

# Unstable: May Change Without Warning

Version 5.3

August 6, 2012

This manual documents some of the libraries available in the `unstable` collection.

The name `unstable` is intended as a warning that the **interfaces** in particular are unstable. Developers of planet packages and external projects should avoid using modules in the unstable collection. Contracts may change, names may change or disappear, even entire modules may move or disappear without warning to the outside world.

Developers of unstable libraries must follow the guidelines in §1 “Guidelines for Developing `unstable` Libraries”.

# 1 Guidelines for Developing `unstable` Libraries

Any collection developer may add modules to the `unstable` collection.

Every module needs an owner to be responsible for it.

- If you add a module, you are its owner. Add a comment with your name at the top of the module.
- If you add code to someone else's module, tag your additions with your name. The module's owner may ask you to move your code to a separate module if they don't wish to accept responsibility for it.

When changing a library, check all uses of the library in the collections tree and update them if necessary. Notify users of major changes.

Place new modules according to the following rules. (These rules are necessary for maintaining PLT's separate text, gui, and dracket distributions.)

- Non-GUI modules go under `unstable` (or subcollections thereof). Put the documentation in `unstable/scribblings` and include with `include-section` from `unstable/scribblings/unstable.scrbl`.
- GUI modules go under `unstable/gui`. Put the documentation in `unstable/scribblings/gui` and include them with `include-section` from `unstable/scribblings/gui.scrbl`.
- Do not add modules depending on DrRacket to the `unstable` collection.
- Put tests in `tests/unstable`.

Keep documentation and tests up to date.

## 2 Automata: Compiling State Machines

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/automata)
```

This package provides macros and functions for writing state machines over `racket/match` patterns (as opposed to concrete characters.)

### 2.1 Machines

```
(require unstable/automata/machine)
```

Each of the subsequent macros compile to instances of the machines provided by this module. This is a documented feature of the modules, so these functions should be used to, for example, determine if the machine is currently accepting.

```
(struct machine (next))  
  next : (any/c . -> . machine?)
```

An applicable structure for machines. When the structure is applied, the `next` field is used as the procedure.

```
(struct machine-accepting machine (next))  
  next : (any/c . -> . machine?)
```

A sub-structure of `machine` that is accepting.

```
(machine-accepts? m i) → boolean?  
  m : machine?  
  i : (listof any/c)
```

Returns `#t` if `m` ends in an accepting state after consuming every element of `i`.

```
(machine-accepts?/prefix-closed m i) → boolean?  
  m : machine?  
  i : (listof any/c)
```

Returns `#t` if `m` stays in an accepting state during the consumption of every element of `i`.

```
machine-null : machine?
```

A machine that is never accepting.

`machine-epsilon : machine?`

A machine that is initially accepting and never accepting afterwards.

`machine-sigma* : machine?`

A machine that is always accepting.

`(machine-complement m) → machine?`  
`m : machine?`

A machine that inverts the acceptance criteria of *m*.

`(machine-star m) → machine?`  
`m : machine?`

A machine that simulates the Kleene star of *m*. *m* may be invoked many times.

`(machine-union m0 m1) → machine?`  
`m0 : machine?`  
`m1 : machine?`

A machine that simulates the union of *m0* and *m1*.

`(machine-intersect m0 m1) → machine?`  
`m0 : machine?`  
`m1 : machine?`

A machine that simulates the intersection of *m0* and *m1*.

`(machine-seq m0 m1) → machine?`  
`m0 : machine?`  
`m1 : machine?`

A machine that simulates the sequencing of *m0* and *m1*. *m1* may be invoked many times.

`(machine-seq* m0 make-m1) → machine?`  
`m0 : machine?`  
`make-m1 : (→ machine?)`

A machine that simulates the sequencing of *m0* and *(make-m1)*. *(make-m1)* may be invoked many times.

## 2.2 Deterministic Finite Automata

```
(require unstable/automata/dfa)
```

This module provides a macro for deterministic finite automata.

```
(dfa start
  (end ...)
  [state ([evt next-state]
          ...)])

start : identifier?
end : identifier?
state : identifier?
next-state : identifier?
```

A `machine` that starts in state `start` where each state behaves as specified in the rules. If a `state` is in `(end ...)`, then it is constructed with `machine-accepting`. `next-state` need not be a state from this DFA.

Examples:

```
(define M
  (dfa s1 (s1)
    [s1 ([0 s2]
          [(? even?) s1])]
    [s2 ([0 s1]
          [(? even?) s2])]))

> (machine-accepts? M (list 2 0 4 0 2))
#t
> (machine-accepts? M (list 0 4 0 2 0))
#f
> (machine-accepts? M (list 2 0 2 2 0 8))
#t
> (machine-accepts? M (list 0 2 0 0 10 0))
#t
> (machine-accepts? M (list))
#t
> (machine-accepts? M (list 4 0))
#f
```

## 2.3 Non-Deterministic Finite Automata

```
(require unstable/automata/nfa)
```

This module provides a macro for non-deterministic finite automata.

```
(nfa (start:id ...)
     (end:id ...)
     [state:id ([evt:expr (next-state:id ...)]
                  ...)]
     ...)

start : identifier?
end   : identifier?
state : identifier?
next-state : identifier?
```

A `machine` that starts in state `(set start ...)` where each state behaves as specified in the rules. If a state is in `(end ...)`, then the machine is accepting. `next-state` must be a state from this NFA.

These machines are efficiently compiled to use the smallest possible bit-string as a set representation and unsafe numeric operations where appropriate for inspection and adjusting the sets.

Examples:

```
(define M
  (nfa (s1 s3) (s1 s3)
    [s1 ([0 (s2)]
          [1 (s1)])]
    [s2 ([0 (s1)]
          [1 (s2)])]
    [s3 ([0 (s3)]
          [1 (s4)])]
    [s4 ([0 (s4)]
          [1 (s3)])]))

> (machine-accepts? M (list 1 0 1 0 1))
#t
> (machine-accepts? M (list 0 1 0 1 0))
#t
> (machine-accepts? M (list 1 0 1 1 0 1))
#t
> (machine-accepts? M (list 0 1 0 0 1 0))
```

```

#t
> (machine-accepts? M (list))
#t
> (machine-accepts? M (list 1 0))
#f

```

## 2.4 Non-Deterministic Finite Automata (with epsilon transitions)

```
(require unstable/automata/nfa-ep)
```

This module provides a macro for non-deterministic finite automata with epsilon transitions.

**epsilon**

A binding for use in epsilon transitions.

```

(nfa/ep (start:id ...)
        (end:id ...)
        [state:id ([epsilon (epsilon-state:id ...)]
                      ...
                      [evt:expr (next-state:id ...)]
                      ...])]

start : identifier?
end   : identifier?
state : identifier?
epsilon-state : identifier?
next-state : identifier?

```

Extends nfa with epsilon transitions, which must be listed first for each state.

Examples:

```

(define M
  (nfa/ep (s0) (s1 s3)
    [s0 ([epsilon (s1)]
           [epsilon (s3)])]
    [s1 ([0 (s2)]
           [1 (s1)])]
    [s2 ([0 (s1)]
           [1 (s2)])]
    [s3 ([0 (s3)]

```

```

        [1 (s4)]]]
[s4 ([0 (s4)
    [1 (s3)]]))]

> (machine-accepts? M (list 1 0 1 0 1))
#t
> (machine-accepts? M (list 0 1 0 1 0))
#t
> (machine-accepts? M (list 1 0 1 1 0 1))
#t
> (machine-accepts? M (list 0 1 0 0 1 0))
#t
> (machine-accepts? M (list))
#t
> (machine-accepts? M (list 1 0))
#f

```

## 2.5 Regular Expressions

```
(require unstable/automata/re)
```

This module provides a macro for regular expression compilation.

```

(re re-pat)

re-pat = (rec id re-pat)
         | ,expr
         | (complement re-pat)
         | (seq re-pat ...)
         | (union re-pat ...)
         | (star re-pat)
         | epsilon
         | nullset
         | re-transformer
         | (re-transformer . datum)
         | (dseq pat re-pat)
         | pat

```

Compiles a regular expression over match patterns to a `machine`.

The interpretation of the pattern language is mostly intuitive. The pattern language may be extended with `define-re-transformer`. `dseq` allows bindings of the `match` pattern to be used in the rest of the regular expression. (Thus, they are not *really* regular expressions.) `unquote` escapes to Racket to evaluate an expression that evaluates to a regular expression



(this happens once, at compile time.) `rec` binds a Racket identifier to a delayed version of the inner expression; even if the expression is initially accepting, this delayed version is never accepting.

The compiler will use an NFA, provided `complement` and `dseq` are not used. Otherwise, many NFAs connected with the machine simulation functions from `unstable/automata/machine` are used.

```
complement
seq
union
star
epsilon
nullset
dseq
rec
```

Bindings for use in `re`.

```
(define-re-transformer id expr)
```

Binds *id* as an regular expression transformer used by the `re` macro. The expression should evaluate to a function that accepts a syntax object and returns a syntax object that uses the regular expression pattern language.

### 2.5.1 Extensions

```
(require unstable/automata/re-ext)
```

This module provides a few transformers that extend the syntax of regular expression patterns.

```
(opt re-pat)
```

Optionally matches *re-pat*.

```
(plus re-pat)
```

Matches one or more *re-pat* in sequence.

```
(rep re-pat num)
```

Matches *re-pat* in sequence *num* times, where *num* must be syntactically a number.

```
(difference re-pat_0 re-pat_1)
```

Matches everything that *re-pat\_0* does, except what *re-pat\_1* matches.

```
(intersection re-pat_0 re-pat_1)
```

Matches the intersection of *re-pat\_0* and *re-pat\_1*.

```
(seq/close re-pat ...)
```

Matches the prefix closure of the sequence (seq *re-pat* ...).

## 2.5.2 Examples

Examples:

```
> (define-syntax-rule (test-re R (succ ...) (fail ...))
  (let ([r (re R)])
    (printf "Success: ~v => ~v\n" succ (machine-
accepts? r succ))
    ...
    (printf "Failure: ~v => ~v\n" fail (machine-
accepts? r fail))
    ...))

> (test-re epsilon
  [(list)]
  [(list 0)])
Success: '() => #t
Failure: '(0) => #f

> (test-re nullset
  []
  [(list) (list 1)])
Failure: '() => #f
Failure: '(1) => #f

> (test-re "A"
  [(list "A")]
  [(list)
   (list "B")])
```

```

Success: '("A") => #t
Failure: '() => #f
Failure: '("B") => #f

> (test-re (complement "A"))
[(list)
 (list "B")
 (list "A" "A")]
[(list "A")])
Success: '() => #t
Success: '("B") => #t
Success: '("A" "A") => #t
Failure: '("A") => #f

> (test-re (union 0 1))
[(list 1)
 (list 0)]
[(list)
 (list 0 1)
 (list 0 1 1)])
Success: '(1) => #t
Success: '(0) => #t
Failure: '() => #f
Failure: '(0 1) => #f
Failure: '(0 1 1) => #f

> (test-re (seq 0 1))
[(list 0 1)]
[(list)
 (list 0)
 (list 0 1 1)])
Success: '(0 1) => #t
Failure: '() => #f
Failure: '(0) => #f
Failure: '(0 1 1) => #f

> (test-re (star 0))
[(list)
 (list 0)
 (list 0 0)]
[(list 1)])
Success: '() => #t
Success: '(0) => #t
Success: '(0 0) => #t
Failure: '(1) => #f

```

```

> (test-re (opt "A")
  [(list)
   (list "A")]
  [(list "B")])
Success: '() => #t
Success: '("A") => #t
Failure: '("B") => #f

> (define-re-transformer my-opt
  (syntax-rules ()
    [(_ pat)
     (union epsilon pat)]))

> (test-re (my-opt "A")
  [(list)
   (list "A")]
  [(list "B")])
Success: '() => #t
Success: '("A") => #t
Failure: '("B") => #f

> (test-re (plus "A")
  [(list "A")
   (list "A" "A")]
  [(list)])
Success: '("A") => #t
Success: '("A" "A") => #t
Failure: '() => #f

> (test-re (rep "A" 3)
  [(list "A" "A" "A")]
  [(list)
   (list "A")
   (list "A" "A")])
Success: '("A" "A" "A") => #t
Failure: '() => #f
Failure: '("A") => #f
Failure: '("A" "A") => #f

> (test-re (difference (? even?) 2)
  [(list 4)
   (list 6)]
  [(list 3)
   (list 2)])
Success: '(4) => #t
Success: '(6) => #t

```

```

Failure: '(3) => #f
Failure: '(2) => #f

> (test-re (intersection (? even?) 2)
  [(list 2)]
  [(list 1)
   (list 4)])
Success: '(2) => #t
Failure: '(1) => #f
Failure: '(4) => #f

> (test-re (complement (seq "A" (opt "B"))))
  [(list "A" "B" "C")]
  [(list "A")
   (list "A" "B")])
Success: '("A" "B" "C") => #t
Failure: '("A") => #f
Failure: '("A" "B") => #f

> (test-re (seq epsilon 1)
  [(list 1)]
  [(list 0)
   (list)])
Success: '(1) => #t
Failure: '(0) => #f
Failure: '() => #f

> (test-re (seq 1 epsilon)
  [(list 1)]
  [(list 0)
   (list)])
Success: '(1) => #t
Failure: '(0) => #f
Failure: '() => #f

> (test-re (seq epsilon
  (union (seq (star 1) (star (seq 0 (star 1) 0 (star 1))))
  (seq (star 0) (star (seq 1 (star 0) 1 (star 0)))))
  epsilon)
  [(list 1 0 1 0 1)
   (list 0 1 0 1 0)
   (list 1 0 1 1 0 1)
   (list 0 1 0 0 1 0)
   (list)]
  [(list 1 0)])
Success: '(1 0 1 0 1) => #t

```

```

Success: '(0 1 0 1 0) => #t
Success: '(1 0 1 1 0 1) => #t
Success: '(0 1 0 0 1 0) => #t
Success: '() => #t
Failure: '(1 0) => #f

> (test-re (star (complement 1)))
      [(list 0 2 3 4)
        (list)
        (list 2)
        (list 234 5 9 1 9 0)
        (list 1 0)
        (list 0 1)]
      [(list 1)])
Success: '(0 2 3 4) => #t
Success: '() => #t
Success: '(2) => #t
Success: '(234 5 9 1 9 0) => #t
Success: '(1 0) => #t
Success: '(0 1) => #t
Failure: '(1) => #f

> (test-re (dseq x (? (curry equal? x))))
      [(list 0 0)
        (list 1 1)]
      [(list)
        (list 1)
        (list 1 0)])
Success: '(0 0) => #t
Success: '(1 1) => #t
Failure: '() => #f
Failure: '(1) => #f
Failure: '(1 0) => #f

```

### 3 Bytes

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/bytes)
```

```
(read/bytes b) → printable/c  
  b : bytes?
```

`reads` a value from `b` and returns it.

```
(write/bytes v) → bytes?  
  v : printable/c
```

`writes` `v` to a bytes and returns it.

## 4 Contracts

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/contract)

(non-empty-string? x) → boolean?
  x : any/c
```

Returns `#t` if `x` is a string and is not empty; returns `#f` otherwise.

```
port-number? : contract?
```

Equivalent to `(between/c 1 65535)`.

```
tcp-listen-port? : contract?
```

Equivalent to `(between/c 0 65535)`.

```
path-piece? : contract?
```

Equivalent to `(or/c path-string? (symbols 'up 'same))`.

```
(if/c predicate then-contract else-contract) → contract?
  predicate : (-> any/c any/c)
  then-contract : contract?
  else-contract : contract?
```

The subsequent bindings were added by Ryan Culpepper.

Produces a contract that, when applied to a value, first tests the value with `predicate`; if `predicate` returns true, the `then-contract` is applied; otherwise, the `else-contract` is applied. The resulting contract is a flat contract if both `then-contract` and `else-contract` are flat contracts.

For example, the following contract enforces that if a value is a procedure, it is a thunk; otherwise it can be any (non-procedure) value:

```
(if/c procedure? (-> any) any/c)
```

Note that the following contract is **not** equivalent:

```
(or/c (-> any) any/c) ; wrong!
```



The last contract is the same as `any/c` because `or/c` tries flat contracts before higher-order contracts.

```
| failure-result/c : contract?
```

A contract that describes the failure result arguments of procedures such as `hash-ref`.

Equivalent to `(if/c procedure? (-> any) any/c)`.

```
| (rename-contract contract name) → contract?
  contract : contract?
  name : any/c
```

Produces a contract that acts like `contract` but with the name `name`.

The resulting contract is a flat contract if `contract` is a flat contract.

```
| (option/c contract) → contract?
  contract : contract?
```

The subsequent bindings were added by Asumu Takikawa.

Creates a contract that acts like `contract` but will also accept `#f`. Intended to describe situations where a failure or default value may be used.

```
| truth/c : flat-contract?
```

The subsequent bindings were added by Carl Eastlund <cce@racket-lang.org>.

This contract recognizes Scheme truth values, i.e., any value, but with a more informative name and description. Use it in negative positions for arguments that accept arbitrary truth values that may not be booleans.

```
| (sequence/c elem/c ...) → contract?
  elem/c : contract?
```

Wraps a sequence, obligating it to produce as many values as there are `elem/c` contracts, and obligating each value to satisfy the corresponding `elem/c`. The result is not guaranteed to be the same kind of sequence as the original value; for instance, a wrapped list is not guaranteed to satisfy `list?`.

Examples:

```
> (define/contract predicates
  (sequence/c (-> any/c boolean?)
    (in-list (list integer?
                  string->symbol))))

> (for ([P predicates])
  (printf "~s\n" (P "cat")))
```

```

#f
predicates: broke its contract
promised: boolean?, produced: 'cat
in: the range of
...
(sequence/c predicate/c)
contract from: (definition predicates)
blaming: (definition predicates)
at: eval:2.0
> (define/contract numbers&strings
  (sequence/c number? string?)
  (in-dict (list (cons 1 "one")
                 (cons 2 "two")
                 (cons 3 'three))))

> (for ([(N S) numbers&strings])
  (printf "~s: ~a\n" N S))
1: one
2: two
numbers&strings: broke its contract
promised: string?, produced: 'three
in: (sequence/c number? string?)
contract from: (definition numbers&strings)
blaming: (definition numbers&strings)
at: eval:4.0

(treeof elem-contract) → contract?
elem-contract : contract?

```

The subsequent  
bindings were  
added by Neil  
Toronto  
<neil.toronto@gmail.com>.

Identifies values that meet the contract *elem-contract*, lists of such values, lists of lists, and so on.

Examples:

```

> (define number-tree/c (treeof number?))

