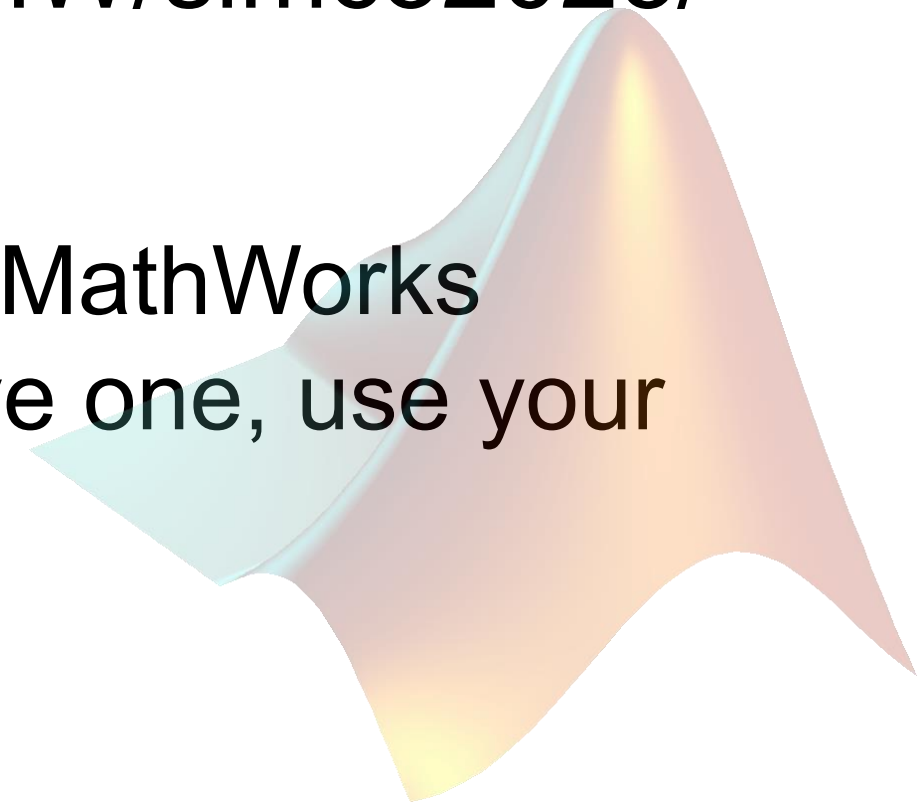
Get Started

- Access GitHub repository
  - https://github.com/nrobertsMW/simco2025/

- This may prompt you to create a MathWorks account if you do not already have one, use your university email address



Introduction to MATLAB

Noah Roberts

MathWorks®

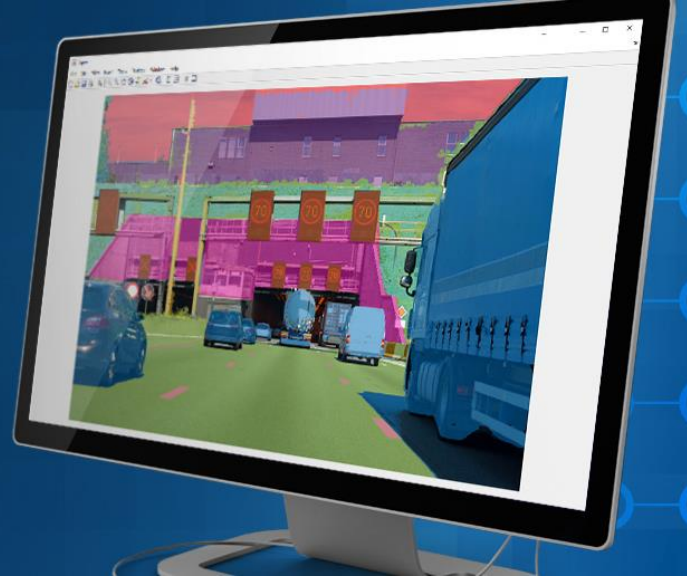
Agenda

I. Introduction
II. MATLAB Desktop and Scripts
III. Data Visualization
IV. Arrays and Matrices
V. Logical Indexing
VI. Resources

MathWorks®

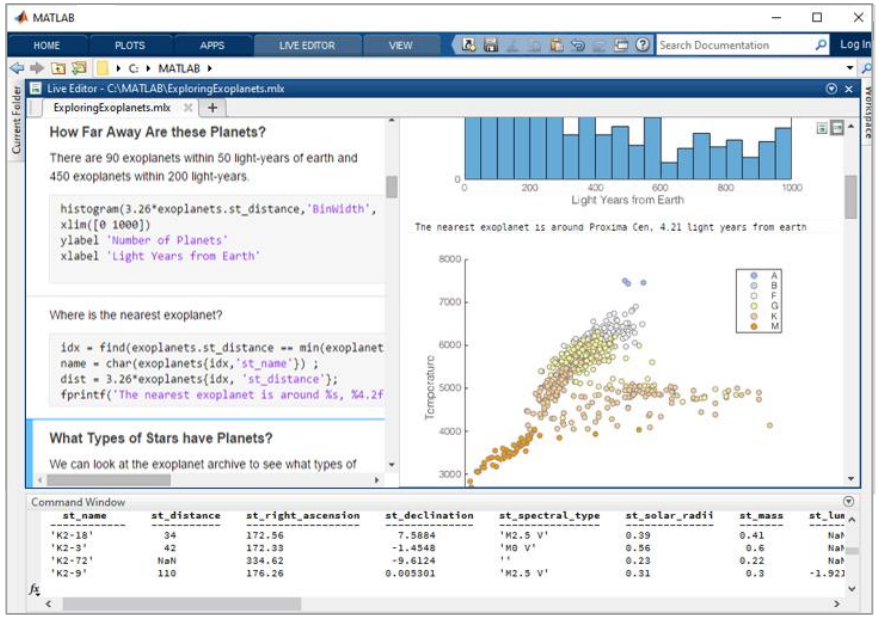
Our Products

MATLAB® & SIMULINK®



- **MATLAB** - Programming environment for algorithm development, data analysis, visualization, and numeric computation.
- **Simulink** - Block diagram environment for simulation and Model-Based Design of multidomain and embedded engineering systems.
- **130+ add-on products** for specialized tasks.

