~~Homomorphic Event Sourcing~~

Consumer-Driven Contracts Done Right

symbiont
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Overview

- Introduction
- Event Sourcing 101
- A Formal Model for Event Sourcing
- Consumer-Driven Contract Testing
- Beyond CDCT
- Conclusion

Part I

Introduction

Why?

or:

How this all began

Who?

Who we are?

What?

Formal Methods ∩ DDD

Languages, Type Systems,
Engineering Techniques

Part II

Event Sourcing 101

Ubiquitous Language

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- Should be made explicit in a glossary

Commands and Events

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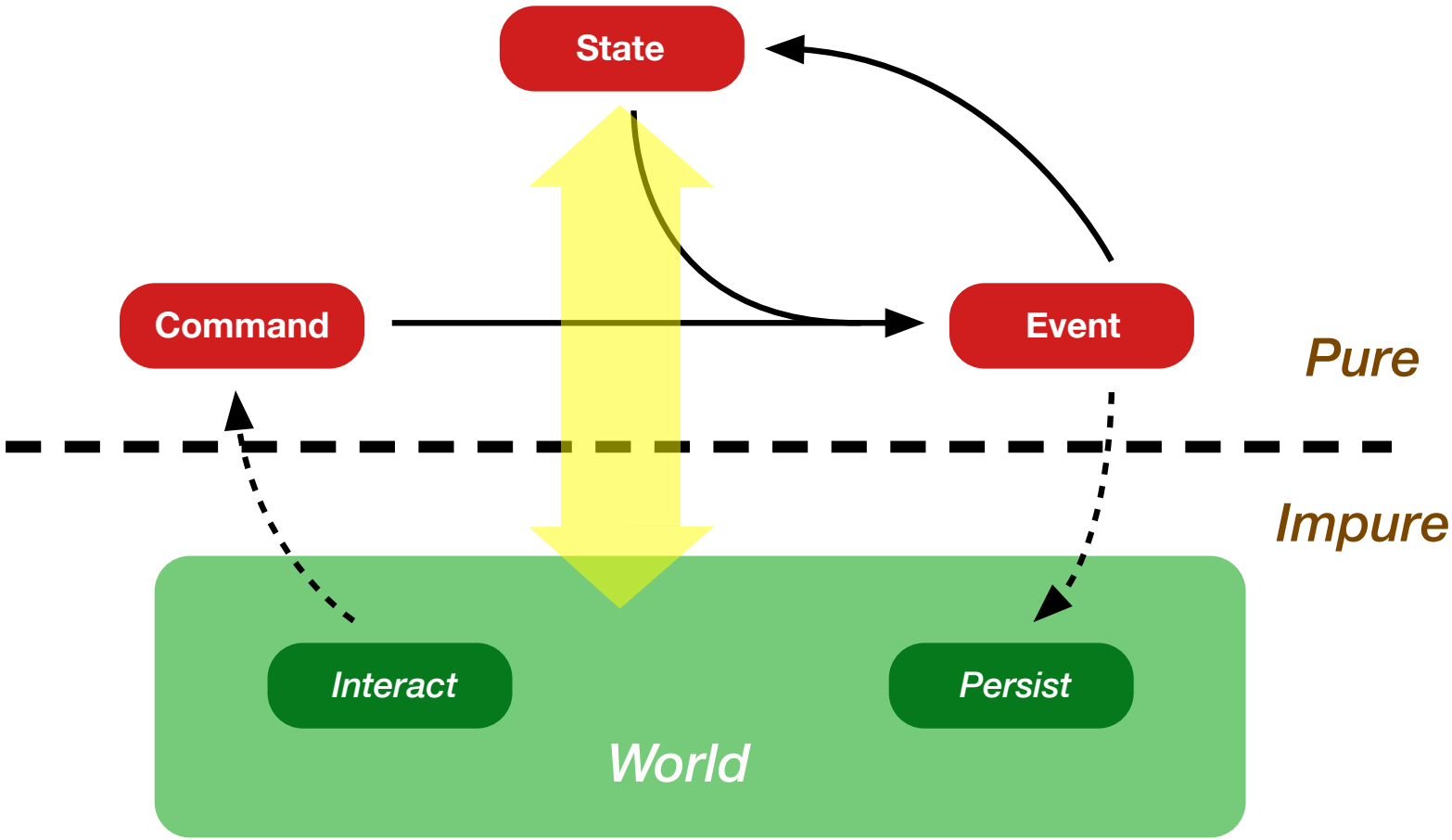
- They are requests to the application
- Events are the system's replies
- Events are persistently stored
- The current state of the system is the result of all events that happened so far

Base Event Loop



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- Model (part of a) *Pets* online shop

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- Model (part of a) *Pets* online shop
- Owner can *Add* some pet or *Remove* it from the store
- "Obvious" business rules: One cannot add the same pet twice or remove a non-existing pet

Inputs: Commands & Queries

```
data Input =
  -- Commands
    Add    { pet :: Pet }
  | Remove { pet :: Pet }
  -- Queries
  | ListPets
```

Outputs: Events & Answers

```
data Output =
  -- Events
    PetAdded   { pet :: Pet }
  | PetRemoved { pet :: Pet }
  -- Answers
  | Pets       { pets :: [ Pet ] }
  | Error      { reason :: PetStoreError }

-- some errors
data PetStoreError = PetAlreadyAdded
                   | PetDoesNotExist
```

