

MATH1010/MATH6904 S1 2023, Matlab Assignment

Due 11:55 pm, Friday 26th May, 2023

Your submission must be a single PDF file.

Create a word document or similar. Copy/paste the relevant code and output from the MATLAB command window to the document. Please ensure each question is labelled, i.e. Question 1, Question 2, etc.

Once you have finished the assignment, save your document as a PDF file. Append all figures to this file and upload to iLearn. Google 'merge pdf' to find online sources that merge multiple PDF files.

1. [5 marks] Consider the linear system of equations

$$\begin{aligned}x_1 + x_2 + 3x_3 + x_4 &= 1, \\x_1 - x_2 - x_3 - x_4 &= 1, \\3x_1 + x_2 + 5x_3 + 3x_4 &= 1, \\x_1 + 5x_2 + 11x_3 + 8x_4 &= -2,\end{aligned}$$

for the unknown vector $\mathbf{x} = (x_1, x_2, x_3, x_4)^T$.

- (a) In MATLAB, define the matrix A and vector \mathbf{b} , such that $A\mathbf{x} = \mathbf{b}$.
- (b) Using the backslash command `\` determine the solution to the linear system $A\mathbf{x} = \mathbf{b}$.
- (c) Determine the determinant of A using the `det` command.
- (d) The answer in (b) is only one solution to the linear system. Using an alternative MATLAB command, determine and state the full set of solutions.

Copy/paste all MATLAB code and output to your document.

2. [4 marks] Consider the line given by the symmetric equation

$$\frac{x-1}{2} = \frac{y-3}{-1} = \frac{z+1}{1},$$

and the plane given by the Cartesian equation

$$3x - y + 5z = 7.$$

- (a) By hand (i.e., the method presented in lectures), determine the point (a, b, c) at which the line intersects the plane.
- (b) Define `[x,y]=meshgrid(0:4)` and using `mesh(x,y,z, 'linestyle', 'none', 'facecolor', 'red')` plot the plane. Type `hold on`.
- (c) Using the `plot3()` command, plot the line in the same figure as the plane.
- (d) In the same figure, plot the point of intersection (a, b, c) of the line and plane, using the command `plot3(a,b,c,'ko','markersize',20, 'MarkerFaceColor','k')`.
- (e) Add an appropriate title, and x -, y -, z -labels to your figure and save as a PDF.

Copy/paste all MATLAB code and output to your document. Attach the figure to the main document, using online merge packages.

3. [4 marks] Consider the functions

$$f(x) = x^2 \quad \text{and} \quad g(x) = \sqrt{4 - x^2}.$$

- (a) Determine the domain of the composite function $(f \circ g)(x)$. In MATLAB, define the domain of $f \circ g$ using the `linspace` command, and define the composite function $f \circ g$.
- (b) Plot the composite function using the `plot()` command.
- (c) Add an appropriate title, and x -, y -labels to your figure and save as a PDF.

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4. [4 marks] Consider the function

$$A(t) = 2b^2t^4 - 2t^2,$$

where $b \in \mathbb{R}$.

- (a) Use the `syms` command to create the symbolic variables t and b , and then create the symbolic function A .
- (b) Use the `diff` command to find dA/dt . (See section 1.9.1 of the MATLAB Manual.)
- (c) Use the `solve` command to solve $dA/dt = 0$. (See section 1.9.3 of the MATLAB Manual.)
- (d) Use the `subs(A,t)` command to compute $A(5b)$.

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5. [3 marks] Use MATLAB to determine the following integrals.

- (a) Determine

$$\int \tan(x) \, dx.$$

(Use the `syms` and `int` commands. See section 1.9.1 of the MATLAB Manual).

- (b) Determine

$$\int \log(x^2) \, dx,$$

where \log is the natural logarithm.

- (c) Determine

$$\int x^2 \sin(2x) \, dx.$$

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