CloudLens

A scripting language to analyse semi-structured textual data

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IBM T.J. Watson

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IBM Cloud

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 Starting test Wsk SDK should download docker action sdk at 2016-07-14 17:17:13.758\n\nsystem.basic.WskSdkTests > Wsk SDK should download docker action sdk PASSED\n\nsystem.basic.WskSdkT
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ft3WhiskObjectTests STANDARD_OUT\n\n    Starting test Swift 3 Whisk backend API should allow Swift actions to invoke other actions at 2016-07-14 17:17:14.164\n\nsystem.basic.Swift3WhiskOb
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should allow Swift actions to trigger events at 2016-07-14 17:17:22.070\n\nsystem.basic.Swift3WhiskObjectTests > Swift 3 Whisk backend API should allow Swift actions to trigger events STA
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part 2 at 1468516730507\n    Thread 2. Running part 2 at 1468516730568\n    Thread 3. Running part 2 at 1468516730589\n    Thread 1. Running part 2 at 1468516730686\n    Thread 4. Done at
1468516732488\n    Thread 3. Done at 1468516732533\n    Thread 2. Done at 1468516732591\n    Thread 1. Done at 1468516732601\n    Now running unrelated activation at 1468516737601\n    Lo
3.468936033Z stdout: hello A_normal_payload!\n\n\nsystem.basic.CLISequentialTests > ruleDeletedAction PASSED\n\nsystem.basic.CLIActionTests STANDARD_OUT\n    ParallelRunner: 1 threads.\n
ActionTests > parameterBinding PASSED\n\nsystem.basic.CLIActionTests > testPingNotAllowed PASSED\n\nsystem.basic.CLIActionTests > helloWorldDemo PASSED\n\nsystem.basic.CLIActionTests > up
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of nodejs:default to the current default NodeJS runtime at 2016-07-14 17:20:10.033\n\nsystem.basic.WskBasicNodeTests > NodeJS runtime should Map a kind of nodejs:default to the current de
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  Finished test NodeJS runtime should Map a kind of nodejs:default to the current default NodeJS runtime at 2016-07-14 17:20:10.358\n\n    Starting test NodeJS runtime should Ensure that
plicit kind use the current default NodeJS runtime at 2016-07-14 17:20:10.359\n\nsystem.basic.WskBasicNodeTests > NodeJS runtime should Ensure that JS actions created with no explicit kin
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CLI should show cli build version at 2016-07-14 17:20:10.661\n\nsystem.basic.WskBasicTests > Wsk CLI should show cli build version PASSED\n\nsystem.basic.WskBasicTests STANDARD_OUT\n\n
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BasicTests STANDARD_OUT\n\n    Finished test Wsk CLI should show api version at 2016-07-14 17:20:10.692\n\n    Starting test Wsk CLI should show api build version at 2016-07-14 17:20:10.6
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d show api build number at 2016-07-14 17:20:10.913\n\nsystem.basic.WskBasicTests > Wsk CLI should show api build number PASSED\n\nsystem.basic.WskBasicTests STANDARD_OUT\n\n    Finished
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1.857\n\n    Starting test Wsk CLI should reject creating entities with invalid names at 2016-07-14 17:20:11.858\n\nsystem.basic.WskBasicTests > Wsk CLI should reject creating entities wi
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Goal

- Monitoring: report alerting state
- Troubleshooting: find causes of a crash

Challenges

- Lots of semi-structured data
- Format can change over time

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est Wsk SDK should download docker action sdk at 2016-07-14 17:17:14.017\n\n    Starting test Wsk SDK should download iOS sdk at 2016-07-14 17:17:14.018\n\nsystem.basic.WskSdkTests > Wsk
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Goal

- Monitoring: report alerting state
- Troubleshooting: find causes of a crash

Challenges

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A scripting language
Built on top of JavaScript with dedicated log analysis features

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A scripting language
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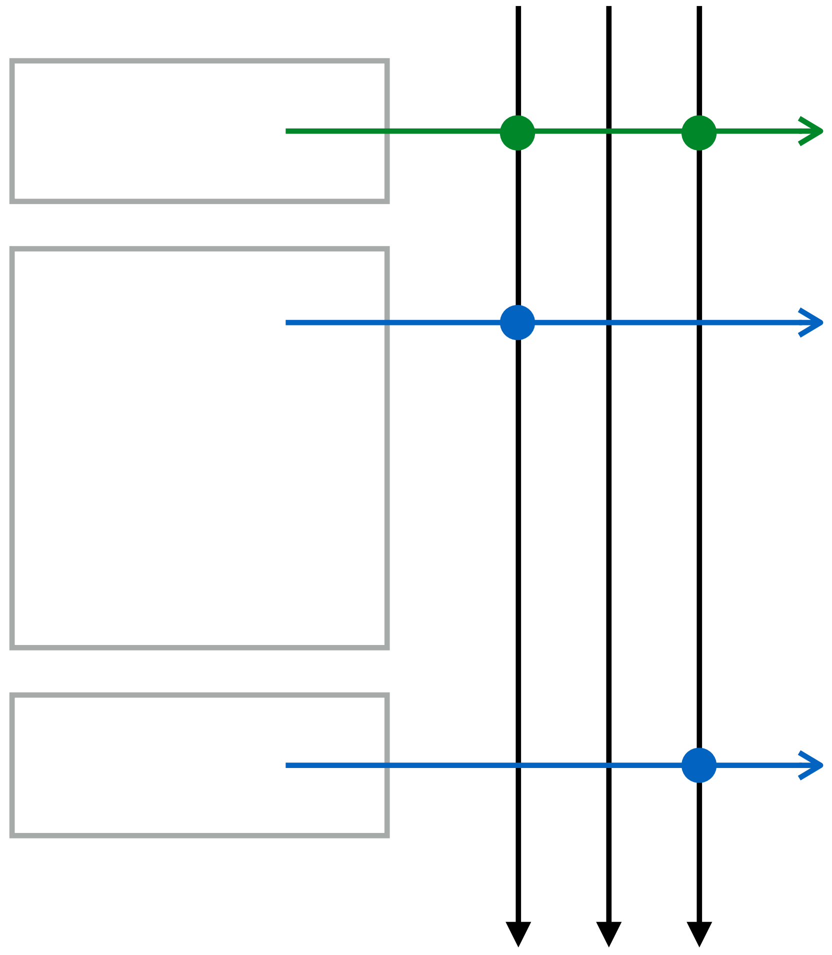
Why not use an existing language?

Features

- Streaming and batch processing
- On-the-fly detection of structure
- Automatic scheduling of Javascript actions
- Stateful computations
- Hierarchical control and data structures
- Rewind analysis

