

Discussion 10

Scheme, Scheme Lists

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Slides available at `teaching.aditbala.com`

Announcements

- Homework 7 due Thursday 11/3.
- Office hours on Thursday 11/3 12-5 are in Warren 101A (the small conference room).
- Submit midterm 2 regrade requests by Wednesday 11/9.

Scheme



Scheme

- What is Scheme?
 - Another programming language!
 - A dialect of Lisp (**LIS**t **P**rocessor)
- Allows us to bring together all of our previous knowledge
- Recursion based
 - No iterative loops!
 - Only recursion and tree recursion :)

Scheme Primitives

- What is a primitive?
 - Expressions that are simplified or cannot be divided up further
- What are some primitives
 - Numbers -> Floats, Integers
 - Booleans -> Truth-y values, False-y values
- NOTE
 - Everything other than `#f` will evaluate to `True` in Scheme

Scheme Primitives (Example)

```
scm> 1  
1  
scm> 2  
2  
scm> #t  
True  
scm> #f  
False
```

Defining Variables in Scheme

- How do we define variables in Scheme?
 - Use `define`
- `(define <variable name> <value>)`
 - `(define adit 10)`
 - `adit -> 10`
 - Evaluates `<value>` and binds the value to `<variable name>` in the current environment.
- `'`
 - Accesses the `<variable name>` but not the value
 - Useful for when you don't want to modify the or evaluate the `<variable name>`

WWSD (Primitives and Defining Variables)

Scheme Call Expressions

- What are Call Expressions?
 - How we invoke functions
- (`<operator>` `<operand>`)
 - `<operator>` comes first (different than Python)
(+ 1 2)
- How do we evaluate?
 - Same as Python
 - Evaluate `<operator>`, `<operand>`, and then apply `<operator>` to `<operands>`

WWSD (Call Expressions)

Scheme Special Forms

- What are Special Forms?
 - Look like Call Expressions, but behave slightly differently
- What do they look like?
 - `define`, `if`, `cond`, `and`, `or`, `lambda`, `begin`, `else`

Scheme `if`

- `(if <predicate> <if-true> [if-false])`
 - Evaluate `<predicate>`
 - if `<predicate>` is truth-y
 - evaluate `<if-true>`
 - if `<predicate>` is false-y
 - evaluate `<if-false>`
- `(if (< 4 5) 1 2)`
- `1`

Scheme cond

- `(cond (<pred1> <if-pred1>) ... (<predn> <if-predn>) [(else <else-expression>)])`
 1. Evaluate the predicates `<pred1>`, `<pred2>`, ..., `<predn>` in order until you reach one that evaluates to a truth-y value, then return corresponding `<if-predn>`.
 2. If none of the predicates are truth-y and there is an else clause, evaluate and return `<else-expression>`.
- `(cond ((< 4 5) 1) (else 2))`
- 1

Scheme Booleans

- `and`, `or`, `not`
 - Similar to Python (short-circuits)
- Equivalence
 - `=` -> numbers
 - `eq?` -> check if same object (`is`)
 - `equal?` -> check if contents are the same (`==`)

Scheme Lambdas

- All functions are Lambdas in Scheme!

```
scm> (define square (lambda (x) (* x x)))  
square  
scm> (define (square x) (* x x))           ; Same as above  
square  
scm> square  
(lambda (x) (* x x))  
scm> (square 4)  
16
```

Q1: Virahanka-Fibonacci

```
def virfib(n):  
    if n == 0 or n == 1:  
        return n  
    return virfib(n - 1) + virfib(n - 2)
```


Scheme Lists

- What are Scheme lists?
 - Linked Lists!!!
- Syntax difference
 - `car <any value> / Link.first`
 - `cdr <nil or another Scheme list> / Link.rest`

```
scm> nil
()
scm> (define lst (cons 1 (cons 2 (cons 3 nil))))
lst
scm> lst
(1 2 3)
scm> (car lst)
1
scm> (cdr lst)
(2 3)
```

Scheme Lists (Creation)

- `(cons <first> <rest>)`
 - `<rest>` must be another list or `nil`
- `(list <item1> ... <itemn>)`
 - Returns a list with the `<item1> ... <itemn>` in order as its elements.
- ``(<expr>)` or `(quote <expr>)`
 - Returns the list exactly as typed, without evaluating any of the individual elements (different than `list` and `cons`)

`=, eq?, equal?`

- `(= <a>)`
 - returns if `a` equals `b`, both must be numbers
- `(eq? <a>)`
 - returns if `a` and `b` are equivalent primitive values, or are the same object, like `is` in Python
- `(equal? <a>)`
 - returns if `a` and `b` are *pairs/lists* that have the same contents, like `==` in Python, if `a` and not `b`, behaves like `eq?`

Worksheet

Thank you!!!

Anon Feedback -> <https://tinyurl.com/adit-anon>