A Pretty Printer that Says what it Means

David Raymond Christiansen[1]

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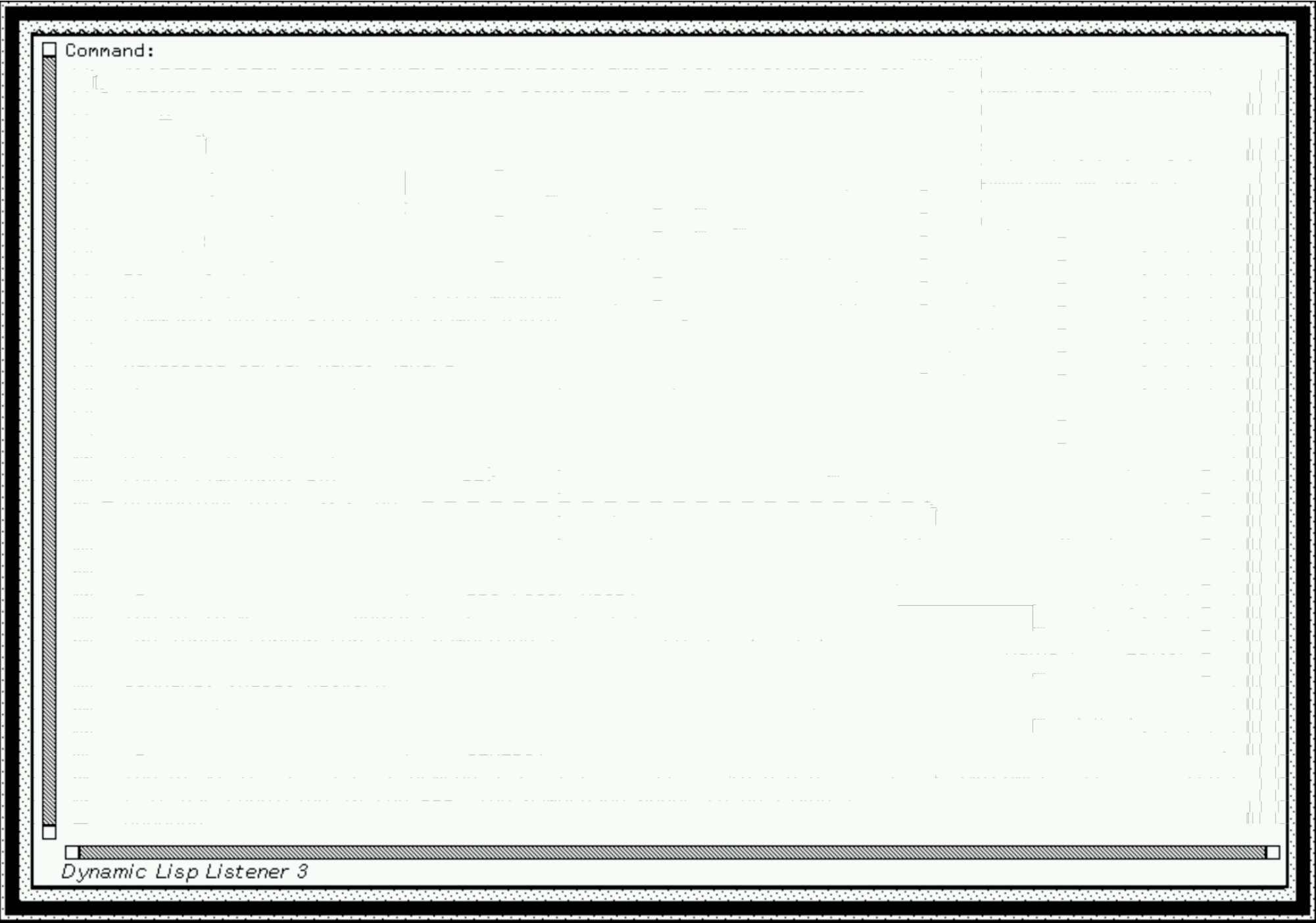
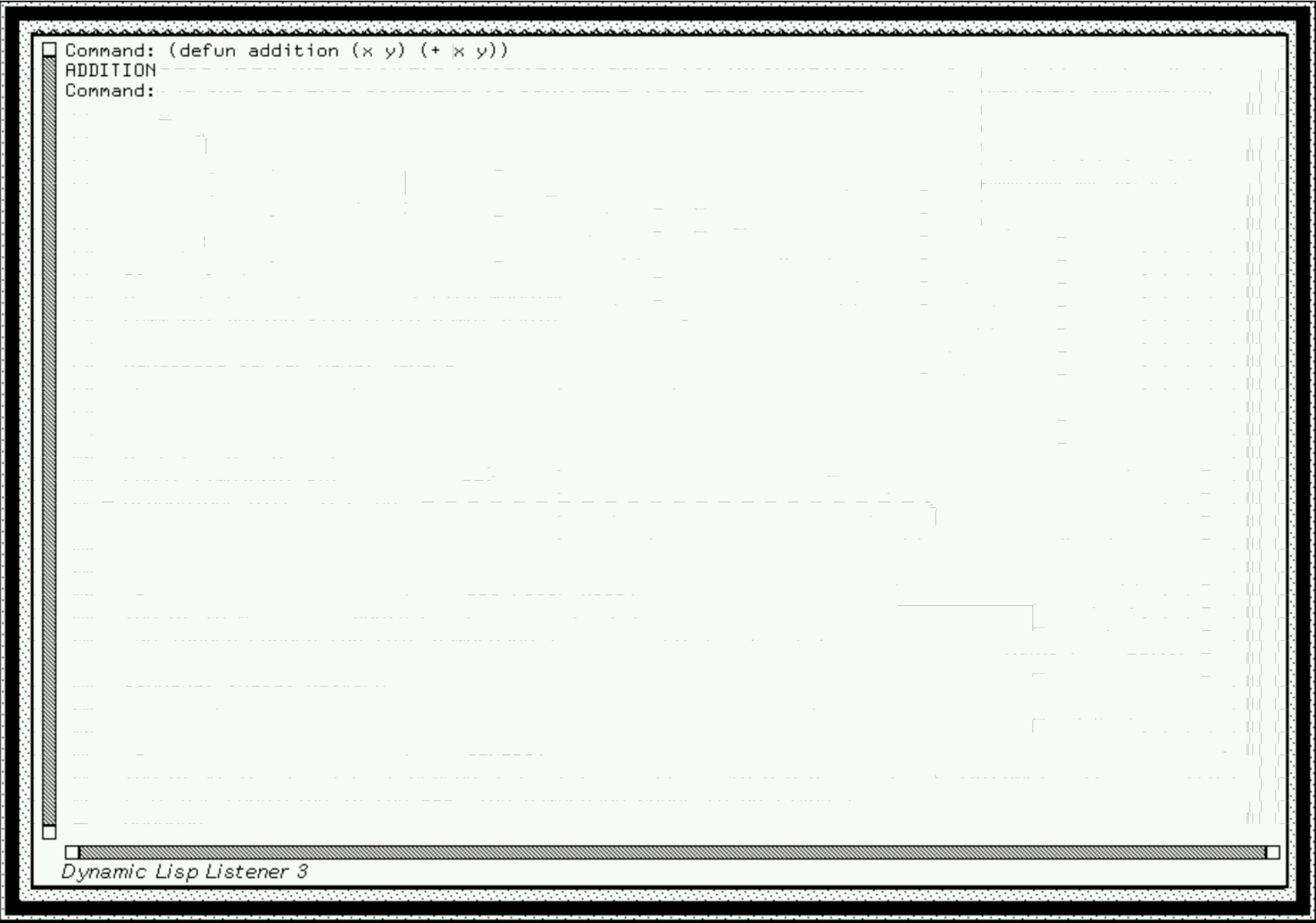
IT University of Copenhagen