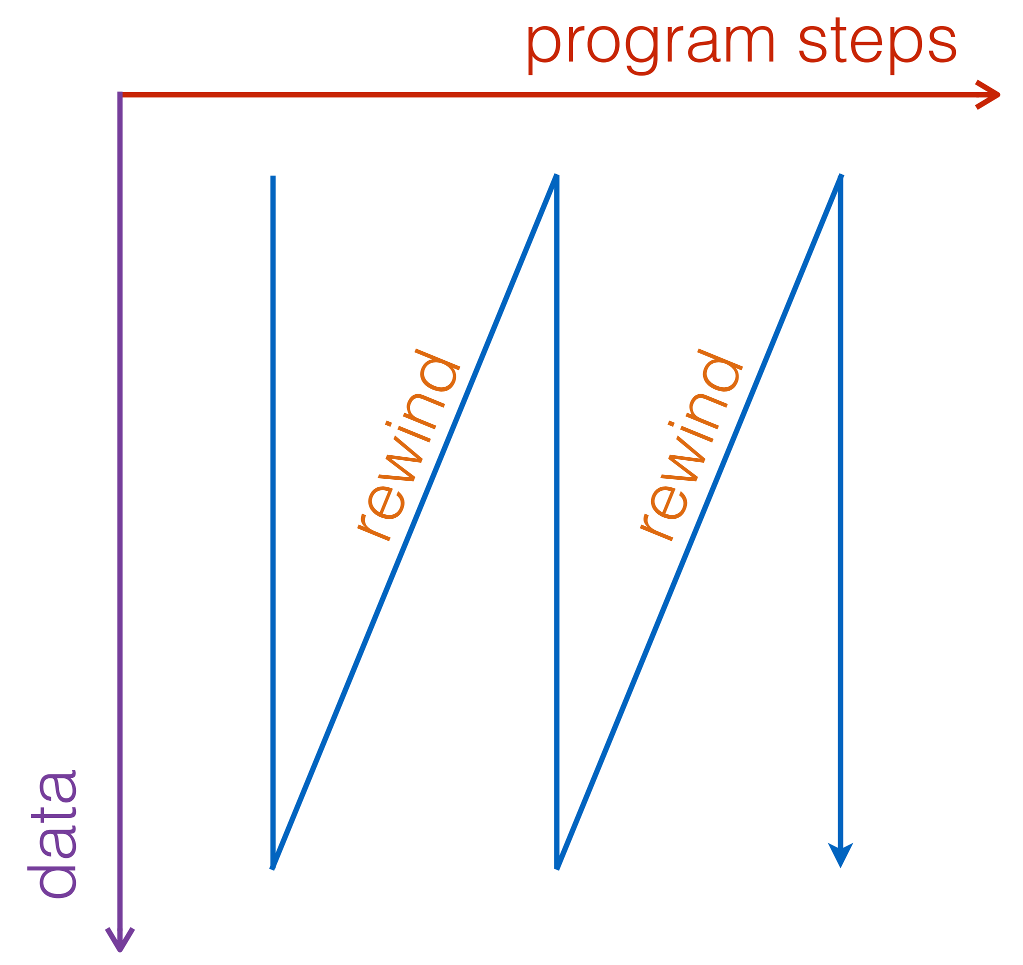
Programming Model

- `source` — *disk, web, databases…*
  - get input data
- `group` — *regex*
  - re-structure data
- `match` — *regex*
  - extract structure
- `stream` — *JavaScript*
  - react when match
- `block`, `restart` — *JavaScript*
  - triggered only once
- Repeat and compose

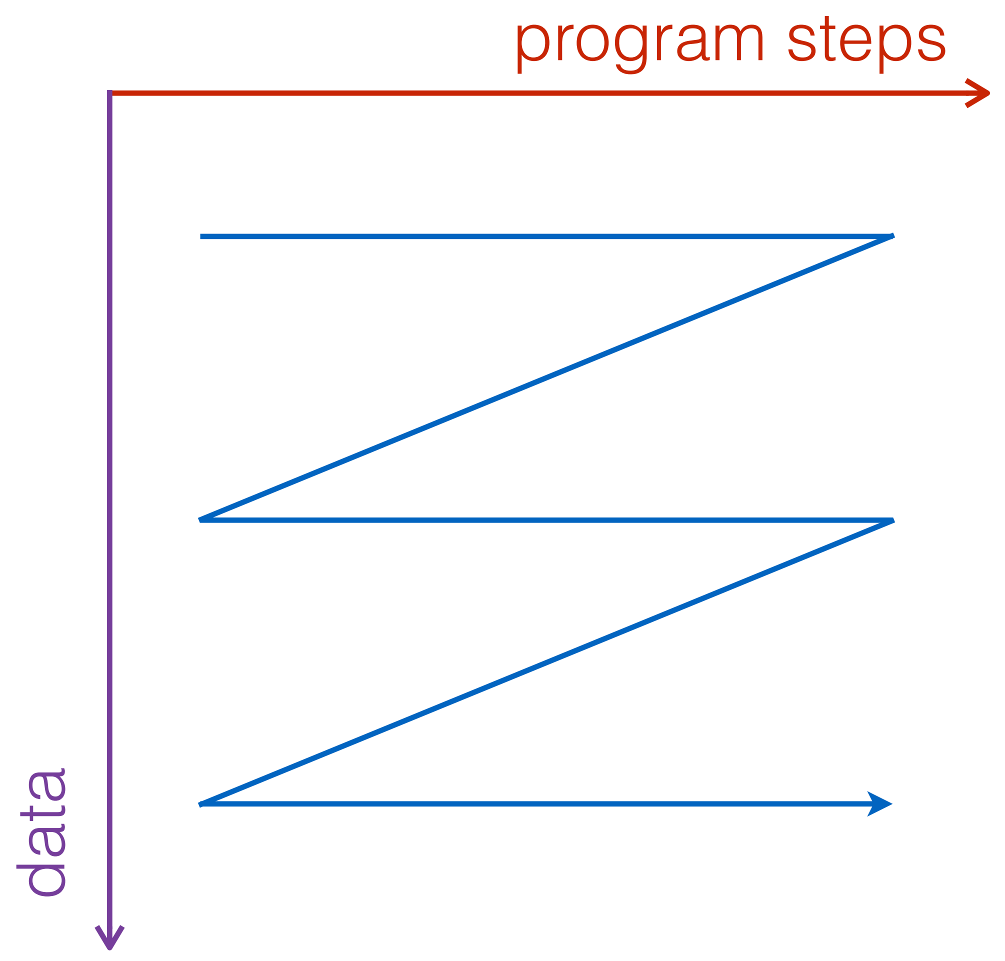


Repeat and Compose

Serial composition



Ordered parallel composition



CloudLens: default parallel composition + explicit `restart`

```
match {
    "(?<failed>.*) > .* FAILED"
}

var failed = 0;

stream (entry) when (entry.failed) {
  print("FAILED:", entry.failed)
  failed++;
}

{ print(failed, "failed tests") }
```

```
match {
    "(?<failed>.*) > .* FAILED"
}

var failed = 0;

stream (entry) {
  print("FAILED:", entry.failed)
  failed++;
}

{ print(failed, "failed tests") }
```

```
var dateFormat = "Date[yyyy-MM-dd' 'HH:mm:ss.SSS]";

match {
    "Starting test (?<desc>.*) at (?<start>.*)# start:" + dateFormat;
    "Finished test (?<desc>.*) at (?<end>.*)# end:" + dateFormat
}

var start;

stream (entry) {
    start = entry.start;
}

stream (entry) {
    entry.dur = entry.end - start;
     if (entry.dur > 12000) {
         print(entry.dur, "\t", entry.desc);
     }
}
```

Hierarchy

```
system.basic.WskBasicTests > Wsk Action CLI should reject delete of action that does not exist FAILED
    org.scalatest.exceptions.TestFailedException: "error: Unable to delete action: Request failure: The requested resource does not exist. (code 914)
    " did not include substring that matched regex error: The requested resource does not exist. \(code \d+\)
        at org.scalatest.MatchersHelper$.newTestFailedException(MatchersHelper.scala:160)
        at org.scalatest.Matchers$ResultOfIncludeWordForString.regex(Matchers.scala:2201)
        at org.scalatest.Matchers$ResultOfIncludeWordForString.regex(Matchers.scala:2173)
        at system.basic.WskBasicTests$$anonfun$25.apply$mcV$sp(WskBasicTests.scala:295)
        at system.basic.WskBasicTests$$anonfun$25.apply(WskBasicTests.scala:295)
        at system.basic.WskBasicTests$$anonfun$25.apply(WskBasicTests.scala:295)
        at org.scalatest.Transformer$$anonfun$apply$1.apply$mcV$sp(Transformer.scala:22)
        at org.scalatest.OutcomeOf$class.outcomeOf(OutcomeOf.scala:85)
        at org.scalatest.OutcomeOf$.outcomeOf(OutcomeOf.scala:104)
        at org.scalatest.Transformer.apply(Transformer.scala:22)
        at org.scalatest.Transformer.apply(Transformer.scala:20)
        at org.scalatest.FlatSpecLike$$anon$1.apply(FlatSpecLike.scala:1647)
        at org.scalatest.Suite$class.withFixture(Suite.scala:1122)
        at org.scalatest.FlatSpec.withFixture(FlatSpec.scala:1683)
        at org.scalatest.FlatSpecLike$class.invokeWithFixture$1(FlatSpecLike.scala:1644)
        at org.scalatest.FlatSpecLike$$anonfun$runTest$1.apply(FlatSpecLike.scala:1656)
        at org.scalatest.FlatSpecLike$$anonfun$runTest$1.apply(FlatSpecLike.scala:1656)
        at org.scalatest.SuperEngine.runTestImpl(Engine.scala:306)
        at org.scalatest.FlatSpecLike$class.runTest(FlatSpecLike.scala:1656)
        at system.basic.WskBasicTests.org$scalatest$BeforeAndAfterEachTestData$$super$runTest(WskBasicTests.scala:50)
        at org.scalatest.BeforeAndAfterEachTestData$class.runTest(BeforeAndAfterEachTestData.scala:193)
        at system.basic.WskBasicTests.runTest(WskBasicTests.scala:50)
```

