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LONOCLOUD









What is a Java stack trace?

What is a Java stack trace?

```
java.lang.Exception: coconut failed with n 2: coconut failed with n 1: coconut failed with n 0: Divide by zero
  at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
  at clojure.lang.AFn.applyToHelper(AFn.java:161)
  at clojure.lang.AFn.applyTo(AFn.java:151)
  at clojure.core$apply.invoke(core.clj:603)
  at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
  at clojure.lang.AFn.applyToHelper(AFn.java:161)
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  at clojure.core$apply.invoke(core.clj:603)
  at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
  at lonocloud.talk_code$eval1970.invoke(NO_SOURCE_FILE:1)
  at clojure.lang.Compiler.eval(Compiler.java:6488)
  at clojure.lang.Compiler.eval(Compiler.java:6454)
  at clojure.core$eval.invoke(core.clj:2797)
  at swank.commands.basic$eval_region.invoke(basic.clj:47)
  at swank.commands.basic$eval_region.invoke(basic.clj:37)
  at swank.commands.basic$eval770$listener_eval__771.invoke(basic.clj:71)
  at clojure.lang.Var.invoke(Var.java:415)
  at lonocloud.talk_code$eval1968.invoke(NO_SOURCE_FILE)
  at clojure.lang.Compiler.eval(Compiler.java:6488)
  at clojure.lang.Compiler.eval(Compiler.java:6454)
  at clojure.core$eval.invoke(core.clj:2797)
  at swank.core$eval_in_emacs_package.invoke(core.clj:92)
  at swank.core$eval_for_emacs.invoke(core.clj:239)
  at clojure.lang.Var.invoke(Var.java:423)
  at clojure.lang.AFn.applyToHelper(AFn.java:167)
  at clojure.lang.Var.applyTo(Var.java:532)
  at clojure.core$apply.invoke(core.clj:601)
  at swank.core$eval_from_control.invoke(core.clj:99)
  at swank.core$eval_loop.invoke(core.clj:104)
  at swank.core$spawn_repl_thread$fn__533$fn__534.invoke(core.clj:309)
  at clojure.lang.AFn.applyToHelper(AFn.java:159)
  at clojure.lang.AFn.applyTo(AFn.java:151)
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  at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
  at lonocloud.talk_code$eval1970.invoke(NO_SOURCE_FILE:1)
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  at swank.commands.basic$eval770$listener_eval__771.invoke(basic.clj:71)
  at clojure.lang.Var.invoke(Var.java:415)
  at lonocloud.talk_code$eval1968.invoke(NO_SOURCE_FILE)
  at clojure.lang.Compiler.eval(Compiler.java:6488)
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  at clojure.core$apply.invoke(core.clj:601)
  at swank.core$spawn_repl_thread$fn__533.doInvoke(core.clj:306)
  at clojure.lang.RestFn.invoke(RestFn.java:397)
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  at java.lang.Thread.run(Thread.java:662)
Caused by: java.lang.Exception: coconut failed with n 1: coconut failed with n 0: Divide by zero
  at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
  at clojure.lang.AFn.applyToHelper(AFn.java:161)
  at clojure.lang.AFn.applyTo(AFn.java:151)
  at clojure.core$apply.invoke(core.clj:603)
  at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
  at clojure.lang.AFn.applyToHelper(AFn.java:161)
  at clojure.lang.AFn.applyTo(AFn.java:151)
  at clojure.core$apply.invoke(core.clj:603)
  at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
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What is a Java stack trace?

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java.lang.Exception: coconut failed with n 2: coconut failed with n 1: coconut failed with n 0: Divide by zero
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at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$eval1970.invoke(NO_SOURCE_FILE:7)
at clojure.lang.Compiler.eval(Compiler.java:6488)
at clojure.lang.Compiler.eval(Compiler.java:6454)
at clojure.core$eval.invoke(core.clj:2797)
at swank.commands.basic$eval_region.invoke(basic.clj:47)
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at clojure.lang.Var.invoke(Var.java:415)
at lonocloud.talk_code$eval1968.invoke(NO_SOURCE_FILE)
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at swank.core$eval_for_emacs.invoke(core.clj:239)
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at clojure.lang.AFn.applyToHelper(AFn.java:167)
at clojure.lang.Var.applyTo(Var.java:532)
at clojure.core$apply.invoke(core.clj:601)
at swank.core$eval_from_control.invoke(core.clj:99)
at swank.core$eval_loop.invoke(core.clj:104)
at swank.core$spawn_repl_thread$fn__533$fn__534.invoke(core.clj:309)
at clojure.lang.AFn.applyToHelper(AFn.java:159)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:601)
at swank.core$spawn_repl_thread$fn__533.doInvoke(core.clj:306)
at clojure.lang.RestFn.invoke(RestFn.java:397)
at clojure.lang.AFn.run(AFn.java:24)
at java.lang.Thread.run(Thread.java:662)
Caused by: java.lang.Exception: coconut failed with n 1: coconut failed with n 0: Divide by zero
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
```

A giant pile of text, screaming
at you when you mess up.
— me

What is a Java stack trace?

```
java.lang.Exception: coconut failed with n 2: coconut failed with n 1: coconut failed with n 0: Divide by zero
  at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
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  at clojure.lang.AFn.applyToHelper(AFn.java:161)
  at clojure.lang.AFn.applyTo(AFn.java:151)
  at clojure.core$apply.invoke(core.clj:603)
  at lonocloud.talk_code$apple.invoke(talk_code.clj:34)
  at lonocloud.talk_code$eval11970.invoke(talk_code.clj:11970)
  at clojure.lang.Compiler.eval(Compiler.java:6488)
  at clojure.lang.Compiler.eval(Compiler.java:6454)
  at clojure.core$eval.invoke(core.clj:248)
```

A Java stack trace is a user-friendly snapshot of the threads and monitors in a Java Virtual Machine (JVM). Depending on how complex your application or applet is, a stack trace can range from fifty lines to thousands of lines of diagnostics.

-- Calvin Austin, July 1998

<http://java.sun.com/developer/technicalArticles/Programming/Stacktrace/>

```
Caused by: java.lang.ArithmeticException: divide by zero
    at clojure.lang.Numbers.divide(Numbers.java:156)
    at clojure.lang.Numbers.divide(Numbers.java:3667)
    at lonocloud.talk_code$scoconut.invoke(talk_code.clj:22)
    ... 54 more
```

