

Control Flow in Common Lisp

aka Why Lisp Doesn't Need To Throw Exceptions

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If this presentation only had a single sentence

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- We need means of **unwinding** and **finally blocks**

If this presentation only had a single slide

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 - `catch/throw`
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 - **The above four groups are implemented in Common Lisp itself**

Let's talk about Common Lisp

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- Compiled multiparadigm interactive programming language

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- Compiled multiparadigm interactive programming language
- ANSI-standardized in 1994
- Multiple conforming implementations with different qualities
- Relatively small but active community
- Continuously used for commercial projects and research

Let's talk about Common Lisp

Let's talk about Common Lisp

GIT THE PRINCESS!

HOW TO SAVE THE PRINCESS
USING 8 PROGRAMMING
LANGUAGES

BY  toggl
Goon Squad

MART VIRKUS '16

Let's talk

BY toggl
Goon Squad

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BY toggi
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MART VIRKUS '16

YOU HAVE C

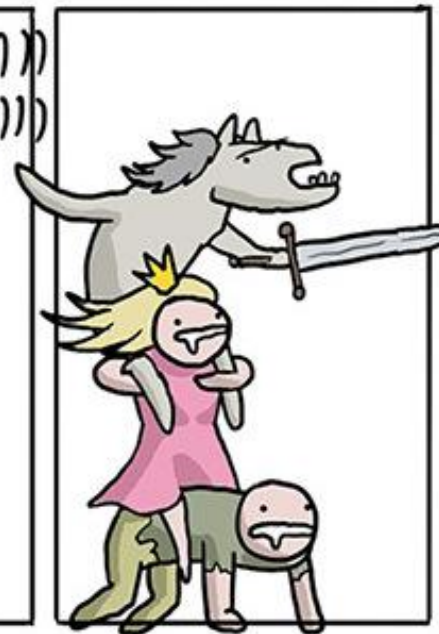


YOU HAVE A LIBRARY
FOR A CASTLE &
A LIBRARY FOR THE
PRINCESS -
CHARGE!



LL-TERMINATOR?

A cartoon illustration showing a queen with blonde hair and a crown riding a grey dog. She is wearing a pink dress and has her arms outstretched. A knight in full plate armor is kneeling behind her, holding a sword upright. A large treasure chest is on the ground between them. The text 'LL-TERMINATOR?' is written above the queen.



Let's talk

BY toggli
Goon Squad

MART VIRKUS '16

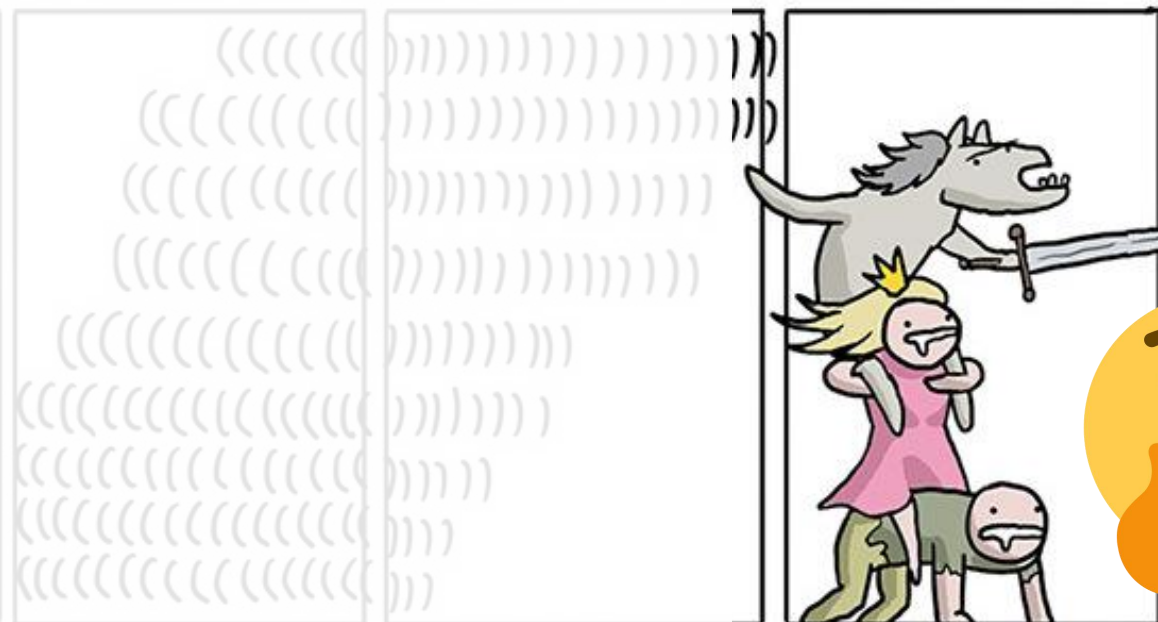
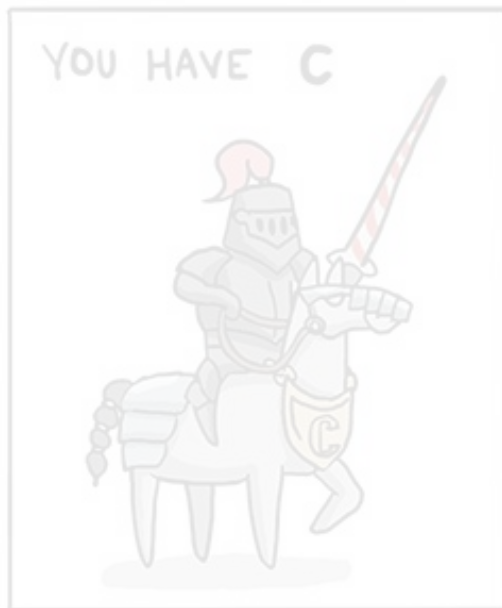
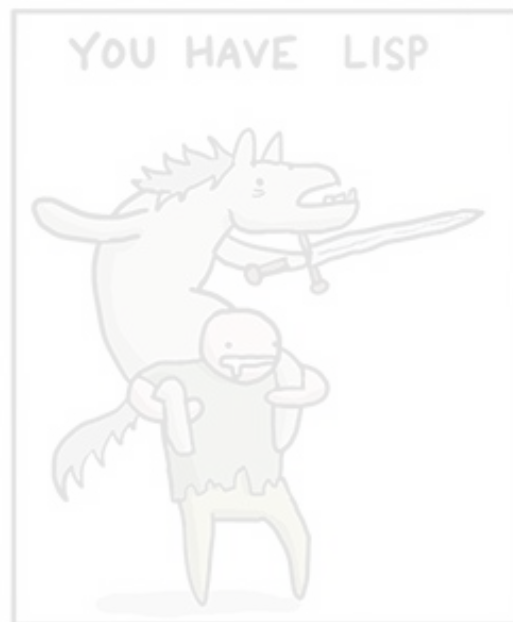
GET THE PRINCESSES!

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Let's talk about control flow

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Let's talk about control flow in Common Lisp

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- `if`

```
(if (foo)  
    (bar)  
    (baz))
```

Let's talk about control flow in Common Lisp

- if
- tagbody/go

```
(tagbody  
  10 (print "hello")  
  20 (go 10))
```

Let's talk about control flow in Common Lisp

- `if`
- `tagbody/go`
- `block/return-from`

```
(block my-block  
  (...)  
  (... (return-from my-block 42))  
  (...))
```

Let's talk about control flow in Common Lisp

- if
- tagbody/go
- block/return-from
- catch/throw

```
(catch 'quux  
  (...)  
  (... (foo))  
  (...)))
```

```
(defun foo ()  
  (throw 'quux 42))
```

Let's talk about control flow in Common Lisp

- `if`
- `tagbody/go`
- `block/return-from`
- `catch/throw`
- `unwind-protect`

```
(let ((thing (make-thing)))  
  (unwind-protect (frob thing)  
    (cleanup thing)))
```

Let's talk about control flow in Common Lisp

- if
- tagbody/go
- block/return-from
- catch/throw
- unwind-protect
- lambda/apply

```
(let ((fn (lambda ...))  
      (args ...))  
  (apply fn 1 2 3 args))
```

Let's talk about control flow in Common Lisp

- if
- tagbody/go
- block/return-from
- catch/throw
- unwind-protect
- lambda/apply ; and funcall

```
(let ((fn (lambda ...))  
      (args ...))  
  (apply fn 1 2 3 args))
```

```
(let ((fn (lambda ...)))  
  (funcall fn 1 2 3))
```

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Let's talk about closures

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```
(let ((x 42))  
  (lambda () x))
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```
;; but we can close over more  
;; than just lexical variables!
```

Let's talk about non-local control flow in Common Lisp

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(let ((x 42))  
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;; #<FUNCTION (LAMBDA ())>
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(funcall *) ; (funcall #<FUNCTION (LAMBDA ())>)  
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(defun foo (x) (funcall x))
```

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(defun foo (x) (funcall x))
```

```
(defun bar () ; block bar  
  ...)
```

Let's talk about non-local control flow in Common Lisp

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(defun foo (x) (funcall x))
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```
(defun bar ()  
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    ...))
```

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(defun bar ()  
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    (foo fn)))
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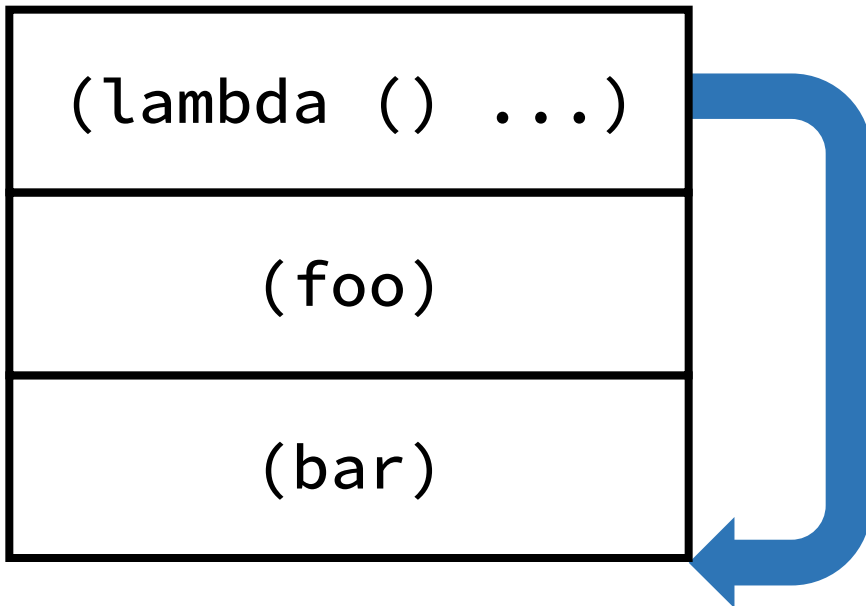
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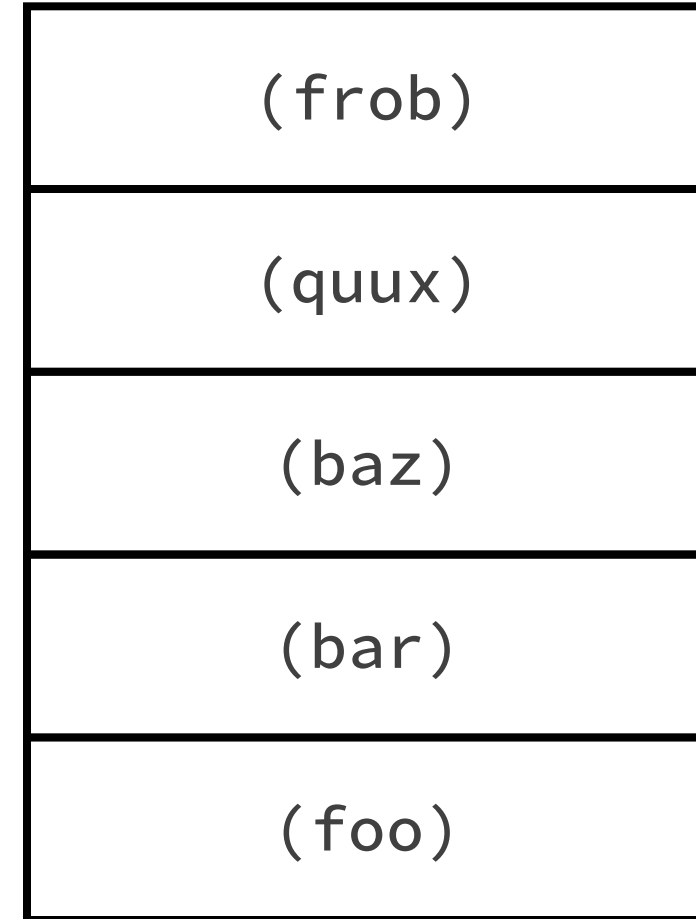
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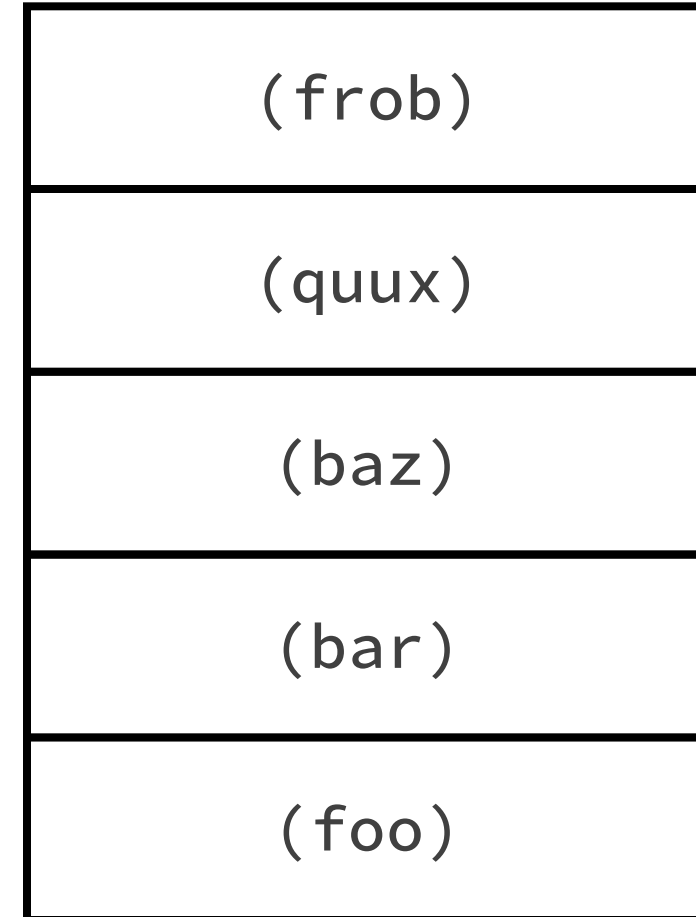
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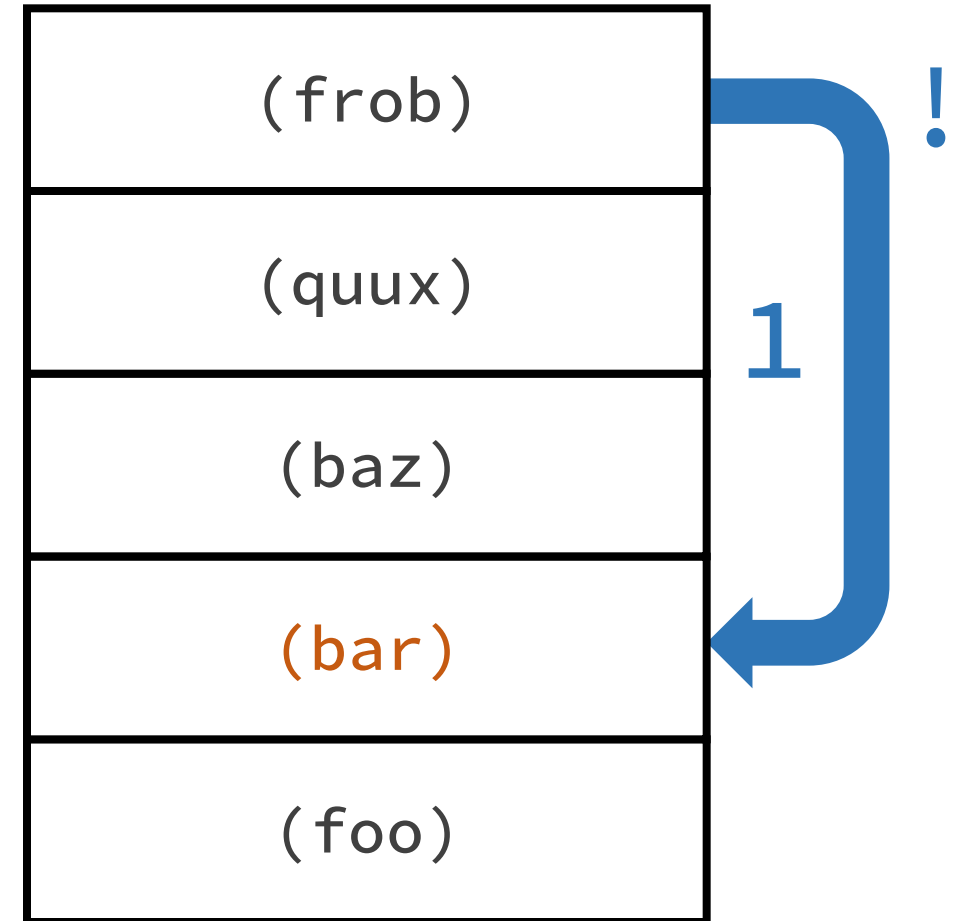
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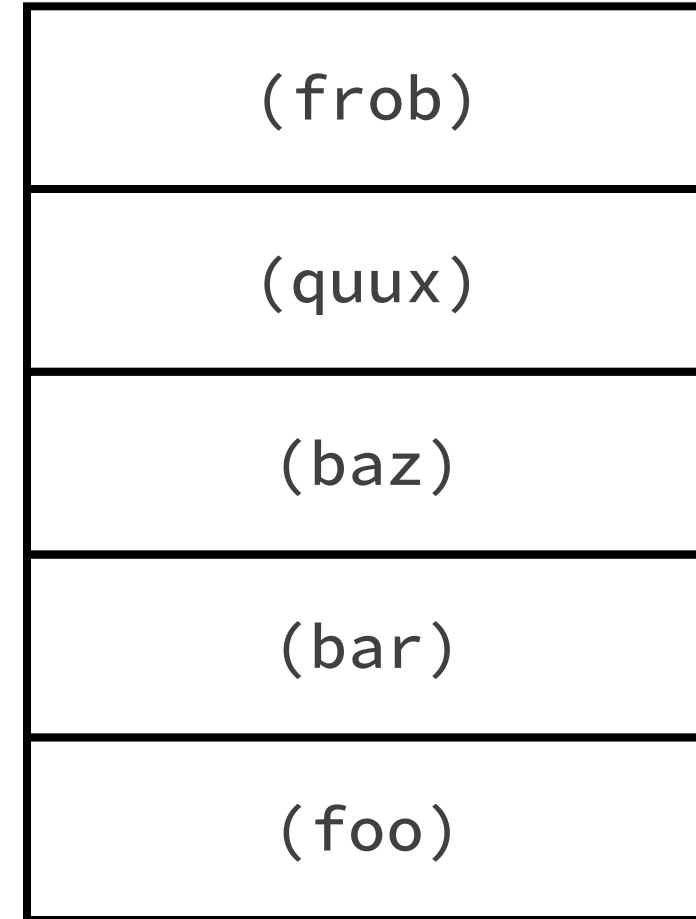
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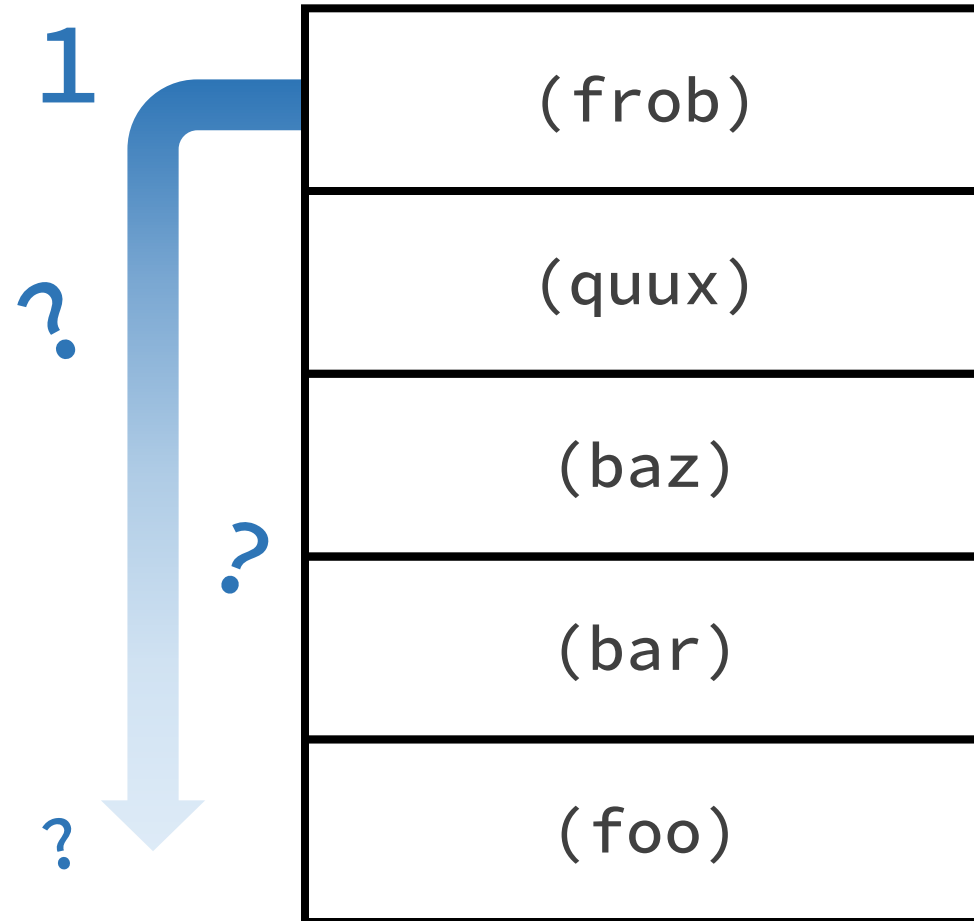
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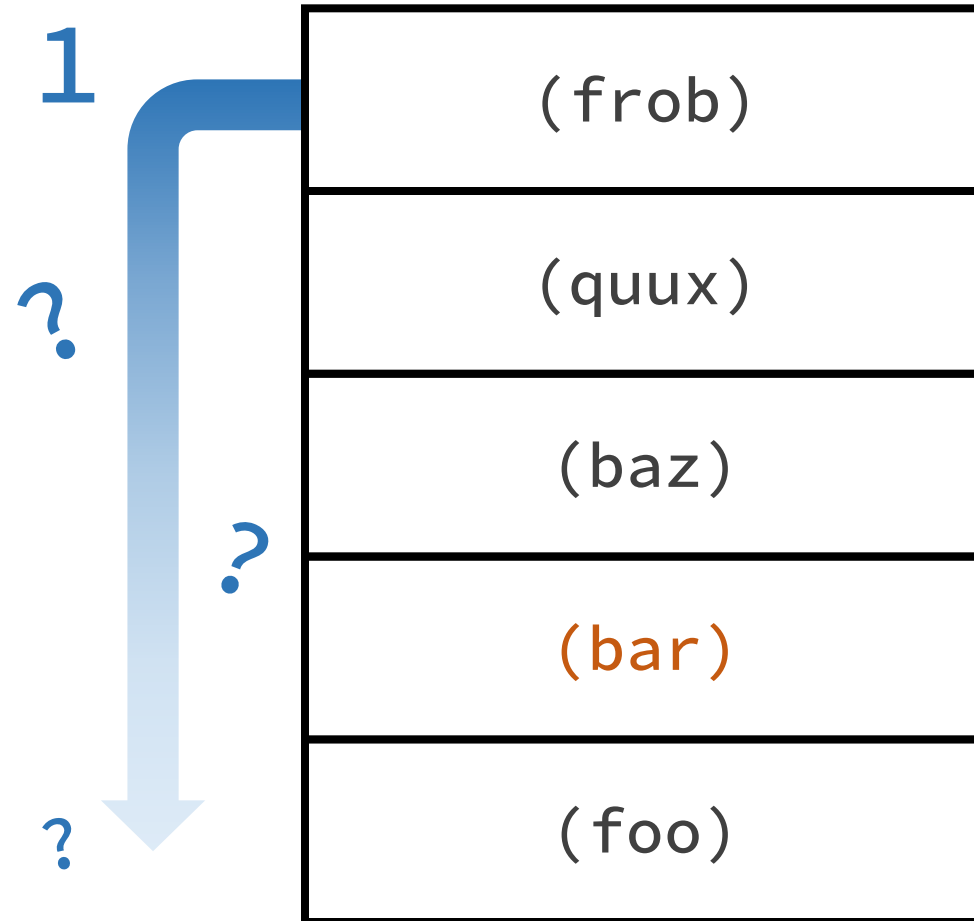
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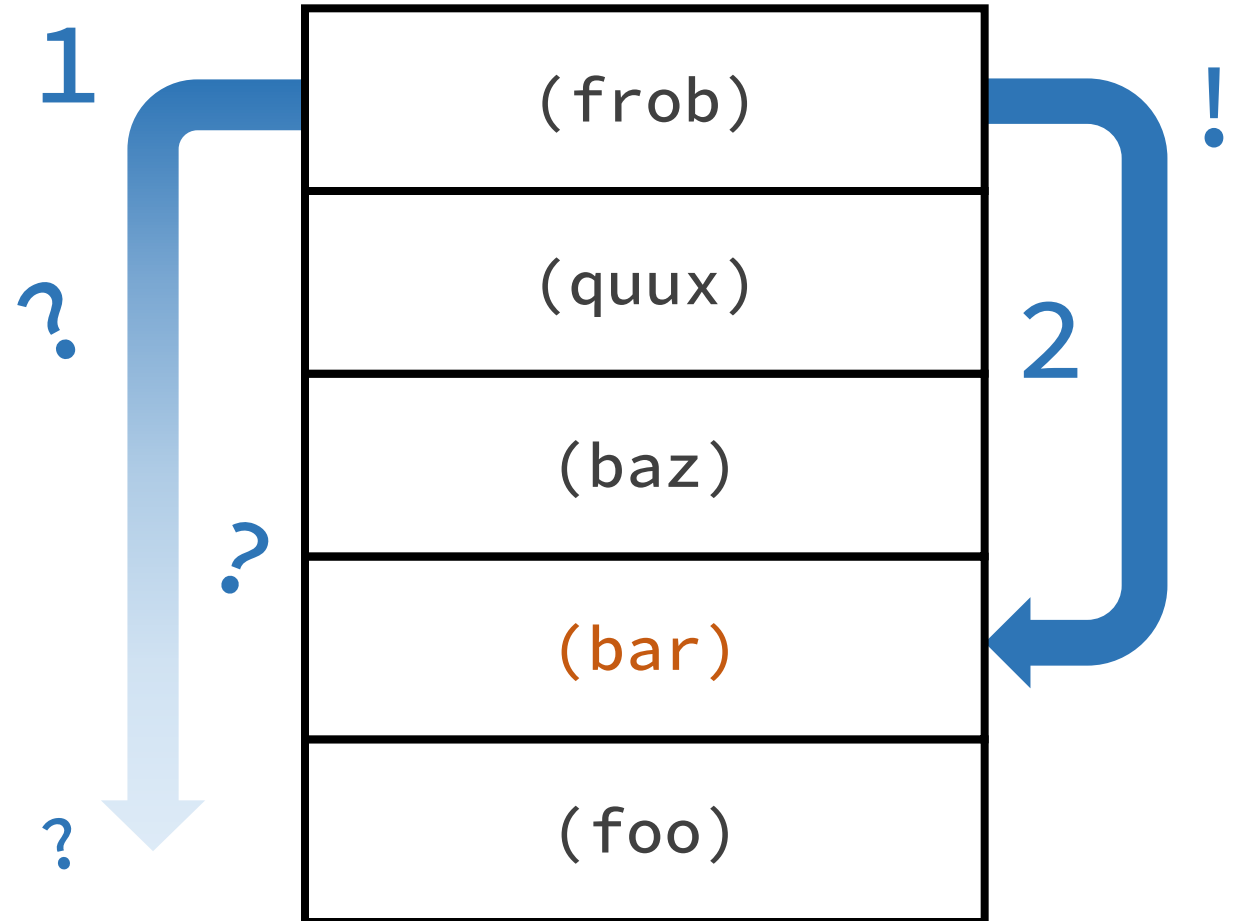
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Let's talk about unwinding in Common Lisp

