

CS368 MATLAB Programming

Lecture 1

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

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Lecture Format

Admin

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

Grading

Admin

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

Quizzes

Admin

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

Example Quiz Questions

Quiz

Programming Homework

Admin

- 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

Admin

- 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.

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.

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) $[a \ b]$.
- $[a \ b; c \ d]$ 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) $[a \ a + 1 \ a + 2 \ \dots \ b]$.
- $a:d:b$ creates the matrix (row vector) $[a \ a + d \ a + 2d \ \dots \ b]$.
- If $b \neq a + dn$ for some n , then the list stops at the largest value of $a + dn$ that is less than b .

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 $\begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$.

Matrix Creation Quiz Questions

Quiz

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, $\text{zeros}(n, m) + 1$ produces the same matrix as $\text{ones}(n, m)$.
- $M * c$ multiplies c to every element of M , for example, $\text{ones}(n, m) * 0$ produces the same matrix as $\text{zeros}(n, m)$.
- More details in the next lecture.

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 .

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 .

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 .

Matrix Access Quiz Questions

Quiz

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