> (flat-contract? number-tree/c)
#t
> (define number-tree? (flat-contract-predicate number-tree/c))

> (number-tree? 4)
#t
> (number-tree? '(4 5))
#t
> (number-tree? '((4 5) 6))
#t

```

```
> (number-tree? '(4 . 5))  
#f
```

## 5 Converting Values to Strings

```
(require unstable/cat)
```

This module provides a few functions for converting Racket values to strings. In addition to features like padding and numeric formatting, the functions have the virtue of being shorter and more pleasant to type than `format` (with format string), `number->string`, or `string-append`.

```
(cat v
  ...
  [#:width width
   #:limit limit
   #:limit-marker limit-marker
   #:pad-to pad-to
   #:align align
   #:padding padding
   #:left-padding left-padding
   #:right-padding right-padding]) → string?
v : any/c
width : (or/c exact-nonnegative-integer? #f) = #f
limit : (or/c exact-nonnegative-integer? +inf.0)
       = (or width +inf.0)
limit-marker : string? = "... "
pad-to : exact-nonnegative-integer? = (or width 0)
align : (or/c 'left 'center 'right) = 'left
padding : non-empty-string? = " "
left-padding : non-empty-string? = padding
right-padding : non-empty-string? = padding
```

Converts each `v` to a string in `display` mode—that is, like `(format "~a" v)`—then concatenates the results and pads or truncates the string to be at least `pad-to` characters and at most `limit` characters.

```
> (cat "north")
"north"
> (cat 'south)
"south"
> (cat #"east")
"east"
> (cat #\w "e" 'st)
"west"
> (cat (list "red" 'green #"blue"))
"(red green blue)"
> (cat 17)
```

```
"17"  
> (cat 100000000000000000000000000000000)  
"100000000000000000000000000000000"  
> (cat pi)  
"3.141592653589793"  
> (cat (expt 6.1 87))  
"2.1071509386211452e+68"
```

The `cat` function is primarily useful for strings, numbers, and other atomic data. The `catp` and `catw` functions are better suited to compound data.

Let `s` be the concatenated string forms of the `vs`. If `s` is longer than `limit` characters, it is truncated to exactly `limit` characters. If `s` is shorter than `pad-to` characters, it is padded to exactly `pad-to` characters. Otherwise `s` is returned unchanged. If `pad-to` is greater than `limit`, an exception is raised.

If *s* is longer than *limit* characters, it is truncated and the end of the string is replaced with *limit-marker*. If *limit-marker* is longer than *limit*, an exception is raised.

```
> (cat "abcde" #:limit 5)
"abcde"
> (cat "abcde" #:limit 4)
"a..."
> (cat "abcde" #:limit 4 #:limit-marker "*")
"abc*"
> (cat "abcde" #:limit 4 #:limit-marker "")
"abcd"
> (cat "The quick brown fox" #:limit 15 #:limit-marker "")
"The quick brown"
> (cat "The quick brown fox" #:limit 15 #:limit-marker "...")
"The quick br..."
```

If `s` is shorter than `pad-to`, it is padded to at least `pad-to` characters. If `align` is `'left'`, then only right padding is added; if `align` is `'right'`, then only left padding is added; and if `align` is `'center'`, then roughly equal amounts of left padding and right padding are added.

Padding is specified as a non-empty string. Left padding consists of *left-padding* repeated in its entirety as many times as possible followed by a *prefix* of *left-padding* to fill the remaining space. In contrast, right padding consists of a *suffix* of *right-padding* followed by a number of copies of *right-padding* in its entirety. Thus left padding starts with the start of *left-padding* and right padding ends with the end of *right-padding*.

```
> (cat "apple" #:pad-to 20 #:align 'left)
"apple                "
> (cat "pear" #:pad-to 20 #:align 'left #:right-padding " .")
"pear . . . . ."
```

```

> (cat "plum" #:pad-to 20 #:align 'right #:left-padding ". ")
". . . . . plum"
> (cat "orange" #:pad-to 20 #:align 'center
      #:left-padding "- " #:right-padding " -")
"- - - -orange- - - -"

```

Use *width* to set both *limit* and *pad-to* simultaneously, ensuring that the resulting string is exactly *width* characters long:

```

> (cat "terse" #:width 6)
"terse "
> (cat "loquacious" #:width 6)
"loq..."

```

```

(catp v
  [#:width width
   #:limit limit
   #:limit-marker limit-marker
   #:pad-to pad-to
   #:align align
   #:padding padding
   #:left-padding left-padding
   #:right-padding right-padding]) → string?
v : any/c
width : (or/c exact-nonnegative-integer? #f) = #f
limit : (or/c exact-nonnegative-integer? +inf.0)
       = (or width +inf.0)
limit-marker : string? = "... "
pad-to : exact-nonnegative-integer? = (or width 0)
align : (or/c 'left 'center 'right) = 'left
padding : non-empty-string? = " "
left-padding : non-empty-string? = padding
right-padding : non-empty-string? = padding

```

Like *cat*, but converts a single *v* to a string in *print* mode—that is, like *(format "~v" v)*.

```

> (catp "north")
"\north\"
> (catp 'south)
"'south"
> (catp #"east")
"#\east\"
> (catp #\w)
"#\w"

```

```
> (catp (list "red" 'green #"blue"))
"'\("red\" green #\"blue\)"
```

Use `catp` to produce text that talks about Racket values.

```
> (let ([nums (for/list ([i 10]) i)])
      (cat "The even numbers in " (catp nums)
           " are " (catp (filter even? nums)) "."))
"The even numbers in '(0 1 2 3 4 5 6 7 8 9) are '(0 2 4 6 8)."
```

```
(catw v
      [#:width width
       #:limit limit
       #:limit-marker limit-marker
       #:pad-to pad-to
       #:align align
       #:padding padding
       #:left-padding left-padding
       #:right-padding right-padding]) → string?
v : any/c
width : (or/c exact-nonnegative-integer? #f) = #f
limit : (or/c exact-nonnegative-integer? +inf.0)
       = (or width +inf.0)
limit-marker : string? = "...
pad-to : exact-nonnegative-integer? = (or width 0)
align : (or/c 'left 'center 'right) = 'left
padding : non-empty-string? = " "
left-padding : non-empty-string? = padding
right-padding : non-empty-string? = padding
```

Like `cat`, but converts a single `v` to a string in `write` mode—that is, like `(format "~s" v)`.

```
> (catw "north")
"\("north\"
> (catw 'south)
"south"
> (catw #"east")
#"\"east\"
> (catw #\w)
#"\\w"
> (catw (list "red" 'green #"blue"))
"'\("red\" green #\"blue\)"
```

```

(catn x
  [:sign sign
   #:base base
   #:precision precision
   #:pos/exp-range pos/exp-range
   #:exp-precision exp-precision
   #:exp-format-exponent exp-format-exponent
   #:pad-digits-to pad-digits-to
   #:digits-padding digits-padding]) → string?
x : rational?
  (or/c #f '+ '++ 'parens
  sign : (let ([ind (or/c string? (list/c string? string?))])
           (list/c ind ind ind)))
        = #f
base : (or/c (integer-in 2 36) (list/c 'up (integer-in 2 36)))
      = 10
precision : (or/c exact-nonnegative-integer?
                  (list/c '= exact-nonnegative-integer?)) = 3
pos/exp-range : (list/c (or/c exact-integer? +inf.0)
                        (or/c exact-integer? -inf.0))
               = (list -inf.0 +inf.0)
exp-precision : (or/c exact-nonnegative-integer?
                    (list/c '= exact-nonnegative-integer?))
               = 5
exp-format-exponent : (or/c #f string? (-> exact-integer? string?))
                     = #f
pad-digits-to : exact-positive-integer? = 1
digits-padding : non-empty-string? = " "

```

Converts the rational number `x` to a string in either positional or exponential notation. The exactness or inexactness of `x` does not affect its formatting.

Numbers whose order of magnitude (with respect to `base`) fall strictly within `pos/exp-range` are formatted using positional notation. More precisely, if the following condition holds:

```

(or (zero? x)
    (< (expt base (car pos/exp-range))
       (abs x)
       (expt base (cadr pos/exp-range))))

```

then the result is equivalent to

```

(catnp x
  #:sign sign-mode

```



```
#:base base
#:precision precision
#:pad-digits-to pad-digits-to
#:digits-padding digits-padding)
```

Otherwise, the number is formatted in exponential notation, and the result is equivalent to

```
(catne x
  #:sign sign-mode
  #:base base
  #:precision exp-precision
  #:format-exponent exp-format-exponent
  #:pad-digits-to pad-digits-to
  #:digits-padding digits-padding)
```

Examples:

```
> (catn 999 #:pos/exp-range '(0 3))
"999"
> (catn 1000 #:pos/exp-range '(0 3))
"1e+03"
> (catn 0.9876 #:pos/exp-range '(0 3))
"9.876e-01"
```

Note that the default value of *pos/exp-range* ensures that positional notation will be used for any rational *x*.

```
(catnp x
  [#:sign sign
   #:base base
   #:precision precision
   #:pad-digits-to pad-digits-to
   #:digits-padding digits-padding]) → string?
x : rational?
  (or/c #f '+ '++ 'parens
sign : (let ([ind (or/c string? (list/c string? string?))])
        (list/c ind ind ind)))
      = #f
base : (or/c (integer-in 2 36) (list/c 'up (integer-in 2 36)))
      = 10
precision : (or/c exact-nonnegative-integer?
                  (list/c '= exact-nonnegative-integer?)) = 3
pad-digits-to : exact-positive-integer? = 1
digits-padding : non-empty-string? = " "
```

Formats the rational number *x* using positional notation according to the following arguments:

- *precision* controls the number of digits after the decimal point (or more accurately, the radix point). If *precision* is a natural number, then up to *precision* digits are displayed, but trailing zeroes are dropped, and if all digits after the decimal point are dropped the decimal point is also dropped. If *precision* is `(list '= digits)`, then exactly *digits* digits after the decimal point are used, and the decimal point is never dropped.

```
> (catnp pi)
"3.142"
> (catnp pi #:precision 4)
"3.1416"
> (catnp pi #:precision 0)
"3"
> (catnp 1.5 #:precision 4)
"1.5"
> (catnp 1.5 #:precision '(= 4))
"1.5000"
> (catnp 50 #:precision 2)
"50"
> (catnp 50 #:precision '(= 2))
"50.00"
> (catnp 50 #:precision '(= 0))
"50."
```

- *pad-digits-to*: if *x* would normally be printed with fewer than *pad-digits-to* digits (including the decimal point but not including the sign indicator), the output is left-padded using *digits-padding*.

```
> (catnp 17)
"17"
> (catnp 17 #:pad-digits-to 4)
"  17"
> (catnp -42 #:pad-digits-to 4)
"-  42"
> (catnp 1.5 #:pad-digits-to 4)
"  1.5"
> (catnp 1.5 #:precision 4 #:pad-digits-to 10)
"      1.5"
> (catnp 1.5 #:precision '(= 4) #:pad-digits-to 10)
"      1.5000"
```

- *digits-padding* specifies the string used to pad the number to at least *pad-digits-to* characters (not including the sign indicator). The padding is placed between the sign and the normal digits of *x*.

```
> (catnp 17 #:pad-digits-to 4 #:digits-padding "0")
```

```
"0017"
> (catnp -42 #:pad-digits-to 4 #:digits-padding "0")
"-0042"
```

- *sign* controls how the sign of the number is indicated.
  - If *sign* is *#f* (the default), no sign output is generated if *x* is either positive or zero, and a minus sign is prefixed if *x* is negative.

```
> (for/list ([x '(17 0 -42)]) (catnp x))
'("17" "0" "-42")
```

- If *sign* is *'+*, no sign output is generated if *x* is zero, a plus sign is prefixed if *x* is positive, and a minus sign is prefixed if *x* is negative.

```
> (for/list ([x '(17 0 -42)]) (catnp x #:sign '+))
'("+17" "0" "-42")
```

- If *sign* is *'++*, a plus sign is prefixed if *x* is zero or positive, and a minus sign is prefixed if *x* is negative.

```
> (for/list ([x '(17 0 -42)]) (catnp x #:sign '++))
'("+17" "+0" "-42")
```

- If *sign* is *'parens*, no sign output is generated if *x* is zero or positive, and the number is enclosed in parentheses if *x* is negative.

```
> (for/list ([x '(17 0 -42)]) (catnp x #:sign 'parens))
'("17" "0" "(42)")
```

- If *sign* is *(list pos-ind zero-ind neg-ind)*, then *pos-ind*, *zero-ind*, and *neg-ind* are used to indicate positive, zero, and negative numbers, respectively. Each indicator is either a string to be used as a prefix or a list containing two strings: a prefix and a suffix.

```
> (let ([sign-table '("(" " up") "an even " (" " down")])
  (for/list ([x '(17 0 -42)]) (catnp x #:sign sign-table)))
'("17 up" "an even 0" "42 down")
```

The default behavior is equivalent to *'("(" " " "-")*; the *'parens* mode is equivalent to *'("(" " " (" " "))*.

- *base* controls the base that *x* is formatted in. If *base* is a number greater than 10, then lower-case letters are used. If *base* is *(list 'up base\*)* and *base\** is greater than 10, then upper-case letters are used.

```

> (catnp 100 #:base 7)
"202"
> (catnp 4.5 #:base 2)
"100.1"
> (catnp 3735928559 #:base 16)
"deadbeef"
> (catnp 3735928559 #:base '(up 16))
"DEADBEEF"

```

```

(catne x
  [:sign sign
   #:base base
   #:precision precision
   #:format-exponent format-exponent
   #:pad-digits-to pad-digits-to
   #:digits-padding digits-padding]) → string?
x : rational?
  (or/c #f '+ '++ 'parens
sign : (let ([ind (or/c string? (list/c string? string?))])
        (list/c ind ind ind)))
      = #f
base : (or/c (integer-in 2 36) (list/c 'up (integer-in 2 36)))
      = 10
precision : (or/c exact-nonnegative-integer?
                  (list/c '= exact-nonnegative-integer?)) = 5
format-exponent : (or/c #f string? (-> exact-integer? string?))
                  = #f
pad-digits-to : exact-positive-integer? = 1
digits-padding : non-empty-string? = " "

```

Formats the rational number *x* in exponential notation according to the following arguments:

- *base*, *sign* are interpreted as in positional notation, described above, except that they apply only to the significand, not the exponent.

```

> (catne -100 #:base 2)
"-1.1001×2+06"

```

- *format-exponent* determines how the exponent is displayed.

If *format-exponent* is a string, the exponent is displayed with an explicit sign (as with a *sign-mode* of *'++*) and at least two digits, separated from the significand by the “exponent marker” *format-exponent*:

```

> (catne 1234 #:format-exponent "E")
"1.234E+03"

```

If *format-exponent* is *#f*, the “exponent marker” is “e” if *base* is 10 and a string involving *base* otherwise:

```
> (catne 1234)
"1.234e+03"
> (catne 1234 #:base 8)
"2.322×8^+03"
```

If *format-exponent* is a procedure, it is applied to the exponent and the resulting string is appended to the significand:

```
> (catne 1234 #:format-exponent (lambda (e) (format "E~a" e)))
"1.234E3"
```

- *precision* determines how many digits after the radix point the significand contains. Like the *precision* argument of *catnp*, the form *(list '= digits)* causes trailing zeroes to be retained.

```
> (catne 12345 #:precision 3)
"1.235e+04"
> (catne 12345 #:precision 2)
"1.23e+04"
> (catne 10000 #:precision 2)
"1e+04"
> (catne 10000 #:precision '(= 2))
"1.00e+04"
```

- *pad-digits-to* and *digits-padding* are interpreted as in positional notation.

```
> (catne 12345 #:pad-digits-to 12 #:digits-padding " ")
" 1.2345e+04"
```

## 6 Contracts for Macro Subexpressions

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/wrapc)
```

This library provides a procedure `wrap-expr/c` for applying contracts to macro subexpressions.

```
(wrap-expr/c contract-expr
  expr
  [#:positive pos-blame
   #:negative neg-blame
   #:name expr-name
   #:macro macro-name
   #:context context]) → syntax?
contract-expr : syntax?
expr : syntax?
pos-blame : (or/c syntax? string? module-path-index?
               'from-macro 'use-site 'unknown)
           = 'use-site
neg-blame : (or/c syntax? string? module-path-index?
               'from-macro 'use-site 'unknown)
           = 'from-macro
expr-name : (or/c identifier? symbol? string? #f) = #f
macro-name : (or/c identifier? symbol? string? #f) = #f
context : (or/c syntax? #f) = (current-syntax-context)
```

Returns a syntax object representing an expression that applies the contract represented by `contract-expr` to the value produced by `expr`.

The other arguments have the same meaning as for `expr/c`.

Examples:

```
> (define-syntax (myparameterize1 stx)
  (syntax-case stx ()
    [(_ ([p v]) body)
     (with-syntax ([cp (wrap-expr/c
                           #'parameter? #'p
                           #:name "the parameter argument"
                           #:context stx)])
       #'(parameterize ([cp v]) body)))]))

> (myparameterize1 ([current-input-port
```

```

                                (open-input-string "(1 2 3)"))])
  (read))
'(1 2 3)
> (myparameterize1 (['whoops 'something]
  'whatever)
the parameter argument of myparameterize1: broke its
contract
  promised: parameter?, produced: 'whoops
  in: parameter?
  contract from: top-level
  blaming: top-level
  at: eval:4.0
> (module mod racket
  (require (for-syntax unstable/wrapc))
  (define-syntax (app stx)
    (syntax-case stx ()
      [(app f arg)
       (with-syntax ([cf (wrap-expr/c
                           #'(-> number? number?)
                           #'f
                           #:name "the function argument"
                           #:context stx)])
         #'(cf arg))]))
  (provide app))

> (require 'mod)

> (app add1 5)
6
> (app add1 'apple)
the function argument of app: contract violation
expected: number?, given: 'apple
in: the 1st argument of
  (-> number? number?)
contract from: top-level
blaming: (quote mod)
at: eval:8.0
> (app (lambda (x) 'pear) 5)
the function argument of app: broke its contract
promised: number?, produced: 'pear
in: the range of
  (-> number? number?)
contract from: top-level
blaming: top-level
at: eval:9.0

```

## 7 Debugging

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/debug)
```

This module provides macros and functions for printing out debugging information.

