Beyond Consumer-Driven Contract Testing

NICOLE RAUCH
software development &
development coaching

Soooo...

- We want to build this nice webapp / distributed system / these microservices
- We want to make sure “Frontend” and “Backend” play nicely together

Soooo...

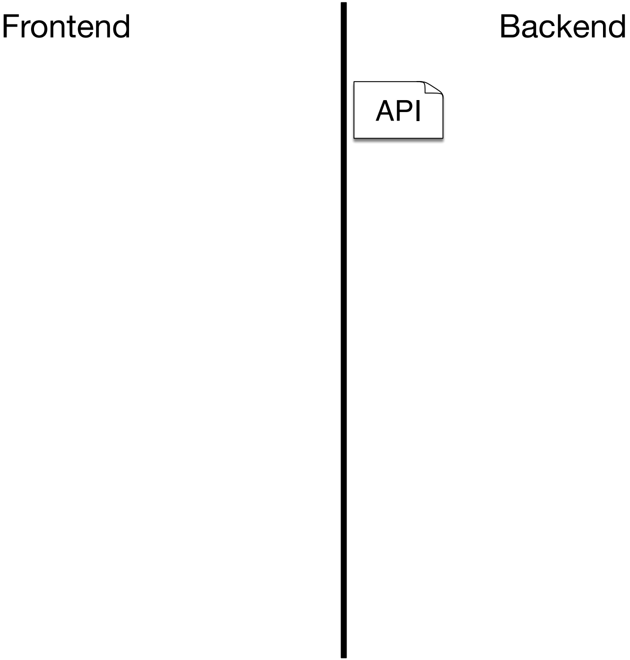
- We want to build this nice webapp / distributed system / these microservices
- We want to make sure “Frontend” and “Backend” play nicely together

- HOW???

‘‘Super-Naïve’’ Approach

Frontend

Backend



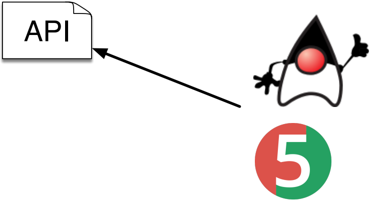
Frontend

Backend

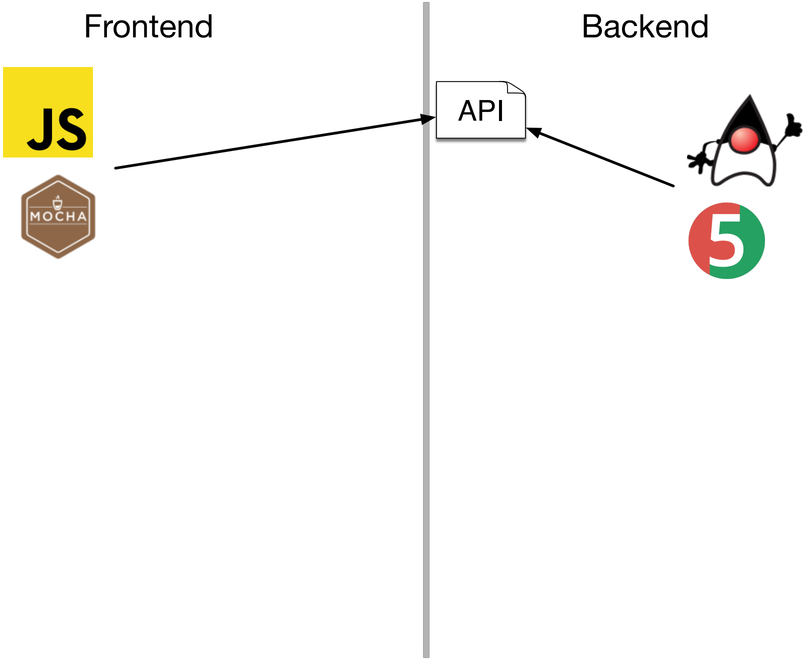
API

Frontend

Backend



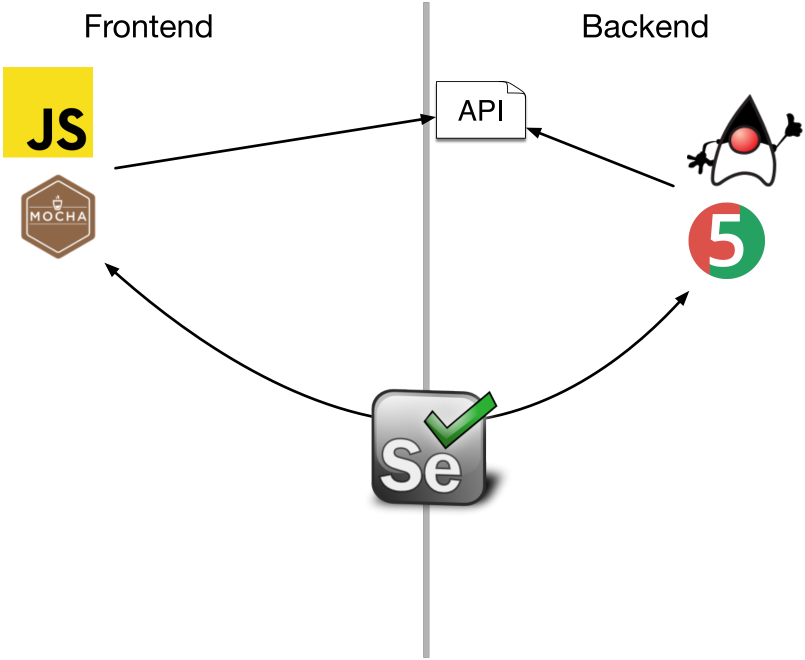
API



Frontend

Backend

API

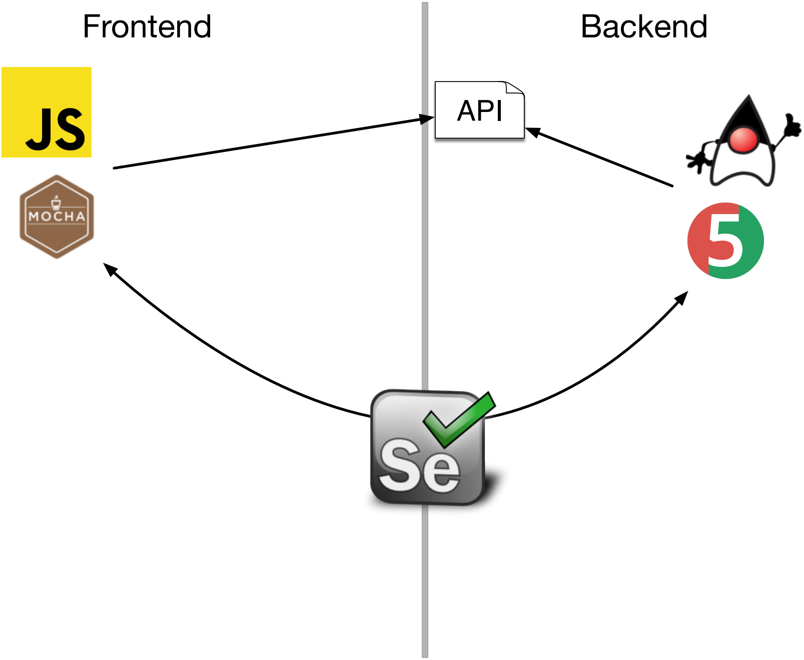


Frontend

Backend

API

But . . .



