

CMPE 326 Programming Languages

Homework 3

Due Date: 31-May-2020 23:59

Problem

In this assignment, you are going to write a Scheme program that finds the correct movements in a path.

Figure 1 shows an example path, which has a grid layout. In the grid, black cells are simply walls, which are basically obstacles for you. You can move among the white cells and you cannot pass the boundaries of the grid. In each path, the starting location will be the square of [0,0]. Additionally, there is also one white cell labeled with F. This label shows the finish square of the path. So, your aim is to find the movements from the starting location to the finish location. To this end, you can move in 4 directions; up, down, left, right. These 4 directions will be represented by characters U, D, L, and R, respectively.

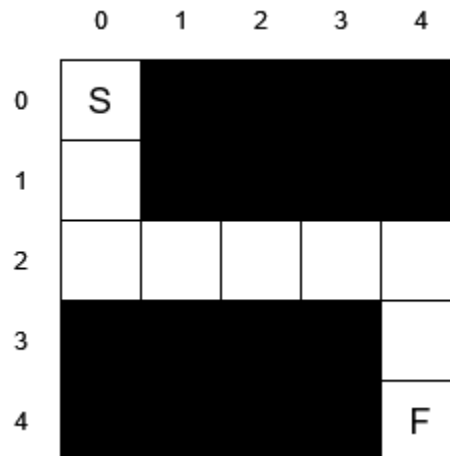


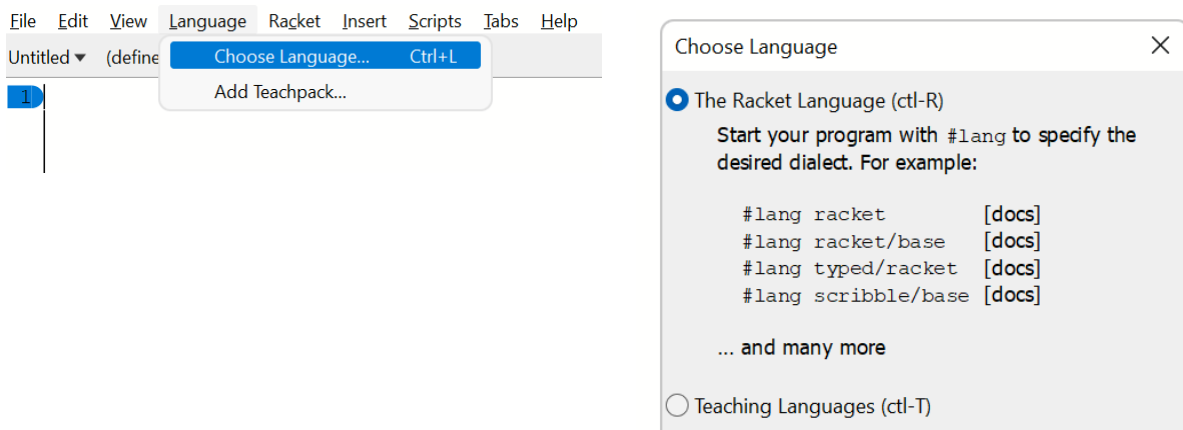
Figure 1: Sample Path

The solution for the path shown in Figure 1 is "D D R R R R D D", which means move down 2 times, then move right 4 times and move down 2 times. The path is not a maze! It is a simple one way road and It has only one solution: there is always one possible next square for each move.

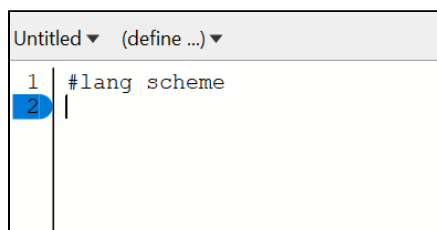
Environment Setup

You will use the Racket Scheme interpreter for this homework. Please do the following:

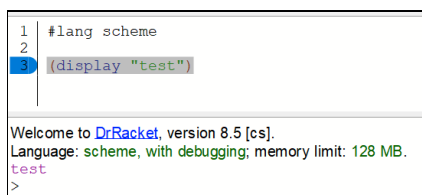
1. Download and install the Racket application from the link: <https://download.racket-lang.org/>
2. Open the Racket program and set the language to "The Racket Language" following the Language -> Choose Language from the menu as shown below:



3. In order to set the Scheme interpreter, you have to write `#lang scheme` at the beginning of every file:



You are ready to write Scheme programs. You can evaluate your code with the "Run" button on the top right.



