Lecture listings for online course

Master MATLAB through guided problem-solving

https://www.udemy.com/master-matlab-through-guided-problem-solving/

How to use this pdf document:

The table provides a list of all videos in this course, with video title, description, and key MATLAB skills. You can:

1. Browse through the list of videos as you would browse through the video list in the online course.
2. Search through the index for a MATLAB function or skill you want to improve, and then find the videos that highlight those skills.

Note that the numbering of the videos here refers only to the numbering in the index in this document. The videos are in the same order in the course website, but they are not numbered.

Number and Title	Description	Skills
	Course introduction	
1. Stages of learning programming and completing projects	How to become a master programmer	learning
	Getting started	
2. Write comments in lines and blocks	Learn several ways to comment your code.	comments, cells
3. Using MATLAB for a personal budget	Compute average daily budget based on monthly income/expenses.	disp, num2str
4. Personalize MATLAB colors	Make your MATLAB experience colorful.	options, preferences
5. Start MATLAB with an encouraging note	Specify start-up preferences.	startup, set
	Vectors and variables	
6. Unsolved: Valid and invalid matrices	Determine whether code is valid	matrices
7. Working with text (characters and strings)	Parse and modify text.	regexp, cellfun, strfind
8. html table from MATLAB code	Use MATLAB to write dynamic html code.	char, randi, clc, for, disp, fprintf
9. Round pi to N significant digits	Compute and print pi to any number of digits.	pi, format, round, disp
10. File/folder information using structures	Use dir and structures to query file/folder information	dir, cellfun
	Command statements	
11. Unsolved: Compare two while loops	Determine the differences between two loops	while
12. Create an upper-triangular matrix	Use for-loops and if statements to create a triangular matrix.	zeros, for, if, sqrt
13. Random count-down timer (Poisson-like)	Implement a random Poisson-like count-down timer.	while, randn, for, plot
14. Display the day of 1 January	Compute the day of 1 January, any year	mod, switch, clock, fprintf, disp
	Importing and exporting data	
15. Import formatted text data	Use fgetl to import data from a formatted text file.	fgetl, strcmpi, while, toggle, str2double, regexp
16. Import Excel-format data	Import data from an Excel file and identify missing data values.	xlsread, find, cell2mat, unique, isnan, ind2sub, warning
17. Convert US$ to Euros using up-to-date info	Import data from the web to convert currencies.	urlread, strfind, fprintf, sscanf
	Translate formulas into code	
18. Laplace and log-normal distributions	Convert distribution functions into MATLAB.	exp, abs, plot, linspace, sqrt, log
19. Complex numbers and Euler's formula	Make complex numbers, apply Euler's formula, and test the law of exponents.	complex, 1i, exp, sin, abs, angle,
20. Piecewise functions	Implement a piecewise formula	linspace, zeros, length, find, dsearchn, plot
21. Piecewise function in one line of code	Produce a piecewise function using one line of code.	dsearchn, sin
22. Sigmoid function	Implement a 3-parameter sigmoid function	linspace, exp, get
23. Unsolved: Sigmoid and error function	Parameterize the sigmoid to look like the ERF function	erf
24. Circular p-value and its approximation	Implement a long and tedious function, and then its approximation.	exp, sqrt, contourf