Hierarchy

```
system.basic.WskBasicTests > Wsk Action CLI should reject delete of action that does not exist FAILED
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        at system.basic.WskBasicTests.runTest(WskBasicTests.scala:50)
```

- `source`
  - stream of JSON object
- `group`
  - combine consecutive entry into arrays
- `lens`
  - define CloudLens functions

```
match {
     "(?<failed>.*) > .* FAILED";
}

group {
    "^[^ ]"
}

lens stackCheck() {
    match {
    "at .*\((?<whisk>Wsk.*)\)";
    }

    stream (line) {
        print('    at', line.whisk)
    }
}

stream (entry) when (entry.failed) {
    print("FAILED", entry.failed);
    stackCheck(entry.group)
}
```

```
lens testStart () {
    match {
        "Starting test (?<start>.*) at (?<date>.*)"
    }

    stream (entry) {
        print("Starting", entry.start)
    }
}

lens testStop() {
    match {
        "Finished test (?<end>.*) at (?<date>.*)"
    }

    stream (entry) {
        print("Finished", entry.end)
    }
}

{ testStart();
  testStop() }
```

```
lens testStart () {
    match {
        "Starting test (?<start>.*) at (?<date>.*)"
    }

    stream (entry) {
        print("Starting", entry.start)
    }
}

lens testStop() {
    match {
        "Finished test (?<end>.*) at (?<date>.*)"
    }

    stream (entry) {
        print("Finished", entry.end)
    }
}

run testStart()
run testStop()
```

Formal Semantics

Stage

- `restart` and `block`, or
- Pipeline
  - succession of `group`, `match`, and `stream`

Program execution	$E \vdash p \Longrightarrow E'$
Stage elaboration	$E, p \vdash p' \Downarrow E'$
Stage execution	$E \vdash p \longrightarrow E'$

$$\frac{E, [] \vdash p \Downarrow E'}{E \vdash p \Longrightarrow E'} \qquad \frac{E, p :: \texttt{match}\ \{\ \textit{patterns}\ \} \vdash p' \Downarrow E'}{E, p \vdash \texttt{match}\ \{\ \textit{patterns}\ \}\ \ p' \Downarrow E'}$$

$$\frac{E \vdash p \longrightarrow E'}{E, p \vdash [] \Downarrow E'} \qquad \frac{E \vdash p \longrightarrow E' \quad E' \vdash p' \Longrightarrow E''}{E, p \vdash \texttt{restart}\ \ p' \Downarrow E''}$$

Implementation

Java 8 and Javascript

- Popular programming language
- Nashorn runtime in the JVM
- Fast prototyping

Two execution modes

- *Monitoring:* on-the fly processing
- *Troubleshooting:* table processing

Closely follows the semantics

1) Build stages (block and pipelines)
2) Execute stages

Handle environment with JavaScript closures

Execution

Each section returns a list of continuations

```
lens f(x) {
    stream {a1(x)}
    {a2(x)}
    stream {a3(x)}
}

stream {p1}
run f(42)
stream {p2}
```

Execution

Each section returns a list of continuations

```
lens f(x) {
    stream {a1(x)}
    {a2(x)}
    stream {a3(x)}
}

stream {p1}
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```