Computer Vision Toolbox



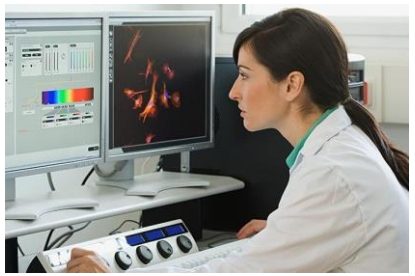
Our software is used to design the products we rely on every day

And the breakthroughs transforming how we live, learn, and work

Our Customers / Key Industries

Aerospace and Defense

Automotive

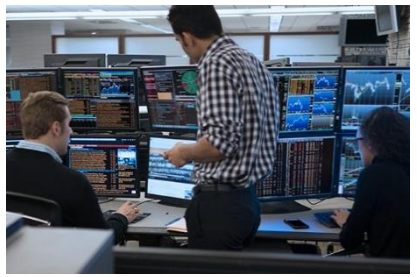

Biological Sciences

Biotech and Pharmaceutical

Communications

Electronics

Energy Production


Financial Services

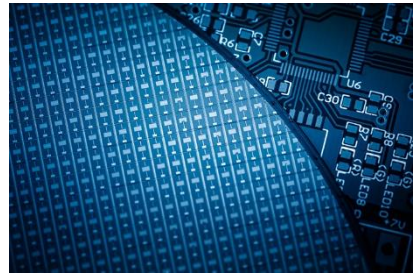
Industrial Machinery

Medical Devices

Process Industries

Neuroscience

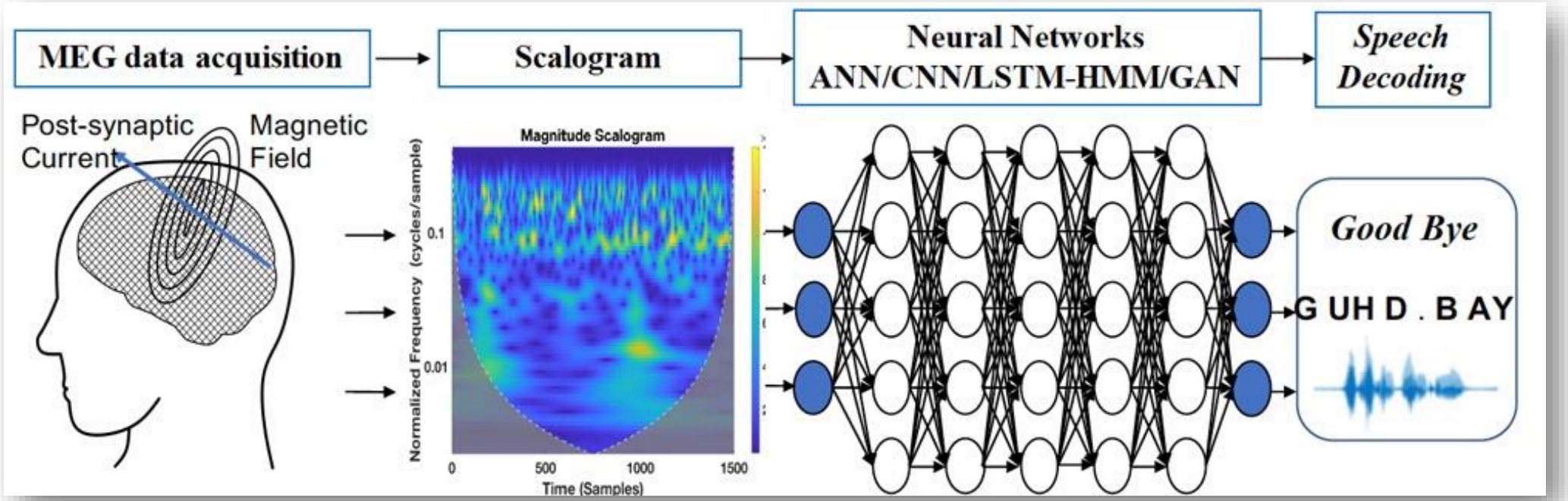
Railway Systems


Semiconductors

Software and Internet

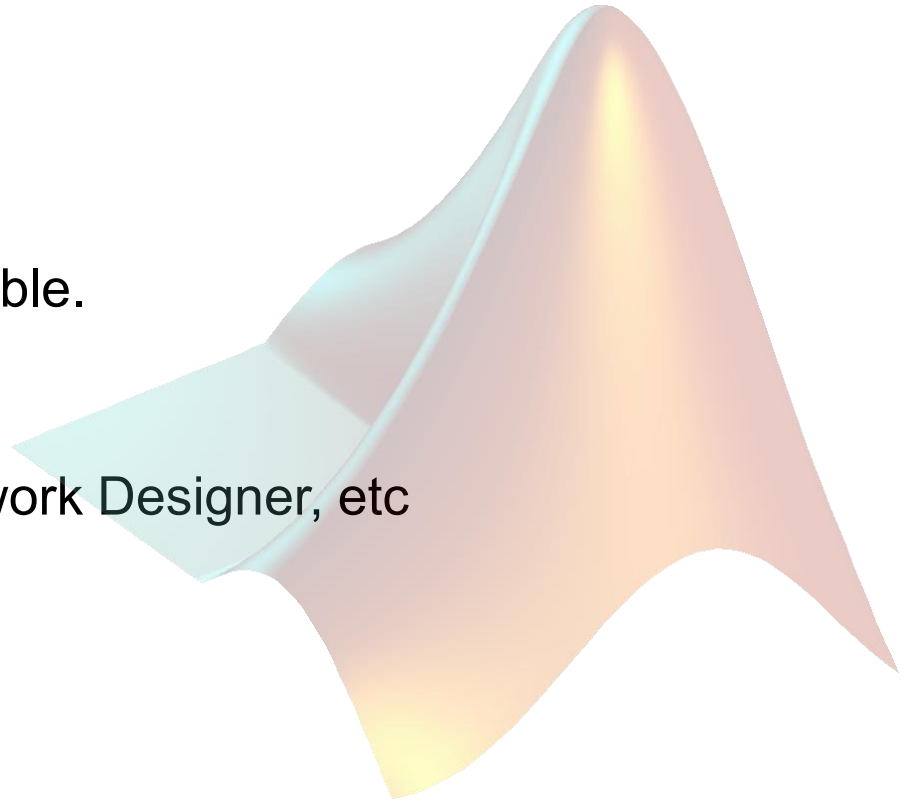
Neuroscience

[UT Austin Researchers Convert Brain Signals to Words and Phrases Using Wavelets and Deep Learning]



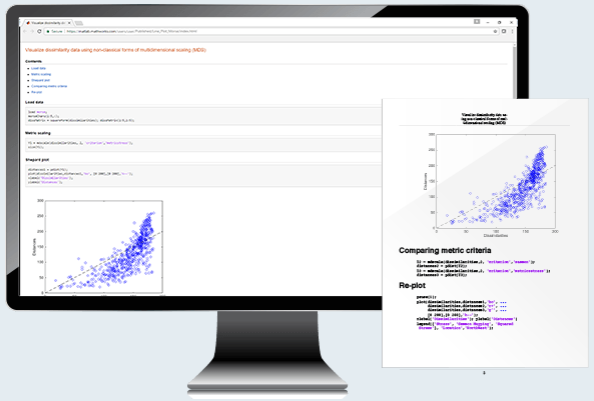
Why MATLAB?