Frontend

Backend

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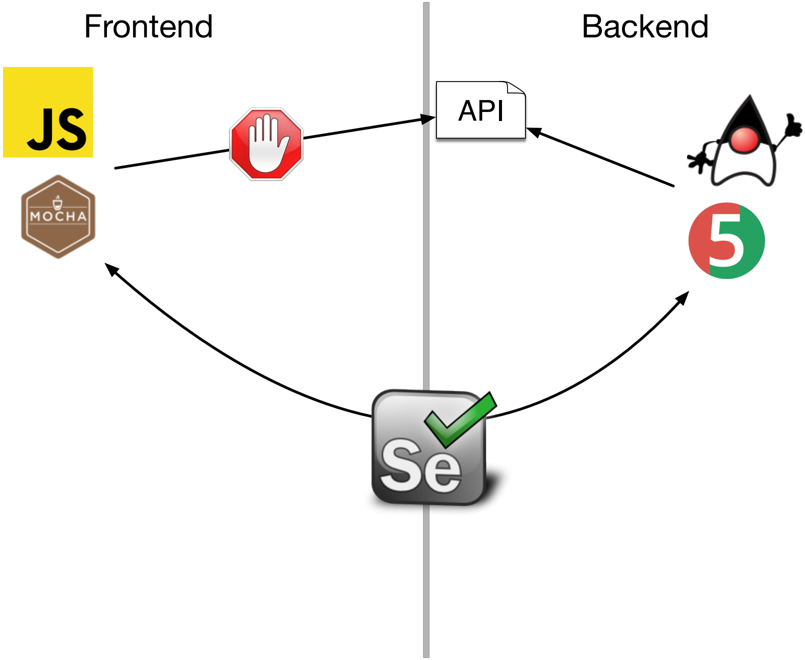

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Backend

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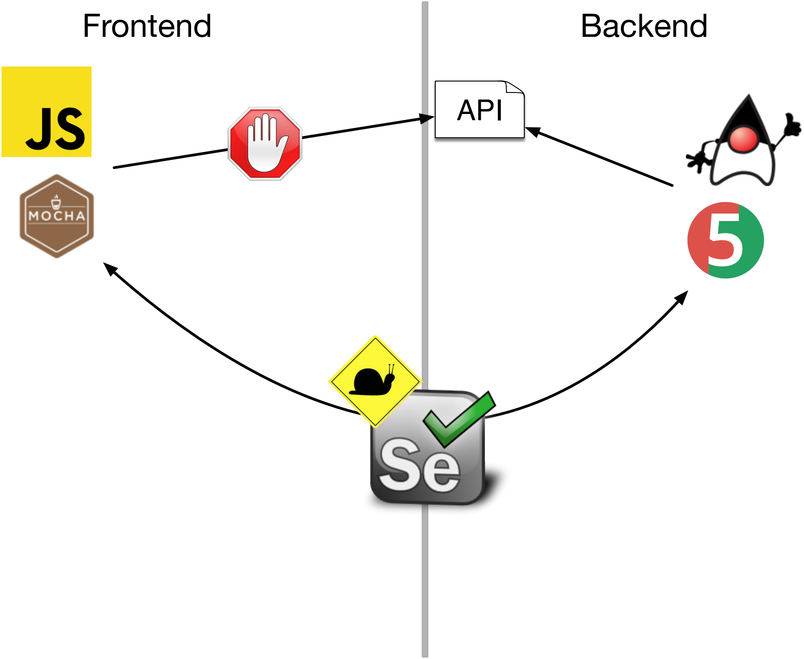

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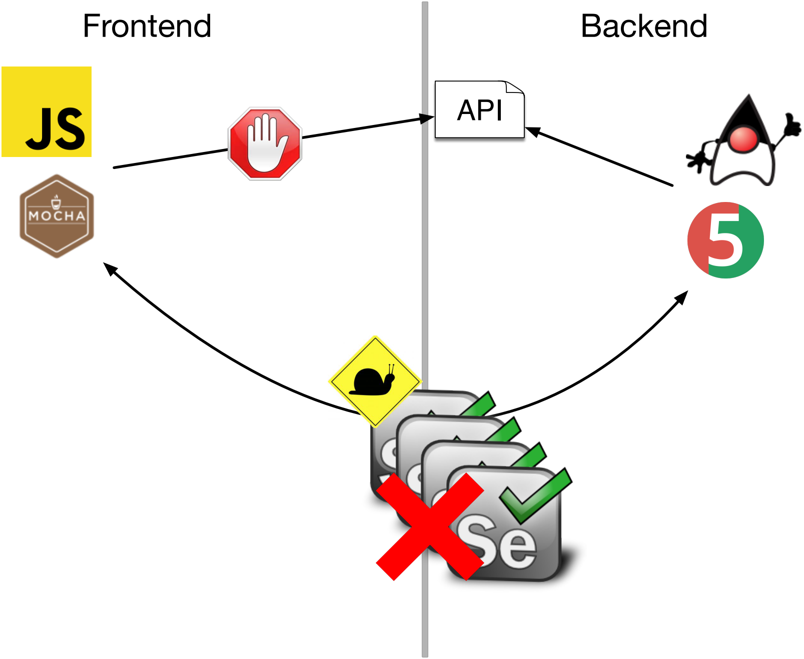