```
script
```

Execution

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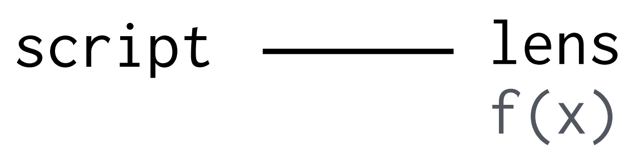

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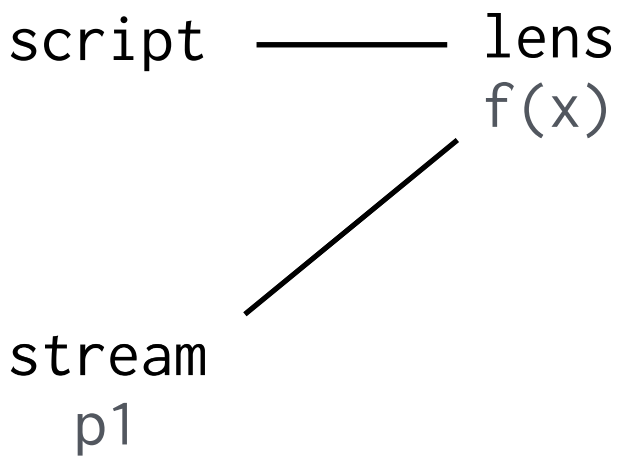

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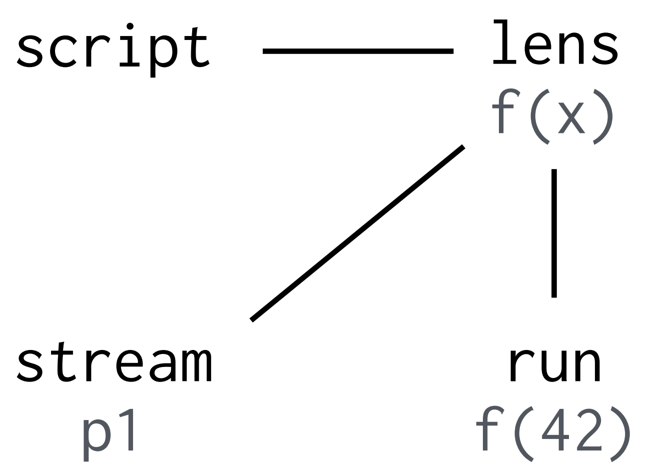

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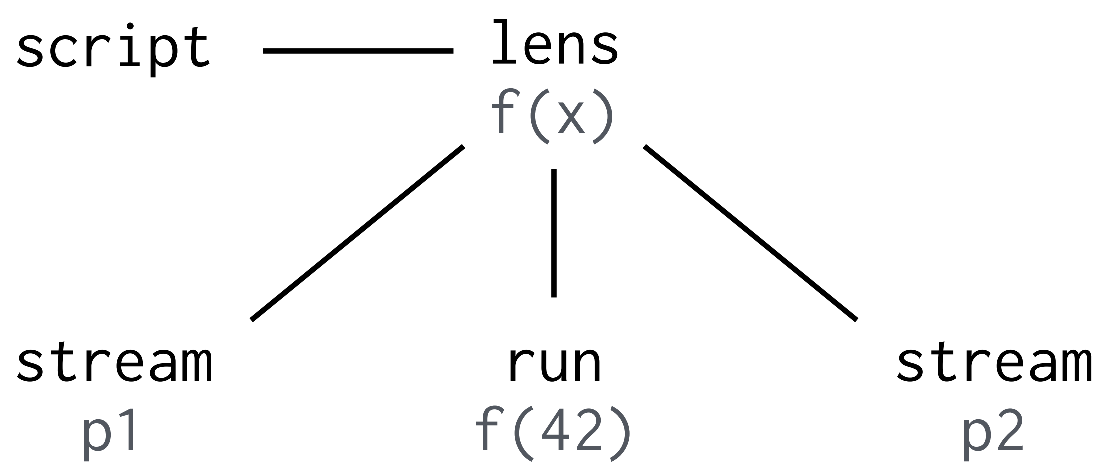

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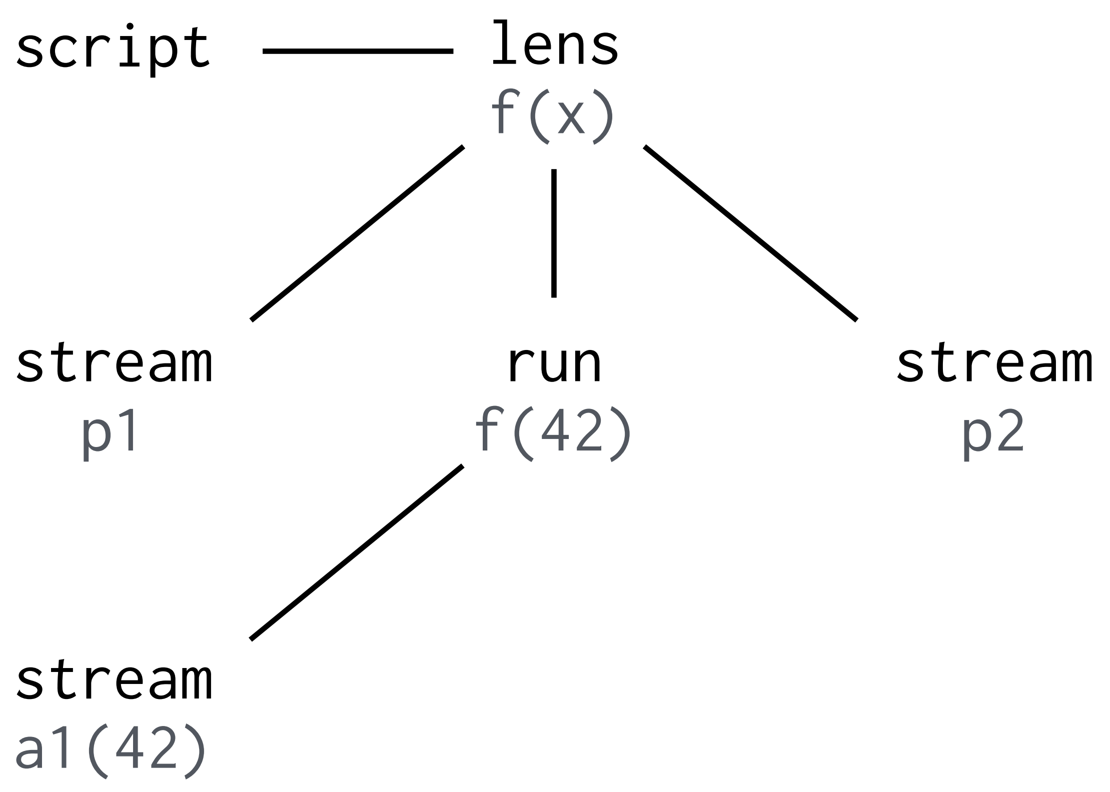

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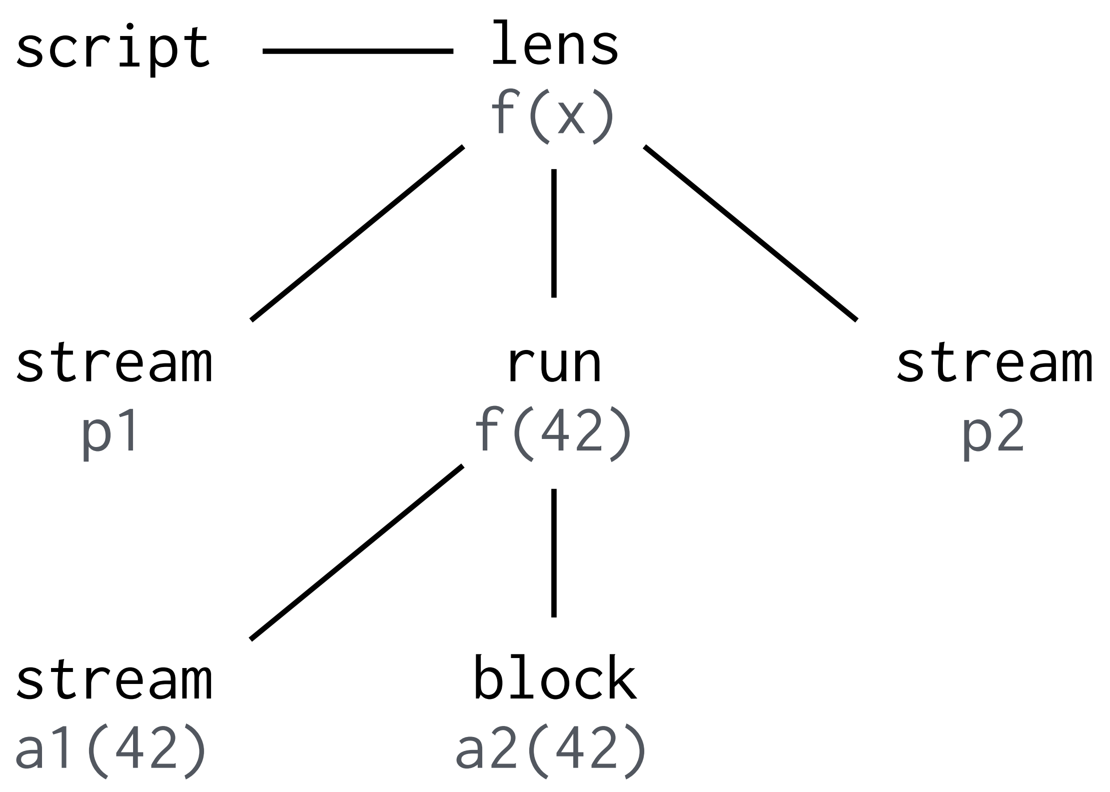

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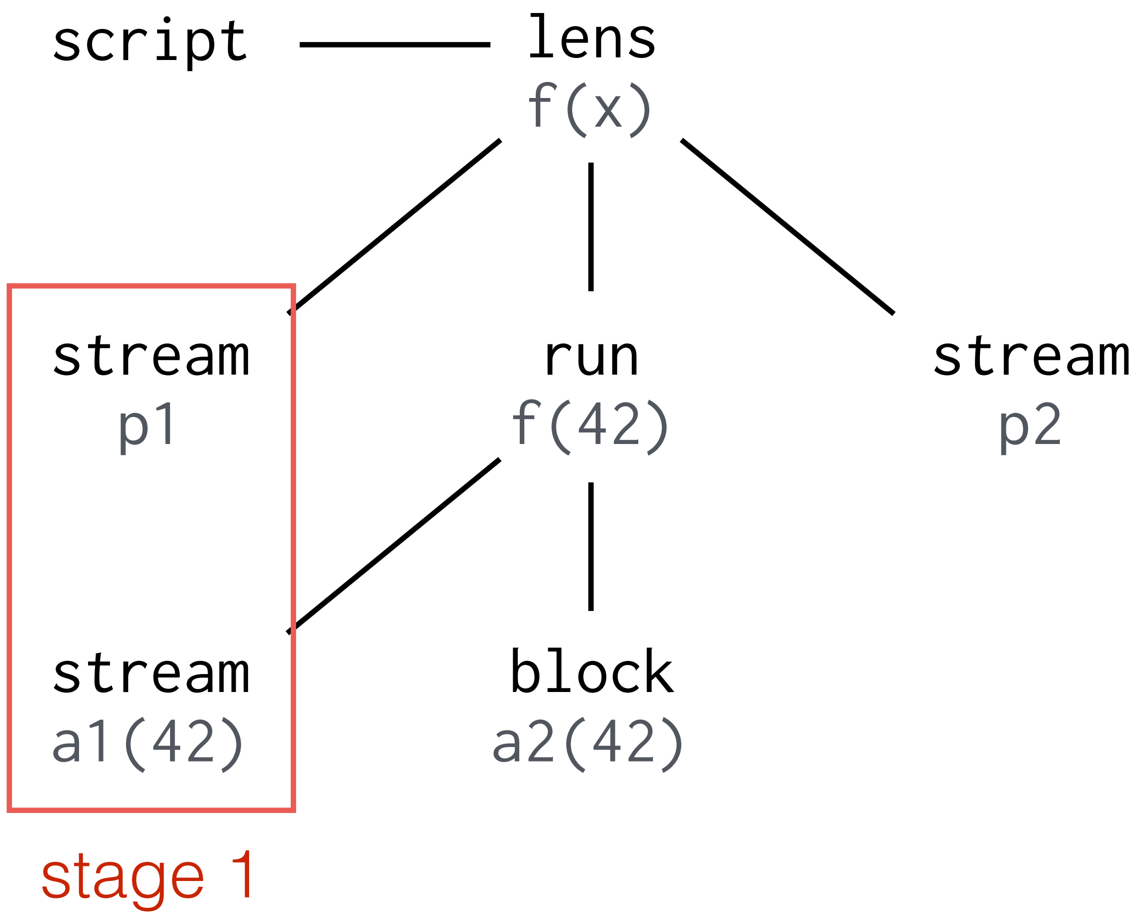

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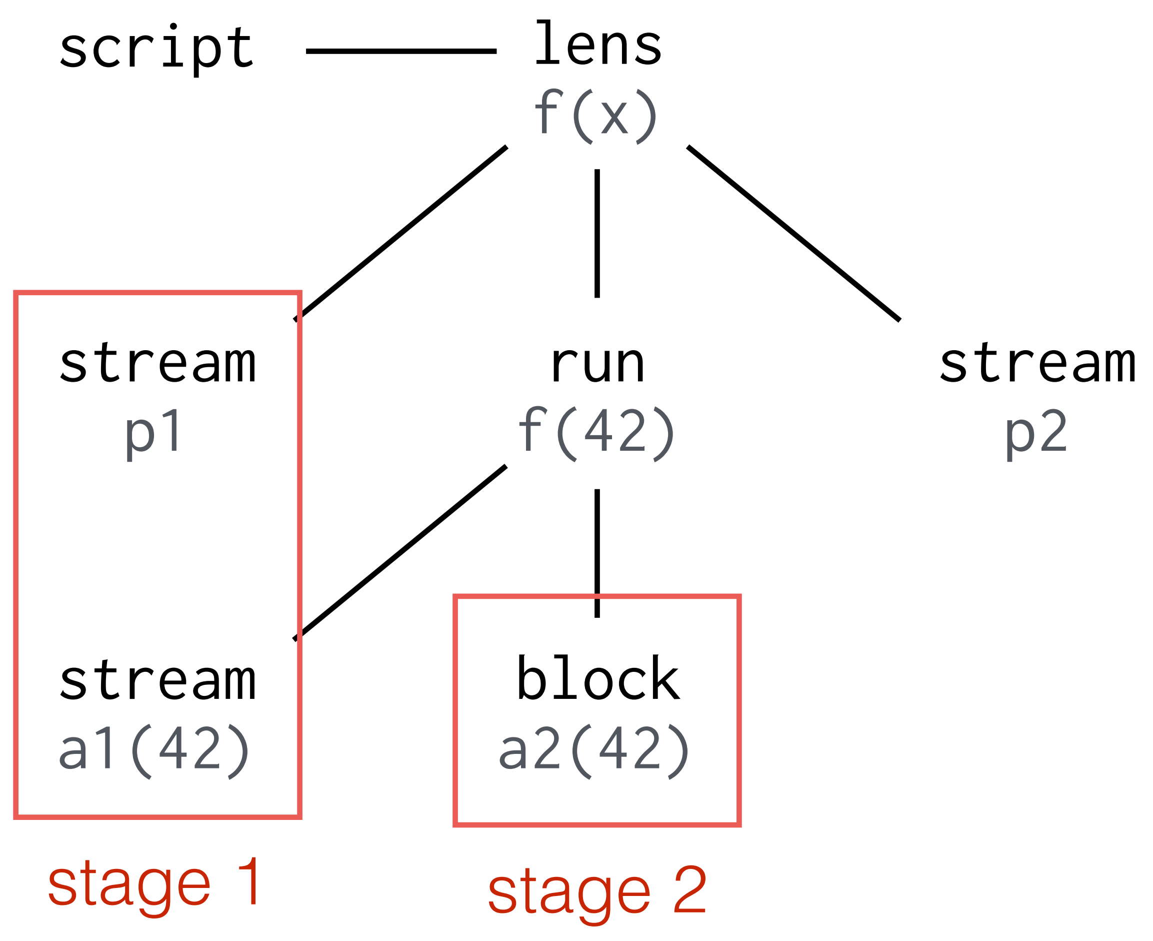

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}

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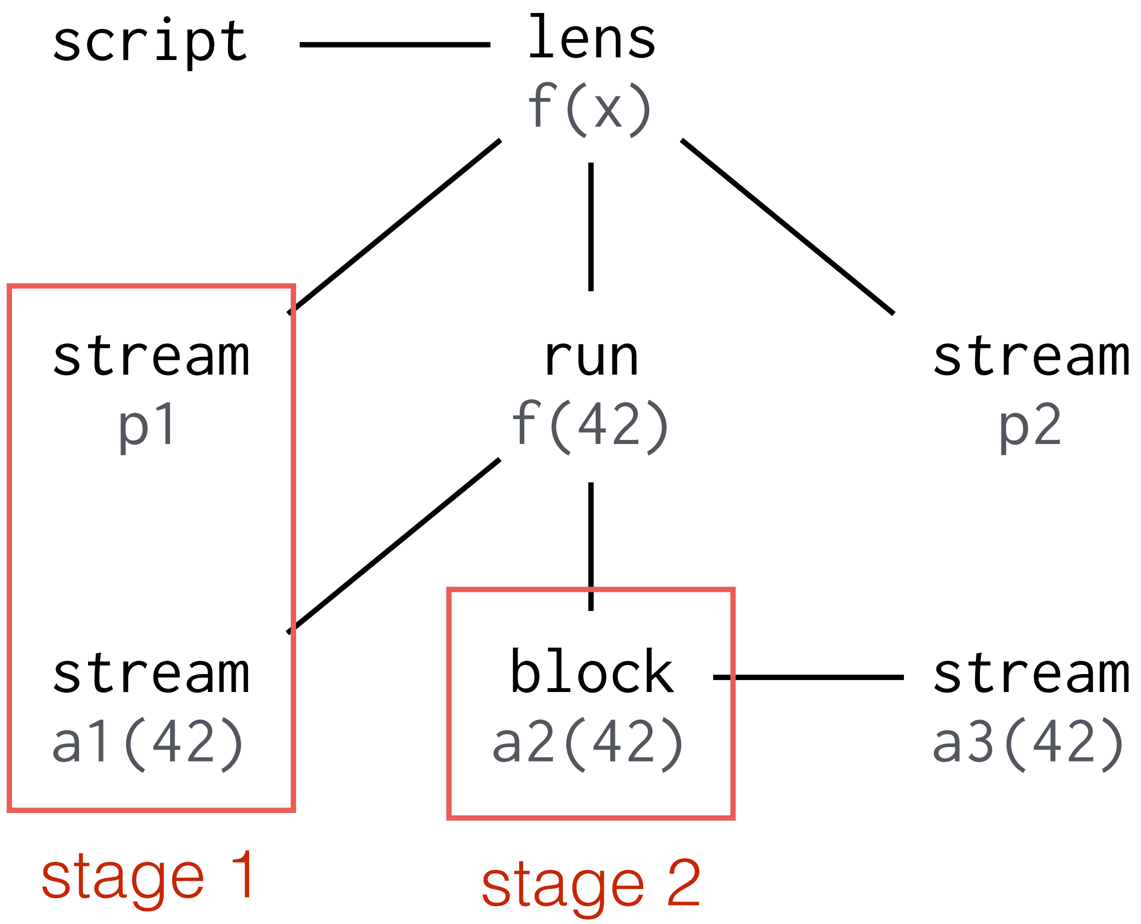
```