What is a Java stack trace?

```
java.lang.Exception: coconut failed with n 2: coconut failed with n 1: coconut failed with n 0: Divide by zero
    at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
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    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
    at clojure.lang.AFn.applyToHelper(AFn.java:161)
    at clojure.lang.AFn.applyTo(AFn.java:151)
    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
    at lonocloud.talk_code$eval1970.invoke(NO_SOURCE_FILE:1)
    at clojure.lang.Compiler.eval(Compiler.java:6488)
    at clojure.lang.Compiler.eval(Compiler.java:6454)
    at clojure.core$eval.invoke(core.clj:2797)
    at swank.commands.basic$eval_region.invoke(basic.clj:47)
    at swank.commands.basic$eval_region.invoke(basic.clj:37)
    at swank.commands.basic$eval770$listener_eval__771.invoke(basic.clj:71)
    at clojure.lang.Var.invoke(Var.java:415)
    at lonocloud.talk_code$eval1968.invoke(NO_SOURCE_FILE)
    at clojure.lang.Compiler.eval(Compiler.java:6488)
    at clojure.lang.Compiler.eval(Compiler.java:6454)
    at clojure.core$eval.invoke(core.clj:2797)
    at swank.core$eval_in_emacs_package.invoke(core.clj:92)
    at swank.core$eval_for_emacs.invoke(core.clj:239)
    at clojure.lang.Var.invoke(Var.java:423)
    at clojure.lang.AFn.applyToHelper(AFn.java:167)
    at clojure.lang.Var.applyTo(Var.java:532)
    at clojure.core$apply.invoke(core.clj:601)
    at swank.core$eval_from_control.invoke(core.clj:99)
    at swank.core$eval_loop.invoke(core.clj:104)
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    at clojure.lang.AFn.applyTo(AFn.java:151)
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    at swank.core$spawn_repl_thread$fn__533.doInvoke(core.clj:306)
    at clojure.lang.RestFn.invoke(RestFn.java:397)
    at clojure.lang.AFn.run(AFn.java:24)
    at java.lang.Thread.run(Thread.java:662)
Caused by: java.lang.Exception: coconut failed with n 1: coconut failed with n 0: Divide by zero
    at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
    at clojure.lang.AFn.applyToHelper(AFn.java:161)
    at clojure.lang.AFn.applyTo(AFn.java:151)
    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
    at clojure.lang.AFn.applyToHelper(AFn.java:161)
    at clojure.lang.AFn.applyTo(AFn.java:151)
    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
    at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
    ... 36 more
Caused by: java.lang.Exception: coconut failed with n 0: Divide by zero
    at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
    at clojure.lang.AFn.applyToHelper(AFn.java:161)
    at clojure.lang.AFn.applyTo(AFn.java:151)
    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
    at clojure.lang.AFn.applyToHelper(AFn.java:161)
    at clojure.lang.AFn.applyTo(AFn.java:151)
    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
    at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
    ... 45 more
Caused by: java.lang.ArithmeticException: Divide by zero
    at clojure.lang.Numbers.divide(Numbers.java:156)
    at clojure.lang.Numbers.divide(Numbers.java:3667)
    at lonocloud.talk_code$coconut.invoke(talk_code.clj:22)
    ... 54 more
```

We can do better!

What is a Java stack trace?

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    at clojure.lang.AFn.applyTo(AFn.java:151)
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    at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
    at clojure.lang.AFn.applyToHelper(AFn.java:161)
    at clojure.lang.AFn.applyTo(AFn.java:151)
    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
    at lonocloud.talk_code$eval1970.invoke(NO_SOURCE_FILE:1)
    at clojure.lang.Compiler.eval(Compiler.java:6488)
    at clojure.lang.Compiler.eval(Compiler.java:6454)
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    at swank.commands.basic$eval_region.invoke(basic.clj:47)
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    at clojure.lang.Var.invoke(Var.java:423)
    at clojure.lang.AFn.applyToHelper(AFn.java:167)
    at clojure.lang.Var.applyTo(Var.java:532)
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    at swank.core$eval_from_control.invoke(core.clj:99)
    at swank.core$eval_loop.invoke(core.clj:104)
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    at swank.core$spawn_repl_thread$fn__533.doInvoke(core.clj:306)
    at clojure.lang.RestFn.invoke(RestFn.java:397)
    at clojure.lang.AFn.run(AFn.java:24)
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Caused by: java.lang.Exception: coconut failed with n 1: coconut failed with n 0: Divide by zero
    at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
    at clojure.lang.AFn.applyToHelper(AFn.java:161)
    at clojure.lang.AFn.applyTo(AFn.java:151)
    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
    at clojure.lang.AFn.applyToHelper(AFn.java:161)
    at clojure.lang.AFn.applyTo(AFn.java:151)
    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
    at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
    ... 36 more
Caused by: java.lang.Exception: coconut failed with n 0: Divide by zero
    at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
    at clojure.lang.AFn.applyToHelper(AFn.java:161)
    at clojure.lang.AFn.applyTo(AFn.java:151)
    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
    at clojure.lang.AFn.applyToHelper(AFn.java:161)
    at clojure.lang.AFn.applyTo(AFn.java:151)
    at clojure.core$apply.invoke(core.clj:603)
    at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
    at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
    ... 45 more
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    at lonocloud.talk_code$coconut.invoke(talk_code.clj:22)
    ... 54 more

Root cause java.lang.ArithmeticException: Divide by zero
clojure.lang.Numbers.divide ..... Numbers.java:156
clojure.lang.Numbers.divide ..... Numbers.java:3667
lonocloud.talk_code/coconut ..... talk_code.clj:22
Rethrown as java.lang.Exception: coconut failed with n 0: ...
lonocloud.talk_code/coconut ..... talk_code.clj:26
lonocloud.talk_code/banana ..... talk_code.clj:30
lonocloud.talk_code/apple ..... talk_code.clj:33
lonocloud.talk_code/coconut ..... talk_code.clj:23
Rethrown as java.lang.Exception: coconut failed with n 1: ...
lonocloud.talk_code/coconut ..... talk_code.clj:26
lonocloud.talk_code/banana ..... talk_code.clj:30
lonocloud.talk_code/apple ..... talk_code.clj:33
lonocloud.talk_code/coconut ..... talk_code.clj:23
Rethrown as java.lang.Exception: coconut failed with n 2: ...
lonocloud.talk_code/coconut ..... talk_code.clj:26
lonocloud.talk_code/banana ..... talk_code.clj:30
lonocloud.talk_code/apple ..... talk_code.clj:33
swank.commands.basic/eval-region ..... basic.clj:47
swank.commands.basic/eval-region ..... basic.clj:37
swank.commands.basic/eval770$listener-eval ..... basic.clj:71
swank.core/eval-in-emacs-package ..... core.clj:92
swank.core/eval-for-emacs ..... core.clj:239
swank.core/eval-from-control ..... core.clj:99
swank.core/eval-loop ..... core.clj:104
swank.core/spawn-repl-thread$fn$fn ..... core.clj:309
swank.core/spawn-repl-thread$fn ..... core.clj:306
```

↑
We can do better!

Why care about stack traces?

- seen frequently
- provide context
- less invasive than interactive debugging (though less powerful)
- sometimes all we've got to understand a problem

The life of a Java call stack

mutated at runtime



exception snapshot



throw and unwind



catch



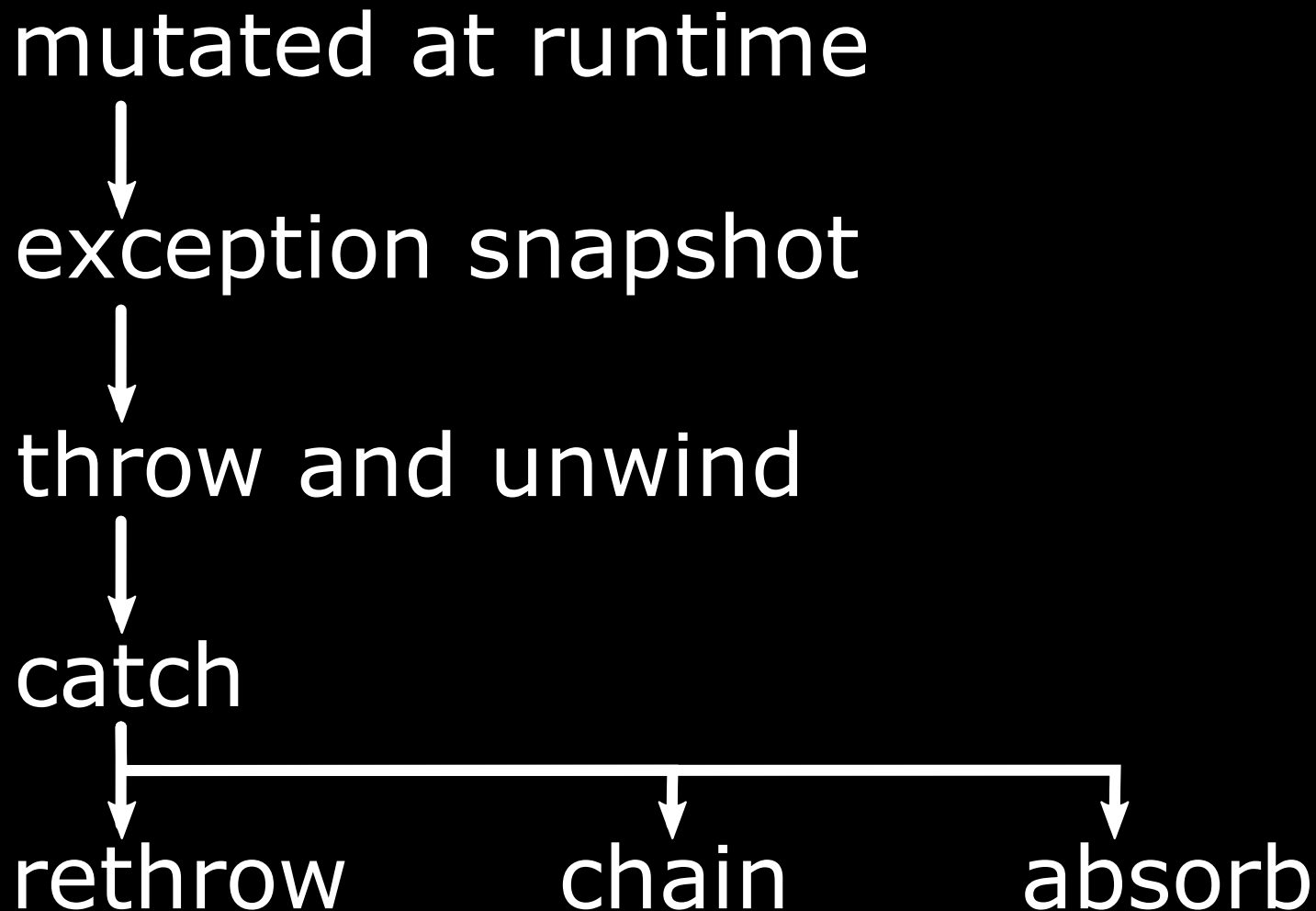
rethrow



chain



absorb



The life of a Java call stack

mutated at runtime



exception snapshot



throw and unwind



catch



rethrow



chain



absorb