- Extremely easy to code
  - Can be used for rapid prototyping and trying out ideas before production
- MATLAB speaks Math
  - Solve equations like you do on your book.
- Specially designed for scientists and engineers
  - Function names and signatures are familiar and memorable.
- Inbuilt apps
  - Filter designer, Signal analysis, Curve Fitting, Deep Network Designer, etc
- Interoperability with other programming languages
  - Python, C++ and many others



Campus Wide License

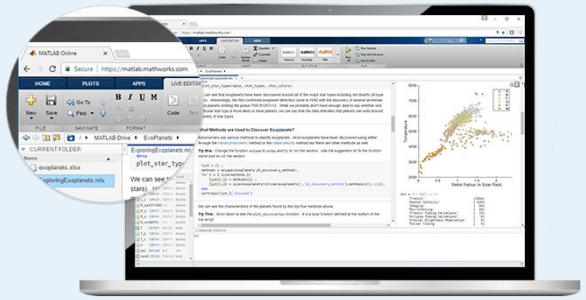
Anytime, Anywhere Access for Faculty, Staff, Students, and Visitors



MATLAB for Desktops

Access MATLAB on personal and university-owned machines

Visit your university MATLAB portal



MATLAB Online

Access MATLAB with a web browser

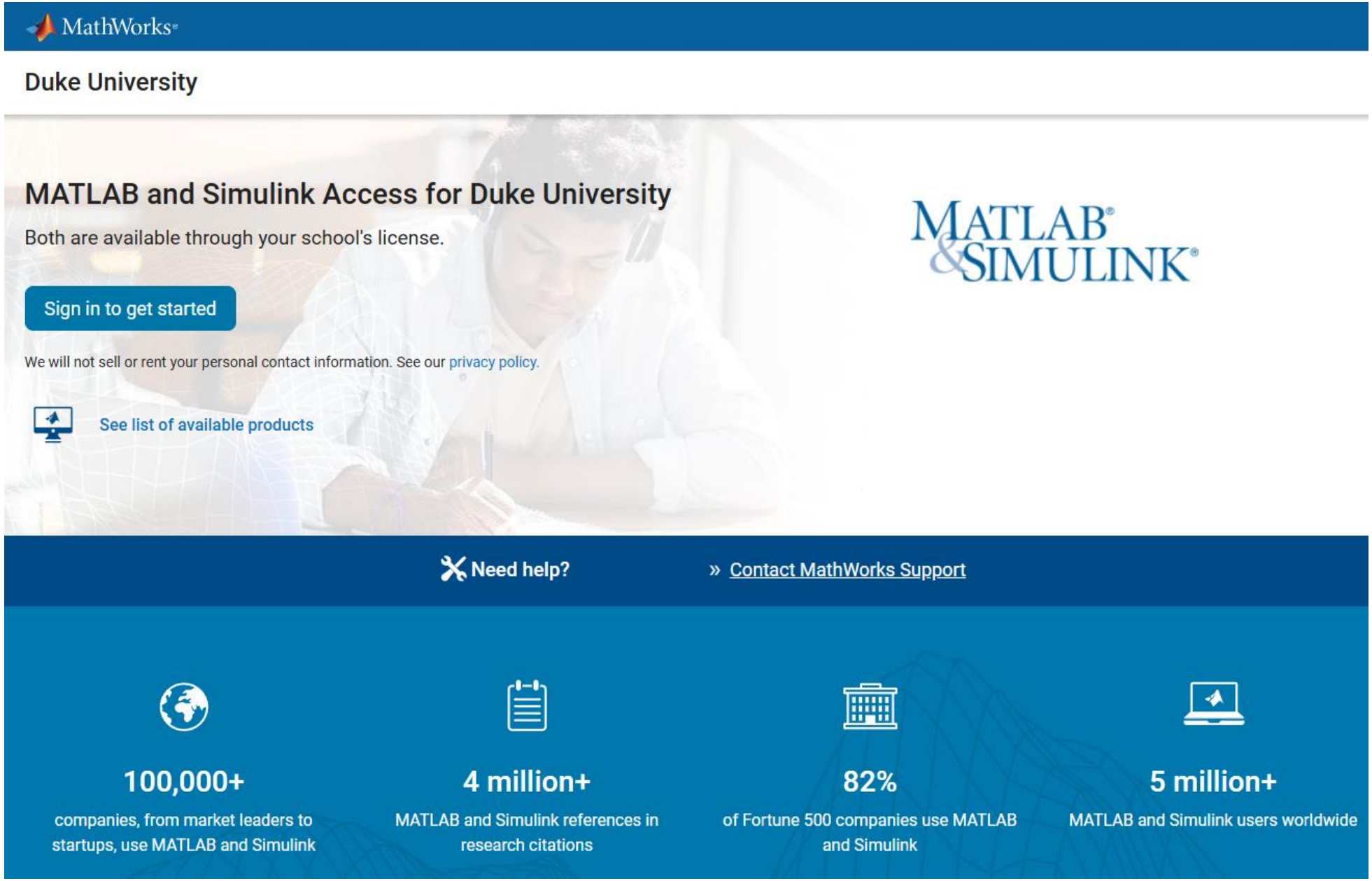
Visit matlab.mathworks.com

MATLAB Mobile

Access MATLAB on iOS/Android devices

GET IT ON Google Play

Download on the App Store


MathWorks
Duke University
MATLAB and Simulink Access for Duke University
Both are available through your school's license.
Sign in to get started
We will not sell or rent your personal contact information. See our privacy policy.
See list of available products
MATLAB & SIMULINK
Need help?
» Contact MathWorks Support
100,000+
companies, from market leaders to startups, use MATLAB and Simulink
4 million+
MATLAB and Simulink references in research citations
82%
of Fortune 500 companies use MATLAB and Simulink
5 million+
MATLAB and Simulink users worldwide

