

Earn a Verified Certificate for this course!

Get Started





Language

[Help](#)

This page provides a summary of the Beginning Student Language (and later Intermediate and Advanced) we use in this course.

Values

- Numbers: 1, 3.5, 1/2, #i1.4142135623730951, ...
- Strings: "Marvolo", "Black", "carrot", ...
- Images: , ...
- Booleans: true, false
- Compound data: (make-person "Claude" "Monet"), ...
- Lists: empty, (cons 2 (cons 1 empty)), (cons "x" (cons "y" (cons "z" empty))), ...

NOTE: The primitive types are: Number, Integer, Natural (Integers greater than or equal to 0), String, Image and Boolean

2htdp/image also provides a primitive Color type

Primitive Operations

+, -, *, / ...

string-append, string-length, substring ...

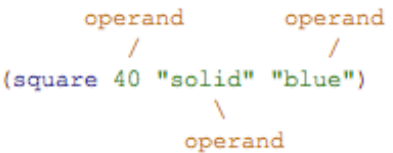
circle, square, overlay, above, beside...

not, =, <, >, string=?, string<?, image=?,

cons, first, rest, empty?, cons?

Forming Expressions

Form	Example
<value>	3
<name-of-defined-constant>	WIDTH
(<name-of-primitive-operation> <expression>...)	(+ 2 (* 3 6))

<pre>(<name-of-defined-function> <expression>...)</pre>  <p>A function call should have the same number of operands as parameters.</p>	<pre>(yell "hello")</pre>
<pre>(if <question> <true-answer> <false-answer>)</pre> <p><question> must be an expression that evaluates to a boolean. <true-answer> and <false-answer> must be expressions.</p>	<pre>(if (> (string-length x) 3) "long" "short")</pre>
<pre>(cond [<question> <answer>] ...)</pre> <p>Each <question> must be either else or an expression that evaluates to a boolean. Each <answer> must be an expression.</p>	<pre>(cond [(> x y) "more"] [(< x y) "less"] [else "same"])</pre>
<pre>(and <question> ...)</pre> <p>Each <question> must be an expression that evaluates to a boolean.</p>	<pre>(and (< 0 x) (>= x 10))</pre>
<pre>(or <question> ...)</pre> <p>Each <question> must be an expression that evaluates to a boolean.</p>	<pre>(or (< x 0) (> x 10))</pre>
<p><i>Intermediate Student Language</i></p> <pre>(local [<definition>...] <expression>)</pre> <p>Any function or constant defined within the local is valid within the entire body of the local expression, but not outside of the local expression.</p>	<pre>(local [(define DOT (circle 5 "solid" "red")) (define (add-dot img) (beside img DOT))] (add-dot <some-image>))</pre>

Forming Definitions

```
(define SIZE (* 3 6))           ;a constant definition, the value of SIZE is 18
```

```
(define (bulb c)                ;defines a function named bulb, with parameter c
  (circle 30 "solid" c))        ;this is the body of the function
```

```
(define-struct wand (wood core length)) ;defines the functions below:
```

```
; constructor: make-wand
; selectors:   wand-wood, wand-core, wand-length
; predicate:   wand?
```

Evaluation Rules

For a **constant reference**, such as `SIZE`:

- The constant reference evaluates to the defined value of the constant.

For a **call to a primitive** such as `(+ 2 (* 3 6))`:

- First reduce the operands to values: proceed left to right making sure all the operands are values, for any that are not, evaluate them.
These values are called the arguments to the primitive.
- Apply the primitive to those arguments.

For a **call to a defined function** such as `(bulb (string-append "r" "ed"))`:

- First reduce the operands to values (as for a call to a primitive). These values are called the arguments to the function.
- Replace the function call expression with the body of the function in which every occurrence of the parameter(s) has been replaced by the corresponding argument(s).

For example:

```
(bulb (string-append "r" "ed"))
(bulb "red")
(circle 30 "solid" "red")
```

For an **if expression**:

- If the question is not a value, evaluate it and replace it with its value.
- If the question is `true`, replace the entire if expression with the true answer expression.
- If the question is `false`, replace the entire if expression with the false answer expression
- If the question is a value other than `true` or `false`, signal an error

For example:

```

(if (> (+ 1 2) 3)
  (* 2 3)
  (* 3 4))      ;since (> (+ 1 2) 3) is an expression, not a value,
                ;evaluate it left to right

(if (> 3 3)
  (* 2 3)
  (* 3 4))

(if false
  (* 2 3)
  (* 3 4))

                ;replace entire if expression with the false answer expression
(* 3 4)

                ;evaluate false answer expression
12

```

For a **cond** expression:

- If there are no question/answer pairs, signal an error.
- If the first question is not a value, evaluate it and replace it with its value. That is, replace the entire `cond` with a new `cond` in which the first question has been replaced by its value.
- If the first question is `true` or `else`, replace the entire `cond` expression with the first answer.
- If the first question is `false` drop the first question/answer pair; that is, replace the `cond` with a new `cond` that does not have the first question/answer pair
- Since the first question is a value other than `true` or `false`, signal an error.
- If there are no question answer pairs signal an error.