- `if`
- `tagbody/go` ; 1-phase unwind (no search)
- `block/return-from` ; 1-phase unwind (no search)
- `catch/throw` ; 2-phase unwind (search)
- `unwind-protect`
- `lambda/apply`

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- This list includes use cases that are *not related* to exception handling

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- Control flow \neq exception handling

Let's talk about control flow in general

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- `block/return-from`
- `catch/throw`
- `unwind-protect`
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 - loops (`do`, `dolist`, `loop`, ...)
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- **Control flow \neq exception handling**

Let's talk about control flow in general

- Control flow \neq exception handling

Let's talk about control flow in general

- Do not conflate unwinding with throwing exceptions
- Control flow \neq exception handling

Let's talk about control flow in general

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 - Throwing exceptions is *a subset* of control flow
- Control flow \neq exception handling

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Let's talk about control flow in general

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- Proofs: Common Lisp, Dylan, Smalltalk
- Control flow \neq exception handling

Let's talk about control flow in WebAssembly

- Do not conflate unwinding with throwing exceptions
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Let's talk about control flow in WebAssembly

- Control flow \neq exception handling

Let's talk about control flow in WebAssembly

- Suggestion: unwinding as a WebAssembly primitive
 - Name the WASM operator `unwind` instead of `throw` perhaps?
- Control flow \neq exception handling

Let's talk about control flow in WebAssembly

- Suggestion: unwinding as a WebAssembly primitive
 - Name the WASM operator `unwind` instead of `throw` perhaps?
- Suggestion: WebAssembly terminology change
 - `1PEH` → `1PU` = one-phase unwinding (`unwind`)
 - `2PEH` → `2PU` = two-phase unwinding (`stack-search` + `unwind`)

• Control flow ≠ exception handling

Let's talk about control flow in WebAssembly

- Suggestion: unwinding as a WebAssembly primitive
 - Name the WASM operator `unwind` instead of `throw` perhaps?
 - Suggestion: WebAssembly terminology change
 - `1PEH` → `1PU` = one-phase unwinding (`unwind`)
 - `2PEH` → `2PU` = two-phase unwinding (`stack-search` + `unwind`)
 - Suggestion: support for dynamic (fluid) variables?
 - Basis for implementing a condition system
 - Otherwise, we will need some other stack-searching operator
 - ...or we'll need to reimplement dynamic variables
- Control flow ≠ exception handling**

Let's talk about control flow in WebAssembly

Let's talk about control flow in WebAssembly

- <https://github.com/phoe/cafe-latte/>
Common Lisp control flow operators and condition system implemented in Java

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- <https://www.youtube.com/watch?v=V4P9IFK79hQ>
Control Flow in Common Lisp - Online Lisp Meeting #11,
a recording of material presented in this talk,
including the differences between conditions and exceptions

<3



but wait hold on for just one moment

Control Flow in Common Lisp

***aka* Why Lisp Doesn't Need To Throw Exceptions**

Appendix A

Differences between conditions and exceptions

Let's talk about control flow

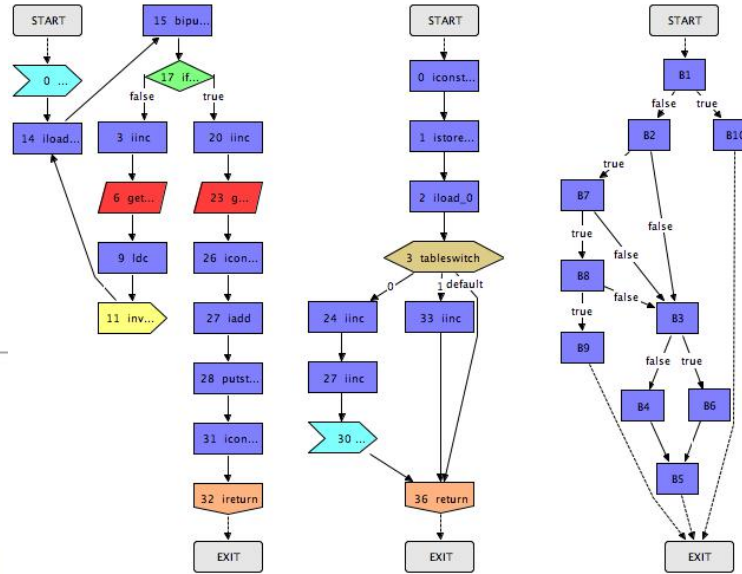
Let's talk about control flow

Control flow

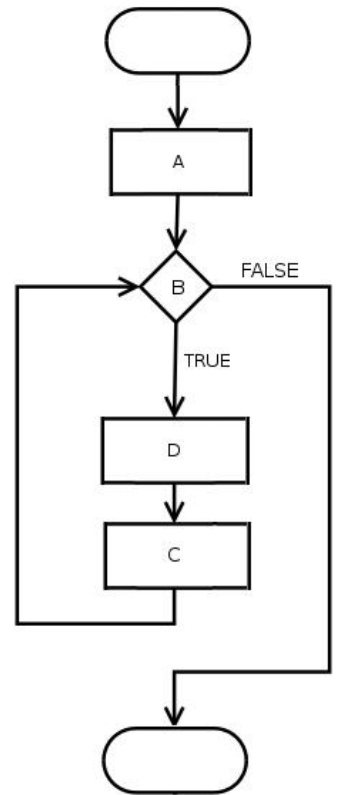
From Wikipedia, the free encyclopedia

Not to be confused with [Flow control \(data\)](#).

In [computer science](#), **control flow** (or **flow of control**) is the order in which individual [statements](#), [instructions](#) or [function calls](#) of an [imperative program](#) are [executed](#) or evaluated. The emphasis on explicit control flow distinguishes an [imperative programming](#) language from a [declarative programming](#) language.



for(A;B;C)
D;



Let's talk about non-local control flow

Structured non-local control flow [\[edit \]](#)

Many programming languages, especially those favoring more dynamic styles of programming, offer constructs for *non-local control flow*. These cause the flow of execution to jump out of a given context and resume at some predeclared point. *Conditions*, *exceptions* and *continuations* are three common sorts of non-local control constructs; more exotic ones also exist, such as *generators*, *coroutines* and the *async* keyword.

Let's talk about non-local control flow

Structured non-local control flow [\[edit \]](#)

Many programming languages, especially those favoring more dynamic styles of programming, offer constructs for *non-local control flow*. These cause the flow of execution to jump out of a given context and resume at some predeclared point. **Conditions, exceptions** and *continuations* are three common sorts of non-local control constructs; more exotic ones also exist, such as *generators*, *coroutines* and the *async* keyword.



Let's talk about exceptions

Exception support in programming languages [\[edit \]](#)

See also: [Exception handling syntax](#)

Many computer languages have built-in support for exceptions and exception handling. This includes [ActionScript](#), [Ada](#), [BlitzMax](#), [C++](#), [C#](#), [Clojure](#), [COBOL](#), [D](#), [ECMAScript](#), [Eiffel](#), [Java](#), [ML](#), [Next Generation Shell](#), [Object Pascal](#) (e.g. [Delphi](#), [Free Pascal](#), and the like), [PowerBuilder](#), [Objective-C](#), [OCaml](#), [PHP](#) (as of version 5), [PL/I](#), [PL/SQL](#), [Prolog](#), [Python](#), [REALbasic](#), [Ruby](#), [Scala](#), [Seed7](#), [Smalltalk](#), [Tcl](#), [Visual Prolog](#) and most [.NET](#) languages. Exception handling is commonly not resumable in those languages, and when an exception is thrown, the program searches back through the [stack](#) of function calls until an exception handler is found.

Some languages call for [unwinding](#) the stack as this search progresses. That is, if function *f*, containing a handler *H* for exception *E*, calls function *g*, which in turn calls function *h*, and an exception *E* occurs in *h*, then functions *h* and *g* may be terminated, and *H* in *f* will handle *E*.

Let's talk about exceptions

Exception support in programming languages [\[edit \]](#)

See also: *Exception handling syntax*

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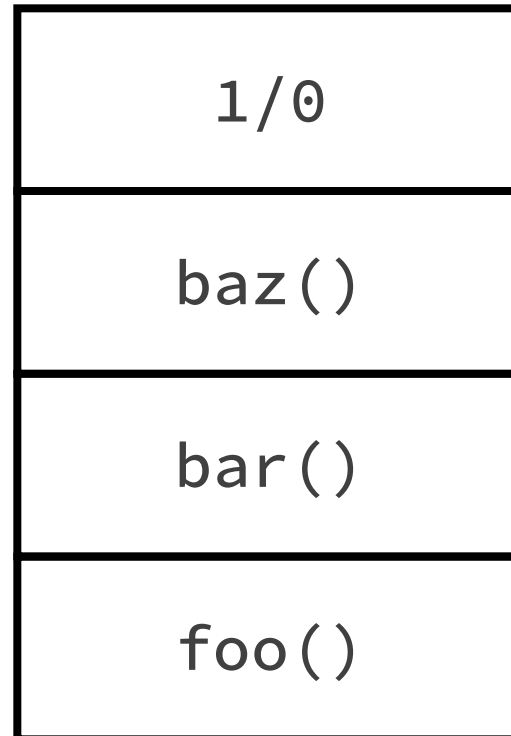


Let's talk about exceptions

Let's talk about exceptions



Let's talk about exceptions



Let's talk about exceptions



ArithmeticException

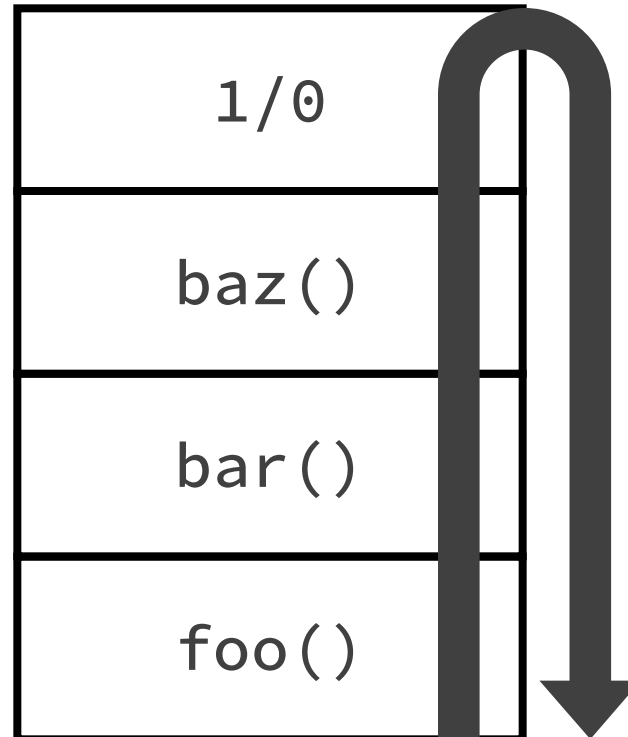
1/0
baz()
bar()
foo()



Let's talk about exceptions



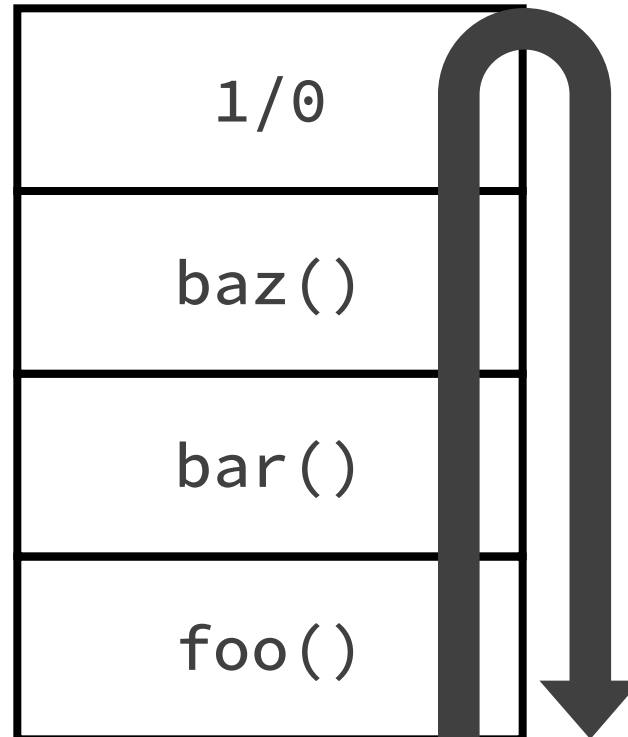
ArithmeticException



Let's talk about exceptions



ArithmeticException



Let's talk about exceptions



ArithmeticException

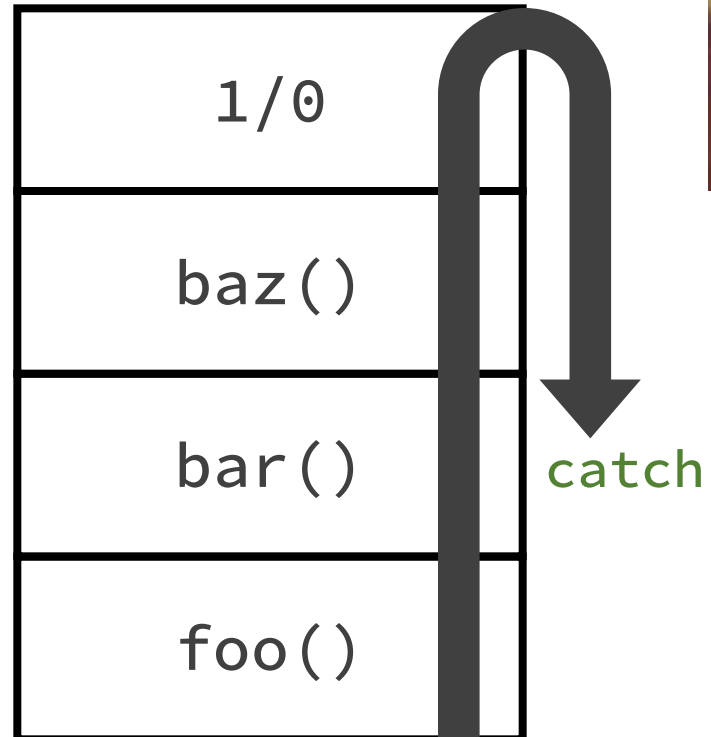
1/0
baz()
bar()
foo()



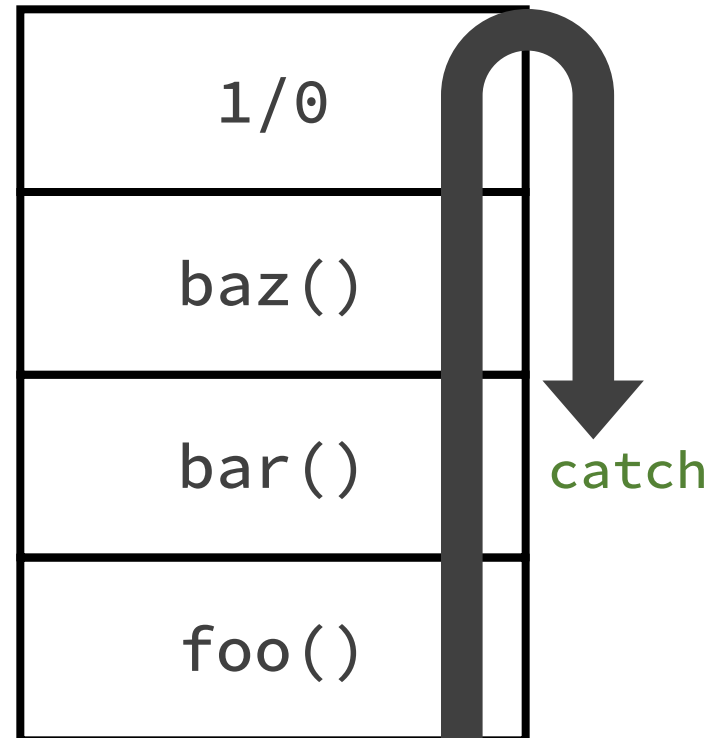
Let's talk about exceptions



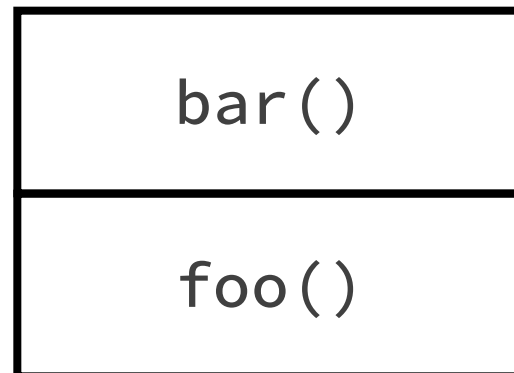
ArithmeticException



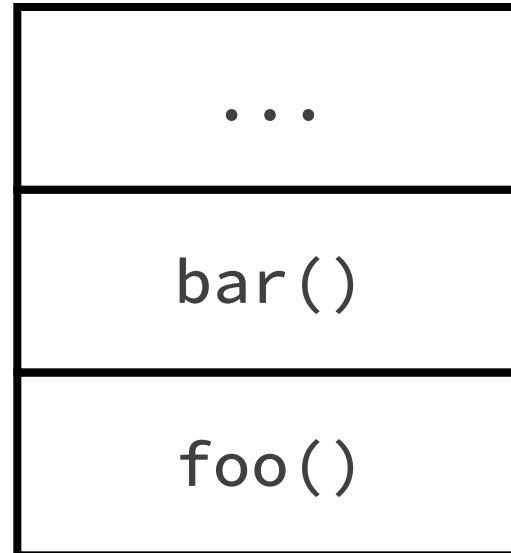
Let's talk about exceptions



Let's talk about exceptions



Let's talk about exceptions



// execution continues

Let's talk about conditions

Condition systems [\[edit \]](#)

Common Lisp, Dylan and Smalltalk have a **condition system**^[53] (see [Common Lisp Condition System](#)) that encompasses the aforementioned exception handling systems. In those languages or environments the advent of a condition (a "generalisation of an error" according to [Kent Pitman](#)) implies a function call, and only late in the exception handler the decision to unwind the stack may be taken.

