Using MATLAB

Data, Files and Data Input and Output

Jilu Li

June 7, 2007

NATIONAL SCIENCE FOUNDATION :: KANSAS TECHNOLOGY ENTERPRISE CORPORATION :: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

The University of Kansas | The Ohio State University | Pennsylvania State University
The University of Maine | Elizabeth City State University | Haskell Indian Nations University

Centre for Polar Observation and Modelling | University of Copenhagen
Technical University of Denmark | Antarctic Climate & Ecosystems CRC

CReSIS

Outline

- MATLAB Data Types

  Logical, Char, Numeric, Cell Array, Structures

- MATLAB Files

  M-files, MAT-files, Text Data files

- Data Input and Output

  Input/Output Display, High Level Input/Output, Low Level Input/Output

MATLAB Data Types

- **Logical Data**

  In MATLAB, the logical data type represents a logical true or false state using the numbers 1 and 0, respectively. Some MATLAB functions and operators return logical true or false to indicate whether a certain condition is found to be true or not. Each logical variable takes 8 bits in storage.

Examples

```
>>[30 40 50 60 70] > 40
ans =
     0     0     1     1     1
```

```
>>ischar('5')
ans = 1
>>ischar(5)
ans = 0
```

isreal, iscell,isstruct
isinteger, isnumeric,
isfloat, islogical,
isfield,

MATLAB Data Types

- **Characters and Strings**

  MATLAB represents each Unicode character internally as its corresponding numeric value. Each character takes 16 bits in storage. A string is an array of characters.

Examples

>>double('AB')	>>strcat('1', '-', '2')	strcmp
ans = 65 66	ans = 1-2	strmatch
>> char(65,66)'	>>strvcat('1', '-', '2')	strfind
ans = AB	ans = $\frac{1}{2}$	

MATLAB Data Types

- **Numeric Data:** Integers and Floating Point Numbers

  --Integers

  int8, uint8; int16, uint16; int32, uint32; int64, uint64

  Range of Values:

  Signed $[-2^{N-1}, 2^{N-1}-1]$; Unsigned $[0, 2^{N}-1]$

Examples

```
>>intmax('int8')        >>intmin('int8')        >>intmax('uint8')
ans =                   ans =                   ans =
      127                     -128                    255
```

MATLAB Data Types

- **Numeric Data:** Integers and Floating Point Numbers

  -- **Floating Point Numbers**

  Double-precision (default), 64 bits $[-1.79769\times10^{308},\ 1.79769\times10^{308}]$

  63 Sign (0 = positive, 1 = negative)
  62 to 52 Exponent, biased by 1023
  51 to 0 Fraction f of the number 1.f

  Single-precision, 32 bits $[-3.40282\times10^{38},\ 3.40282\times10^{38}]$

  31 Sign (0 = positive, 1 = negative)
  30 to 23 Exponent, biased by 127
  22 to 0 Fraction f of the number 1.f

  realmax
  realmin

MATLAB Data Types

- **Numeric Types:** Integers and Floating Point Numbers

  -- **Floating Point Numbers:** **Data accuracy**

  Because of the finite number of bits available for floating point numbers, on any computer, there is a small gap between each number and the next larger number. The size of this gap limits the precision of your results. You can use the eps function to determine a numbers accuracy.

Examples

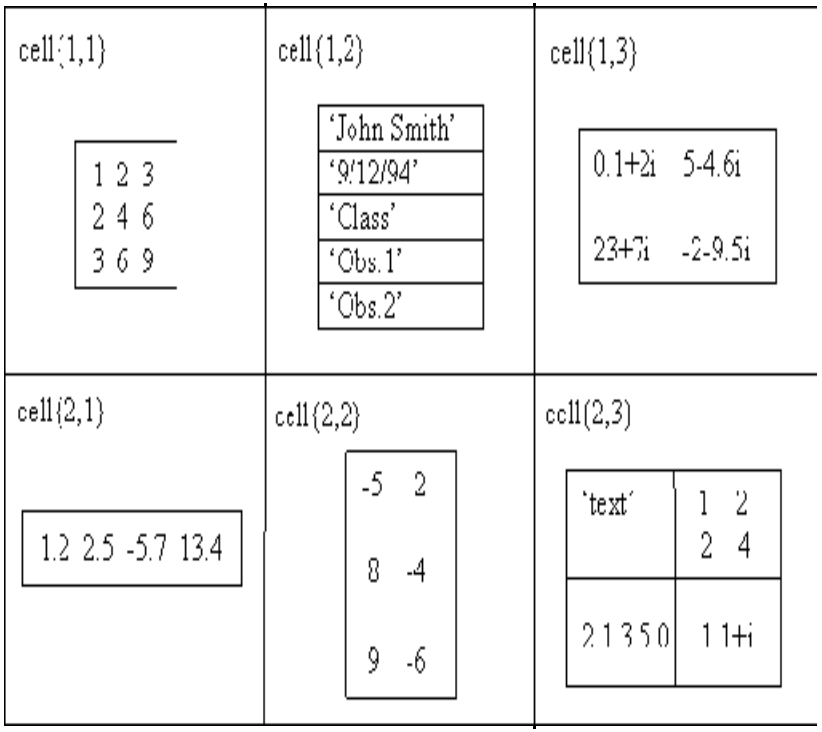
```
>>eps(double(pi))
ans =
        4.4409e-016
>>eps(single(pi))
ans =
        2.3842e-007
```

```
>>eps(5)
 ans =
         8.8818e-016
>>eps(50)
 ans =
         7.1054e-015
```

MATLAB Data Types

- **Cell Array**

  A cell array provides a storage mechanism for dissimilar kinds of data. You can store arrays of different types and sizes within the cells of a cell array.



