CS 2SC3 and SE 2S03

McMaster University, Fall 2009

Assignment 3

Instructor: William M. Farmer

Revised: 23 October 2009

Files due: 30 October 2009

1 Overview

The purpose of this programming assignment is to create a mutable data structure for storing vectors using records, arrays, and exceptions.

2 Background

For the purposes of this assignment, let us define a *vector store* to be a data structure that holds a finite sequence of vectors ordered by magnitude from smallest to largest. A vector store can be represented by an array a of vectors and an integer n called the *size* of the store. n is the number of vectors held in a and is less than or equal to the length of a. That is, the sequence of vectors stored in a is $a.(0), a.(1), \ldots, a.(n-1)$.

3 Requirements

3.1 Program Requirements

Write an OCaml program that includes:

1. The definition of a type `vector` as a type of records with two immutable fields `x` and `y` of type `float` such that the pair (`x`, `y`) represents a vector in 2-dimensional Euclidean space.

2. A function named `vec_mag` of type

   ```
   vector -> float
   ```

   that maps a vector to its magnitude.

3. A vector store data structure defined by the following:

   (a) A type `vec_store` defined as a type of records with mutable fields `seq` of type `vector array` and `size` of type `int`.

(b) A variable named `max_seq_length` of type `int` bound to some positive integer ≥ 100 (chosen by you) that serves as a constant. Its value is the maximum allowable length for the `seq` field in a vector store.

(c) Two exceptions `Out_of_bounds` and `Vec_store_full`.

(d) A constructor `make_vec_store` of type

```
unit -> vec_store
```

that constructs an empty vector store where the array has length `max_seq_length` and the size is 0.

(e) A selector named `get_vec` of type

```
vec_store -> int -> vector
```

such that `get_vec` s i gets the ith vector in s. If i is negative or greater than s.`size` $- 1$, the `Out_of_bounds` exception is raised.

(f) A mutator named `delete_vec` of type

```
vec_store -> int -> unit
```

such that `delete_vec` s i deletes the ith vector in s (and thus decrements the size of s). If i is negative or greater than s.`size` $-$ 1, the `Out_of_bounds` exception is raised.

(g) A mutator named `insert_vec` of type

```
vec_store -> vector -> unit
```

such that `insert_vec` s v inserts vector v into s (and thus increments the size of s). If the size of s is `max_seq_length`, the `Vec_store_full` is raised.

(h) The vectors in s are stored in the cells indexed by 0 to s.`size` $- 1$ and ordered by magnitude from smallest to largest. (The order is preserved by the mutators.)

4. Code that tests the implementation of the vector store by making a representative series of calls to the constructor, selector, and mutators. The results of these calls is printed out when the program is executed. The testing code should catch the `Out_of_bounds` and `Vec_store_full` exceptions.

3.2 Submission Requirements

Put your program in a file named `prog3.ml`, and put a copy of your log book in a file named `log3.txt`. (Make sure that the files are named exactly as specified. Case matters!) Put your name and MacID at the top of each of these files. Create a directory named `assign3`. Put the files `prog3.ml` and `log3.txt` into this directory. Using subversion, import this directory into your directory in the course subversion repository at `https://websvn.mcmaster.ca/se2s03`

Your files must be submitted no later than **10:30 a.m. on Friday, October 30, 2009.**

4 Marking Scheme

This assignment is worth 100 points allocated as follows:

1. **Objective** (checked automatically by software)

   (a) Program file is present **_____/10 pts.**
   (b) Program compiles **_____/10 pts.**
   (c) Program runs **_____/10 pts.**
   (d) Program prints test results **_____/10 pts.**
   (e) Program passes objective tests **_____/20 pts.**

2. **Subjective** (assessed by TAs)

   (a) Program satisfies the requirements **_____/20 pts.**
   (b) Choice of test inputs **_____/10 pts.**
   (c) Quality of print out of test results **_____/10 pts.**
   (d) Style (comments only)

3. **Penalties**

   (a) Missing or substandard log book **_____/-10 pts.**

Notes:

1. A program that is submitted late will receive 0 points.

2. Your program must compile and execute correctly on mills to receive full marks.

3. Your program must be your own work.

5 Extra Challenges

1. Do the assignment over using a different representation for a vector store. For example, the sequence of vectors in the store can be represented by a list or a function.

2. Do the assignment over with a vector store defined as a data structure that holds a queue of vectors.