
    }, 1000);
  };
}
```

# Using Middleware

- 3rd party **extension point**
- Between **action** and **reducer**
- For **logging**, **routing**, etc.
- **Async** middleware, e.g.: ***redux-thunk***

./middleware/logger.js

```
export default store => next => action => {
  console.log('dispatching', action);

  let result = next(action);
  console.log('next state', store.getState());

  return result;
}
```

./index.js

```
import { createStore, applyMiddleware } from 'redux';
import thunk from 'redux-thunk';
import logger from './middleware/logger.js';
import appReducer from './appReducer';

let store = createStore(
  appReducer,
  applyMiddleware(logger, thunk)
);
```

# Action Creators with Validation

- ***redux-thunk*** middleware
  - **Thunk**: a subroutine used to inject additional calculation into another subroutine
  - Action creators could also **return a callback function**
  - Provide Store's ***dispatch()*** and ***getState()*** for callback functions
  - Allows **async** calculation
- For **validation** use callback function instead of action object

actions/authenticationWithValidation.js

```
import { LOGIN } from './actionTypes';

const loginWithoutCheck = (username) => ({
  type: LOGIN,
  username
});

export const login = (username) =>
  (dispatch, getState) => {
    if (getState().logged) {
      return;
    }
    dispatch(loginWithoutCheck(username));
  };



dispatch(login(username));
```

Redux

# SUMMARY

# Summary of Data Flow with Best Practices

1

**You *call* dispatch**

- Create **Action** via **Action Creator**
- Action describes what happened

2

**Store *calls* reducer**

- In: *Previous state* and *Action*
- Out: Next state

3

**Root reducer *combines* output tree**

- `combineReducers()`

4

**Store *saves* whole state**

- Listeners invoked
- Bind to UI (later): `react-redux`

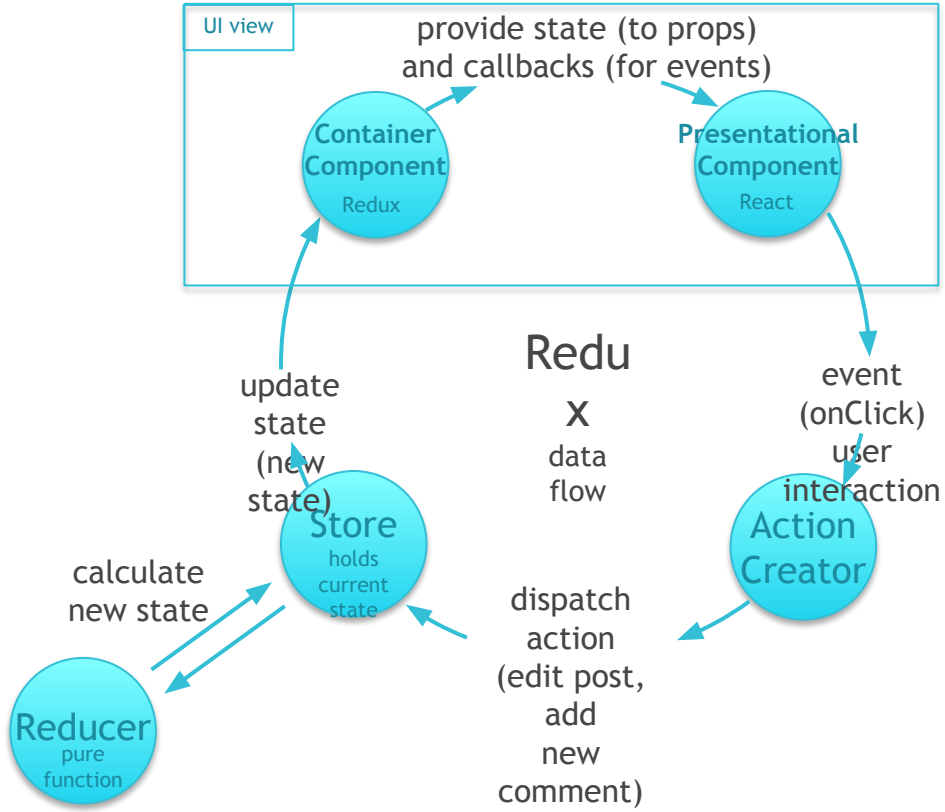

Redux
USAGE WITH REACT
Superdry

Redux

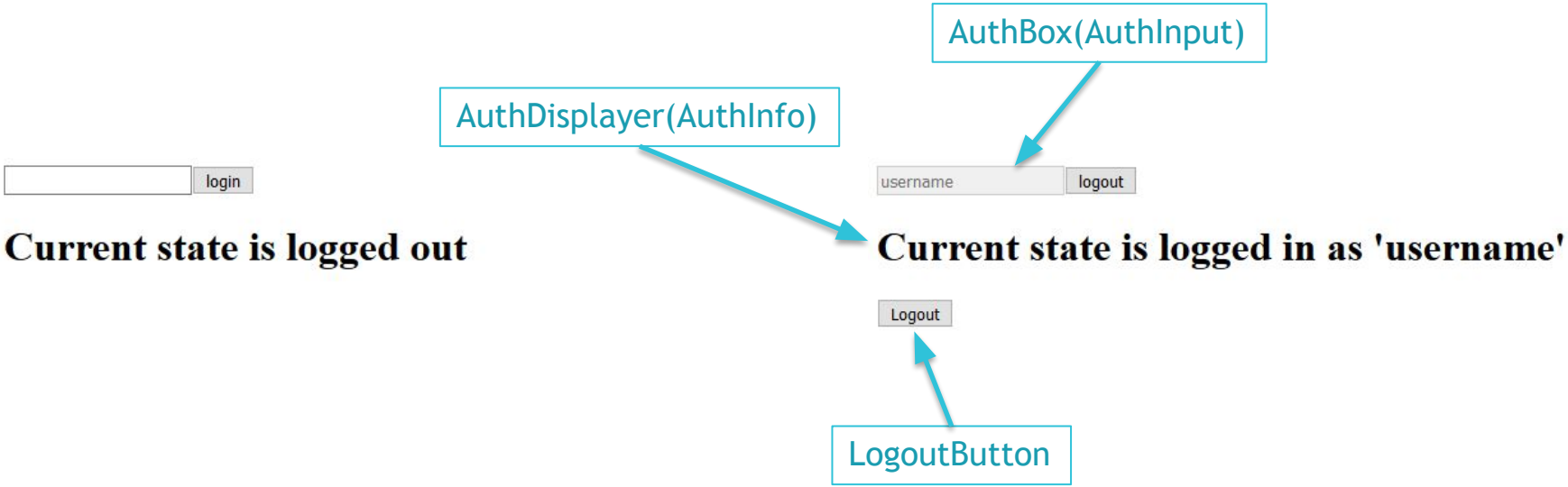
# DESIGN

# Interworking between React and Redux

- Split UI view: **logic** and **rendering**
- ***Container Component***
  - Provide state parts via ***props***
  - Dispatch events via ***callbacks***
- ***Presentational Component***
  - Using ***props*** to observe **state changes**
  - Invoke ***callbacks*** on **events**



# Application for design



Redux

# BASIC COMPONENTS

# Presentational Components

- ***Redux*** **not used** here
- **Properties** provided by its **container component** from **state**

components/AuthInfo.js