Mouse-R: Menu.
To see other commands, press Shift, Control, Meta-Shift, or Super.



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Command: (defun addition (x y) (+ x y))
ADDITION
Command:
Dynamic Lisp Listener 3
Mouse-L: 'ADDITION; Mouse-M: (DESCRIBE 'ADDITION); Mouse-R: Menu.
To see other commands, press Shift, Control, Meta, Meta-Shift, Super, or Super-Shift.
[Thu 27 Aug 1:07:30] LISPM CL USER: User Input


Operation on ADDITION:
'ADDITION
(DESCRIBE 'ADDITION)
(INSPECT 'ADDITION)
ADDITION
ADDITION [will not activate]
Edit Definition (name) ADDITION (type) Function
Edit viewspecs
Show this function's argument list
Marking and yanking menu
Presentation debugging menu
System menu
Window operation menu
Command:
ADDITION
Command:
Dynamic Lisp Listener 3
Mouse-L, -M, -R: Show this function's argument list.
To see other commands, press Shift, Control, Meta-Shift, or Super.
[Thu 27 Aug 1:07:52] LISPM CL USER: User Input


Command: (defun addition (x y) (+ x y))
ADDITION
Command: Show Function Arguments ADDITION
ADDITION: (X Y)
Command:
Dynamic Lisp Listener 3
Mouse-L: Show Function Arguments (function s; Mouse-M: Re-execute command after modifyi; Mouse-R: Menu
To see other commands, press Shift, Control, Meta-Shift, or Super.
[Thu 27 Aug 1:09:17] LISPM CL USER: User Input


