# Homework 8: Scheme **hw08.zip (hw08.zip)**

*Due by 11:59pm on Thursday, November 17*

## Instructions

Download hw08.zip (hw08.zip). Inside the archive, you will find a file called hw08.scm (hw08.scm), along with a copy of the `ok` autograder.

**Submission:** When you are done, submit with `python3 ok --submit`. 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 okpy.org (https://okpy.org/). See Lab 0 (/lab/lab00#submitting-the-assignment) for more instructions on submitting assignments.

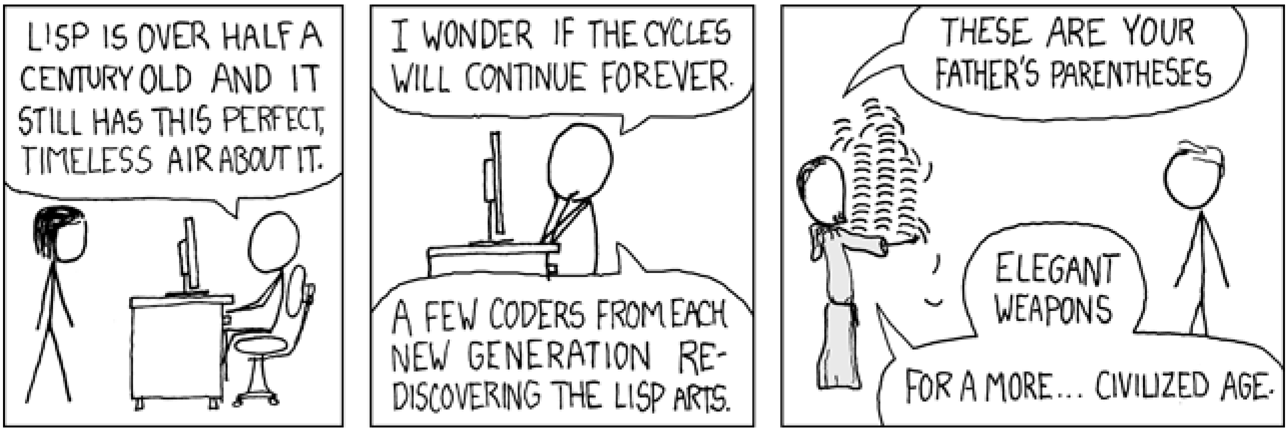
**Using Ok:** If you have any questions about using Ok, please refer to this guide. (/articles/using-ok)

**Readings:** You might find the following references useful:

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

**Grading:** Homework is graded based on correctness. Each incorrect problem will decrease the total score by one point. There is a homework recovery policy as stated in the syllabus. **This homework is out of 2 points.**

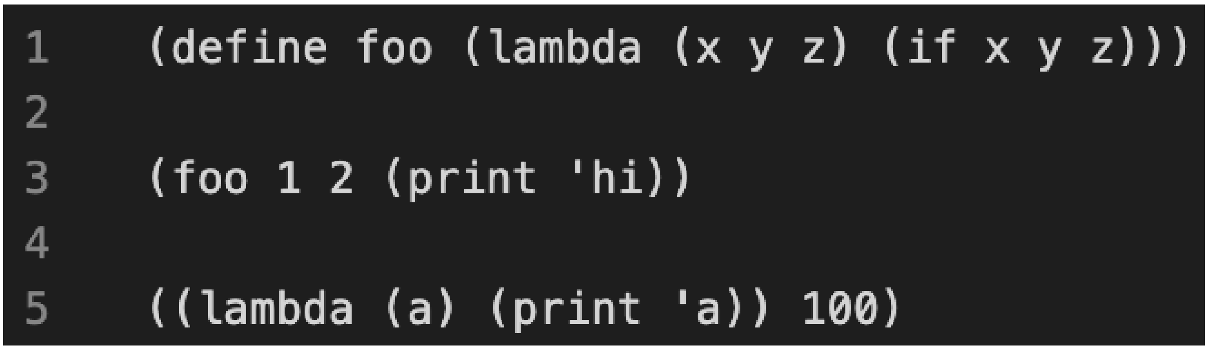
Scheme is a famous functional programming language from the 1970s. It is a dialect of Lisp (which stands for LISt Processing). The first observation most people make is the unique syntax, which uses a prefix notation and (often many) nested parentheses (see http://xkcd.com/297/ (http://xkcd.com/297/)). Scheme features first-class functions and optimized tail-recursion, which were relatively new features at the time.