Try writing `(display "test")` and press the Run button to see the result.

Tasks

In Scheme, a path will be represented in the form of a **linked-list**. Figure 2 shows how the path in Figure 1 is represented in terms of a linked list in Scheme. Starting cell [0,0] has the letter S, the finishing cell has the letter F and empty cells have the letter E. The walls have the letter - (minus).

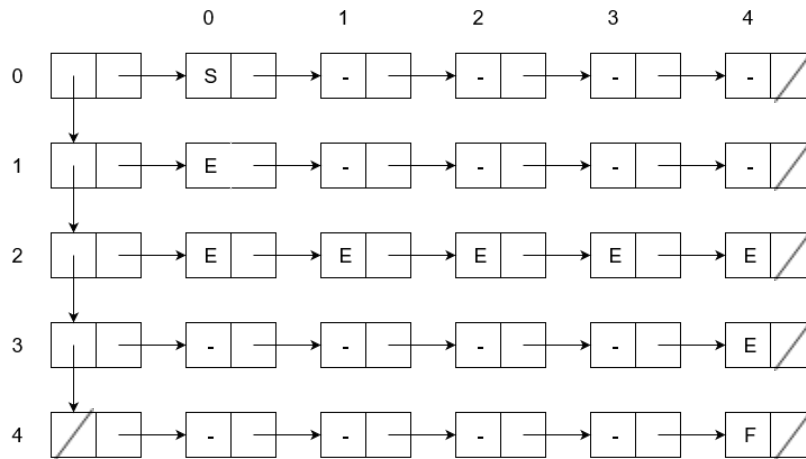


Figure 2 - Linked List representation of the path shown in Figure 1

The following function "buildPath" on the left is given for you which takes a list of lists and creates a path (grid) using the lists. You can use this function to create different paths in order to test your code. On the right the code shows how the path in Figure 2 is created.

```
(define (buildPath rows)
  (cond
    ((null? rows) null)
    (else (cons (buildPath (cdr rows))
                  (car rows)))))
```

Scheme code for creating a path

```
(define sample-path (buildPath
  ' ( ("S" "-" "-" "-" "-")
      ("E" "-" "-" "-" "-")
      ("E" "E" "E" "E" "E")
      ("- " "-" "-" "-" "E")
      ("- " "-" "-" "-" "F")))))
```

Scheme code of the sample path in Figure 2

Task 1: Define two functions "getHeight" and "getWidth" which takes a path as an input and returns the height and the width of the path.

(getHeight sample-path) → should return 5

(getWidth sample-path) → should return 5

Task 2: Define a function "getLetter" which takes a path, a row number and a column number. Then it returns the letter from the path on the corresponding location [row, column]

(getLetter sample-path 0 0) → should return S

(getLetter sample-path 1 0) → should return E

(getLetter sample-path 1 1) → should return -

(getLetter sample-path 4 4) → should return F

Task 3: Define a function "solvePath" which takes a path and returns the solution for the path.

(solvePath sample-path) → should return (D D R R R R D D)

Submission Notes

- Each person must submit **his or her own work**.
- You have to submit one file having the name "studentNumber_studentName.rkt" containing at least "getHeight", "getWidth", "getLetter" and "solvePath" functions. If you use additional functions, don't forget to add them too, otherwise your code won't run.
- Information about submitting your homework via LMS will be provided by your teaching assistant.
- Your program will be evaluated using the same Racket Scheme interpreter that you used on your development
- Your program will be tested on different paths with different sizes.
- You may be asked for a demo session.
- There are going to be 2 Zoom sessions for your questions on 18/05/2022 and 24/05/2022. The times are going to be announced by your teaching assistant
- Your submission will be graded w.r.t. the maximum points calculated according to the following formula: $100 - (2^{\text{NumOfLateDays}} \times 5)$