Conditions are a generalization of exceptions. When a condition arises, an appropriate condition handler is searched for and selected, in stack order, to handle the condition. Conditions that do not represent errors may safely go unhandled entirely; their only purpose may be to propagate hints or warnings toward the user.^[54]

Let's talk about conditions

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Let's talk about signaling an error

Let's talk about signaling an error

(baz)
(bar)
(foo)

Let's talk about signaling an error

(/ 1 0)
(baz)
(bar)
(foo)

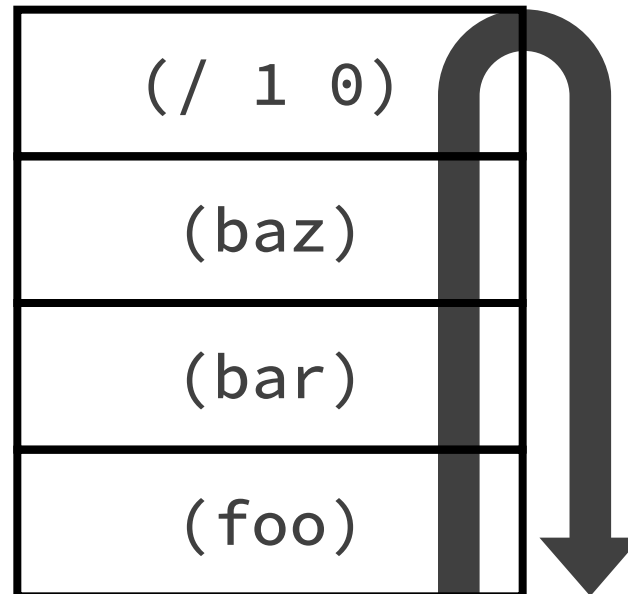
Let's talk about signaling an error

division-by-zero

(/ 1 0)
(baz)
(bar)
(foo)