Number and Title	Description	Skills
	Descriptive statistics	
25. Compute variance and standard deviation	Implement algorithms to compute variance and standard deviation	var, std
26. Unsolved: Sort data up and down	Sort numeric data	sort
27. Data transformations (log, sqrt, rank)	Transform datasets to have different distributions	log, sqrt, tiedrank, atanh, hist
	2D plotting	
28. Bars and errorbars	Generate data to learn about bar and errorbar.	bsxfun, subplot, mean, std, bar, errorbar
29. Dots	Make scatterplots to show data.	exp, linspace, plot, get/set, scatter, log
30. Multidimensional data with colored scatter	Use color for multidimensional data on a 2D plot.	linspace, sin, exp, randn, scatter
31. Unsolved: imagesc vs. pcolor	Determine the difference between two image plotting functions	imagesc, pcolor
32. Histograms	Make histograms of log-normal distributions.	exp, randn, histogram, hist, plot, num2str, pause, iqr, title
33. Uncertainty in future money (using patch)	Use patches to visualize the future value of your money.	patch, get/set, deal
34. Blend pictures using transparency	Use transparency to combine pictures.	imagesc, alphadata, imread, meshgrid, interp2, imresize, sin, logspace, set
35. Vertically stacking data series	View multichannel data in a single line plot.	eig, sqrt, detrend, cumsum, bsxfun
36. Distance matrix from generated points	Compute a distance matrix from mouse-generated points.	ginput, strcmp, numel, bsxfun, nonzeros, triu
37. Gabor patch marginal histograms	Create a Gabor patch and show its marginal distributions	ndgrid, sin, cos, exp, axes
	3D plotting	
38. Colorful cube (a.k.a. the happy Borg ship)	Generate a cube of connected nodes.	linspace, meshgrid, randn, scatter3
39. Expanding wavelets with surfaces	Surface map of wavelets	zeros, for, surf, rotate3d
40. Textured Gaussian surfaces	Curved surface with various textures.	linspace, meshgrid, exp, surf, shading
41. A ball in 3D color space	Define and plot a sphere in RGB space	meshgrid, sqrt, ind2sub, scatter3, rotate3d
42. Plane in R3 spanned by two vectors	Plot a plane defined by two 3D vectors.	ezmesh, get/set, rotate3d, plot3
43. Complex sinc surface	Create a modern-art table using the sinc function	sin, complex, surf, abs
44. The prickly Gabor patch	Create a Gabor patch and show with its normals	ndgrid, mesh, surfnorm
	Segmentation	
45. Derivative-based time series segmentation	Identify jumps in a simulated stock market.	conv, linspace, diff, zscore, num2str
46. Intensity-based image segmentation	Segment a smoothed random image based on relative intensity.	meshgrid, exp, conv2, bwlabeln, logical
47. identify neurons in a mouse brain slice	Segment a high-res image to identify brain cells.	imread, hist, imagesc, contour, bwconncomp, cellfun, false, continue, log

Number and Title	Description	Skills
	Data animations	
48. The square chases the mouse	A square moves to the mouse-click location.	while, get/set, currentpoint, mouse
49. The magically materializing peaks	Animate the famous "peaks" function to materialize slowly and randomly.	peaks, set, for, pause
50. Smooth sailing: The movie	Generate a movie of traveling waves on standing waves.	
51. Real-time audio spectrum from mic	Collect mic data and analyze in real time.	while, audiorecorder, fft, abs
52. Möbius transformation	Watch how the Mobius transformation glides across the screen.	complex, set, imagesc
53. UFO on a sandcastle	Create and animate a glowing ball on a surface	sphere, Gaussian, meshgrid, set
	Graphical user interfaces	
54. Interface to select a file	Dialog box to select files and folders.	uigetfile, uigetdir
55. Input and message boxes	Simple GUIs to evalute chocolate consumption.	questdlg, inputdlg, msgbox
56. GUI to create random landscapes	User interface to make adjustable 3D landscapes.	figure, uicontrol, get/set, function, fft, handles, align
57. GUIDE to sigmoid parameter space	Create a GUI that helps understand the sigmoid parameters	get/set, exp, GUIDE, handles, guidata
	Functions and anonymous functions	
58. Damped oscillator	Create an anonymous function to produce a damped oscillator	inline, func2str
59. Unsolved: damped arcsine	Implement a damped arcsine anonymous function and explore its parameter space	exp, asin
60. Find and extract a function core	Inspect the median function to find the important code, and put that in a separate function.	median, sort, floor
61. Smooth plotting function with options	Apply a mean smoothing filter and optionally plot the results.	function, nargin, varargin, isempty, floor
62. Unsolved: Zscore function	write a function that computes the zscore with various options	zscore, mean, std
	Find, min, and max	
63. Unsolved: manual peak-picking	Use datacursor to find a local minimum	datacursormode
64. Find negative extrema in a 2D function	Finding extreme points is not as easy as you might think!	linspace, bsxfun, surf, shading, max, min, find, sub2ind, plot3
65. Unsolved: Find ridges of a 2D surface	Plot points on the ridges of a 2D landscape	find, max, min
66. Find local maxima	Indentify local maxima of a sinc function	sin, max, plot, dsearchn, diff, detrend
67. Replace image pixels in an intensity range	Change the color of mid-range intensity pixels	sum, hist, log, imagesc,
68. Find signal clipping points	Mark time points where a signal gets clipped (e.g., amp saturation)	diff, mode, find
	Calculus and differential equations	
69. Function limits	Compute the limits of two functions at interesting points	limit, fplot, syms
70. Function derivatives	Use the symbolic toolbox to compute the derivative and value of a function	syms, diff, subs, pretty
71. Function integration	Compute integrals and partial integrals, symbolically and numerically.	int
72. Solving differential equations	Solve an ODE and plot the results	diff, dsolve, quiver, meshgrid, ezplot

