QuickCheck for EUnit

(using unit tests differently)

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Unit tests

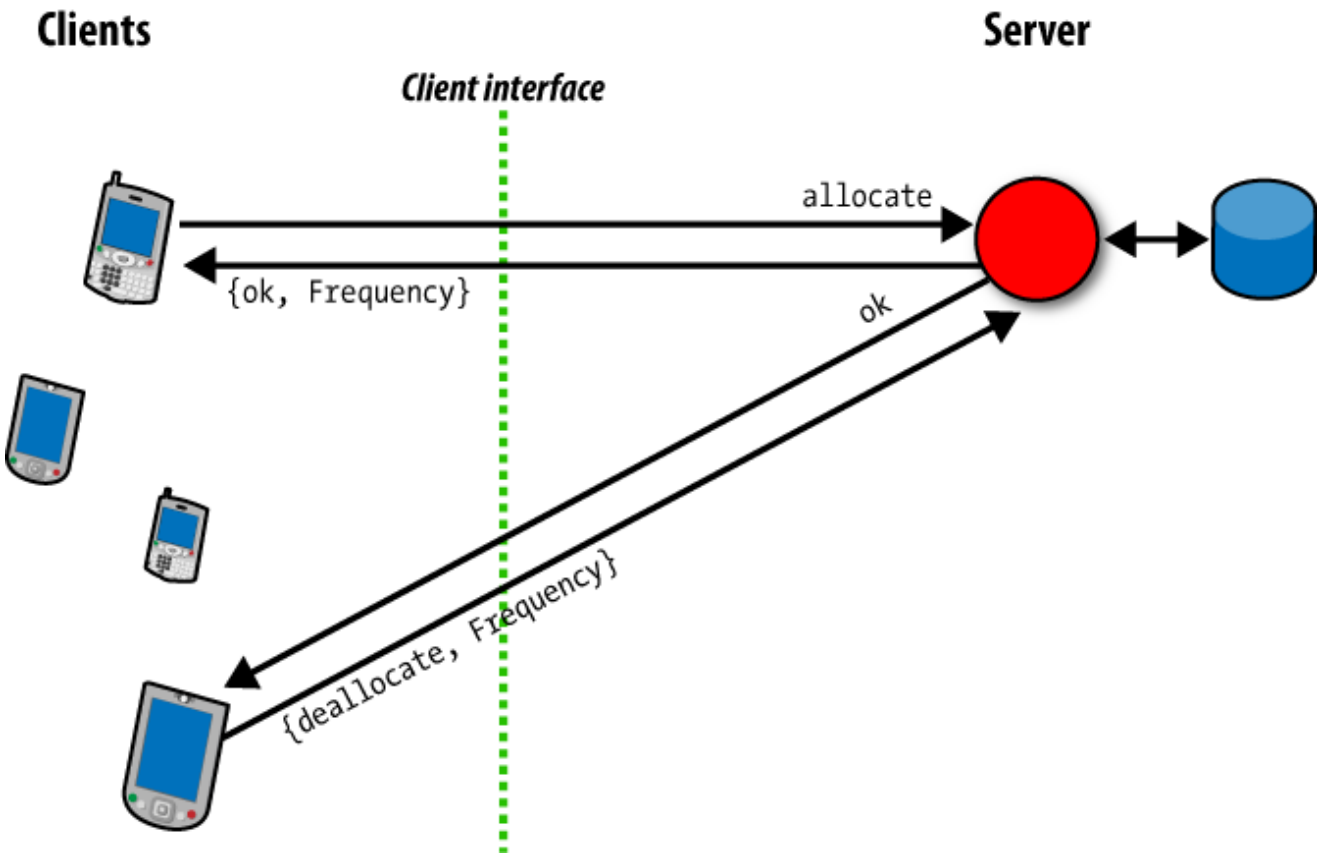
Developers write Unit tests… but never enough

How can we help them?

- Use the existing tests to learn (machine learning)
- Visualize the information in the tests
- Automatically propose new tests

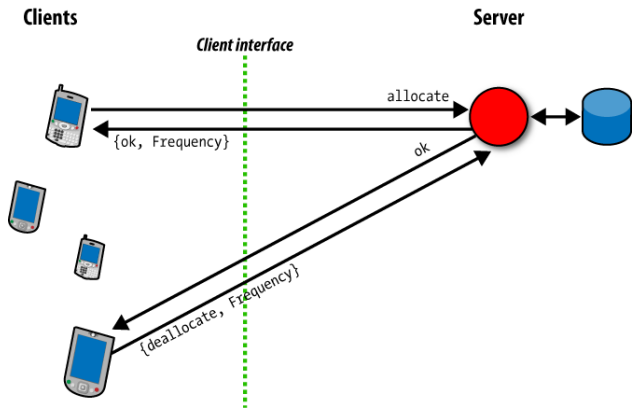
(for details: ACM Sigplan Erlang workshop publications, 2010 + 2011).