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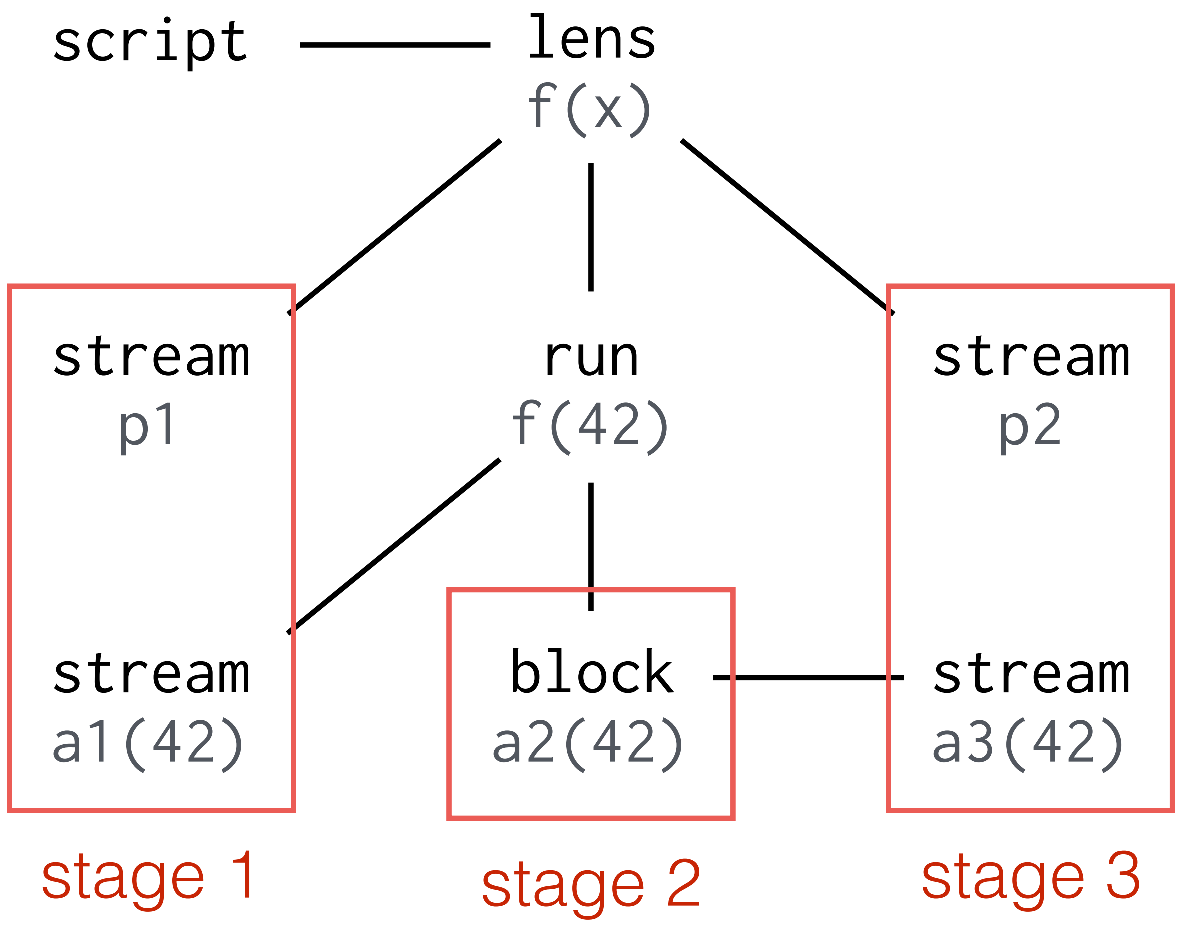
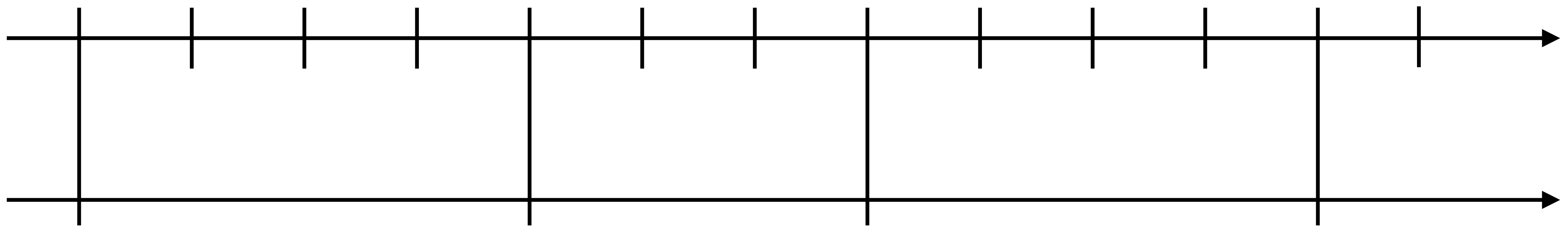