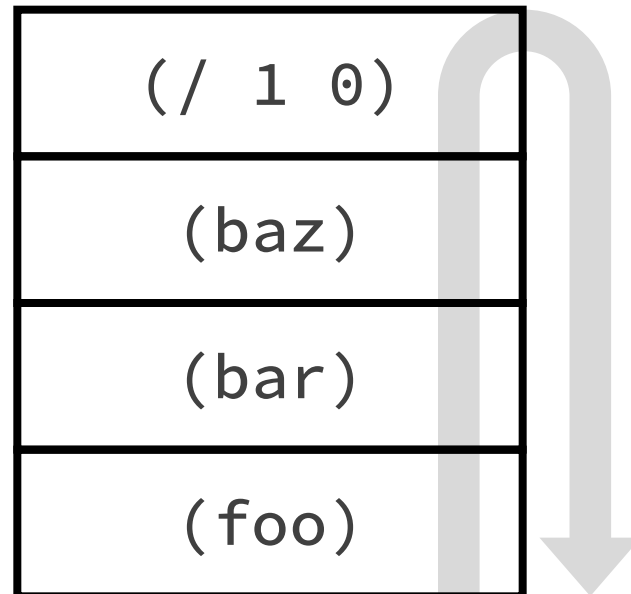
Let's talk about signaling an error

division-by-zero



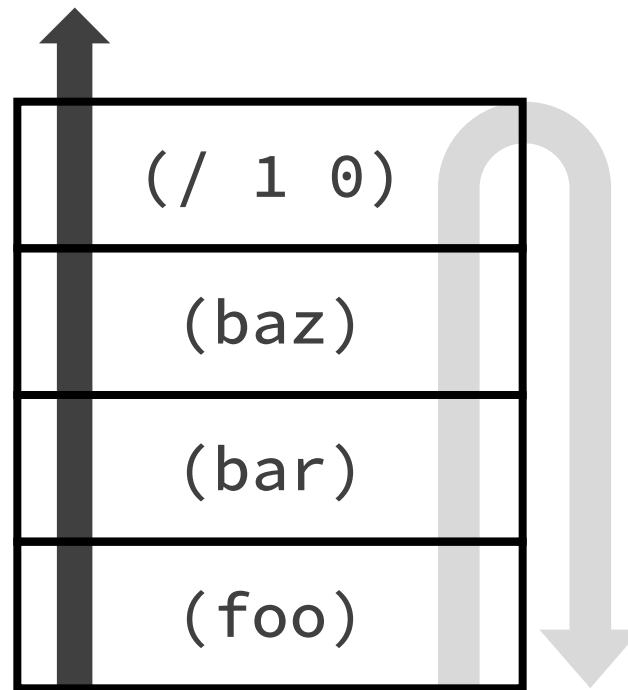
Let's talk about signaling an error

division-by-zero

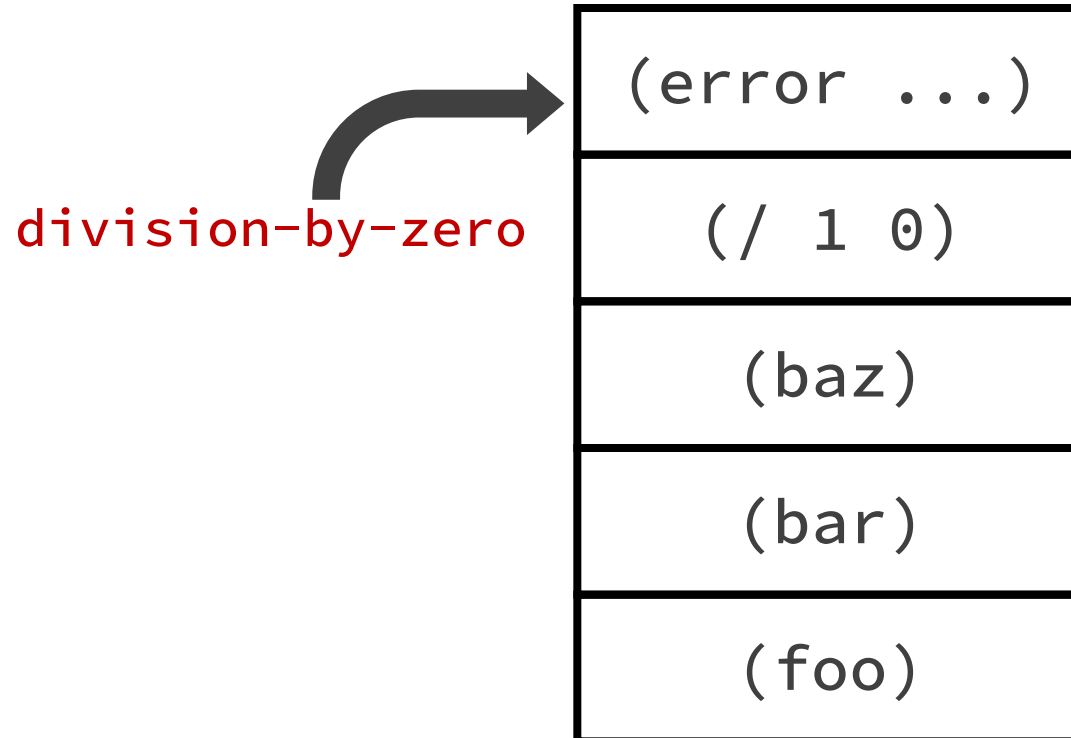


Let's talk about signaling an error

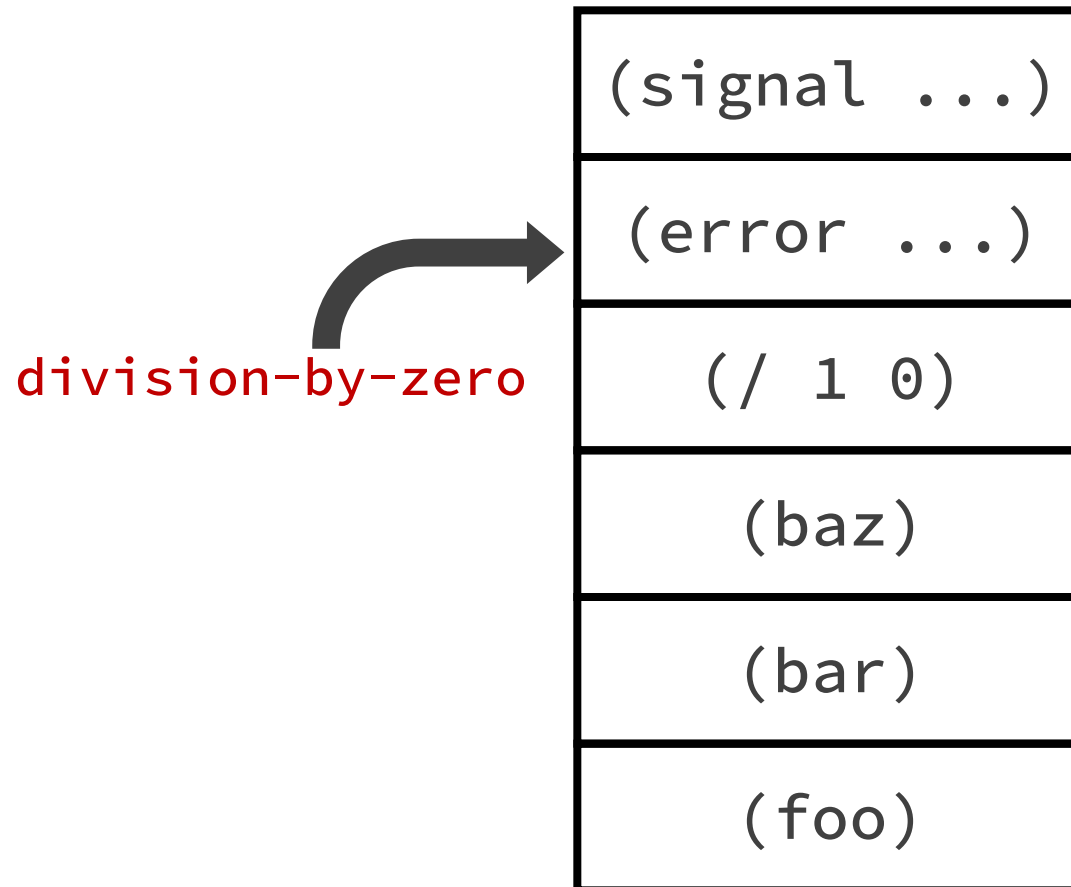
division-by-zero



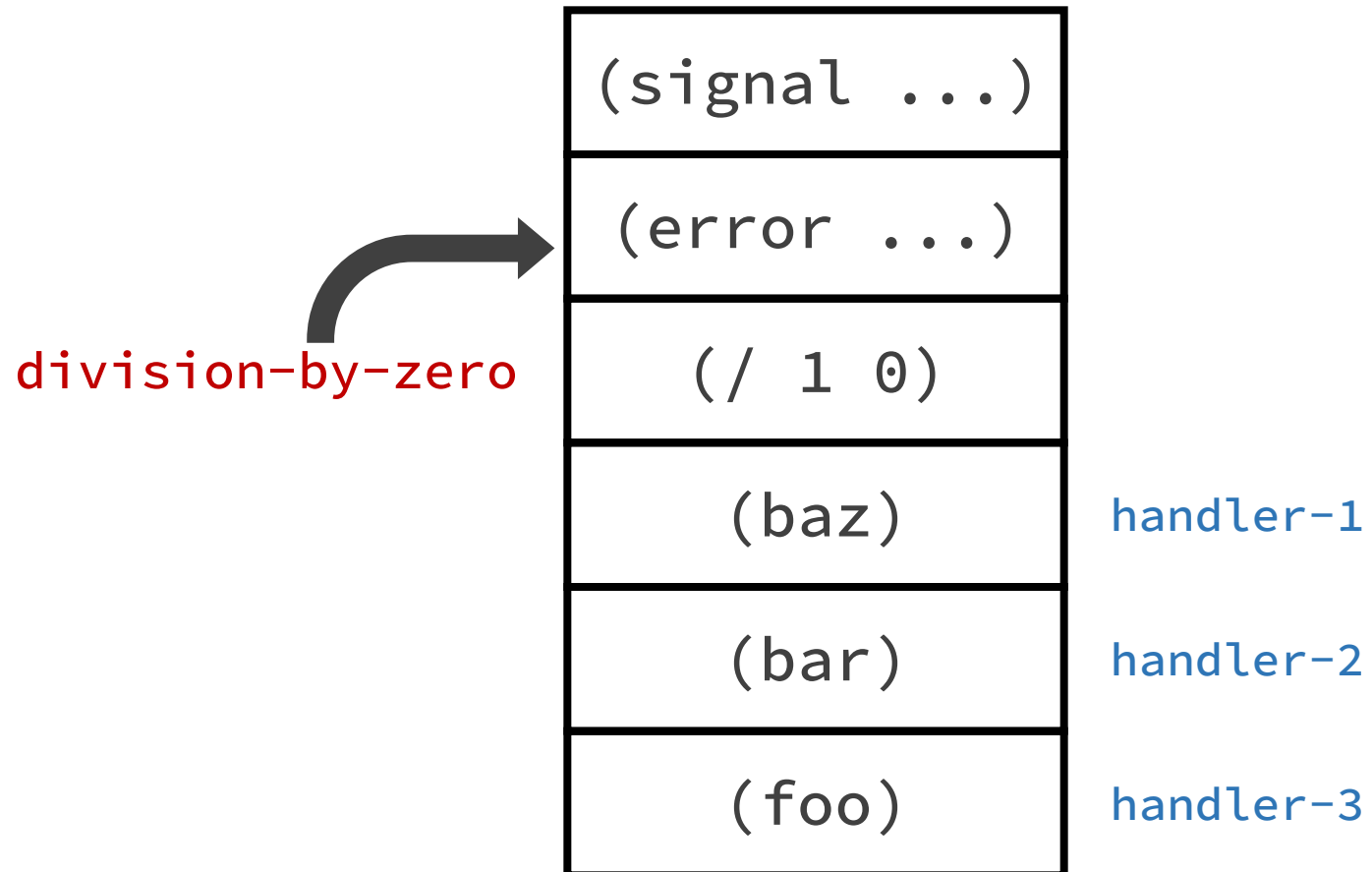
Let's talk about signaling an error



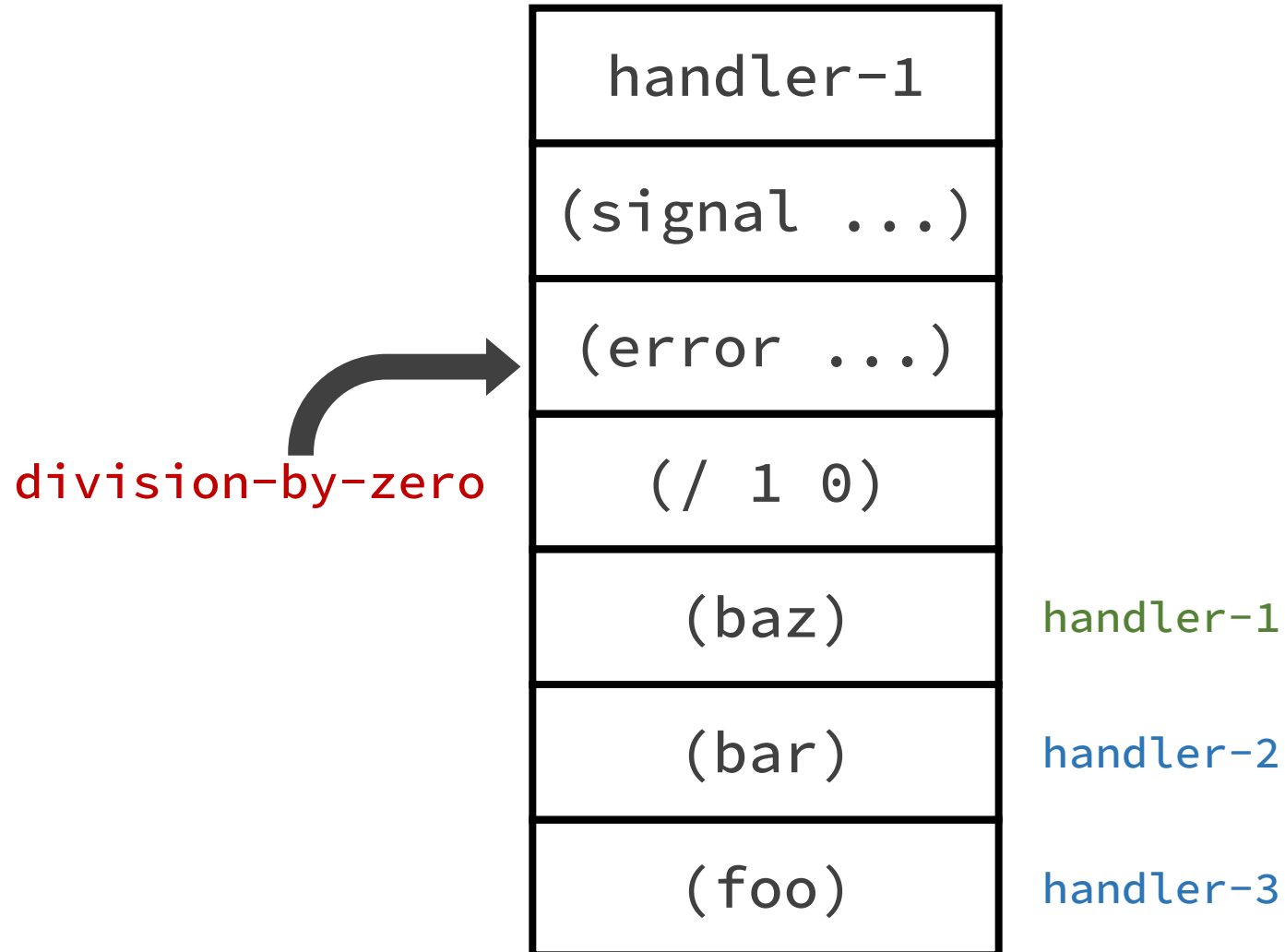
Let's talk about signaling an error



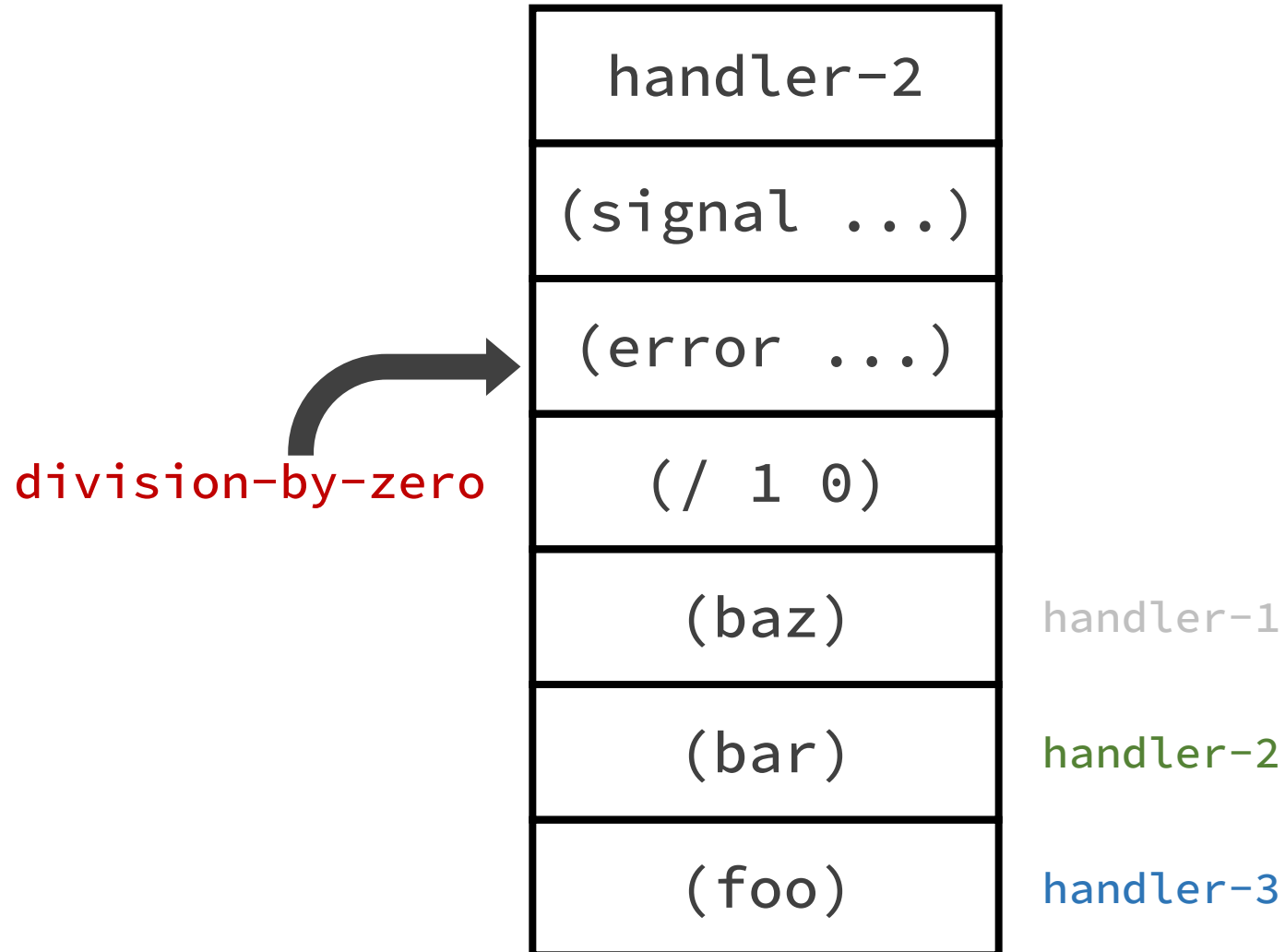
Let's talk about signaling an error



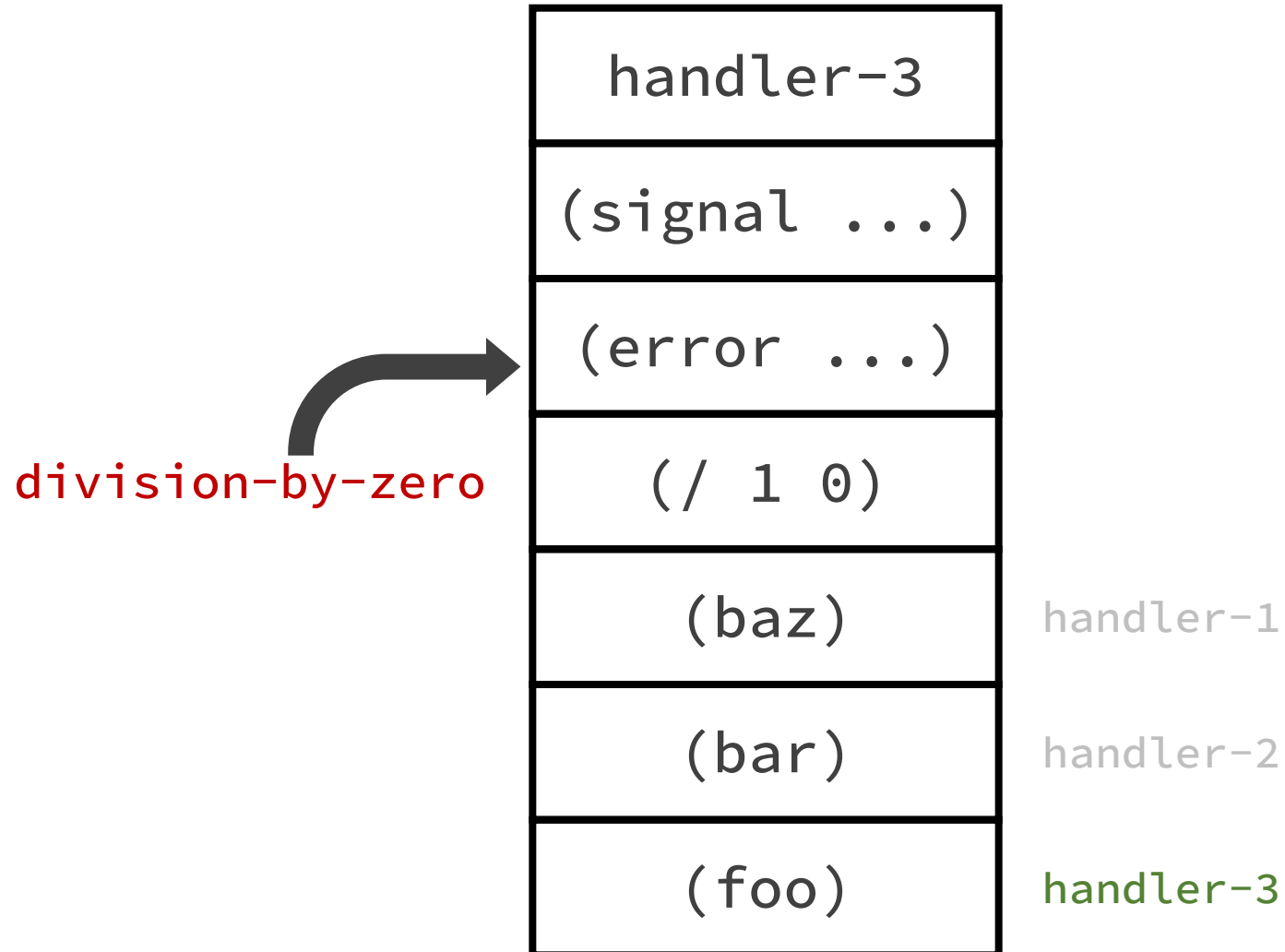
Let's talk about signaling an error



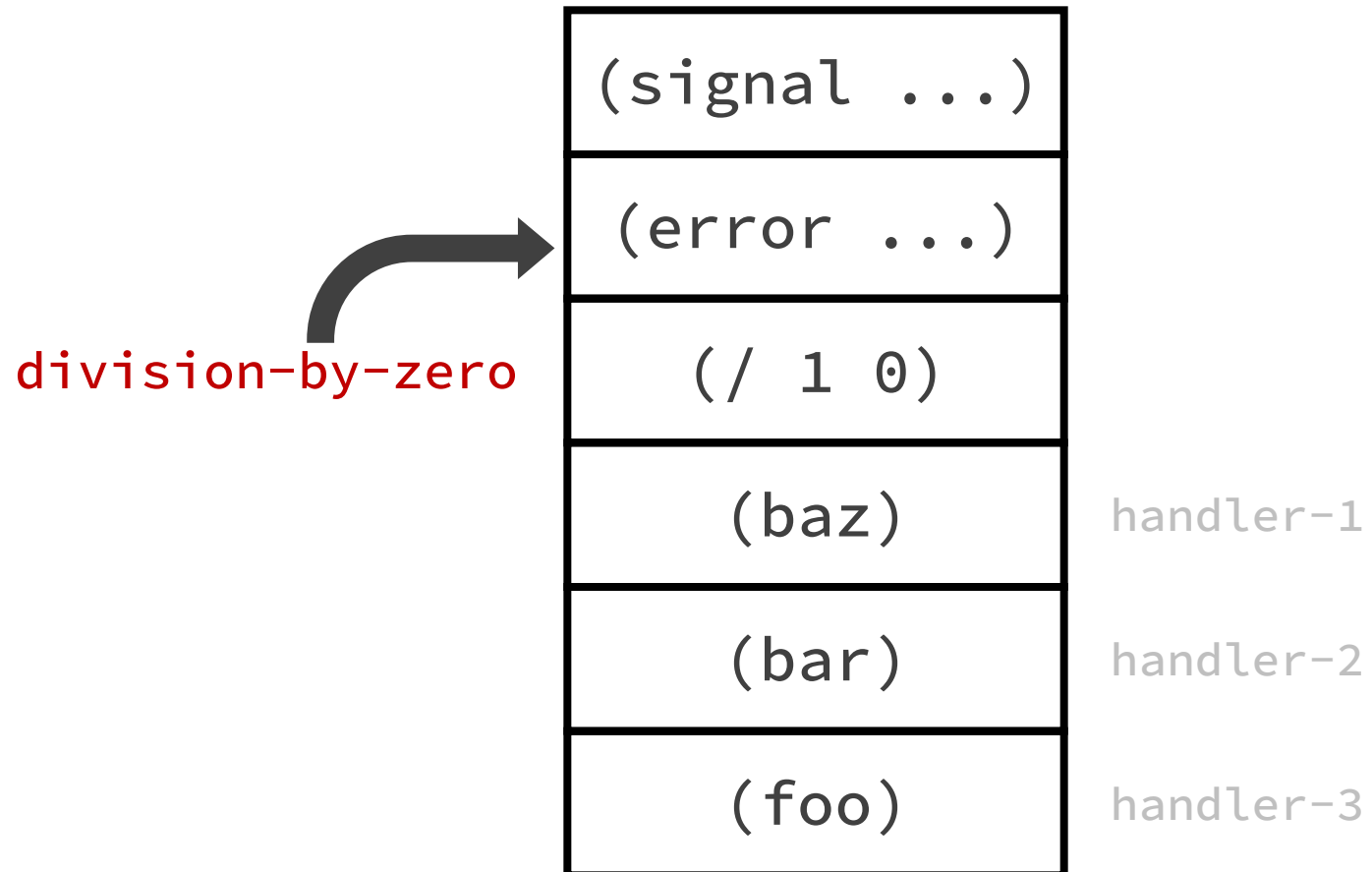
Let's talk about signaling an error



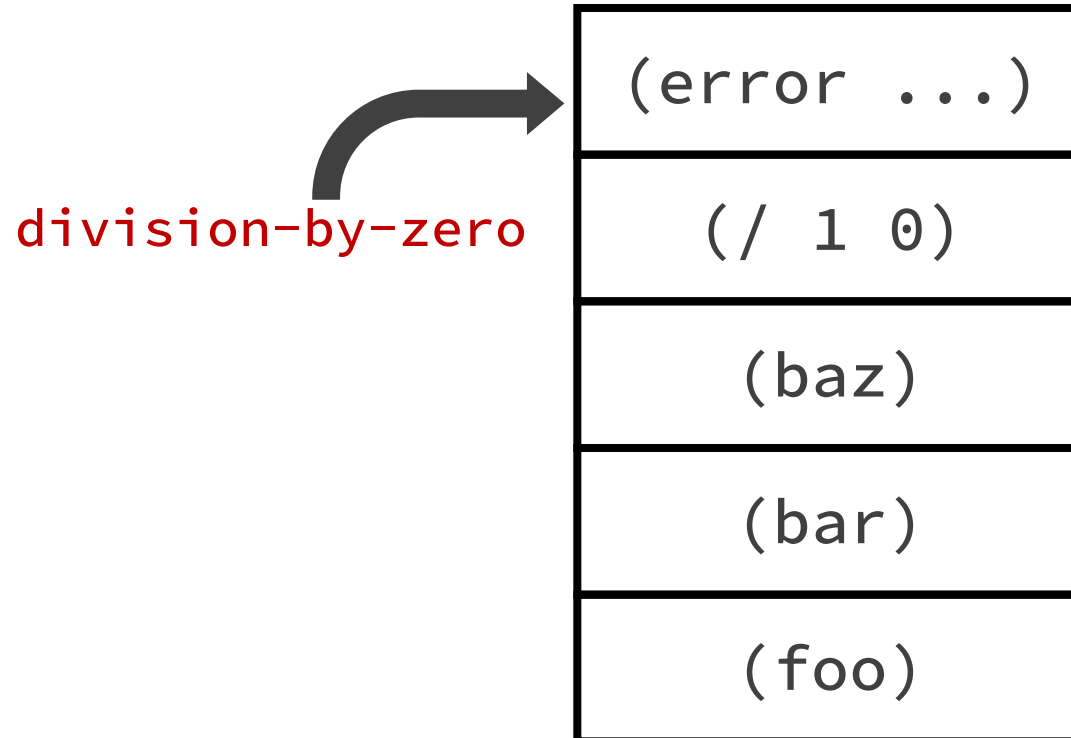
Let's talk about signaling an error



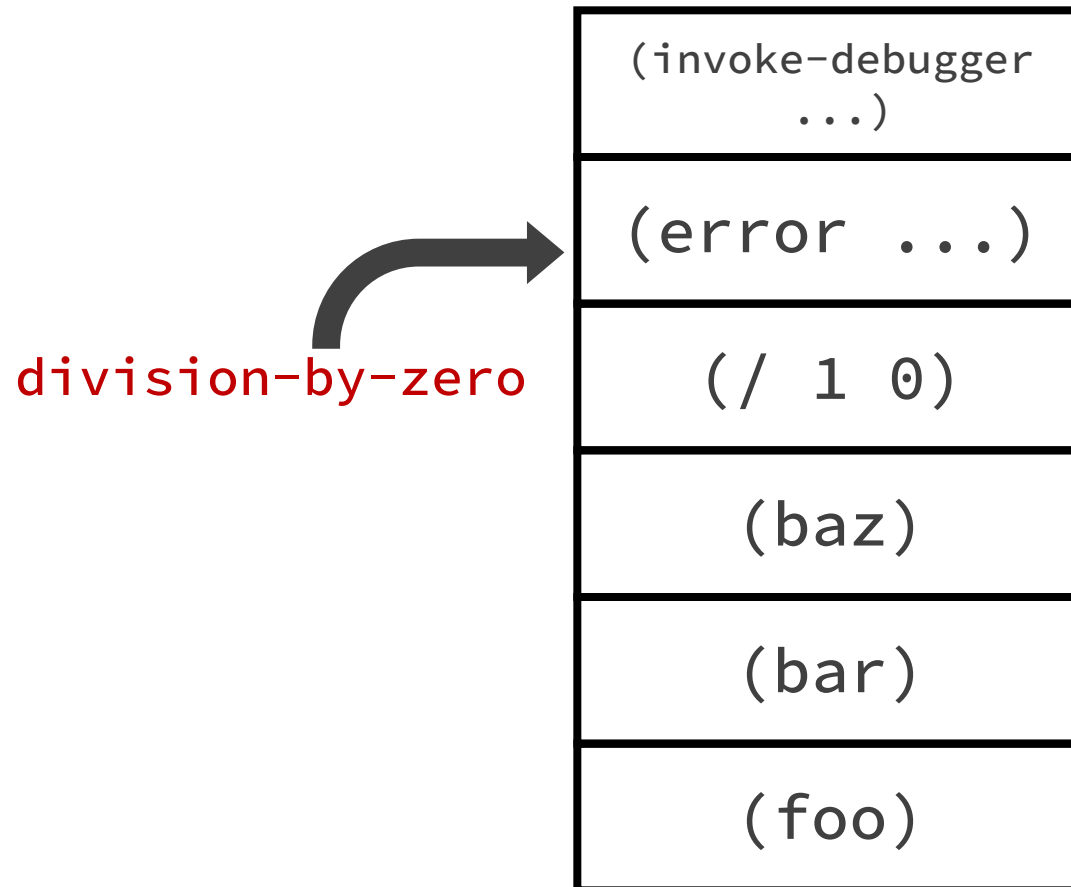
Let's talk about signaling an error



Let's talk about signaling an error



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Let's talk about signaling an error

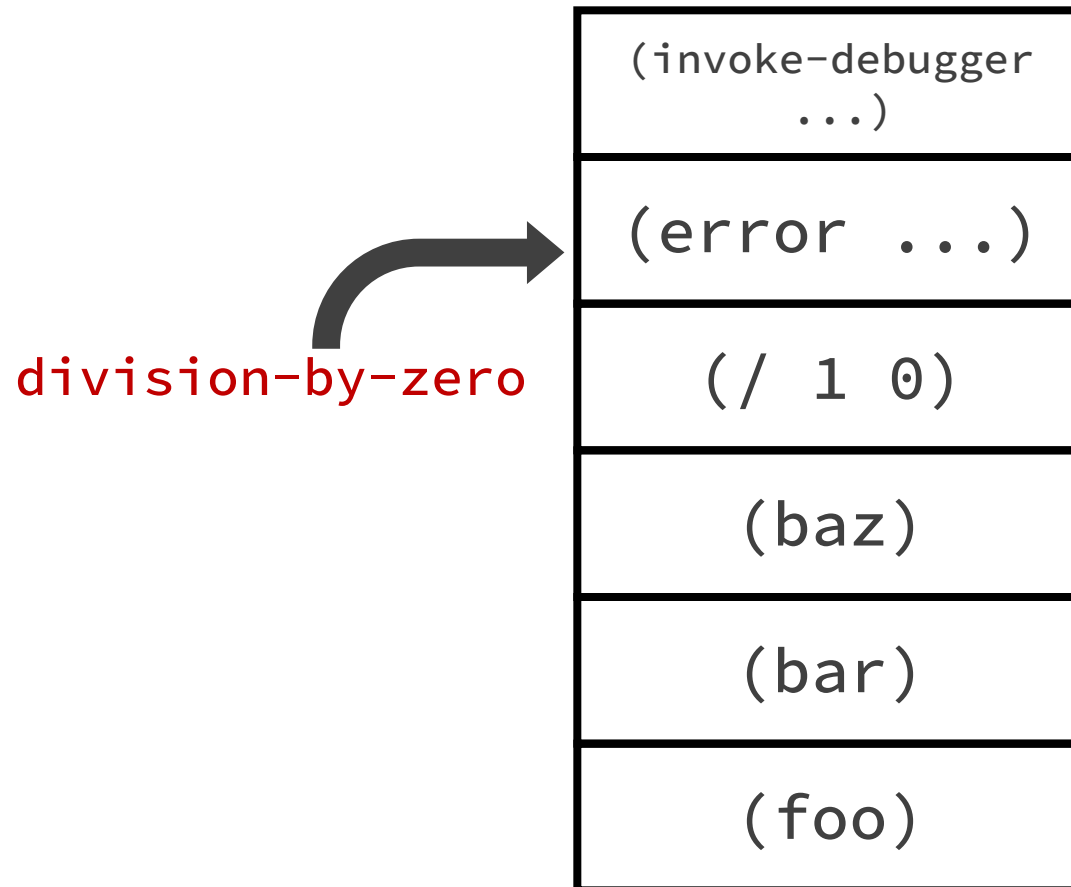
division-by-zero



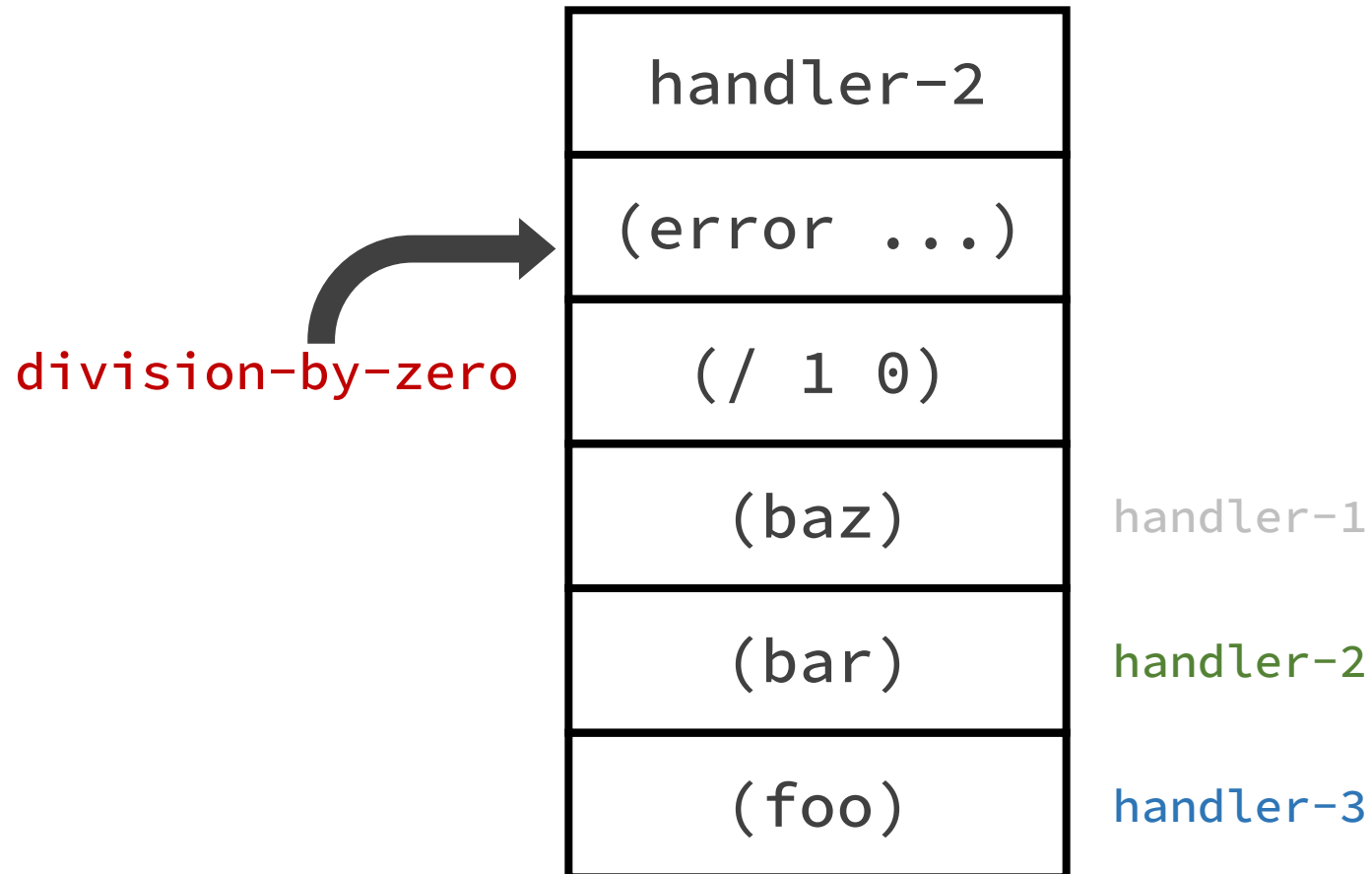
(invoke-debugger ...)
(error ...)
(/ 1 0)
(baz)
(bar)
(foo)



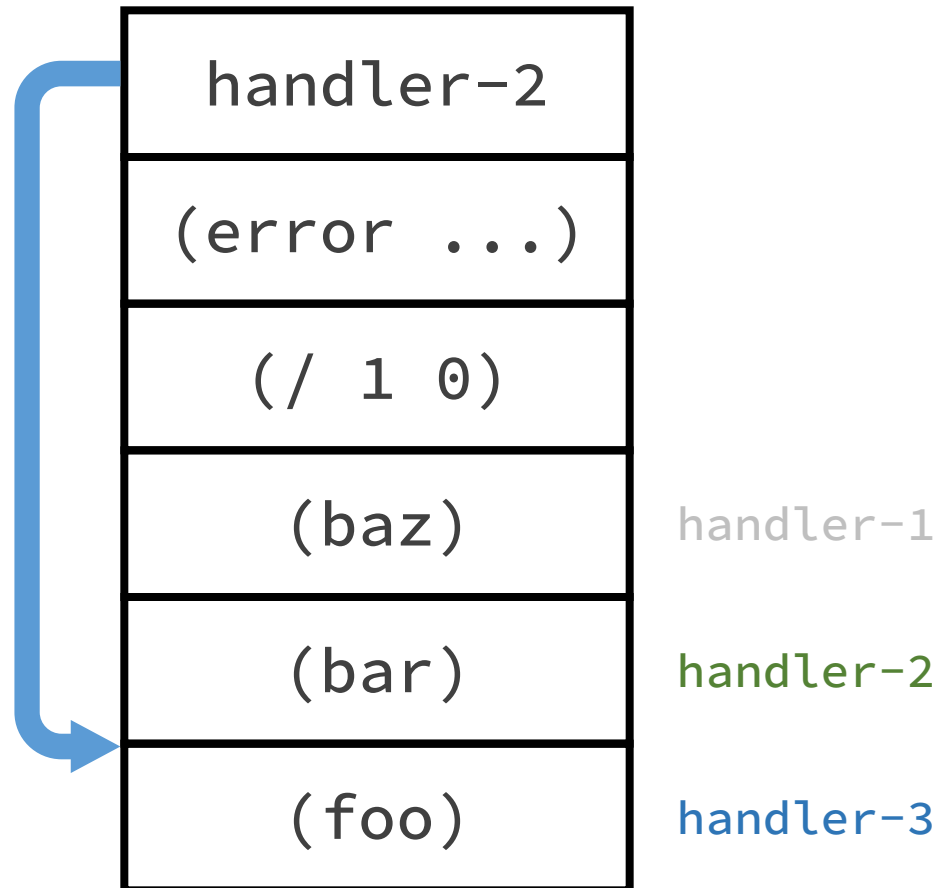
Let's talk about unwinding the stack



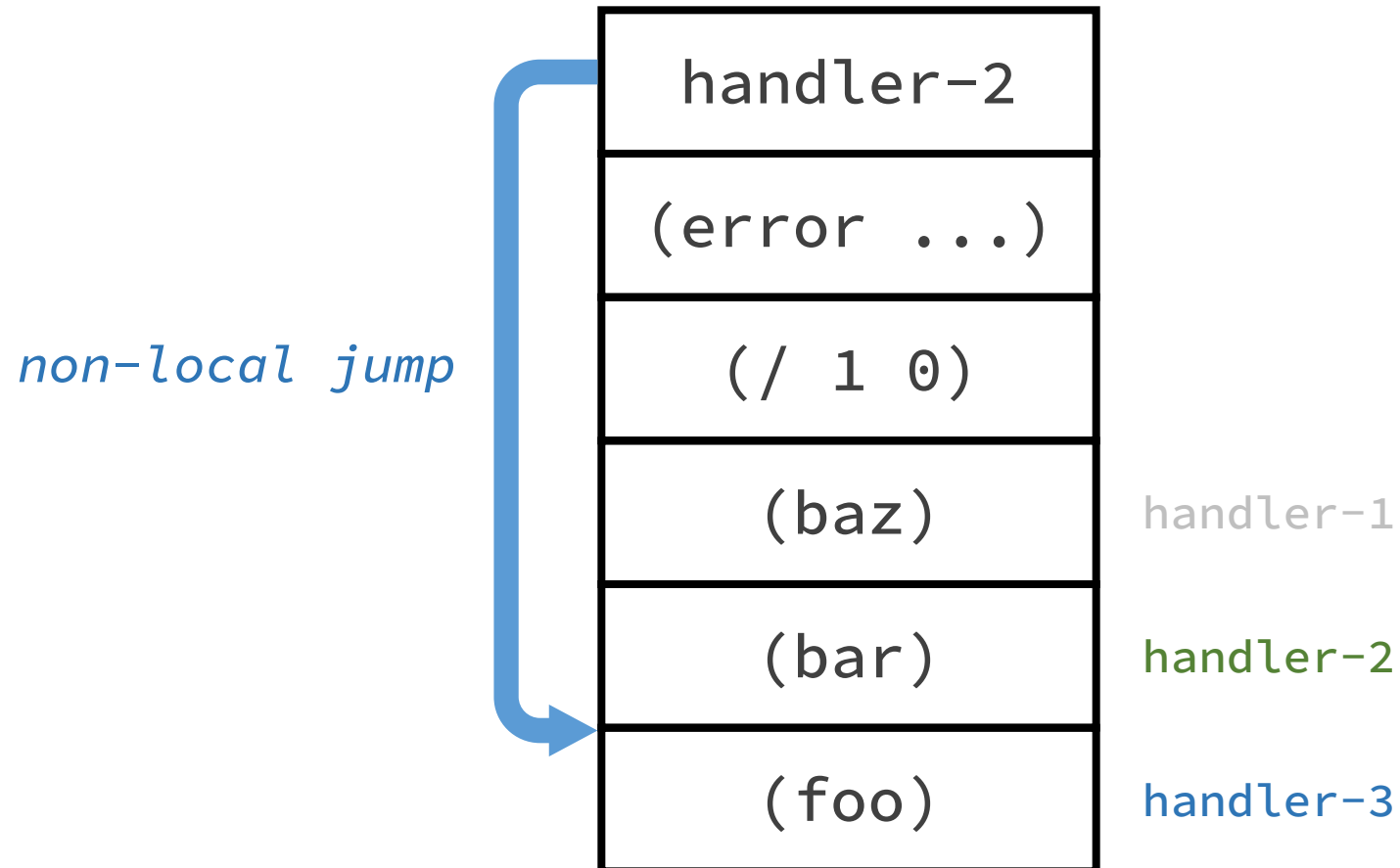
Let's talk about unwinding the stack



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Let's talk about unwinding the stack