Part III

A Formal Model for Event Sourcing

Event Sourcing as a Formal Language

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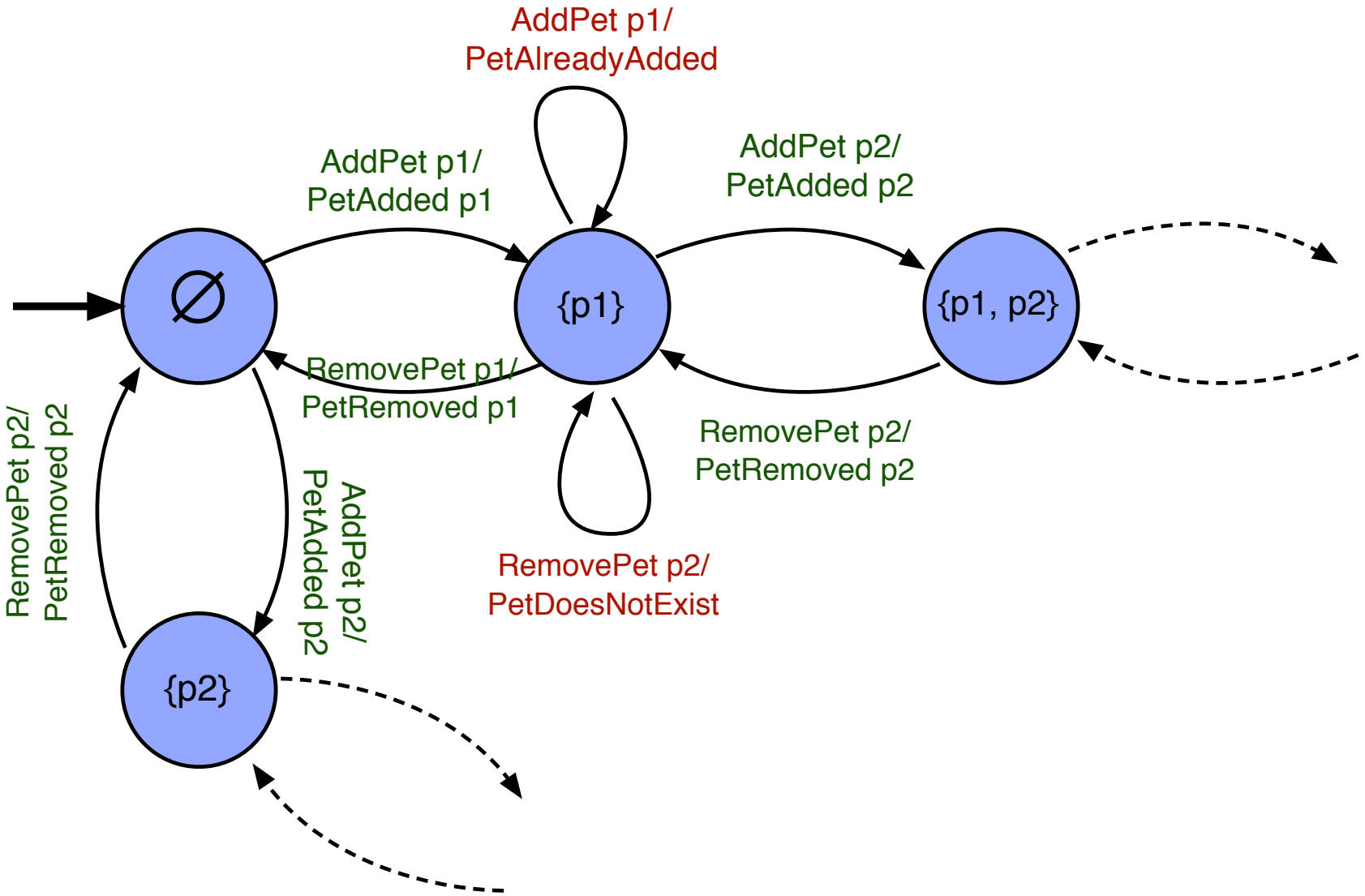
- A *word* is a valid sequence of letters from this alphabet
- The set of all possible words is a *language*
- This means each word of the language corresponds to a *state* of the system
- So the language enumerates all the reachable states of the system