Frontend

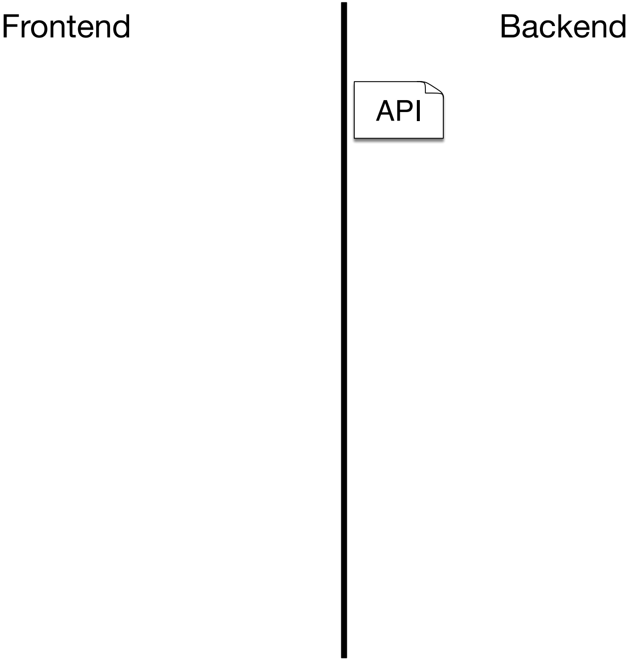
Backend

API

“Still Quite Naïve” Approach

Frontend

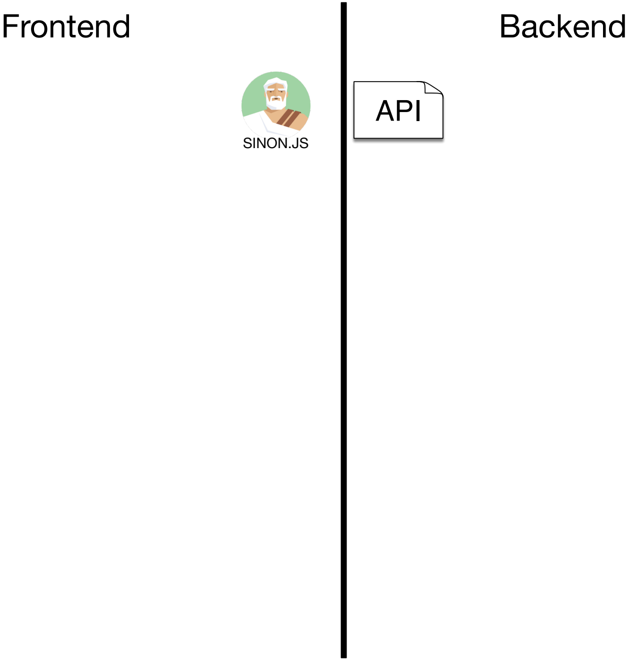
Backend



Frontend

Backend

API



Frontend

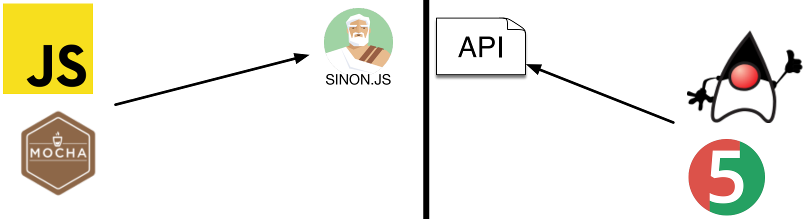
Backend

SINON.JS

API

Frontend

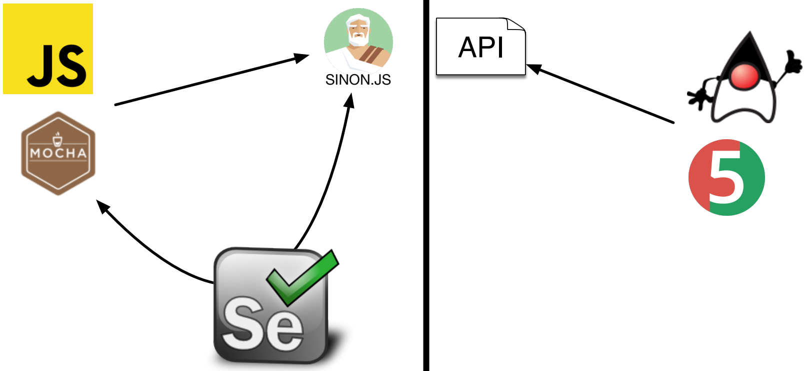
Backend



API

Frontend

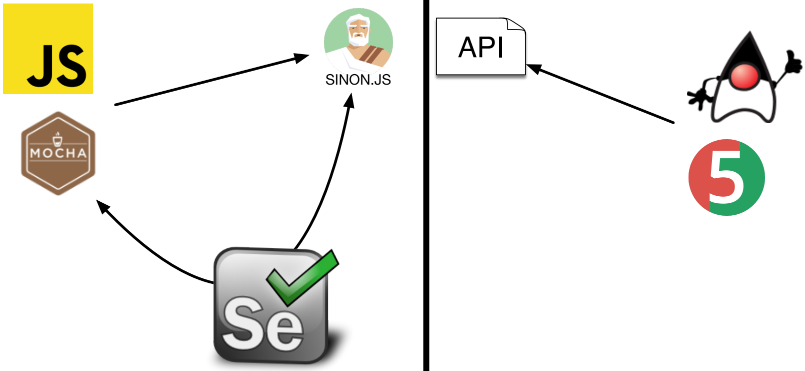
Backend



But . . .

Frontend

Backend



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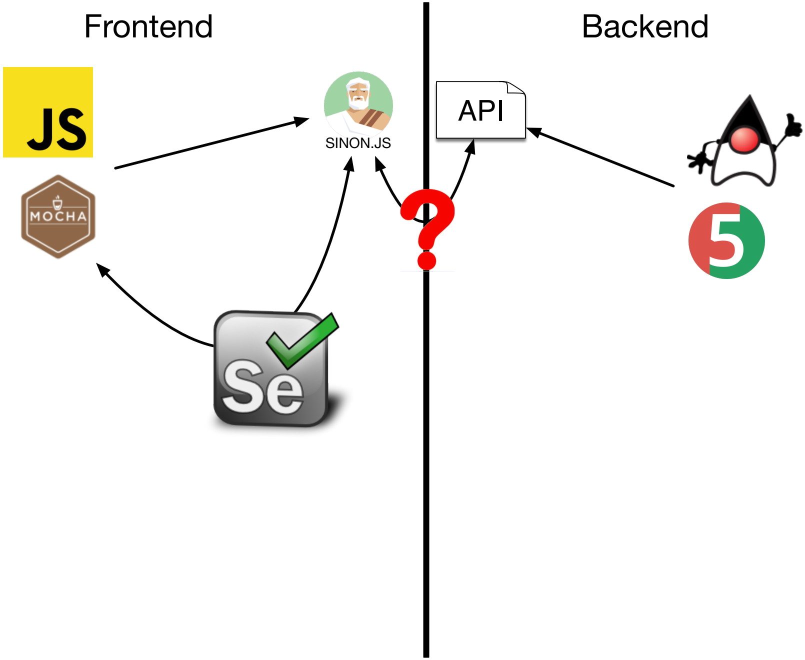