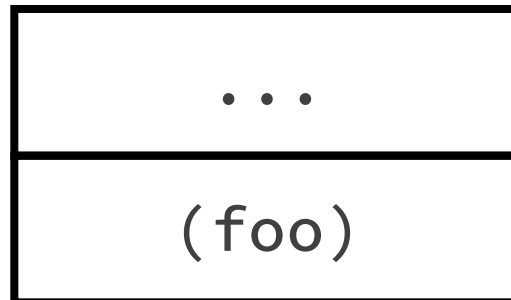
(foo)

Let's talk about unwinding the stack



// execution continues

Let's talk about restarts



// execution continues

Let's talk about restarts

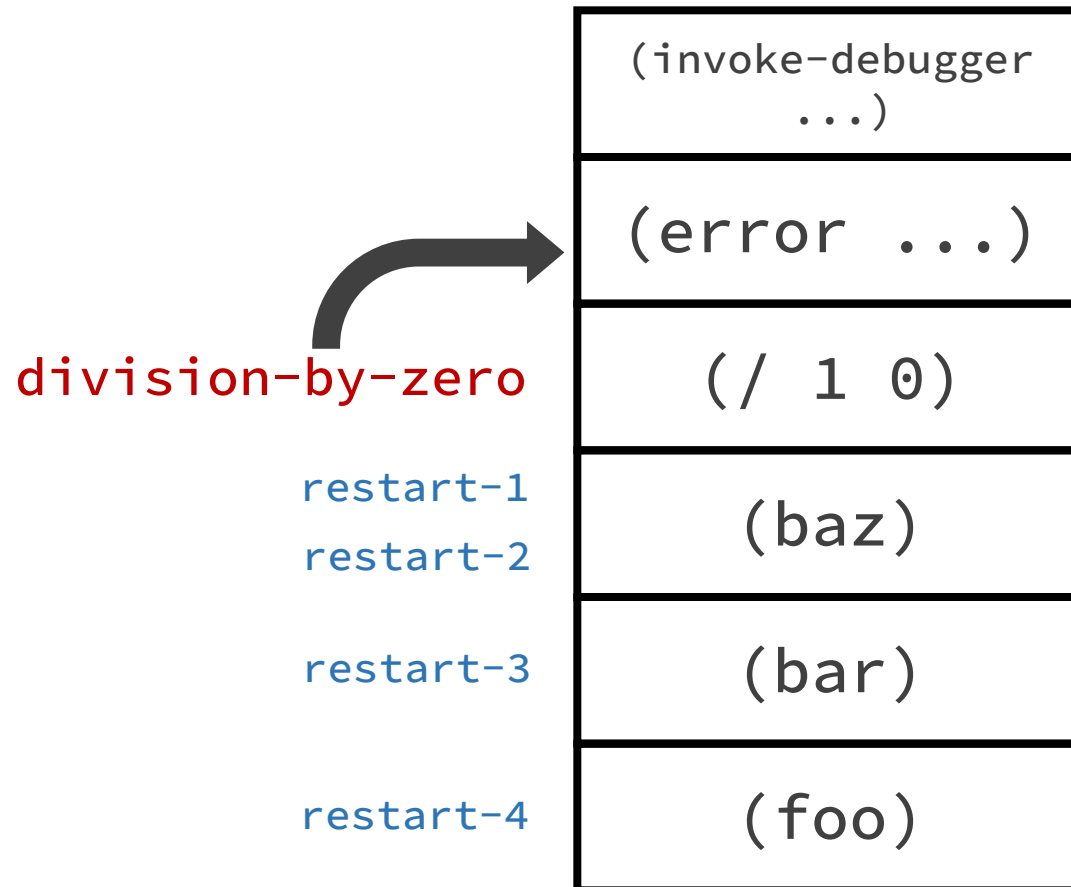
division-by-zero



(invoke-debugger ...)
(error ...)
(/ 1 0)
(baz)
(bar)
(foo)



Let's talk about restarts



Let's talk about restarts

division-by-zero

“Return 42 instead.”

“Query the user for new numbers.”

“Try opening another file.”

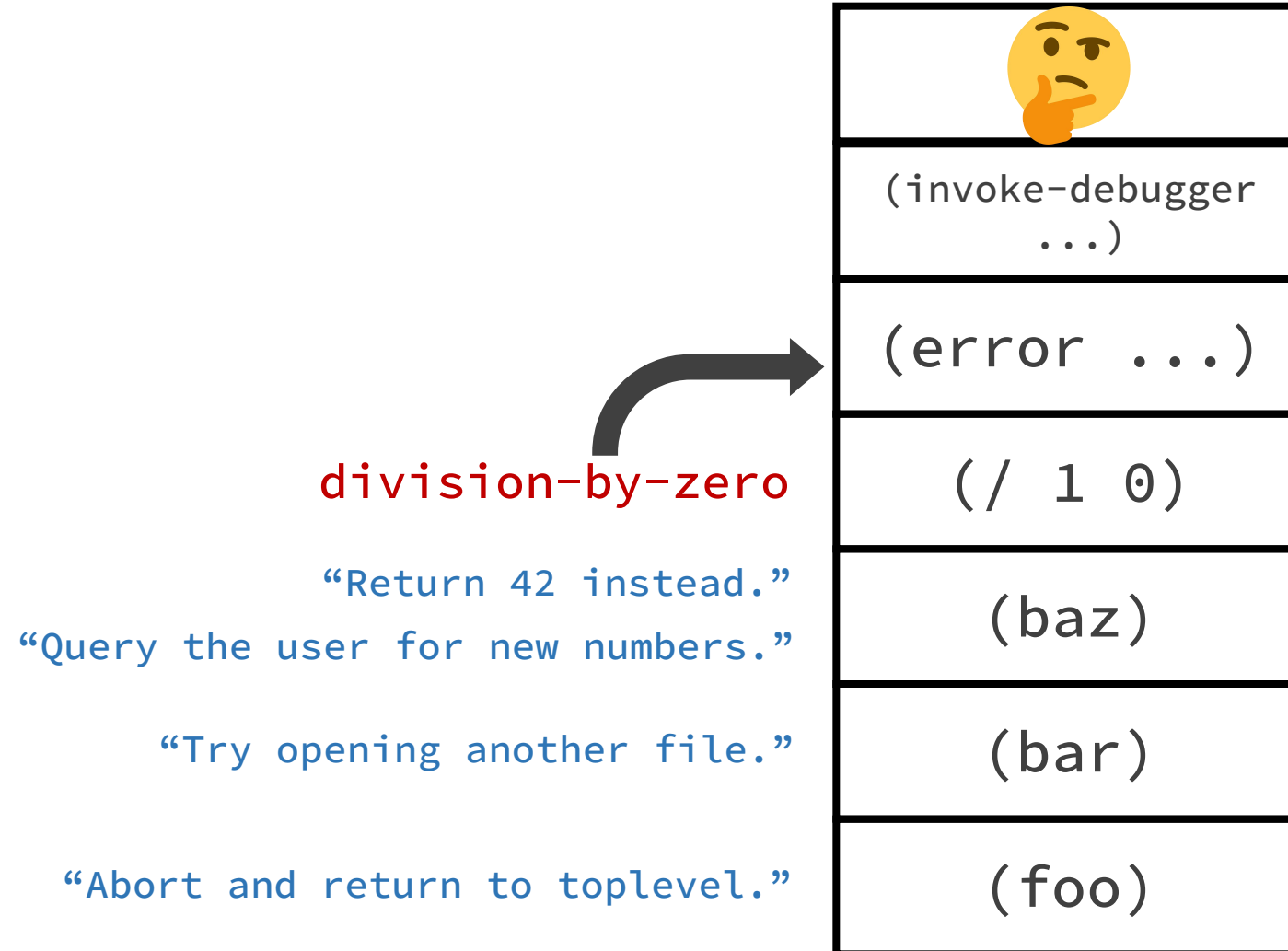
“Abort and return to toplevel.”



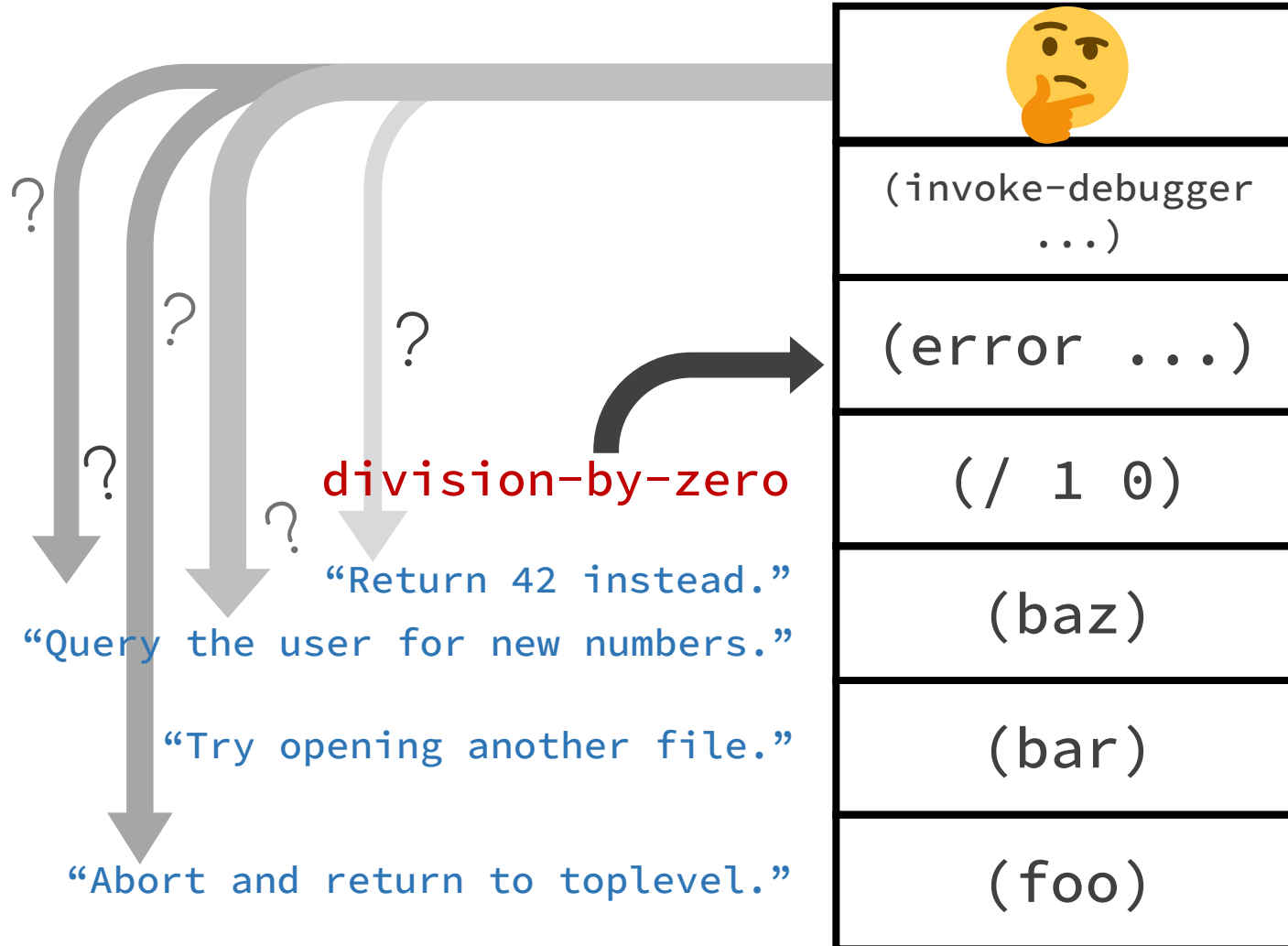
(invoke-debugger ...)
(error ...)
(/ 1 0)
(baz)
(bar)
(foo)