Connections

Logical time

one step = one line of log
`lens` and `run`: concurrency
syntactic scheduling

`stream (entry) when (` *condition* `)`



Connections

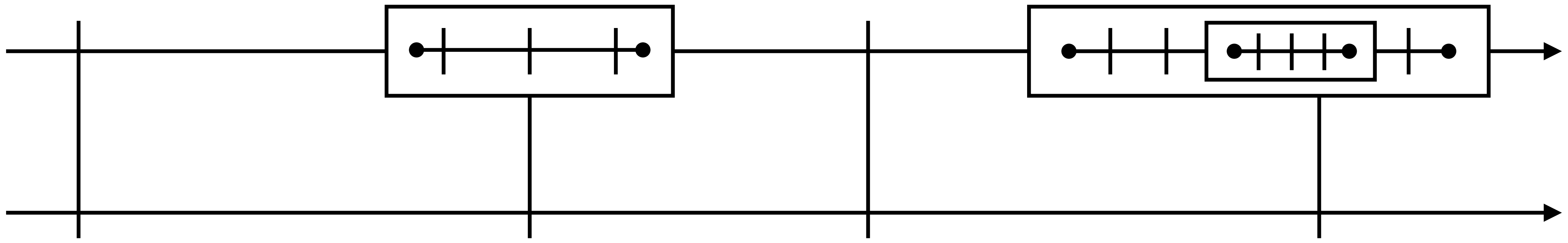
Logical time

one step = one line of code
`lens` and `run`: concurrency
syntactic scheduling

Reactive domains [MPP15]

`group` to define sub-streams
`lens` execution over sub-streams

`group` { *pattern* }



[MPP15] Mandel, Pasteur, Pouzet
Time Refinement in a Functional Synchronous Language

Applications

IBM Bluemix OpenWhisk

Logs from Travis
CloudLens as a whisk action...
...to analyze whisk builds

Applications

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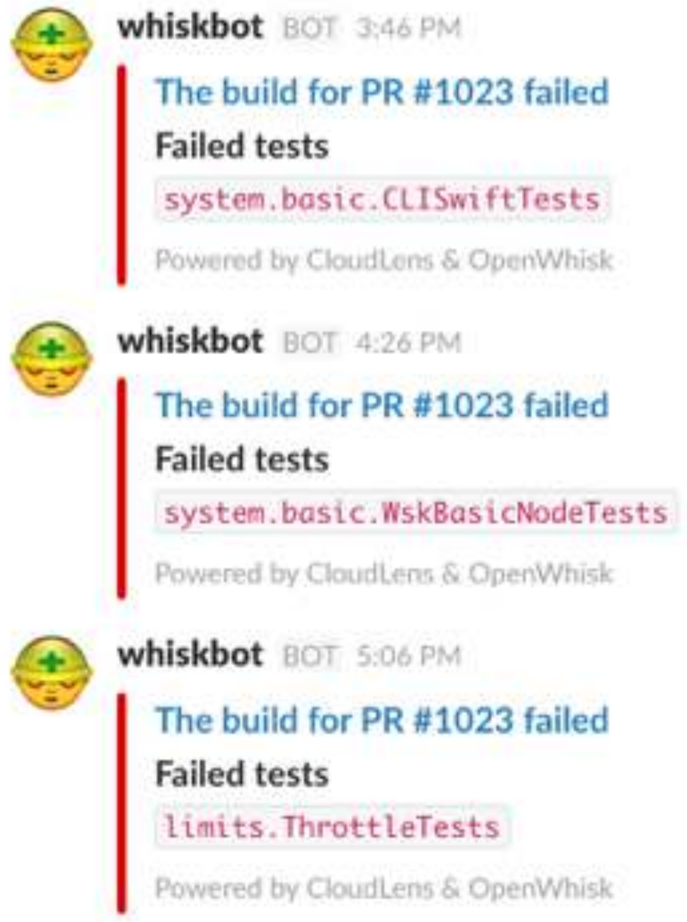

whiskbot BOT 3:46 PM
The build for PR #1023 failed
Failed tests
`system.basic.CLISwiftTests`
Powered by CloudLens & OpenWhisk

whiskbot BOT 4:26 PM
The build for PR #1023 failed
Failed tests
`system.basic.WskBasicNodeTests`
Powered by CloudLens & OpenWhisk

whiskbot BOT 5:06 PM
The build for PR #1023 failed
Failed tests
`limits.ThrottleTests`
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Applications

IBM Bluemix OpenWhisk

Lo
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...