```
(defn coconut [n]  
  (prn (/ 42 n)))
```

```
(defn banana [n]  
  (coconut n))
```

```
(defn apple [n]  
  (banana n))
```

```
(defn coconut [n]  
  (prn (/ 42 n)))
```

```
(defn banana [n]  
  (coconut n))
```

```
(defn apple [n]  
  (banana n))
```



```
(defn coconut [n]  
  (prn (/ 42 n)))
```

```
(defn banana [n]  
  (coconut n))
```

```
(defn apple [n]  
  (banana n))
```

apple

```
(defn coconut [n]  
  (prn (/ 42 n)))
```

```
(defn banana [n]  
  (coconut n))
```

```
(defn apple [n]  
  (banana n))
```

↖ banana
apple

```
(defn coconut [n]  
  (prn (/ 42 n)))
```

```
(defn banana [n]  
  (coconut n))
```

```
(defn apple [n]  
  (banana n))
```



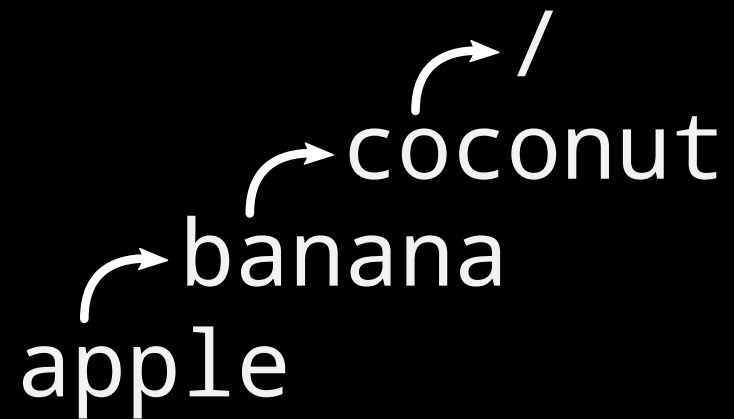
Diagram illustrating the sequence of function calls:

- An arrow points from `apple` to `banana`.
- An arrow points from `banana` to `coconut`.

```
(defn coconut [n]  
  (prn (/ 42 n)))
```

```
(defn banana [n]  
  (coconut n))
```

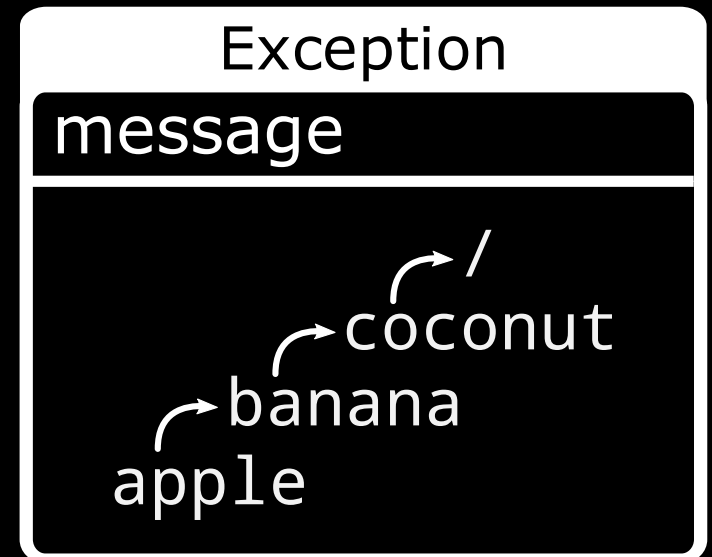
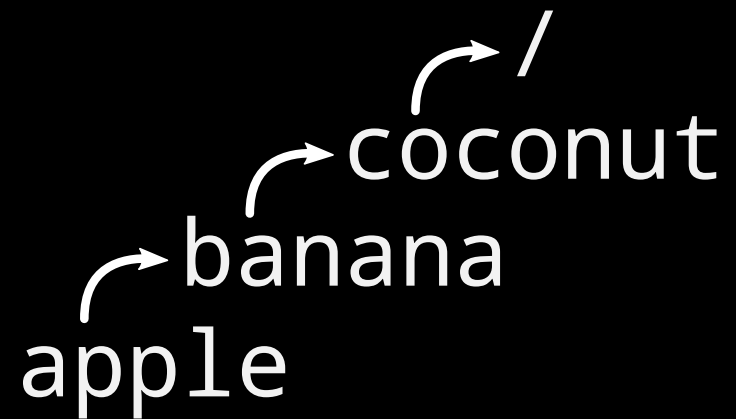
```
(defn apple [n]  
  (banana n))
```



```
(defn coconut [n]  
  (prn (/ 42 n)))
```

```
(defn banana [n]  
  (coconut n))
```

```
(defn apple [n]  
  (banana n))
```



The life of a Java call stack

mutated at runtime



exception snapshot



throw and unwind



catch



rethrow



chain

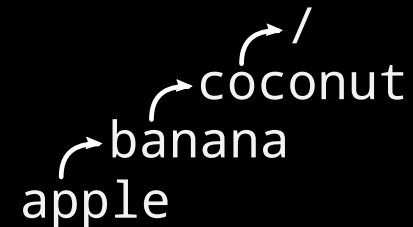


absorb

