

QuickCheck

Test Driven Development

Thomas Arts
031 772 6031

Thomas Arts

1978 first computer

...

1987 start studying Mathematics and Computer science

...

1993 start PhD

....

1997 moved to Ericsson in Sweden

....

2002 IT University in Göteborg

....

2006 started Quviq AB

...

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Term Rewriting Systems

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Erlang:
Type System
Theorem prover
Model checker

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Model checker
Testing: QuickCheck

....

2006 started Quviq AB

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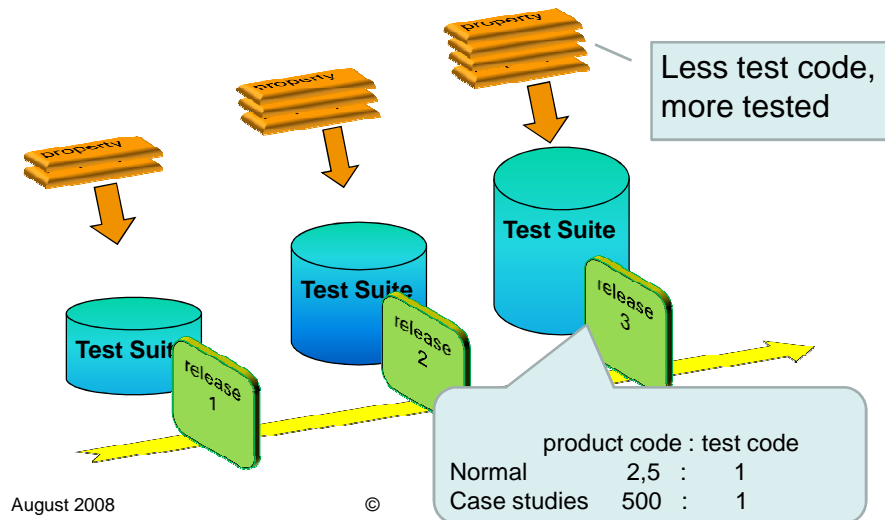
2006 started Quviq AB

...

INNOVATION

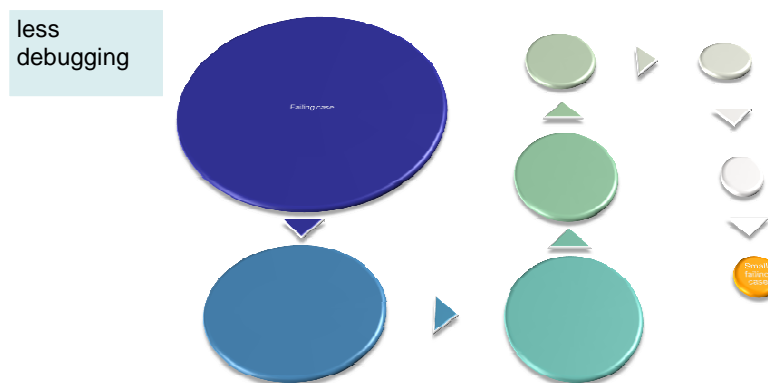
QuickCheck: 3 basic ideas

Write **Properties** instead of Test Cases



QuickCheck: 3 basic ideas

Find smaller failing tests automatically



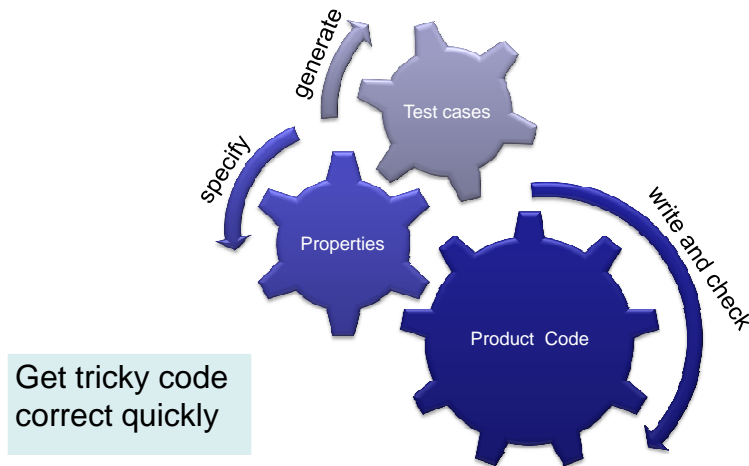
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QuickCheck: 3 basic ideas

Testing and Property specification part of Coding



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Examples

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SMS encode/decode

Encoding SMS messages

GSM standard

Technical Specification **03.38**

Version 5.3.0, July 1996

Packing of 7 bit characters

6.1.2.1.1 (page 13-14)

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SMS encode/decode

6.1.2.1.1 Packing of 7-bit characters

If a character number *a* is noted in the following way:

b7 b6 b5 b4 b3 b2 b1
aa ab ac ad ae af ag

The packing of the 7-bits characters in octets is done by completing the octets with zeros on the left.