whiskbot BOT 3:46 PM

The build for PR #1023 failed

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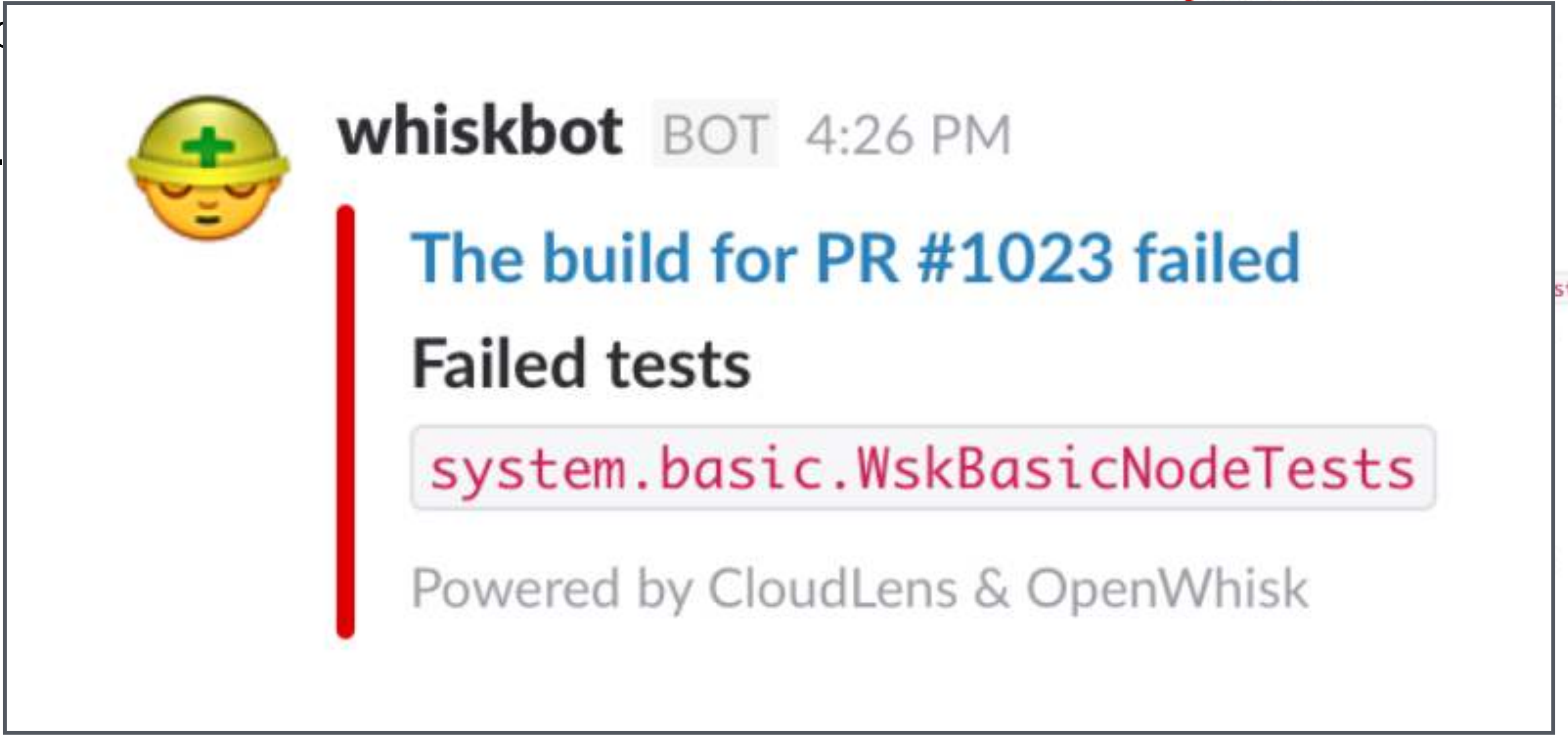

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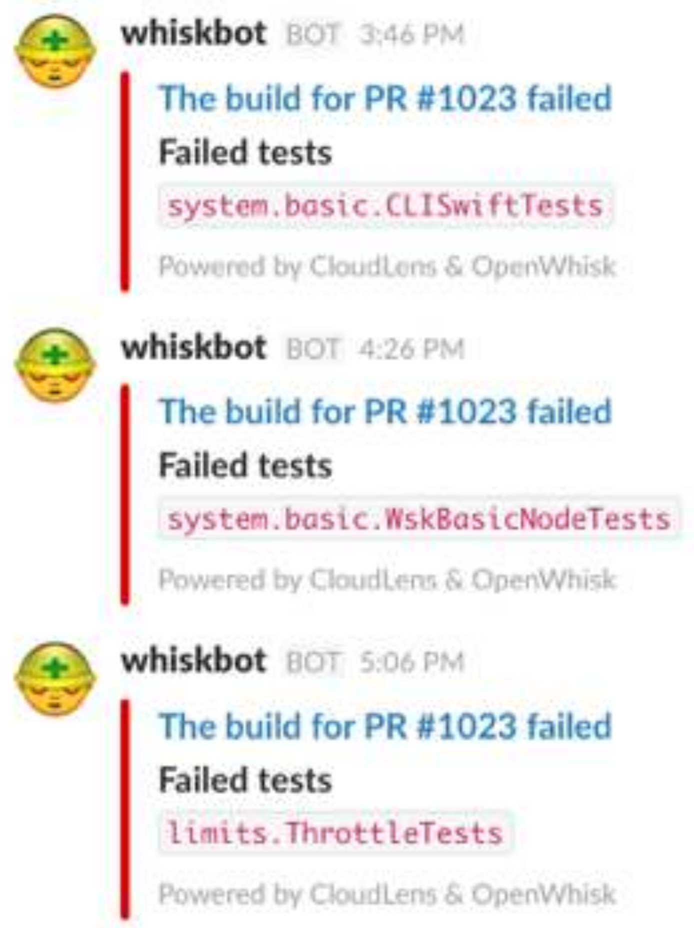

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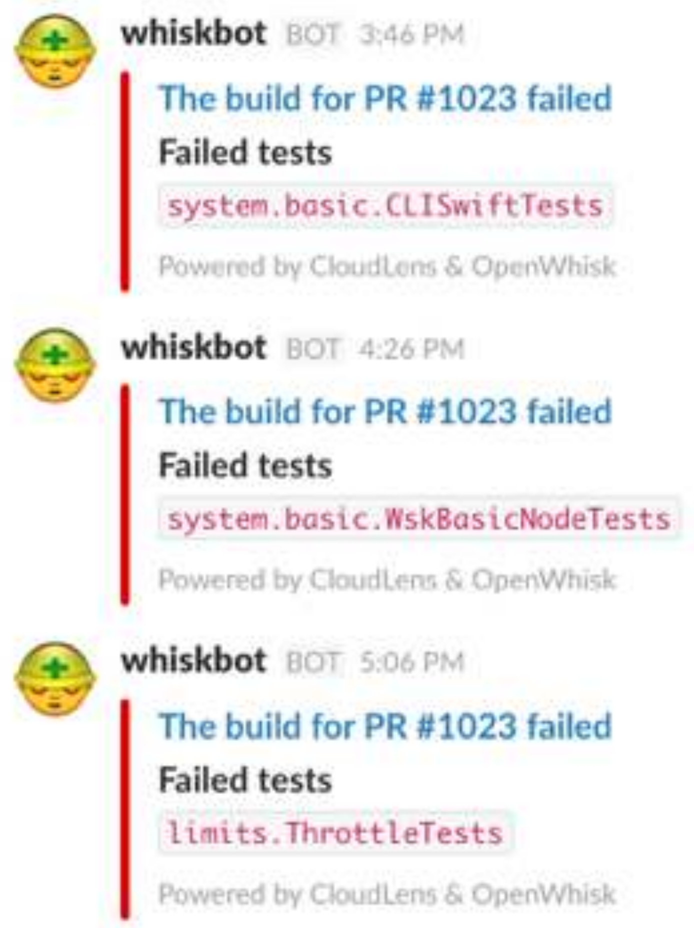