```
import React from 'react';

export const AuthInfo =
  ({ logged, username }) => (
    <h1>
      Current state is {
        'logged ' + (logged
          ? `in as '${username}'`
          : 'out')
      }
    </h1>
  );

export default AuthInfo;
```

# Container Components

- ***React*** **not used** here
- These are just **data providing**
- **No visual** elements
- Use them in the ***App.js*** (later)

containers/AuthDisplayer.js

```
import { connect } from 'react-redux';
import AuthInfo from '../components/AuthInfo';

const mapStateToProps = state => ({
  logged: state.logged,
  username: state.username
});

const AuthDisplayer =
  connect(mapStateToProps)(AuthInfo);
export default AuthDisplayer;
```

# Presentational Components with Local State

- Presentational components could have local state

components/AuthInput.js

```
export class AuthInput extends Component {
  constructor(props) {
    super(props);
    this.state = { username: '' };
  }
  handleChange = (event) => {
    this.setState({ [event.target.name]: event.target.value }); }
  loginClick = () => {
    this.props.handleLogin(this.state.username); }
  logoutClick = () => {
    this.props.handleLogout();
    this.setState({ username: '' });
  }

  render = () => {
    const btnLabel = this.props.logged ? 'logout' : 'login';
    const btnClick = this.props.logged
        ? this.logoutClick : this.loginClick;
    return (
     <div>
      <input type="text" name="username" disabled={this.props.logged}
          onChange={this.handleChange} value={this.state.username} />
      <button type="button" onClick={btnClick}>{btnLabel}</button>
     </div>
) } }

export default AuthInput;
```

# Container Components with Callbacks

- Here we provided **callbacks**

containers/AuthBox.js