LISP IS OVER HALF A CENTURY OLD AND IT STILL HAS THIS PERFECT, TIMELESS AIR ABOUT IT.
I WONDER IF THE CYCLES WILL CONTINUE FOREVER.
A FEW CODERS FROM EACH NEW GENERATION RE-DISCOVERING THE LISP ARTS.
THESE ARE YOUR FATHER'S PARENTHESES
ELEGANT WEAPONS
FOR A MORE... CIVILIZED AGE.

# Recommended VSCode Extensions

If you use VSCode as your text editor, we have found these extensions to be quite helpful for Scheme :)

Before:

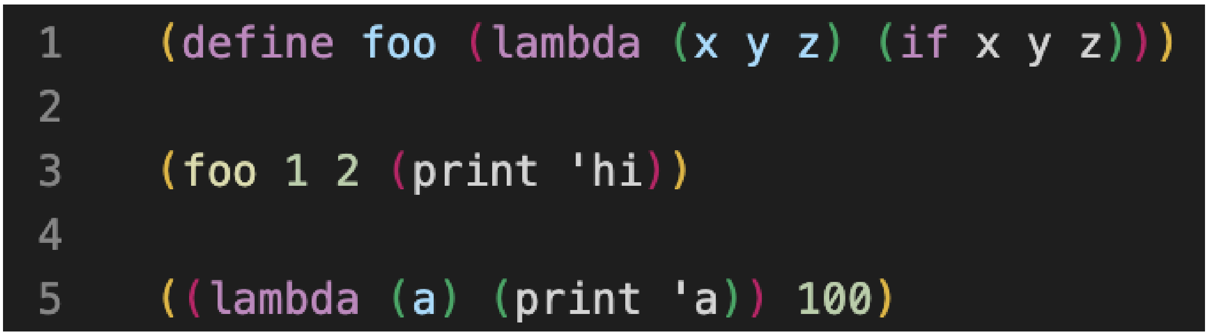


```
(define foo (lambda (x y z) (if x y z)))

(foo 1 2 (print 'hi))

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

After:



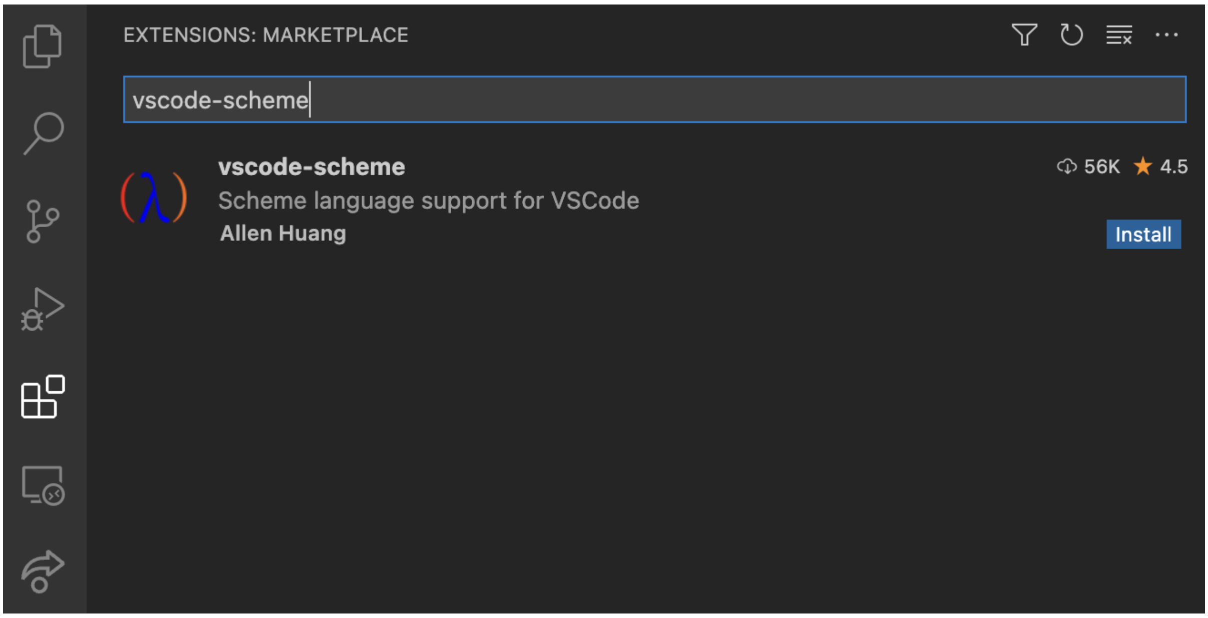
```
(define foo (lambda (x y z) (if x y z)))