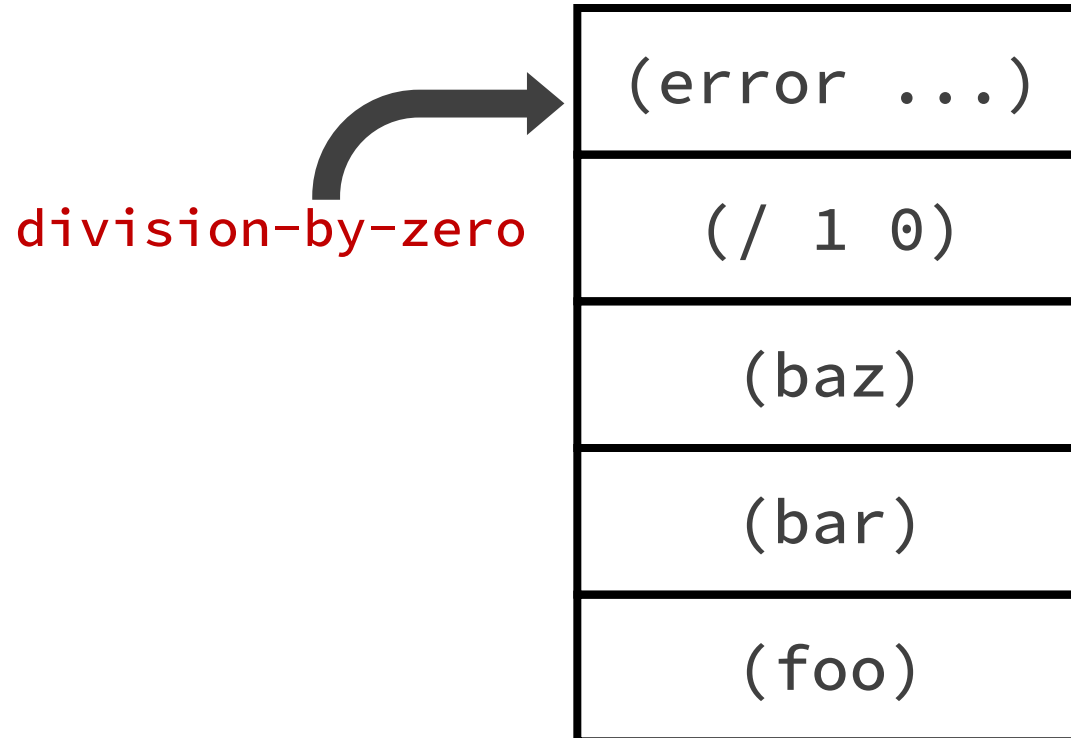
Let's talk about restarts



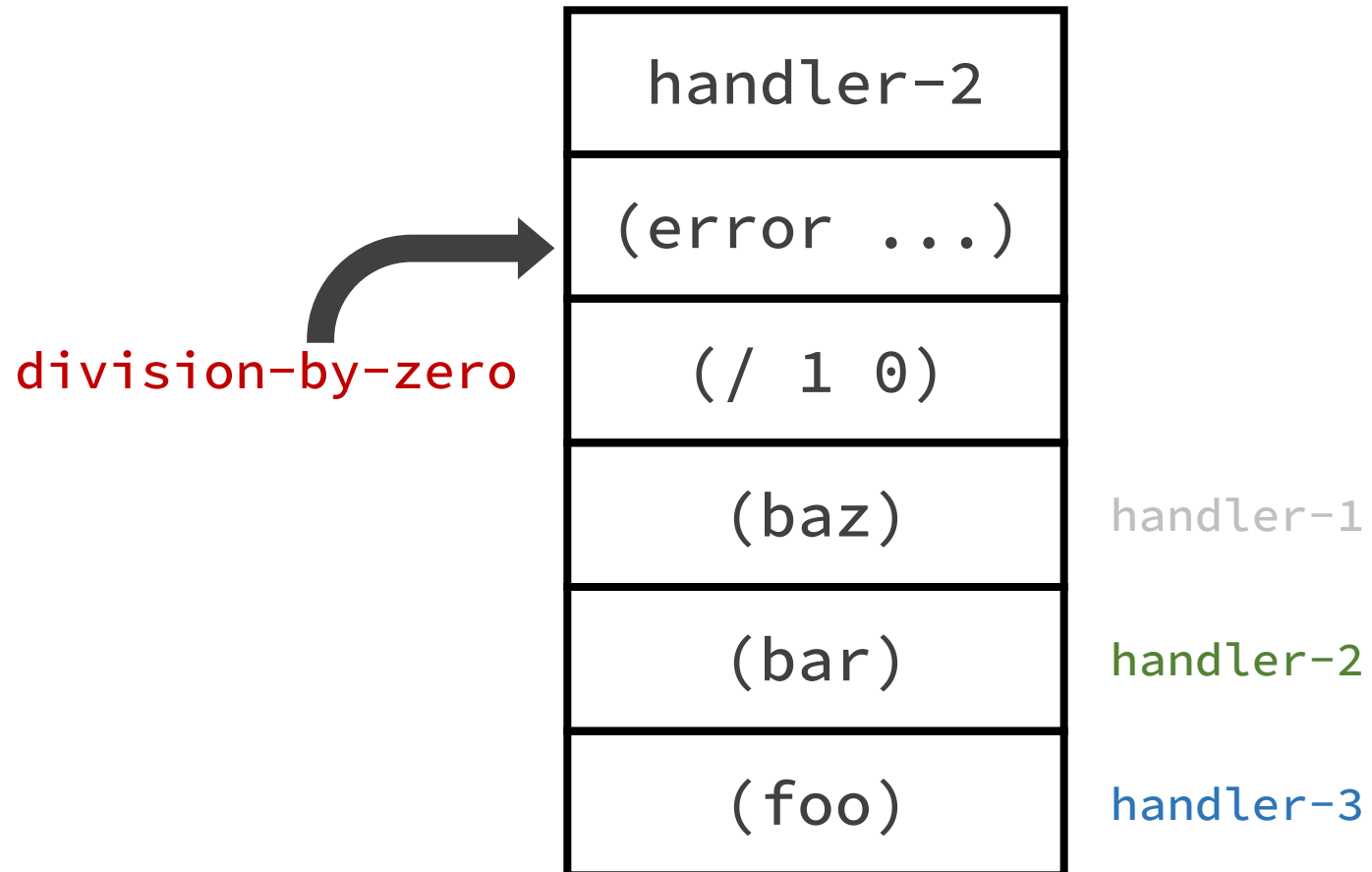
Let's talk about restarts



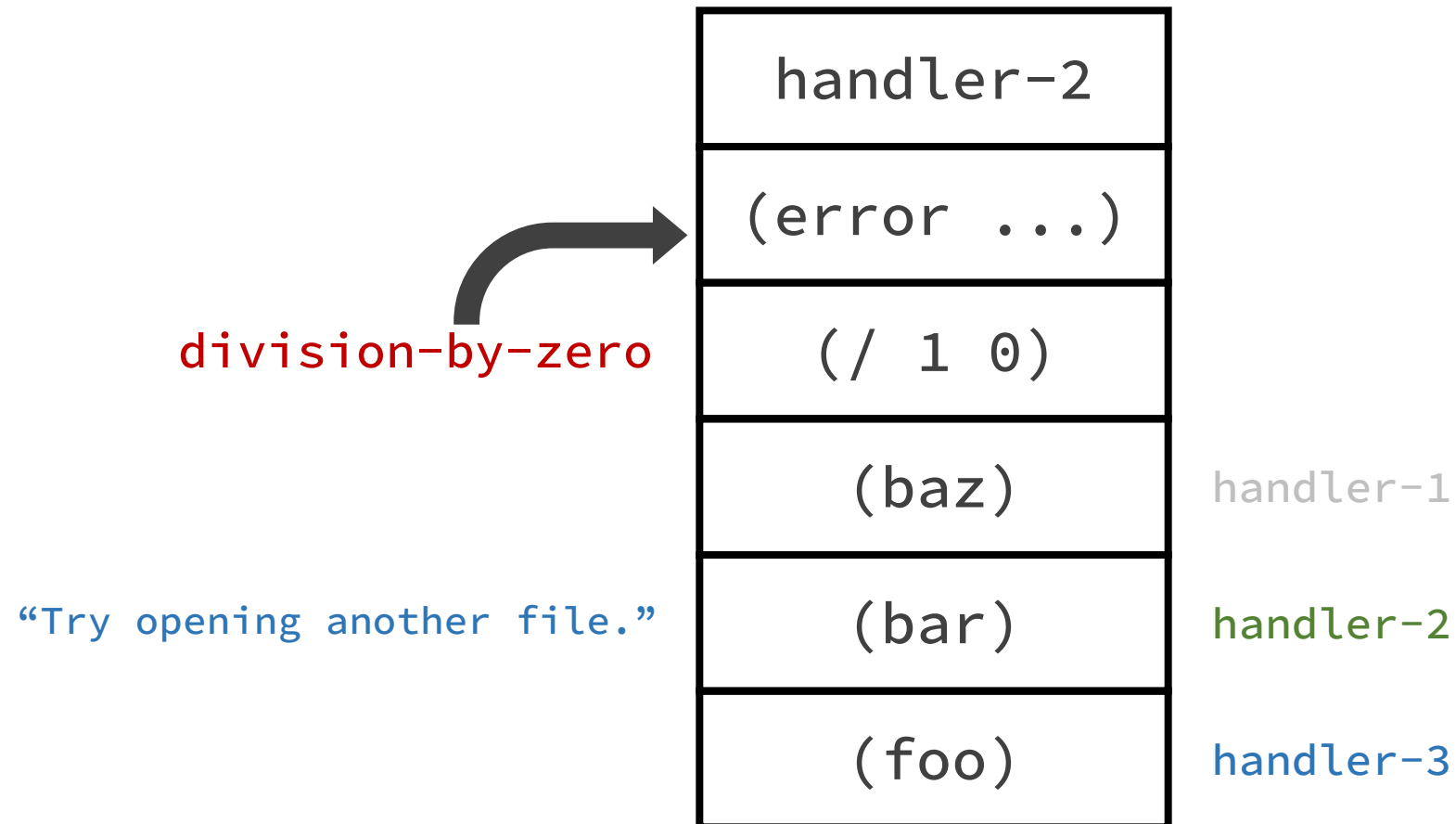
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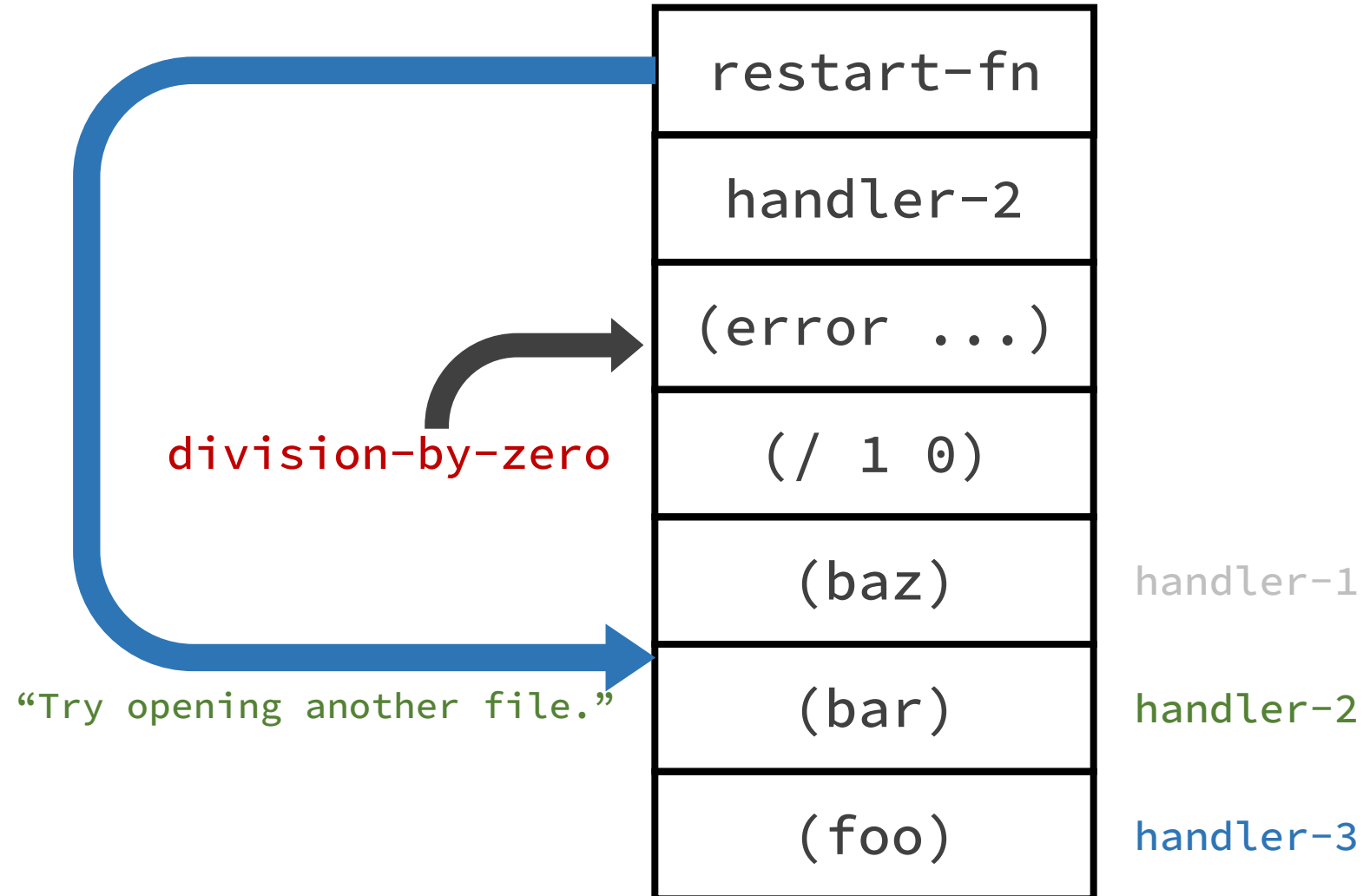
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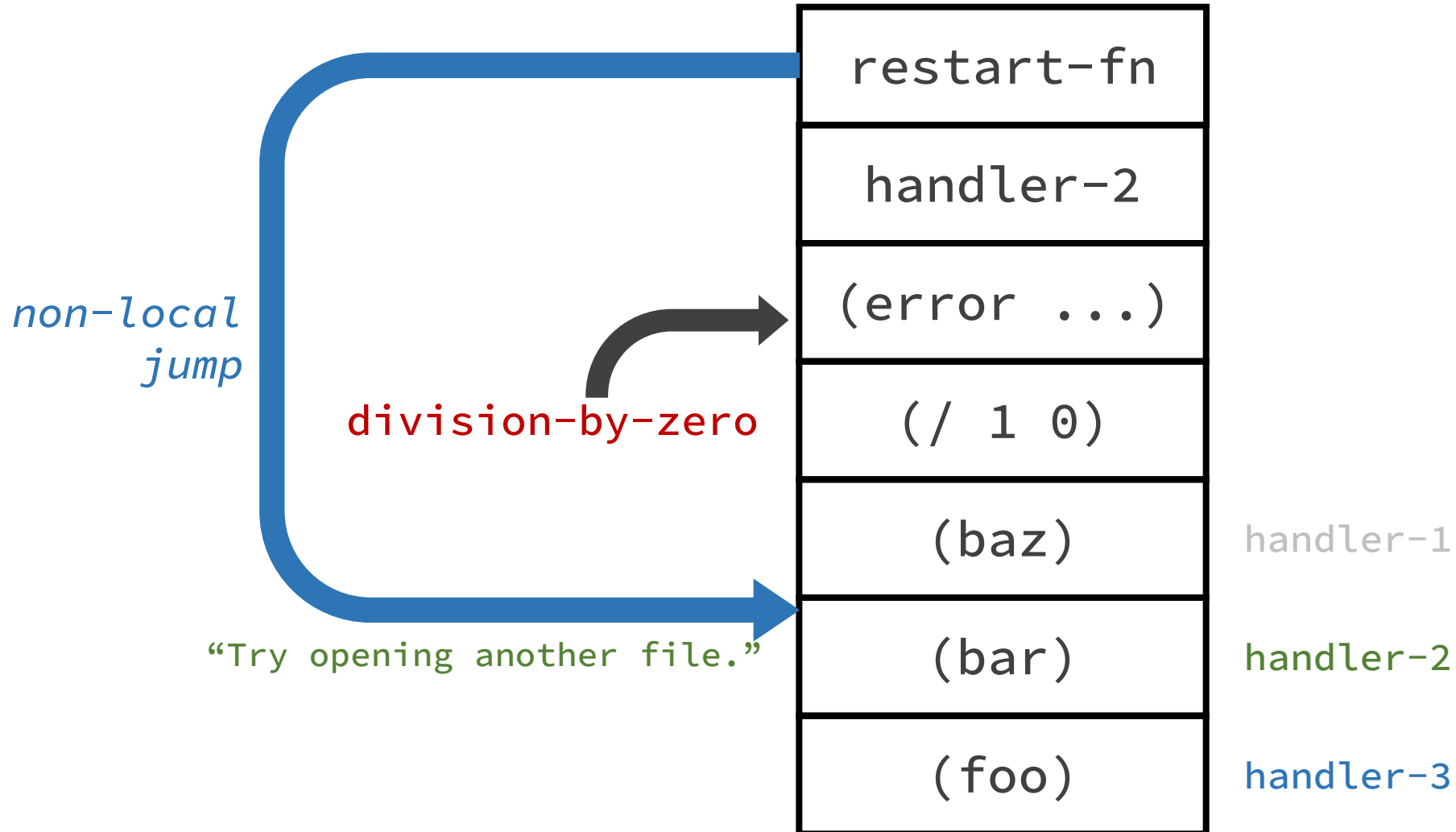
Let's talk about restarts



Let's talk about restarts



Let's talk about restarts



Let's talk about restarts

(bar)
(foo)

Let's talk about restarts



// execution continues

Let's talk about signaling a non-error condition

Let's talk about signaling a non-error condition

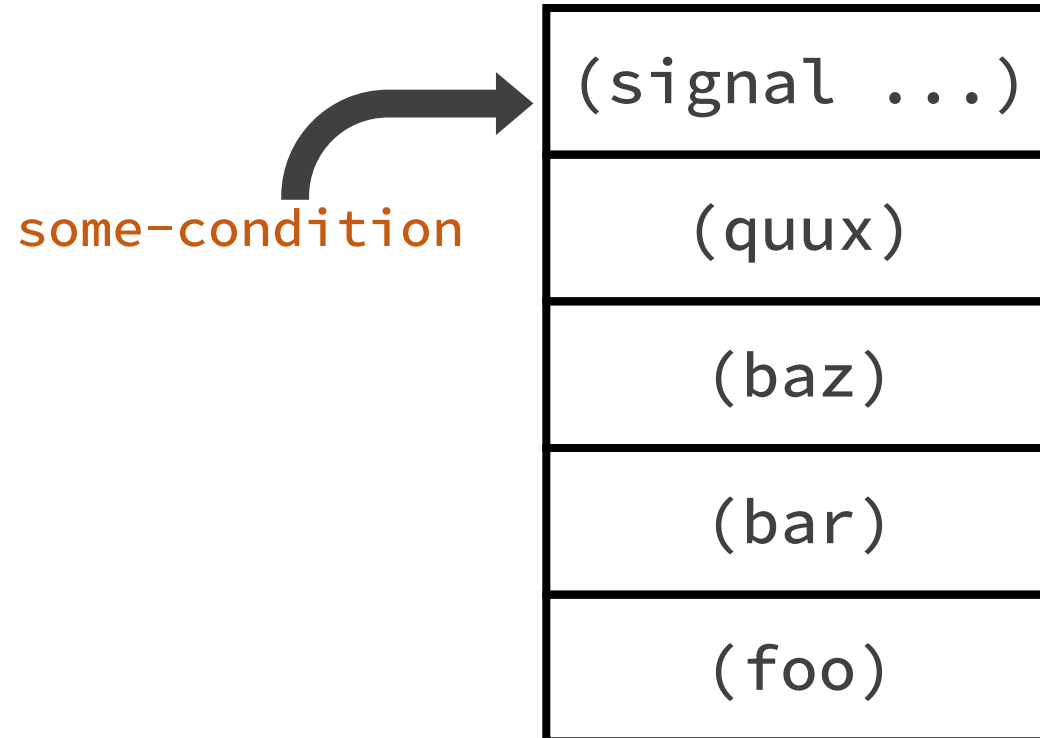
(quux)
(baz)
(bar)
(foo)

Let's talk about signaling a non-error condition

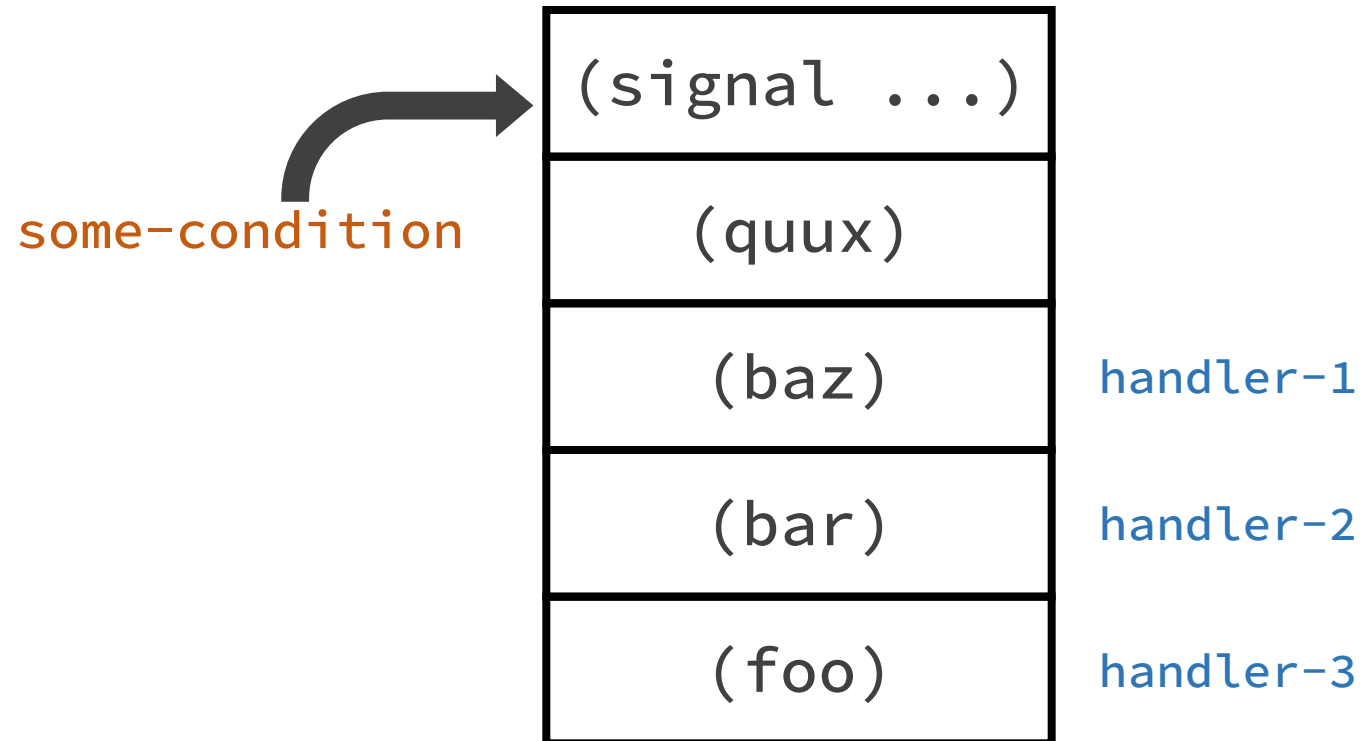
some-condition

(quux)
(baz)
(bar)
(foo)

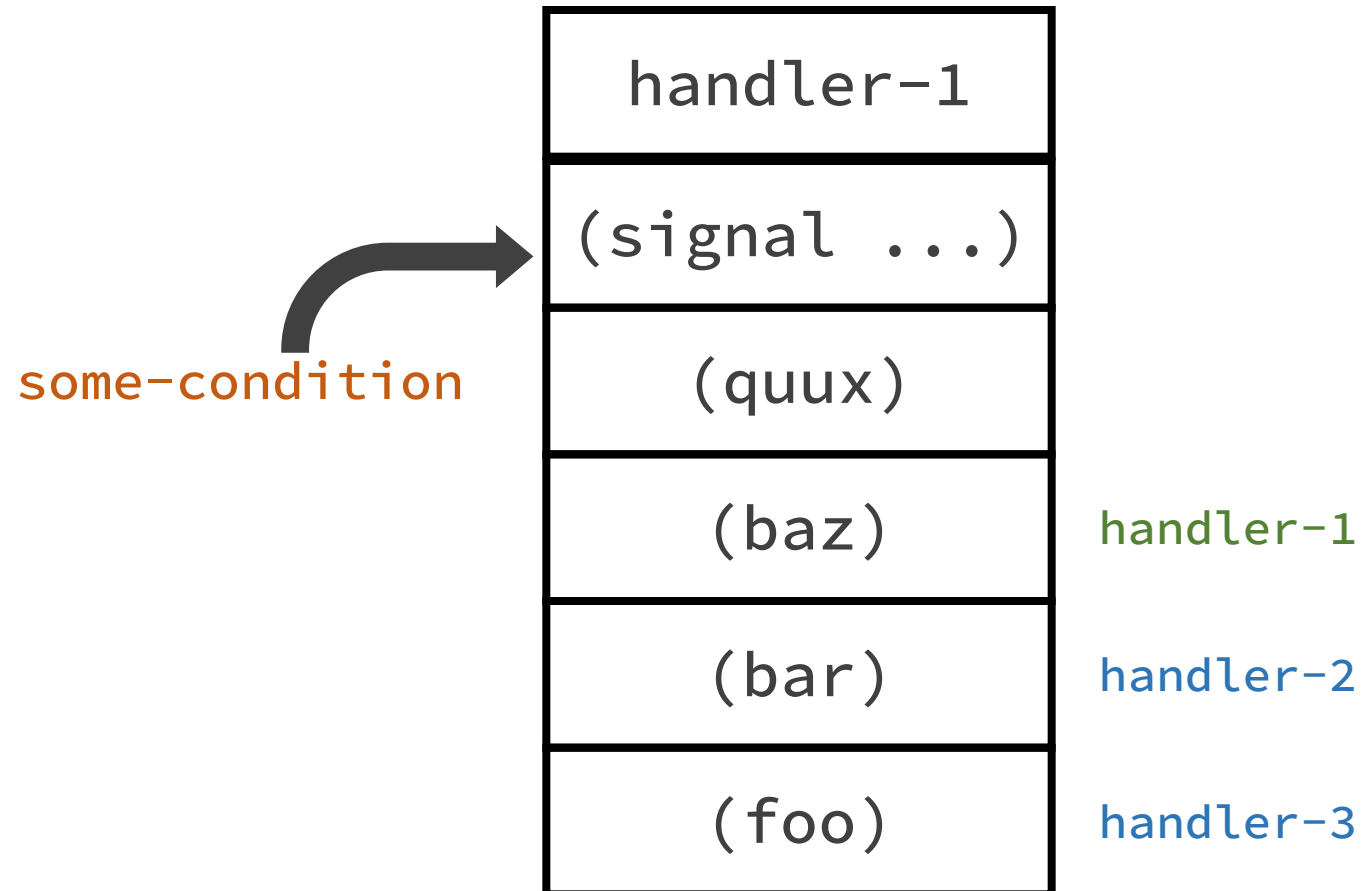
Let's talk about signaling a non-error condition



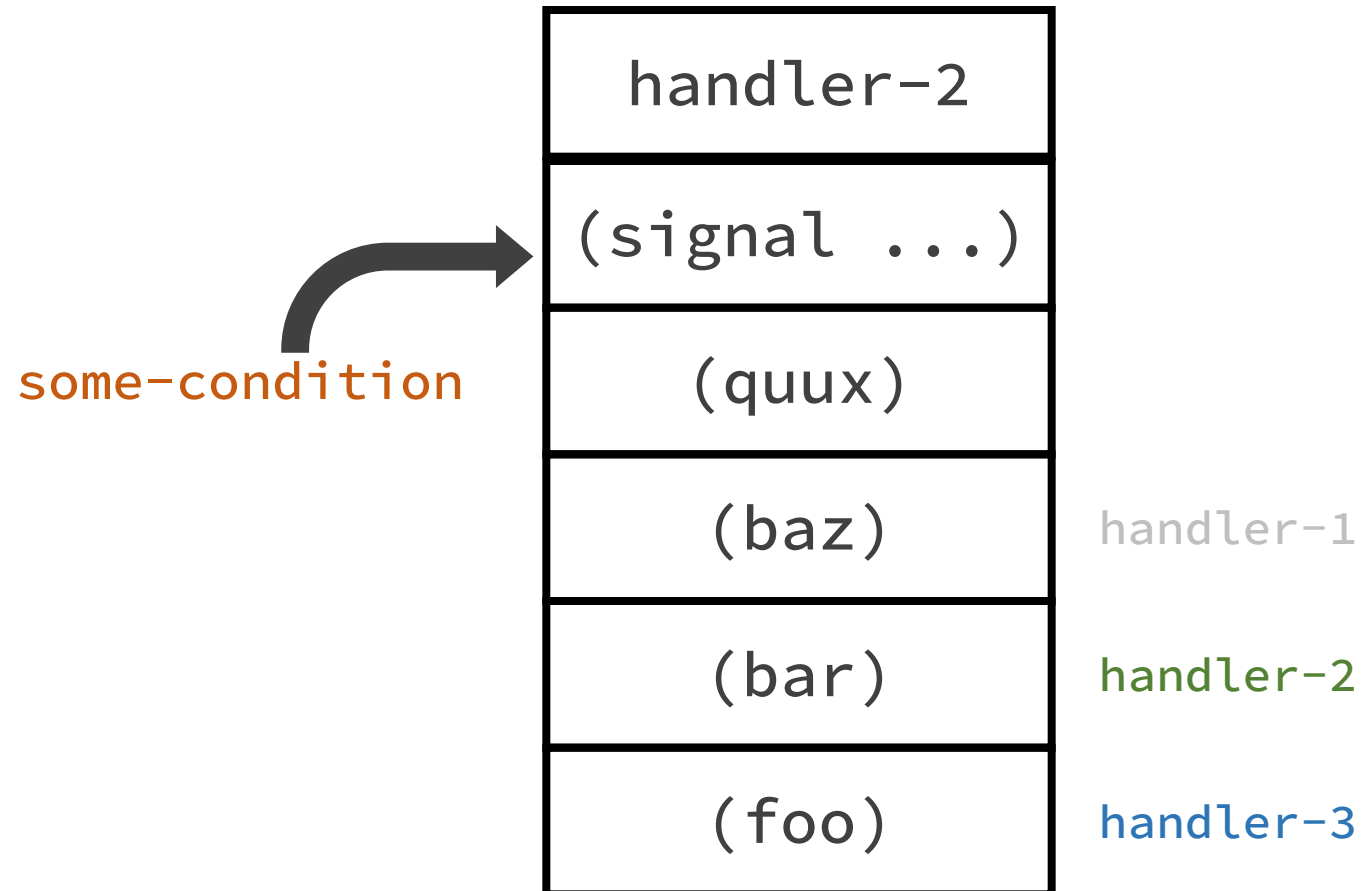
Let's talk about signaling a non-error condition



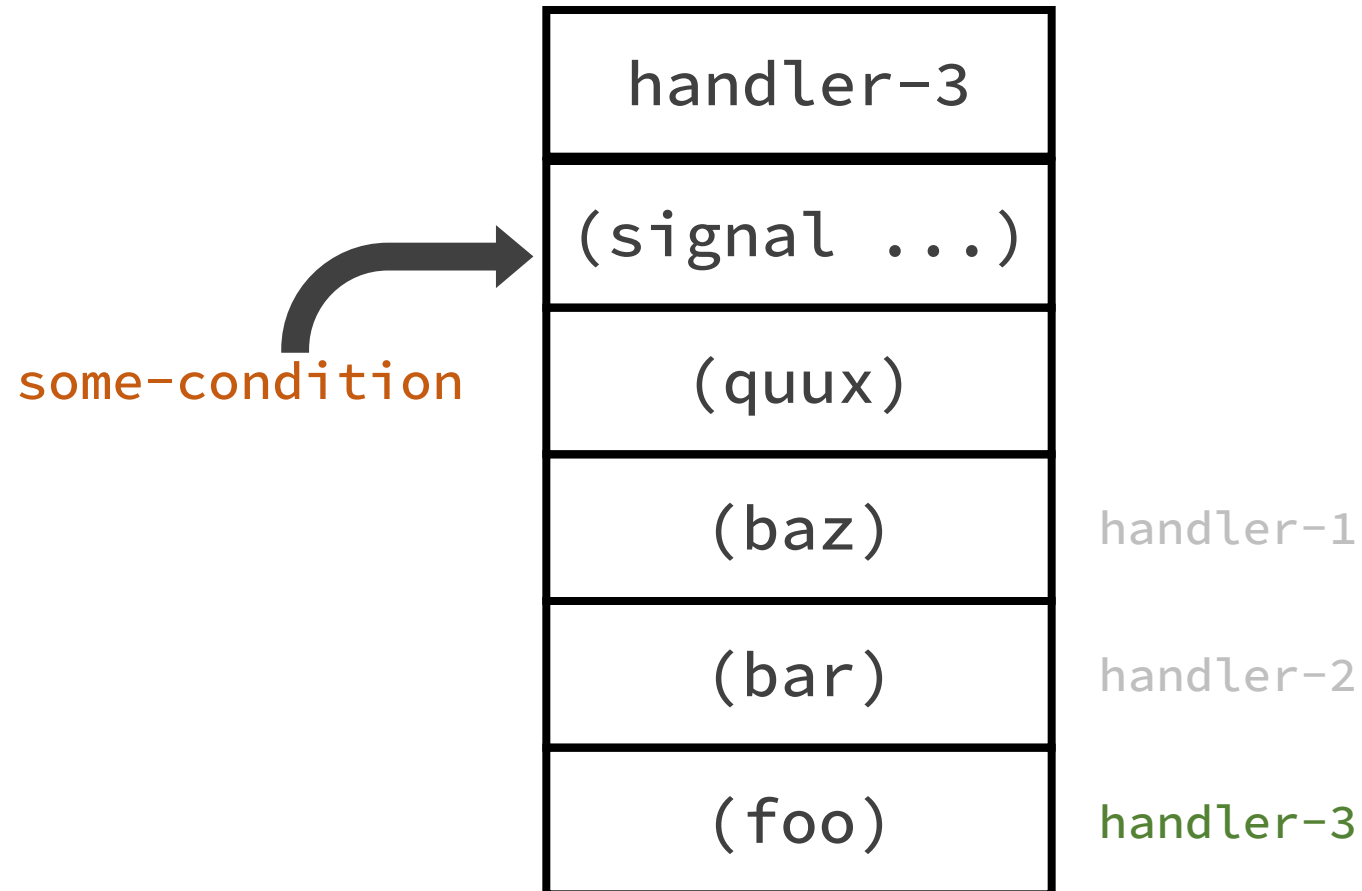
Let's talk about signaling a non-error condition