Server for mobile frequencies



Server for mobile frequencies

State-based system allows allocation and de-allocation of frequencies from an initial list, once system is started.

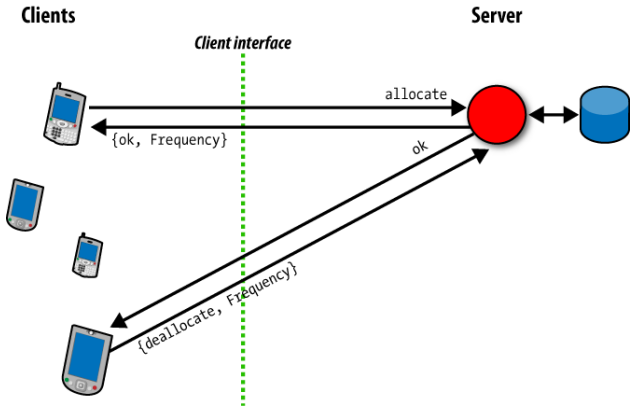



```
-spec start([integer()]) -> true.
-spec stop() -> ok.
-spec allocate() -> {ok,integer()} |
                    {error, no_frequency}.
-spec deallocate(integer()) -> ok.
```

Unit testing the server

EUnit is a unit testing framework for Erlang.

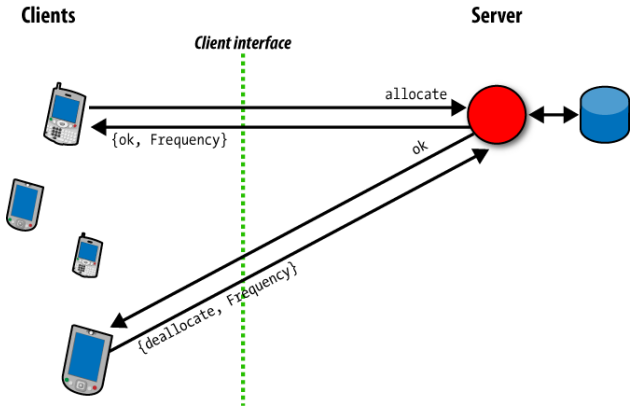
Test start / stop behaviour.




```
startstop_test() ->
    ?assertMatch( … ,start([])),
    ?assertMatch(ok,stop()),
    ?assertMatch( … ,start([1])),
    ?assertMatch(ok,stop()).
```

Which models meet the test?

What is the simplest FSM model which meets this test?

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startstop_test() ->
    ?assertMatch( … ,start([])),
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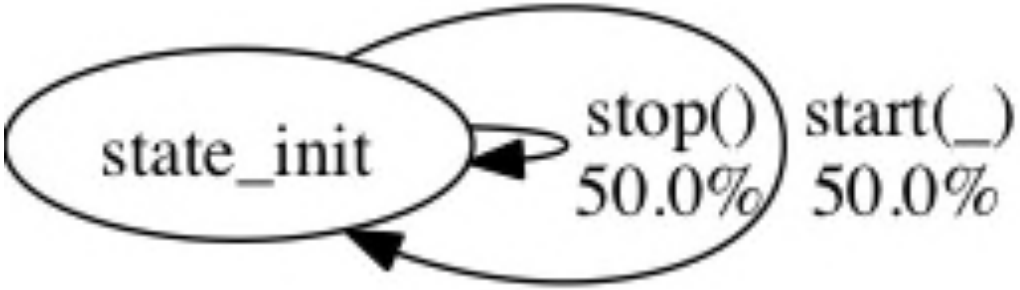
    ?assertMatch(ok,stop()).
```

Models from unit tests

DEMO
- running the test(s)
- visualzing the model

Model 1

Simplest model meeting the test.