For example:

```

(cond [(> 3 3) "more"]
      [< 3 3) "less"]
      [else "same"])

                ;the first question is not a value, the expression
                ;(> 3 3) is evaluated and replaced with a value

(cond [false "more"]
      [< 3 3) "less"]
      [else "same"])

                ;the first question is false, so the first
                ;question/answer pair is dropped

(cond [< 3 3) "less"]
      [else "same"])

                ;the first question is not a value, so (< 3 3)
                ;is evaluated and replaced with its value

(cond [false "less"]
      [else "same"])

```

```

;the first question is false, so the first
;question/answer pair is dropped

(cond [else "same"])

;since the question is else, the entire cond expression

;is replaced by the answer

"same"

```

For an **and** expression:

- If there are no expressions produce `true`.
- If the first expression is not a value, evaluate it and replace it with its value.
- If the first expression is `false` produce `false`
- If the first expression is `true` replace the entire `and` expression with an `and` expression without the first expression.
- If the first expression is a value other than `true` or `false`, signal an error.

For example:

```

(and (< 0 3)
      (< 3 10)) ;since (< 0 3) is an expression, not a value,
                ;evaluate it

(and true
      (< 3 10)) ;first expression is true, drop it from the and

(and (< 3 10)) ;now evaluate (< 3 10)

(and true)      ;now drop true

(and)           ;an empty and produces true

```

For an **or** expression:

- If there are no expressions produce `false`.
- If the first expression is not a value, evaluate it and replace it with its value.
- If the first expression is `true` produce `true`
- If the first expression is `false` replace the entire `or` expression with an `or` expression without the first expression.
- If the first expression is a value other than `true` or `false`, signal an error.

For example:

```

(or (< 14 0)
     (> 14 10)) ;since (< 14 0) is an expression, not a value,
                ;evaluate it

(or false
     (> 14 10)) ;first expression is false, drop it from the and

```

```
(or (> 14 10))    ;now evaluate (> 14 10)

(or true)         ;first expression is true so produce true

true
```

Intermediate Student Language

For a **local expression**:

- For each locally defined function or constant, rename it and all references to it to a globally unique name, and
- **in the same step** lift the local definition(s) to the top level with any existing global definitions, and
- **in the same step** replace the local expression with the body of the local in which all references to the defined functions and constants have been renamed.

For example:

```
(define b 1)
(+ b
  (local [(define b 2)]
    (* b b))
  b)

; b evaluates to its defined value, 1

(define b 1)
(+ 1
  (local [(define b 2)]
    (* b b))
  b)

; since b is a locally-defined constant,
; it is renamed to a globally unique name b_0
; the local definition of b_0 is lifted to
; the top level and the entire local expression
; is replaced it's body

(define b 1)
(define b_0 2)    ;---this renamed define was lifted

(+ 1
  (* b_0 b_0)      ;---entire local replaced by renamed body
  b)
```

```
;evaluation continues normally from this point
```

Built-In Abstract Functions

ISL and ASL have the following built-in abstract functions.

```
;; Natural (Natural -> X) -> (listof X)
;; produces (list (f 0) ... (f (- n 1)))
(define (build-list n f) ...)

;; (X -> boolean) (listof X) -> (listof X)
;; produce a list from all those items on lox for which p holds
(define (filter p lox) ...)

;; (X -> Y) (listof X) -> (listof Y)
;; produce a list by applying f to each item on lox
;; that is, (map f (list x-1 ... x-n)) = (list (f x-1) ... (f x-n))
(define (map f lox) ...)

;; (X -> boolean) (listof X) -> boolean
;; produce true if p produces true for every element of lox
(define (andmap p lox) ...)

;; (X -> boolean) (listof X) -> boolean
;; produce true if p produces true for some element of lox
(define (ormap p lox) ...)

;; (X Y -> Y) Y (listof X) -> Y
;; (foldr f base (list x-1 ... x-n)) = (f x-1 ... (f x-n base))
(define (foldr f base lox) ...)

;; (X Y -> Y) Y (listof X) -> Y
;; (foldl f base (list x-1 ... x-n)) = (f x-n ... (f x-1 base))
(define (foldl f base lox) ...)
```

Created Mon 11 Mar 2013 5:11 PM EDT (UTC -0400)

Last Modified Thu 12 Sep 2013 1:39 AM EDT (UTC -0400)