Chapter 2 (Part 1)
MATLAB Basics

Arrays

- The fundamental unit of data in MATLAB is the **array**.
- An array is a collection of data values organized into rows and columns.
- All of the elements of an array are listed in **row order**.
- Individual data values within an array are accessed by a specified name and subscripts of indexes.
  - For example: abc(1,2)

Arrays²

- A single value is called a **scalar**.
  - Matrix with one row and one column
- This is a 4x6 **matrix**, containing 24 elements.

\[
\begin{bmatrix}
3 & 0 & 0 & 4 & 4 & 0 \\
0 & 3 & 0 & 4 & 4 & 0 \\
1 & 1 & 3 & 4 & 4 & 1 \\
0 & 0 & 1 & 1 & 1 & 0
\end{bmatrix}
\]

- [1 2 3 4] is a 1x4 array, known as a **row vector**.
- A 4x1 array is called a **column vector**.

Arrays³

- [ ] creates an empty array.
- In MATLAB, transpose matrix $M^T$ is denoted as $M'$, $'$ is a **transpose operator**.
  - The transpose operator changes rows to columns or vice versa.
Arrays

The transpose operator makes it easy to create tables.

[degrees;radians]

Variables

- A MATLAB variable is a region of memory containing an array, which is known by a user-specified name.
- Variable names must start with a letter.
- They may contain letters, numbers and the underscore (_).
- Names are case sensitive.

There are certain keywords you can’t use:
- Use iskeyword function to check whether a name is a system reserved name.
- MATLAB will let you use built-in function names as variables – but it’s a really bad idea.
- What if you accidentally overwritten a function to a variable name?
Naming Variables

- test
- Test
- if
- my\text{x}book
- my\_book
- Thisisoneverylongnamebutitisstillallowed?
- 1stgroup
- group\_one
- zzaAbc
- z34wAway?12#
- sin  \text{ bad}
- log  \text{ idea}

Basic Data Types

- The most common types of MATLAB variables are \textit{double} and \textit{char}.
- A variable of type \textbf{double} consists of 64-bit double-precision floating-point values.
- Variable of type \textbf{char} consist of scalars or arrays of \textbf{16-bit} values.

Default Data Type

- By default, a variable of type \textbf{double} is automatically created whenever a numerical value is assigned to a name
  - It can be positive or negative number in the range of $10^{-386}$ to $10^{386}$, with 15 to 16 significant decimal digits.

Assignment Operator

- \texttt{=} is the assignment operator
- To define a variable \texttt{a} we might type \texttt{a=10.5}
  - which should be read as:
    - \texttt{a} is assigned a value of 10.5
Data Initialization

- MATLAB variables are automatically created when they are initialized.
  - `a=10.5`
  - `b='abc'`, `c=4+3i`
  - `d=[1 2 3 4];`

Data Initialization^2

Define Arrays

- Use a semicolon as a delimiter to create a new row.
- Use either a space or a comma as a delimiter in a row vector.
- ; is the command separator
- ; suppresses the output and also acts as a command separator

Define Arrays^2

- It's easier to keep track of how many values you've entered into a matrix, if you enter each row on a separate line. The semicolons are optional.
Shortcut Expressions

- While a complicated matrix might have to be entered by hand, evenly spaced matrices can be entered much more readily.
- The general form of a colon operator
  - first:increment:last
  - [first:increment:last]
- If the stepping increment is one, then use
  - first:last

Shortcut Indexing

- The general form of indexing is (row, col)
- Color operator can be used to represent a range of indexes
  - n:m represents indexes from n to m.
  - ':' denotes all the indexes
  - [p q ...] represents positions of pᵗʰ, qᵗʰ, and etc.
Build-In Functions

- `eye(n,m)` returns the identity matrix.
- `ones(n)` and `ones(n,m)` return all-ones.
- `zeros(n,m)` returns an all-zero nxm array. `zeros(n)=zeros(n,n)`.

Build-In Functions²

- `length` returns the length of a vector, or the longest dimension of a matrix.
- `size` returns all the dimensions of a variable.
- When a function is used as an argument of a 2nd function, the output of the 1st function is the actual input to the 2nd function.

Keyboard Input

- To allow a M-script to prompt a user for input interactively.
- The `input` function displays a prompt string in the command window and then waits for the user to type in a response at the keyboard.
  - `input(prompt_string)`
  - `input(prompt_string, string_option)`
Keyboard Input

Stores the string ‘1.23’ into b as an array of characters.

Stores the number 1.23 into a as a double value.

Homework Assignment #2

- Quiz 2.1
  - Page 31: 3, 4, 5, 6, 7
- You should do your assignment at your Lab session and hand in your work to your TA at the end of the Lab before our next class.
- Late submission will not be accepted.

Multidimensional Arrays

- Sometimes you may want to store data in multidimensional arrays
  - Rows
  - Columns
  - Pages
  - Additional dimensions are possible

The 1st page is two-dimensional.
Multidimensional Arrays

- For a multidimensional matrix $c$ with a size of $2 \times 3 \times 2$ will contain 12 elements.
- These elements will occupy 12 successive locations in the memory in column major order.
  - It allocates the 1st column in memory, then the 2nd, then the 3rd, and so on.

Memory Allocations

- The 1st page is reset as one-dimensional vector.
- The 2nd page is reset as one-dimensional vector.
Memory Allocations

Row major order
Column major order

Reference to Sub-Arrays

Keyword | Predefined value
---|---
pi | 3.141592653589793
l, j | -1
inf | \( \infty \), infinite
NaN | Not-a-Number
clock | current date and time
date | current date in string form
eps | smallest difference between numbers
ans | the variable stores the unassigned result
Homework Assignment #3

- Quiz 2.2
  - Page 39: 1, 2, 3
- You should do your assignment at your Lab session and hand in your work to your TA at the end of the Lab before our next class.
- Late submission will not be accepted.