CS368 MATLAB Programming

Lecture 1

Young Wu

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

January 24, 2022
Socrative
Admin
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 Type 1

Quiz
Example Quiz Type 2

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.
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.
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 $1 \times 1$ 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) \(\begin{bmatrix} a & b \end{bmatrix}\).
- \([a \ b; c \ d]\) 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) \([a \ a+1 \ a+2 \ \ldots \ b]\).

- \( a:d:b \) creates the matrix (row vector) \([a \ a+d \ a+2d \ \ldots \ b]\).

- 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

- \textit{zeros}(n, m) creates an \( n \times m \) matrix of 0s (\( n \) rows and \( m \) columns).
- \textit{ones}(n, m) creates an \( n \times m \) matrix of 1s (\( n \) rows and \( m \) columns).
- \textit{repmat}(x, n, m) repeats the scalar or matrix \( x \), \( n \times m \) times.
- \textit{eye}(n) creates an \( n \times n \) identity matrix, for example,
\[
\begin{bmatrix}
1 & 0 & 0 \\
0 & 1 & 0 \\
0 & 0 & 1
\end{bmatrix}
\text{ when } n = 3.
\]
- \textit{diag}([a b c]) creates a diagonal matrix
\[
\begin{bmatrix}
a & 0 & 0 \\
0 & b & 0 \\
0 & 0 & c
\end{bmatrix}
\]
Matrix Creation, Vector Quiz
Matrix Creation, Block Matrix

Quiz
Matrix Creation, Repeat Matrix

Quiz
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 \(\begin{bmatrix} a \\ b \end{bmatrix}^T = \begin{bmatrix} a & b \end{bmatrix}\).
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 $\text{ones}(n, m)$.

- $M \times c$ multiplies $c$ to every element of $M$, for example, $\text{ones}(n, m) \times 0$ 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 $j$.
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, Vector Quiz
Matrix Access, Vector Sequence

Quiz
Matrix Access, Matrix Quiz
Matrix Access, Matrix Sequence

Quiz
Blank Slide