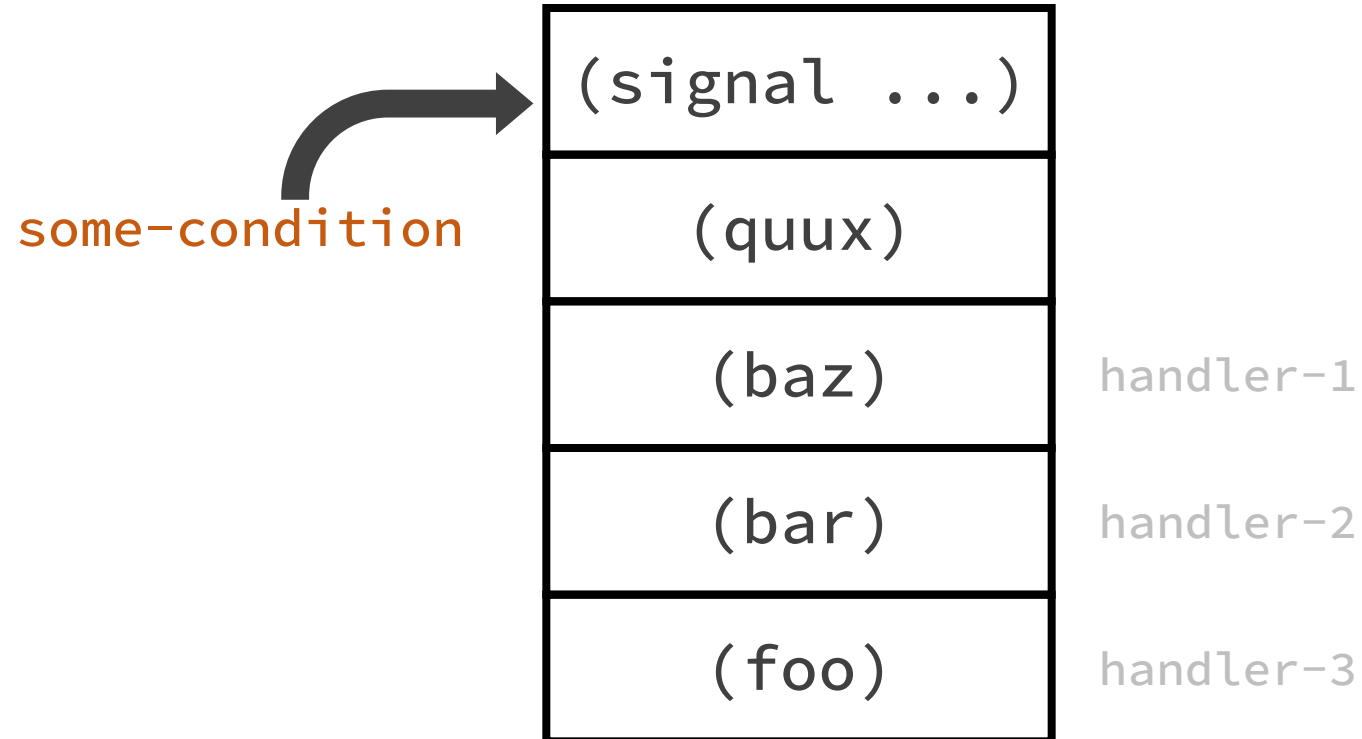
Let's talk about signaling a non-error condition



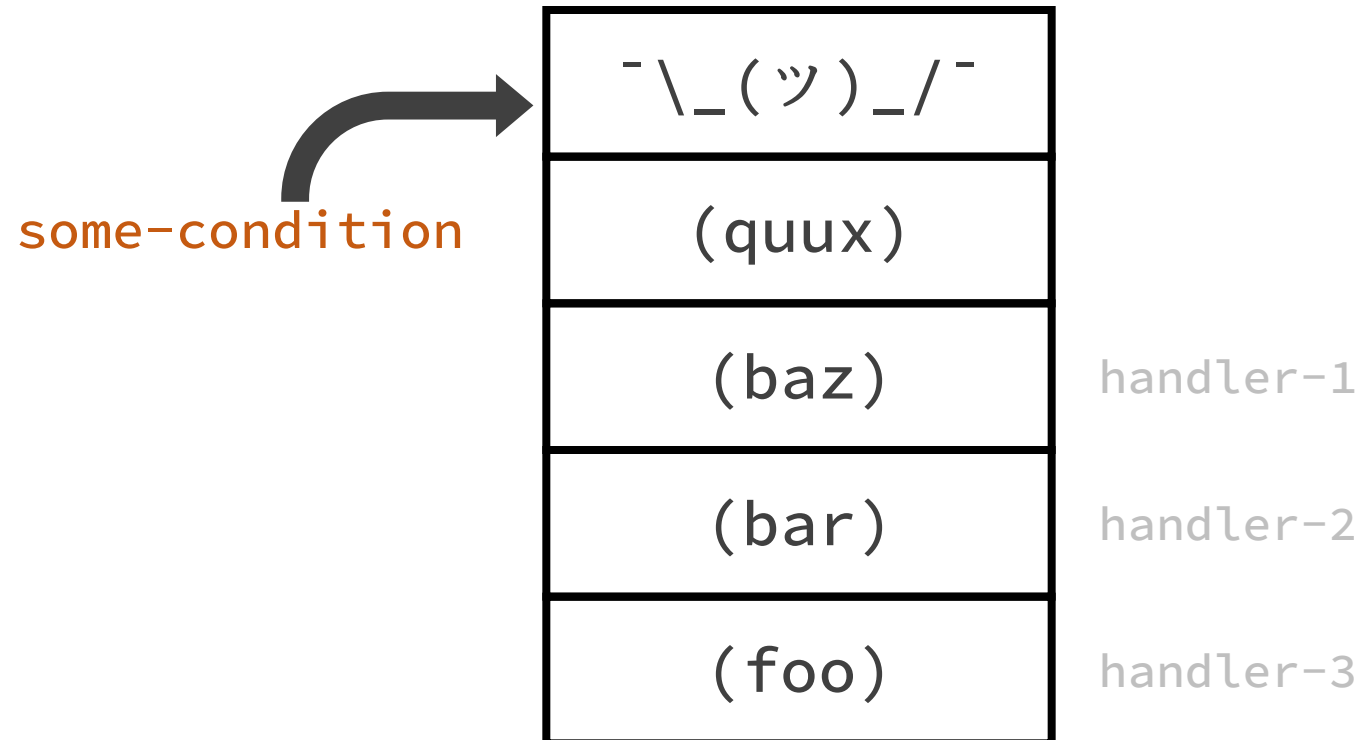
Let's talk about signaling a non-error condition



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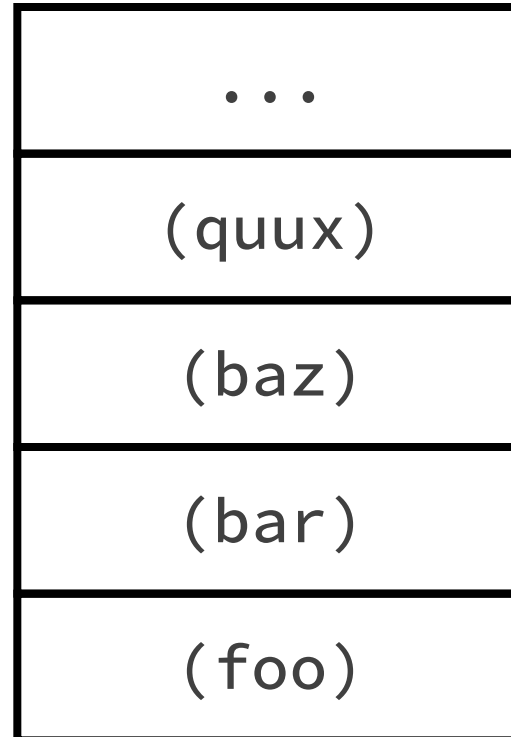
Let's talk about signaling a non-error condition



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Let's talk about signaling a non-error condition



// execution continues

Let's talk about throwing exceptions

Let's talk about throwing exceptions

- Construct the exception object

Let's talk about throwing exceptions

- Construct the exception object
- Unwind the stack immediately
 - Stop unwinding when something catches the exception

Let's talk about throwing exceptions

- Construct the exception object
- Unwind the stack immediately
 - Stop unwinding when something catches the exception
- Continue execution from that point

Let's talk about signaling conditions

Let's talk about signaling conditions

- Construct the condition object

Let's talk about signaling conditions

- Construct the condition object
- Call handlers from the stack in order
 - What do the handlers do?

Let's talk about signaling conditions

- Construct the condition object
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 - What do the handlers do?



Let's talk about signaling conditions

- Construct the condition object
- Call handlers from the stack in order
 - What do the handlers do?
 - Maybe execute some code



Let's talk about signaling conditions

- Construct the condition object
- Call handlers from the stack in order
 - What do the handlers do?
 - Maybe execute some code
 - Maybe invoke a restart



Let's talk about signaling conditions

- Construct the condition object
- Call handlers from the stack in order
 - What do the handlers do?
 - Maybe execute some code
 - Maybe invoke a restart
 - Maybe do nothing and return



Let's talk about signaling conditions

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 - Maybe do nothing and return
 - Maybe unwind the stack to a predefined point



Let's talk about signaling conditions

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 - Maybe there are no handlers



Let's talk about signaling conditions

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 - Maybe she's born with it



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- If there was no transfer of control, return
 - ...and maybe enter the debugger to halt the program



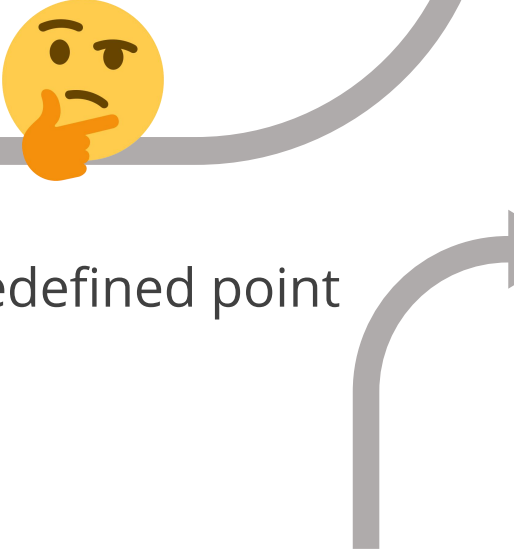
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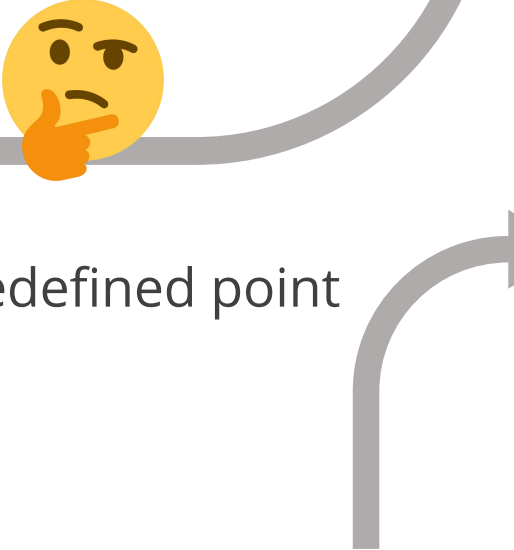


- signaling = a dynamically scoped hooking mechanism
 - progress bars
 - message passing
 - calling asynchronous code
 - etc..

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 - context-dependent actions for interactive programming
 - context-dependent means of automated error recovery (e.g. when parsing incomplete source code)
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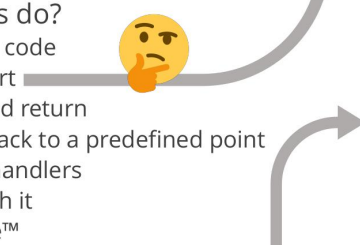
Let's talk about conditions versus exceptions

Let's talk about throwing exceptions

- Construct the exception object
- Unwind the stack immediately
 - Stop unwinding when something catches the exception
- Continue execution from that point

77

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91

Let's talk about conditions versus exceptions

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77

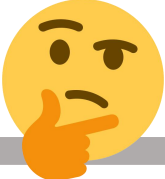
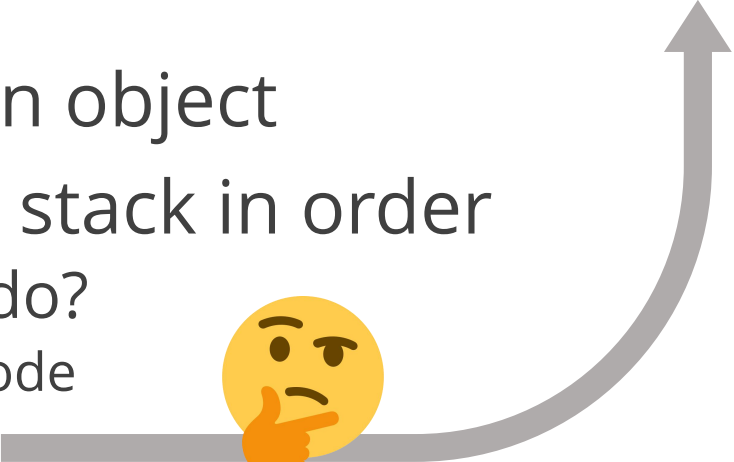
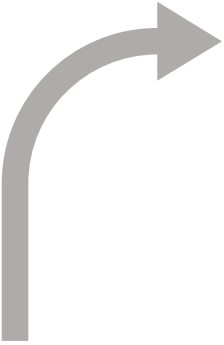
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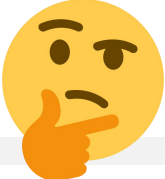

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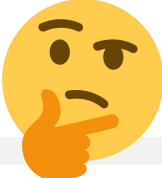
Let's talk about signaling conditions

- Construct the condition object
 - Call handlers from the stack in order
 - What do the handlers do?
 - Maybe execute some code
 - Maybe invoke a restart
 - Maybe do nothing and return
 - Maybe unwind the stack to a predefined point
 - Maybe there are no handlers
 - Maybe she's born with it
 - Maybe it's Maybelline™
 - If there was no transfer of control, return
 - ...and maybe enter the debugger to halt the program
- 
- 
- 
- restarts = a dynamically scoped mechanism of choices
 - context-dependent actions for interactive programming
 - context-dependent means of automated error recovery (e.g. when parsing incomplete source code)
 - etc..
 - signaling = a dynamically scoped hooking mechanism
 - progress bars
 - message passing
 - calling asynchronous code
 - etc..

Let's talk about signaling conditions

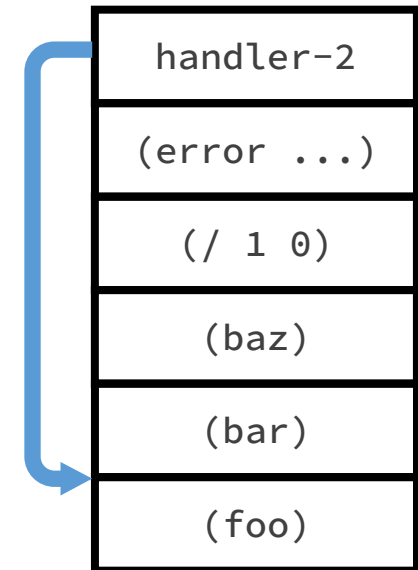
- Construct the condition object
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 - message passing
 - calling asynchronous code
 - etc..

Let's talk about non-local control flow

- Construct the condition object
 - Call handlers from the stack in order
 - What do the handlers do?
 - Maybe execute some code
 - Maybe invoke a restart
 - Maybe do nothing and return
 - **Maybe unwind the stack to a predefined point**
 - Maybe there are no handlers
 - Maybe she's born with it
 - Maybe it's Maybelline™
 - If there was no transfer of control, return
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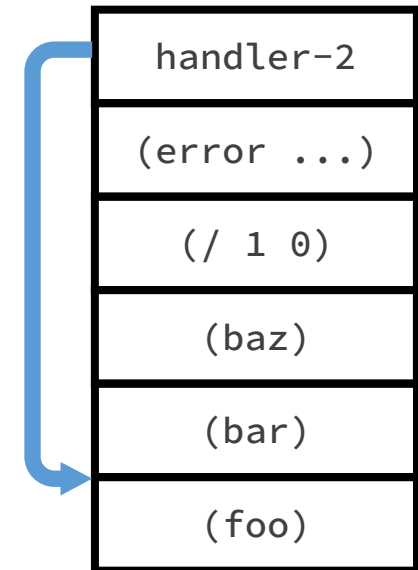
Let's talk about non-local control flow

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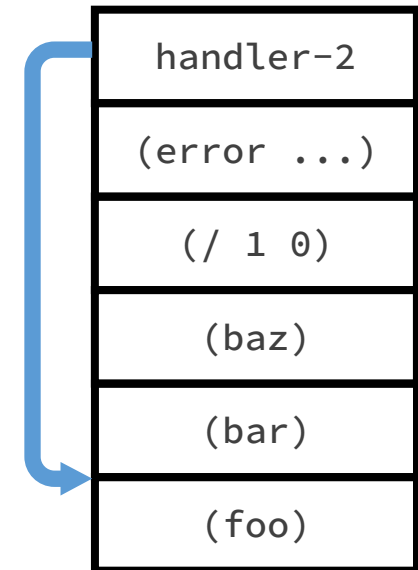
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Let's talk about control flow in Common Lisp

- Construct the condition object
- Call handlers from the stack in order
 - What do the handlers do?
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 - Maybe do nothing and return
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 - Maybe there are no handlers
 - Maybe she's born with it
 - Maybe it's Maybelline™
- If there was no transfer of control, return
 - ...and maybe enter the debugger to halt the program



Control Flow in Common Lisp

***aka* Why Lisp Doesn't Need To Throw Exceptions**

Appendix B

Proving one-phase unwind in TAGBODY and BLOCK

Let's talk about non-local control flow in Common Lisp

- `if`
- `tagbody/go` ; 1-phase unwind (no search)
- `block/return-from` ; 1-phase unwind (no search)
- `catch/throw` ; 2-phase unwind (search)
- `unwind-protect`
- `lambda/apply`

Let's talk about non-local control flow in Common Lisp

- `if`
- `tagbody/go` ; 1-phase unwind (no search)
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Let's talk about one-phase unwind in Common Lisp

- `if`
- `tagbody/go` ; 1-phase unwind (no search)
- `block/return-from` ; 1-phase unwind (no search)
- `catch/throw` ; 2-phase unwind (search)
- `unwind-protect`
- `lambda/apply`

Let's talk about one-phase unwind in Common Lisp

- `if`
- `tagbody/go` ; 1-phase unwind (no search)
- `block/return-from` ; 1-phase unwind (no search)
- `catch/throw` ; 2-phase unwind (search)
- `unwind-protect`
- `lambda/apply`

```
(block foo  
  (lambda ()  
    (return-from foo)))
```

Let's talk about one-phase unwind in Common Lisp

- `if`
- `tagbody/go` ; 1-phase unwind (no search)
- `block/return-from` ; 1-phase unwind (no search)
- `catch/throw` ; 2-phase unwind (search)
- `unwind-protect`
- `lambda/apply`

```
(let ((fn (block foo
              (lambda ()
                (return-from foo))))
    (funcall fn))
; ...?
```


Let's talk about one-phase unwind in Common Lisp

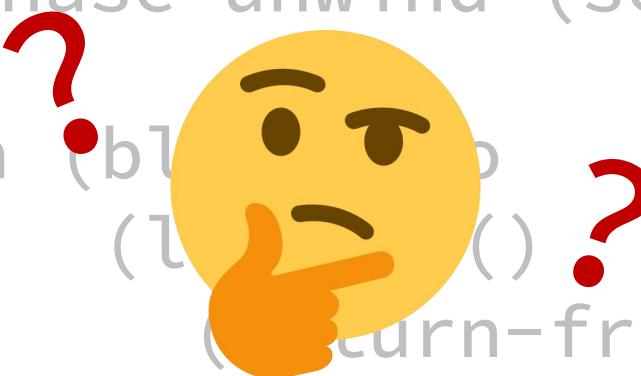
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 - `tagbody/go` ; 1-phase unwind (no search)
 - `block/return-from` ; 1-phase unwind (no search)
 - `catch/throw` ; 2-phase unwind (search)
 - `unwind-protect`
 - `lambda/apply`
- ```
(let ((fn (block foo
 (lambda ()
 (return-from foo))))))
 (funcall fn))
; ERROR: Condition CONTROL-ERROR
; was signaled.
```

# Let's talk about one-phase unwind in Common Lisp

- `if`
- `tagbody/go` ; 1-phase unwind (no search)
- `block/return-from` ; 1-phase unwind (no search)
- `catch/throw` ; 2-phase unwind (search)
- `unwind-protect`
- `lambda/apply`

```
(let ((fn (block foo
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 (return-from foo))))))
 (funcall fn))
; ERROR: Condition CONTROL-ERROR
; was signaled.
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# Let's talk about one-phase unwind in Common Lisp

- `if`
  - `tagbody/go` ; 1-phase unwind (no search)
  - `block/return-from` ; 1-phase unwind (no search)
  - `catch/throw` ; 2-phase unwind (search)
  - `unwind-protect`
  - `lambda/apply`
- ```
(let ((fn (block (lambda ()  
  (let ((x 1))  
    (unwind-protect  
      (return-from foo))))))  
  (funcall fn))  
; ERROR: Condition CONTROL-ERROR  
; was signaled.
```
- 

Let's talk about one-phase unwind in Common Lisp

```
(block foo  
  (lambda ()  
    (return-from foo)))
```

Let's talk about one-phase unwind in Common Lisp

```
(block foo  
  ...)
```

Let's talk about one-phase unwind in Common Lisp

```
(let ((return-valid-p t))  
  (unwind-protect  
    (%unwind-tag foo  
      ...)  
    (setf return-valid-p nil)))
```

Let's talk about one-phase unwind in Common Lisp

```
(let ((return-valid-p t))  
  (unwind-protect  
    (%unwind-tag foo  
      ...) ;; let's expand the lambda!  
    (setf return-valid-p nil)))
```

Let's talk about one-phase unwind in Common Lisp

```
(let ((return-valid-p t))
  (unwind-protect
    (%unwind-tag foo
      (lambda ()
        (if return-valid-p
          (%1-phase-unwind-to-tag foo)
          (error 'control-error)))))
    (setf return-valid-p nil)))
```


Let's talk about one-phase unwind in Common Lisp

```
(let ((return-valid-p t))  
  (unwind-protect  
    (%unwind-tag foo  
      (lambda ()  
        (if return-valid-p  
            (%1-phase-unwind-to-tag foo)  
            (error 'control-error)))))  
  (setf return-valid-p nil)))
```

Let's talk about one-phase unwind in Common Lisp

```
(let ((return-valid-p t))
  (unwind-protect
    (%unwind-tag foo
      (lambda ()
        (if return-valid-p
          (%1-phase-unwind-to-tag foo)
          (error 'control-error))))
    (setf return-valid-p nil)))
```

Let's talk about one-phase unwind in Common Lisp