For examples, packing:

- one character in one octet:

bits number:
7 6 5 4 3 2 1 0
0 1a 1b 1c 1d 1e 1f 1g

- two characters in two octets:

bits number:
7 6 5 4 3 2 1 0
2g 1a 1b 1c 1d 1e 1f 1g
0 0 2a 2b 2c 2d 2e 2f

- three characters in three octets:

bits number:
7 6 5 4 3 2 1 0
2g 1a 1b 1c 1d 1e 1f 1g
3f 3g 2a 2b 2c 2d 2e 2f
0 0 0 3a 3b 3c 3d 3e

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SMS encode/decode

- seven characters in seven octets:
bits number:
7 6 5 4 3 2 1 0
2g 1a 1b 1c 1d 1e 1f 1g
3f 3g 2a 2b 2c 2d 2e 2f
4e 4f 4g 3a 3b 3c 3d 3e
5d 5e 5f 5g 4a 4b 4c 4d
6c 6d 6e 6f 6g 5a 5b 5c
7b 7c 7d 7e 7f 7g 6a 6b
0 0 0 0 0 0 0 7a

- eight characters in seven octets:
bits number:
7 6 5 4 3 2 1 0
2g 1a 1b 1c 1d 1e 1f 1g
3f 3g 2a 2b 2c 2d 2e 2f
4e 4f 4g 3a 3b 3c 3d 3e
5d 5e 5f 5g 4a 4b 4c 4d
6c 6d 6e 6f 6g 5a 5b 5c
7b 7c 7d 7e 7f 7g 6a 6b
8a 8b 8c 8d 8e 8f 8g 7a

The bit number zero is always transmitted first.
Therefore, in 140 octets, it is possible to pack $(140 \times 8) / 7 = 160$ characters.

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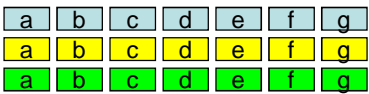
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Example

Interpretation

3 characters containing 7 bits

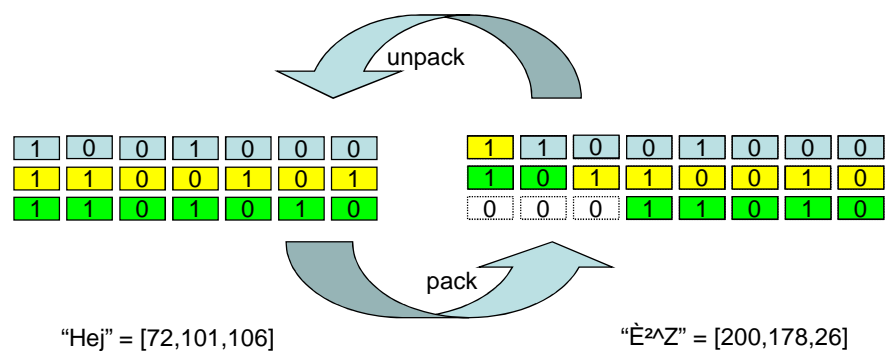
packets 8 bits



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Example

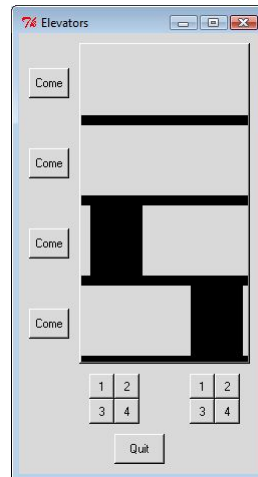


DEMO

Elevator

System with

- state
- asynchronous events
- timing dependencies



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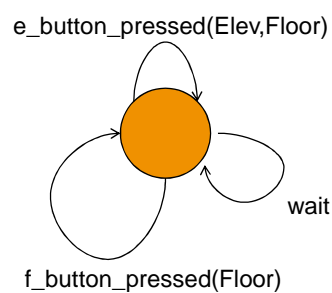
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Elevator