```
(debug options ... expr)

options = #:name name-expr
         | #:source srcloc-expr
```

Writes debugging information about the evaluation of `expr` to the current error port. The name and source location of the expression may be overridden by keyword options; their defaults are the syntactic form of the expression and its syntactic source location, respectively.

Examples:

```
> (debug 0)
>> eval:2.0: 0
    result: 0
<< eval:2.0: 0
0
> (debug #:name "one, two, three" (values 1 2 3))
>> eval:3.0: "one, two, three"
    results: (values 1 2 3)
<< eval:3.0: "one, two, three"
1
2
3
> (debug #:source (make-srcloc 'here 1 2 3 4)
    (error 'function "something went wrong"))
>> here:1.2: (error 'function "something went wrong")
    raised exception: function: something went wrong
<< here:1.2: (error 'function "something went wrong")
function: something went wrong
```

```
(dprintf fmt arg ...) → void?
  fmt : string?
  arg : any/c
```

Constructs a message in the same manner as `format` and writes it to `(current-error-port)`, with indentation reflecting the number of nested debug forms.



Examples:

```
> (dprintf "level: ~a" 0)
level: 0

> (debug (dprintf "level: ~a" 1))
>> eval:6.0: (dprintf "level: ~a" 1)
level: 1
result: #<void>
<< eval:6.0: (dprintf "level: ~a" 1)

> (debug (debug (dprintf "level: ~a" 2)))
>> eval:7.0: (debug (dprintf "level: ~a" 2))
>> eval:7.0: (dprintf "level: ~a" 2)
level: 2
result: #<void>
<< eval:7.0: (dprintf "level: ~a" 2)
result: #<void>
<< eval:7.0: (debug (dprintf "level: ~a" 2))
```

```
(debugf function-expr argument ...)

argument = argument-expr
          | argument-keyword argument-expr
```

Logs debugging information for `(#%app function-expr argument ...)`, including the evaluation and results of the function and each argument.

Example:

```
> (debugf + 1 2 3)
>> eval:8.0: debugf
>> eval:8.0: +
result: #<procedure:+>
<< eval:8.0: +
>> eval:8.0: 1
result: 1
<< eval:8.0: 1
>> eval:8.0: 2
result: 2
<< eval:8.0: 2
>> eval:8.0: 3
result: 3
<< eval:8.0: 3
result: 6
<< eval:8.0: debugf
```

```

(begin/debug expr ...)
(define/debug id expr)
(define/debug (head args) body ...+)
(define/private/debug id expr)
(define/private/debug (head args) body ...+)
(define/public/debug id expr)
(define/public/debug (head args) body ...+)
(define/override/debug id expr)
(define/override/debug (head args) body ...+)
(define/augment/debug id expr)
(define/augment/debug (head args) body ...+)
(let/debug ([lhs-id rhs-expr] ...) body ...+)
(let/debug loop-id ([lhs-id rhs-expr] ...) body ...+)
(let*/debug ([lhs-id rhs-expr] ...) body ...+)
(letrec/debug ([lhs-id rhs-expr] ...) body ...+)
(let-values/debug ([(lhs-id ...) rhs-expr] ...) body ...+)
(let*-values/debug ([(lhs-id ...) rhs-expr] ...) body ...+)
(letrec-values/debug ([(lhs-id ...) rhs-expr] ...) body ...+)
(with-syntax/debug ([pattern stx-expr] ...) body ...+)
(with-syntax*/debug ([pattern stx-expr] ...) body ...+)
(parameterize/debug ([param-expr value-expr] ...) body ...+)

```

These macros add logging based on `debug` to the evaluation of expressions in `begin`, `define`, `define/private`, `define/public`, `define/override`, `define/augment`, `let`, `let*`, `letrec`, `let-values`, `let*-values`, `letrec-values`, `with-syntax`, `with-syntax*`, and `parameterize`.

## 8 Definitions

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/define)
```

Provides macros for creating and manipulating definitions.

```
(at-end expr)
```

When used at the top level of a module, evaluates *expr* at the end of the module. This can be useful for calling functions before their definitions.

Examples:

```
> (module Failure scheme
  (f 5)
  (define (f x) x))

> (require 'Failure)
f: undefined;
cannot reference an identifier before its definition
in module: 'Failure

> (module Success scheme
  (require unstable/define)
  (at-end (f 5))
  (define (f x) x))

> (require 'Success)
```

```
(in-phase1 e)
```

Executes *e* during phase 1 (the syntax transformation phase) relative to its context, during pass 1 if it occurs in a head expansion position.

```
(in-phase1/pass2 e)
```

Executes *e* during phase 1 (the syntax transformation phase) relative to its context, during pass 2 (after head expansion).

## 9 Filesystem

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/file)

(make-directory*/ignore-exists-exn pth) → void
pth : path-string?
```

Like `make-directory*`, except it ignores errors when the path already exists. Useful to deal with race conditions on processes that create directories.

## 10 Find

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/find)

(find pred
  x
  [#:stop-on-found? stop-on-found?
   #:stop stop
   #:get-children get-children]) → list?
pred : (-> any/c any/c)
x : any/c
stop-on-found? : any/c = #f
stop : (or/c #f (-> any/c any/c)) = #f
get-children : (or/c #f (-> any/c (or/c #f list?))) = #f
```

Returns a list of all values satisfying *pred* contained in *x* (possibly including *x* itself).

If *stop-on-found?* is true, the children of values satisfying *pred* are not examined. If *stop* is a procedure, then the children of values for which *stop* returns true are not examined (but the values themselves are; *stop* is applied after *pred*). Only the current branch of the search is stopped, not the whole search.

The search recurs through pairs, vectors, boxes, and the accessible fields of structures. If *get-children* is a procedure, it can override the default notion of a value's children by returning a list (if it returns false, the default notion of children is used).

No cycle detection is done, so *find* on a cyclic graph may diverge. To do cycle checking yourself, use *stop* and a mutable table.

Examples:

```
> (find symbol? '((all work) and (no play)))
'(all work and no play)
> (find list? '#((all work) and (no play)) #:stop-on-found? #t)
'((all work) (no play))
> (find negative? 100
   #:stop-on-found? #t
   #:get-children (lambda (n) (list (- n 12))))
'(-8)
> (find symbol? (shared ([x (cons 'a x)] x)
   #:stop (let ([table (make-hasheq)])
             (lambda (x)
               (begin0 (hash-ref table x #f))
```

```

                                (hash-set! table x #t))))))
'(a)

(find-first pred
  x
  [#:stop stop
   #:get-children get-children
   #:default default]) → any/c
pred : (-> any/c any/c)
x : any/c
stop : (or/c #f (-> any/c any/c)) = #f
get-children : (or/c #f (-> any/c (or/c #f list?))) = #f
default : any/c = (lambda () (error ....))

```

Like `find`, but only returns the first match. If no matches are found, `default` is applied as a thunk if it is a procedure or returned otherwise.

Examples:

```

> (find-first symbol? '((all work) and (no play)))
'all
> (find-first list? '#((all work) and (no play)))
'(all work)
> (find-first negative? 100
   #:get-children (lambda (n) (list (- n 12))))
-8
> (find-first symbol? (shared ([x (cons 'a x)]) x))
'a

```

## 11 Flonums

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/flonum)
```

```
(flonum->bit-field x) → (integer-in 0 (- (expt 2 64) 1))  
  x : flonum?
```

Returns the bits comprising *x* as an integer. A convenient shortcut for composing `integer-bytes->integer` with `real->floating-point-bytes`.

Examples:

```
> (number->string (flonum->bit-field -inf.0) 16)  
"fff0000000000000"  
> (number->string (flonum->bit-field +inf.0) 16)  
"7ff0000000000000"  
> (number->string (flonum->bit-field -0.0) 16)  
"8000000000000000"  
> (number->string (flonum->bit-field 0.0) 16)  
"0"  
> (number->string (flonum->bit-field -1.0) 16)  
"bff0000000000000"  
> (number->string (flonum->bit-field 1.0) 16)  
"3ff0000000000000"  
> (number->string (flonum->bit-field +nan.0) 16)  
"7ff8000000000000"  
  
(bit-field->flonum i) → flonum?  
  i : (integer-in 0 (- (expt 2 64) 1))
```

The inverse of `flonum->bit-field`.

```
(flonum->ordinal x)  
→ (integer-in (- (- (expt 2 63) 1)) (- (expt 2 63) 1))  
  x : flonum?
```

Returns the signed ordinal index of *x* in a total order over flonums.

When inputs are not `+nan.0`, this function is monotone and symmetric; i.e. if `(fl<= x y)` then `(<= (flonum->ordinal x) (flonum->ordinal y))`, and `(= (flonum->ordinal (- x)) (- (flonum->ordinal x)))`.

Examples:

```

> (flonum->ordinal -inf.0)
-9218868437227405312
> (flonum->ordinal +inf.0)
9218868437227405312
> (flonum->ordinal -0.0)
0
> (flonum->ordinal 0.0)
0
> (flonum->ordinal -1.0)
-4607182418800017408
> (flonum->ordinal 1.0)
4607182418800017408
> (flonum->ordinal +nan.0)
9221120237041090560

```

These properties mean that `flonum->ordinal` does not distinguish `-0.0` and `0.0`.

The following plot demonstrates how the density of floating-point numbers decreases with magnitude:

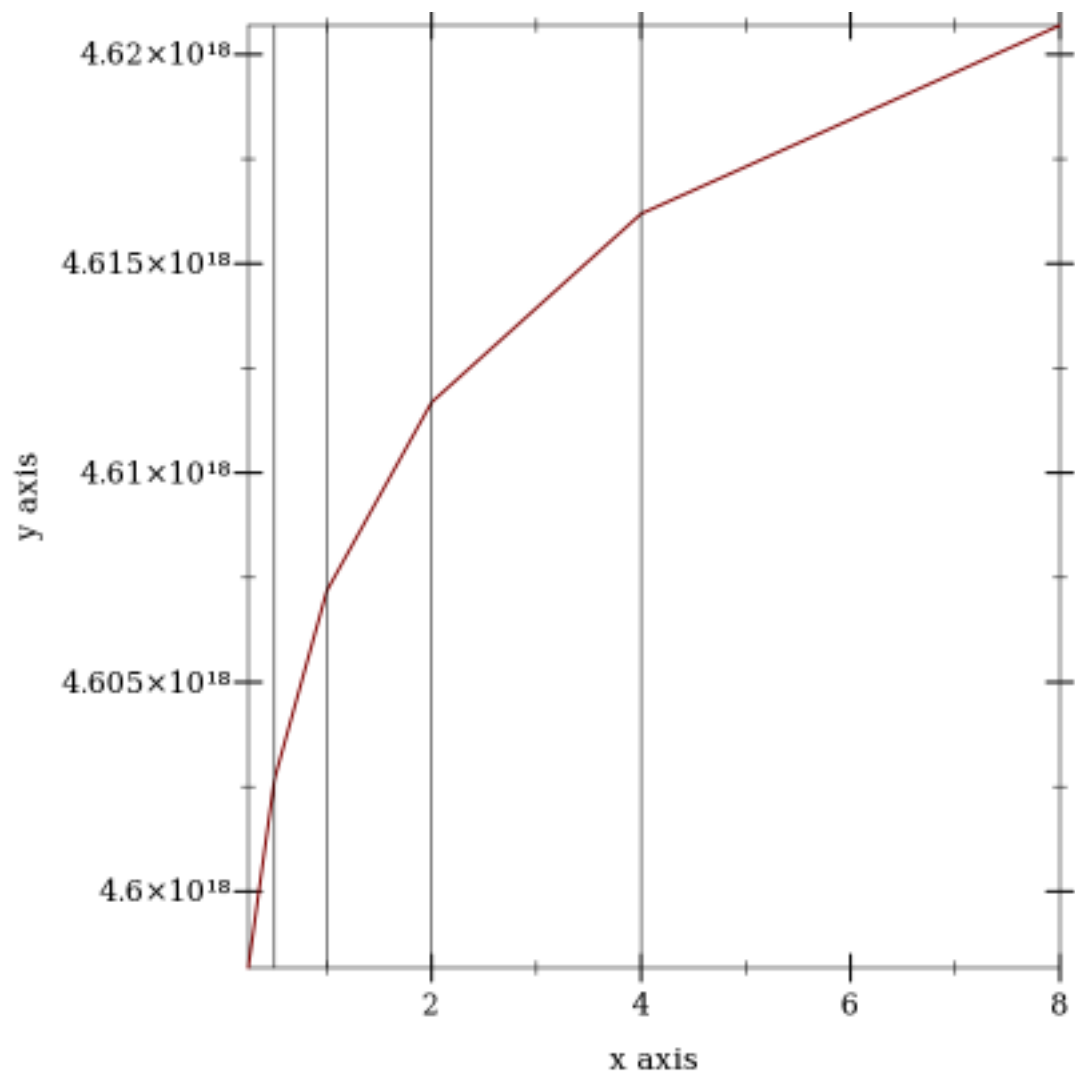
Example:

```

> (parameterize ([y-axis-ticks? #f])
  (plot (list (function (compose flonum->ordinal exact-
>inexact) 1/4 8)
          (y-axis 1/2) (y-axis 1) (y-axis 2) (y-axis 4))))

```





```
(ordinal->flonum i) → flonum?
  i : (integer-in (- (- (expt 2 63) 1)) (- (expt 2 63) 1))
```

The inverse of `flonum->ordinal`.

```
(flonums-between x y) → exact-integer?
  x : flonum?
  y : flonum?
```

Returns the number of flonums between  $x$  and  $y$ , excluding one endpoint. Equivalent to `(- (flonum->ordinal y) (flonum->ordinal x))`.

Examples:

```
> (flonums-between 0.0 1.0)
4607182418800017408
> (flonums-between 1.0 2.0)
4503599627370496
> (flonums-between 2.0 3.0)
2251799813685248
> (flonums-between 1.0 +inf.0)
4611686018427387904
```

```
(flstep x n) → flonum?
  x : flonum?
  n : exact-integer?
```

Returns the flonum  $n$  flonums away from  $x$ , according to `flonum->ordinal`. If  $x$  is `+nan.0`, returns `+nan.0`.

Examples:

```
> (flstep 0.0 1)
4.9406564584125e-324
> (flstep (flstep 0.0 1) -1)
0.0
> (flstep 0.0 -1)
-4.9406564584125e-324
> (flstep +inf.0 1)
+inf.0
> (flstep +inf.0 -1)
1.7976931348623157e+308
> (flstep -inf.0 -1)
-inf.0
> (flstep -inf.0 1)
-1.7976931348623157e+308
> (flstep +nan.0 1000)
+nan.0
```

```
(flnext x) → flonum?
  x : flonum?
```

Equivalent to `(flstep x 1)`.

```
(flprev x) → flonum?
  x : flonum?
```

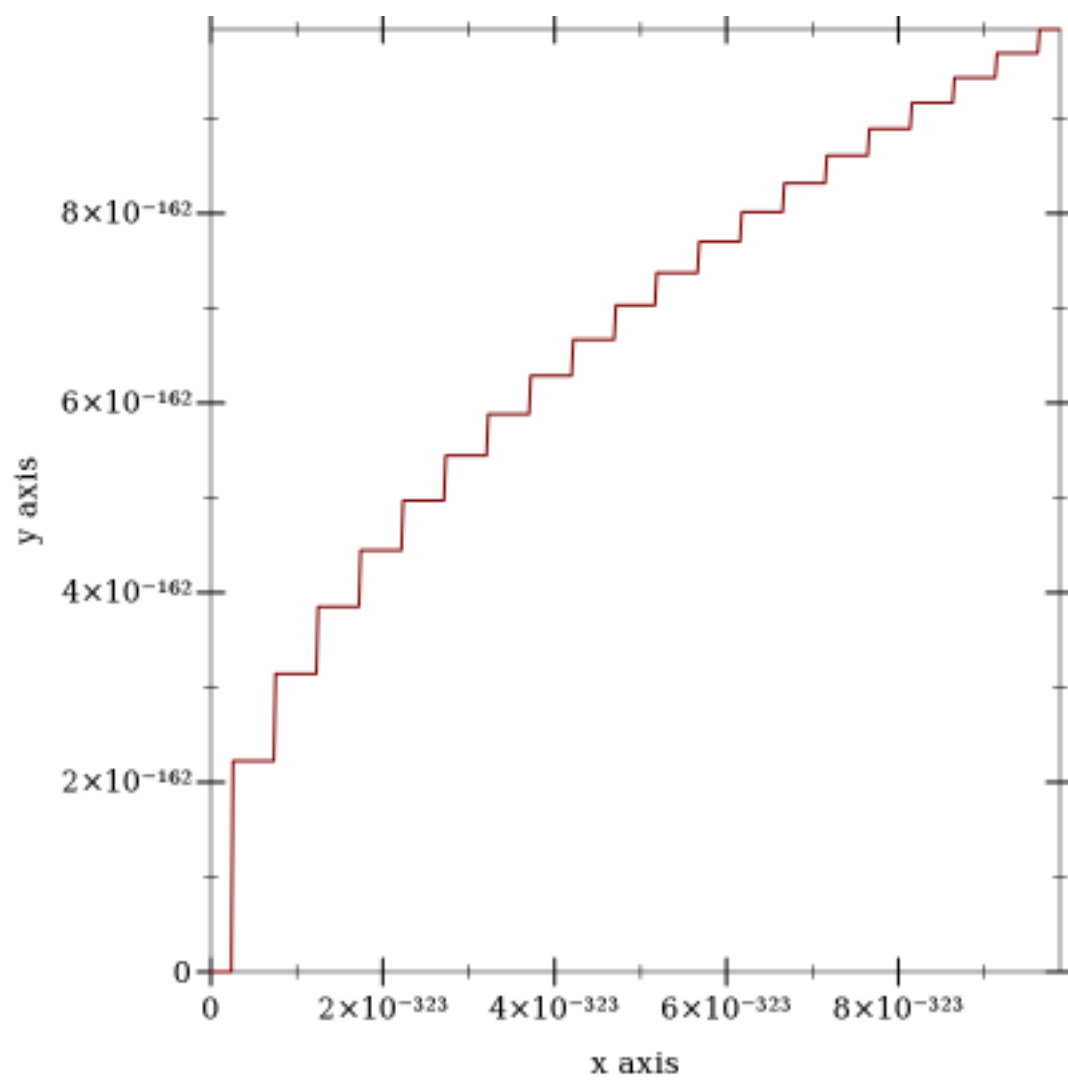
Equivalent to `(flstep x -1)`.