```
startstop_test_() ->
   ?assertMatch( … ,start([])),
   ?assertMatch(ok,stop()),
   ?assertMatch( … ,start([1])),
   ?assertMatch(ok,stop())]}.
```

QuickCheck Model

QuickCheck automatically generates test...

from a specification

The state machine is a specification

automatically create textual representation

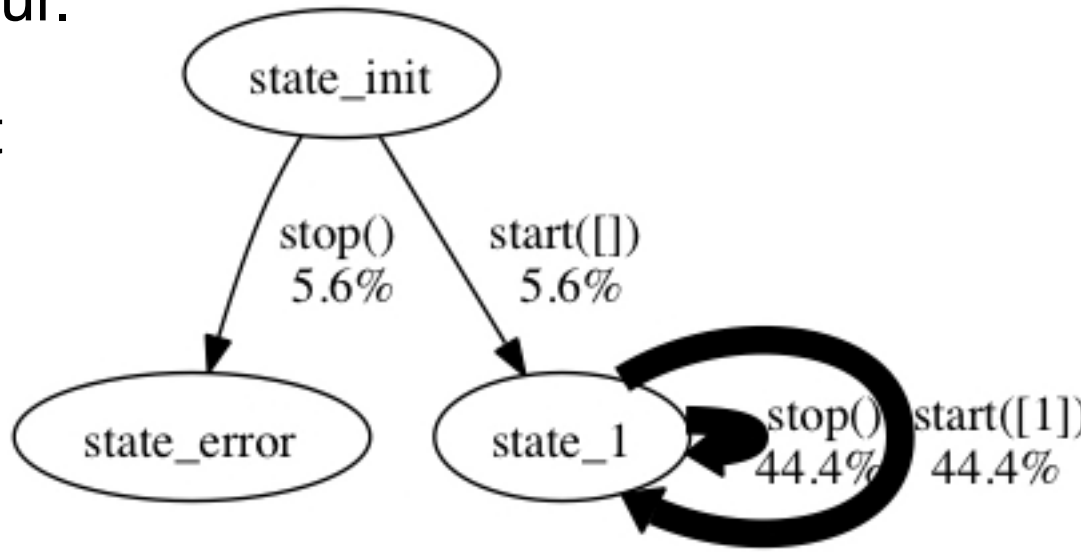
DEMO:

- show the representation
- run QuickCheck

Model 2

Test start / stop behaviour.

Can't stop a server that isn't running.




```
startstop_test() -> …

stopFirst_test() ->
     ?assertError(badarg,frequency:stop([])).
```

Demo

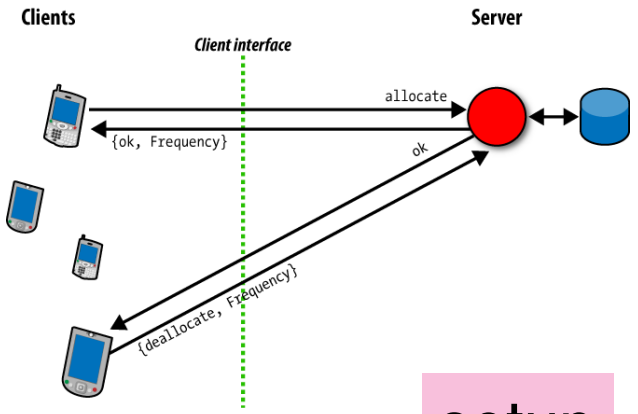
- Run QuickCheck again

Test set 3

Test start / stop behaviour.

Can't stop a server that isn't running.

Can't start a running server.




```
start_twice_test_() ->
      {setup,
       fun() -> start([]) end,
       fun(_) -> stop() end,
       fun() -> ?_assertError(_,start([])) end}.
```

setup

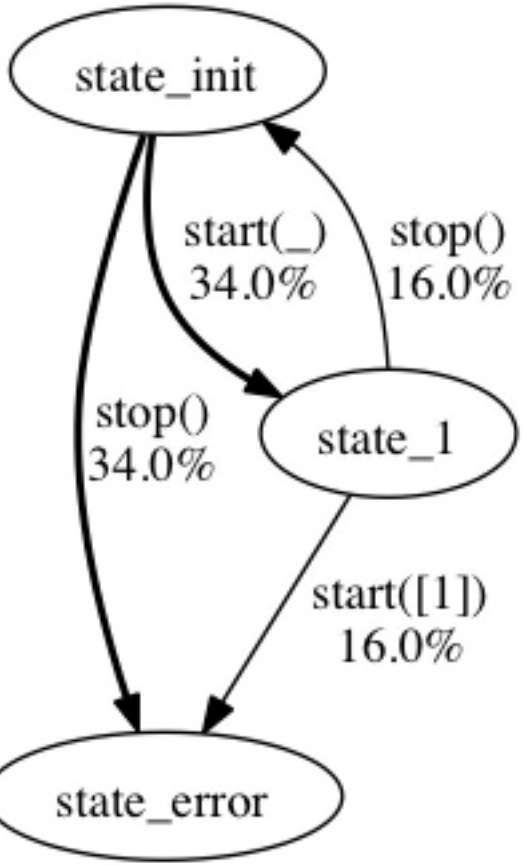
teardown

test

Demo

- Run QuickCheck again

Test set 3



Test start / stop behaviour.

Can't stop a server that isn't running.

Can't start a running server.

```
start_twice_test_() ->
     {setup,
      fun() -> start([]) end,
      fun(_) -> stop() end,
      fun() -> ?assertException(_,_,start([])) end}.
```

Tests for free!

- Build new tests from existing test suites.
- Property-based testing:

  Check the system with **any** path through the finite-state machine for **any** value of the API arguments.

Implementation

- Extract traces from Eunit tests: dynamic or static
- Add assertions to the trace, such that return values are extractable
- Use bluefringe algorithm for learning fsm
- Compute machine on an abstraction, but keep real values
- Introduce generator (oneof) when several arguments give same transition

Conclusion

Writing EUnit tests gets fun!