```
(defn coconut [n]  
  (prn (/ 42 n)))
```

```
(defn banana [n]  
  (coconut n))
```

```
(defn apple [n]  
  (banana n))
```





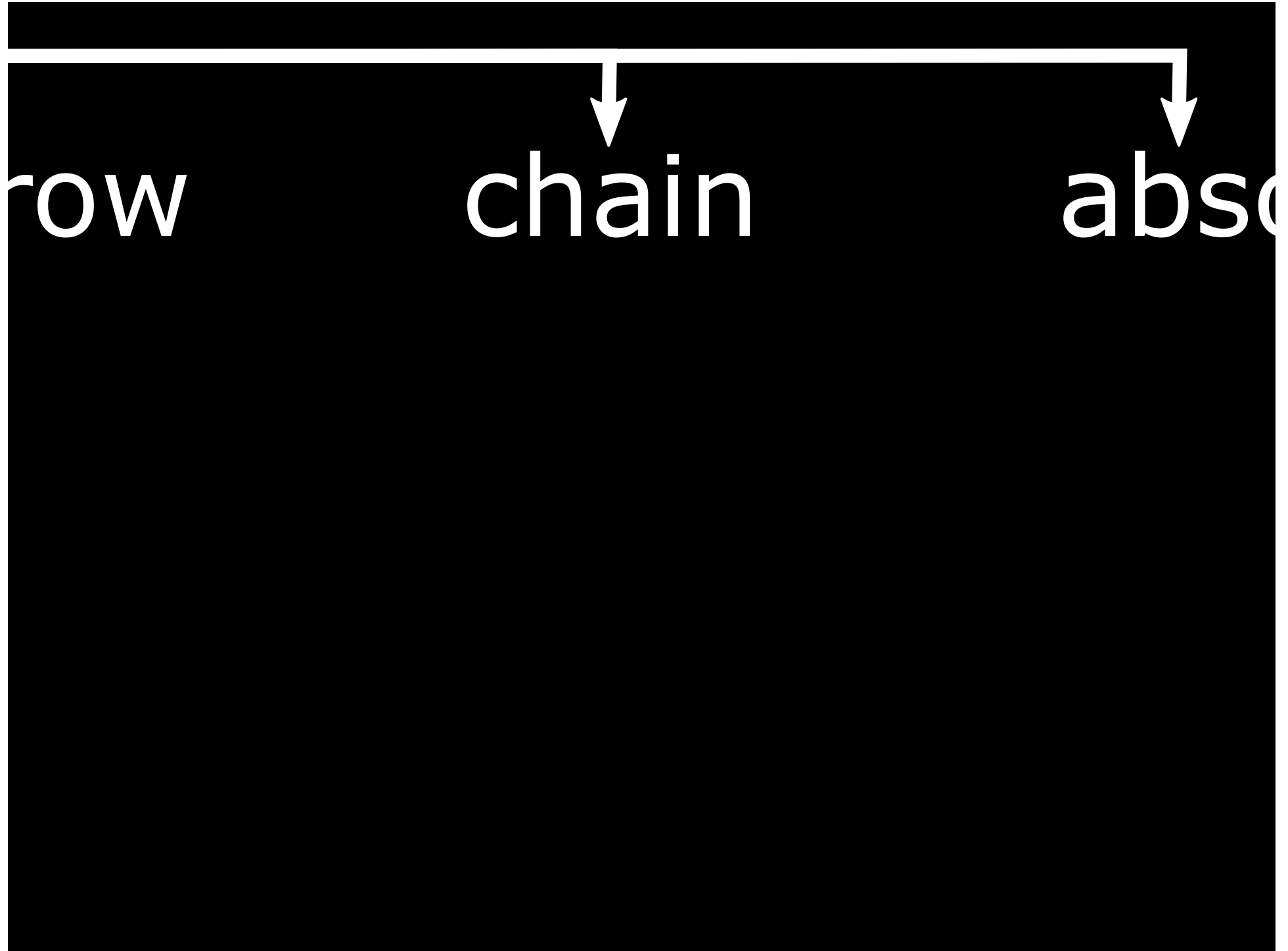
rethrow



rethrow

as if never caught

```
(try
  (dangerous-work)
  (catch Exception e
    (when (want-to-rethrow? e)
      (throw e))))
```

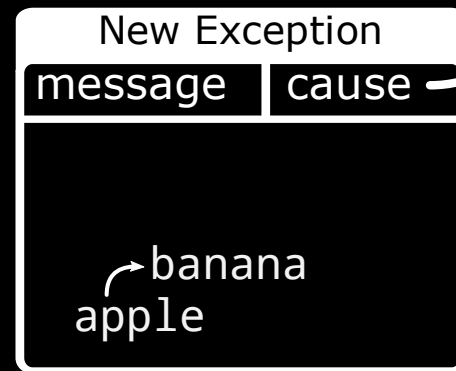
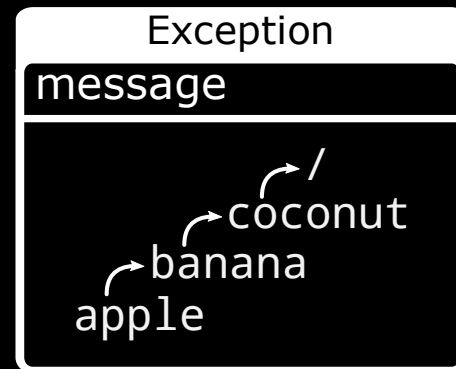
row

chain

abso

Root cause

```
(defn banana [n]
  (try
    (coconut n)
    (catch Exception e
      (when (want-to-chain? e)
        (throw (Exception.
                  (str "new message"
                      (.getMessage e))
                    e))))))
```





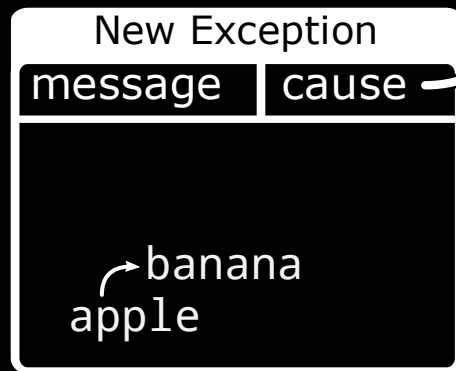
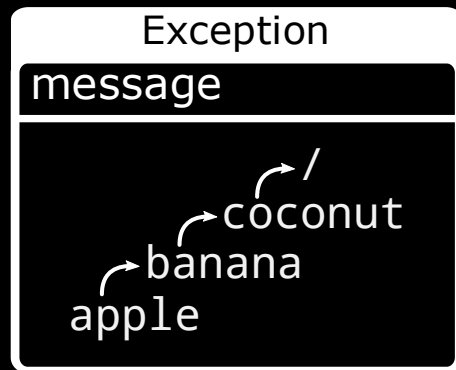
ain



absorb

se

e))



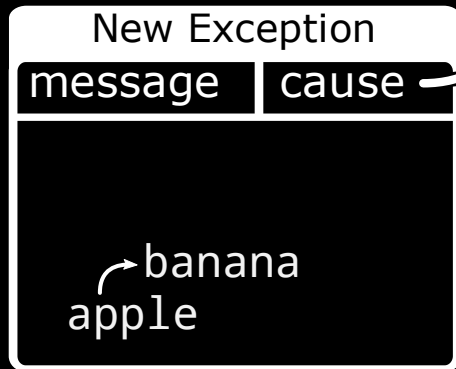
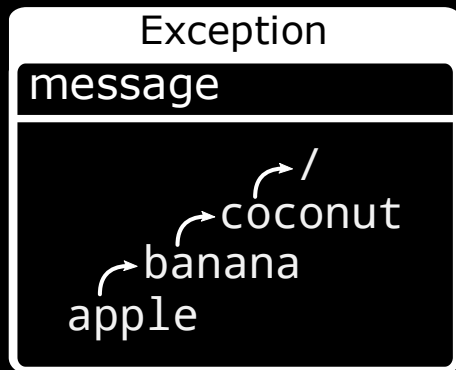
ain

absorb

ignore?
respond?

se

e))



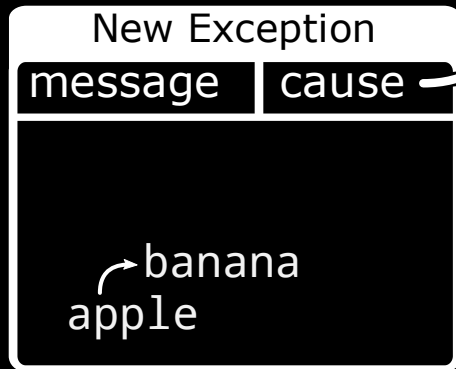
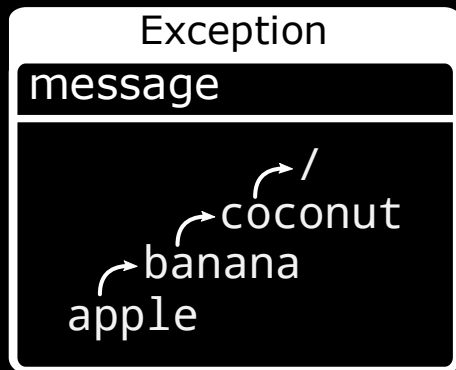
ain

absorb

ignore?
respond?
print!

se

e))