Example: Pet Store States



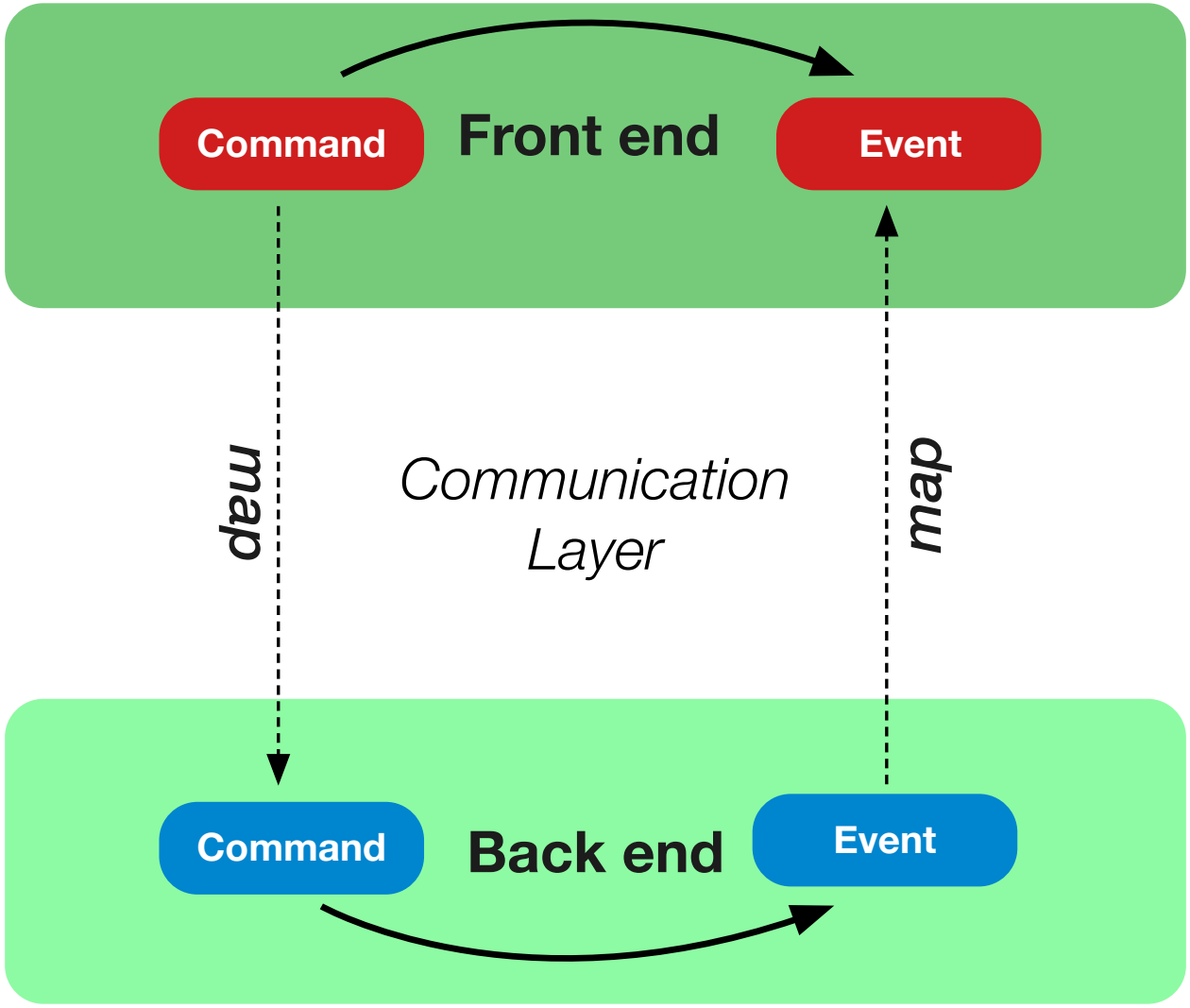
Part IV

Consumer-Driven Contract Testing

Standard Problem for Webapps?

- Testing that frontend and backend play nicely together

The Interaction Problem



Standard Approach: "Super-Naïve"

- Backend designs API
- Backend is developed, tests are written
- Frontend waits until backend is implemented
- Frontend is developed
- Tests for frontend are written
- Interaction is tested via integration tests

Standard Approach: "Super-Naïve"

Problems:

- Frontend development is blocked
- Integration tests are slow
- Full integration testing does not scale

Standard Approach: “Still Quite Naïve”

- Backend designs API
- Frontend writes mocks for backend API
- Backend is developed, tests are written
- Frontend can also be developed immediately
- Interaction tests for frontend use these mocks

Standard Approach: “Still Quite Naïve”

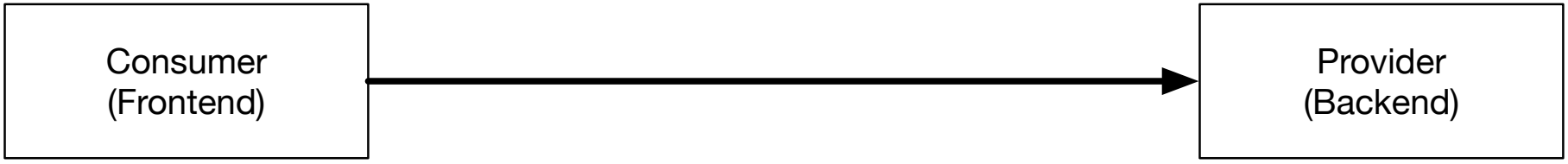
Problems:

- Frontend relies on mocks for backend API
- Do the mocks reflect the backend’s actual behaviour?
- Usually, backend behaviour changes
- Frontend does not notice because mocks still look good

Standard “Industry-Strength” Approach

- Consumer-Driven Contract Testing
- Hand-written contracts

Standard “Industry-Strength” Approach



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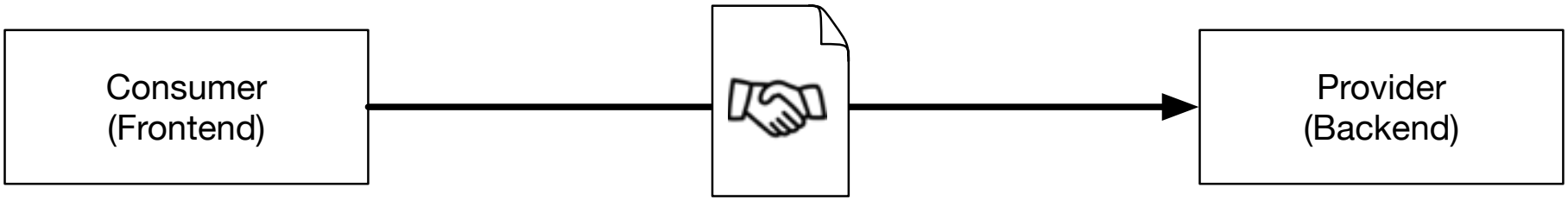

