Topics: 1-dimensional array, more iteration!

Reading (ML): Sec 2.1-2.4, 2.8 for discussion on 1-d array, make sure you’ve done all the required reading!

1-Dimensional Array: Vector

An array is a named collection of data values organized into rows and/or columns. A 1-d array is a row or a column, also known as a vector. An index is a positive integer that identifies the position of a value in the vector.

Suppose vector v is a collection of 4 values, i.e., vector v has 4 cells.

The ith value can be accessed as v(i).

Assign a value of 9 to into the 4th cell of vector v: v(4) = 9.

Copy the value in the 4th cell to the 2nd cell of vector v: v(2) = v(4).

Copy the value in the current cell to the next cell of vector v: v(i+1) = v(i).

Array Initialization

MATLAB function zeros: vecA = zeros(1,5)
MATLAB function ones: vecB = ones(5,1)
MATLAB short-cut expression for consecutive numbers: 1:6 or 1:1:6
“Manual”: vecC(5) = 10

Can you write a program for calculating the average of 10 numbers (Example 1 from 2/5 lecture) that stores all the data entered by the user? Below is the original program that doesn’t store all user input.

% Average 10 numbers from user input

n = 10; % number of data values
total = 0; % current sum (initialized to zero)
i = 1; % initialize counter
while (i<=n)
   % read and process input value
   num = input(‘Enter a number: ’);
   total = total + num;
   % update
   i = i + 1;
end
ave = total/n % average of n numbers

What are some useful MATLAB built-in functions for the above problem?
Example 1

Write a program segment that calculates the *cumulative sums* of a given vector $v$. The cumulative sums should be stored in a vector of the same length as $v$. E.g., the cumulative sums for the sequence 1,3,5,0 is 1,4,9,9. Do not use MATLAB predefined functions other than *length*.

Example 2

Write a program segment that determines whether a given integer $n$ is prime. Assume $n>2$. (Hint: MATLAB function $\text{mod}(x,y)$ returns the value of the remainder of $x$ divided by $y$ assuming integer values of $x$, $y$.)

Example 3

Sketch a program that will list all the prime numbers in the range of [2,$n$] given an integer $n>1$.

Example 4

Develop an algorithm for calculating the *mode* of a sequence. The mode is the number in the sequence that occurs with maximum frequency. Assume that the sequence is (a) non-negative, (b) entered one by one and terminated by a negative number, and (c) entered in non-decreasing order. E.g., the mode of the sequence 87,92,92,98,98,98,100 is 98. Assume that only scalar variables are allowed.

read first grade
initialize other variables
   (prevgrade, prevfreq, mode, modefreq)
while not stop signal
   process current grade
      update frequencies
      update mode
   read next grade
print answer

Programming Rules of Thumb

- *Learn program patterns* of general utility and *use relevant pattern* for the problem at hand.

- *Seek inspiration* by systematically working test data by hand. Be introspective; ask yourself: “what am I doing?”

- *Declare variables* for each piece of information you maintain when working problem by hand. *Write comments* that precisely describe the contents of each variable.

- *Decompose* problem into manageable tasks.

- *Remember* the problem’s boundary conditions.

- *Validate* your program by tracing it on simple test data.