```
(let ((return-valid-p t))  
  (unwind-protect  
    (%unwind-tag foo  
      (lambda ()  
        (if return-valid-p  
          (%1-phase-unwind-to-tag foo)  
          (error 'control-error))))  
    (setf return-valid-p nil)))
```

;; similar validation scheme applies for TAGBODY/GO

Control Flow in Common Lisp

***aka* Why Lisp Doesn't Need To Throw Exceptions**

Appendix C

Describing UNWIND-PROTECT

Let's talk about non-local control flow in Common Lisp

- `if`
- `tagbody/go`
- `block/return-from`
- `catch/throw`
- `unwind-protect`
- `lambda/apply`

Let's talk about non-local control flow in Common Lisp

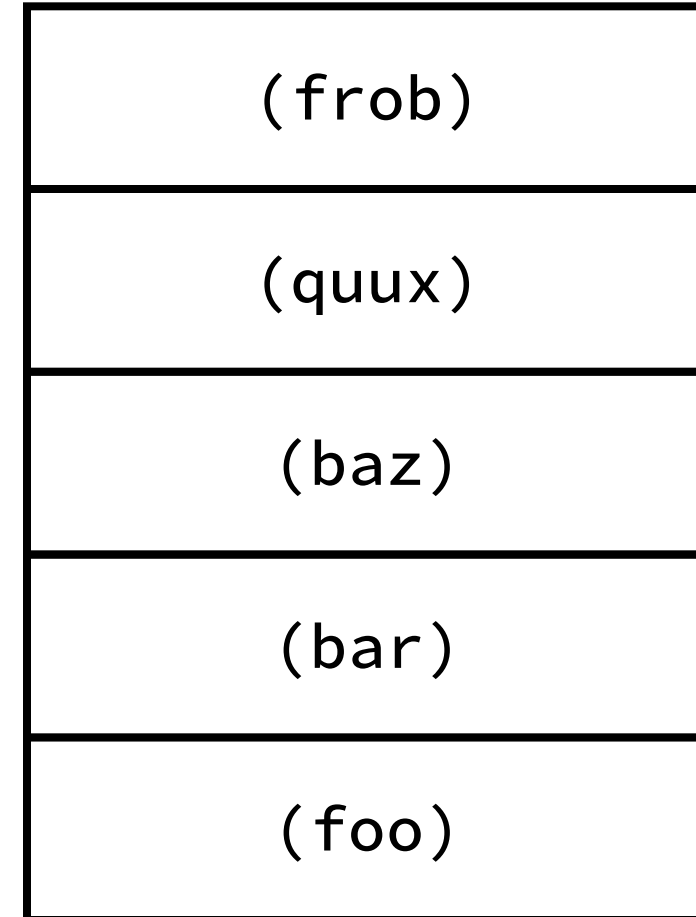
- `if`
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- `lambda/apply`

Let's talk about unwinding in Common Lisp

- if
- tagbody/go
- block/return-from
- catch/throw
- unwind-protect
- lambda/apply

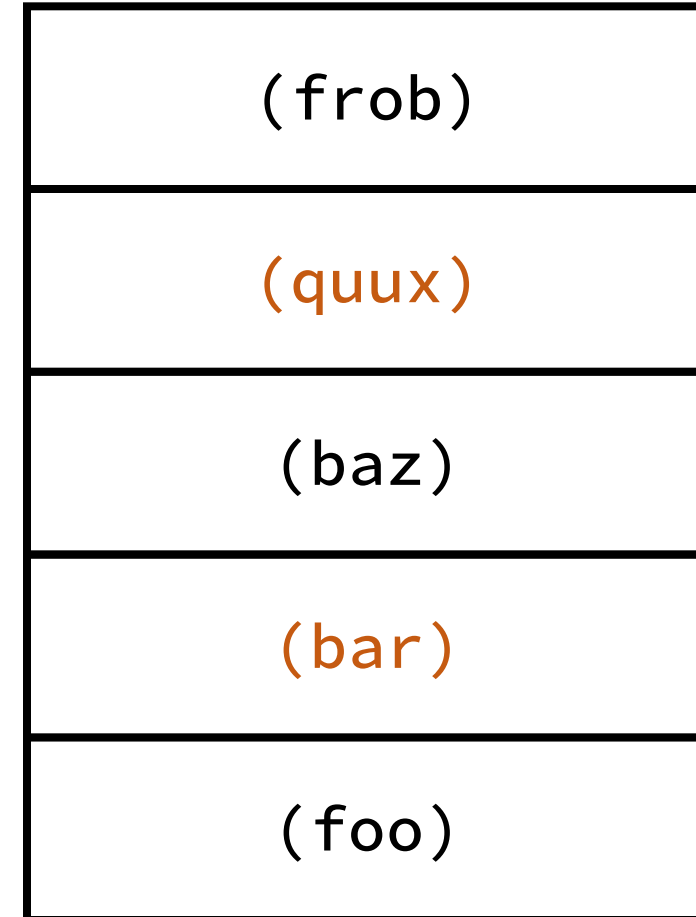
Let's talk about unwinding in Common Lisp

- `if`
- `tagbody/go`
- `block/return-from`
- `catch/throw`
- **`unwind-protect`**
- `lambda/apply`



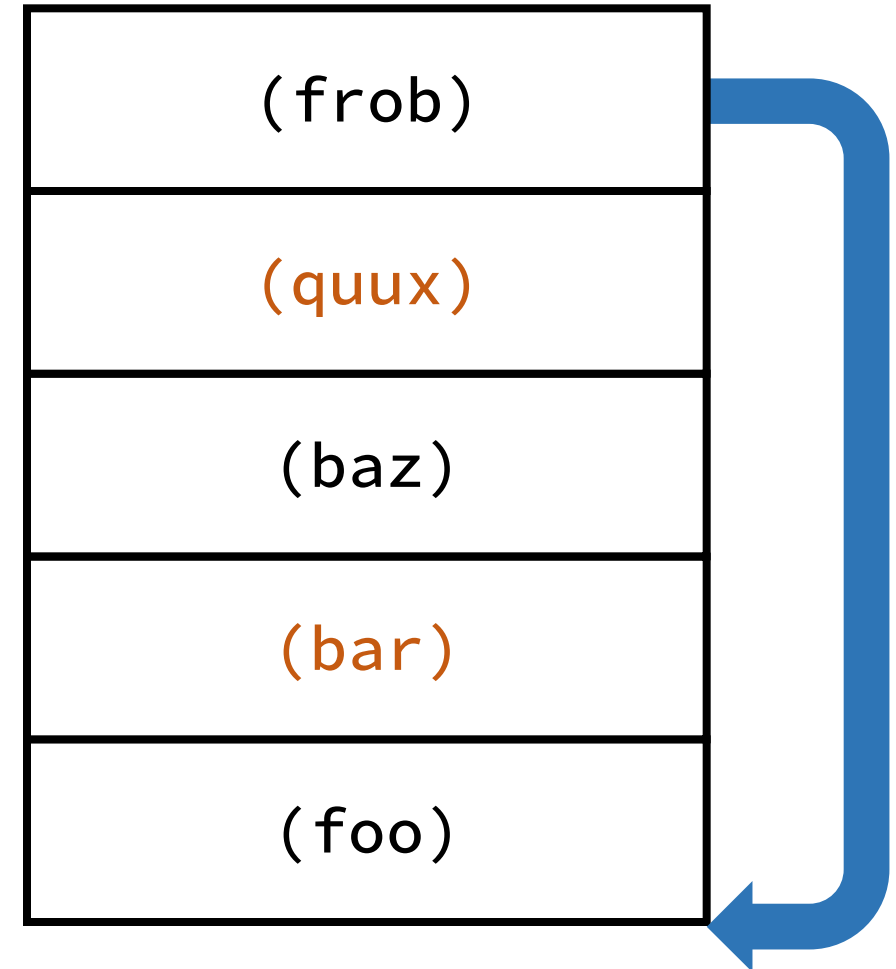
Let's talk about unwinding in Common Lisp

- `if`
- `tagbody/go`
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- `catch/throw`
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- `lambda/apply`



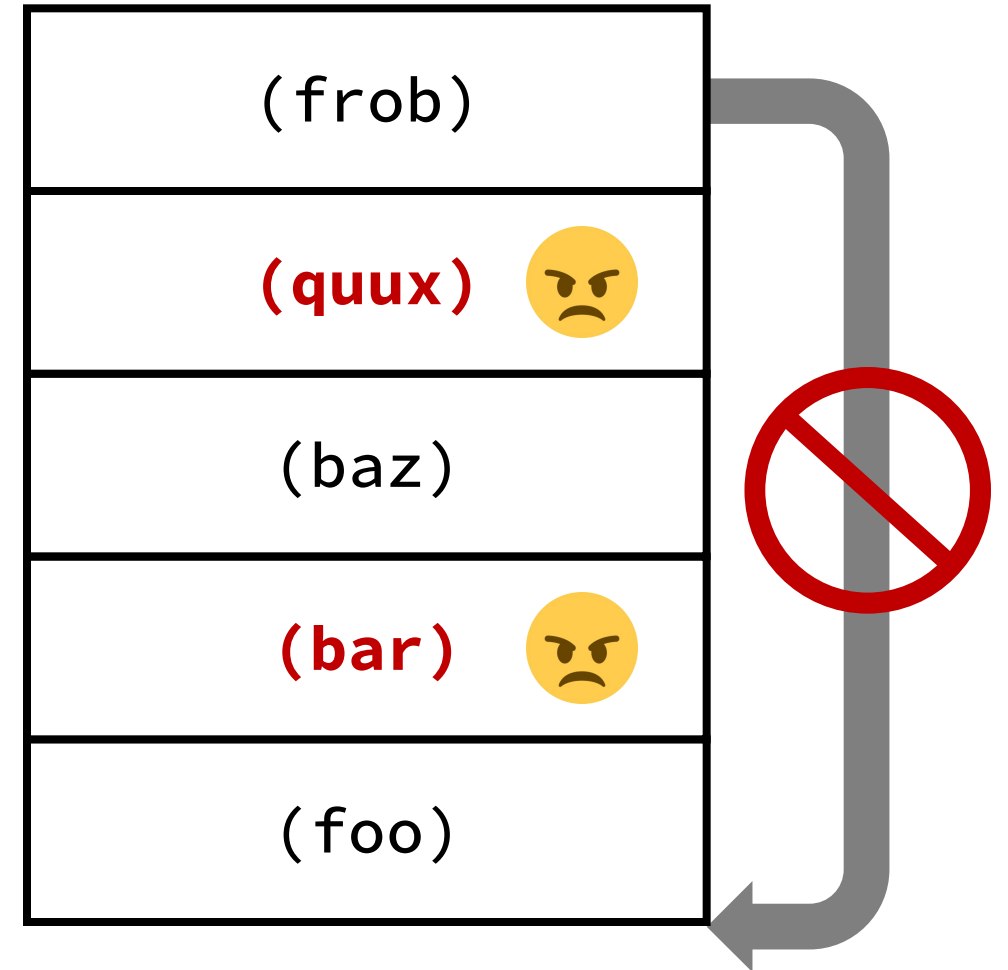
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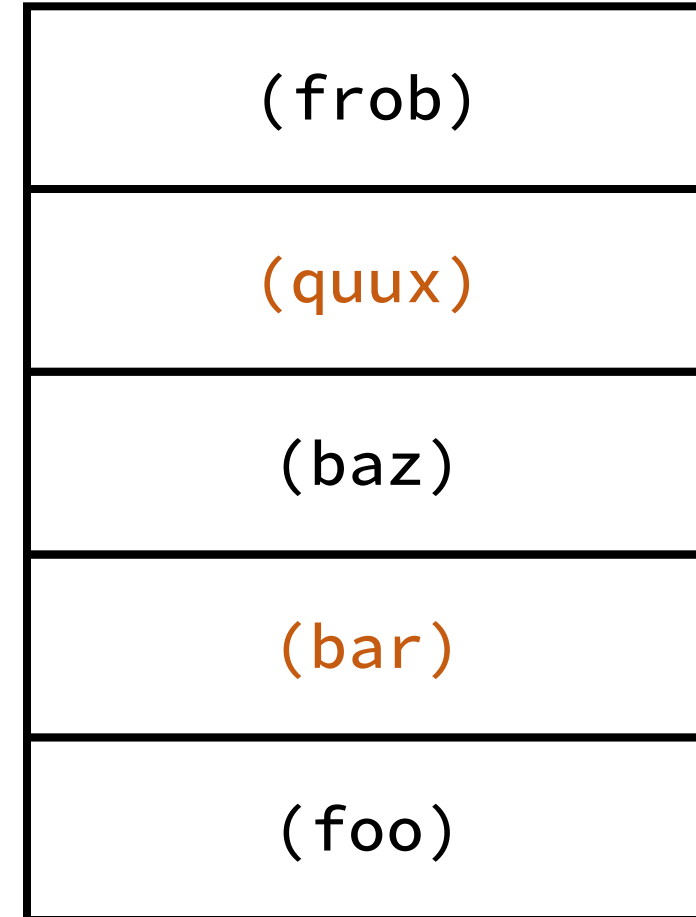
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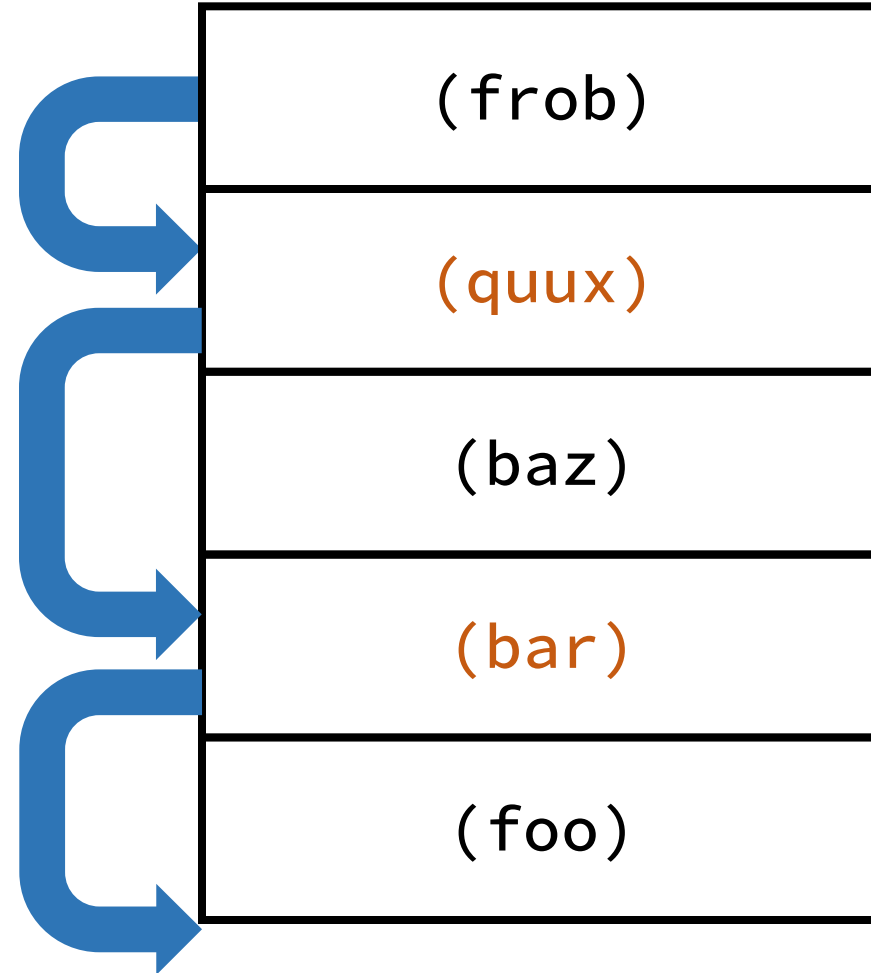
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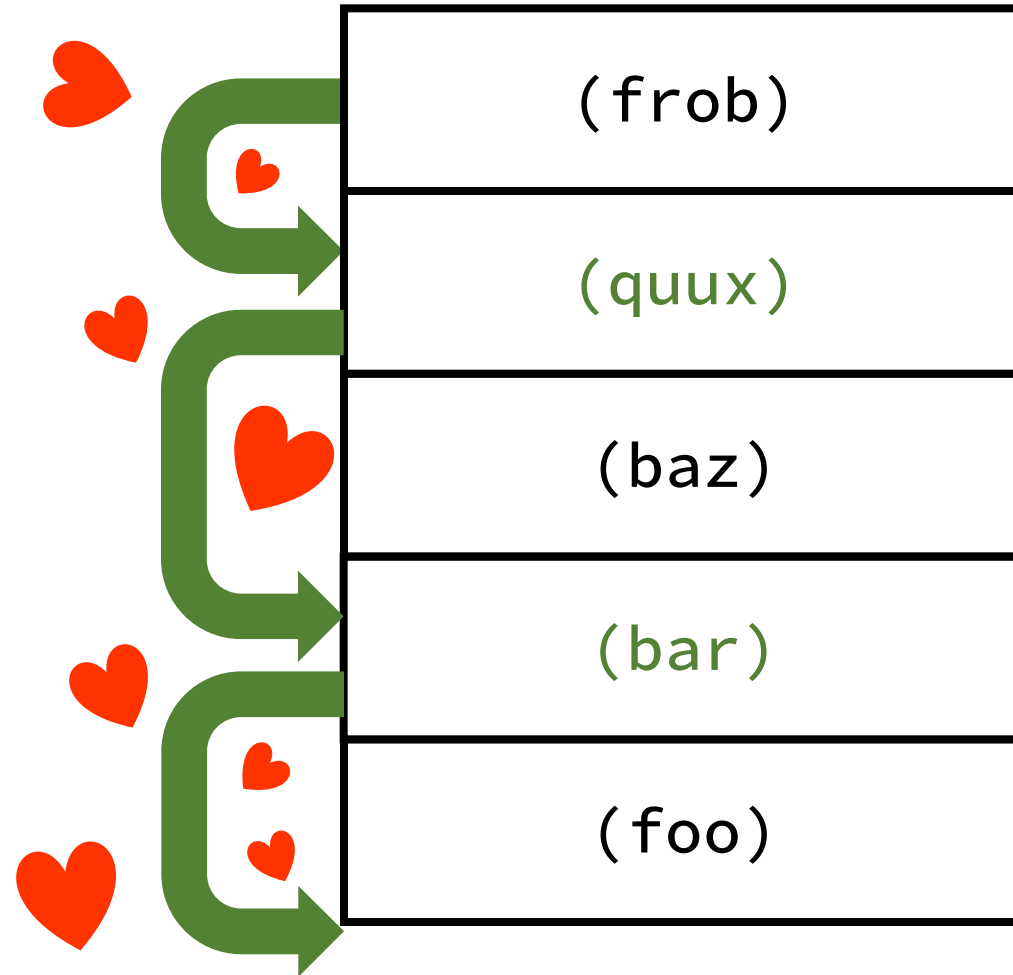
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Let's talk about unwinding in Common Lisp

- `if`
- `tagbody/go`
- `block/return-from`
- `catch/throw`
- **`unwind-protect`**
- `lambda/apply`



Control Flow in Common Lisp

***aka* Why Lisp Doesn't Need To Throw Exceptions**

Appendix D

Common Lisp condition system without Common Lisp

(this is the last one I promise)

Let's talk about control flow in Common Lisp

- `if`
- `tagbody/go`
- `block/return-from`
- `catch/throw`
- `unwind-protect`
- `lambda/apply`

Let's talk about control flow in Common Lisp and Java

- `if`
- `tagbody/go`
- `block/return-from`
- `catch/throw`
- `unwind-protect`
- `lambda/apply`

- `if`
- `tagbody/go`
- `block/return-from`
- `catch/throw`
- `try/finally`
- `new/.apply()`
- `throw exception`

Let's talk about control flow in Common Lisp and Java

Metacircular Semantics for Common Lisp Special Forms

[Henry G. Baker](#)

Nimble Computer Corporation, 16231 Meadow Ridge Way, Encino, CA 91436

(818) 986-1436 (818) 986-1360 (FAX)

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McCarthy's metacircular interpreter for Lisp has been criticized by Reynolds and others for not providing precise semantics. Unfortunately, the alternative of English prose currently favored by the ANSI X3J13 and ISO committees for the definition of Common Lisp is even less precise than a metacircular interpreter. Thus, while a system of denotational semantics á la Scheme or ML could be developed for Common Lisp, we believe that a carefully fashioned system of metacircular definitions can achieve most of the precision of denotational semantics.

Furthermore, a metacircular definition is also more readable and understandable by the average Common Lisp programmer, since it is written in terms he mostly understands. Finally, a metacircular definition for Common Lisp special forms enables us to transparently customize the representation of certain "built-in" mechanisms such as function closures, to enable sophisticated systems like "Portable Common Loops" to become truly portable.

Let's talk about control flow in Common Lisp and Java

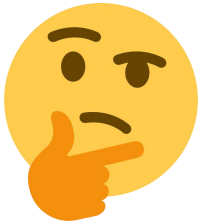
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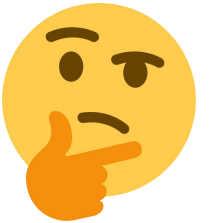
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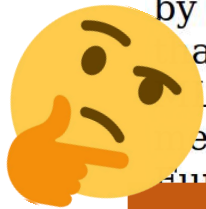
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Let's talk about control flow in Common Lisp and Java

Metacircular Semantics for Common Lisp Special Forms

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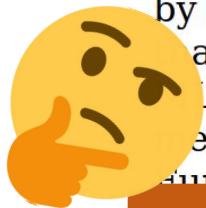
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Finally, a metacircular definition for Common Lisp special forms enables us to enable sophisticated systems like "Portable Common Loops" to become truly portable.

- Can we port the condition system to Java?



Let's talk about control flow in Common Lisp and Java

Metacircular Semantics for Common Lisp Special Forms

[Henry G. Baker](#)

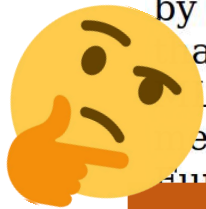
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- Can we port CL control flow to Java?



Let's talk about Common Lisp control flow in Java

Metacircular Semantics for Common Lisp Special Forms

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- Can we port CL control flow to Java?

Let's talk about Common Lisp control flow in Java


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- `tagbody/go`
- `block/return-from`
- `catch/throw`
- `unwind-protect`
- `lambda/apply`

- `if`
- `tagbody/go`
- `block/return-from`
- `catch/throw`
- `try/finally`
- `new/.apply()`
- `throw exception`

Let's talk about Common Lisp control flow in Java

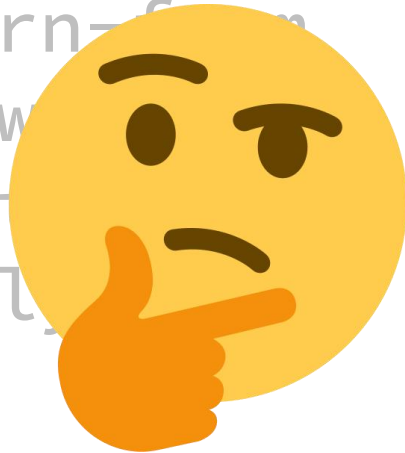
- if
- tagbody/go
- block/return-from
- catch/throw
- unwind-protect
- lambda/apply



- 
- A large blue bracket graphic on the left side of the list, with an arrow pointing from the top of the bracket to the first item, 'if'.
- if
 - tagbody/go
 - block/return-from
 - catch/throw
 - try/finally
 - new/.apply()
 - throw exception

Let's talk about Common Lisp control flow in Java

- if
- tagbody/go
- block/return-from
- catch/throw
- unwind-protect
- lambda/apply



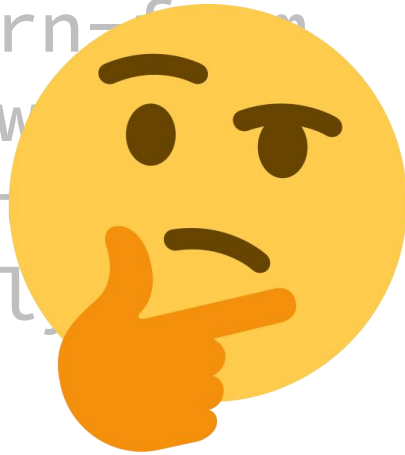
- if
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- block/return-from
- catch/throw
- try/finally
- new/.apply()
- throw exception

"I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail."

--- Abraham H. Maslow

Let's talk about Common Lisp control flow in Java

- if
- tagbody/go
- block/return-from
- catch/throw
- unwind-protect
- lambda/apply



- if
- tagbody/go
- block/return-from
- catch/throw
- try/finally
- new/.apply()
- throw exception

<https://github.com/phoe/cafe-latte>

<3



yes, it's seriously the end this time