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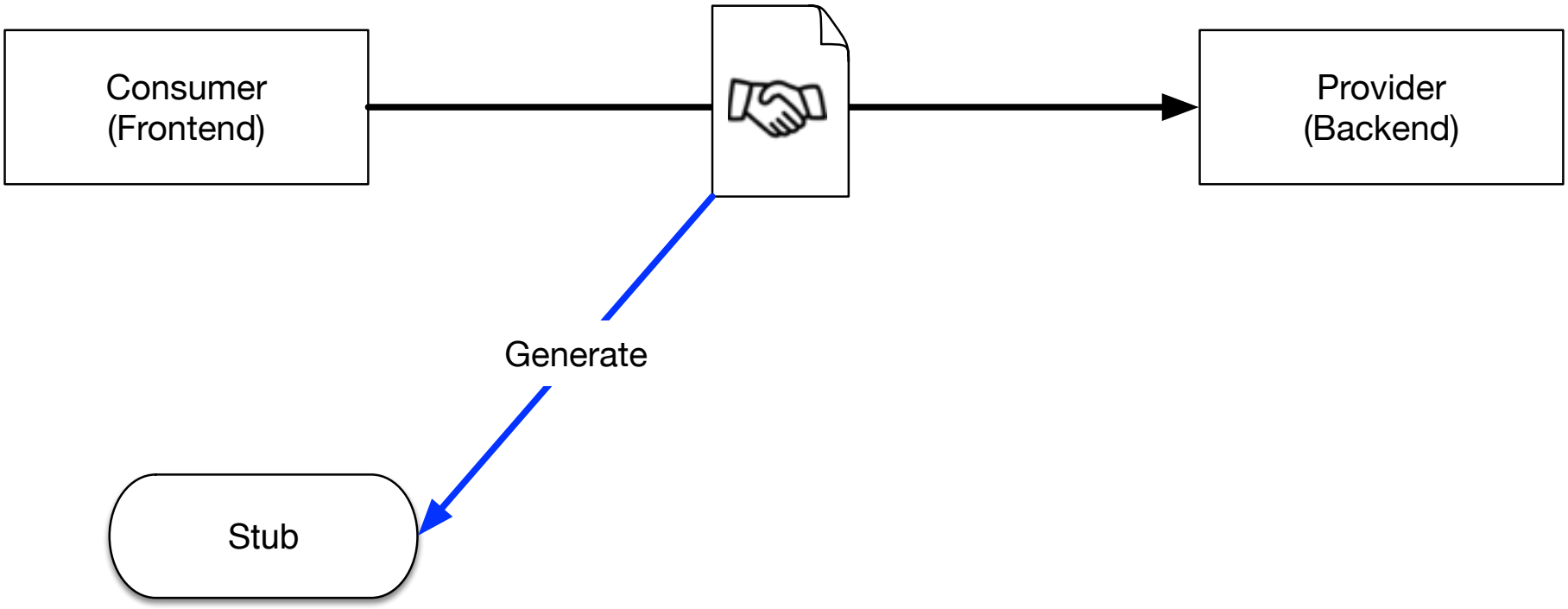

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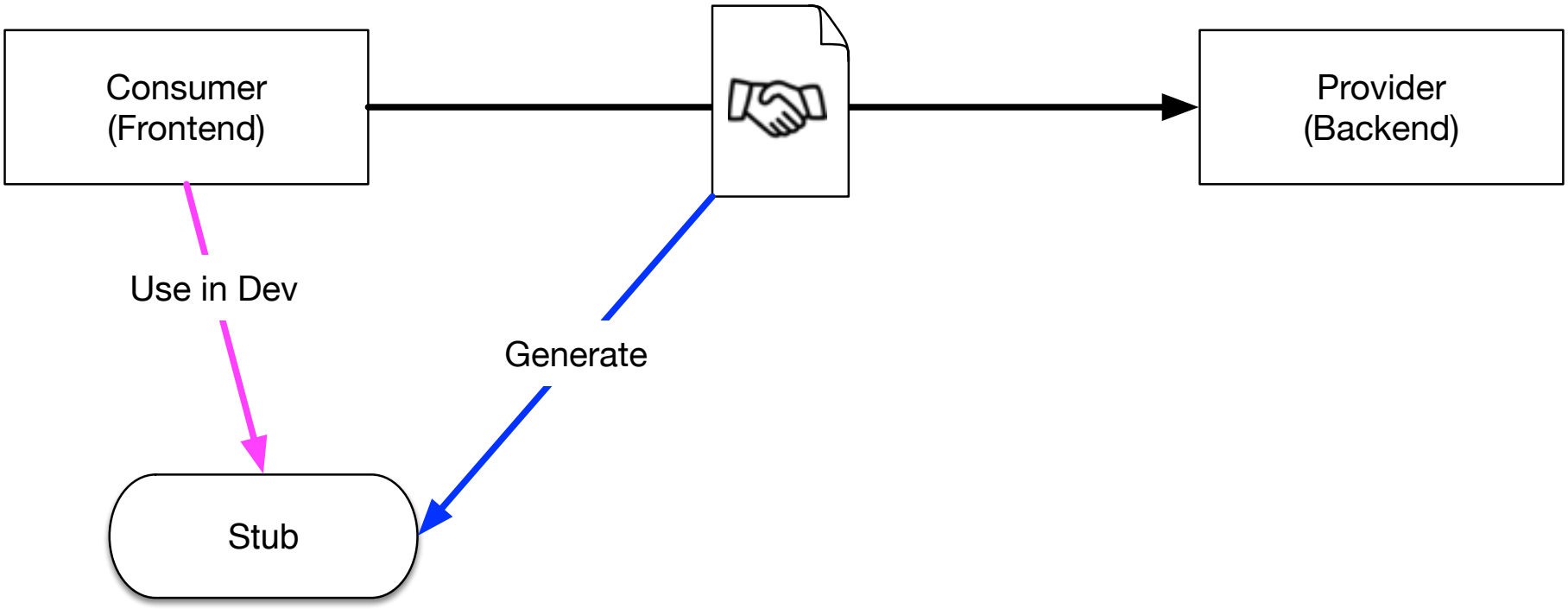