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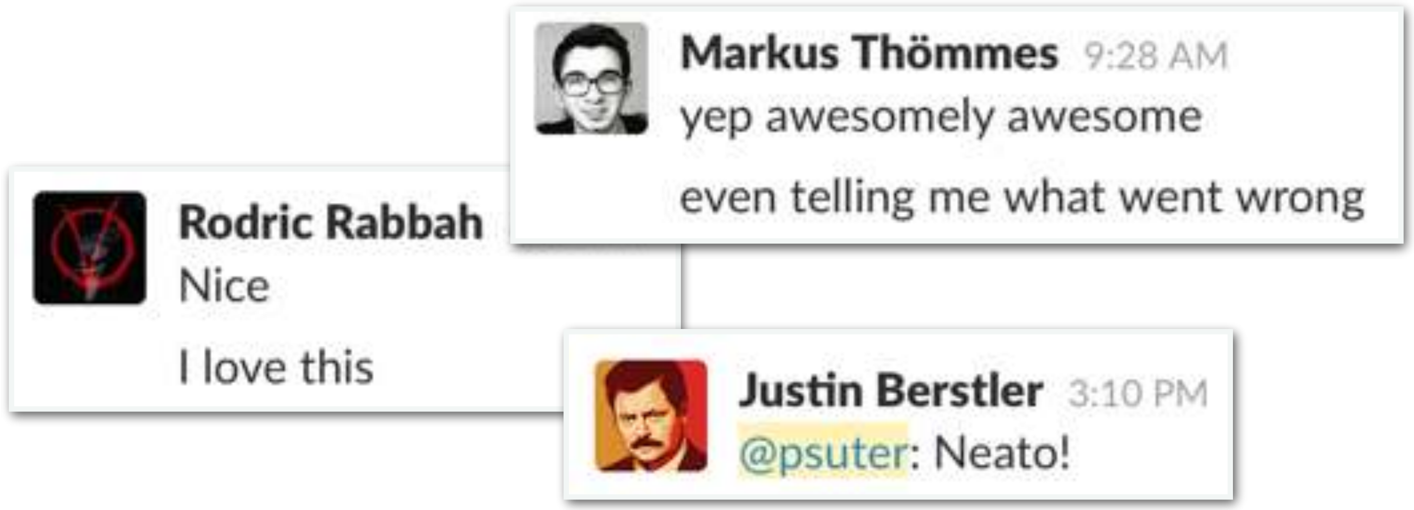

Markus Thömmes 9:28 AM
yep awesomely awesome
even telling me what went wrong

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Nice
I love this

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Applications

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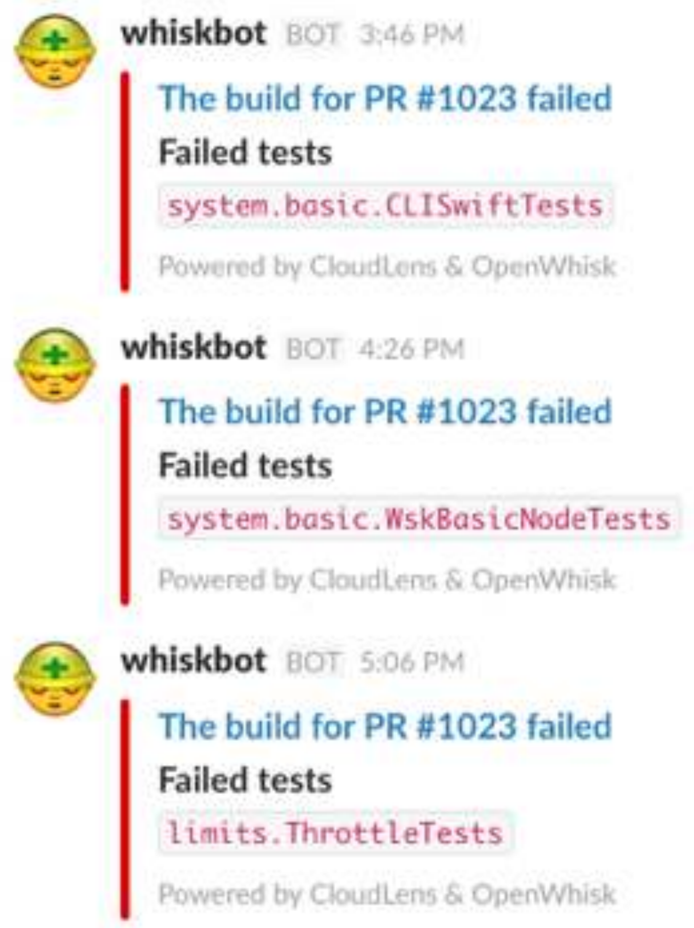
Review code repositories

Comments analysis



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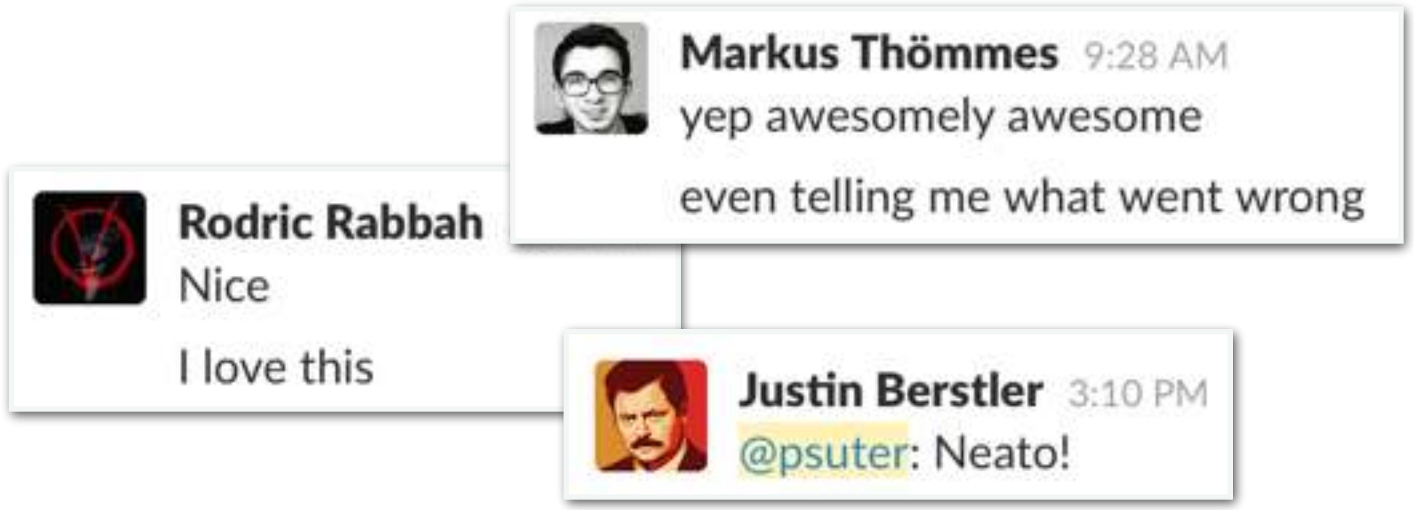

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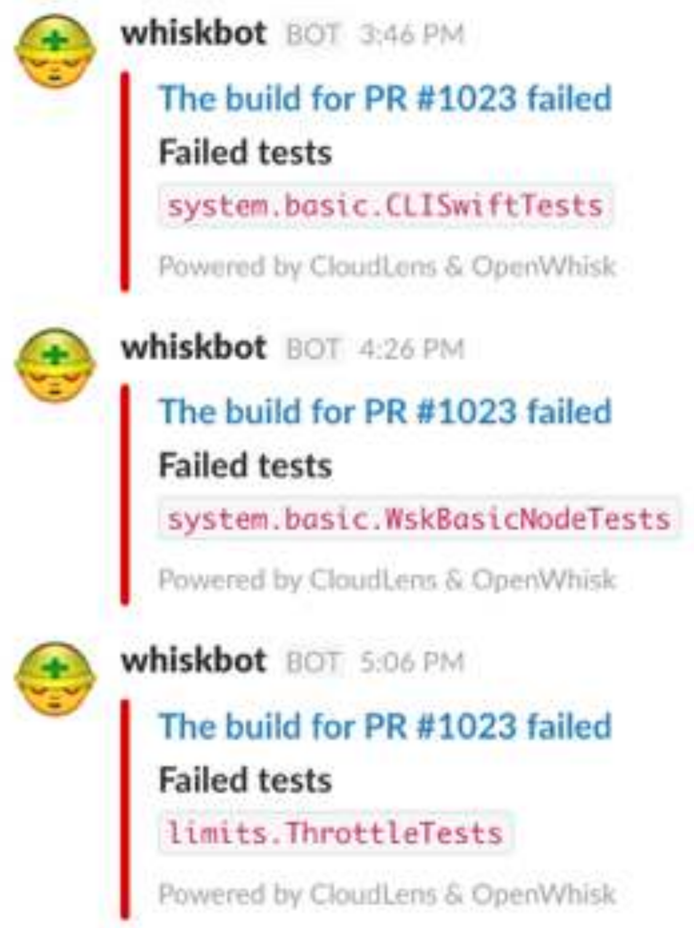

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Zeppelin

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http://cloudlens.github.io

[JFLA17] Baudart, Mandel, Tardieu, Vaziri
CloudLens, un langage de script pour l'analyse de données semi-structurées