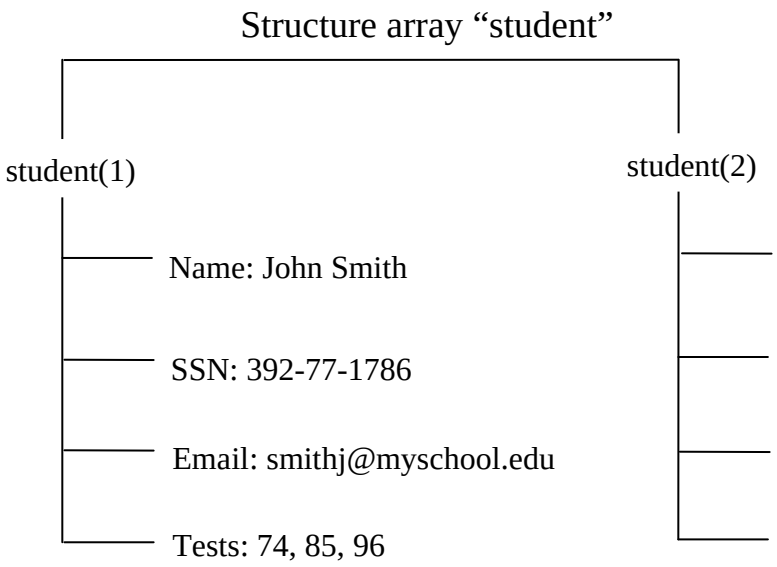
Example

```
>>cell{1,1}=[1 2 3; 4 5 6; 7 8 9];
>>x=cell{1,1}(2,1)
ans =
        4
```

MATLAB Data Types

- **Structures**

  Structures are MATLAB arrays with named fields. The fields of a structure can contain any kind of data.




```
>>student(1).name= ‘John Smith’;
>>n1=student(1).name
   ans =
         John Smith
```

MATLAB Files

- **M-files:** filename.m

  M-files are ASCII files written in MATLAB language. M-file names must start with an alphabetic character, may contain any alphanumeric characters or underscores, and must be no longer than 63 characters.

--MATLAB Scripts

. Are a bunch of commands or steps you need to perform many times.
. Do not accept input arguments or return output arguments.
. Store variables in the Workspace that is shared with other scripts and with the MATLAB command line interface.

--MATLAB Functions

. Can accept input arguments and return output arguments.
. Store variables in a workspace internal to the function.

MATLAB Files

- **An Example of M-files**

```
function f = fact (n)          <-- Function definition line
% Compute a factorial value.  <-- H1 line
% FACT(N) returns the factorial of N,  <-- Help text
% usually denoted by N!

% Put simply, FACT(N) is PROD(1:N).  <-- Comment
f = prod(1:n);                 <-- Function body
```

MATLAB Files

- **MAT-files:** filename.mat

--MAT-files are the format MATLAB uses for saving variable names and values created during a MATLAB session. They are in binary format to achieve a compact storage.

