Antifragile Software and Genetic Improvement

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Geneva

```
try {
   prepare_meringue()
   add_cream()
   make_balls()
   add_chocolate_shavings()
}
catch (MissingChocolateEx e) {
  use_nutella();
}
```

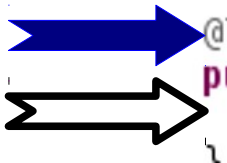
« Anticipated errors »

Expected errors in test suites

Blue and white tests specify anticipated errors
White tests specify resilience

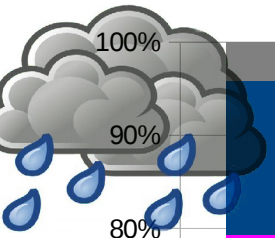
- Test colors
  - Pink
  - Blue
  - White

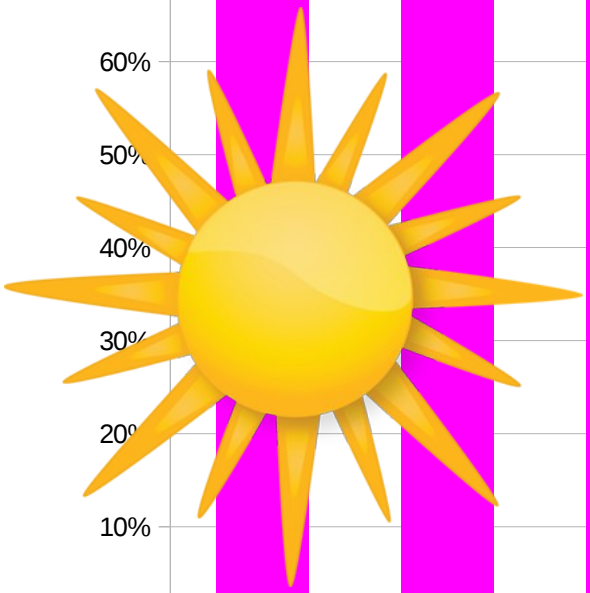
```
public String getProperty(String s) {
    String res = null;
    try{
        res = getPropertyFromFile(s);
    }catch(PropertyNotFoundException pnfe){
        return null;
    }
    return res;
}
```



```
@Test
public void testAbsentProperty(){
    assertNull(getProperty("@$%^ù*µ;?!"));
}
```

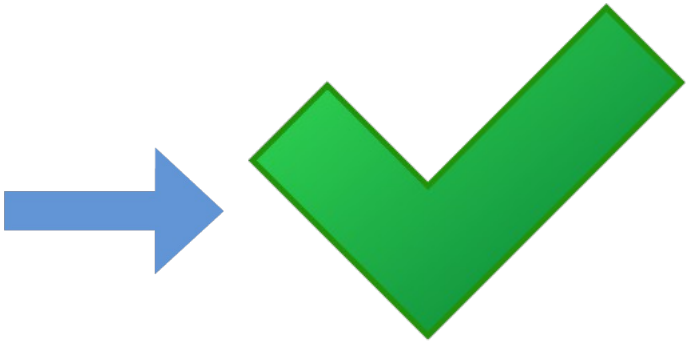
Empirical results

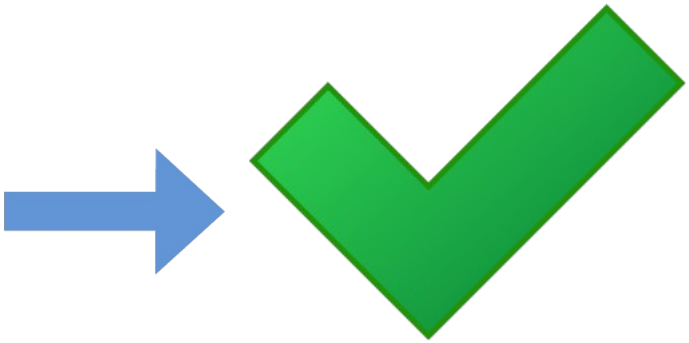




Our intuition: simulating unforeseen errors by perturbing test case execution

Why ?