```
-max.0 : flonum?  
-min.0 : flonum?  
+min.0 : flonum?  
+max.0 : flonum?
```

The rational flonums with maximum and minimum magnitude.

Examples:

```
> (list -max.0 +max.0 -min.0 +min.0)  
'(-1.7976931348623157e+308  
  1.7976931348623157e+308  
 -4.9406564584125e-324  
  4.9406564584125e-324)  
> (plot (function sqrt 0 (* 20 +min.0)))
```



## 12 Futures

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/future)

(for/async (for-clause ...) body ...+)
(for*/async (for-clause ...) body ...+)
```

Like `for` and `for*`, but each iteration of the *body* is executed in a separate *future*, and the futures may be *touched* in any order.

## 13 Functions

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/function)
```

This module provides tools for higher-order programming and creating functions.

### 13.1 Higher Order Predicates

```
((conjoin f ...) x ...) → boolean?  
  f : (-> A ... boolean?)  
  x : A
```

Combines calls to each function with and. Equivalent to `(and (f x ...) ...)`

Examples:

```
(define f (conjoin exact? integer?))
```

```
> (f 1)  
#t  
> (f 1.0)  
#f  
> (f 1/2)  
#f  
> (f 0.5)  
#f
```

```
((disjoin f ...) x ...) → boolean?  
  f : (-> A ... boolean?)  
  x : A
```

Combines calls to each function with or. Equivalent to `(or (f x ...) ...)`

Examples:

```
(define f (disjoin exact? integer?))
```

```
> (f 1)  
#t  
> (f 1.0)  
#t
```

```
> (f 1/2)
#t
> (f 0.5)
#f
```

## 14 Hash Tables

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/hash)
```

This module provides tools for manipulating hash tables.

```
(hash-union h0
  h ...
  [#:combine combine
   #:combine/key combine/key])
→ (and/c hash? hash-can-functional-set?)
h0 : (and/c hash? hash-can-functional-set?)
h : hash?
combine : (-> any/c any/c any/c)
         = (lambda _ (error 'hash-union ....))
combine/key : (-> any/c any/c any/c any/c)
             = (lambda (k a b) (combine a b))
```

Computes the union of *h0* with each hash table *h* by functional update, adding each element of each *h* to *h0* in turn. For each key *k* and value *v*, if a mapping from *k* to some value *v0* already exists, it is replaced with a mapping from *k* to *(combine/key k v0 v)*.

Examples:

```
> (hash-union (make-immutable-hash '([1 . one]))
  (make-immutable-hash '([2 . two]))
  (make-immutable-hash '([3 . three])))
'#hash((1 . one) (2 . two) (3 . three))
> (hash-union (make-immutable-hash '([1 one uno] [2 two dos]))
  (make-immutable-hash '([1 ein une] [2 zwei deux])))
  #:combine/key (lambda (k v1 v2) (append v1 v2)))
'#hash((1 . (one uno ein une)) (2 . (two dos zwei deux)))
```

```
(hash-union! h0
  h ...
  [#:combine combine
   #:combine/key combine/key]) → void?
h0 : (and/c hash? hash-mutable?)
h : hash?
combine : (-> any/c any/c any/c)
         = (lambda _ (error 'hash-union ....))
combine/key : (-> any/c any/c any/c any/c)
             = (lambda (k a b) (combine a b))
```



Computes the union of *h0* with each hash table *h* by mutable update, adding each element of each *h* to *h0* in turn. For each key *k* and value *v*, if a mapping from *k* to some value *v0* already exists, it is replaced with a mapping from *k* to (*combine/key* *k* *v0* *v*).

Examples:

```
(define h (make-hash))

> h
'#hash()
> (hash-union! h (make-immutable-hash '([1 one uno] [2 two dos])))

> h
'#hash((2 . (two dos)) (1 . (one uno)))
> (hash-union! h
  (make-immutable-hash '([1 ein une] [2 zwei deux])))
  #:combine/key (lambda (k v1 v2) (append v1 v2)))

> h
'#hash((2 . (two dos zwei deux)) (1 . (one uno ein une)))
```

## 15 Interface-Oriented Programming for Classes

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/class-iop)
```

```
(define-interface name-id (super-ifc-id ...) (method-id ...))
```

Defines *name-id* as a static interface extending the interfaces named by the *super-ifc-ids* and containing the methods specified by the *method-ids*.

A static interface name is used by the checked method call variants (send/i, send\*/i, and send/apply/i). When used as an expression, a static interface name evaluates to an interface value.

Examples:

```
> (define-interface stack<%> () (empty? push pop))

> stack<%>
#<|interface:stack<%>|>
> (define stack%
  (class* object% (stack<%>)
    (define items null)
    (define/public (empty?) (null? items))
    (define/public (push x) (set! items (cons x items)))
    (define/public (pop) (begin (car items) (set! items (cdr items))))
    (super-new)))
```

```
(define-interface/dynamic name-id ifc-expr (method-id ...))
```

Defines *name-id* as a static interface with dynamic counterpart *ifc-expr*, which must evaluate to an interface value. The static interface contains the methods named by the *method-ids*. A run-time error is raised if any *method-id* is not a member of the dynamic interface *ifc-expr*.

Use define-interface/dynamic to wrap interfaces from other sources.

Examples:

```
> (define-interface/dynamic object<%> (class-
>interface object%) ())

> object<%>
#<interface:object%>
```

```
(send/i obj-exp static-ifc-id method-id arg-expr ...)
```

Checked variant of send.

The argument *static-ifc-id* must be defined as a static interface. The method *method-id* must be a member of the static interface *static-ifc-id*; otherwise a compile-time error is raised.

The value of *obj-exp* must be an instance of the interface *static-ifc-id*; otherwise, a run-time error is raised.

Examples:

```
> (define s (new stack%))

> (send/i s stack<%> push 1)

> (send/i s stack<%> popp)
eval:9:0: send/i: method not in static interface
in: popp

> (send/i (new object%) stack<%> push 2)
send/i: interface check failed on: (object)
```

```
(send*/i obj-exp static-ifc-id (method-id arg-expr ...) ...)
```

Checked variant of send\*.

Example:

```
> (send*/i s stack<%>
   (push 2)
   (pop))
```

```
(send/apply/i obj-exp static-ifc-id method-id arg-expr ... list-
arg-expr)
```

Checked variant of send/apply.

Example:

```
> (send/apply/i s stack<%> push (list 5))
```

```
(define/i id static-ifc-id expr)
```

Checks that *expr* evaluates to an instance of *static-ifc-id* before binding it to *id*. If *id* is subsequently changed (with *set!*), the check is performed again.

No dynamic object check is performed when calling a method (using *send/i*, etc) on a name defined via *define/i*.

```
(init/i (id static-ifc-id maybe-default-expr) ...)
(init-field/i (id static-ifc-id maybe-default-expr) ...)
(init-private/i (id static-ifc-id maybe-default-expr) ...)

maybe-default-expr = ()
                     | default-expr
```

Checked versions of *init* and *init-field*. The value attached to each *id* is checked against the given interface.

No dynamic object check is performed when calling a method (using *send/i*, etc) on a name bound via one of these forms. Note that in the case of *init-field/i* this check omission is unsound in the presence of mutation from outside the class. This should be fixed.

```
(define-interface-expander id transformer-expr)
```

Defines *id* as a macro that can be used within *define-interface* forms.

Examples:

```
> (define-interface-expander stack-methods
    (lambda (stx) #'[empty? push pop]))

> (define-interface stack<%> ()
    ((stack-methods)))

> (interface->method-names stack<%>)
'(empty? pop push)
```

## 16 Lazy Require

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/lazy-require)

(lazy-require [mod (imported-fun-id ...)] ...)

mod = module-path
    | ,module-path-expr

module-path-expr : module-path?
```

Defines each *imported-fun-id* as a function that, when called, dynamically requires the export named *'imported-fun-id* from the module specified by *mod* and calls it with the same arguments.

The module *mod* can be specified as a *module-path* (see *require*) or as an unquote-escaped expression that computes a module path. As with *define-runtime-module-path-index*, a *module-path-expr* is evaluated both in phase 0 and phase 1.

```
(begin-on-demand #:export (fun-id ...)
  body ...+)
```

Defines each *fun-id* as a function that, when called, dynamically loads and executes the *body* forms. The *body* forms must contain definitions for each *fun-id*, and the value of each *fun-id* must be a function.

A *body* form may be any module-level form except *provide*. In particular, *require* forms are allowed.

The *body* forms are placed within a submodule that extends the scope of the enclosing module (ie, *module\** with *#f* in the language position). Consequently, any references to sibling submodules must include a with *".."* module path element.

## 17 Lists

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/list)
```

```
(list-prefix? l r) → boolean?  
  l : list?  
  r : list?
```

True if *l* is a prefix of *r*.

Example:

```
> (list-prefix? '(1 2) '(1 2 3 4 5))  
#t
```

```
(take-common-prefix l r #:same? same?) → list?  
  l : list?  
  r : list?  
  same? : equal?
```

Returns the longest common prefix of *l* and *r*.

Example:

```
> (take-common-prefix '(a b c d) '(a b x y z))  
'(a b)
```

```
(drop-common-prefix l r #:same? same?) → list? list?  
  l : list?  
  r : list?  
  same? : equal?
```

Returns the tails of *l* and *r* with the common prefix removed.

Example:

```
> (drop-common-prefix '(a b c d) '(a b x y z))  
'(c d)  
'(x y z)
```

```
(split-common-prefix l r #:same? same?) → list? list? list?  
  l : list?  
  r : list?  
  same? : equal?
```

Returns the longest common prefix together with the tails of *l* and *r* with the common prefix removed.

Example:

```
> (split-common-prefix '(a b c d) '(a b x y z))
'(a b)
'(c d)
'(x y z)
(filter-multiple l f ...) → list? ...
  l : list?
  f : procedure?
```

The subsequent bindings were added by Sam Tobin-Hochstadt.

Produces (values (filter *f* *l*) ...).

Example:

```
> (filter-multiple (list 1 2 3 4 5) even? odd?)
'(2 4)
'(1 3 5)
(extend l1 l2 v) → list?
  l1 : list?
  l2 : list?
  v : any/c
```

Extends *l2* to be as long as *l1* by adding  $(- (\text{length } l1) (\text{length } l2))$  copies of *v* to the end of *l2*.

Example:

```
> (extend '(1 2 3) '(a) 'b)
'(a b b)
(check-duplicate lst
  [#:key extract-key
   #:same? same?]) → (or/c any/c #f)
  lst : list?
  extract-key : (-> any/c any/c) = (lambda (x) x)
  same? : (or/c (any/c any/c . -> . any/c) = equal? dict?)
```

The subsequent bindings were added by Ryan Culpepper.

Returns the first duplicate item in *lst*. More precisely, it returns the first *x* such that there was a previous *y* where (*same?* (*extract-key* *x*) (*extract-key* *y*)).

The *same?* argument can either be an equivalence predicate such as `equal?` or `eqv?` or a dictionary. In the latter case, the elements of the list are mapped to `#t` in the dictionary until an element is discovered that is already mapped to a true value. The procedures `equal?`, `eqv?`, and `eq?` automatically use a dictionary for speed.

Examples:

```
> (check-duplicate '(1 2 3 4))
#f
> (check-duplicate '(1 2 3 2 1))
2
> (check-duplicate '((a 1) (b 2) (a 3)) #:key car)
'(a 3)
> (define id-t (make-free-id-table))

> (check-duplicate (syntax->list #'(a b c d a b))
                    #:same? id-t)
#<syntax:13:0 a>
> (dict-map id-t list)
'((#<syntax:13:0 d> #t)
  (#<syntax:13:0 a> #t)
  (#<syntax:13:0 b> #t)
  (#<syntax:13:0 c> #t))

(map/values n f lst ...) → (listof B1) ... (listof Bn)
n : natural-number/c
f : (-> A ... (values B1 ... Bn))
lst : (listof A)
```

The subsequent bindings were added by Carl Eastlund.

Produces lists of the respective values of *f* applied to the elements in *lst* ... sequentially.

Example:

```
> (map/values
    3
    (lambda (x)
      (values (+ x 1) x (- x 1))))
(list 1 2 3))
'(2 3 4)
'(1 2 3)
'(0 1 2)

(map2 f lst ...) → (listof B) (listof C)
f : (-> A ... (values B C))
lst : (listof A)
```

Produces a pair of lists of the respective values of *f* applied to the elements in *lst* ... sequentially.

Example:

```
> (map2 (lambda (x) (values (+ x 1) (- x 1))) (list 1 2 3))
```



```
'(2 3 4)
'(0 1 2)
```

```
(remf pred lst) → list?
pred : procedure?
lst : list?
```

The subsequent bindings were added by David Van Horn.

Returns a list that is like *lst*, omitting the first element of *lst* for which *pred* produces a true value.

Example:

```
> (remf negative? '(1 -2 3 4 -5))
'(1 3 4 -5)
```

```
(group-by =? lst [#:key extract-key]) → (listof (listof A))
=? : (-> B B any/c)
lst : (listof A)
extract-key : (-> A B) = values
```

The subsequent bindings were added by Vincent St-Amour.

Groups the given list into equivalence classes, with equivalence being determined by *=?*.

Example:

```
> (group-by = '(1 2 1 2 54 2 5 43 7 2 643 1 2 0))
'((0) (2 2 2 2 2) (7) (43) (5) (54) (643) (1 1 1))
```

## 18 Logging

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/logging)
```

This module provides tools for logging.

```
(with-logging-to-port port
  proc
  [#:level level]) → any
port : output-port?
proc : (-> any)
level : (or/c 'fatal 'error 'warning 'info 'debug) = 'debug
```

Runs *proc*, outputting any logging of level *level* or higher to *port*. Returns whatever *proc* returns.

Example:

```
> (let ([my-log (open-output-string)])
  (with-logging-to-port my-log
    (lambda ()
      (log-warning "Warning World!")
      (+ 2 2))
    #:level 'warning)
  (get-output-string my-log))
"Warning World!\n"

(with-intercepted-logging interceptor
  proc
  [#:level level]) → any
(-> (vector/c
  (or/c 'fatal 'error 'warning 'info 'debug)
  string?
  any/c)
  any)
interceptor :
proc : (-> any)
level : (or/c 'fatal 'error 'warning 'info 'debug) = 'debug
```

Runs *proc*, calling *interceptor* on any log message of level *level* or higher. *interceptor* receives the entire log vectors (see §14.5.3 “Receiving Logged Events”) as arguments. Returns whatever *proc* returns.

Example:

```

> (let ([warning-counter 0])
    (with-intercepted-logging
      (lambda (l)
        (when (eq? (vector-ref l 0)
                    'warning)
          (set! warning-counter (add1 warning-counter))))
      (lambda ()
        (log-warning "Warning!")
        (log-warning "Warning again!")
        (+ 2 2))
      #:level 'warning)
    warning-counter)
2

```

A lower-level interface to logging is also available.

```

(start-recording [#:level level]) → listener?
  level : (or/c 'fatal 'error 'warning 'info 'debug) = 'debug
(stop-recording listener)
  (listof (vector/c (or/c 'fatal 'error 'warning 'info 'debug)
                    string?
                    any/c))
→
  listener : listener?

```

`start-recording` starts recording log messages of the desired level or higher. Messages will be recorded until stopped by passing the returned listener object to `stop-recording`. `stop-recording` will then return a list of the log messages that have been reported.

Examples:

```

(define l (start-recording #:level 'warning))

> (log-warning "1")

> (log-warning "2")

> (stop-recording l)
'(#(warning "1" #<continuation-mark-set>)
  #(warning "2" #<continuation-mark-set>))

```

## 19 Mark Parameters

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/markparam)
```

This library provides a simplified version of parameters that are backed by continuation marks, rather than parameterizations. This means they are slightly slower, are not inherited by child threads, do not have initial values, and cannot be imperatively mutated.

```
(struct mark-parameter ())
```

The struct for mark parameters. It is guaranteed to be serializable and transparent. If used as a procedure, it calls `mark-parameter-first` on itself.

```
(mark-parameter-first mp [tag]) → any/c  
  mp : mark-parameter?  
  tag : continuation-prompt-tag?  
       = default-continuation-prompt-tag
```

Returns the first value of `mp` up to `tag`.

```
(mark-parameter-all mp [tag]) → list?  
  mp : mark-parameter?  
  tag : continuation-prompt-tag?  
       = default-continuation-prompt-tag
```

Returns the values of `mp` up to `tag`.

```
(mark-parameters-all mps none-v [tag]) → (listof vector?)  
  mps : (listof mark-parameter?)  
  none-v : [any/c #f]  
  tag : continuation-prompt-tag?  
       = default-continuation-prompt-tag
```

Returns the values of the `mps` up to `tag`. The length of each vector in the result list is the same as the length of `mps`, and a value in a particular vector position is the value for the corresponding mark parameter in `mps`. Values for multiple mark parameter appear in a single vector only when the mark parameters are for the same continuation frame in the current continuation. The `none-v` argument is used for vector elements to indicate the lack of a value.

```
(mark-parameterize ([mp expr] ...) body-expr ...)
```

Parameterizes `(begin body-expr ...)` by associating each `mp` with the evaluation of `expr` in the parameterization of the entire expression.

## 20 Match

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/match)
```

```
(match? val-expr pat ...)
```

Returns `#t` if the result of `val-expr` matches any of `pat`, and returns `#f` otherwise.

Examples:

```
> (match? (list 1 2 3)
          (list a b c)
          (vector x y z))
#t
> (match? (vector 1 2 3)
          (list a b c)
          (vector x y z))
#t
> (match? (+ 1 2 3)
          (list a b c)
          (vector x y z))
#f
```

```
(as ([lhs-id rhs-expr] ...) pat ...)
```

As a match expander, binds each `lhs-id` as a pattern variable with the result value of `rhs-expr`, and continues matching each subsequent `pat`.