```
import { connect } from 'react-redux';
import { LOGIN, LOGOUT } from '../actions/actionTypes';
import AuthInput from '../components/AuthInput';

const mapStateToProps = (state, ownProps) => ({
  logged: state.logged
});
const mapDispatchToProps = (dispatch, ownProps) => ({
  handleLogin: (username) => {
    dispatch({ type: LOGIN, username });
  },
  handleLogout: () => {
    dispatch({ type: LOGOUT });
  }
});

export const AuthBox = connect(
  mapStateToProps, mapDispatchToProps
)(AuthInput);

export default AuthBox;
```

Redux

# MIXED COMPONENTS

# Presentational Container Components

- Use ***React*** and ***Redux*** also
- Got ***dispatch*** in ***props***
- ***connect*** provides to the *presentational component part*

Presentational Component part

- Use only when logic is small
- Split as component grows

Container Component part

containers/LogoutButton.js

```
import React from 'react';
import { connect } from 'react-redux';
import { LOGOUT } from '../actions/actionTypes';

const LogoutButtonLayout = ({dispatch, logged}) => {
  if (!logged) {
    return false;
  }
  const handleLogout = () => {
    dispatch({ type: LOGOUT });
  }
  return (
    <button type="button"
        onClick={handleLogout}>Logout</button>
  )
}

const mapStateToProps =
    state => ({ logged: state.logged });
export const LogoutButton =
    connect(mapStateToProps)(LogoutButtonLayout)
export default LogoutButton;
```

Redux

# SUMMARY OF COMPONENTS

# Compare Presentational and Container Components

## *Presentational Components*

- **Design** with ***React***
- Using **props**
- Invoke prop **callbacks**
- Should **implement**

## *Container Components*

- Business **logic** with ***Redux***
- Subscribe **state**
- Dispatch **actions**
- **Generated** by ***react-redux***

Install react-redux

```
npm install --save react-redux
```

Redux

# CONNECT REDUX AND REACT

# Passing the Store

- Create the ***App*** component
- Use ***Provider*** from ***react-redux***

components/App.js

```
export const App = () => (
  <div>
    <AuthBox />
    <AuthDisplayer />
    <LogoutButton />
  </div>
);
export default App;
```

index.js

```
import React from 'react';
import ReactDOM from 'react-dom';
import { createStore } from 'redux';
import { Provider } from 'react-redux';
import auth from './reducers/auth';
import App from './components/App';
const store = createStore(auth);
ReactDOM.render(
  <Provider store={store}>
    <App />
  </Provider>,
  document.getElementById('root')
);
```


Redux
ADVANCED
TECHNICS

Redux

# IMMUTABLE.JS

# Benefits of Immutable.js

- Functional Programming
- Avoid bugs
- Performance
- Rich API

**Bad things**:

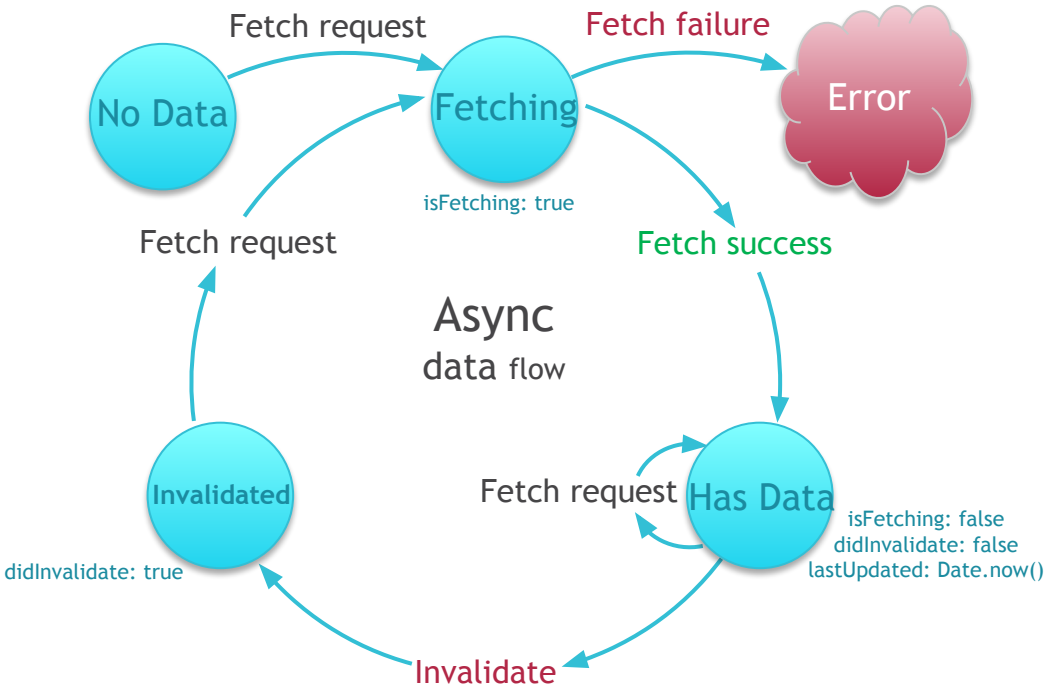
- Interoperate is hard
  (avoid `.toJS()` calls)
  (never mix with plain objects)
- No destructuring and spread operator
  (more verbose code)
- Slower on small often changed values
  (not the case in Redux)
- Harder debug
  (use object formatter)

Redux

# ASYNC DATA FLOW

# Async Data Flow

- Actions:
  - POSTS_FETCH_REQUEST:
    - *isFetching*: true
  - POSTS_FETCH_SUCCESS:
    - *isFetching*: false
    - *didInvalidate*: false
    - *lastUpdated*: Date.now()
  - POSTS_FETCH_FAILURE:
    - Handle error
  - POSTS_INVALIDATE:
    - *didInvalidate*: true



# Async State Shape

- Some state variable needed for store async process status:
  - ***isFetching***: the fetch has begun
  - ***didInvalidate***: refresh needed
  - ***lastUpdated***: last fetch time
- These should be handled in the reducer.

Example of Async State Shape