Number and Title	Description	Skills
	Cleaning univariate time series	
73. Threshold median filter	Remove extreme noise spikes with median filter.	randperm, round, rand, find, median, min, max
74. Interpolate missing time points	Find missing data values and interpolate to fill-in.	deal, conv, randperm, bwconncomp, cellfun, continue, diff
75. Unsolved: all-points median filter	Median-filter a time series at all points, not just extreme points	median
76. Spectral mixing interpolation	Fill-in missing data based on spectral mixing.	deal, cumsum, nan, fft, detrend
77. Polynomial fitting to remove drifts	Find an optimal polynomial model order and remove slow drifts from data.	polyval, polyfit, sum, log, min
78. Unsolved: polynomial fitting to isolate drifts	Use polynomial fitting to separate low-frequency signal from high-frequency noise	polyfit, polyval
79. Unsolved: Local maximima in noisy data	Find local maxima in noisy data	diff, find, randn
	Cleaning multivariate time series	
80. Reject data based on extreme covariance	Use covariance distances to identify and remove artifact data	cov, sqrt, histogram
81. Effects of averaging on covariance matrices	Compare different ways of computing covariance matrices for "phase-locked" and "non-phase-locked" data	linspace, sin, bsxfun, repmat
82. Simulate tri-component time-space data	Combine forward models of sine, Gaussian, and linear slope to create spatiotemporal patterns	meshgrid, exp, imagesc, interp1
83. Unsolved: Tri-component data without loops	Reproduce the multivariate dataset without any for-loops.	for
84. Space-based single channel interpolation	Corrupt random pixels in space-time data, and reconstruct using spatial interpolation	ceil, set, scatteredInterpolant
85. Spatial smoothing on a grid of channels.	Add random noise to space-time data and removing using spatial convolution.	conv2, mean
86. Spatial sharpening via Laplacian.	Apply the Laplacian operator to sharpen the space-time dataset	conv2
	Time series analysis	
87. High-pass filter using FIR filter	High-pass filter a time series to remove slow trends.	firls, filtfilt, fft, floor, cumsum
88. Narrow-band filter via frequency-domain Gaussian	Apply a narrowband filter to broadband noise via circular convolution.	linspace, exp, ifft, bsxfun, dsearchn, diff, get/set
89. Causal vs. zero-phase-shift filter	See the difference between causal and acausal filter.	sin, exp, firls, filter,
90. Line noise notch filter	Use FIR filters to remove electrical line noise.	fir1, filtfilt, fft,
91. Compute envelope over peaky, noisy signal	Use automated peak-detection to interpolate over maximum values.	randperm, zscore, for, linspace, dsearchn, interp1, zoom
92. Frequency-domain mean filter	Show that the running-mean filter can be implemented (faster) in the frequency domain.	tic/toc, mean, fft, bar
93. Create a "chirp" (FM signal)	Create signals with time-varying frequencies and compute instantaneous frequency.	sin, mean, fft, abs, angle, hilbert, unwrap, diff
94. Detrended fluctuation analysis	Compute the DFA (similar to Hurst exponent) of different colored noise.	randn, ifft, ceil, cumsum, detrend, reshape, sqrt, log10, legend