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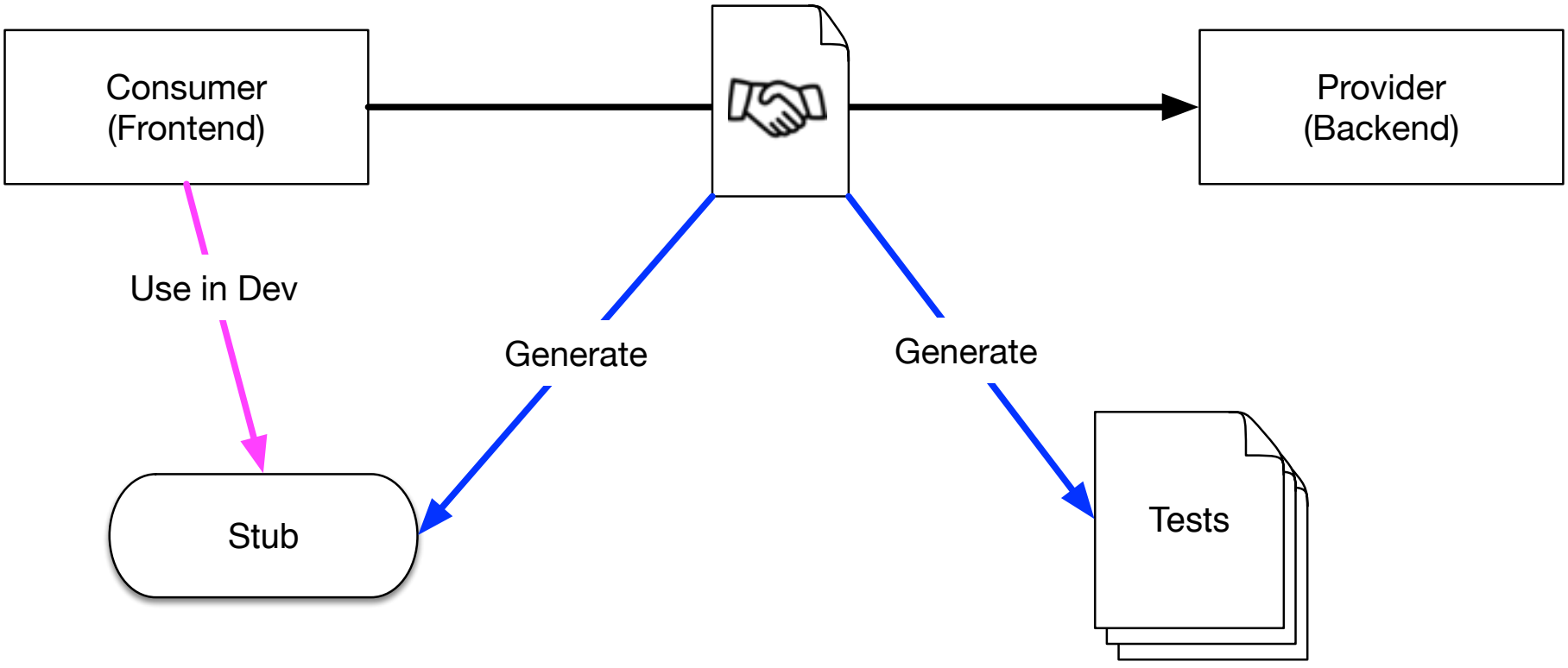

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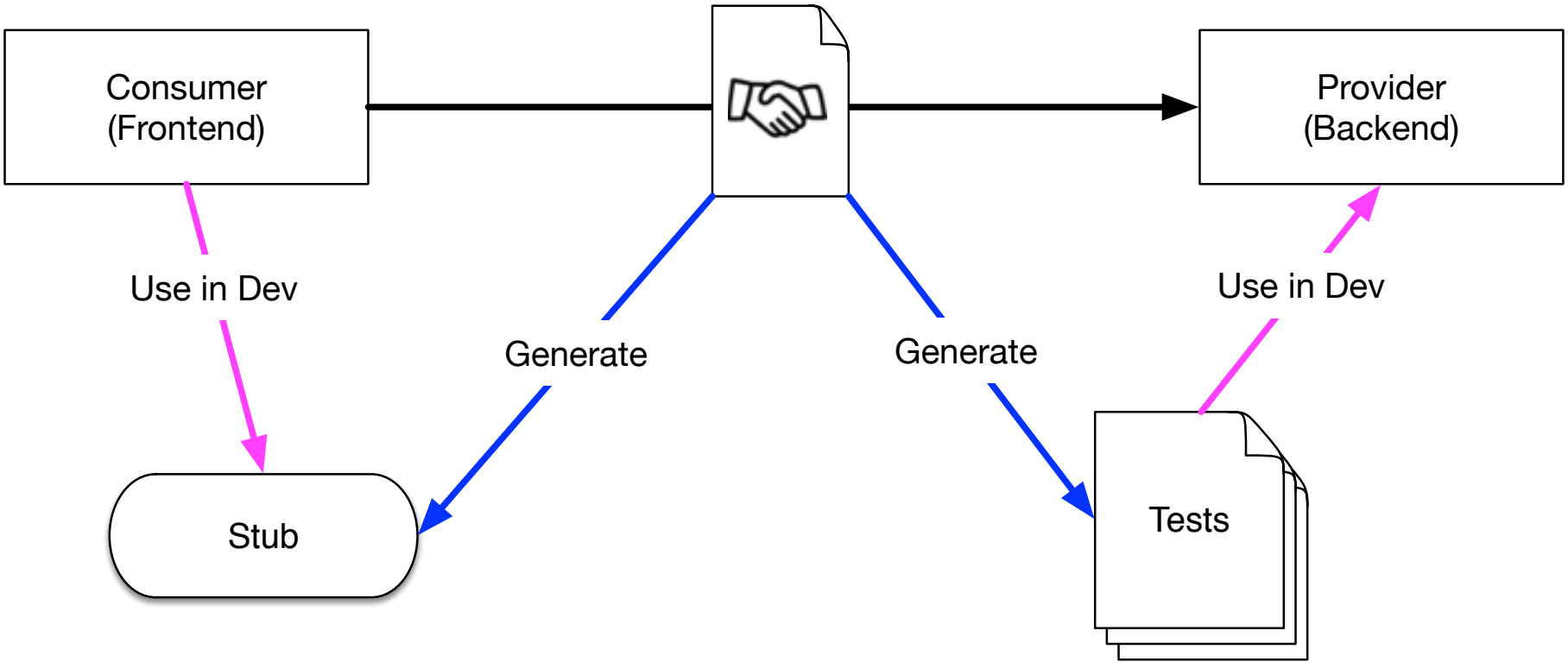

