

# CS302: Paradigms of Programming

Spring 2021

## PA1: Functional Programming using Lists

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In this assignment, the objective is to get used to functional programming with Scheme. Though not necessary, try writing as modular programs as possible. We would soon look at a few list functions, particularly `cons`, `car` and `cdr`, which will help you solve the problems.

### 1 Questions

**Q1 [3].** Write a higher order function `make-qsort` that takes a comparison function (e.g., `<` or `>`) as input and returns a function that could be used to sort a given list of elements using quick-sort technique. For example:

- `(make-qsort <)` should return a procedure that when given the list `'(5 4 2 9 8 4 3 7 6)` as input returns `'(2 3 4 4 5 6 7 8 9)`.
- `(make-qsort >)` should return a procedure that when given the list `'(5 4 2 9 8 4 3 7 6)` as input returns `'(9 8 7 6 5 4 4 3 2)`.

**Q2 [3].** Imagine the following game: You are given a path that consists of black and white squares. You start on the leftmost square (say square 1) and your goal is to move off the right end of the path in the least number of moves. Here are the rules:

- If you are on a white square, you can move either 1 or 2 squares to the right.
- If you are on a black square, you can move either 1 or 4 squares to the right.

Write a function `fewest-moves` that takes a path represented as a list of 0s and 1s (where 0 represents black and 1 represents white) and computes the minimum number of moves. For example:

`(fewest-moves '(1 0 1 1 1 0 1 1 0 1 0 1 1 0 0 1 1 1))` returns 6 and is obtained by stepping on the squares at positions 1, 2, 6, 10, 11 and 15.

(You may get some inspiration from the *counting change* example of SICP; see Section 1.2.)

**Q3 [4].** Write a function `filter-all` that takes a list of predicates, a lower bound and an upper bound (in order), and returns a list of integers in the (inclusive) range that satisfy all the predicates. For example, if the list of predicates consists of two functions `is-positive` and `is-prime` that respectively check for positiveness and primeness, the lower bound as `-4`, and the upper bound as `10`, then the returned list should be `'(2 3 5 7)`.

## 2 Submission

Your submission must be named `rollnum-pa1.zip`, where `rollnum` is your roll-number in small letters. Upon unzipping the submission, we should get a directory named `rollnum-pa1`. This directory should contain three files: `q1.scm`, `q2.scm` and `q3.scm`, containing the solutions to Q1, Q2 and Q3, respectively.

## 3 Plagiarism Warning

The assignment has to be done individually. Any hint of plagiarism will lead to serious implications.