```
{
  selectedUser: user1',
  posts: {
    12: { id: 12, post: '...' }
  },
  postsByUsers: {
    'user1': {
      items: [12],
      isFetching: false,
      didInvalidate: false,
      lastUpdated: 1439478405547
    }
  }
}
```

# Fetch in Redux

- Create **action creators** (*same as before*)
- Create **reducer** (*same as before*)
- Create **thunk** that use action creators (“async action creator”)
- **Dispatch** with the thunk

- This code always fetches
  - Create another thunk that use ***fetchPosts()*** **when needed**

## Fetch in Redux

```
const requestPosts = (user) => ({
  type: REQUEST_POSTS,
  user
});
const receivePosts = (user, json) => ({
  type: RECEIVE_POSTS,
  user,
  posts: json.data.children.map(child => child.data),
  receivedAt: Date.now()
});
export const invalidateSubreddit = (user) => ({
  type: INVALIDATE_POSTS,
  user
});

const fetchPosts = user => dispatch => {
  dispatch(requestPosts(user));
  return fetch(`https://www.reddit.com/r/${user}.json`)
    .then(response => response.json())
    .then(json => dispatch(receivePosts(user, json)))
};

// store.dispatch(fetchPosts('reactjs'))
//   .then(() => console.log(store.getState()));
```

# Fetch with Checks

- Create a function for the **condition**
- Create the new thunk that **invoke** the previous thunk when condition true
- Dispatch is the **same**
- Use the thunk in the UI **as** used action creators before

## Async Actions

```
const shouldFetchPosts = (state, user) => {
  const posts = state.postsByUser[user];
  if (!posts) {
    return true;
  } else if (posts.isFetching) {
    return false;
  } else {
    return posts.didInvalidate;
  }
};

const fetchPostsIfNeeded = user => (dispatch, getState) => {
  if (shouldFetchPosts(getState(), user)) {
    return dispatch(fetchPosts(user));
  } else {
    return Promise.resolve();
  }
};

// store.dispatch(fetchPostsIfNeeded('reactjs'))
//   .then(() => console.log(store.getState()));
```

Redux

# RESELECT

# Computing Derived Data

- Render todos with filter
- Re-render without change:
  - every time ***todos*** are **same value**,
  - but **different reference**
- It makes **change detection inefficient**
- **Performance issue** because rendering
- Solve this with ***reselect*** library

containers/VisibleTodoList.js

```
import { connect } from 'react-redux';
import TodoList from '../components/TodoList';

const getVisibleTodos = (todos, filter) => {
  switch (filter) {
    case 'SHOW_ALL':
      return todos;
    case 'SHOW_COMPLETED':
      return todos.filter(t => t.completed);
    case 'SHOW_ACTIVE':
      return todos.filter(t => !t.completed);
  }
}

const mapStateToProps = state => ({
  todos: getVisibleTodos(state.todos, state.filter)
});

export const VisibleTodoList = connect(
  mapStateToProps
)(TodoList);
```

# Efficiently Compute Derived Data with *reselect* Library

- ***createSelector()***:
  creates **memorized selector**
- When
  - related state **values are same** (via **input-selectors**)
  - then **result is the same** (via **transform function**)
- ***Problem***: **couldn't reuse** the selector
- ***Solution***: **Make factories** for **selector** and ***mapStateToProps***

Could split to: selectors/*.js

containers/VisibleTodoList.js