Number and Title	Description	Skills
	Spectral analysis	
95. Power spectrum from FFT and Welch's method	Compute the power spectrum of a multispectral signal using two methods	fft, abs
96. Spectrogram of bird call	Show the time-frequency response of a bird call	audioread, spectrogram, soundsc
97. Phase-scramble narrowband time series	Produce narrowband random data, then see what happens when you scramble the phases.	ifft, rand
98. Hilbert transform	Implement the Hilbert transform	complex, ifft, 1i
99. Oscillations in human brain recordings	Adapt existing code to see the spectral features of human electrical brain activity.	fft, abs, mean, linspace
100. Time frequency analysis via wavelet convolution	Extract time-frequency power using complex Morlet wavelet convolution.	sin, deal, exp, fft, floor, contourf, subplot
101. Unsolved: Time-frequency analysis of interpolated signal	Implement a time-frequency analysis of the spectrally filtered corrupted time series.	exp, sin, 1i, fft
	Matrix analysis	
102. Unsolved: Plot vectors and compute lengths	Plot vectors in 2D and 3D and compute and report the vector lengths	sqrt, norm
103. Hermitian vs. regular transpose	Learn the difference between Hermitian and regular transpose, and why Hermitian is needed.	transpose, complex
104. Create a symmetric matrix: Additive	Create a symmetric from asymmetric square matrix.	transpose, reshape
105. Create a square symmetric matrix: Multiplicative	Multiply a rectangular matrix by its transpose to get a square symmetric matrix.	transpose, imagesc, set
106. MxM matrix with rank M-1	Learn about matrix rank and create a reduced-rank matrix.	rank, randn, bsxfun, size
107. MxN matrix with rank r via SVD	Use matrix decomposition to create a reduced-rank approximation of a matrix.	svd, rank, title, norm
108. Create a random Hankel matrix	Two ways to create a Hankel matrix from a random vector.	hankel, numel, subplot
109. Unsolved: Element-wise Hankel matrix with mod function	Find an alternative algorithm to create the Hankel matrix using matrix indexing.	hankel, for
110. Unsolved: Create a Toeplitz matrix	Repeat the Hankel matrix project but with a Toeplitz matrix	toeplitz, hankel
111. Eigenvectors of a Hankel matrix	Explore the rhythmic nature of eigenvectors of a Hankel matrix.	hankel, eig, sort, diff, sign, numel, diag
112. Compute a unit vector in some direction	Scale a vector to length=1 to obtain a unit vector	norm
113. Orthogonalize a pair of vectors	Decompose a vector into parallel and orthogonal components, relative to some other vector.	norm, orthogonalize, handlevisibility
114. Gram-Schmidt algorithm	Create an orthogonal matrix using the Gram-Schmidt algorithm	dot, norm, qr
115. Matrix inverse via QR decomposition	Use QR decomposition to compute the inverse of a matrix.	qr, inv
116. Visualize the quadratic form of a 2x2 matrix	Compute and make a surface of the quadratic form of a 2x2 matrix.	for, zeros, surf, rotate3d, shading
117. Eigenvectors and quadratic form	Compute and plot the eigenvectors of a matrix, and display on top of the quadratic form	eig
118. PCA of low-rank space-time data	Generate 3D data and perform a principal components analysis	eig, meshgrid
119. Covariance shrinkage regularization in PCA	Explore the effects of shrinkage of eigenvalues and eigenvectors	meshgrid, exp, reshape, pause, eig, sort, for, axis
	Circular distributions and analyses	
120. Circular histogram	Generate histograms of uniform and bulged phase angle distributions.	sin, angle, hilbert, polarplot, rose
121. Compute and plot mean vector length	Comptue the average of a set of unit vectors.	angle, hilbert, mean, exp, polarplot
122. Phase difference between two distributions	Extract phase angles from two signals, and compute the variance of the phase angle differences.	angle, abs, hilbert, sin, detrend, set

Number and Title	Description	Skills
	Fractal time series and images	
123. Unsolved: Sierpinksi triangle as dense matrix	Convert XY indices into a full matrix.	zeros, imagesc, round
124. Brownian motion	Show Brownian motion (random walk) in the time and frequency domains.	cumsum, fft, randn
125. Cantor set and devil's staircase	Compute the Cantor's set and its accompanying devil's staircase	repmat, reshape, plot
126. Unsolved: Initialize the Cantor set	Repeat the Cantor set with indexing instead of concatenation.	zeros, for, cat
127. Mandelbrot set	Create the "quadratic map," which leads to the famous fractal flower.	complex, meshgrid
128. Weierstrass function	Explore a member of the Weierstrass function family.	cos
129. Fractal circles and bubbles	Create circles and bubbles with radii drawn from a scale-free distribution	sin, cos, sphere, surf
	Nonparametric statistics	
130. 2D space of Wilcoxon effect sizes	Explore the mean-deviation space of Wilcoxon effects sizes	contourf, colorbar, ranksum
131. KL divergence of two distributions	Compute two probability densities and the KL divergence between them.	histcounts, isfinite
132. 2D space of KL divergences	Generate a space of KL distances based on distribution parameters.	histcounts, colormap
133. Permutation testing	Use permutation testing to determine whether two distributions are significantly different.	histogram, subplot
134. Bootstrapping for confidence intervals	Compute 95% confidence intervals around the mean of a distribution	mean, subplot, hist
135. Unsolved: bootstrapping medians	Create a complex function, split the distribution into three groups, and compute the median for each subgroup.	randsample, histogram, prctile, complex, isfinite
	Nonlinear model fitting	
136. Fit a Gaussian to a distribution	Generate noisy Gaussian data, and find the parameters that make a model best fit the data.	exp, function handles, fminsearch
137. Two-piece linear regression	Generate random data drawn from a triangle-distribution, and then piece a two-piece linear regression to the data.	sqrt, hist, fminsearch
138. Fit a sine wave	Use several nonlinear search methods to identify the three sine-wave parametres of a given sine curve.	sin, fminsearch, plot
139. Fit a circle to a noisy ring	Fit rings to noisy circles and ovals.	cos, lsqnonlin, tic, toc, randn, fminsearch

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