Operation on ADDITION:
'ADDITION
(DESCRIBE 'ADDITION)
(INSPECT 'ADDITION)
ADDITION
ADDITION [will not activate]
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Edit viewspecs
Show this function's argument list
Marking and yanking menu
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System menu
Window operation menu
Command:
ADDITION
Command:
ADDITION
Command:
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Mouse-L, -M, -R: (DESCRIBE 'ADDITION).
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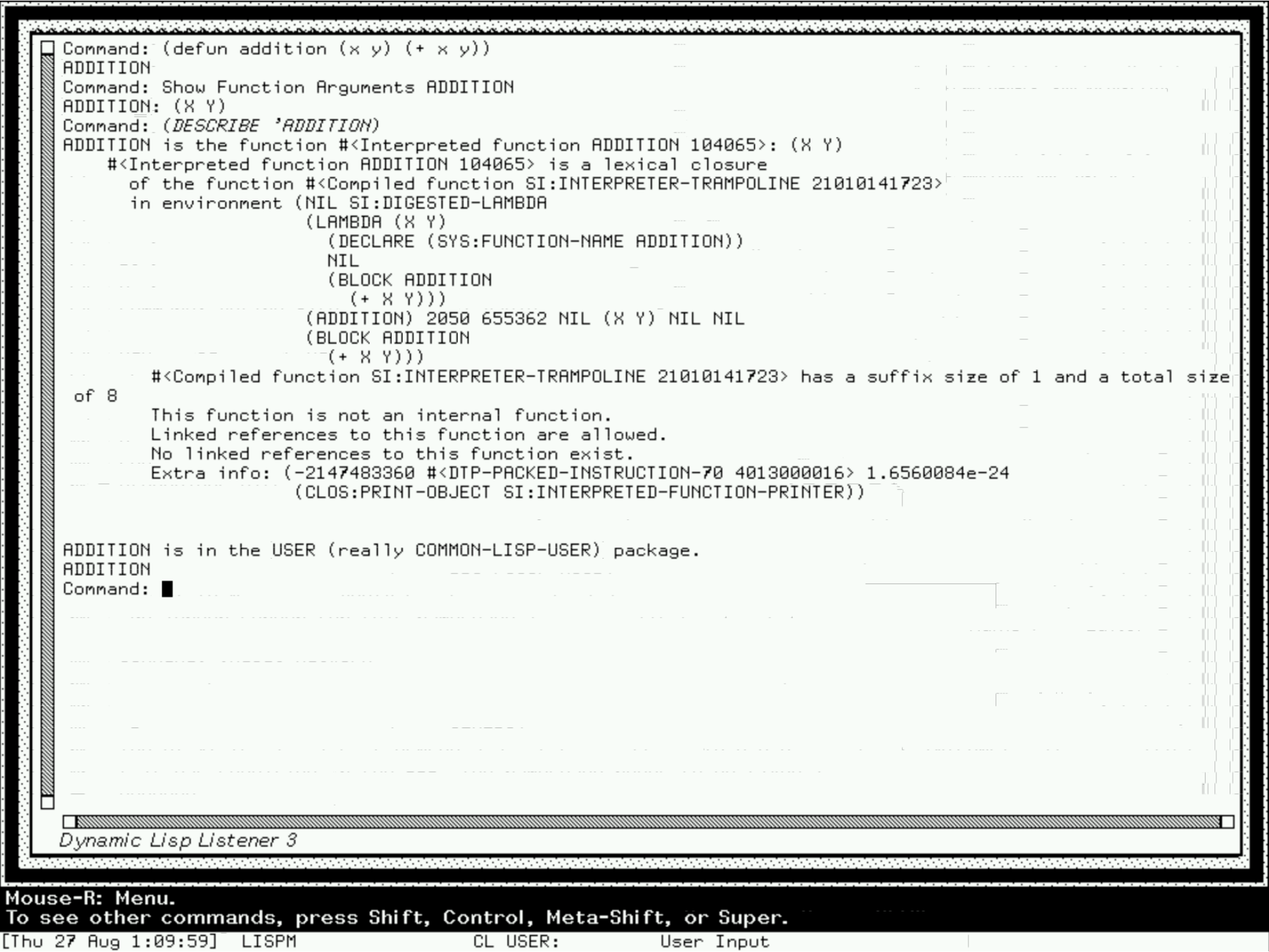
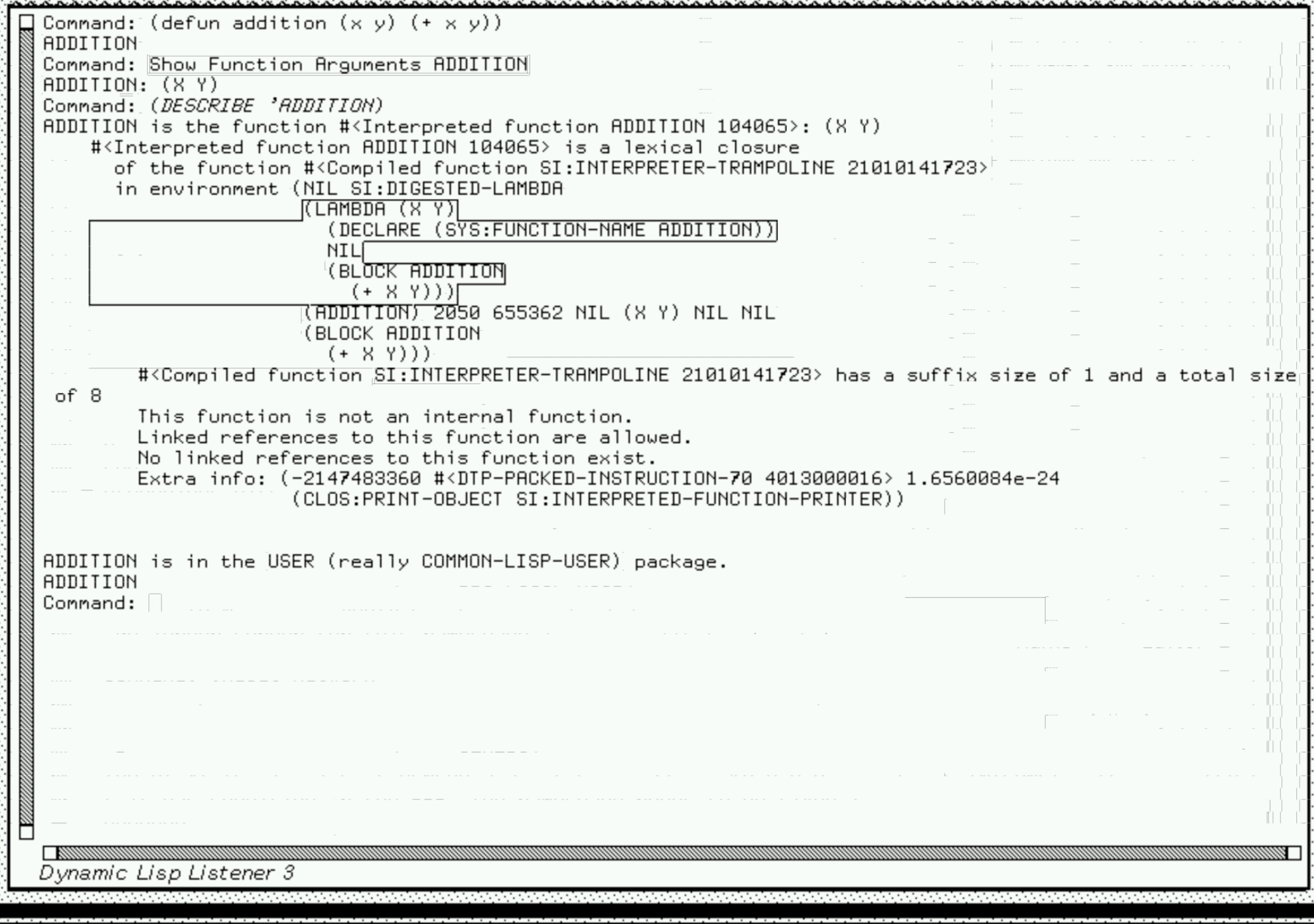
[Thu 27 Aug 1:09:37] LISPM CL USER: User Input