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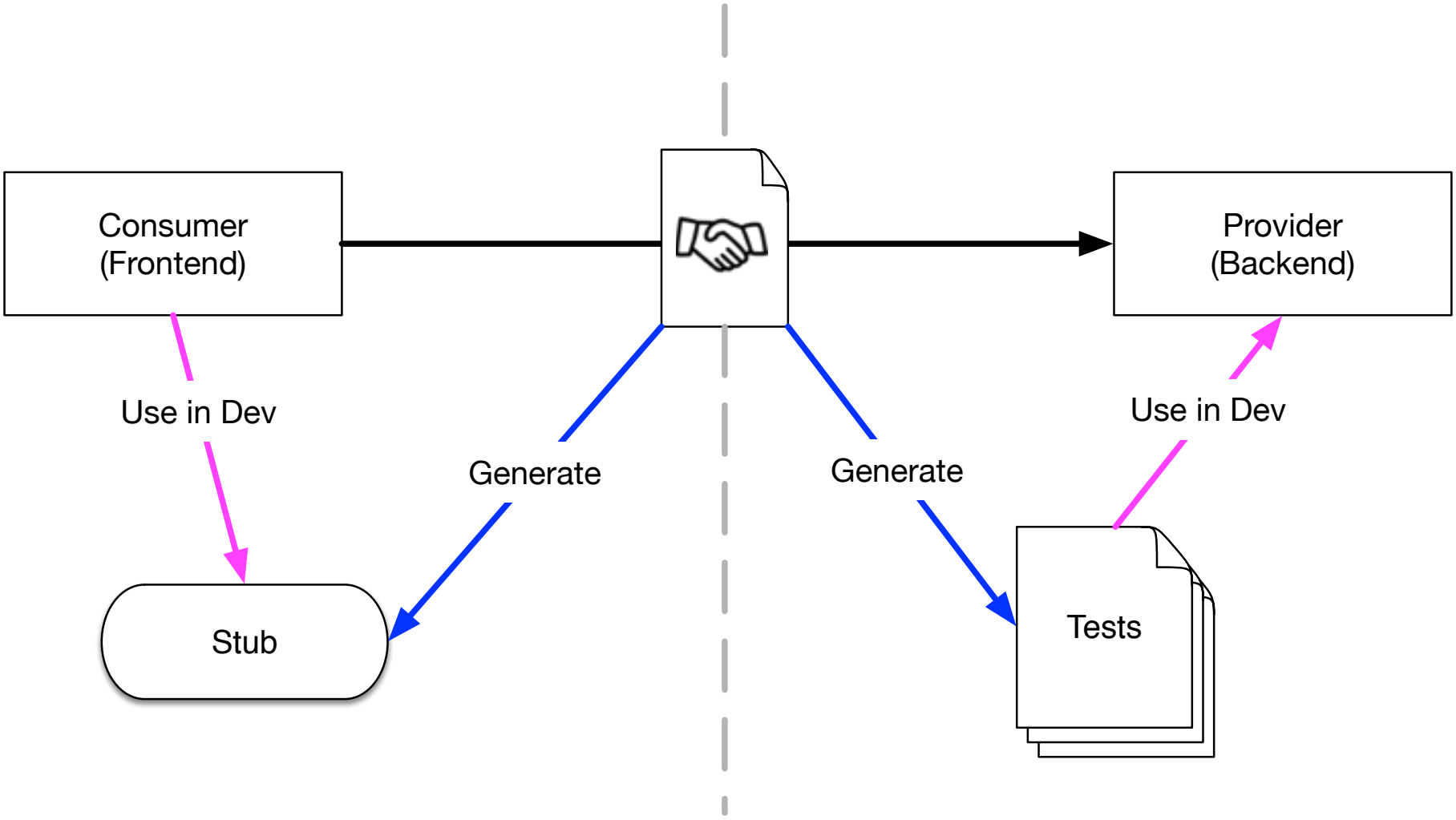

