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Matrix Access
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CS368 MATLAB Programming
Lecture 1

Young Wu

Based on lecture slides by Michael O'Neill and Beck Hasti

January 24, 2022

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Lecture Format
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- In person and/or on Zoom.
- ~ 20 minutes introduction of the problem.
- ~ 30 minutes examples and quizzes.

Grading
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- Quizzes (Q): weekly, 2 points each.
- Programming homework (P): biweekly, 10 points each.
- Credit if $Q + P \geqslant 75$.

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Quizzes
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- Obviously incorrect answers will lose points.
- Otherwise not graded for correctness.

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Example Quiz Type 1

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Example Quiz Type 2

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Programming Homework
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- Please do not start before announcement on Canvas and Piazza.
- Due dates: biweekly on Wednesday.
- No penalty for late submissions within a week, except you have to submit a regrade request form.
- Submit output on course website.
- Submit code on Canvas.

Programming Homework Due Dates
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- Example solutions will be posted around the due date.
- If you are unable to solve some of the questions correctly before the due date, you can look at the solutions, fix your code and resubmit without penalty.
- Example solutions should not be used as starter code.

Office Hours
Admin

- Daily from 4 : 35 to 5 : 25, either in-person or on Zoom, see schedule on course website.

- If you don't have specific questions, you are welcome to join and work with other students on programming homework.

- If you have personal issues to discuss, private message me on Piazza or email me to set up an appointment.

What is MATLAB
Math

- MATrix LABoratory.
- Mainly used for numerical matrix computations.
1. Numerical: approximation of continuous functions.
2. Matrix: rectangular 2D array of numbers.

Why MATLAB
Math

- Matrix operations are simple to code.
- Matrix operations are very fast.

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How to Open MATLAB
Code

- Download MATLAB or use the online version. There is a mobile app too.
- Command Window executes commands line by line.
- Text Editor creates an m-file script used to store a series of commands or to define functions.
- Current Folder lists the files in the working directory.
- Workspace lists the variables defined in the current session.

MATLAB Variables

Code

- Every variable in MATLAB is a matrix.
- A scalar is a 1×1 matrix.
- A column vector is an $N \times 1$ matrix.
- A row vector is a $1 \times N$ matrix.

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Matrix Creation
Code

- *[a; b]* creates the matrix (column vector) $\begin{bmatrix} a \\ b \end{bmatrix}$.

- *[a b]* or *[a, b]* creates the matrix (row vector) $\begin{bmatrix} a & b \end{bmatrix}$.

- *[a b; c d]* creates the matrix $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$.

- a, b, c, d can be (sub)matrices themselves.

Vector Creation Shortcuts
Code

- $a{:}b$ creates the matrix (row vector) $\begin{bmatrix} a & a+1 & a+2 & ... & b \end{bmatrix}$.

- $a{:}d{:}b$ creates the matrix (row vector) $\begin{bmatrix} a & a+d & a+2d & ... & b \end{bmatrix}$.

- If $b \neq a + dn$ for some n, then the list stops at the largest value of $a + dn$ that is less than b.

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Matrix Creation Shortcuts
Code

- *zeros(n, m)* creates an $n \times m$ matrix of 0s (n rows and m columns).

- *ones(n, m)* creates an $n \times m$ matrix of 1s (n rows and m columns).

- *repmat(x, n, m)* repeats the scalar or matrix x, $n \times m$ times.

- *eye(n)* creates an $n \times n$ identity matrix, for example,
$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \text{ when } n = 3.$$

- *diag([a b c])* creates a diagonal matrix $\begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$.

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Matrix Creation, Vector

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Matrix Creation, Block Matrix

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Matrix Creation, Repeat Matrix

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Transpose
Code

- Transposing a matrix rearranges the elements of the matrix so that columns become rows and rows become columns.

1. *[a b; c d]'* produces the transpose $\begin{bmatrix} a & b \\ c & d \end{bmatrix}^T = \begin{bmatrix} a & c \\ b & d \end{bmatrix}$.

2. *[a b]'* produces the column vector $\begin{bmatrix} a & b \end{bmatrix}^T = \begin{bmatrix} a \\ b \end{bmatrix}$.

3. *[a; b]'* produces the row vector $\begin{bmatrix} a \\ b \end{bmatrix}^T = \begin{bmatrix} a & b \end{bmatrix}$.

Matrix Scalar Operations
Code

- Suppose M is a matrix and c is a scalar.
- $M + c$ adds c to every element of M, for example, *zeros(n, m) + 1* produces the same matrix as *ones(n, m)*.
- $M * c$ multiplies c to every element of M, for example, *ones(n, m) * 0* produces the same matrix as *zeros(n, m)*.
- More details in the next lecture.

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Vector Access

Code

- Suppose M is a row vector.
- If i is a scalar, $M(i)$ accesses the i-th element of M.
- If i is a row vector, $M(i)$ accesses the (sub)vector of M containing elements with indices in i.

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Matrix Access
Code

- Suppose M is a matrix.
- If i, j are scalars, $M(i, j)$ accesses row i column j of M.
- If i, j are vectors, $M(i, j)$ accesses the (sub)matrix of M containing rows with indices in i and columns with indices in j.

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Matrix Access Shortcuts

Code

- Suppose M is a matrix.
- If i is a scalar, *M(i, :)* or *M(i, 1:end)* accesses row i of M.
- If i is a vector, *M(i, :)* or *M(i, 1:end)* accesses the (sub)matrix of M containing rows with indices in i.
- Suppose M is a matrix.
- If j is a scalar, *M(:, j)* or *M(1:end, j)* accesses column j of M.
- If j is a vector, *M(:, j)* or *M(1:end, j)* accesses the (sub)matrix of M containing columns with indices in j.

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Matrix Access, Vector
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Matrix Access, Vector Sequence

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Matrix Access, Matrix

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Matrix Access, Matrix Sequence

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