Short circuit testing: Exception injection in test suites

White test

+ throw new X()

=

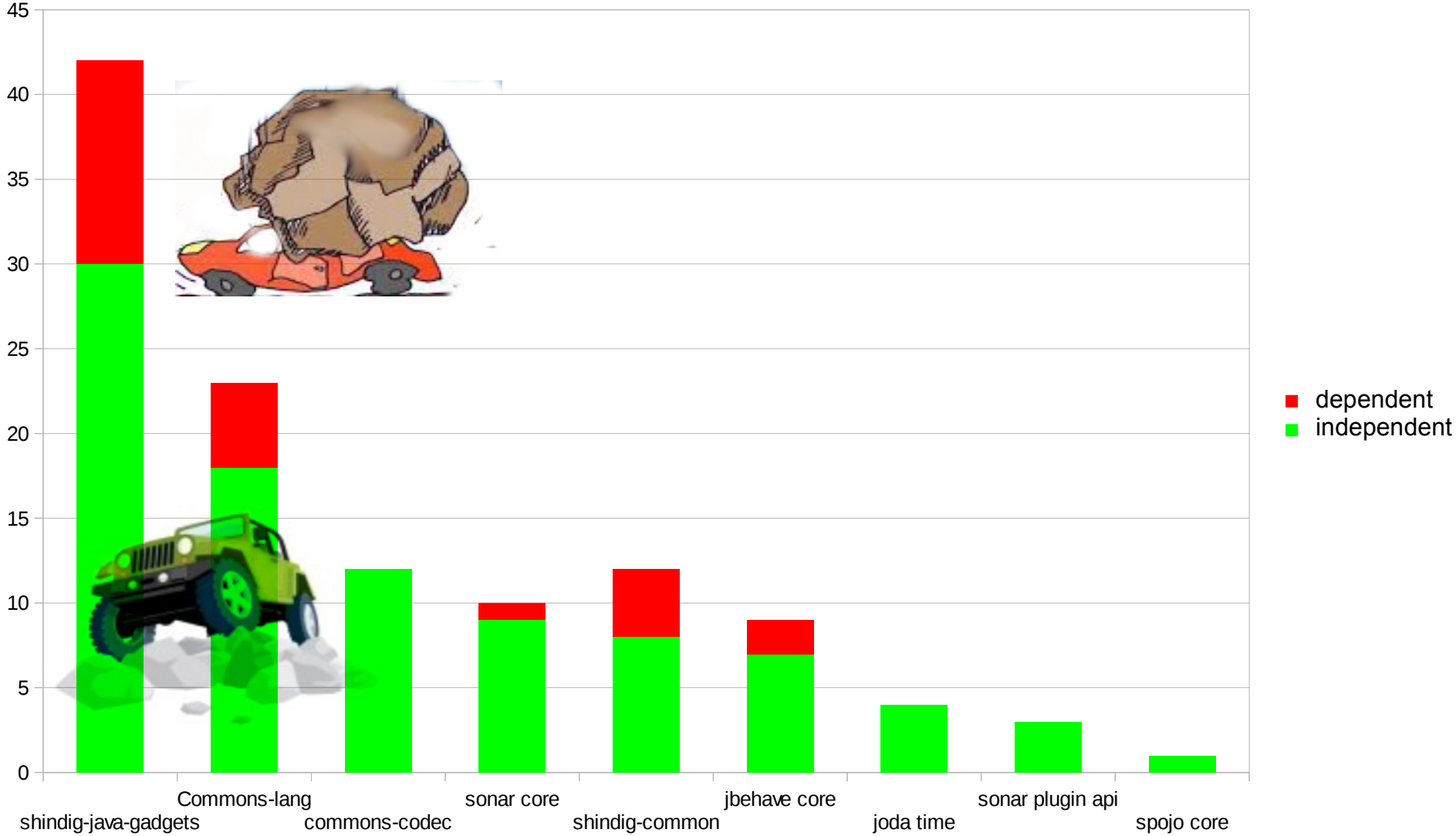
Source-Independence

The try-catch blocks that keep the tests passing under exception injection are capable to handle unanticipated errors.

We call them "source-independent".

Empirical assessment of resilience against unforeseen errors

Empirical Evaluation



Test driver

```
try{
   // instrumentation code
   if(Controller.isCurrentTryCatchWithInjection())
        throw new IOException();
   }

   ... //normal try body
...
} catch (IOException e ) {  // Genetic Improvement
... //normal catch body
}
```