Example:

```
> (match (list 1 2 3)
        [(as ([a 0]) (list b c d)) (list a b c d)])
'(0 1 2 3)
```

```
(object maybe-class field-clause ...)

maybe-class =
  | class-expr

field-clause = (field field-id maybe-pat)

maybe-pat =
  | pat
```

The subsequent bindings were added by Carl Eastlund <cce@racket-lang.org>.

The subsequent bindings were added by Asumu Takikawa <asumu@racket-lang.org>.

A match expander that checks if the matched value is an object and contains the fields named by the *field-ids*. If *pats* are provided, the value in each field is matched to its corresponding *pat*. If a *pat* is not provided, it defaults to the name of the field.

If *class-expr* is provided, the match expander will also check that the supplied object is an instance of the class that the given expression evaluates to.

Examples:

```
(define point%
  (class object%
    (super-new)
    (init-field x y)))

> (match (make-object point% 3 5)
  [(object point% (field x) (field y))
   (sqrt (+ (* x x) (* y y)))])
5.830951894845301

> (match (make-object point% 0 0)
  [(object (field x (? zero?))
           (field y (? zero?)))
   'origin])
'origin

> (match (make-object object%)
  [(object (field x) (field y))
   'ok]
  [_ 'fail])
'fail
```

## 21 Parameter Groups

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/parameter-group)
```

Parameter groups are parameter-like *views* that represent multiple parameters.

Examples:

```
> (require unstable/parameter-group)

> (define param1 (make-parameter 1))

> (define param2 (make-parameter 2))

> (define-parameter-group params (param1 param2))

> (params)
(params-value 1 2)
> (parameterize/group ([params (params-value 10 20)])
  (list (param1) (param2)))
'(10 20)
> (params)
(params-value 1 2)
> (params (params-value 100 200))

> (list (param1) (param2))
'(100 200)
```

Use parameter groups to conveniently set multiple parameters. For example, the `plot` library uses parameter groups to save and restore appearance-controlling parameters when it must draw plots within a thunk.

```
(parameter-group? v) → boolean?
v : any/c
```

Returns `#t` when `v` is a parameter group.

```
(define-parameter-group name (param-or-group-expr ...) options)

options =
  | #:struct struct-name

param-or-group-expr : (or/c parameter? parameter-group?)
```

Defines a new parameter group.

If *struct-name* is not given, `define-parameter-group` defines a new struct *<name>-value* to hold the values of parameters.

If *struct-name* is given, it must have a constructor (*struct-name param-or-group-expr ...*) that accepts as many arguments as there are parameters in the group, and a *struct-name* match expander that accepts as many patterns as there are parameters.

Examples:

```
> (struct two-params (p1 p2) #:transparent)

> (define-parameter-group params* (param1 param2) #:struct two-
  params)

> (params*)
(two-params 100 200)

(parameterize/group ([param-or-group-expr value-expr] ...)
  body-expr ...+)

param-or-group-expr : (or/c parameter? parameter-group?)
```

Corresponds to `parameterize`, but can parameterize parameter groups as well as parameters.

```
(parameterize*/group ([param-or-group-expr value-expr] ...)
  body-expr ...+)

param-or-group-expr : (or/c parameter? parameter-group?)
```

Corresponds to `parameterize*`, but can parameterize parameter groups as well as parameters.



## 22 Pretty-Printing

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/pretty)
```

This module provides tools for pretty-printing.

```
(pretty-format/write x [columns]) → string?
x : any/c
columns : (or/c exact-nonnegative-integer? 'infinity)
          = (pretty-print-columns)
```

This procedure behaves like `pretty-format`, but it formats values consistently with `write` instead of `print`.

Examples:

```
> (struct both [a b] #:transparent)

> (pretty-format/write (list (both (list 'a 'b) (list "a" "b"))))
" (#(struct:both (a b) (\a\ \b\)))\n"

(pretty-format/display x [columns]) → string?
x : any/c
columns : (or/c exact-nonnegative-integer? 'infinity)
          = (pretty-print-columns)
```

This procedure behaves like `pretty-format`, but it formats values consistently with `display` instead of `print`.

Examples:

```
> (struct both [a b] #:transparent)

> (pretty-format/display (list (both (list 'a 'b) (list "a" "b"))))
" (#(struct:both (a b) (a b)))\n"

(pretty-format/print x [columns]) → string?
x : any/c
columns : (or/c exact-nonnegative-integer? 'infinity)
          = (pretty-print-columns)
```

This procedure behaves the same as `pretty-format`, but is named more explicitly to describe how it formats values. It is included for symmetry with `pretty-format/write` and `pretty-format/display`.

Examples:

```
> (struct both [a b] #:transparent)

> (pretty-format/print (list (both (list 'a 'b) (list "a" "b"))))
"(list (both '(a b) '("\a\" \"b\")))\n"
```

```
(break-lines s [columns]) → string?
  s : string?
  columns : exact-nonnegative-integer? = (pretty-print-columns)
```

The subsequent bindings were added by Vincent St-Amour <stamourv@racket-lang.org>.

Splits the string *s* into multiple lines, each of width at most *columns*, splitting only at whitespace boundaries.

Example:

```
> (display (break-lines "This string is more than 80 characters
long. It is 98 characters long, nothing more, nothing less."))
This string is more than 80 characters long. It is 98 characters
long,
nothing more, nothing less.
```

## 23 Sequences

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/sequence)
```

```
(in-syntax stx) → sequence?  
stx : syntax?
```

Produces a sequence equivalent to `(syntax->list lst)`.

An `in-syntax` application can provide better performance for syntax iteration when it appears directly in a `for` clause.

Example:

```
> (for/list ([x (in-syntax #'(1 2 3))])  
  x)  
'(<#<syntax:2:0 1> #<syntax:2:0 2> #<syntax:2:0 3>)
```

```
(in-pairs seq) → sequence?  
seq : sequence?
```

Produces a sequence equivalent to `(in-parallel (sequence-lift car seq) (sequence-lift cdr seq))`.

```
(in-sequence-forever seq val) → sequence?  
seq : sequence?  
val : any/c
```

Produces a sequence whose values are the elements of `seq`, followed by `val` repeated.

```
(sequence-lift f seq) → sequence?  
f : procedure?  
seq : sequence?
```

Produces the sequence of `f` applied to each element of `seq`.

Example:

```
> (for/list ([x (sequence-lift add1 (in-range 10))])  
  x)  
'(1 2 3 4 5 6 7 8 9 10)
```

The subsequent bindings were added by David Vanderson.

```
(in-slice length seq) → sequence?  
  length : exact-positive-integer?  
  seq : sequence?
```

Returns a sequence where each element is a list with *length* elements from the given sequence.

Example:

```
> (for/list ([e (in-slice 3 (in-range 8))]) e)  
'((0 1 2) (3 4 5) (6 7))
```

## 24 Strings

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/string)

(regexp-filter pattern lst)
→ (listof (or/c string? bytes? path? input-port?))
   pattern : (or/c string? bytes? regexp? byte-regexp?)
   lst : (listof (or/c string? bytes? path? input-port?))
```

The subsequent bindings were added by Vincent St-Amour.

Keeps only the elements of *lst* that match *pattern*.

## 25 Structs

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/struct)
```

```
(make struct-id expr ...)
```

Creates an instance of *struct-id*, which must be bound as a struct name. The number of *exprs* is statically checked against the number of fields associated with *struct-id*. If they are different, or if the number of fields is not known, an error is raised at compile time.

Examples:

```
> (define-struct triple (a b c))
```

```
> (make triple 3 4 5)
```

```
#<triple>
```

```
> (make triple 2 4)
```

```
eval:4:0: make: wrong number of arguments for struct triple  
(expected 3, got 2)
```

```
in: (make triple 2 4)
```

```
(struct->list v [#:on-opaque on-opaque]) → (or/c list? #f)  
v : any/c  
on-opaque : (or/c 'error 'return-false 'skip) = 'error
```

Returns a list containing the struct instance *v*'s fields. Unlike *struct->vector*, the struct name itself is not included.

If any fields of *v* are inaccessible via the current inspector the behavior of *struct->list* is determined by *on-opaque*. If *on-opaque* is *'error* (the default), an error is raised. If it is *'return-false*, *struct->list* returns *#f*. If it is *'skip*, the inaccessible fields are omitted from the list.

Examples:

```
> (define-struct open (u v) #:transparent)
```

```
> (struct->list (make-open 'a 'b))
```

```
'(a b)
```

```
> (struct->list #s(pre 1 2 3))
```

```
'(1 2 3)
```

```
> (define-struct (secret open) (x y))
```

```
> (struct->list (make-secret 0 1 17 22))
struct->list: expected argument of type <non-opaque struct>;
given: (secret 0 1 ...)
> (struct->list (make-secret 0 1 17 22) #:on-opaque 'return-false)
#f
> (struct->list (make-secret 0 1 17 22) #:on-opaque 'skip)
'(0 1)
> (struct->list 'not-a-struct #:on-opaque 'return-false)
#f
> (struct->list 'not-a-struct #:on-opaque 'skip)
'()
```

## 26 Syntax

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/syntax)

(explode-module-path-index mpi)
→ (listof (or/c module-path? resolved-module-path? #f))
    mpi : module-path-index?
```

Unfolds *mpi* using *module-path-index-split*, returning a list of the relative module paths together with the terminal resolved module path or *#f* for the “self” module.

Examples:

```
> (explode-module-path-index (car (identifier-binding #'lambda)))
'("kw.rkt" racket/private/pre-base #f)
> (explode-module-path-index (caddr (identifier-binding #'lambda)))
'(racket/base #f)
> (explode-module-path-index (car (identifier-binding #'define-values)))
'(' #%kernel #f)
```

```
(phase-of-enclosing-module)
```

Returns the phase level of the module in which the form occurs (and for the instantiation of the module in which the form is executed). For example, if a module is required directly by the “main” module (or the top level), its phase level is 0. If a module is required for-syntax by the “main” module (or the top level), its phase level is 1.

Examples:

```
> (module helper racket
    (require unstable/syntax)
    (displayln (phase-of-enclosing-module)))

> (require 'helper)
0

> (require (for-meta 1 'helper))
1
```

The subsequent bindings were added by Vincent St-Amour <stamourv@racket-lang.org>.



```
(format-unique-id lctx
                  fmt
                  v ...
                  [#:source src
                   #:props props
                   #:cert cert]) → identifier?
lctx : (or/c syntax? #f)
fmt : string?
v : (or/c string? symbol? identifier? keyword? char? number?)
src : (or/c syntax? #f) = #f
props : (or/c syntax? #f) = #f
cert : (or/c syntax? #f) = #f
```

Like `format-id`, but returned identifiers are guaranteed to be unique.

```
(syntax-within? a b) → boolean?
a : syntax?
b : syntax?
```

Returns true if syntax `a` is within syntax `b` in the source. Bounds are inclusive.

```
(syntax-map f stxl ...) → (listof A)
f : (-> syntax? A)
stxl : syntax?
```

The subsequent bindings were added by Sam Tobin-Hochstadt <samth@racket-lang.org>.

Performs `(map f (syntax->list stxl) ...)`.

Example:

```
> (syntax-map syntax-e #'(a b c))
'(a b c)
```

The subsequent bindings were added by Carl Eastlund <cce@racket-lang.org>.

## 26.1 Syntax Object Source Locations

```
(syntax-source-directory stx) → (or/c path? #f)
stx : syntax?
(syntax-source-file-name stx) → (or/c path? #f)
stx : syntax?
```

These produce the directory and file name, respectively, of the path with which `stx` is associated, or `#f` if `stx` is not associated with a path.

Examples:

```
(define loc
  (list (build-path "/tmp" "dir" "somewhere.rkt")
        #f #f #f #f))

(define stx1 (datum->syntax #f 'somewhere loc))

> (syntax-source-directory stx1)
#<path:/tmp/dir/>
> (syntax-source-file-name stx1)
#<path:somewhere.rkt>
(define stx2 (datum->syntax #f 'nowhere #f))

> (syntax-source-directory stx2)
#f
> (syntax-source-directory stx2)
#f
```

## 27 Temporal Contracts: Explicit Contract Monitors

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/temp-c)
```

The contract system implies the presence of a "monitoring system" that ensures that contracts are not violated. The `racket/contract` system compiles this monitoring system into checks on values that cross a contracted boundary. This module provides a facility to pass contract boundary crossing information to an explicit monitor for approval. This monitor may, for example, use state to enforce temporal constraints, such as a resource is locked before it is accessed.

### 27.1 Warning! Experimental!

This library is truly experimental and the interface is likely to drastically change as we get more experience making use of temporal contracts. In particular, the library comes with no advice about designing temporal contracts, which are much more subtle than standard contracts. This subtlety is compounded because, while temporal contract violations have accurate blame information, we cannot yet connect violations to sub-pieces of the temporal formula.

For example, applying `f` to `"three"` when it is contracted to only accept numbers will error by blaming the caller and providing the explanation "expected a <number?>, received: "three"". In contrast, applying `g` to `"even"` and then to `"odd"` when `g` is contracted to accept strings on every odd invocation, but numbers on every even invocation, will error by blaming the second (odd) call, but will not provide any explanation except "the monitor disallowed the call with arguments: "odd"". Translating non-acceptance of an event trace by an automata into a palatable user explanation is an open problem.

### 27.2 Monitors

```
(require unstable/temp-c/monitor)

(struct monitor (label)
  #:transparent)
  label : symbol?
(struct monitor:proj monitor (label proj-label v)
  #:transparent)
  label : symbol?
  proj-label : symbol?
  v : any/c
```

```

(struct monitor:call monitor (label
                             proj-label
                             f
                             app-label
                             kws
                             kw-args
                             args)

    #:transparent)
label : symbol?
proj-label : symbol?
f : procedure?
app-label : symbol?
kws : (listof keyword?)
kw-args : list?
args : list?
(struct monitor:return monitor (label
                                proj-label
                                f
                                app-label
                                kws
                                kw-args
                                args
                                rets)

    #:transparent)
label : symbol?
proj-label : symbol?
f : procedure?
app-label : symbol?
kws : (listof keyword?)
kw-args : list?
args : list?
rets : list?
(monitor/c monitor-allows? label c) → contract?
monitor-allows? : (-> monitor? boolean?)
label : symbol?
c : contract?

```

`monitor/c` creates a new contract around `c` that uses `monitor-allows?` to approve contract boundary crossings. (`c` approves positive crossings first.)

Whenever a value `v` is projected by the result of `monitor/c`, `monitor-allows?` must approve a `(monitor:proj label proj-label v)` structure, where `proj-label` is a unique symbol for this projection.

If `monitor-allows?` approves and the value is not a function, then the value is returned.

If the value is a function, then a projection is returned, whenever it is called, `monitor-allows?` must approve a `(monitor:call label proj-label v app-label kws kw-args args)` structure, where `app-label` is a unique symbol for this application and `kws`, `kw-args`, `args` are the arguments passed to the function.

Whenever it returns, `monitor-allows?` must approve a `(monitor:return label proj-label v app-label kws kw-args args rets)` structure, where `rets` are the return values of the application.

The unique projection label allows explicitly monitored contracts to be useful when used in a first-class way at different boundaries.

The unique application label allows explicitly monitored contracts to pair calls and returns when functions return multiple times or never through the use of continuations.

Here is a short example that uses an explicit monitor to ensure that `malloc` and `free` are used correctly.

```
(define allocated (make-weak-hasheq))
(define memmon
  (match-lambda
    [(monitor:return 'malloc _ _ _ _ (list addr))
     (hash-set! allocated addr #t)
     #t]
    [(monitor:call 'free _ _ _ _ (list addr))
     (hash-has-key? allocated addr)]
    [(monitor:return 'free _ _ _ _ (list addr) _)
     (hash-remove! allocated addr)
     #t]
    [_
     #t]))
(provide/contract
 [malloc (monitor/c memmon 'malloc (-> number?))]
 [free (monitor/c memmon 'free (-> number? void))])
```

## 27.3 Domain Specific Language

```
(require unstable/temp-c/dsl)
```

Constructing explicit monitors using only `monitor/c` can be a bit onerous. This module provides some helpful tools for making the definition easier. It provides everything from `unstable/temp-c/monitor`, as well as all bindings from `unstable/automata/re` and `unstable/automata/re-ext`. The latter provide a DSL for writing "dependent" regular expression machines over arbitrary `racket/match` patterns.

First, a few match patterns are available to avoid specify all the details of monitored events (since most of the time the detailed options are unnecessary.)

```
| (call n a ...)
```

A match expander for call events to the labeled function *n* with arguments *a*.

```
| (ret n a ...)
```

A match expander for return events to the labeled function *n* with return values *a*.

```
| (with-monitor contract-expr re-pat)
```

Defines a monitored contract where the structural portion of the contract is the *contract-expr* (which may included embedded label expressions) and where the temporal portion of the contract is the regular expression given by *re-pat*. (Note: *re-pat* is not a Racket expression that evaluates to a regular expression. It is a literal regular expression.) An optional *#:concurrent* may be added between the contract and the regular expression to ensure that the machine is safe against race-conditions.

```
| (label id contract-expr)
```

Labels a portion of a structural contract inside of with-monitor with the label *id*.

Here is a short example for *malloc* and *free*:

```
(with-monitor
  (cons/c (label 'malloc (-> addr?))
          (label 'free (-> addr? void?)))
  (complement
    (seq (star _)
          (dseq (call 'free addr)
                 (seq
                  (star (not (ret 'malloc (== addr))))
                  (call 'free (== addr)))))))
```

## 28 GUI Libraries

### 28.1 Notify-boxes

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/gui/notify)
```

```
notify-box% : class?  
  superclass: object%
```

A notify-box contains a mutable cell. The notify-box notifies its listeners when the contents of the cell is changed.

Examples:

```
> (define nb (new notify-box% (value 'apple)))  
  
> (send nb get)  
'apple  
> (send nb set 'orange)  
  
> (send nb listen (lambda (v) (printf "New value: ~s\n" v)))  
  
> (send nb set 'potato)  
New value: potato
```

```
(new notify-box% [value value]) → (is-a?/c notify-box%)  
  value : any/c
```

Creates a notify-box initially containing *value*.

```
(send a-notify-box get) → any/c
```

Gets the value currently stored in the notify-box.

```
(send a-notify-box set v) → void?  
  v : any/c
```

Updates the value stored in the notify-box and notifies the listeners.

```
(send a-notify-box listen listener) → void?  
  listener : (-> any/c any)
```

Adds a callback to be invoked on the new value when the notify-box's contents change.

```
(send a-notify-box remove-listener listener) → void?  
listener : (-> any/c any)
```

Removes a previously-added callback.

```
(send a-notify-box remove-all-listeners) → void?
```

Removes all previously registered callbacks.

```
(notify-box/pref proc  
  [#:readonly? readonly?]) → (is-a?/c notify-box%)  
proc : (case-> (-> any/c) (-> any/c void?))  
readonly? : boolean? = #f
```

Creates a notify-box with an initial value of (*proc*). Unless *readonly?* is true, *proc* is invoked on the new value when the notify-box is updated.