Get Started

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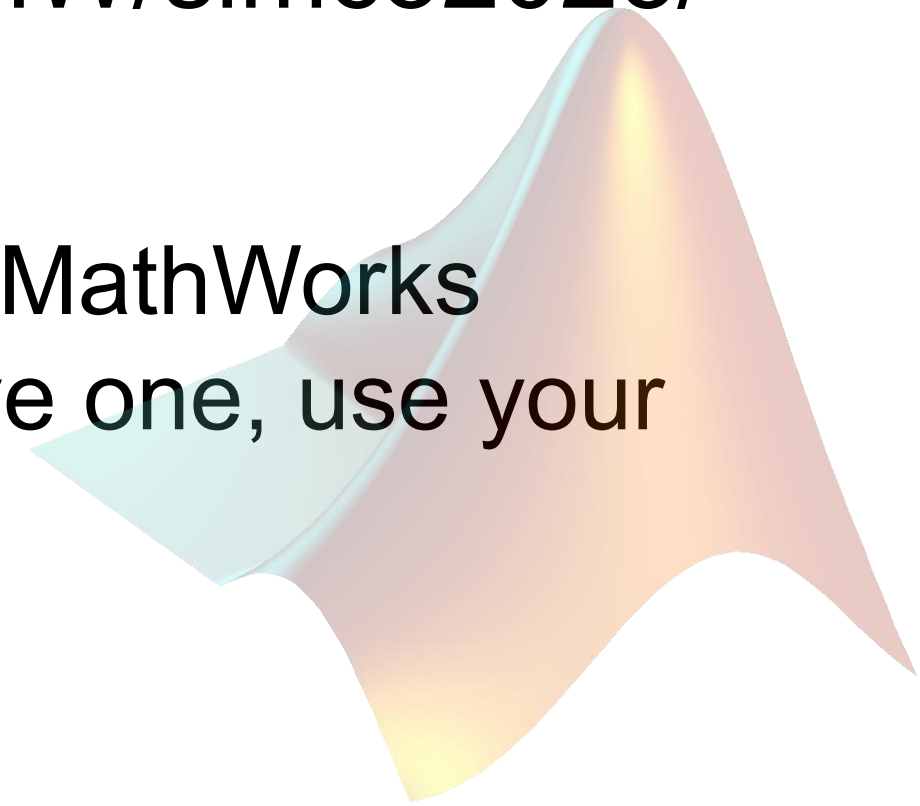
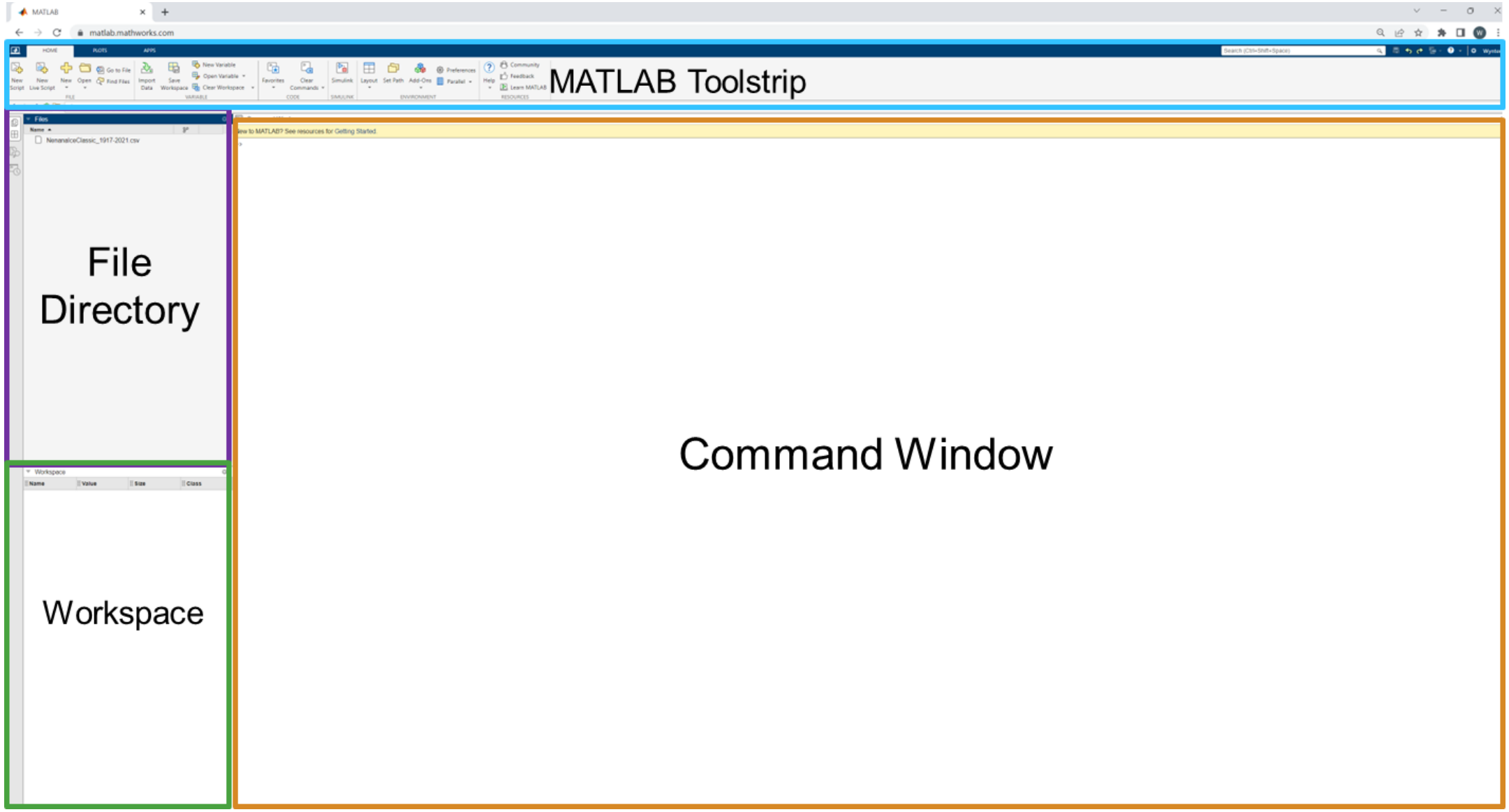


MATLAB Environment Introduction



Build MATLAB Proficiency

LEARNING PATH

Develop a broad set of MATLAB skills, enabling you to tackle more complex problems.

Topics covered:

- Creating informative scripts
- Analysis of data in vectors, matrices, and tables
- Techniques for extracting subsets of data
- Programming constructs and functions

Recommended prerequisite:

MATLAB Onramp
2 hours

MATLAB Desktop Tools and Troubleshooting Scripts
1 hour

Explore Data with MATLAB Plots
2 hours

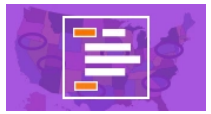
Make and Manipulate Matrices
1 hour

Calculations with Vectors and Matrices
1.5 hours

Tables
2 hours

Find and Extract Subsets of Data
1.5 hours

Programming Constructs
2 hours

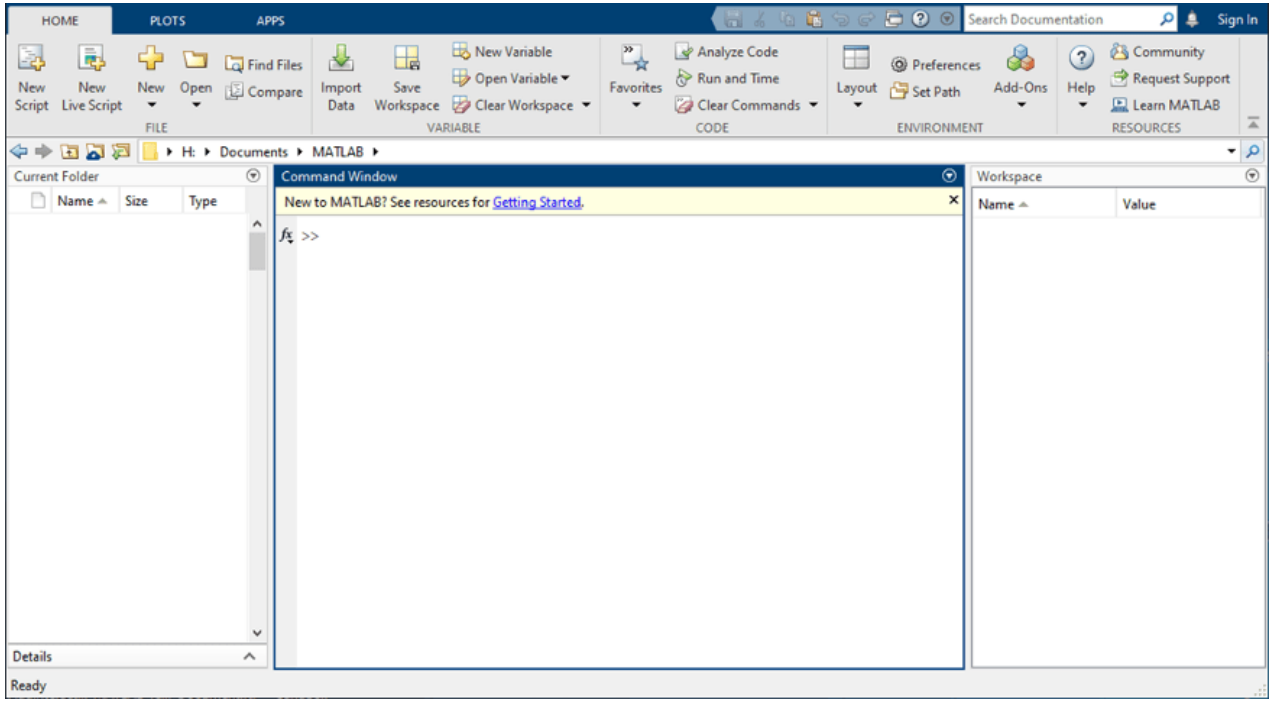


The How and Why of Writing Functions
1 hour

Exercise 1: Using the MATLAB Desktop

MATLAB Desktop Tools and Troubleshooting Scripts
1 hour

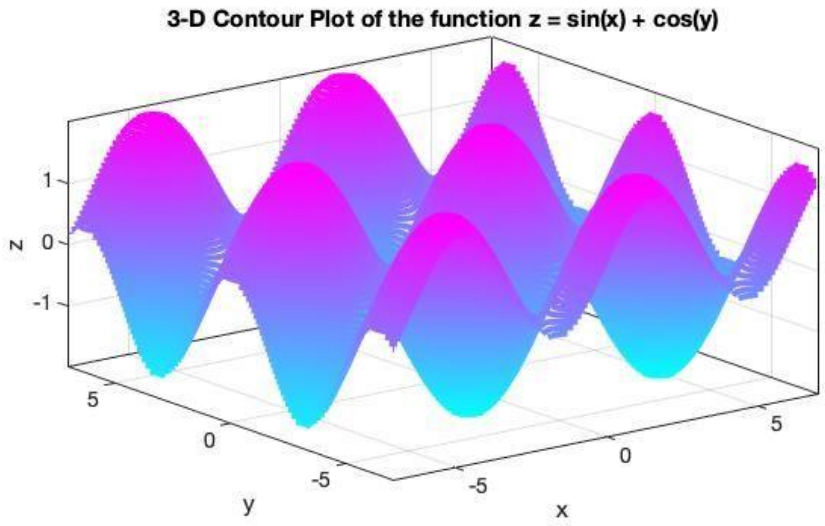
- MATLAB Desktop Editor
- Storytelling with Scripts
- Debugging MATLAB Code