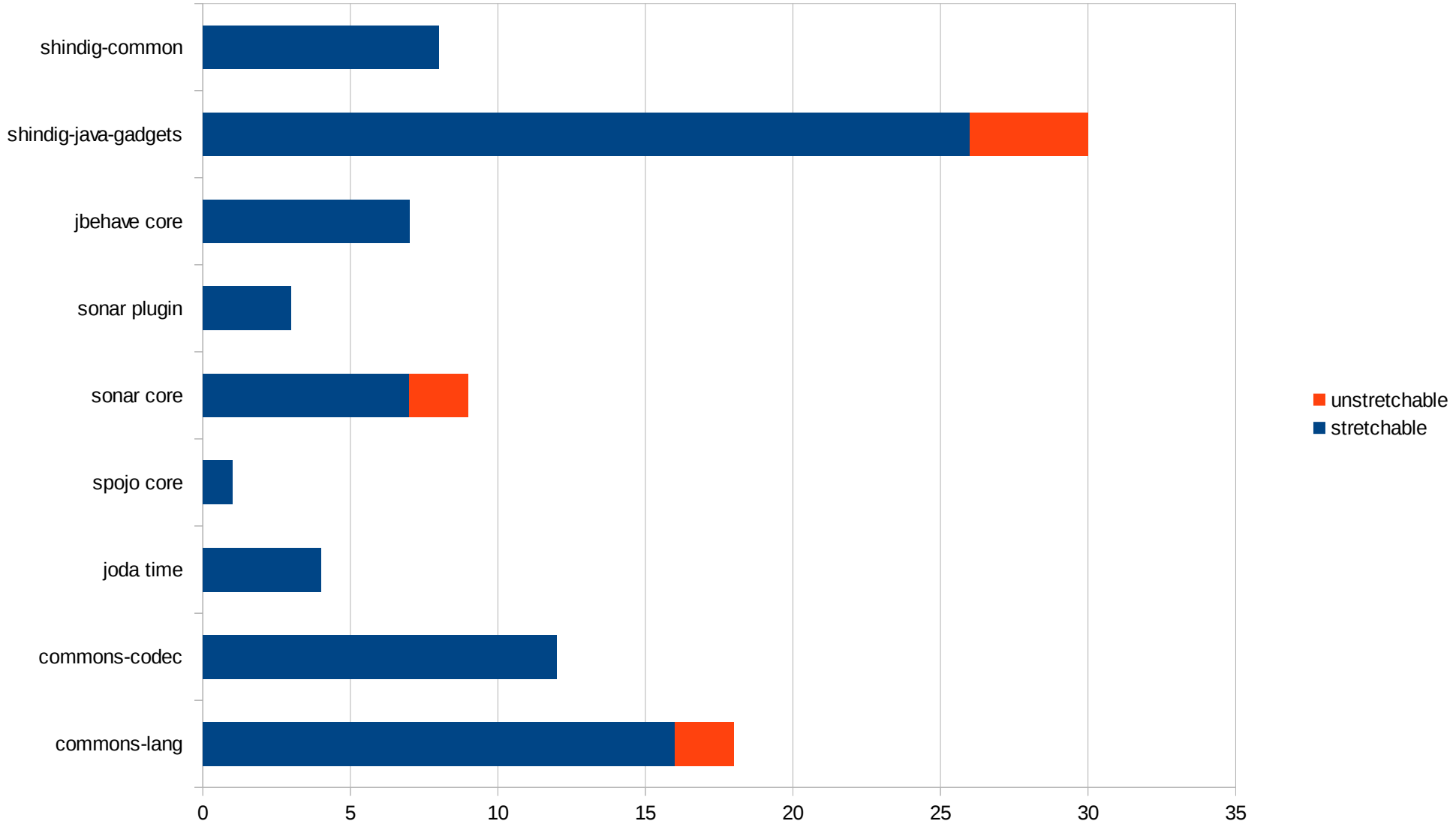
Limit cases

Stack of try-catch at runtime

```
// original
Catch (OufofMemory) {
  Catch (NullPointer) {
    Catch (IOException) {
      throw new NullPointerException()
    }
  }
}
```

```
// stretched
Catch (OufofMemory) {
  Catch (NullPointer) {
    Catch (Exception) {
      }
    }
  }
}
```

Empirical Evaluation



Take-away

"We inject exceptions during test suite execution to assess and improve resilience"

References:

Exception Handling Analysis and Transformation Using Fault Injection: Study of Resilience Against Unanticipated Exceptions (Benoit Cornu, Lionel Seinturier, Martin Monperrus), In Information and Software Technology, Elsevier, 2014.

Definition

A thing is **antifragile** if it becomes

better with stressors, shocks, volatility, noise, mistakes, faults, attacks, failures . . .

(Antifragile, N. N. Taleb, 2013)

A software system is **antifragile** if it becomes

better with failures, attacks, failures, misconfigurations, weird usages . . .

(Principles of Antifragile Software, M. Monperrus, 2014)

Short circuit testing is antifragile:

- Better with exception injection
- Does not try to anticipate or predict

Chaos Monkey

```
// Chaos Engineering
// principlesofchaos.org, 2015

hypothesis ← perturbation, measure
while (true) {
  perturb
  if (measure unacceptable) {
    report failure
  }
}
```

Antifragile software engineering

Core model:

- perturbation model
- perturbation controller
- perturbation cost
- perturbation gain

http://www.monperrus.net/martin/antifragile-software