```
(declare apple)
```

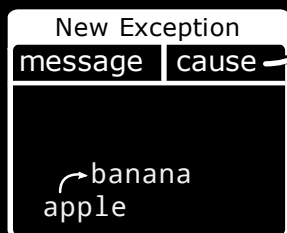
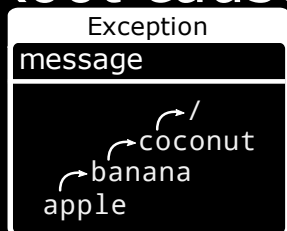
```
(defn coconut [n]  
  (try  
    (prn (/ 42 n))  
    (apple (dec n))  
    (catch Exception e  
      (throw (Exception.  
                (str "coconut failed with n " n  
                    ": " (.getMessage e))  
                e))))))
```

```
(defn banana [n]  
  (apply coconut n nil))
```

```
(defn apple [n]  
  (apply banana n nil))
```

Final Cause

Root cause



Root Cause

```
java.lang.Exception: coconut failed with n 2: coconut failed with n 1: coconut failed with n 0: Divide by zero
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$eval1970.invoke(NO_SOURCE_FILE:1)
at clojure.lang.Compiler.eval(Compiler.java:6488)
at clojure.lang.Compiler.eval(Compiler.java:6454)
at clojure.core$eval.invoke(core.clj:2797)
at swank.commands.basic$eval_region.invoke(basic.clj:47)
at swank.commands.basic$eval_region.invoke(basic.clj:37)
at swank.commands.basic$eval1770$listener_eval__771.invoke(basic.clj:71)
at clojure.lang.Var.invoke(Var.java:415)
at lonocloud.talk_code$eval1968.invoke(NO_SOURCE_FILE)
at clojure.lang.Compiler.eval(Compiler.java:6488)
at clojure.lang.Compiler.eval(Compiler.java:6454)
at clojure.core$eval.invoke(core.clj:2797)
at swank.core$eval_in_emacs_package.invoke(core.clj:92)
at swank.core$eval_for_emacs.invoke(core.clj:239)
at clojure.lang.Var.invoke(Var.java:423)
at clojure.lang.AFn.applyToHelper(AFn.java:167)
at clojure.lang.Var.applyTo(Var.java:532)
at clojure.core$apply.invoke(core.clj:601)
at swank.core$eval_from_control.invoke(core.clj:99)
at swank.core$eval_loop.invoke(core.clj:104)
at swank.core$spawn_repl_thread$fn__533$fn__534.invoke(core.clj:309)
at clojure.lang.AFn.applyToHelper(AFn.java:159)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:601)
at swank.core$spawn_repl_thread$fn__533.doInvoke(core.clj:306)
at clojure.lang.RestFn.invoke(RestFn.java:397)
at clojure.lang.AFn.run(AFn.java:24)
at java.lang.Thread.run(Thread.java:662)
Caused by: java.lang.Exception: coconut failed with n 1: coconut failed with n 0: Divide by zero
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
... 36 more
Caused by: java.lang.Exception: coconut failed with n 0: Divide by zero
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
... 45 more
Caused by: java.lang.ArithmeticException: Divide by zero
at clojure.lang.Numbers.divide(Numbers.java:156)
at clojure.lang.Numbers.divide(Numbers.java:3667)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:22)
... 54 more
```

```
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
... 36 more
```

Caused by: java.lang.Exception: coconut failed with n 0: Divide by zero

```
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
... 45 more
```

Caused by: java.lang.ArithmeticException: Divide by zero

```
at clojure.lang.Numbers.divide(Numbers.java:156)
at clojure.lang.Numbers.divide(Numbers.java:3667)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:22)
... 54 more
```



```
java.lang.Exception: coconut failed with n 2: coconut failed with n 1: coconut failed with n 0: Divide by zero
```

```
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$eval1970.invoke(NO_SOURCE_FILE:1)
at clojure.lang.Compiler.eval(Compiler.java:6488)
at clojure.lang.Compiler.eval(Compiler.java:6454)
at clojure.core$eval.invoke(core.clj:2797)
at swank.commands.basic$eval_region.invoke(basic.clj:47)
at swank.commands.basic$eval_region.invoke(basic.clj:37)
at swank.commands.basic$eval770$listener_eval__771.invoke(basic.clj:71)
at clojure.lang.Var.invoke(Var.java:415)
at lonocloud.talk_code$eval1968.invoke(NO_SOURCE_FILE)
at clojure.lang.Compiler.eval(Compiler.java:6488)
at clojure.lang.Compiler.eval(Compiler.java:6454)
at clojure.core$eval.invoke(core.clj:2797)
at swank.core$eval_in_emacs_package.invoke(core.clj:92)
at swank.core$eval_for_emacs.invoke(core.clj:239)
at clojure.lang.Var.invoke(Var.java:423)
at clojure.lang.AFn.applyToHelper(AFn.java:167)
at clojure.lang.Var.applyTo(Var.java:532)
at clojure.core$apply.invoke(core.clj:601)
at swank.core$eval_from_control.invoke(core.clj:99)
at swank.core$eval_loop.invoke(core.clj:104)
at swank.core$spawn_repl_thread$fn__533$fn__534.invoke(core.clj:309)
at clojure.lang.AFn.applyToHelper(AFn.java:159)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:601)
at swank.core$spawn_repl_thread$fn__533.doInvoke(core.clj:306)
at clojure.lang.RestFn.invoke(RestFn.java:397)
at clojure.lang.AFn.run(AFn.java:24)
at java.lang.Thread.run(Thread.java:662)
```

```
Caused by: java.lang.Exception: coconut failed with n 1: coconut failed with n 0: Divide by zero
```