Command: (defun addition (x y) (+ x y))
ADDITION
Command: Show Function Arguments ADDITION
ADDITION: (X Y)
Command: (DESCRIBE 'ADDITION)
ADDITION is the function #<Interpreted function ADDITION 104065>: (X Y)
#<Interpreted function ADDITION 104065> is a lexical closure
of the function #<Compiled function SI:INTERPRETER-TRAMPOLINE 21010141723>
in environment (NIL SI:DIGESTED-LAMBDA
(LAMBDA (X Y)
(DECLARE (SYS:FUNCTION-NAME ADDITION))
NIL
(BLOCK ADDITION
(+ X Y)))
(ADDITION) 2050 655362 NIL (X Y) NIL NIL
(BLOCK ADDITION
(+ X Y)))
#<Compiled function SI:INTERPRETER-TRAMPOLINE 21010141723> has a suffix size of 1 and a total size
of 8
This function is not an internal function.
Linked references to this function are allowed.
No linked references to this function exist.
Extra info: (-2147483360 #<DTP-PACKED-INSTRUCTION-70 4013000016> 1.6560084e-24
(CLOS:PRINT-OBJECT SI:INTERPRETED-FUNCTION-PRINTER))
ADDITION is in the USER (really COMMON-LISP-USER) package.
ADDITION
Command:
Dynamic Lisp Listener 3
Mouse-R: Menu.
To see other commands, press Shift, Control, Meta-Shift, or Super.
[Thu 27 Aug 1:09:59] LISPM CL USER: User Input



Mouse-L: '(LAMBDA (X Y) (DECLARE #) ...); Mouse-M: (DESCRIBE '(LAMBDA # # ...)); Mouse-R: Menu.
To see other commands, press Shift, Control, Meta, Meta-Shift, Control-Meta, Super, or Super-Shift.

[Thu 27 Aug 1:12:27] LISPM CL USER: User Input

The Legend

Presentations: a connection between screen output and the underlying objects.

The world, today

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- It is useful to support clients other than development environments: IRC bots, search engines, and unknown products of ingenuity

This talk

How did we implement presentations in Idris? Can Haskell make use of the same technique?

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- Resembles Haskell: type classes, do-notation, monadic IO, layout syntax
- Full dependent types
- Primarily developed by Edwin Brady at St Andrews, contributors around the world
- **Written in Haskell**

Demo!

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- The pretty printing library supports **semantic annotations**
- Annotations describe the **meaning** of sub-documents
- Provide in-band and out-of-band communication of annotations
- REPL commands take annotations as arguments

Concretely

Begin with a pretty-printing library:

- Hughes-Peyton Jones style
- Wadler-Leijen style

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- Combinators for constructing a `Doc`
- Renderers that convert a `Doc` into a `String`, or to write it to a handle