Useful for tying a notify-box to a preference or parameter. Of course, changes made directly to the underlying parameter or state are not reflected in the notify-box.

Examples:

```
> (define animal (make-parameter 'ant))  
  
> (define nb (notify-box/pref animal))  
  
> (send nb listen (lambda (v) (printf "New value: ~s\n" v)))  
  
> (send nb set 'bee)  
New value: bee  
  
> (animal 'cow)  
  
> (send nb get)  
'bee  
> (send nb set 'deer)  
New value: deer  
  
> (animal)  
'deer  
  
(define-notify name value-expr)  
value-expr : (is-a?/c notify-box%)
```



Class-body form. Declares *name* as a field and *get-name*, *set-name*, and *listen-name* as methods that delegate to the *get*, *set*, and *listen* methods of *value*.

The *value-expr* argument must evaluate to a notify-box, not just the initial contents for a notify box.

Useful for aggregating many notify-boxes together into one “configuration” object.

Examples:

```
> (define config%
  (class object%
    (define-notify food (new notify-box% (value 'apple)))
    (define-notify animal (new notify-box% (value 'ant)))
    (super-new)))

> (define c (new config%))

> (send c listen-food
      (lambda (v) (when (eq? v 'honey) (send c set-
animal 'bear))))

> (let ([food (get-field food c)])
  (send food set 'honey))

> (send c get-animal)
'bear

(menu-option/notify-box parent
  label
  notify-box)
→ (is-a?/c checkable-menu-item%)
parent : (or/c (is-a?/c menu%) (is-a?/c popup-menu%))
label : label-string?
notify-box : (is-a?/c notify-box%)
```

Creates a *checkable-menu-item%* tied to *notify-box*. The menu item is checked whenever *(send notify-box get)* is true. Clicking the menu item toggles the value of *notify-box* and invokes its listeners.

```
(checkbox/notify-box parent
  label
  notify-box) → (is-a?/c checkbox%)
parent : (or/c (is-a?/c frame%) (is-a?/c dialog%)
  (is-a?/c panel%) (is-a?/c pane%))
label : label-string?
notify-box : (is-a?/c notify-box%)
```

Creates a `check-box%` tied to `notify-box`. The check-box is checked whenever `(send notify-box get)` is true. Clicking the check box toggles the value of `notify-box` and invokes its listeners.

```
(choice/notify-box parent
      label
      choices
      notify-box) → (is-a?/c choice%)
parent : (or/c (is-a?/c frame%) (is-a?/c dialog%)
           (is-a?/c panel%) (is-a?/c pane%))
label : label-string?
choices : (listof label-string?)
notify-box : (is-a?/c notify-box%)
```

Creates a `choice%` tied to `notify-box`. The choice control has the value `(send notify-box get)` selected, and selecting a different choice updates `notify-box` and invokes its listeners.

If the value of `notify-box` is not in `choices`, either initially or upon an update, an error is raised.

```
(menu-group/notify-box parent
      labels
      notify-box)
→ (listof (is-a?/c checkable-menu-item%))
parent : (or/c (is-a?/c menu%) (is-a?/c popup-menu%))
labels : (listof label-string?)
notify-box : (is-a?/c notify-box%)
```

Returns a list of `checkable-menu-item%` controls tied to `notify-box`. A menu item is checked when its label is `(send notify-box get)`. Clicking a menu item updates `notify-box` to its label and invokes `notify-box`'s listeners.

## 28.2 Preferences

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/gui/prefs)
(pref:get/set pref) → (case-> (-> any/c) (-> any/c void?))
pref : symbol?
```

Returns a procedure that when applied to zero arguments retrieves the current value of the preference (`framework/preferences`) named `pref` and when applied to one argument updates the preference named `pref`.

## 28.3 Pict Utilities

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/gui/pict)
```

The functions and macros exported by this module are also exported by `unstable/gui/slideshow`.

### 28.3.1 Pict Colors

```
(color c p) → pict?  
  c : color/c  
  p : pict?
```

Applies color `c` to picture `p`. Equivalent to `(colorize p c)`.

Example:

```
> (color "red" (disk 20))
```



```
(red pict) → pict?  
  pict : pict?  
(orange pict) → pict?  
  pict : pict?  
(yellow pict) → pict?  
  pict : pict?  
(green pict) → pict?  
  pict : pict?  
(blue pict) → pict?  
  pict : pict?  
(purple pict) → pict?  
  pict : pict?  
(black pict) → pict?  
  pict : pict?  
(brown pict) → pict?  
  pict : pict?  
(gray pict) → pict?  
  pict : pict?  
(white pict) → pict?  
  pict : pict?  
(cyan pict) → pict?  
  pict : pict?
```

```
(magenta pict) → pict?
  pict : pict?
```

These functions apply appropriate colors to picture *p*.

Example:

```
> (red (disk 20))
```



```
(light color) → color/c
  color : color/c
(dark color) → color/c
  color : color/c
```

These functions produce lighter or darker versions of a color.

Example:

```
> (hc-append (colorize (disk 20) "red")
              (colorize (disk 20) (dark "red")))
              (colorize (disk 20) (light "red")))
```



```
color/c : flat-contract?
```

This contract recognizes color strings, `color%` instances, and RGB color lists.

### 28.3.2 Pict Manipulation

```
(fill pict width height) → pict?
  pict : pict?
  width : (or/c real? #f)
  height : (or/c real? #f)
```

Extends *pict*'s bounding box to a minimum *width* and/or *height*, placing the original picture in the middle of the space.

Example:




```
> (frame (fill (disk 20) 40 40))
```



```
(scale-to pict width height [#:mode mode]) → pict?
  pict : pict?
  width : real?
  height : real?
  mode : (or/c 'preserve 'inset 'distort) = 'preserve
```

Scales *pict* so that its width and height are at most *width* and *height*, respectively. If *mode* is *'preserve*, the width and height are scaled by the same factor so *pict*'s aspect ratio is preserved; the result's bounding box may be smaller than *width* by *height*. If *mode* is *'inset*, the aspect ratio is preserved as with *'preserve*, but the resulting pict is centered in a bounding box of exactly *width* by *height*. If *mode* is *'distort*, the width and height are scaled separately.

Examples:

```
> (frame (scale-to (circle 100) 40 20))

> (frame (scale-to (circle 100) 40 20 #:mode 'inset))

> (frame (scale-to (circle 100) 40 20 #:mode 'distort))

```

## Conditional Manipulations

These pict transformers all take boolean arguments that determine whether to transform the pict or leave it unchanged. These transformations can be useful for staged slides, as the resulting pict always has the same size and shape, and its contents always appear at the same position, but changing the boolean argument between slides can control when the transformation occurs.

```
(show pict [show?]) → pict?
  pict : pict?
  show? : truth/c = #t
(hide pict [hide?]) → pict?
  pict : pict?
  hide? : truth/c = #t
```

These functions conditionally show or hide an image, essentially choosing between *pict* and (*ghost pict*). The only difference between the two is the default behavior and the opposite meaning of the *show?* and *hide?* booleans. Both functions are provided for mnemonic purposes.

```
(strike pict [strike?]) → pict?
  pict : pict?
  strike? : truth/c = #t
```

Displays a strikethrough image by putting a line through the middle of *pict* if *strike?* is true; produces *pict* unchanged otherwise.

Example:

```
> (strike (colorize (disk 20) "yellow"))
```



```
(shade pict [shade? #:ratio ratio]) → pict?
  pict : pict?
  shade? : truth/c = #t
  ratio : (real-in 0 1) = 1/2
```

Shades *pict* to show with *ratio* of its normal opacity; if *ratio* is 1 or *shade?* is #f, shows *pict* unchanged.

Example:

```
> (shade (colorize (disk 20) "red"))
```



## Conditional Combinations

These pict control flow operators decide which pict of several to use. All branches are evaluated; the resulting pict is a combination of the pict chosen by normal conditional flow with *ghost* applied to all the other pict. The result is a picture large enough to accommodate each alternative, but showing only the chosen one. This is useful for staged slides, as the pict chosen may change with each slide but its size and position will not.

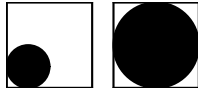
```
(pict-if maybe-combine test-expr then-expr else-expr)

maybe-combine =
  | #:combine combine-expr
```

Chooses either *then-expr* or *else-expr* based on *test-expr*, similarly to if. Combines the chosen, visible image with the other, invisible image using *combine-expr*, defaulting to *pict-combine*.

Example:

```
> (let ([f (lambda (x)
              (pict-if x
                        (disk 20)
                        (disk 40)))]])
    (hc-append 10
              (frame (f #t))
              (frame (f #f))))
```



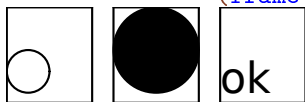
```
(pict-cond maybe-combine [test-expr pict-expr] ...)
```

```
maybe-combine =
| #:combine combine-expr
```

Chooses a *pict-expr* based on the first successful *test-expr*, similarly to *cond*. Combines the chosen, visible image with the other, invisible images using *combine-expr*, defaulting to *pict-combine*.

Example:

```
> (let ([f (lambda (x)
              (pict-cond
                [(eq? x 'circle) (circle 20)]
                [(eq? x 'disk) (disk 40)]
                [(eq? x 'text) (text "ok" null 20)]))]])
    (hc-append 10
              (frame (f 'circle))
              (frame (f 'disk))
              (frame (f 'text)))))
```



```
(pict-case test-expr maybe-combine [literals pict-expr] ...)
```

```
maybe-combine =
| #:combine combine-expr
```

Chooses a *pict-expr* based on *test-expr* and each list of *literals*, similarly to *case*. Combines the chosen, visible image with the other, invisible images using *combine-expr*, defaulting to *pict-combine*.

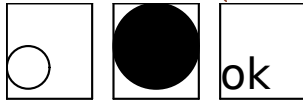
Example:

```
> (let ([f (lambda (x)
```

```

      (pict-case x
        [(circle) (circle 20)]
        [(disk) (disk 40)]
        [(text) (text "ok" null 20)])))]))
    (hc-append 10
      (frame (f 'circle))
      (frame (f 'disk))
      (frame (f 'text))))

```



```

(pict-match test-expr maybe-combine [pattern pict-expr] ...)

maybe-combine =
  | #:combine combine-expr

```

Chooses a *pict-expr* based on *test-expr* and each *pattern*, similarly to *match*. Combines the chosen, visible image with the other, invisible images using *combine-expr*, defaulting to *pict-combine*.

*pict-combine*

This syntax parameter determines the default pict combining form used by the above macros. It defaults to *lbl-superimpose*.

(with-pict-combine *combine-id* *body* ...)

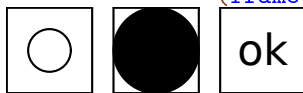
Sets *pict-combine* to refer to *combine-id* within each of the *body* terms, which are spliced into the containing context.

Example:

```

> (let ([f (lambda (x)
              (with-pict-combine cc-superimpose
                (pict-case x
                  [(circle) (circle 20)]
                  [(disk) (disk 40)]
                  [(text) (text "ok" null 20)])))]))
  (hc-append 10
    (frame (f 'circle))
    (frame (f 'disk))
    (frame (f 'text))))

```





### 28.3.3 Shapes with Borders

The subsequent bindings were added by Vincent St-Amour.

```
(ellipse/border w
                h
                [#:color color
                 #:border-color border-color
                 #:border-width border-width]) → pict?

w : real?
h : real?
color : color/c = "white"
border-color : color/c = "black"
border-width : real? = 2

(circle/border diameter
              [#:color color
               #:border-color border-color
               #:border-width border-width]) → pict?

diameter : real?
color : color/c = "white"
border-color : color/c = "black"
border-width : real? = 2

(rectangle/border w
                  h
                  [#:color color
                   #:border-color border-color
                   #:border-width border-width]) → pict?



w : real?
h : real?
color : color/c = "white"
border-color : color/c = "black"
border-width : real? = 2

(rounded-rectangle/border w
                          h
                          [#:color color
                           #:border-color border-color
                           #:border-width border-width
                           #:corner-radius corner-radius
                           #:angle angle])

→ pict?
w : real?
h : real?
color : color/c = "white"
border-color : color/c = "black"
border-width : real? = 2
corner-radius : real? = -0.25
angle : real? = 0
```

These functions create shapes with border of the given color and width.

Examples:

```
> (ellipse/border 40 20 #:border-color "blue")  
  
> (rounded-rectangle/border 40 20 #:color "red")  

```

### 28.3.4 Lines with Labels

The subsequent bindings were added by Scott Owens.

```
(pin-label-line label  
                pict  
                src-pict  
                src-coord-fn  
                dest-pict  
                dest-coord-fn  
                [#:start-angle start-angle  
                #:end-angle end-angle  
                #:start-pull start-pull  
                #:end-pull end-pull  
                #:line-width line-width  
                #:color color  
                #:under? under?  
                #:x-adjust x-adjust  
                #:y-adjust y-adjust]) → pict?  
  
label : pict?  
pict : pict?  
src-pict : pict-path?  
src-coord-fn : (-> pict-path? (values real? real?))  
dest-pict : pict-path?  
dest-coord-fn : (-> pict-path? (values real? real?))  
start-angle : (or/c real? #f) = #f  
end-angle : (or/c real? #f) = #f  
start-pull : real? = 1/4  
end-pull : real? = 1/4  
line-width : (or/c real? #f) = #f  
color : (or/c #f string? (is-a?/c color%)) = #f  
under? : any/c = #f  
x-adjust : real? = 0  
y-adjust : real? = 0
```

```

(pin-arrow-label-line label
  arrow-size
  pict
  src-pict
  src-coord-fn
  dest-pict
  dest-coord-fn
  [#:start-angle start-angle
   #:end-angle end-angle
   #:start-pull start-pull
   #:end-pull end-pull
   #:line-width line-width
   #:color color
   #:under? under?
   #:hide-arrowhead? hide-arrowhead?
   #:x-adjust x-adjust
   #:y-adjust y-adjust])
→ pict?
label : pict?
arrow-size : real?
pict : pict?
src-pict : pict-path?
src-coord-fn : (-> pict-path? (values real? real?))
dest-pict : pict-path?
dest-coord-fn : (-> pict-path? (values real? real?))
start-angle : (or/c real? #f) = #f
end-angle : (or/c real? #f) = #f
start-pull : real? = 1/4
end-pull : real? = 1/4
line-width : (or/c real? #f) = #f
color : (or/c #f string? (is-a?/c color%)) = #f
under? : any/c = #f
hide-arrowhead? : any/c = #f
x-adjust : real? = 0
y-adjust : real? = 0

```

```

(pin-arrows-label-line label
  arrow-size
  pict
  src-pict
  src-coord-fn
  dest-pict
  dest-coord-fn
  [#:start-angle start-angle
    #:end-angle end-angle
    #:start-pull start-pull
    #:end-pull end-pull
    #:line-width line-width
    #:color color
    #:under? under?
    #:hide-arrowhead? hide-arrowhead?
    #:x-adjust x-adjust
    #:y-adjust y-adjust])
→ pict?
label : pict?
arrow-size : real?
pict : pict?
src-pict : pict-path?
src-coord-fn : (-> pict-path? (values real? real?))
dest-pict : pict-path?
dest-coord-fn : (-> pict-path? (values real? real?))
start-angle : (or/c real? #f) = #f
end-angle : (or/c real? #f) = #f
start-pull : real? = 1/4
end-pull : real? = 1/4
line-width : (or/c real? #f) = #f
color : (or/c #f string? (is-a?/c color%)) = #f
under? : any/c = #f
hide-arrowhead? : any/c = #f
x-adjust : real? = 0
y-adjust : real? = 0

```

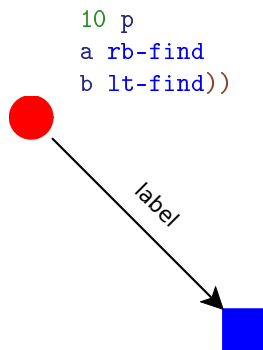
These functions behave like `pin-line`, `pin-arrow-line` and `pin-arrows-line` with the addition of a label attached to the line.

Example:

```

> (let* ([a (red (disk 20))]
         [b (blue (filled-rectangle 20 20))]
         [p (vl-append a (hb-append (blank 100) b))])
  (pin-arrow-label-line
    (rotate (text "label" null 10) (/ pi -4))

```



### 28.3.5 Blur

```

(blur p h-radius [v-radius]) → pict?
  p : pict?
  h-radius : (and/c real? (not/c negative?))
  v-radius : (and/c real? (not/c negative?)) = h-radius

```

The subsequent bindings were added by Ryan Culpepper.

Blurs *p* using an iterated box blur that approximates a gaussian blur. The *h-radius* and *v-radius* arguments control the strength of the horizontal and vertical components of the blur, respectively. They are given in terms of pict units, which may not directly correspond to screen pixels.

The `blur` function takes work proportional to

```
(* (pict-width p) (pict-height p))
```

but it may be sped up by a factor of up to `(processor-count)` due to the use of `futures`.

Examples:

```

> (blur (text "blur" null 40) 5)
blur

> (blur (text "more blur" null 40) 10)
more blur

> (blur (text "much blur" null 40) 20)
much blur

```

```
> (blur (text "horiz. blur" null 40) 10 0)
```



The resulting pict has the same bounding box as *p*, so when picts are automatically **clipped** (as in Scribble documents), the pict should be **inset** by the blur radius.

Example:

```
> (inset (blur (text "more blur" null 40) 10) 10)
```



```
(shadow p
  radius
  [dx
   dy
   #:color color
   #:shadow-color shadow-color]) → pict?
p : pict?
radius : (and/c real? (not/c negative?))
dx : real? = 0
dy : real? = dx
color : (or/c #f string? (is-a?/c color%)) = #f
shadow-color : (or/c #f string? (is-a?/c color%)) = #f
```

Creates a shadow effect by superimposing *p* over a blurred version of *p*. The shadow is offset from *p* by (*dx*, *dy*) units.