```
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
... 36 more
```

```
Caused by: java.lang.Exception: coconut failed with n 0: Divide by zero
```

```
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
... 45 more
```

```
Caused by: java.lang.ArithmeticException: Divide by zero
```

```
at clojure.lang.Numbers.divide(Numbers.java:156)
at clojure.lang.Numbers.divide(Numbers.java:3667)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:22)
... 54 more
```

```
ArithmeticException Divide by zero
```

```
clojure.lang.Numbers.divide (Numbers.java:156)
clojure.lang.Numbers.divide (Numbers.java:3667)
lonocloud.talk-code/coconut (talk_code.clj:22)
clojure.core/apply (core.clj:603)
lonocloud.talk-code/banana (talk_code.clj:30)
clojure.core/apply (core.clj:603)
lonocloud.talk-code/apple (talk_code.clj:33)
lonocloud.talk-code/coconut (talk_code.clj:23)
clojure.core/apply (core.clj:603)
lonocloud.talk-code/banana (talk_code.clj:30)
clojure.core/apply (core.clj:603)
lonocloud.talk-code/apple (talk_code.clj:33)
lonocloud.talk-code/coconut (talk_code.clj:23)
clojure.core/apply (core.clj:603)
lonocloud.talk-code/banana (talk_code.clj:30)
clojure.core/apply (core.clj:603)
lonocloud.talk-code/apple (talk_code.clj:33)
lonocloud.talk-code/coconut (talk_code.clj:23)
clojure.core/apply (core.clj:603)
lonocloud.talk-code/banana (talk_code.clj:30)
clojure.core/apply (core.clj:603)
lonocloud.talk-code/apple (talk_code.clj:33)
lonocloud.talk-code/eval1970 (NO_SOURCE_FILE:1)
clojure.lang.Compiler.eval (Compiler.java:6488)
clojure.lang.Compiler.eval (Compiler.java:6454)
clojure.core/eval (core.clj:2797)
swank.commands.basic/eval-region (basic.clj:47)
swank.commands.basic/eval-region (basic.clj:37)
swank.commands.basic/eval770/listener-eval--771 (basic.clj:71)
clojure.lang.Var.invoke (Var.java:415)
lonocloud.talk-code/eval1968 (NO_SOURCE_FILE:-1)
clojure.lang.Compiler.eval (Compiler.java:6488)
clojure.lang.Compiler.eval (Compiler.java:6454)
clojure.core/eval (core.clj:2797)
swank.core/eval-in-emacs-package (core.clj:92)
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clojure.core/apply (core.clj:601)
swank.core/eval-from-control (core.clj:99)
swank.core/eval-loop (core.clj:104)
swank.core/spawn-repl-thread/fn--533/fn--534 (core.clj:309)
clojure.core/apply (core.clj:601)
swank.core/spawn-repl-thread/fn--533 (core.clj:306)
java.lang.Thread.run (Thread.java:662)
```

clojure.repl/pst

led with n 0: Divide by zero

```
ArithmeticException Divide by zero
  clojure.lang.Numbers.divide (Numbers.java:156)
  clojure.lang.Numbers.divide (Numbers.java:3667)
  lonocloud.talk-code/coconut (talk_code.clj:22)
  clojure.core/apply (core.clj:603)
  lonocloud.talk-code/banana (talk_code.clj:30)
  clojure.core/apply (core.clj:603)
  lonocloud.talk-code/apple (talk_code.clj:33)
  lonocloud.talk-code/coconut (talk_code.clj:23)
  clojure.core/apply (core.clj:603)
  lonocloud.talk-code/banana (talk_code.clj:30)
  clojure.core/apply (core.clj:603)
  lonocloud.talk-code/apple (talk_code.clj:33)
  lonocloud.talk-code/coconut (talk_code.clj:23)
  clojure.core/apply (core.clj:603)
  lonocloud.talk-code/banana (talk_code.clj:30)
  clojure.core/apply (core.clj:603)
  lonocloud.talk-code/apple (talk_code.clj:33)
  lonocloud.talk-code/eval1970 (NO_SOURCE_FILE:1)
  clojure.lang.Compiler.eval (Compiler.java:6488)
  clojure.lang.Compiler.eval (Compiler.java:6454)
  clojure.core/eval (core.clj:2797)
  swank.commands.basic/eval-region (basic.clj:47)
  swank.commands.basic/eval-region (basic.clj:37)
  swank.commands.basic/eval770/listener-eval--771 (basic.clj:71)
  clojure.lang.Var.invoke (Var.java:415)
  lonocloud.talk-code/eval1968 (NO_SOURCE_FILE:-1)
  clojure.lang.Compiler.eval (Compiler.java:6488)
  clojure.lang.Compiler.eval (Compiler.java:6454)
  clojure.core/eval (core.clj:2797)
  swank.core/eval-in-emacs-package (core.clj:92)
  swank.core/eval-for-emacs (core.clj:239)
  clojure.lang.Var.invoke (Var.java:423)
  clojure.lang.Var.applyTo (Var.java:532)
  clojure.core/apply (core.clj:601)
  swank.core/eval-from-control (core.clj:99)
  swank.core/eval-loop (core.clj:104)
  swank.core/spawn-repl-thread/fn--533/fn--534 (core.clj:309)
  clojure.core/apply (core.clj:601)
  swank.core/spawn-repl-thread/fn--533 (core.clj:306)
  java.lang.Thread.run (Thread.java:662)
```

Root

C

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Divide by zero

pst syntax error

```
CompilerException java.lang.RuntimeException:  
  Too few arguments to if, compiling:(lonocloud/talk_code.clj:35)  
  clojure.lang.Compiler.analyzeSeq (Compiler.java:6439)  
  clojure.lang.Compiler.analyze (Compiler.java:6239)  
  clojure.lang.Compiler.access$100 (Compiler.java:37)  
  clojure.lang.Compiler$DefExpr$Parser.parse (Compiler.java:512)  
  clojure.lang.Compiler.analyzeSeq (Compiler.java:6432)  
  clojure.lang.Compiler.analyze (Compiler.java:6239)  
  clojure.lang.Compiler.analyze (Compiler.java:6200)  
  clojure.lang.Compiler.eval (Compiler.java:6492)  
  clojure.lang.Compiler.load (Compiler.java:6929)  
  clojure.lang.RT.loadResourceScript (RT.java:359)  
  clojure.lang.RT.loadResourceScript (RT.java:350)  
  clojure.lang.RT.load (RT.java:429)  
Caused by:  
RuntimeException Too few arguments to if  
  clojure.lang.Util.runtimeException (Util.java:170)  
  clojure.lang.Compiler$IfExpr$Parser.parse (Compiler.java:2612)  
  clojure.lang.Compiler.analyzeSeq (Compiler.java:6432)  
  clojure.lang.Compiler.analyze (Compiler.java:6239)
```

New library

```
Root cause java.lang.ArithmeticException: Divide by zero
  clojure.lang.Numbers.divide ..... Numbers.java:156
  clojure.lang.Numbers.divide ..... Numbers.java:3667
  lonocloud.talk_code/coconut ..... talk_code.clj:22
Rethrown as java.lang.Exception: coconut failed with n 0: ...
  lonocloud.talk_code/coconut ..... talk_code.clj:26
  lonocloud.talk_code/banana ..... talk_code.clj:30
  lonocloud.talk_code/apple ..... talk_code.clj:33
  lonocloud.talk_code/coconut ..... talk_code.clj:23
Rethrown as java.lang.Exception: coconut failed with n 1: ...
  lonocloud.talk_code/coconut ..... talk_code.clj:26
  lonocloud.talk_code/banana ..... talk_code.clj:30
  lonocloud.talk_code/apple ..... talk_code.clj:33
  lonocloud.talk_code/coconut ..... talk_code.clj:23
Rethrown as java.lang.Exception: coconut failed with n 2: ...
  lonocloud.talk_code/coconut ..... talk_code.clj:26
  lonocloud.talk_code/banana ..... talk_code.clj:30
  lonocloud.talk_code/apple ..... talk_code.clj:33
swank.commands.basic/eval-region ..... basic.clj:47
swank.commands.basic/eval-region ..... basic.clj:37
swank.commands.basic/eval770°listener-eval ..... basic.clj:71
  swank.core/eval-in-emacs-package ..... core.clj:92
  swank.core/eval-for-emacs ..... core.clj:239
  swank.core/eval-from-control ..... core.clj:99
  swank.core/eval-loop ..... core.clj:104
  swank.core/spawn-repl-thread°fn°fn ..... core.clj:309
  swank.core/spawn-repl-thread°fn ..... core.clj:306
```

New library

