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 \( i \)th 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 \texttt{zeros}: \texttt{vecA = zeros(1,5)}

MATLAB function \texttt{ones}: \texttt{vecB = ones(5,1)}

MATLAB short-cut expression for consecutive numbers: \texttt{1:6} or \texttt{1:1:6}

“Manual”: \texttt{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.

\[
\text{\% Average 10 numbers from user input}
\]

\[
\begin{align*}
n &= 10; \quad \% \text{number of data values} \\
\text{total} &= 0; \quad \% \text{current sum (initialized to zero)} \\
i &= 1; \quad \% \text{initialize counter} \\
\text{while } (i\leq n) \\
\quad \% \text{read and process input value} \\
\quad \text{num} &= \text{input('Enter a number: ');} \\
\quad \text{total} &= \text{total} + \text{num}; \\
\quad \% \text{update} \\
\quad i &= i + 1; \\
\text{end} \\
\text{ave} &= \text{total}/n \quad \% \text{average of n numbers}
\end{align*}
\]

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 \texttt{length}.

Example 2

Write a program segment that determines whether a given integer \( n \) is prime. Assume \( n>2 \). (Hint: MATLAB function \texttt{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.

Programming Rules of Thumb

- \textit{Learn program patterns} of general utility and \textit{use relevant pattern} for the problem at hand.
- \textit{Seek inspiration} by systematically working test data by hand. Be introspective; ask yourself: “what am I doing?”
- \textit{Declare variables} for each piece of information you maintain when working problem by hand. \textit{Write comments} that precisely describe the contents of each variable.
- \textit{Decompose} problem into manageable tasks.
- \textit{Remember} the problem’s boundary conditions.
- \textit{Validate} your program by tracing it on simple test data.