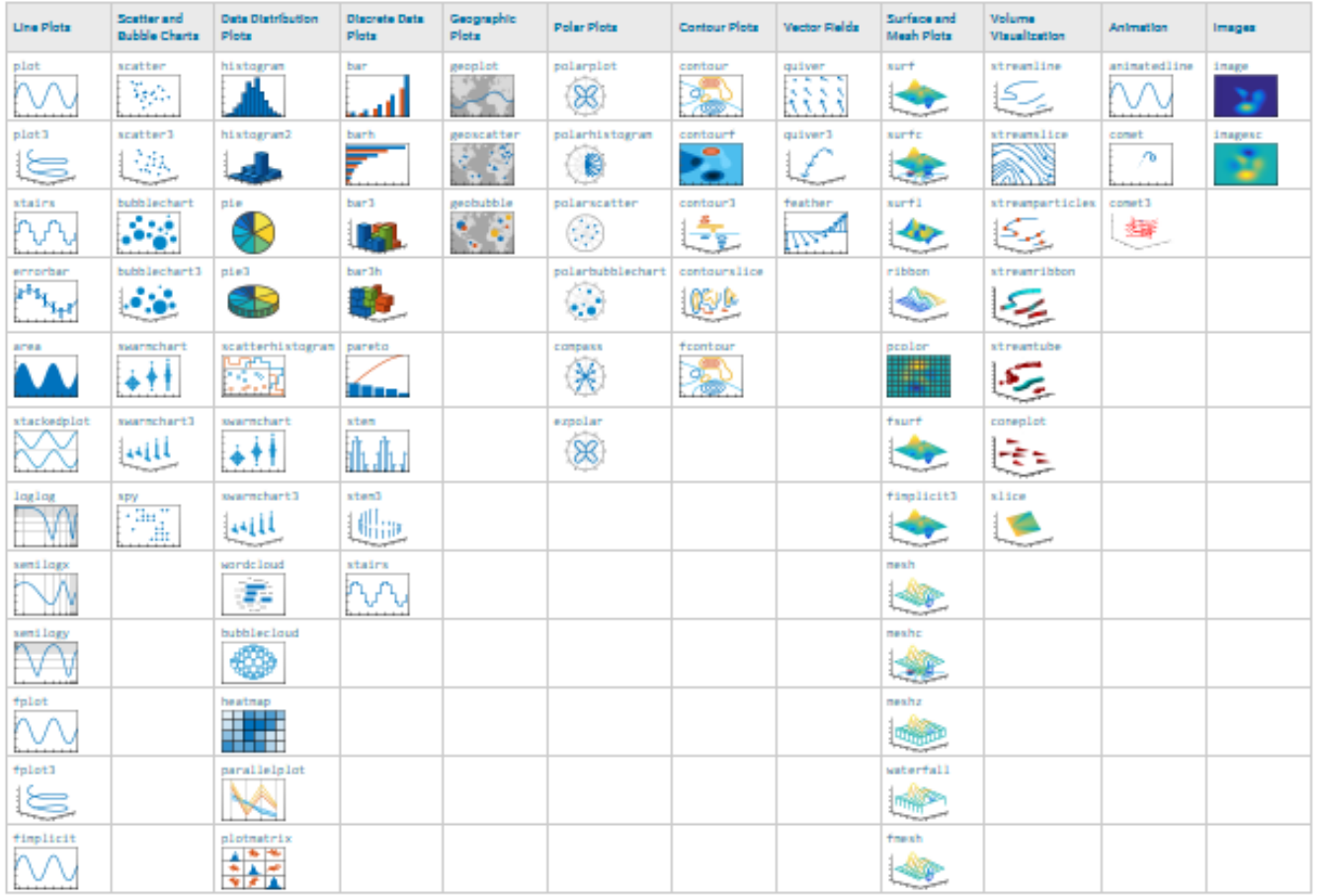


Exercise 2: Visualizing your Data

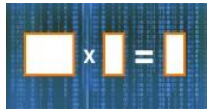
Explore Data with MATLAB Plots
2 hours

- Visualize Vectors
- Plot Data for Comparison



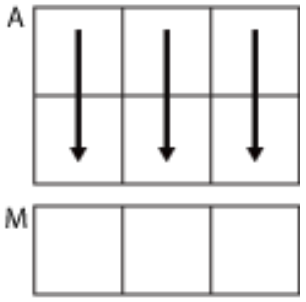


Exercise 3: Statistical Operations



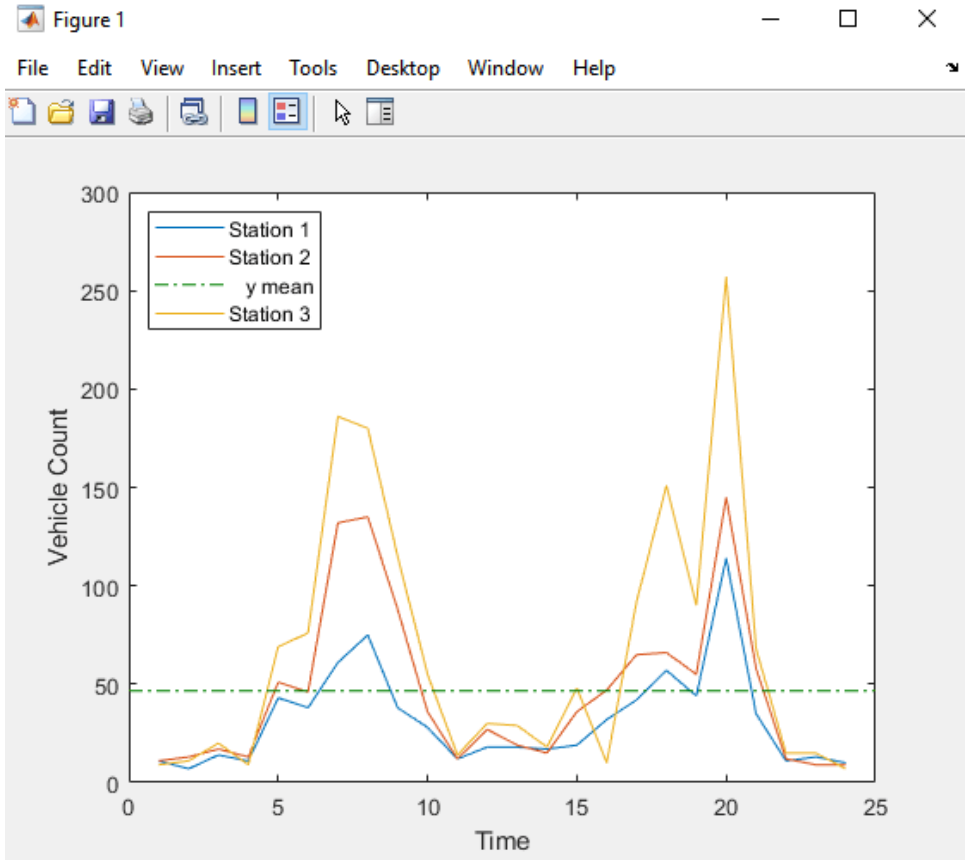
Calculations with Vectors and Matrices
1.5 hours

- Operations on Arrays
- Statistical Operations on Matrices

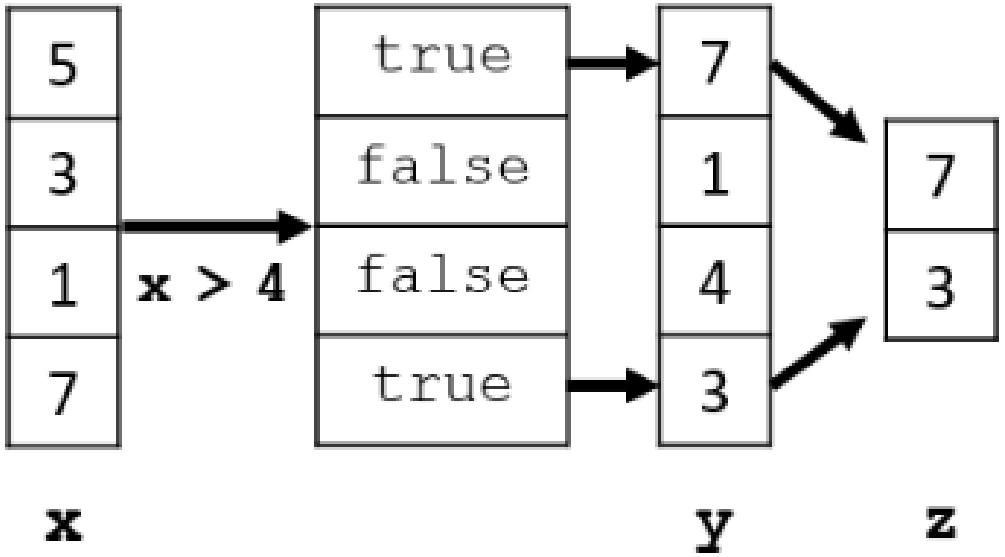


max(A,[],1)

max(A,[],2)



Logical Indexing



Exercise 4: Logical Indexing

Find and Extract Subsets of Data
1.5 hours

- Logical Operations
- Logical Vectors
- Conditional Data Selection

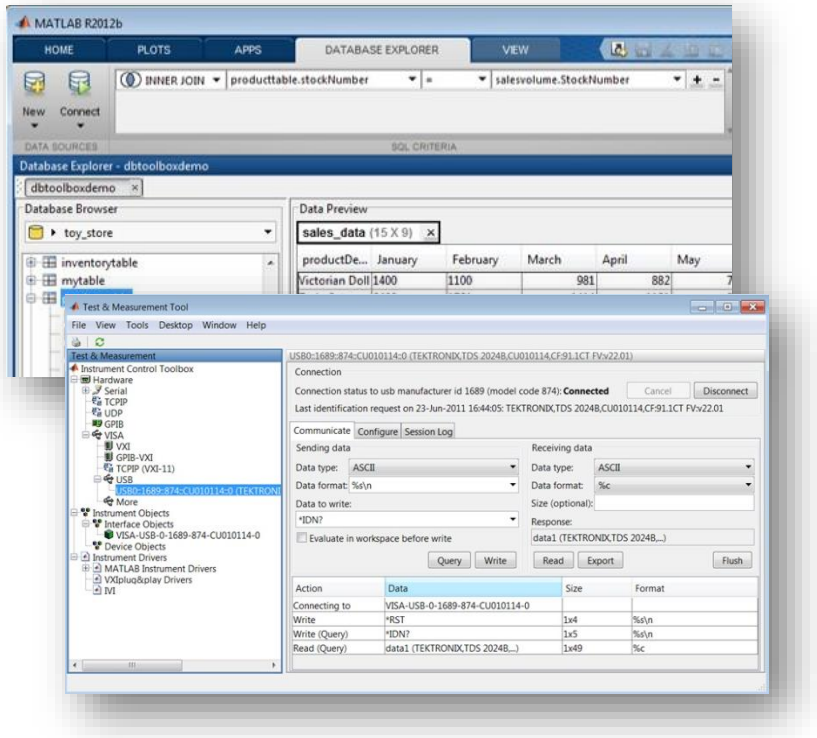
Logical Indexing

Team	Wins		Losses	
Montevideo Matrices	20		7	✓
Fresno Fireants	3		27	✗
Imaginario Madrid	19		10	✓
Manchester Divided	19	>	10	✓
Pittsburgh Penguins	9		19	✗
Natick Narwhals	9		22	✗

