

Functional Programming 1: Recursion and Immutable Data

CS 350

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Overview

- Topic: Functional Programming in Racket and plait

Programming in CS 350

All coding for this class uses:

- The Racket Programming Language

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- The `plait` library for Racket

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- The Dr. Racket editor

Racket

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- Language for making languages

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- IDE for Racket

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 - see <https://docs.racket-lang.org/guide/other-editors.html>

Plait

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 - Declaring and pattern matching on data types
 - Type annotations for functions
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 - Has what you need to write programming languages
 - Not much else
 - You can do a lot with very little

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- Algebraic Data Types

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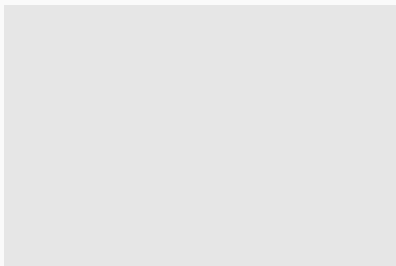
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 - Racket writes `(f x)`, not `f(x)`
- `x` is not the same as `(x)`
 - `x` gets the value of the variable `x`
 - `(x)` is calling a function named `x` with zero arguments



Numbers

(+ 2 7)

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(+ 2 7)

9

Numbers

```
(+ 2 7)  
(- 10 0.5)
```

9

Numbers

(+ 2 7)
(- 10 0.5)

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Numbers

(+ 2 7)
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(* 1/3 2/3)

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Numbers

```
(+ 2 7)  
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(* 1/3 2/3)  
(/ 1 1000000000000000.0)
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```

Booleans

```
(= (+ 2 3) 5)
(> (/ 0 1) 1)
(zero? (- (+ 1 2) (+ 3 0)))
(and (< 1 2) (> 1 0))
(or (zero? 1) (even? 3))
```

```
#t
```

```
#f
```

```
#t
```

```
#t
```

```
#f
```

Conditionals

- Conditionals are **expressions**, not statements

```
(if (< 2 3) "hello" "goodbye")  
(+ 3  
  (if (= 2 (+ 1 1))  
    3  
    40))
```

```
"hello"  
6
```

Conditionals

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- Boolean changes what the expression **is**, not what it does

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Functions

- Calling a function replaces variable with concrete argument

```
(define (addOne [x : Number]) : Number  
  (+ x 1))  
(addOne 10)
```

```
(define (isRemainder [x : Number]  
          [y : Number]  
          [remainder : Number])  
  : Boolean  
  (= remainder (modulo x y)))  
(isRemainder 10 3 1)  
(isRemainder 10 4 1)
```

```
11
```

```
#t
```

Functions (ctd.)

- General form:

```
(define (functionName  
    [argName : argType]  
    ...  
    [argNameN : argTypeN]) : returnType  
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- Later in the course we'll see another way of defining functions

Functional Thinking: Lists And Recursion

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 - Fast, memory efficient

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 - But lots aren't

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Further reference:

<http://hdp.org>, Matthew Flatt's Notes (URCourses)