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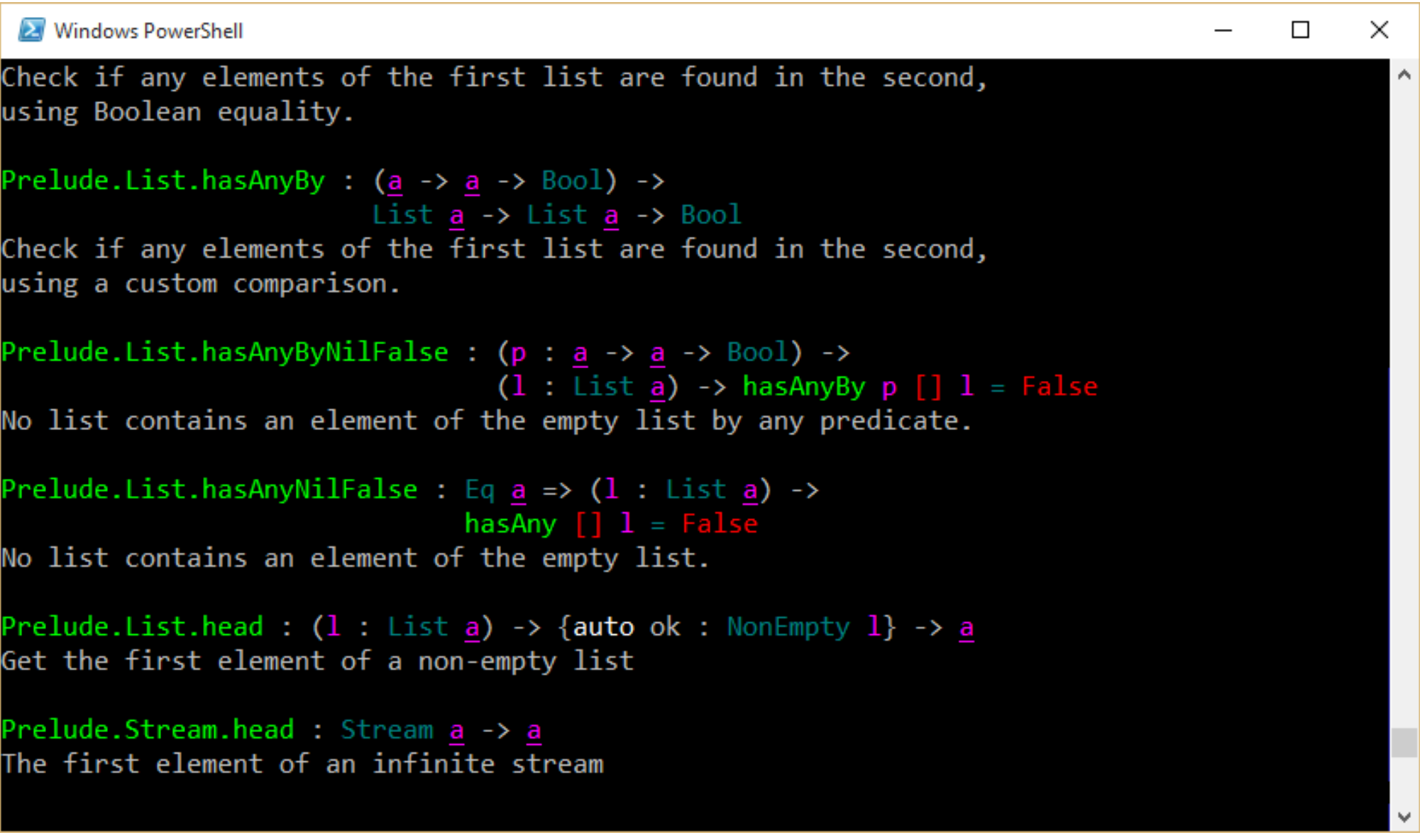
3. Add output methods:

```
outputSpans :: Doc a → (String, [(Int, Int, a)])

displayDecorated :: (a → String → String)
                 → Doc a → String
```

What About Windows?

Windows needs side effects to change console colors: ANSI codes don’t work!


Windows PowerShell
Check if any elements of the first list are found in the second,
using Boolean equality.
Prelude.List.hasAnyBy : (a -> a -> Bool) ->
List a -> List a -> Bool
Check if any elements of the first list are found in the second,
using a custom comparison.
Prelude.List.hasAnyByNilFalse : (p : a -> a -> Bool) ->
(l : List a) -> hasAnyBy p [] l = False
No list contains an element of the empty list by any predicate.
Prelude.List.hasAnyNilFalse : Eq a => (l : List a) ->
hasAny [] l = False
No list contains an element of the empty list.
Prelude.List.head : (l : List a) -> {auto ok : NonEmpty l} -> a
Get the first element of a non-empty list
Prelude.Stream.head : Stream a -> a
The first element of an infinite stream

More generality, please!

```
displayDecoratedA :: (Applicative f, Monoid b)
                  ⇒ (String → f b)
                  → (a → f b) → (a → f b)
                  → Doc a → f b
```

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displayDecoratedA :: (Applicative f, Monoid b)
                  ⇒ (String → f b)
                  → (a → f b) → (a → f b)
                  → Doc a → f b
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For Windows output, let `f` be `IO` and let `b` be `()`

Doc is a Functor

Because Doc is a Functor, we can transform or decorate annotations.

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Because Doc is a Functor, we can transform or decorate annotations. Uses:

- Add additional type information without imposing dependencies on pretty-printer
- Convert annotations to the IDE protocol
- Type check terms that occur inside of docstrings

Implementations

`annotated-wl-pprint`

Idris's pretty-printing library — a Wadler-Leijen derivative

`pretty`

Trevor Elliott at Galois implemented annotations for it in 2014

Similar libraries

`wl-pprint-extras`

A free monad based on `wl-pprint` where effects can be embedded in documents

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```
type Doc = Annotated.Doc ()
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- Let's take good ideas from Lisp and Smalltalk UIs, and make them **even better** with types!