Accessing Data from MATLAB

Access | Explore & Discover | Share

- Files
  - Excel, text, or binary
  - Audio and video, image
  - Scientific formats and XML
- Web Services
  - JSON, CSV, and image data
- Applications and languages
  - C/C++, Java, FORTRAN, Python
  - COM, .NET, shared libraries
  - Databases (*Database Toolbox*)
- Measurement hardware
  - Data acquisition hardware *(Data Acquisition Toolbox)*
  - Stand-alone instruments and devices *(Instrument Control Toolbox)*

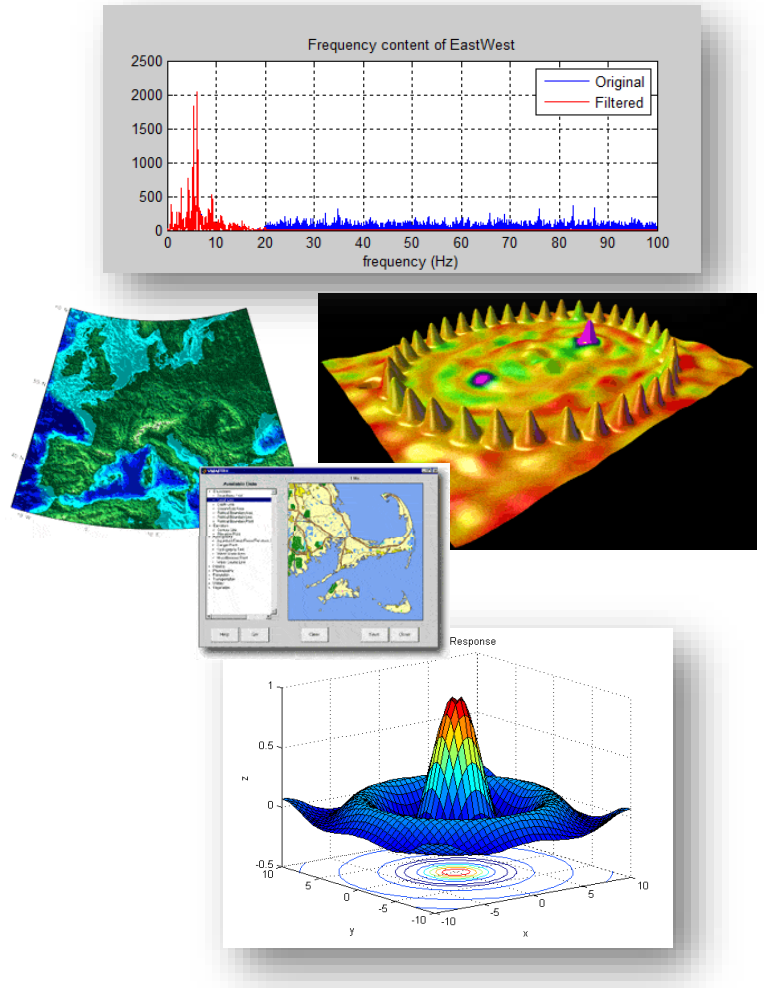


Data Analysis and Visualization in MATLAB

Access | **Explore & Discover** | Share

- Data analysis
  - Manipulate, preprocess, and manage data
  - Fast, accurate analysis with pre-built math and engineering functions

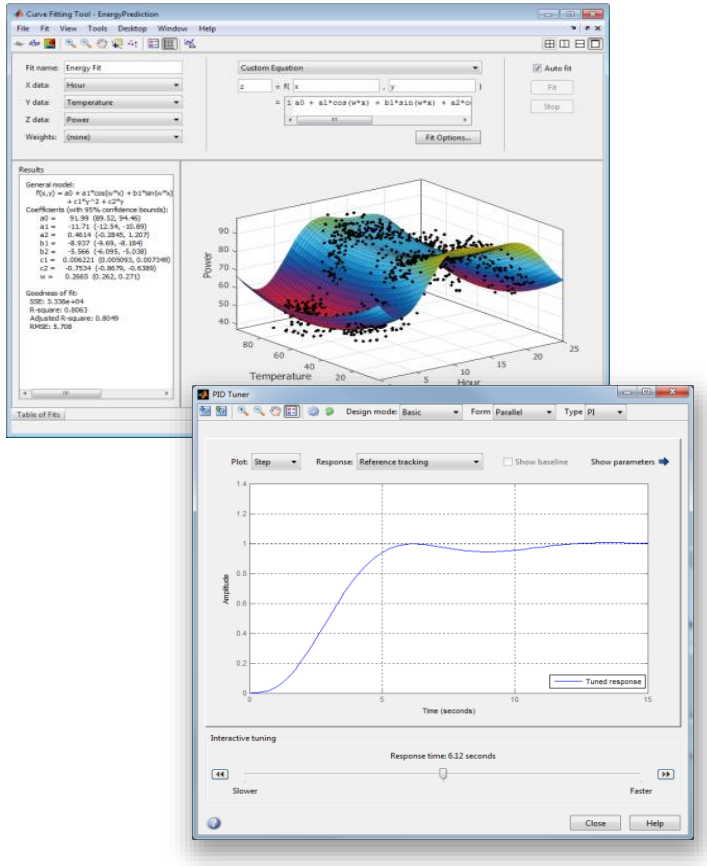
- Visualization
  - Built in graphics functions for engineering and science (2D, 3D, volume visualization)
  - Interactive tools to annotate and customize graphics