Generate sequences of events

(push floor buttons and buttons in elevators)



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Elevator

Property

```
prop_stop_where_requested() ->
  ?FORALL({Floors,Elevators},{choose(1,6),choose(1,4)},
    prop_stop_where_requested(Floors,Elevators)).

prop_stop_where_requested(Floors,Elevators) ->
  ?FORALL(Cmds,commands(?MODULE,initialstate(Floors,Elevators)),
    begin
      start(Floors,Elevators),
      {H,S,Res} = run_commands(?MODULE,Cmds),
      Events = collectevents(),
      util:stop(),
      Res==ok andalso
        eqc_trace:validate(elevator_trace_eqc,Events,
          elevator_trace_eqc:initial_state(Elevators))
    end).
```

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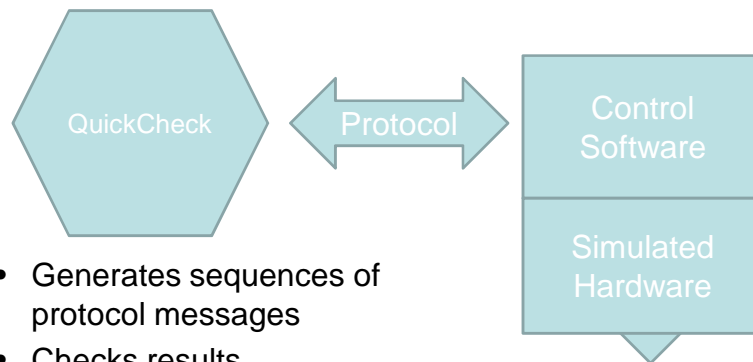
DEMO

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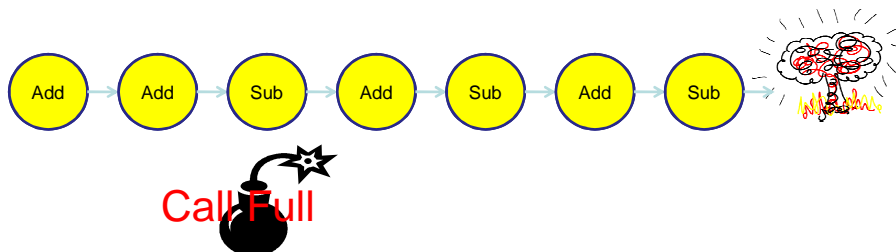
Real life examples



- Generates sequences of protocol messages
- Checks results
- Check message sequences to hardware

Media Proxy

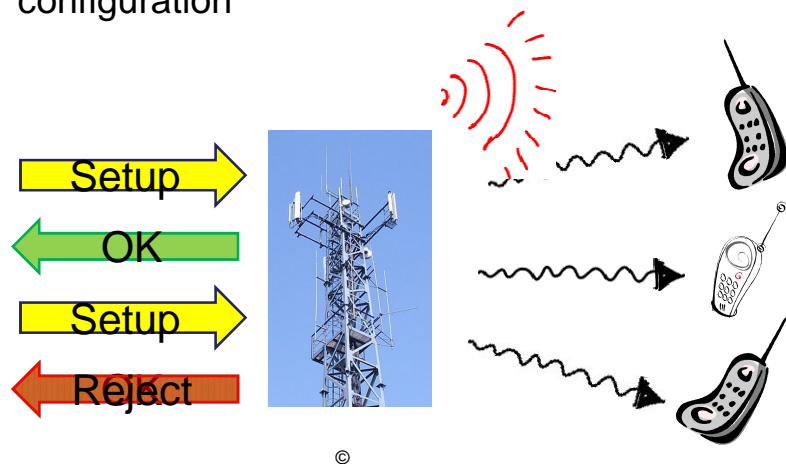
- IMS Telephony: connect calls across a firewall
- Tests: Megaco sequences of Add, Subtract, Modify callers in calls



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3G Radio Base Station

- Testing cell and channel setup/teardown and configuration



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Lessons

- Shrinking reduces time to analyze faults
- Simple properties can find subtle errors
 - Once software goes wrong, it can soon be made to go *very* wrong
- Unrealistic tests can reveal serious errors
- Same property can detect different faults
- Code is *very solid* once QuickCheck tests pass—few errors found later