Example: Pet Store Contracts

```
{
  "description": "a request for all pets",
  "providerState": "i have no pets",
  "request": {
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    "path": "/pets",
    "headers": { "Accept": "application/json" }
  },
  "response": {
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- If contracts are too sparse, we miss out
- If contracts are too verbose (or too many), testing takes too long

Part V

Beyond CDCT

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- What if some request only makes sense in a certain state?
- We need more information: Let's use *State Machines*!

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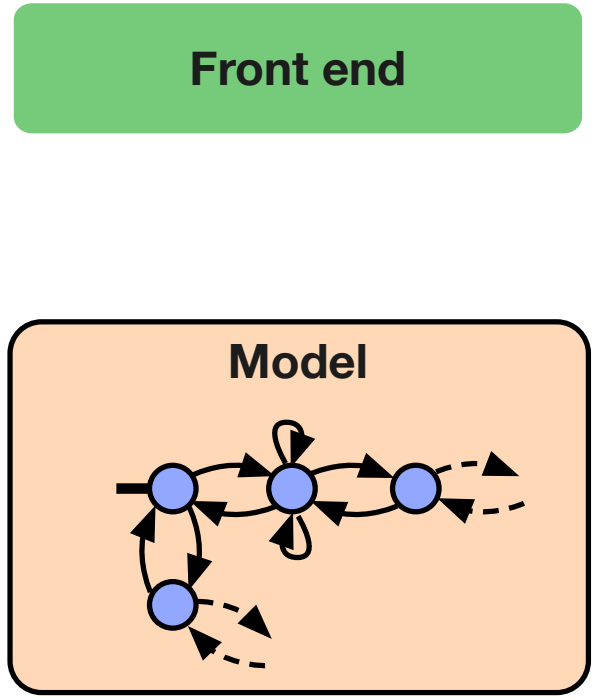
- Describe the core domain interactions as a formally verifiable model
- Generate mocks for the frontend: Use the State Machine as an *Acceptor*
- Generate tests for the backend: Use the State Machine as a *Generator*
- Guarantee: All aspects of the model are covered by tests and mocks

Model-Based Interaction Testing



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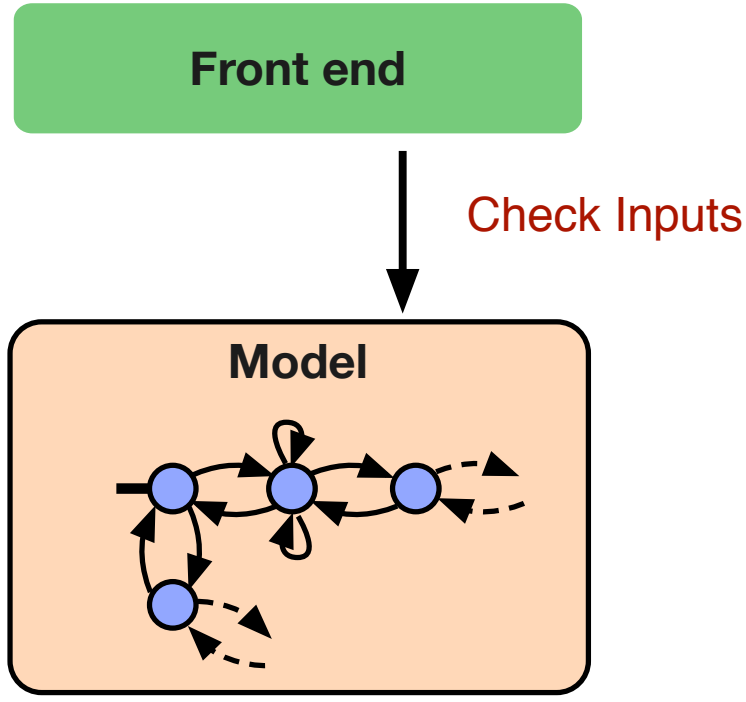

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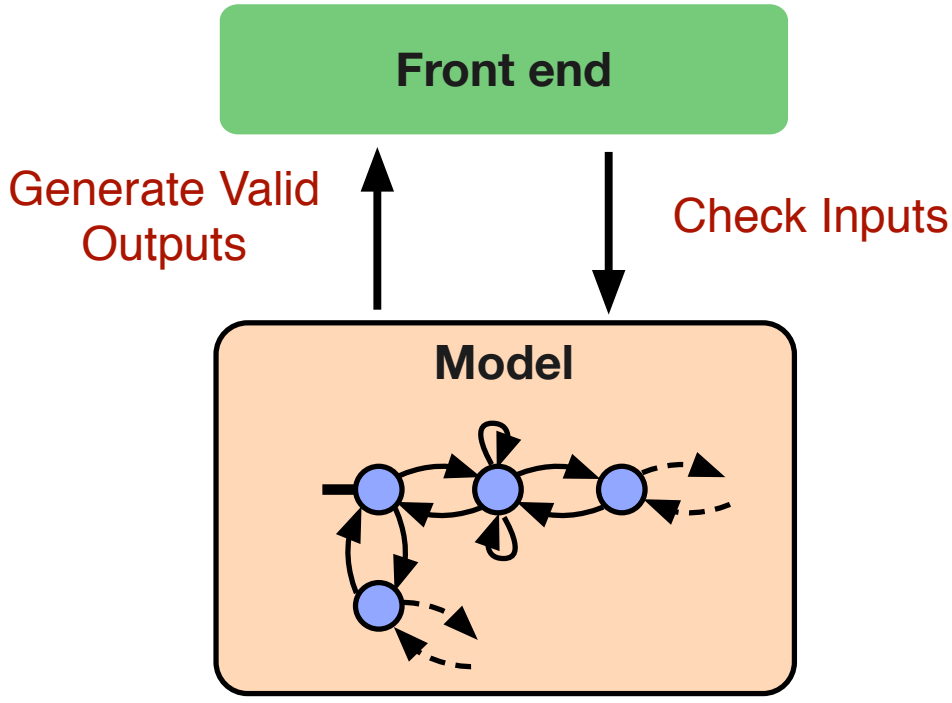

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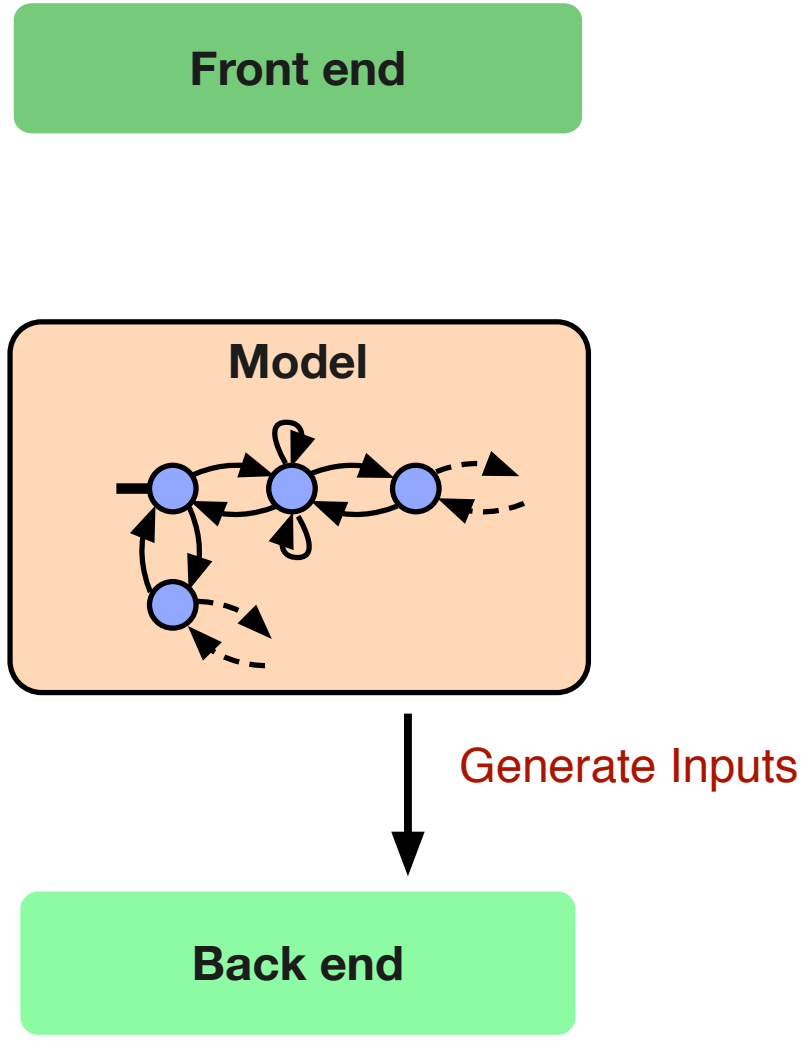

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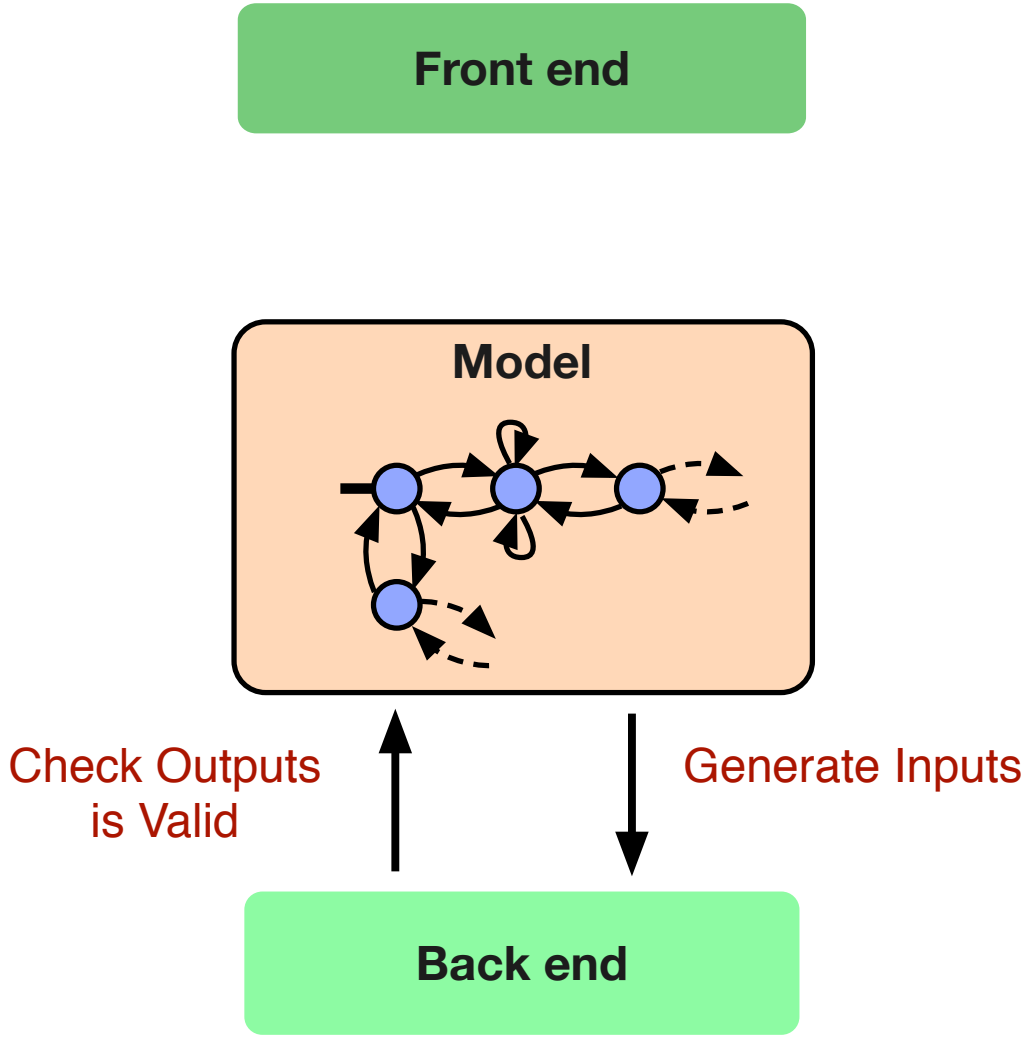

Example: PetStore Model

```
petStore :: Input
         -> PetStore
         -> (Maybe Output, PetStore)

petStore Add{pet}  store@PetStore{storedPets}
  | pet `notElem` storedPets =
      (Just $ PetAdded pet,
       store { storedPets = pet:storedPets } )

  | otherwise                =
      (Just $ Error PetAlreadyAdded, store)
```

Demo

Validating the backend & frontend

Demo

Updating the model

The Code

https://github.com/aleryo/homomorphic-event-sourcing

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- (*v2*) Forgetting to move basket's content back to store when user logs out
- (*v2*) Bad copy/pasting leading to `RemovePet` actually adding it

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- Check reached states in Implementation is identical to the Model's

Part VI

Conclusion

Event Sourcing & Formal Methods

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- Modelling as a *State Machine* over a *Formal Language* seems a promising approach
- Provides foundations to develop independent parts of the system and *validate* their interaction
- It takes time and energy to devise and refine a model!

Takeaways

Plans are worthless,
but planning is everything

Dwight D. Eisenhower

Takeaways

Models are worthless,
but modelling is everything

Nicole & Arnaud

Thank you very much!

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