Expanding the Capabilities of MATLAB

Access | **Explore & Discover** | Share

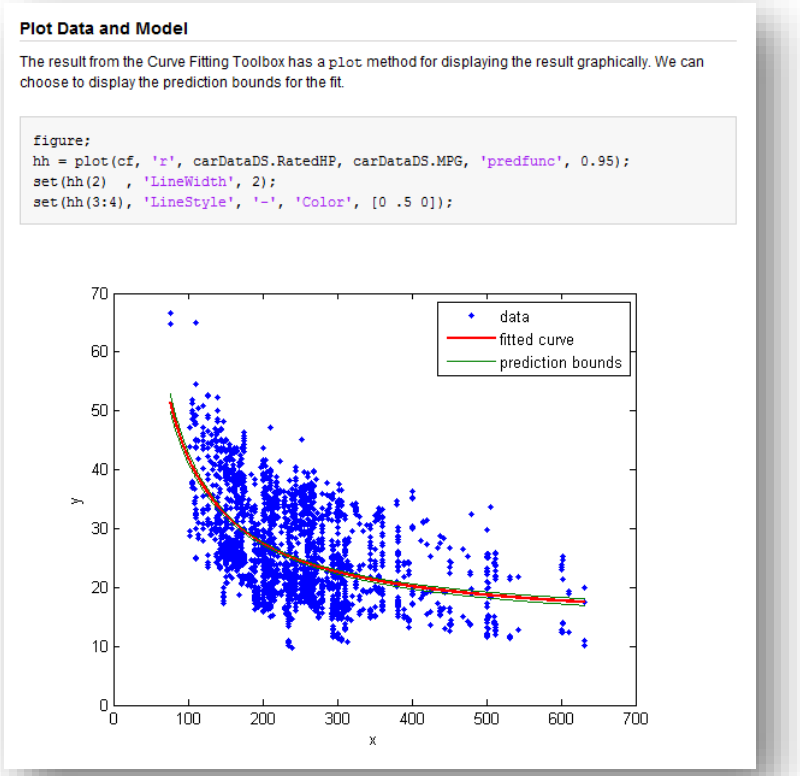
- MathWorks add-on tools for:
  - Math, statistics, and optimization
  - Control system design and analysis
  - Signal processing and communications
  - Image processing and computer vision
  - Parallel computing and more…
- Partner products provide:
  - Additional interfaces
  - Domain-specific analysis
  - Support for niche applications



Sharing Results from MATLAB

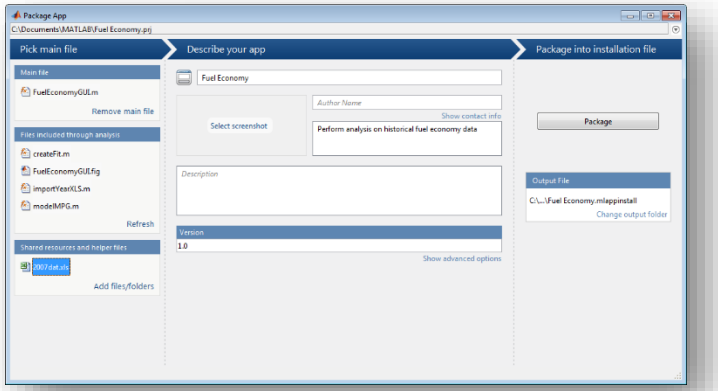
Access | Explore & Discover | **Share**

- Automatically generate reports
  - Publish MATLAB files
  - Customize reports using MATLAB Report Generator
- Package as an app
- Deploy applications to other environments



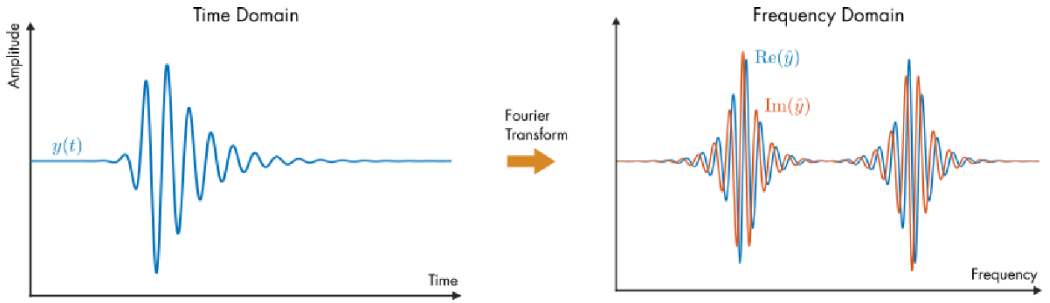
Packaging and Sharing MATLAB Apps

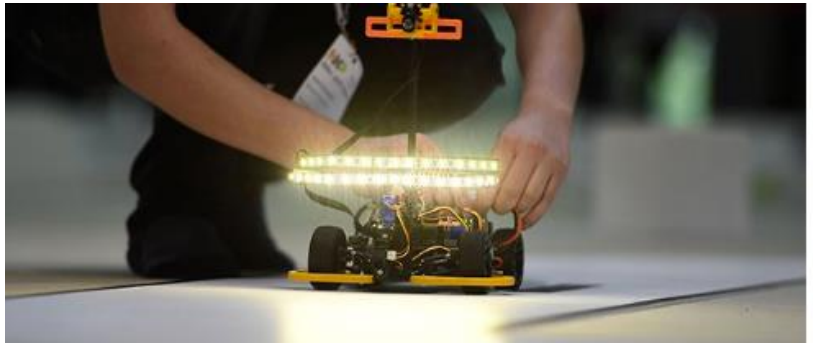
- MATLAB apps
  - Interactive applications to perform technical computing tasks
  - Displayed in apps gallery
- Included in many MATLAB products
- Package your own app
  - Create single file for distribution and installation into gallery
  - Packaging tool:
    - Automatically includes all necessary files
    - Documents required products



Resources

- Self-paced Trainings
  - Free, Online and Certificates
  - MATLAB
  - Image Processing
  - Signal Processing
  - Artificial Intelligence
- Teaching Resources
  - Curriculum Modules
  - Project ideas
- Code Examples
- Videos





Self-Paced Courses

FREE "getting started" content – available for everyone

MATLAB Onramp

Simulink Onramp

Machine Learning Onramp

Deep Learning Onramp

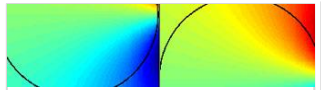
Image Processing Onramp

Stateflow Onramp

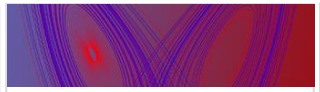
Control Design Onramp with Simulink

Computational Mathematics

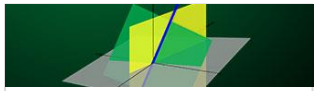
*Available only to users at universities that offer campus-wide training access.



Solving Nonlinear Equations with MATLAB



Solving Ordinary Differential Equations with MATLAB



Introduction to Linear Algebra with MATLAB

Introduction to Statistical Methods with MATLAB

Introduction to Symbolic Math with MATLAB

Other Resources:

- Introduction to Model-Based Design with Simulink
- Physical Modeling with Simscape
- Simulink Control Design
- Robotics and Autonomous Systems
- (NEW) Multibody Simulation
- (NEW) Battery Systems

Core MATLAB

MATLAB Fundamentals

MATLAB Programming Techniques

MATLAB for Financial Applications

Data Science

MATLAB for Data Processing and Visualization

Machine Learning with MATLAB

Deep Learning with MATLAB

Continue the conversation!

- **MathWorks Education Application Engineers**
- Noah Roberts
- nroberts@mathworks.com

- We consult with faculty and researchers to support them with their STEM initiatives, including integrating computational or systems thinking into their curriculum and research

- Office hours with Noah
  - (link in GitHub Repository!)