# CS 2SC3 and SE 2S03

# McMaster University, Fall 2009

# Assignment 5

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**Files due: 27 November 2009**

## 1   Overview

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

## 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 a C program that includes:

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

2. A function named `vec_mag` of type

    $$\texttt{vector} \rightarrow \texttt{double}$$

    that maps a vector to its magnitude.

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

    (a) A macro named `MAX_SEQ_LENGTH` set equal to some positive integer $\geq 100$ (chosen by you) that serves as a constant. Its value is the maximum allowable length for the `seq` field in a vector store.

(b) A type `vec_store` defined as a type of pointers to records with mutable fields `seq` of type `vector [MAX_SEQ_LENGTH]` and `size` of type `int`.

(c) A constructor `make_vec_store` of type

$$\rightarrow \texttt{vec\_store}$$

that constructs an empty vector store where the size is 0.

(d) A selector named `get_vec` of type

$$\texttt{vec\_store,int} \rightarrow \texttt{vector}$$

such that (1) `get_vec`$(s, i)$ gets the $i$th vector in $s$ if $0 \leq i \leq$ `s->size` $- 1$ and (2) prints an error message that $i$ is out of bounds if $i < 0$ or `s->size` $- 1 < i$.

(e) A mutator named `delete_vec` of type

$$\texttt{vec\_store,int} \rightarrow \texttt{void}$$

such that (1) `delete_vec`$(s, i)$ deletes the $i$th vector in $s$ (and thus decrements the size of $s$) if $0 \leq i \leq$ `s->size`$-1$ and (2) prints an error message that $i$ is out of bounds if $i < 0$ or `s->size`$-1 < i$.

(f) A mutator named `insert_vec` of type

$$\texttt{vec\_store,vector} \rightarrow \texttt{void}$$

such that (1) `insert_vec`$(s, v)$ inserts vector $v$ into $s$ (and thus increments the size of $s$) if `s->size` $<$ `MAX_SEQ_LENGTH` and (2) prints an error message that $s$ is full if `s->size` $=$ `MAX_SEQ_LENGTH`.

(g) 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.

## 3.2 Submission Requirements

Put your program in a file named `prog5.c`, and put a copy of your log book in a file named `log5.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 `assign5`. Put the files `prog5.c` and `log5.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, November 27, 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.