Eng 101

Matlab again

Misc.

- Exams back in lab Tues/Wed.
  - Exam scores posted on Tuesday.
- Don’t have final numbers yet, but with 80% graded and recorded:
  - Average 76, Median 79, high 100, low 11, STDEV 16

Matlab

- Half of today will be review. Then we will start on a problem.
  - We will spend the next 2 weeks on:
    - The language
    - Plotting
    - Curve fitting
    - Problem solving

On-line Help

- help lists topics on which help is available
- helpwin opens interactive help window
- helpdesk opens web browser based help
- help topic provides help on topic
- lookfor string lists help topics containing string
- demo runs the demo program
- [http://www.engin.umich.edu/group/ctm/basic/basic.html](http://www.engin.umich.edu/group/ctm/basic/basic.html)
Workspace Info

• who  lists variables currently in workspace
• whos lists variables currently in workspace with their size
• what lists m-files in current directory
• clear clears workspace, all variables are removed
• clear x y z clears only variables x,y,z

arithmetic calculations

• +  addition
• -  subtraction
• *  multiplication
• /  division
• \  left division
• ^  exponentiation
• '  transpose

Examples:

>> 2+2
ans = 4

if don’t specify a variable, MATLAB uses ans

>> x=2+2
x = 4

Examples: “;”

>> y = 2^2 + log(pi)*sin(x);
>> y
y = 3.1337

; at the end suppresses screen output

pi  MATLAB constant
\[
\theta = \arccos(-1) \\
\theta = 3.1416 \\
\]
\[
\text{format short e} \\
\theta \\
\theta = 3.1416e+000 \\
\]
(There are other formats such as hex, bank & ratio)

---

arrays

\[
\text{format short} \\
31.4159 \\
\text{format short e} \\
e.1416e+001 \\
\text{format long} \\
31.41592653589793 \\
\text{format long e} \\
3.141592653589793e+001 \\
\text{format short g} \\
31.416 \\
\text{format long g} \\
31.4159265358979 \\
\]

---

arrays

\[
>> x = [1 2 3] \\
x = \\
1 2 3 \\
\]
\[
>> y = [2 ; 1 ; 5] \\
y = \\
2 1 5 \\
\]

---

arrays

\[
a = [1 2 ; 3 4] \quad \% 2 \times 2 \text{ matrix} \\
a = \\
1 2 \\
3 4 \\
\]
\[
\begin{align*}
\text{>> } z \\
z &= \\
2 & 1 & 0 \\
\text{>> } x \\
x &= \\
1 & 2 & 3 \\
\text{>> } a = x.*z \\
a &= \\
2 & 2 & 0 \\
\text{Can multiply by a scalar. Each item affected.} \\
\text{>> } \text{a} \\
a &= \\
2 & 2 & 0 \\
\text{>> } \text{b} = 2 * a \\
a &= \\
4 & 4 & 0 \\
\end{align*}
\]

\textit{transpose}

\textit{swap rows \& columns}

\[
\begin{align*}
\text{>> } A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \\
A &= \\
1 & 2 \\
3 & 4 \\
\text{>> } A' \\
\text{ans} &= \\
1 & 3 \\
2 & 4 \\
\end{align*}
\]

\[
\begin{align*}
A &= \begin{bmatrix} 16 & 3 & 2 & 13; \\
5 & 10 & 11 & 8; \\
9 & 6 & 7 & 12; \\
4 & 15 & 14 & 1; \end{bmatrix} \\
\text{>> } \text{sum(}A\text{)} \quad \texttt{sums cols} \\
\text{ans} &= \\
34 & 34 & 34 & 34 \\
\end{align*}
\]
con’t

>> sum(A’)
% sums rows
ans =
 34
 34
 34
 34

>> sum(diag(A))
ans =
 16
 10
  7
  1

the other diag

>> sum(diag(fliplr(A)))
ans =
 34

flipr slips a matrix from left to right

sum all rows = 34
sum all cols = 34
sum both diags = 34
MAGIC

Magic Square

B = magic(4)
B =
 16   2   3  13
  5  11  10   8
  9   7   6  12
  4  14  15   1

eye

c = eye(3,3)
c =
 1  0  0
 0  1  0
 0  0  1
arrays

\[ d = \text{zeros}(4,4); \]  
% 4x4 matrix of all 0’s

linspace

\[
>> x = \text{linspace}(0,10,5) \\
x = \\
0 \ 2.5000 \ 5.0000 \ 7.5000 \ 10.0000
\]

Create a vector \( x \) with 5 elements linearly spaced between 0 and 10.

Subscripts

element in row \( i \) 
column \( j \) 
noted as \( A(i,j) \)

\[ A(1,4) + A(2,4) + A(3,4) + A(4,4) \]

not elegant

Watch assignments

t = A(4,5) 
Index exceeds matrix dimensions

HOWEVER,
\[ X = A; \]
\[ X(4,5) = 17 \]
outside of the range of \( X \) 
EXPANDS to accommodate
Colon Operator

one of MATLAB’s most important operators
1:10
row vector containing integers 1-10
1 2 3 4 5 6 7 8 9 10

non-unit spacing

- specify an increment
100: -7: 50
is
100 93 86 79 72 65 58 51
and
0 : pi/4 : pi
is
0 0.7854 1.5708 2.3562 3.1416

Subscript expressions

A (1 : k,j)
first k elements of the jth column of A

sum(A(1:4,4)
sums the 4th column (assuming there are only 4 rows)

: by itself refers to entire row/col
keyword end refers to last row/col
sum(A (: , end))
sums elem of last col of A

Elementary Math Functions

Available

- help elfun
- More advanced math fns
- help specfun
- help elmat
Useful Constants

- pi  3.14159265…
- i    imaginary unit \(\sqrt{-1}\)
- j    same as i
- eps  floating-point relative precision \(2^{-52}\)
- realmin smallest floating PT \(2^{-1022}\)
- realmax largest floating PT \((2-\varepsilon)2^{1023}\)
- Inf  infinity
- NaN  not-a-number

load command

- create a data file
  16.0 3.0 2.0 13.0
  5.0 10.0 11.0 8.0
  9.0 6.0 7.0 12.0
  4.0 15.0 14.0 10
- save as magik.dat

M-files

- files that contain MATLAB code
- save using *.m extension
- magik.m
- command magik
  - reads the file and executes the code

Concatenation

- process of joining items together
- join smaller arrays to make larger ones
- \(A=[1 \ 2; \ 3 \ 4]\);
- \(B=[A \ A+3; \ A+4 \ A+1]\)

\(B=\)

\[
\begin{bmatrix}
1 & 2 & 4 & 5 \\
3 & 4 & 6 & 7 \\
5 & 6 & 2 & 3 \\
7 & 8 & 4 & 5
\end{bmatrix}
\]
Deleting Rows & Columns

- $X = A$;
- delete 2\textsuperscript{nd} column of $X$
  
  $X(:, 2) = []$

\[
X = \\
1 \\
2
\]

Delete One

- Delete a single element: ERROR
  
  $X = [1 \ 2 \ ; \ 3 \ 4]$
  
  $X(1,2) = []$

  No longer a matrix