```
import { createSelector } from 'reselect';

const getFilter = state => state.filter;
const getTodos = state => state.todos;
export const getVisibleTodos = createSelector(
  [getFilter, getTodos],
  (filter, todos) => {
    switch (filter) {
      case 'SHOW_ALL':
        return todos;
      case 'SHOW_COMPLETED':
        return todos.filter(t => t.completed);
      case 'SHOW_ACTIVE':
        return todos.filter(t => !t.completed);
    }
  }
);

const mapStateToProps = state => ({
  todos: getVisibleTodos(state)});
export const VisibleTodoList = connect(
  mapStateToProps)(TodoList);
```

Redux

# REDUX UNDO

# Understanding Undo History

- Use 3 variable in the root state:
  - past: Array<T>
  - present: T
  - future: Array<T>
- Cases:
  - Undo
  - Redo
  - Handle other action

## Example of Counter State with Undo History

```
// Count 0 to 9:
past = [0,1,2,3,4,5,6,7,8]
present = 9
future = []

// Undo 4 times:
past = [0,1,2,3,4]
present = 5
future = [9,8,7,6]

// Redo 2 times:
past = [0,1,2,3,4,5,6]
present = 7
future = [9,8]

// Decrement 4 times:
past = [0,1,2,3,4,5,6,7,6,5,4]
present = 3
future = []
```

# Undo History with *redux-undo*

- Use ***redux-undo*** library
- ***distinctState()***: ignore actions that didn't result state change
- Dispatch actions with ***ActionCreators.undo()***, ***ActionCreators.redo()***, etc.

Install redux-undo

```
npm install --save redux-undo
```

reducers/undoableTodos.js

```
import undoable from 'redux-undo';
import todos from '../reducers/todos';

export const undoableTodos = undoable(
  todos, { filter: distinctState() }
);
```

index.js

```
import { ActionCreators } from 'redux-undo';

store.dispatch(ActionCreators.undo());
store.dispatch(ActionCreators.redo());

store.dispatch(ActionCreators.jump(-2));
store.dispatch(ActionCreators.jump(5));

store.dispatch(ActionCreators.clearHistory());
```

Redux

# REACT ROUTER

# React Router

- ***Redux***:
  source of truth of **data**
- ***React Router***:
  source of truth of **url**

- **Cannot change URL in actions**
  - *Cannot time travel*
  - *Cannot rewind action*

## Redux and React Router

```
// Connect React Router with Redux App:
const Root = ({ store }) => (
  <Provider store={store}>
    <Router>
      <Route path="/:filter?" component={App} />
    </Router>
  </Provider>);

// Navigating with React Router:
const Links = () => (<div>
  <Link to="/">Show All</Link>
  <Link to="/SHOW_ACTIVE">Show Active</Link>
  <Link to="/SHOW_COMPLETED">Show Completed</Link>
</div>);

// App gets the matched URL parameters,
// and provide components to their props
const App = ({ match: { params } }) => (<div>
  <VisibleTodoList filter={params.filter || 'SHOW_ALL'} />
  <Links />
</div>);

// In container components you could use
// the matched parameter from ownProps
const mapStateToProps = (state, ownProps) => ({
  todos: getVisibleTodos(state.todos, ownProps.filter)
});
```

Redux

# SUB-APP APPROACH

# Isolating SubApps

- **Independent** SubApps
  - Won't share **data**
  - Won't share **actions**
  - Won't **communicate** each other
- Useful for **large teams**
- Each component have **own store**

subapps/SubApp.js

```
import subAppReducer from './subAppReducer.js';
export class SubApp extends Component {
  constructor(props) {
    super(props);
    this.store = createStore(subAppReducer);
  }
  render = () => (
    <Provider store={this.store}>
      <App />
    </Provider>
  )
}
```

app.js

```
import SubApp from './subapps/SubApp.js';
export const BigApp = () => (<div>
  <SubApp />
  <OtherSubApp2 />
  <OtherSubApp3 />
</div>);
```


Redux
QUESTIONS?


Redux
RESOURCES


Redux

# THANKS FOR YOUR ATTENTION!