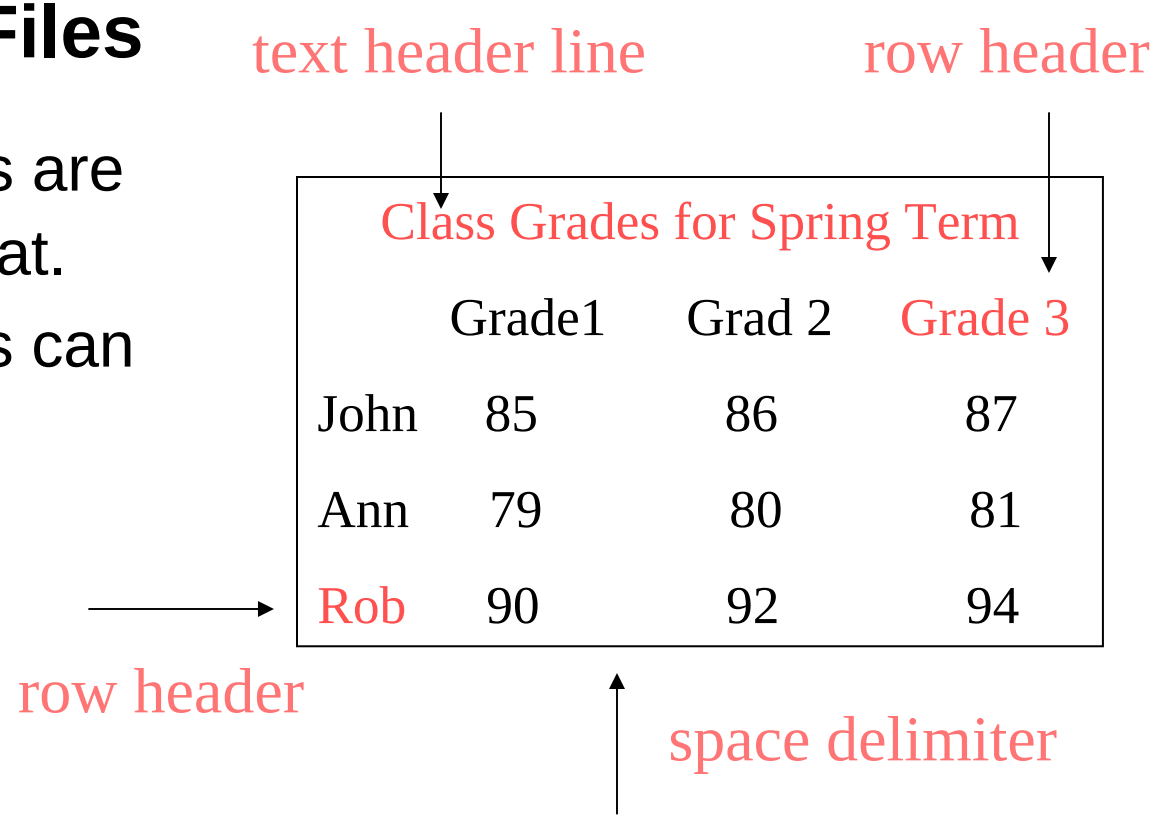
--MAT-files provide a convenient way for MATLAB to import and export data, or to move data between different MATLAB applications.

MATLAB Files

- **Text Data Files**

--Text data files are in ASCII format.

--Text data files can be numeric, alphabetic or mixed.



Data Input and Output

- **Input/Output Display**

Command	Description
disp(A)	Displays an array, without printing the array name
disp('text')	Displays the text string enclosed within the single quotes
Sprintf (format, Data)	Write formatted data to string
x=input ('prompt')	Request user input a numerical value
x=input ('prompt','s')	Request user input a string
k=menu('title', 'option 1', 'option 2',…, 'option n')	Generate menu of choices for user input
Format	Set display format for output

Data Input and Output

- **Input/Output Display**

Command	Description	Example
format short	Four decimal digits(Default)	3.1416
format long	16 digits (14 decimals for double, 7 decimals for single)	3.14159265358979
format short e	Scientific notation with 5 digits(four decimal digits)	3.1416e+000
format long e	Scientific notation with 16 digits (15 decimals for double, 7 decimals for single)	3 .141592653589793e+000
format short g	Best of fixed or floating point, with 5 digits	3.1416
format long g	Best of fixed or floating point, with 15 digits for double; 7 digits for single	3.14159265358979
format short eng	Engineering format. Four decimals and a power that is a multiple of three	3.1416e+000
format long eng	Engineering format. 15 digits for double, 7 digits for single, and a power that is a multiple of three	3.14159265358979e+000
format hex	Hexadecimal	400921fb54442d18
format bank	Two decimal digits for monetary calculations	3.14
format +	Positive, negative, or zero	+
format rat	Rational approximation	355/113
format compact	Compact display mode	
format loose	Loose display mode	

Data Input and Output

- **Input/Output Display** -- Examples:

  >>A = input('Please enter the value of A: ')

  >>menu('Choose a color','Red','Green','Blue')

Data Input and Output

- **High Level Input/Output**

--Using MATLAB Import Wizard

Example 1: import an ASCII data file;
Example 2: import a MAT-file file;
Example 3: import an Excel spreadsheet data file;

Data Input and Output

- **High Level Input/Output**

  --Using MATLAB functions

load	⟷	save	most useful
csvread	⟷	csvwrite	files with comma as delimiter
dlmread	⟷	dlmwrite	identify delimiter
xlsread	⟷	xlswrite	Microsoft Excel spreadsheets
wk1read	⟷	wk1write	Lotus 1-2-3 spreadsheets

Data Input and Output

- **High Level Input/Output**

  --Using MATLAB functions

load	save
load filename	save('filename')
load filename X Y Z ...	save('filename', 'var1', 'var2', ...)
	save('..., 'format')

Examples

Data Input and Output

- **Low Level Input/Output**

--Using MATLAB functions

fclose Close one or more open files
feof Test for end-of-file
ferror Query MATLAB about errors in file input or output
fgetl Return next line of file as string without line terminator(s)
fgets Return next line of file as string with line terminator(s)
fopen Open file or obtain information about open files
fprintf Write formatted data to file
fread Read binary data from file
frewind Rewind open file
fscanf Read formatted data from file
fseek Set file position indicator
ftell Get file position indicator
fwrite Write binary data to file

Questions?

National Science Foundation
WHERE DISCOVERIES BEGIN

KTEC
KANSAS
TECHNOLOGY
ENTERPRISE
CORPORATION

KU THE UNIVERSITY OF KANSAS

CReSIS