Frontend

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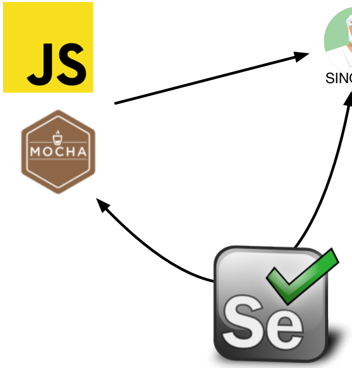
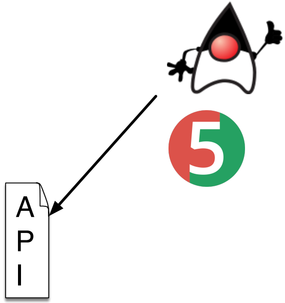
SINON.JS

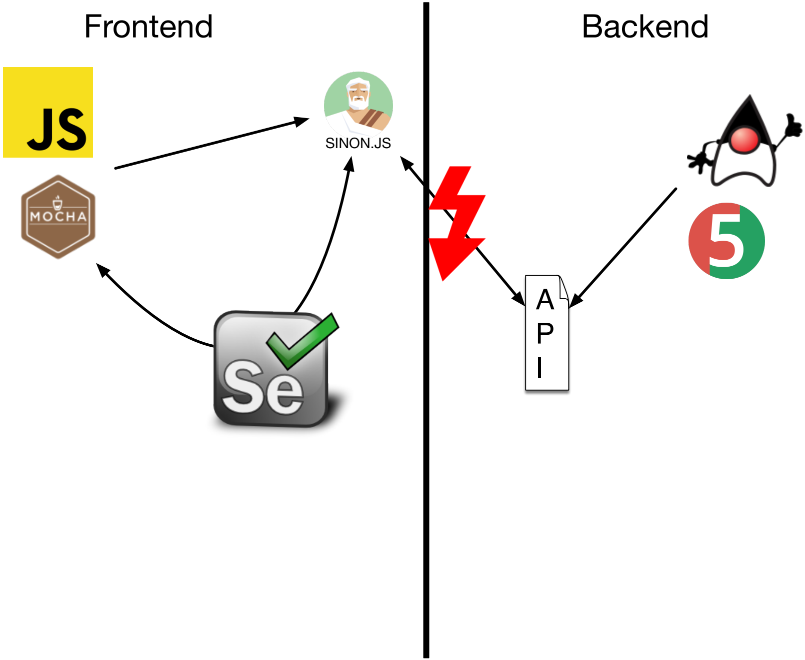
API

Frontend



Backend



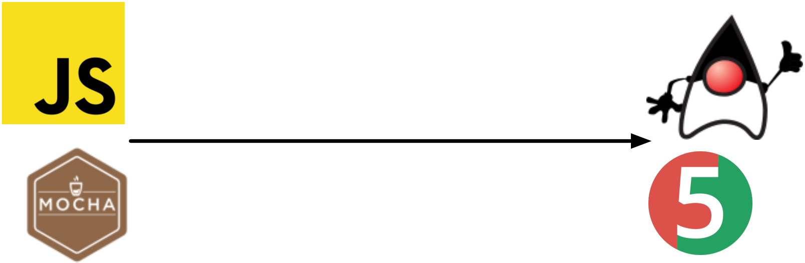


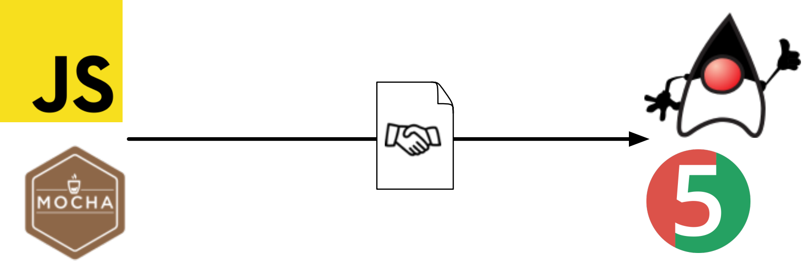
Frontend

Backend

“Industry-Strength” Approach:

Consumer-Driven Contract Testing


JS
MOCHA
5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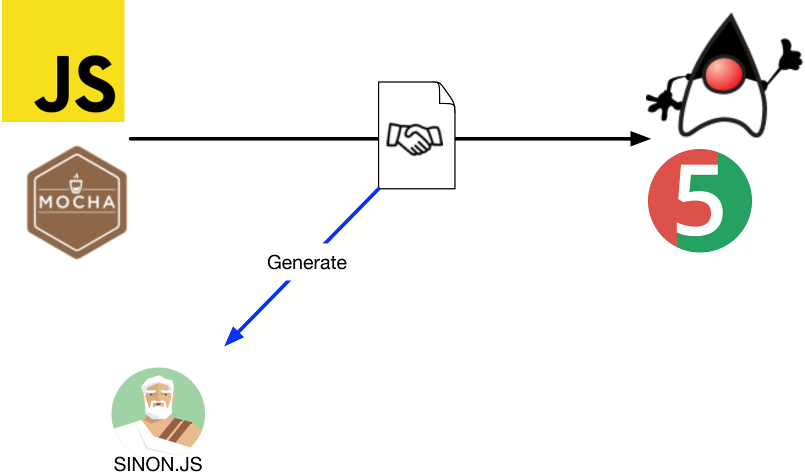
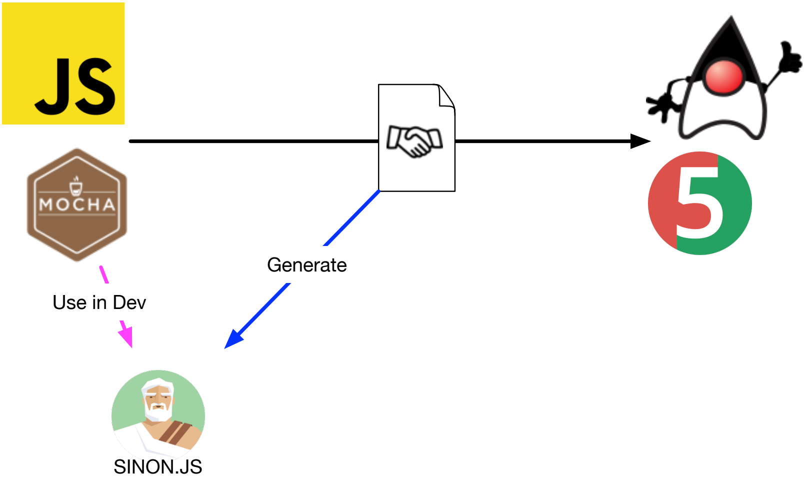