(foo 1 2 (print 'hi))

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

**Extensions**:

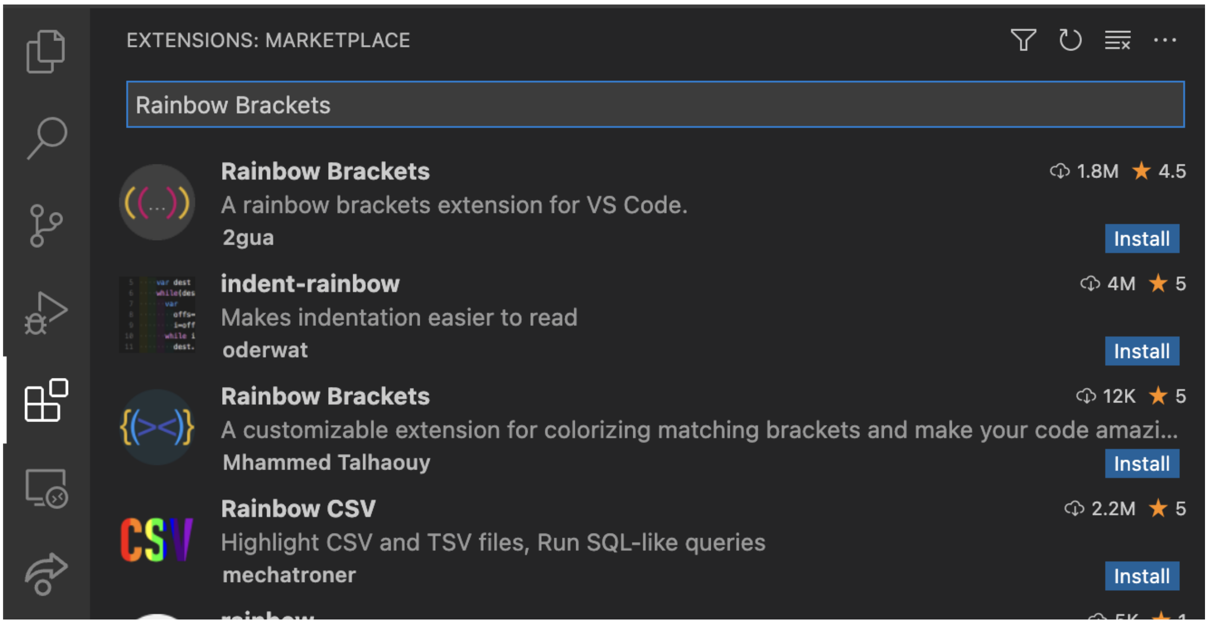
**vscode-scheme (https://marketplace.visualstudio.com/items?itemName=sjhuangx.vscode-scheme)**



vscode-scheme

vscode-scheme
Scheme language support for VSCode
Allen Huang

**Rainbow Brackets (https://marketplace.visualstudio.com/items?itemName=2gua.rainbow-brackets)**



EXTENSIONS: MARKETPLACE

Rainbow Brackets

Rainbow Brackets — 1.8M ★ 4.5
A rainbow brackets extension for VS Code.
2gua — Install

indent-rainbow — 4M ★ 5
Makes indentation easier to read
oderwat — Install

Rainbow Brackets — 12K ★ 5
A customizable extension for colorizing matching brackets and make your code amazi...
Mhammed Talhaouy — Install

Rainbow CSV — 2.2M ★ 5
Highlight CSV and TSV files, Run SQL-like queries
mechatroner — Install

You may find it useful to try code.cs61a.org/scheme (https://code.cs61a.org/scheme) when working through problems, as it can draw environment and box-and-pointer diagrams and it lets you walk your code step-by-step (similar to Python Tutor). Don't forget to submit your code through Ok though!

