MATLAB Extras

Fun with DOTS

George Washington University

Background

- Two Ways to Deal with Matrices
  - As a Matrix
    - Each Value is Related to Each Other Value
    - EX. When Solving a Series of Equations

$$\begin{aligned} 2x + 3y + 4z &= 12 \\ -5x + 9z &= -12 \\ 7y + 3z &= 7 \end{aligned} \quad \Rightarrow \quad \begin{bmatrix} 2 & 3 & 4 \\ -5 & 0 & 9 \\ 0 & 7 & 3 \end{bmatrix}^{-1} * \begin{bmatrix} 12 \\ -12 \\ 7 \end{bmatrix} = \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

    - The Solution Involves Inversing Matrix A and Performing Matrix Multiplication with that Product and B.
  - As a List
    - Each Term is Considered Independent of the Others
    - EX. When Plotting $F(x)=\sin(x^2)$, where x = 1:1:100, x is a list.
    - X^2 means $[1^2\ 2^2 \ldots 100^2]$, not [1 2 … 100] * [1 3 … 100]

Handling Matrices as Matrices

- Why?
  - Matrices have special rules for multiplication and division. We need to tell MATLAB that we want to use those rules.
- How?
  - Nothing Extra Required; Just Type Out What You Want Done!

Paper & Pencil Format

$$\begin{pmatrix} 2 & 3 & 4 \\ -5 & 0 & 9 \\ 0 & 7 & 3 \end{pmatrix}^2$$

$$\begin{pmatrix} 2 & 3 & 4 \\ -5 & 0 & 9 \\ 0 & 7 & 3 \end{pmatrix} * \begin{pmatrix} 1 & 2 & 3 \\ -5 & 0 & 9 \\ 8 & 7 & 1 \end{pmatrix}$$

MATLAB Format

```
[2  3 4;-5 0 9;0 7 3]^2
```

```
[2  3 4;-5 0 9;0 7 3] * [1 2 3;-5 0 9;8 7 1]
```

Handling Matrices as Lists

- Why?
  - Many times we want to evaluate a function over a range of individual values. We need to tell MATLAB to evaluate the function at each value individually.
- How?
  - Before certain operators place a DOT
    - Multiplication: * goes to .*
    - Power: ^ goes to .^
    - Division: / goes to ./
    - No Change Required for Addition or Subtraction

Example: Convert the following equation into the MATLAB equivalent

$$f(x) = \frac{\sin(x^2)}{(x+3)^x} \longrightarrow$$

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f = sin(x.^2)./(x + 3).^x
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Tips For When DOTS Are Not Needed

- DOTS are ONLY required when Matrix by Matrix multiplication or division is used.
- Examples of When DOTS are not needed
  - When multiplying by a scalar
    - 3 * A (Note, 3 .* A also works)
  - When dividing by a scalar
    - A / 3 (Note, A ./ 3 also works)
  - When Adding Two Matrices
    - A + B
  - When Subtracting Two Matrices
    - A – B

$$\begin{bmatrix} 2 & 3 & 4 \\ -5 & 0 & 9 \\ 0 & 7 & 3 \end{bmatrix} = A$$

$$\begin{bmatrix} 7 & 2 & 3 \\ 8 & 5 & 9 \\ 3 & 6 & 1 \end{bmatrix} = B$$

Multiplication Examples

$$\begin{pmatrix} 2 & 3 \\ -5 & 0 \end{pmatrix} = A$$

$$\begin{pmatrix} 7 & 2 \\ 8 & 5 \end{pmatrix} = B$$

- Calculate A * B

$$\begin{pmatrix} 38 & 19 \\ -35 & -10 \end{pmatrix}$$

- Calculate A .* B

$$\begin{pmatrix} 14 & 6 \\ -40 & 0 \end{pmatrix}$$

- Calculate B * A

$$\begin{pmatrix} 4 & 21 \\ -9 & -24 \end{pmatrix}$$

- Calculate B .* A

$$\begin{pmatrix} 14 & 6 \\ -40 & 0 \end{pmatrix}$$

Order Dependant!

Not Order Dependant!