

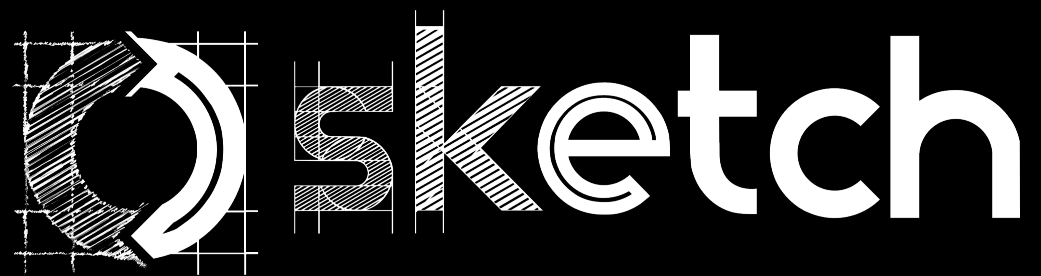
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Wrangling Complex State with FSM's and Statecharts in a React.js App

<https://connect.tech>





Wrangling Complex State with FSM's and Statecharts in a React.js App

Jeff Barczewski

October 14th, 2020

codewinds.com/ct20-xstate

Jeff Barczewski

by the numbers

STATS

- Married, Father, Catholic
- 31 yrs professional experience (yes, he's old)
- JS / Node.js (since 95, primary last 9 yrs)
- BS Aerospace Engineering Univ of Illinois
- Work: USAF, RGA, MasterCard ApplePay, Elsevier, Monsanto, Sketch
- Senior Software Engineer / Trainer
- Languages: Fortran, C, C++, Java, Ruby, JavaScript, Go, Rust
- Enjoys: Growing in my faith, Functional Programming, Snow Skiing, Polka Dancing



Goals

WHY ARE WE HERE?

- Understand basics of Finite State Machines and Statecharts
- Acquire a working knowledge of using the XState JS library to create FSM's and Statecharts and how to use it with React.js
- Learn some of the many benefits Statecharts provide for managing state and logic
- Experience some of the Statechart visualization and live interactivity tools

Setting the stage

The joy of application state

“Shared mutable state
is the root of all evil”
- Herrik Eichenhardt



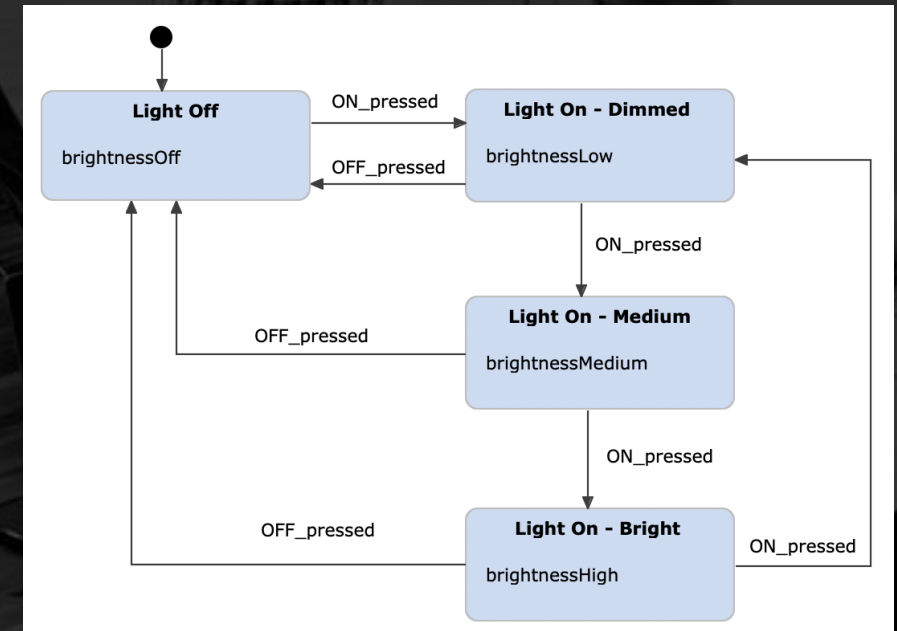
Finite State Machines

IT MUST BE GREAT WITH SUCH A FANCY NAME

Mealy Machines - George H. Mealy 1955

Moore Machines - Edward Moore 1956

A state machine is a behavior model. It consists of a finite number of states and is therefore also called finite-state machine (FSM). Based on the current state and a given input the machine performs state transitions and produces outputs.



From: Itemrs AG Yakindu - What is a state machine?