Generate

SINON.JS


JS
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Use in Dev
5
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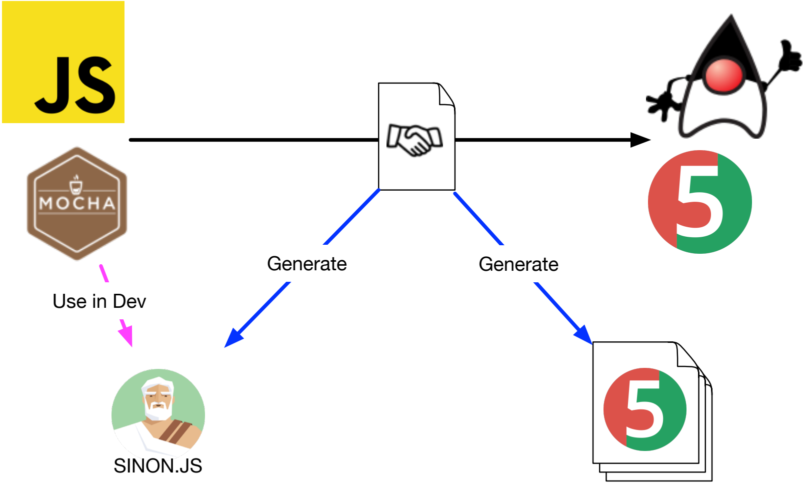
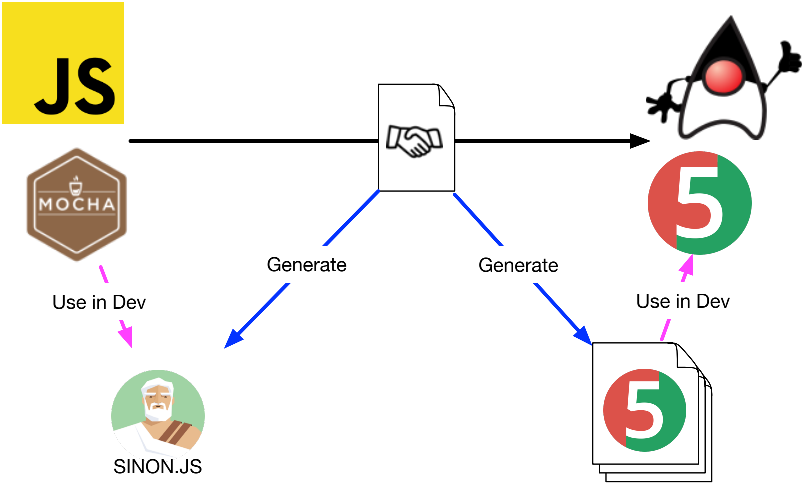


Generate

Generate

Use in Dev

SINON.JS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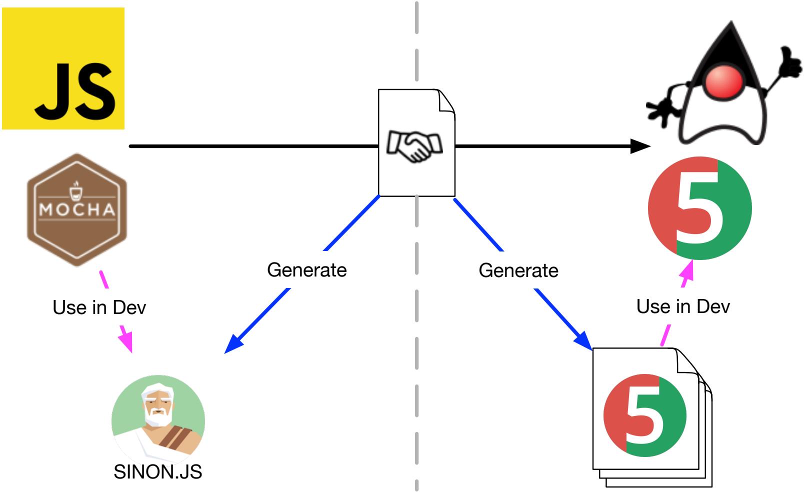
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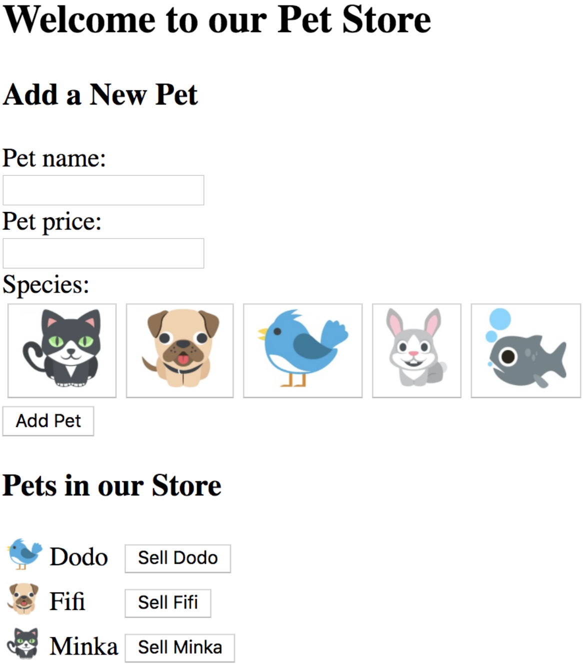


Welcome to our Pet Store

Add a New Pet

Pet name:

Pet price:

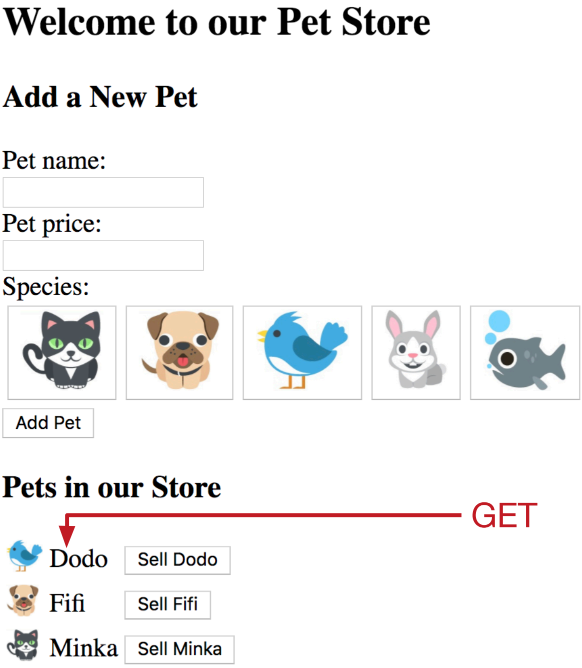
Species:

Pets in our Store

Dodo

Fifi

Minka



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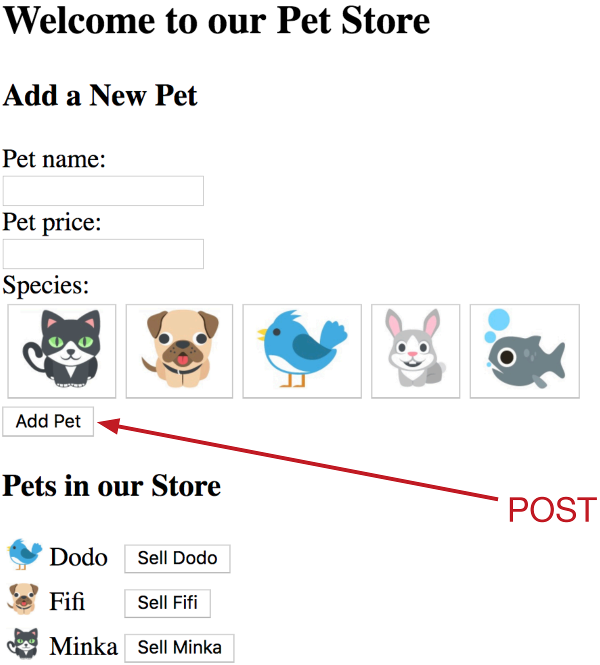

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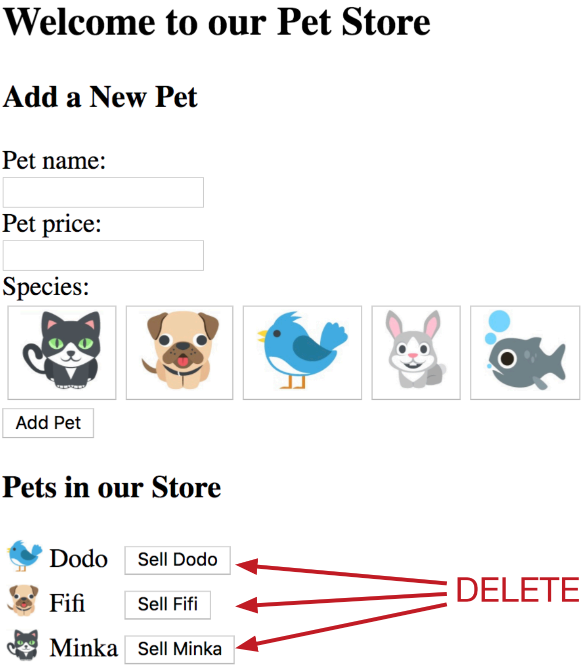

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Pet name:

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Minka

DELETE

Example: Pet Store Contracts I

```
{
  "description": "a request for all pets",
  "providerState": "i have no pets",
  "request": {
    "method": "GET",
    "path": "/pets",
    "headers": { "Accept": "application/json" }
  },
  "response": {
    "status": 200,
    "headers": { "Content-Type": "application/json" },
    "body": {
      "tag": "Pets",
      "pets": []
    }
  }
}
```

Situation

- GET-Request

Situation

- GET-Request
- Does not depend on state

Situation

- GET-Request
- Does not depend on state
- Easy to handle with CDCT

Questions

- Completeness

Questions

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  - Did we really capture all requests (+ responses) in our contract?

Example: Pet Store Contracts II

```
{
  "description": "a request for all pets",
  "providerState": "i have a list of pets",
  "request": {
    "method": "GET",
    "path": "/pets",
    "headers": { "Accept": "application/json" }
  },
  "response": {
    "status": 200,
    "headers": { "Content-Type": "application/json" },
    "body": {
      "tag": "Pets",
      "pets": [
        { "petName": "Fifi",  "petType": "Dog" },
        { "petName": "Minki", "petType": "Cat" }
      ]
    }
  }
}
```

Situation

- GET-Request that depends on state

Situation

- GET-Request that depends on state
- POST-/PUT-/DELETE-Requests

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- State checks need to be established somehow

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- Maintenance
  - How can we keep track of our contracts and avoid redundancies?
  - How can we effectively maintain the contracts in case of changes?

We need the Functional Essence!

Sounds cool, but. . .

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. . .what does that mean?

Functional Essence

- Fake Server

Functional Essence

- Fake Server
- Lightweight Implementation

Functional Essence

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- Model

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- Rapid Prototype

Functional Essence

- Fake Server
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- Rapid Prototype
- Minimal Viable Product

Functional Essence Serves Many Purposes

- To learn about the domain

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- To learn about the domain
- To discuss with domain experts

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Functional Essence Serves Many Purposes

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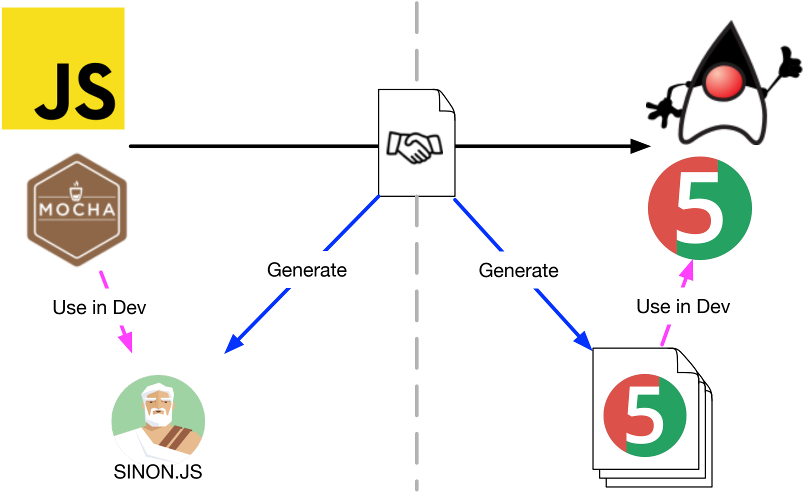
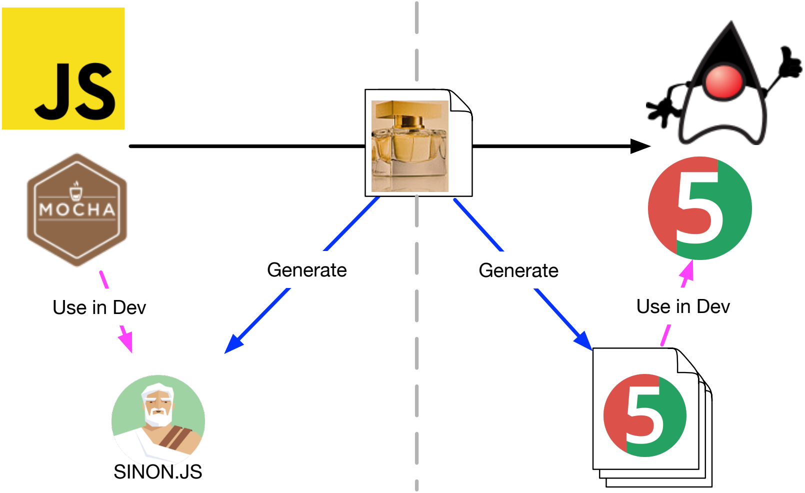
- To check the real implementation:


JS
MOCHA
Generate
Generate
Use in Dev
Use in Dev
SINON.JS


JS
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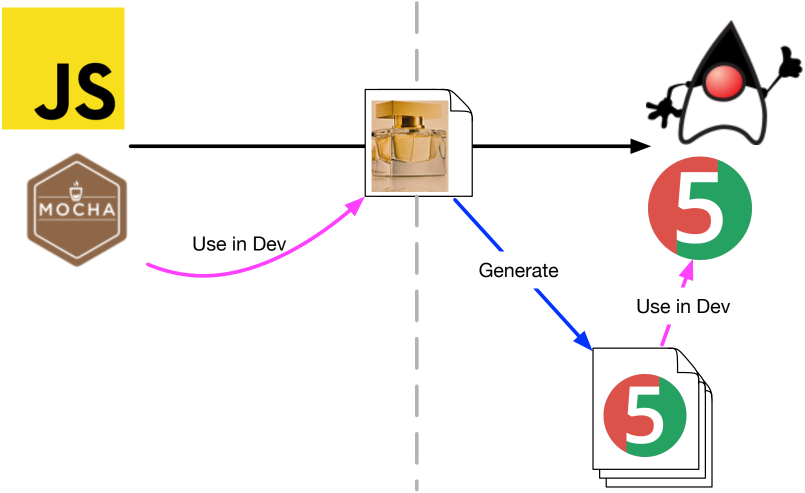
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Use in Dev
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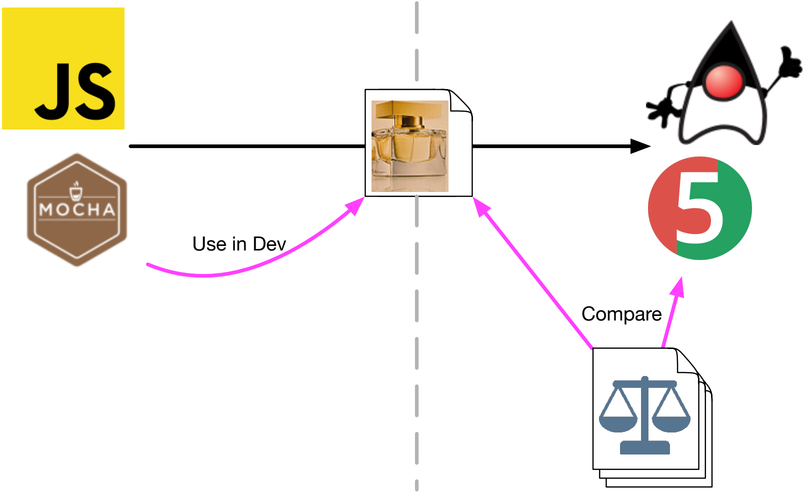
JS
MOCHA
Use in Dev
Compare
5

Sounds cool, but. . .

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. . .how can I build this?

How to Build a Functional Essence

- Implement the domain logic

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- Implement the domain logic
- In the simplest possible way

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- In an arbitrary language

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The Pets Essence

```
class Pets {
    constructor(){
        this._pets = [];
    }

    getPets() {
        return petSorter.sortPets(this._pets);
    }

    addPet(pet) {
        this._pets.push(pet);
        return 'Pet successfully added.';
    }

    removePet(pet) {
        this._pets = this._pets.filter(
            p => p.petName !== pet.petName || p.petType !== pet.petType);
        return 'Pet successfully removed.';
    }
}
```

The Overall Essence

```
class Essence {
    constructor() {
        this._pets = new Pets();
        this._somethingElse = new SomethingElse();
    }

    pets() {
        return this._pets;
    }

    somethingElse() {
        return this._somethingElse;
    }
}
```

The Essence App

```
let essence = new Essence();

router.get('/pets', (req, res) => {
    const pets = essence.pets().getPets();
    res.json({tag: 'Pets', pets});
});

router.post('/pets', (req, res) => {
    const message = essence.pets().addPet({ petName: req.body.petName,
        petPrice: req.body.petPrice, petType: req.body.petType });
    res.json({message});
});

router.delete('/pets', (req, res) => {
    const message = essence.pets().removePet({ petName: req.body.petName,
        petPrice: req.body.petPrice, petType: req.body.petType });
    res.json({message});
});
```

Important Addition

```
router.delete('/reset', (req, res) => {
    essence = new Essence();
    res.json({message: 'All pets successfully removed.'});
});
```

Important Addition

```
router.delete('/reset', (req, res) => {
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});
```

Also for the real backend!

Isn't That The Same Code As The Backend?

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- …

How does the Comparison work?