If *color* is not **#f**, the foreground part is (**colorize** *p* *color*); otherwise it is just *p*. If *shadow-color* is not **#f**, the shadow part is produced by blurring (**colorize** *p* *shadow-color*); otherwise it is produced by blurring *p*.

The resulting pict has the same bounding box as *p*.

Examples:

```
> (inset (shadow (text "shadow" null 50) 10) 10)
```



```
> (inset (shadow (text "shadow" null 50) 10 5) 10)
```

# shadow

```
> (inset (shadow (text "shadow" null 50)
                 5 0 2 #:color "white" #:shadow-color "red")
        10)
```

# shadow

```
(blur-bitmap! bitmap h-radius [v-radius]) → void?
  bitmap : (is-a?/c bitmap%)
  h-radius : (and/c real? (not/c negative?))
  v-radius : (and/c real? (not/c negative?)) = h-radius
```

Blurs *bitmap* using blur radii *h-radius* and *v-radius*.

## Tagged Picts

```
(tag-pict p tag) → pict?
  p : pict?
  tag : symbol?
```

Returns a pict like *p* that carries a symbolic tag. The tag can be used with `find-tag` to locate the pict.

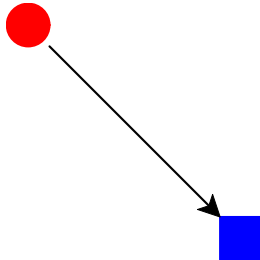
```
(find-tag p find) → (or/c pict-path? #f)
  p : pict?
  find : tag-path?
```

Locates a sub-pict of *p*. Returns a pict-path that can be used with functions like `lt-find`, etc.

Example:

```
> (let* ([a (tag-pict (red (disk 20)) 'a)]
         [b (tag-pict (blue (filled-rectangle 20 20)) 'b)]
         [p (vl-append a (hb-append (blank 100) b))])
```

```
(pin-arrow-line 10 p
  (find-tag p 'a) rb-find
  (find-tag p 'b) lt-find))
```

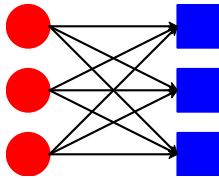


```
(find-tag* p find) → (listof pict-path?)
p : pict?
find : tag-path?
```

Like `find-tag`, but returns all pict-paths corresponding to the given tag-path.

Example:

```
> (let* ([a (lambda () (tag-pict (red (disk 20)) 'a))]
  [b (lambda () (tag-pict (blue (filled-
rectangle 20 20)) 'b))])
  [as (vc-append 10 (a) (a) (a))]
  [bs (vc-append 10 (b) (b) (b))]
  [p (hc-append as (blank 60 0) bs)])
  (for*/fold ([p p])
    ([apath (in-list (find-tag* p 'a))]
     [bpath (in-list (find-tag* p 'b))])
    (pin-arrow-line 4 p
      apath rc-find
      bpath lc-find)))
```



```
(tag-path? x) → boolean?
x : any/c
```

Returns `#t` if `x` is a symbol or a non-empty list of symbols, `#f` otherwise.

### 28.3.6 Shadow Frames



```

(shadow-frame pict
  ...
  [#:sep separation
   #:margin margin
   #:background-color bg-color
   #:frame-color frame-color
   #:frame-line-width frame-line-width
   #:shadow-side-length shadow-side-length
   #:shadow-top-y-offset shadow-top-y-offset
   #:shadow-bottom-y-offset shadow-bottom-y-offset
   #:shadow-descent shadow-descent
   #:shadow-alpha-factor shadow-alpha-factor
   #:blur blur-radius])
→ pict?
pict : pict?
separation : real? = 5
margin : real? = 20
bg-color : (or/c string? (is-a?/c color%)) = "white"
frame-color : (or/c string? (is-a?/c color%)) = "gray"
frame-line-width : (or/c real? #f) = 0
shadow-side-length : real? = 4
shadow-top-y-offset : real? = 10
shadow-bottom-y-offset : real? = 4
shadow-descent : (and/c real? (not/c negative?)) = 40
shadow-alpha-factor : real? = 3/4
blur-radius : (and/c real? (not/c negative?)) = 20

```

Surrounds the *picts* with a rectangular frame that casts a symmetric “curled paper” shadow.

The *picts* are vertically appended with *separation* space between them. They are placed on a rectangular background of solid *bg-color* with *margin* space on all sides. A frame of *frame-color* and *frame-line-width* is added around the rectangle. The rectangle casts a shadow that extends *shadow-side-length* to the left and right, starts *shadow-top-y-offset* below the top of the rectangle and extends to *shadow-bottom-y-offset* below the bottom of the rectangle in the center and an additional *shadow-descent* below that on the sides. The shadow is painted using a linear gradient; *shadow-alpha-factor* determines its density at the center. Finally, the shadow is blurred by *blur-radius*; all previous measurements are pre-blur measurements.

Example:

```

> (scale (shadow-frame (text "text in a nifty
frame" null 60)) 1/2)

```

# text in a nifty frame

```
(arch outer-width
      inner-width
      solid-height
      leg-height) → pict?
outer-width : real?
inner-width : real?
solid-height : real?
leg-height : real?
```

Creates an arch.

Example:

```
> (colorize (arch 100 80 20 20) "red")
```



## 28.4 Slideshow Presentations

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/gui/slideshow)
```

This module also exports everything provided by `unstable/gui/pict`.

### 28.4.1 Text Formatting

```
(with-size size expr)
```

Sets `current-font-size` to `size` while running `expr`.

```
(with-scale scale expr)
```

Multiplies `current-font-size` by `scale` while running `expr`.

```
(big text)
(small text)
```

Scale `current-font-size` by  $3/2$  or  $2/3$ , respectively, while running `text`.

```
(with-font font expr)
```

Sets `current-main-font` to `font` while running `expr`.

```
(with-style style expr)
```

Adds `style` to `current-main-font` (via `cons`) while running `expr`.

```
(bold text)
(italic text)
(subscript text)
(superscript text)
(caps text)
```

Adds the attributes for bold, italic, superscript, subscript, or small caps text, respectively, to `current-main-font` while running `text`.

## 28.4.2 Tables

```
(tabular row
  ...
  [#:gap gap
   #:hgap hgap
   #:vgap vgap
   #:align align
   #:halign halign
   #:valign valign]) → pict?
row : (listof (or/c string? pict?))
gap : natural-number/c = gap-size
hgap : natural-number/c = gap
vgap : natural-number/c = gap
align : (->* [] [] #:rest (listof pict?) pict?)
       = lbl-superimpose
halign : (->* [] [] #:rest (listof pict?) pict?) = align
valign : (->* [] [] #:rest (listof pict?) pict?) = align
```

Constructs a table containing the given `rows`, all of which must be of the same length. Applies `t` to each string in a `row` to construct a pict. The `hgap`, `vgap`, `halign`, and `valign` are used to determine the horizontal and vertical gaps and alignments as in `table` (except that every row and column is uniform).

### 28.4.3 Multiple Columns

```
(two-columns one two)
```

Constructs a two-column pict using *one* and *two* as the two columns. Sets *current-para-width* appropriately in each column.

```
(mini-slide pict ...) → pict?  
pict : pict?
```

Appends each *pict* vertically with space between them, similarly to the *slide* function.

```
(columns pict ...) → pict?  
pict : pict?
```

Combines each *pict* horizontally, aligned at the top, with space in between.

```
(column width body ...)
```

Sets *current-para-width* to *width* during execution of the *body* expressions.

```
(column-size n [r]) → real?  
n : exact-positive-integer?  
r : real? = (/ n)
```

Computes the width of one column out of *n* that takes up a ratio of *r* of the available space (according to *current-para-width*).

### 28.4.4 Staged Slides

```
(staged [name ...] body ...)
```

Executes the *body* terms once for each stage *name*. The terms may include expressions and mutually recursive definitions. Within the body, each *name* is bound to a number from 1 to the number of stages in order. Furthermore, during execution stage is bound to the number of the current stage and stage-name is bound to a symbol representing the *name* of the current stage. By comparing stage to the numeric value of each *name*, or stage-name to quoted symbols of the form *'name*, the user may compute based on the progression of the stages.

```
stage  
stage-name
```

These keywords are bound during the execution of `staged` and should not be used otherwise.

```
(slide/staged [name ...] arg ...)
```

Creates a staged slide. Equivalent to `(staged [name ...] (slide arg ...))`.

Within a staged slide, the boolean arguments to `hide`, `show`, `strike`, and `shade` can be used to determine in which stages to perform a transformation. The macros `pict-if`, `pict-cond`, `pict-case`, and `pict-match` may also be used to create images which change naturally between stages.

#### 28.4.5 Miscellaneous Slide Utilities

```
(blank-line) → pict?
```

The subsequent bindings were added by Scott Owens.

Adds a blank line of the current font size’s height.

### 28.5 Progressive Picts and Slides

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

#### 28.5.1 Progressive Picts

```
(require unstable/gui/ppict)
```

A *progressive pict* or “ppict” is a kind of `pict` that has an associated “pict placer,” which generally represents a position and alignment. New picts can be placed on the progressive pict by calling `ppict-add`, and the placer can be updated by calling `ppict-go`. The `ppict-do` form provides a compact notation for sequences of those two operations.

```
(ppict-do base-expr ppict-do-fragment ...)
```

```

(ppict-do* base-expr ppict-do-fragment ...)

ppict-do-fragment = #:go placer-expr
                  | #:set pict-expr
                  | #:next
                  | #:alt (ppict-do-fragment ...)
                  | elem-expr

base-expr : pict?
placer-expr : placer?
pict-expr : pict?
elem-expr : (or/c pict? real? #f)

```

Builds a pict (and optionally a list of intermediate picts) progressively. The `ppict-do` form returns only the final pict; any uses of `#:next` are ignored. The `ppict-do*` form returns two values: the final pict and a list of all partial picts emitted due to `#:next` (the final pict is not included).

A `#:go` fragment changes the current placer. A `#:set` fragment replaces the current pict state altogether with a new computed pict. A `#:next` fragment saves a pict including only the contents emitted so far (but whose alignment takes into account pict's yet to come). A `#:alt` fragment saves the current pict state, executes the sub-sequence that follows, saves the result (as if the sub-sequence ended with `#:next`), then restores the saved pict state before continuing.

The `elem-exprs` are interpreted by the current placer. A numeric `elem-expr` usually represents a spacing change, but some placers do not support them. A spacing change only affects added pict's up until the next placer is installed; when a new placer is installed, the spacing is reset, usually to 0.

The `ppict-do-state` form tracks the current state of the pict. It is updated before a `#:go` or `#:set` fragment or before a sequence of `elem-exprs`. It is not updated in the middle of a chain of `elem-exprs`, however.

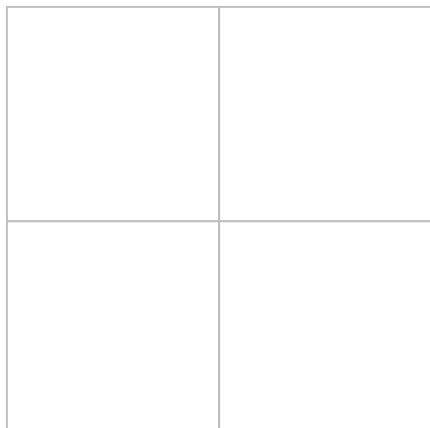
Examples:

```

> (define base
  (ppict-do (colorize (rectangle 200 200) "gray")
            #:go (coord 1/2 1/2 'cc)
            (colorize (hline 200 1) "gray")
            #:go (coord 1/2 1/2 'cc)
            (colorize (vline 1 200) "gray")))

> base

```



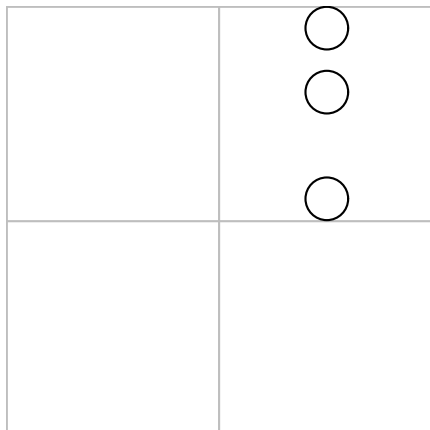
The use of `ppict-do` in the definition of `base` above is equivalent to

```
(let* ([pp (colorize (rectangle 200 200) "gray")]
      [pp (ppict-go pp (coord 1/2 1/2 'cc))]
      [pp (ppict-add pp (colorize (hline 200 1) "gray"))]
      [pp (ppict-go pp (coord 1/2 1/2 'cc))]
      [pp (ppict-add pp (colorize (vline 1 200) "gray"))])
  pp)
```

Examples:

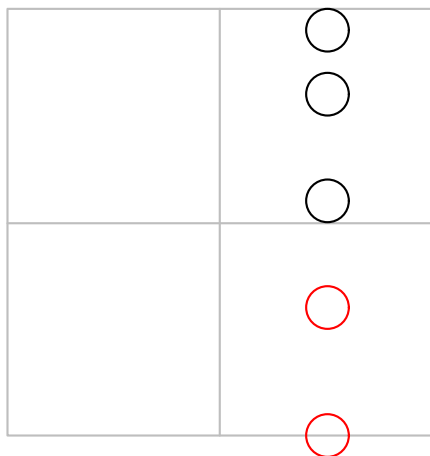
```
> (define circles-down-1
  (ppict-do base
    #:go (grid 2 2 2 1 'ct)
    10
    (circle 20)
    (circle 20)
    30
    (circle 20)))

> circles-down-1
```



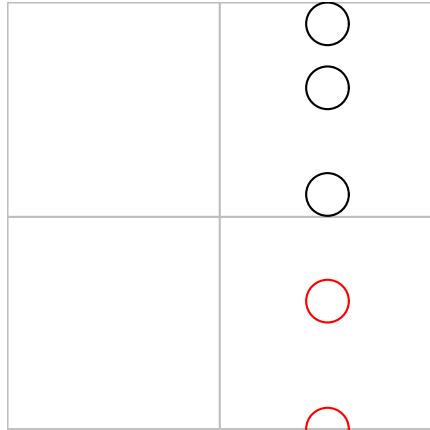
```
> (define circles-down-2
  (ppict-do circles-down-1
    (colorize (circle 20) "red")
    40
    (colorize (circle 20) "red"))))

> (inset circles-down-2 20) ; draws outside its bounding box
```

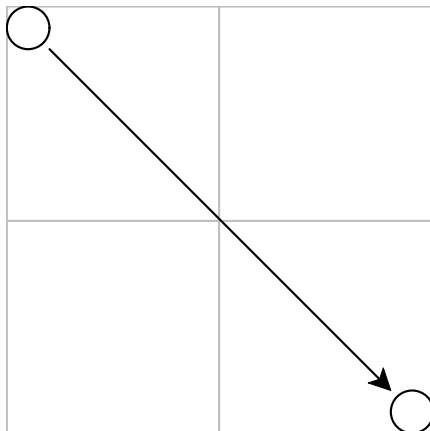


```
> (inset (clip circles-down-2) 20)
```







```
> (ppict-do base
    #:go (coord 0 0 'lt)
    (tag-pict (circle 20) 'circA)
    #:go (coord 1 1 'rb)
    (tag-pict (circle 20) 'circB)
    #:set (let ([p ppict-do-state])
            (pin-arrow-line 10 p
                            (find-tag p 'circA) rb-find
                            (find-tag p 'circB) lt-find))))
```



```
> (let-values ([ (final intermediates)
                  (ppict-do* base
                    #:go (coord 1/4 1/2 'cb)
                    (text "shapes:")
                    #:go (coord 1/2 1/2 'lb)
                    #:alt [(circle 20)]
                    #:alt [(rectangle 20 20)])
```

```
(text "and more!"))]]
(append intermediates (list final)))
```

shapes:		shapes:		shapes:	and more!

```
, (
```

More examples of `ppict-do` are scattered throughout this section.

#### `ppict-do-state`

Tracks the current state of a `ppict-do` or `ppict-do*` form.

```
(ppict? x) → boolean?
x : any/c
```

Returns `#t` if `x` is a progressive pict, `#f` otherwise.

```
(ppict-go p pl) → ppict?
p : pict?
pl : placer?
```

Creates a progressive pict with the given base pict `p` and the placer `pl`.

```
(ppict-add pp elem ...) → pict?
pp : ppict?
elem : (or/c pict? real? #f 'next)
(ppict-add* pp elem ...) → pict? (listof pict?)
pp : ppict?
elem : (or/c pict? real? #f 'next)
```

Creates a new pict by adding each `elem` pict on top of `pp` according to `pp`'s placer. The result pict may or may not be a progressive pict, depending on the placer used. The `ppict-add` function only the final pict; any occurrences of `'next` are ignored. The `ppict-add*` function returns two values: the final pict and a list of all partial picts emitted due to `'next` (the final pict is not included).

An *elem* that is a real number changes the spacing for subsequent additions. A *elem* that is *#f* is discarded; it is permitted as a convenience for conditionally including sub-picts. Note that *#f* is not equivalent to *(blank 0)*, since the latter will cause spacing to be added around it.

```
(placer? x) → boolean?
  x : any/c
```

Returns *#t* if *x* is a placer, *#f* otherwise.

```
(refpoint-placer? x) → boolean?
  x : any/c
```

Returns *#t* if *x* is a placer based on a reference point, *#f* otherwise.