```
Root cause java.lang.ArithmeticException: Divide by zero
  clojure.lang.Numbers.divide ..... Numbers.java:156
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  lonocloud.talk_code/apple ..... talk_code.clj:33
  lonocloud.talk_code/coconut ..... talk_code.clj:23
Rethrown as java.lang.Exception: coconut failed with n 2: ...
  lonocloud.talk_code/coconut ..... talk_code.clj:26
  lonocloud.talk_code/banana ..... talk_code.clj:30
  lonocloud.talk_code/apple ..... talk_code.clj:33
  lonocloud.talk_code/coconut ..... talk_code.clj:26
```

New library

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swank.commands.basic/eval-region ..... basic.clj:47
swank.commands.basic/eval-region ..... basic.clj:37
swank.commands.basic/eval770°listener-eval ..... basic.clj:71
  swank.core/eval-in-emacs-package ..... core.clj:92
  swank.core/eval-for-emacs ..... core.clj:239
  swank.core/eval-from-control ..... core.clj:99
  swank.core/eval-loop ..... core.clj:104
  swank.core/spawn-repl-thread°fn°fn ..... core.clj:309
  swank.core/spawn-repl-thread°fn ..... core.clj:306
```

A step further

- We've got the cause chain as data
- Sending across threads loses stack
- ...SO...
- Snapshot before send
- In new thread, catch any exception
- Splice the two together for printing

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- In new thread, catch any exception
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This is Longbottom

This is Longbottom

```
(ns examples
  (:require [lonocloud.longbottom :as lb]))

;; Print any exceptions thrown by calling apple
(lb/printing-exceptions
 (apple 2))

;; Send a function that smuggles our call stack
(send (agent :foo)
      (lb/smuggling-fn* inc "my agent send"))
```

```
Root cause java.lang.ClassCastException: clojure.lang.Keyword cannot be cast to java.lang.Number
  clojure.lang.Numbers.inc ..... Numbers.java:110
    clojure.core/inc ..... core.clj:863
Smuggled: my agent send
  swank.commands.basic/eval-region ..... basic.clj:47
  swank.commands.basic/eval-region ..... basic.clj:37
  swank.commands.basic/eval770°listener-eval ..... basic.clj:71
```

```
Root cause java.lang.ClassCastException
  clojure.lang.Numbers.inc .....
    clojure.core/inc .....
```

Smuggled: my agent send

```
swank.commands.basic/eval-region ....
swank.commands.basic/eval-region ....
swank.commands.basic/eval770°listener
  swank.core/eval-in-emacs-pa
  swank.core/eval-for-emacs .
  swank.core/eval-from-control
  swank.core/eval-loop .....
  swank.core/spawn-repl-thread
  swank.core/spawn-repl-thread
```

java.lang.Exception: coconut failed with n 2: coconut failed with n 1: coconut failed with n 0: Divide by zero

```
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$eval1970.invoke(NO_SOURCE_FILE:1)
at clojure.lang.Compiler.eval(Compiler.java:6488)
at clojure.lang.Compiler.eval(Compiler.java:6454)
at clojure.core$eval.invoke(core.clj:2797)
at swank.commands.basic$eval_region.invoke(basic.clj:47)
at swank.commands.basic$eval_region.invoke(basic.clj:37)
at swank.commands.basic$eval770$listener_eval_771.invoke(basic.clj:71)
at clojure.lang.Var.invoke(Var.java:415)
at lonocloud.talk_code$eval1968.invoke(NO_SOURCE_FILE)
at clojure.lang.Compiler.eval(Compiler.java:6488)
at clojure.lang.Compiler.eval(Compiler.java:6454)
at clojure.core$eval.invoke(core.clj:2797)
at swank.core$eval_in_emacs_package.invoke(core.clj:92)
at swank.core$eval_for_emacs.invoke(core.clj:239)
at clojure.lang.Var.invoke(Var.java:423)
at clojure.lang.AFn.applyToHelper(AFn.java:167)
at clojure.lang.Var.applyTo(Var.java:532)
at clojure.core$apply.invoke(core.clj:601)
at swank.core$eval_from_control.invoke(core.clj:99)
at swank.core$eval_loop.invoke(core.clj:104)
at swank.core$spawn_repl_thread$fn__533$fn__534.invoke(core.clj:309)
at clojure.lang.AFn.applyToHelper(AFn.java:159)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:601)
at swank.core$spawn_repl_thread$fn__533.doInvoke(core.clj:306)
at clojure.lang.RestFn.invoke(RestFn.java:397)
at clojure.lang.AFn.run(AFn.java:24)
at java.lang.Thread.run(Thread.java:662)
```

Caused by: java.lang.Exception: coconut failed with n 1: coconut failed with n 0: Divide by zero

```
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
... 36 more
```

Caused by: java.lang.Exception: coconut failed with n 0: Divide by zero

```
at lonocloud.talk_code$coconut.invoke(talk_code.clj:26)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
at clojure.lang.AFn.applyTo(AFn.java:151)
at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$banana.invoke(talk_code.clj:30)
at clojure.lang.AFn.applyToHelper(AFn.java:161)
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at clojure.core$apply.invoke(core.clj:603)
at lonocloud.talk_code$apple.invoke(talk_code.clj:33)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:23)
... 45 more
```

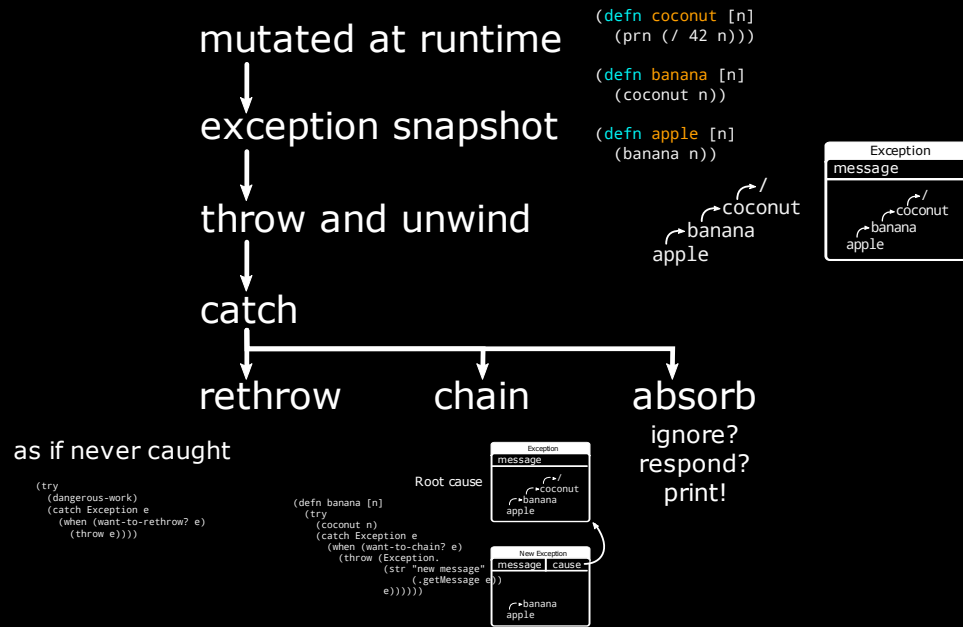
Caused by: java.lang.ArithmeticException: Divide by zero

```
at clojure.lang.Numbers.divide(Numbers.java:156)
at clojure.lang.Numbers.divide(Numbers.java:3667)
at lonocloud.talk_code$coconut.invoke(talk_code.clj:22)
... 54 more
```