Detour: Quick Check / Property-Based Testing

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- User specifies properties
- Tool generates examples
- Checks properties against examples

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```
prop_RevRev xs = reverse (reverse xs) == xs
  where types = xs::[Int]
```

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```
Main> quickCheck prop_RevRev
OK, passed 100 tests.
```

Detour: Quick Check / Property-Based Testing

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```
prop_RevRev xs = reverse (reverse xs) == xs
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Main> quickCheck prop_RevRev
OK, passed 100 tests.
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```
prop_RevId xs = reverse xs == xs
  where types = xs::[Int]
```

Detour: Quick Check / Property-Based Testing

- User specifies properties
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- Checks properties against examples

```
prop_RevRev xs = reverse (reverse xs) == xs
  where types = xs::[Int]
```

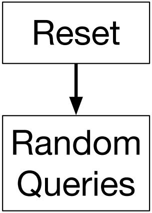
```
Main> quickCheck prop_RevRev
OK, passed 100 tests.
```

```
prop_RevId xs = reverse xs == xs
  where types = xs::[Int]
```

```
Main> quickCheck prop_RevId
Falsifiable, after 1 tests:
[-3,15]
```

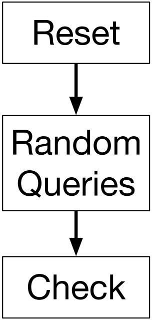
How to Mimic QuickCheck?

Reset



Reset

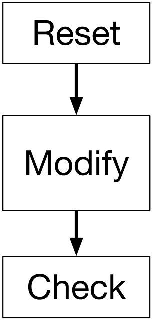
Random Queries



Reset

Random Queries

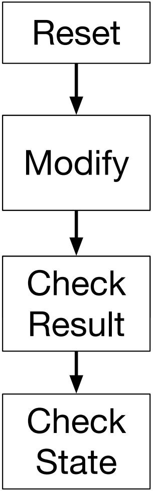
Check



Reset

Modify

Check

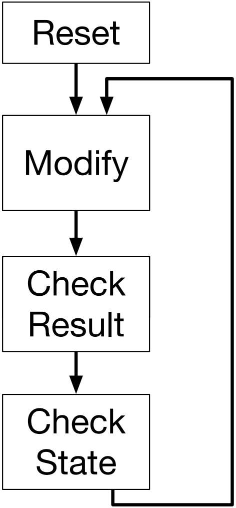


Reset

Modify

Check Result

Check State



Reset

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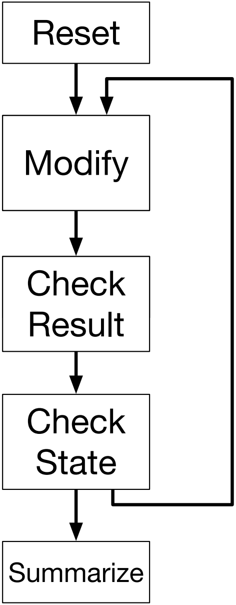
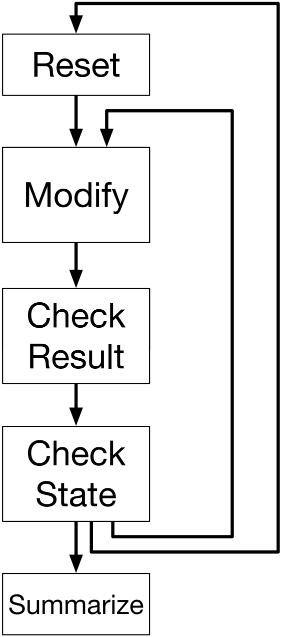
Check Result

Check State


Reset
Modify
Check Result
Check State
Summarize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Comparator Implementation

The Main Loop

```
const requests = [resets[0]()]; // initial reset

let count = 0;

while (count < 50) {
    count++;
    requests.push(chooseFrom(modifyingRequestGenerator)());
}

async.mapSeries(requests, requestAndCompare, (err, results) => {
    results.map(result => console.log(result));
    if (err) {
        console.log(err);
    }
});
```

Request Generator

```
const resets = [
    // delete all pets
    () => ({url: '/reset', method: 'DELETE'}),
];

const modifyingRequestGenerator = [
    // addPet
    () => ({url: '/pets', method: 'POST', json: true, body: randomPet()}),
    // removePet
    () => ({url: '/pets', method: 'DELETE', json: true, body: randomPet()})
];

const comparisons = [
    // getPets
    () => ({url: '/pets', method: 'GET'}),
];
```

Pet Generator

```
const chooseFrom = arr => arr[Math.floor(arr.length * Math.random())];

const possibleNames = ['Minka', 'Fifi', 'Pucki'];
const possibleSpecies = ['Cat', 'Dog', 'Canary', 'Rabbit', 'Fish'];

const name = () => chooseFrom(possibleNames);
const price = () => Math.floor(150 * Math.random());
const species = () => chooseFrom(possibleSpecies);

const randomPet = () =>
          ({petName: name(), petPrice: price(), petType: species()});
```

Revisiting the Main Loop

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Request-Compare-Loop

```
const requestAndCompare = (request, mainCallback) => {

    console.log('Running the modification request:');

    runRequest(request, (err, result) => {
        const backendString = JSON.stringify(result.backend);
        const essenceString = JSON.stringify(result.essence);

        if (backendString !== essenceString) {
            mainCallback('Backend and Essence responses differ! Backend: '
                + backendString + ' - Essence: ' + essenceString);

        } else {

            console.log('Comparing all data:');
            compareEverything(mainCallback);
        }
    });
};
```

Query Submission

```
const backend = {baseURL: 'http://localhost:9090'};
const essence = {baseURL: 'http://localhost:8080'};

const merge = (req, server) =>
        Object.assign({}, req, {url: server.baseURL + req.url});

const requestFunctionFor = (req, server) =>
    callback => request(merge(req, server),
                        (err, response) => callback(err, response.body));

const runRequest = (req, callback) => {
    console.log('Now checking:', req);
    async.parallel({
        backend: requestFunctionFor(req, backend),
        essence: requestFunctionFor(req, essence)
    }, callback);
};
```

Comparisons

```
function compareEverything(mainCallback) {
    async.map(comparisons, (itemFunc, callback) =>
        runRequest(itemFunc(), (err, res) => {
            if (res.backend === res.essence) {
                callback(null, null); // no differences
            } else {
                const formatDiff = formatter.formatDiff({
                    backend: JSON.parse(res.backend),
                    essence: JSON.parse(res.essence)
                });
                callback(null, formatDiff);
            }
        }),
        (err, results) => {
            const nonmatching = results.filter(x => x);
            mainCallback(nonmatching.length
                    ? 'Backend and Essence differ in their data' : null);
        });
}
```

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- Completeness
  - Did we really capture all requests (+ responses) in our contract?
  - All possible combinations with different backend states?

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  - Completeness is established over time

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- State Validity
  - What are valid states in our stub?
  - Did we always establish a valid state in our stub?
  - How do we establish them (technically) before the request?
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    - later because of comparison errors

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- This is rather at the top of the test pyramid.

Thank you very much!

Nicole Rauch

E-Mail info@nicole-rauch.de
Twitter @NicoleRauch
Web http://www.nicole-rauch.de

EventStorming · Domain-Driven Design
Training · Coaching · Facilitation
Software Craftsmanship
React.js and Redux
Functional Programming

Credits

Essence: Mark Morgan - Perfume

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