## Scheme Editor

You can write your code by either opening the designated `.scm` file in your text editor, or by typing directly in the Scheme Editor, which can also be useful for debugging. To run this editor, run `python3 editor`. This should pop up a window in your browser; if it does not, please navigate to localhost:31415 (localhost:31415) while `python3 editor` is still running and you should see it. If you choose to code directly in the Scheme Editor, don't forget to save your work before running Ok tests and before closing the editor. To stop running the editor and return to the command line, type `Ctrl-C`.

Make sure to run `python3 ok` in a separate tab or window so that the editor keeps running.

If you find that your code works in the online editor but not in your own interpreter, it's possible you have a bug in your code from an earlier part that you'll have to track down. Every once in a while there's a bug that our tests don't catch, and if you find one you should let us know!

# Required Questions

Getting Started Videos

## Q1: My Filter

Write a procedure `my-filter`, which takes a predicate `pred` and a list `s`, and returns a new list containing only elements of the list that satisfy the predicate. The output should contain the elements in the same order that they appeared in the original list.

**Note:** Make sure that you are not just calling the built-in `filter` function in Scheme - we are asking you to re-implement this!

```
(define (my-filter pred s)
  'YOUR-CODE-HERE
)
```

Use Ok to unlock and test your code:

```
python3 ok -q filter -u
python3 ok -q filter
```

## Q2: Interleave

Implement the function `interleave`, which takes a two lists `lst1` and `lst2` as arguments. `interleave` should return a new list that interleaves the elements of the two lists. (In other words, the resulting list should contain elements alternating between `lst1` and `lst2`.)

If one of the input lists to `interleave` is shorter than the other, then `interleave` should alternate elements from both lists until one list has no more elements, and then the remaining elements from the longer list should be added to the end of the new list.

```
(define (interleave lst1 lst2)
  'YOUR-CODE-HERE
)
```

Use Ok to unlock and test your code:

```
python3 ok -q interleave -u
python3 ok -q interleave
```

## Q3: Accumulate

Fill in the definition for the procedure `accumulate`, which joins the first `n` natural numbers (ie. 1 to n, inclusive) according to the following parameters:

1. `joiner`: a function of two arguments

2. `start` : a number with which we start joining
3. `n` : the number of natural numbers to join
4. `term` : a function of one argument that computes the *n*th term of a sequence

For example, we can find the product of all the numbers from 1 to 5 by using the multiplication operator as the `joiner` , and starting our product at 1:

```
scm> (define (identity x) x)
scm> (accumulate * 1 5 identity)  ; 1 * 1 * 2 * 3 * 4 * 5
120
```

We can also find the sum of the squares of the same numbers by using the addition operator as the `joiner` and `square` as the `term` :

```
scm> (define (square x) (* x x))
scm> (accumulate + 0 5 square)  ; 0 + 1^2 + 2^2 + 3^2 + 4^2 + 5^2
55
scm> (accumulate + 5 5 square)  ; 5 + 1^2 + 2^2 + 3^2 + 4^2 + 5^2
60
```

You may assume that the `joiner` will always be commutative: i.e. the order of arguments do not matter.

```
(define (accumulate joiner start n term)
  'YOUR-CODE-HERE
)
```

Use Ok to unlock and test your code:

```
python3 ok -q accumulate -u
python3 ok -q accumulate
```

## Q4: No Repeats

Implement `no-repeats` , which takes a list of numbers `lst` as input and returns a list that has all of the unique elements of `lst` in the order that they first appear, but no repeats. For example, `(no-repeats (list 5 4 5 4 2 2))` evaluates to `(5 4 2)` .

> **Hint:** How can you make the first time you see an element in the input list be the first and only time you see the element in the resulting list you return?

> **Hint:** You may find it helpful to use the `my-filter` procedure with a helper `lambda` function to use as a filter. To test if two numbers are equal, use the `=` procedure. To test if two numbers are not equal, use the `not` procedure in combination with `=`.

```
(define (no-repeats lst)
  'YOUR-CODE-HERE
)
```

Use Ok to unlock and test your code:

```
python3 ok -q no_repeats -u
python3 ok -q no_repeats
```