Root cause java.lang.ArithmeticException: Divide by zero

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```

The life of a Java call stack



- Convert snapshot to Clojure data
- Fix the order of causes
- Filter out redundant cause messages
- Filter out low-signal call frames
- Clean up Clojure function names
- Column layout so eye can follow related info
- Replaceable print function

```
(declare apple)

(defn coconut [n]
  (try
    (prn (/ 42 n))
    (apple (dec n))
    (catch Exception e
      (throw (Exception.
                    (str "coconut failed with n " n
                        ": " (.getMessage e))
                    e))))))

(defn banana [n]
  (apply coconut n nil))

(defn apple [n]
  (apply banana n nil))
```

[illegible]

clojure.repl/pst

[illegible]

pst syntax error

[illegible]

New library

[illegible]

A step further

- We've got the cause chain as data
- Sending across threads loses stack ...SO...
- Snapshot before send
- In new thread, catch any exception
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This is Longbottom

```
(ns examples
  (:require [lonocloud.longbottom :as lb]))

;; Print any exceptions thrown by calling apple
(lb/printing-exceptions
 (apple 2))

;; Send a function that smuggles our call stack
(send (agent :foo)
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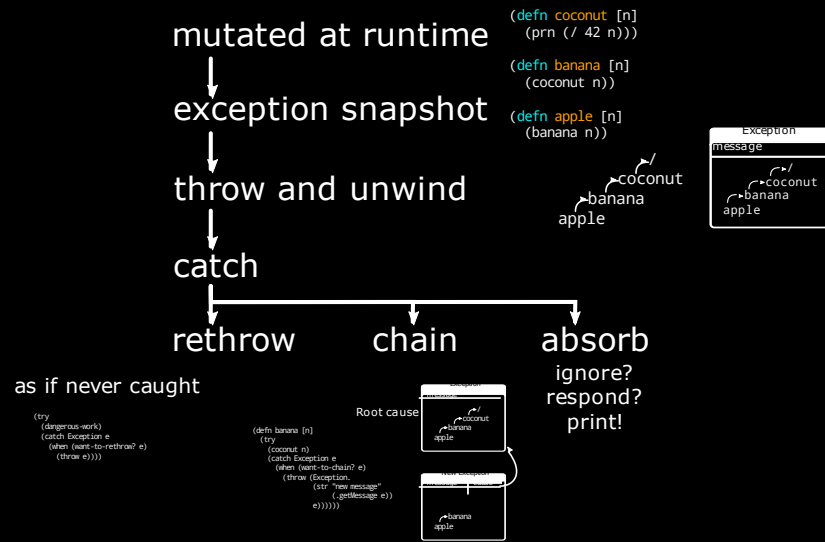
[illegible]

```

1  # Import the necessary libraries
2  import pandas as pd
3  import numpy as np
4  from sklearn.preprocessing import StandardScaler
5  from sklearn.model_selection import train_test_split
6  from sklearn.metrics import mean_squared_error, r2_score
7  from sklearn.linear_model import LinearRegression
8  from sklearn.ensemble import RandomForestRegressor
9  from sklearn.svm import SVR
10 from sklearn.neural_network import MLPRegressor
11
12 # Load the dataset
13 data = pd.read_csv('data.csv')
14
15 # Split the data into features (X) and target variable (y)
16 X = data[['feature1', 'feature2', 'feature3']]
17 y = data['target']
18
19 # Split the data into training and testing sets
20 X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
21
22 # Standardize the features
23 scaler = StandardScaler()
24 X_train = scaler.fit_transform(X_train)
25 X_test = scaler.transform(X_test)
26
27 # Train the Linear Regression model
28 lr = LinearRegression()
29 lr.fit(X_train, y_train)
30
31 # Predict using the Linear Regression model
32 y_pred_lr = lr.predict(X_test)
33
34 # Calculate the Mean Squared Error (MSE) and R-squared (R2) for Linear Regression
35 mse_lr = mean_squared_error(y_test, y_pred_lr)
36 r2_lr = r2_score(y_test, y_pred_lr)
37
38 # Train the Random Forest model
39 rf = RandomForestRegressor()
40 rf.fit(X_train, y_train)
41
42 # Predict using the Random Forest model
43 y_pred_rf = rf.predict(X_test)
44
45 # Calculate the Mean Squared Error (MSE) and R-squared (R2) for Random Forest
46 mse_rf = mean_squared_error(y_test, y_pred_rf)
47 r2_rf = r2_score(y_test, y_pred_rf)
48
49 # Train the Support Vector Regression (SVR) model
50 svr = SVR()
51 svr.fit(X_train, y_train)
52
53 # Predict using the SVR model
54 y_pred_svr = svr.predict(X_test)
55
56 # Calculate the Mean Squared Error (MSE) and R-squared (R2) for SVR
57 mse_svr = mean_squared_error(y_test, y_pred_svr)
58 r2_svr = r2_score(y_test, y_pred_svr)
59
60 # Train the Multi-Layer Perceptron (MLP) model
61 mlp = MLPRegressor()
62 mlp.fit(X_train, y_train)
63
64 # Predict using the MLP model
65 y_pred_mlp = mlp.predict(X_test)
66
67 # Calculate the Mean Squared Error (MSE) and R-squared (R2) for MLP
68 mse_mlp = mean_squared_error(y_test, y_pred_mlp)
69 r2_mlp = r2_score(y_test, y_pred_mlp)
70
71 # Print the results
72 print("Linear Regression Results:")
73 print("MSE: ", mse_lr)
74 print("R2: ", r2_lr)
75
76 print("Random Forest Results:")
77 print("MSE: ", mse_rf)
78 print("R2: ", r2_rf)
79
80 print("SVR Results:")
81 print("MSE: ", mse_svr)
82 print("R2: ", r2_svr)
83
84 print("MLP Results:")
85 print("MSE: ", mse_mlp)
86 print("R2: ", r2_mlp)

```

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  (try
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    (catch Exception e
      (throw (Exception.
        (str "coconut failed with n " n
          ": " (.getMessage e))
        e))))))

(defn banana [n]
  (apply coconut n nil))

(defn apple [n]
  (apply banana n nil))
```

.printStackTrace

Final Cause

Root cause

Root Cause

clojure.repl/pst

pst syntax error

New library

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- Sending across threads loses stack
- ...SO...
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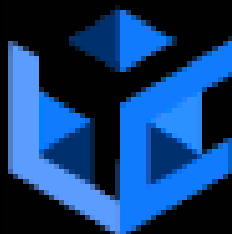
```
(ns examples
  (:require [longcloud.longbottom :as lb]))

;; Print any exceptions thrown by calling apple
;; (lib/printing-exceptions
;;  (exn 2))

;; Send a function that mangles our call stack
;; (send (agent -foo)
;;  (lib/mangle-fn-inc "my agent send"))
```

```
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LONOCLOUD