Harel Statecharts

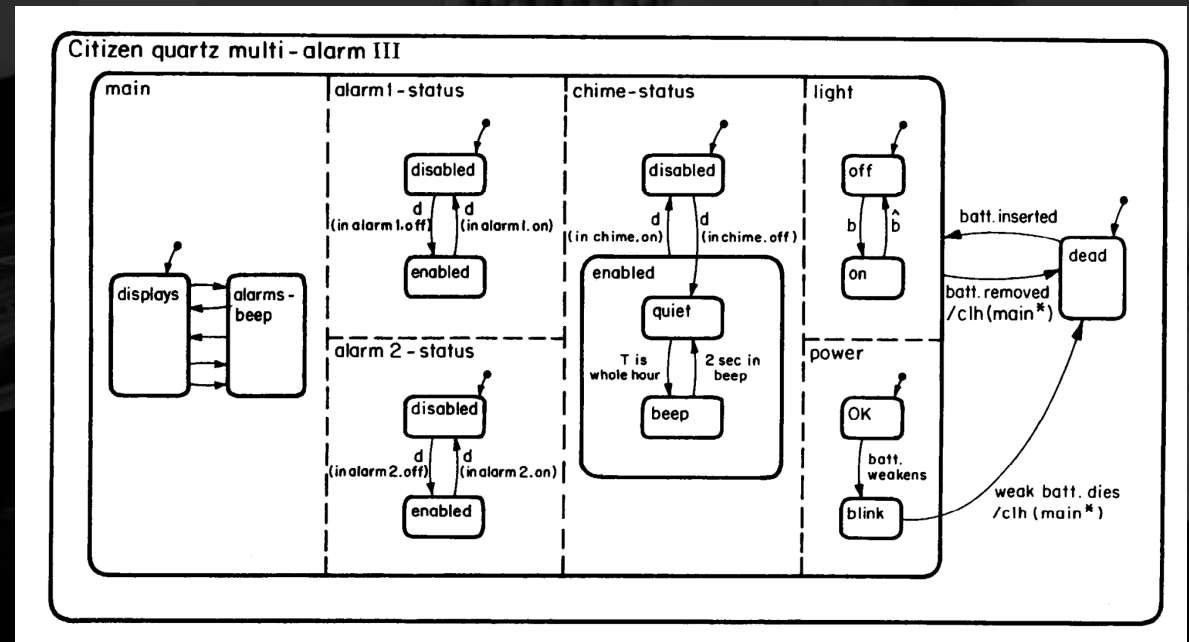
FSM, YOU AIN'T SEEN NOTHING YET

Statecharts: A visual formalism for complex systems
- David Harel 1984

Regarding FSM's, "A complex system cannot be beneficially described in this naive fashion, because of the unmanageable, exponentially growing multitude of states, all of which have to be arranged in a 'flat' unstratified fashion, resulting in an unstructured, unrealistic, and chaotic state diagram."

Harel concluded that "a state approach must be modular, hierarchical and well-structured" and introduced additional concepts like state composition and orthogonality.

"statecharts = state-diagrams + depth + orthogonality + broadcast communication" (+ expanded state)



From: Statecharts - Harel 1984

XState

STATE MACHINES AND STATECHARTS FOR JAVASCRIPT

- Created by David Khourshid
- JS Library
- Use with any JS framework or plain JS
 - Additional Helpers
 - React
 - Vue
- Implements Finite State Machines and Statecharts
- Simple configuration
- Great documentation
- Responsive Team

Super quick start

```
npm install xstate
```

```
import { createMachine, interpret } from 'xstate';

// Stateless machine definition
// machine.transition(...) is a pure function used by the interpreter.
const toggleMachine = createMachine({
  id: 'toggle',
  initial: 'inactive',
  states: {
    inactive: { on: { TOGGLE: 'active' } },
    active: { on: { TOGGLE: 'inactive' } }
  }
});

// Machine instance with internal state
const toggleService = interpret(toggleMachine)
  .onTransition((state) => console.log(state.value))
  .start();
// => 'inactive'

toggleService.send('TOGGLE');
// => 'active'

toggleService.send('TOGGLE');
// => 'inactive'
```

Demos & Code

Summary

REMIND ME WHAT WE LEARNED

Visualizing / Interacting with Machine (design & live)

Formal Definition (States, Events, Transitions, Guards, Actions, Services, Activities)

Separation of Concerns

Framework Independent

Override / Provide Implementation in App or Tests

Trigger on state entry, transitions or state exit

Services / Actors

Model based Testing

Resources

WHERE DO I GO FROM HERE?

- Review the slides at codewinds.com/ct20-xstate
- Review the code we briefly explored ([multi-stop light](#), [cart](#))
- [Model-Based Testing in React with State Machines](#)
- xstate.js.org - XState home
- statecharts.io - statechart tools
- David Harel's 1987 paper - [Statecharts: A visual formalism for complex systems](#)
- Cypress Real World App ([blog article](#), [machine definitions](#))
- Reach out to [Sketch](#) for mentoring, training, development, or coaching needs

Thank you

codewinds.com/ct20-xstate

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