Homework 7: Scheme **hw07.zip (hw07.zip)**

Due by 11:59pm on Thursday, April 4

Instructions

Download hw07.zip (hw07.zip). Inside the archive, you will find a file called hw07.scm (hw07.scm), along with a copy of the `ok` autograder.

Submission: When you are done, submit the assignment by uploading all code files you've edited to Gradescope. You may submit more than once before the deadline; only the final submission will be scored. Check that you have successfully submitted your code on Gradescope. See Lab 0 (/~cs61a/sp24/lab/lab00#task-c-submitting-the-assignment) for more instructions on submitting assignments.

Using Ok: If you have any questions about using Ok, please refer to this guide. (/~cs61a/sp24/articles/using-ok)

Readings: You might find the following references useful:

- Scheme Specification (/~cs61a/sp24/articles/scheme-spec/)
- Scheme Built-in Procedure Reference (/~cs61a/sp24/articles/scheme-builtins/)

Grading: Homework is graded based on correctness. Each incorrect problem will decrease the total score by one point. **This homework is out of 2 points.**

The 61A Scheme interpreter is included in each Scheme assignment. To start it, type `python3 scheme` in a terminal. To load a Scheme file called `f.scm`, type `python3 scheme -i f.scm`. To exit the Scheme interpreter, type `(exit)`.

Scheme Editor

All Scheme assignments include a web-based editor that makes it easy to run ok tests and visualize environments. Type `python3 editor` in a terminal, and the editor will open in a browser window (at `http://127.0.0.1:31415/`). To stop running the editor and return to the command line, type `Ctrl-C` in the terminal where you started the editor.

The `Run` button loads the current assignment's `.scm` file and opens a Scheme interpreter, allowing you to try evaluating different Scheme expressions.

The `Test` button runs all ok tests for the assignment. Click `View Case` for a failed test, then click `Debug` to step through its evaluation.

Recommended VS Code Extensions

If you choose to use VS Code as your text editor (instead of the web-based editor), install the vscode-scheme (https://marketplace.visualstudio.com/items?itemName=sjhuangx.vscode-scheme) extension so that parentheses are highlighted.

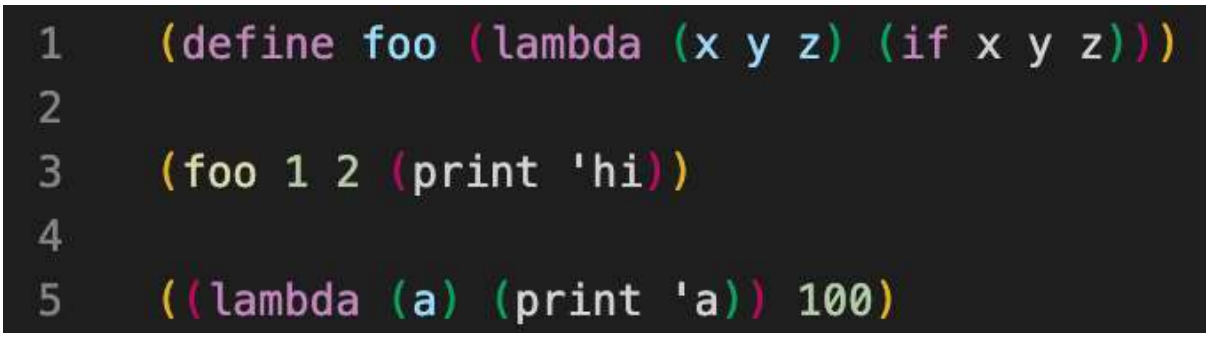
Before:

```
(define foo (lambda (x y z) (if x y z)))

(foo 1 2 (print 'hi))

((lambda (a) (print 'a)) 100)
```

After:



In addition, the 61a-bot (installation instructions (/~cs61a/sp24/articles/61a-bot)) VS Code extension is available for Scheme homeworks. The bot is also integrated into `ok`.

Required Questions

Getting Started Videos

Q1: Pow

Implement a procedure `pow` that raises a `base` to the power of a nonnegative integer `exp`. The number of recursive `pow` calls should grow logarithmically with respect to `exp`, rather than linearly. For example, `(pow 2 32)` should result in 5 recursive `pow` calls rather than 32 recursive `pow` calls.

> *Hint:*
>
> 1. $x^{2y} = (x^y)^2$
> 2. $x^{2y+1} = x(x^y)^2$
>
> For example, $2^{16} = (2^8)^2$ and $2^{17} = 2 * (2^8)^2$.
>
> You may use the built-in predicates `even?` and `odd?`. Also, the `square` procedure is defined for you.
>
> Scheme doesn't have `while` or `for` statements, so use recursion to solve this problem.

```
(define (square n) (* n n))

(define (pow base exp)
  'YOUR-CODE-HERE
)
```

Use Ok to test your code:

```
python3 ok -q pow
```

Q2: Repeatedly Cube

Implement `repeatedly-cube`, which receives a number `x` and cubes it `n` times.

Here are some examples of how `repeatedly-cube` should behave:

```
scm> (repeatedly-cube 100 1) ; 1 cubed 100 times is still 1
1
scm> (repeatedly-cube 2 2) ; (2^3)^3
512
scm> (repeatedly-cube 3 2) ; ((2^3)^3)^3
134217728
```

> For information on `let`, see the Scheme spec (/~cs61a/sp24/articles/scheme-spec/#let).

```
(define (repeatedly-cube n x)
    (if (zero? n)
        x
        (let
            (__________________)
            (* y y y))))
```

Use Ok to test your code:

```
python3 ok -q repeatedly-cube
```

Q3: Cadr

Note: *Scheme lists are covered in the lecture videos for Wednesday, April 3.*

Define the procedure `cadr`, which returns the second element of a list. Also define `caddr`, which returns the third element of a list.

```
(define (cddr s)
  (cdr (cdr s)))

(define (cadr s)
  'YOUR-CODE-HERE
)

(define (caddr s)
  'YOUR-CODE-HERE
)
```

Use Ok to test your code:

```
python3 ok -q cadr-caddr
```