```
(coord rel-x
      rel-y
      [align
       #:abs-x abs-x
       #:abs-y abs-y
       #:compose composer]) → refpoint-placer?
rel-x : real?
rel-y : real?
align : (or/c 'lt 'ct 'rt 'lc 'cc 'rc 'lb 'cb 'rb) = 'cc
abs-x : real? = 0
abs-y : real? = 0
composer : procedure? = computed from align
```

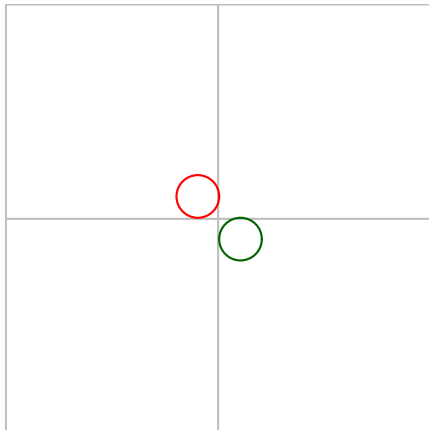
Returns a placer that places picts according to *rel-x* and *rel-y*, which are interpreted as fractions of the width and height of the base progressive pict. That is, 0, 0 is the top left corner of the base's bounding box, and 1, 1 is the bottom right. Then *abs-x* and *abs-y* offsets are added to get the final reference point.

Additions are aligned according to *align*, a symbol whose name consists of a horizontal alignment character followed by a vertical alignment character. For example, if *align* is *'lt*, the pict is placed so that its left-top corner is at the reference point; if *align* is *'rc*, the pict is placed so that the center of its bounding box's right edge coincides with the reference point.

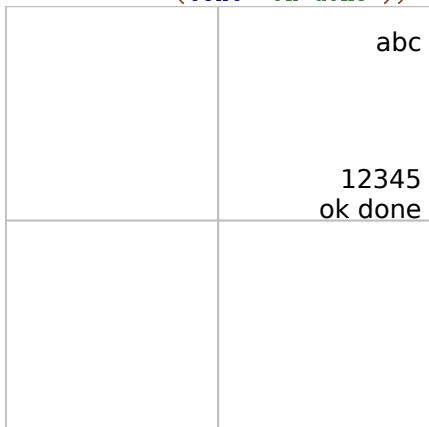
By default, if there are multiple picts to be placed, they are vertically appended, aligned according to the horizontal component of *align*. For example, if *align* is *'cc*, the default *composer* is *vc-append*; for *'lt*, the default *composer* is *vl-append*. The spacing is initially 0.

Examples:

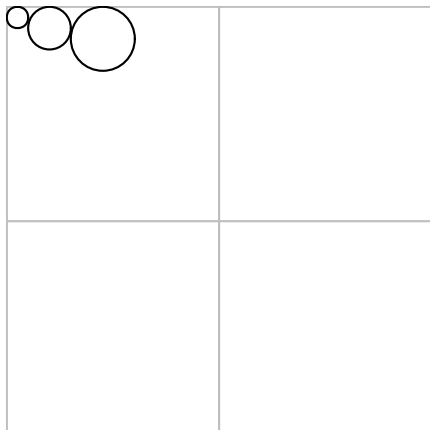
```
> (ppict-do base
  #:go (coord 1/2 1/2 'rb)
  (colorize (circle 20) "red")
  #:go (coord 1/2 1/2 'lt)
  (colorize (circle 20) "darkgreen"))
```



```
> (ppict-do base
  #:go (coord 1 0 'rt #:abs-x -5 #:abs-y 10)
  50 ; change spacing
  (text "abc")
  (text "12345")
  0 ; and again
  (text "ok done"))
```



```
> (ppict-do base
  #:go (coord 0 0 'lt #:compose ht-append)
  (circle 10)
  (circle 20)
  (circle 30))
```



```
(grid cols
      rows
      col
      row
      [align
        #:abs-x abs-x
        #:abs-y abs-y
        #:compose composer]) → reftype-placer?
cols : exact-positive-integer?
rows : exact-positive-integer?
col : exact-integer?
row : exact-integer?
align : (or/c 'lt 'ct 'rt 'lc 'cc 'rc 'lb 'cb 'rb) = 'cc
abs-x : real? = 0
abs-y : real? = 0
composer : procedure? = computed from align
```

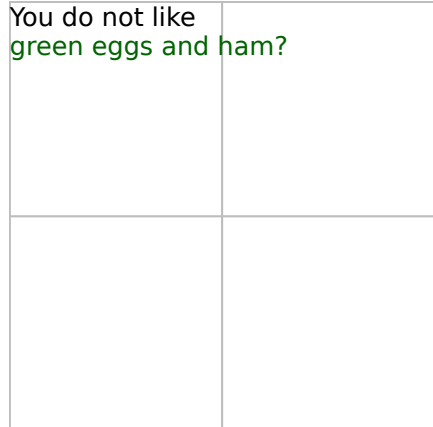
Returns a placer that places picts according to a position in a virtual grid. The `row` and `col` indexes are numbered starting at 1.

Uses of `grid` can be translated into uses of `coord`, but the translation depends on the alignment. For example, `(grid 2 2 1 1 'lt)` is equivalent to `(coord 0 0 'lt)`, but `(grid 2 2 1 1 'rt)` is equivalent to `(coord 1/2 0 'rt)`.

Examples:

```
> (define none-for-me-thanks
  (ppict-do base
    #:go (grid 2 2 1 1 'lt)
    (text "You do not like")
    (colorize (text "green eggs and
ham?" "darkgreen"))))
```

```
> none-for-me-thanks
```



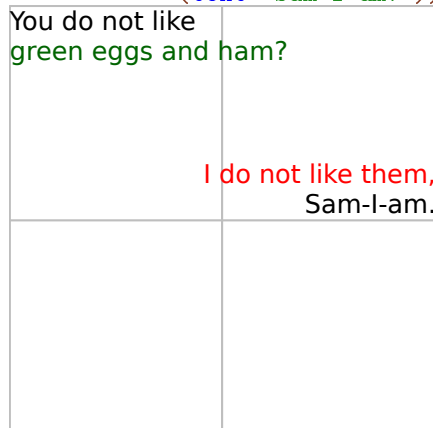
You do not like  
green eggs and ham?

```
> (ppict-do none-for-me-thanks
```

```
  #:go (grid 2 2 2 1 'rb)
```

```
  (colorize (text "I do not like them,") "red")
```

```
  (text "Sam-I-am."))
```



You do not like  
green eggs and ham?

I do not like them,  
Sam-I-am.

```
(cascade [step-x step-y]) → placer?
```

```
  step-x : (or/c real? 'auto) = 'auto
```

```
  step-y : (or/c real? 'auto) = 'auto
```

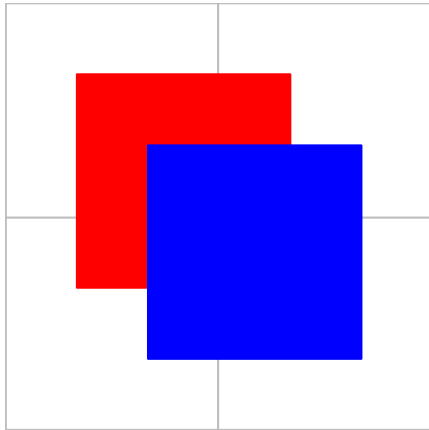
Returns a placer that places pict's by evenly spreading them diagonally across the base pict in “cascade” style. This placer does not support changing the spacing by including a real number within the pict sequence.

When a list pict's is to be placed, their bounding boxes are normalized to the maximum width and height of all pict's in the list; each pict is centered in its new bounding box. The pict's are then cascaded so there is *step-x* space between each of the pict's' left edges; there is also *step-x* space between the base pict's left edge and the first pict's left edge. Similarly for *step-y* and the vertical spacing.

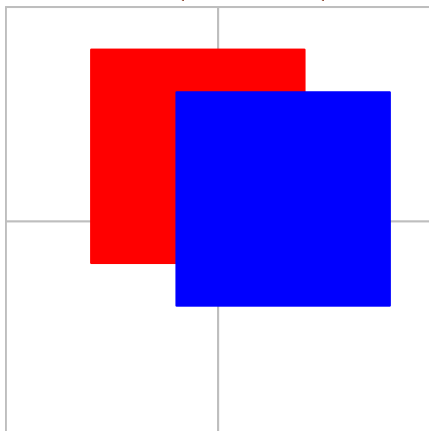
If *step-x* or *step-y* is 'auto', the spacing between the centers of the pict to be placed is determined automatically so that the inter-pict spacing is the same as the spacing between the last pict and the base.

Examples:

```
> (ppict-do base
    #:go (cascade)
    (colorize (filled-rectangle 100 100) "red")
    (colorize (filled-rectangle 100 100) "blue"))
```



```
> (ppict-do base
    #:go (cascade 40 20)
    (colorize (filled-rectangle 100 100) "red")
    (colorize (filled-rectangle 100 100) "blue"))
```

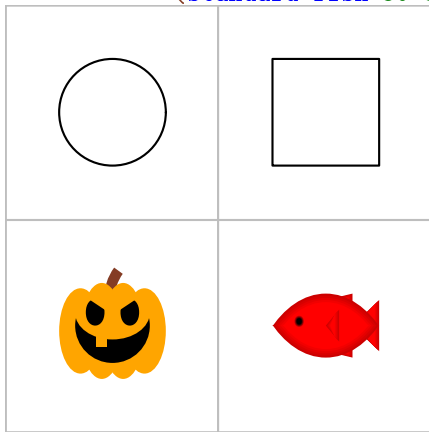


```
(tile cols rows) → placer?
  cols : exact-positive-integer?
  rows : exact-positive-integer?
```

Returns a placer that places picts by tiling them in a grid *cols* columns wide and *rows* rows high.

Example:

```
> (ppict-do base
    #:go (tile 2 2)
    (circle 50)
    (rectangle 50 50)
    (jack-o-lantern 50)
    (standard-fish 50 30 #:color "red"))
```



```
(at-find-pict find-path
  [finder
   align
   #:abs-x abs-x
   #:abs-y abs-y
   #:compose composer]) → refpoint-placer?

find-path : (or/c tag-path? pict-path?)
finder : procedure? = cc-find
align : (or/c 'lt 'ct 'rt 'lc 'cc 'rc 'lb 'cb 'rb) = 'cc
abs-x : real? = 0
abs-y : real? = 0
composer : procedure? = computed from align
```

Returns a placer that places picts according to a reference point based on an existing pict within the base.

Example:

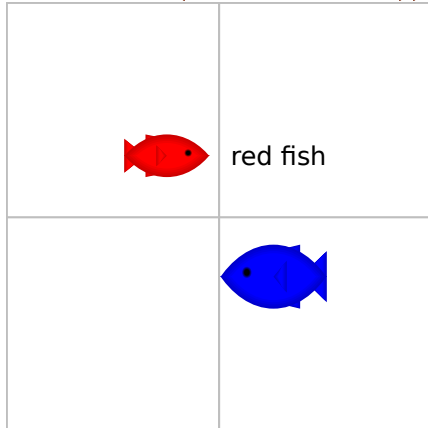
```
> (ppict-do base
    #:go (cascade)
    (tag-pict (standard-fish 40 20 #:direction 'right #:color "red") 'red-
fish))
```



```

        (tag-pict (standard-fish 50 30 #:direction 'left #:color "blue") 'blue-
fish)
        #:go (at-find-pict 'red-fish rc-find 'lc #:abs-x 10)
        (text "red fish"))

```



```

(merge-refpoints x-placer y-placer) → refpoint-placer?
  x-placer : refpoint-placer?
  y-placer : refpoint-placer?

```

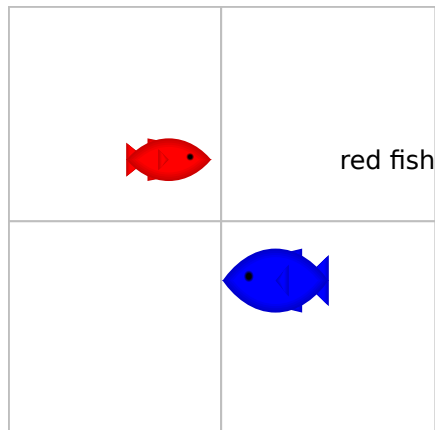
Returns a placer like *x-placer* except that the y-coordinate of its reference point is computed by *y-placer*.

Example:

```

> (ppict-do base
  #:go (cascade)
  (tag-pict (standard-fish 40 20 #:direction 'right #:color "red") 'red-
fish)
  (tag-pict (standard-fish 50 30 #:direction 'left #:color "blue") 'blue-
fish)
  #:go (merge-refpoints (coord 1 0 'rc)
    (at-find-pict 'red-fish))
  (text "red fish"))

```



### 28.5.2 Progressive Slides

```
(require unstable/gui/pslide)
| (pslide ppict-do-fragment ...)
```

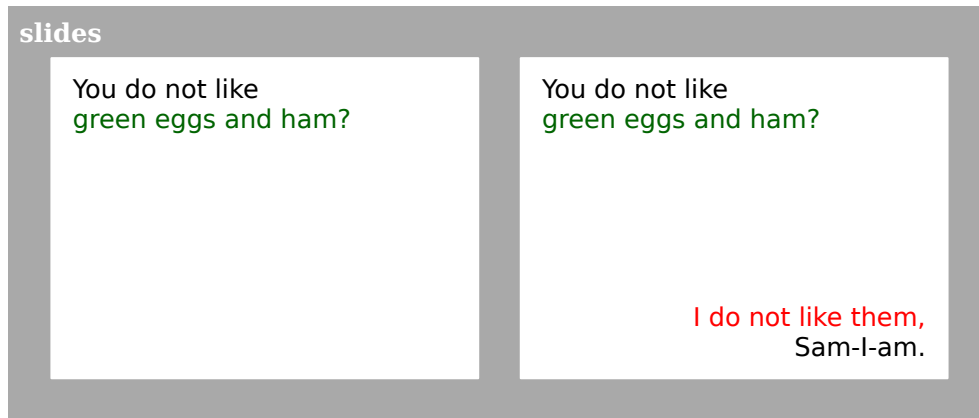
Produce slide(s) using progressive pict. See `ppict-do` for an explanation of *ppict-do-fragments*.

Note that like `slide` but unlike `ppict-do*`, the number of slides produced is one greater than the number of `#:next` uses; that is, a slide is created for the final pict.

Remember to include `gap-size` after updating the current placer if you want `slide`-like spacing.

Example:

```
> (pslide #:go (coord 0 0 'lt)
      (t "You do not like")
      (colorize (t "green eggs and ham?") "darkgreen")
      #:next
      #:go (coord 1 1 'rb)
      (colorize (t "I do not like them,") "red")
      (t "Sam-I-am."))
```



Note that the text is not flush against the sides of the slide, because `pslide` uses a base pict the size of the client area, excluding the margins.

```
(pslide-base-pict) → (-> pict)
(pslide-base-pict make-base-pict) → void?
make-base-pict : (-> pict)
```

Controls the initial pict used by `pslide`. The default value is

```
(lambda () (blank client-w client-h))
```

```
(pslide-default-placer) → placer?
(pslide-default-placer placer) → void?
placer : placer?
```

Controls the initial placer used by `pslide`. The default value is

```
(coord 1/2 1/2 'cc)
```

## 28.6 Snip Utilities

This library is *unstable*; compatibility will not be maintained. See *Unstable: May Change Without Warning* for more information.

```
(require unstable/gui/snip)
```

```
snip-canvas% : class?
superclass: editor-canvas%
```

A canvas that contains a single snip.

Snips cannot be placed directly on dialogs, frames and panels. To use an interactive snip (such as one returned by `plot-snip`) in a GUI, it must be inserted into an editor, which itself must be placed on a special canvas, which can be placed in a GUI container. To provide a seamless user experience, the editor should be enabled but not writable, not be able to receive focus, not have scrollbars, and other small details.

The `snip-canvas%` class handles these details, making it easy to use interactive snips as normal GUI elements.

```
(new snip-canvas%
  [parent parent]
  [make-snip make-snip]
  [[style style]
   [label label]
   [horizontal-inset horizontal-inset]
   [vertical-inset vertical-inset]
   [enabled enabled]
   [vert-margin vert-margin]
   [horiz-margin horiz-margin]
   [min-width min-width]
   [min-height min-height]
   [stretchable-width stretchable-width]
   [stretchable-height stretchable-height]])
→ (is-a?/c snip-canvas%)
parent : (or/c (is-a?/c frame%) (is-a?/c dialog%)
              (is-a?/c panel%) (is-a?/c pane%))
make-snip : ((integer-in 0 10000) (integer-in 0 10000) . -> . snip%)
              (listof (one-of/c 'no-border 'control-border 'combo
                                'resize-corner 'no-focus 'deleted
                                'transparent))
style :
= null
label : (or/c label-string? false/c) = #f
horizontal-inset : (integer-in 0 1000) = 5
vertical-inset : (integer-in 0 1000) = 5
enabled : any/c = #t
vert-margin : (integer-in 0 1000) = 0
horiz-margin : (integer-in 0 1000) = 0
min-width : (integer-in 0 10000) = 0
min-height : (integer-in 0 10000) = 0
stretchable-width : any/c = #t
stretchable-height : any/c = #t
```

Unlike instances of `editor-canvas%`, each instance of this class creates and

manages its own editor. The editor contains one object: a `snip%` instance created by `make-snip`.

The `make-snip` function receives the requested width and height of the snip, which are calculated from the size of the snip canvas. It is called the first time the snip canvas is resized, which most likely coincides with the first time the snip canvas is shown. The snip is thus created *lazily*: only when needed, at the size needed. See `on-size` for more details and an example.

The `style` list is prepended with `'no-hscroll` and `'no-vscroll` before being passed to the `editor-canvas%` constructor. The other constructor arguments are passed untouched.

```
(send a-snip-canvas get-snip) → (or/c (is-a?/c snip%) #f)
```

Returns the wrapped snip, or `#f` if `make-snip` has not been called yet.

```
(send a-snip-canvas on-size width height) → void?
width : (integer-in 0 10000)
height : (integer-in 0 10000)
```

Overrides `on-size` in `editor-canvas%`.

This is called when the snip canvas is resized.

On the first call, `on-size` calls `make-snip` with width and height arguments respectively `(max 0 (- width (* 2 horizontal-inset)))` and `(max 0 (- height (* 2 vertical-inset)))`. It then inserts the resulting snip into its editor.

On subsequent calls, `on-size` calls the snip's `resize` method, calculating the width and height arguments the same way.

When a `snip-canvas%` instance is intended to wrap an existing `snip%` instance, `make-snip` should simply resize it and return it.

Example: `plot-frame` and `plot3d-frame` create snips and call a function similar to the following to place them in a frame:

```
(define (make-snip-frame snip w h label)
  (define (make-snip width height)
    (send snip resize width height)
    snip)

  (define frame
    (new frame%
      [label label]
      [width (+ 5 5 5 5 w)]
      [height (+ 5 5 5 5 h)]))

  (new snip-canvas%
```

```
[parent frame]
[make-snip make-snip]
[horiz-margin 5] [vert-margin 5]
[horizontal-inset 5] [vertical-inset 5])

frame)
```