MATLAB for Computational Finance and what's new since 2012b

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R2012b
R2013a
R2013b
R2014a

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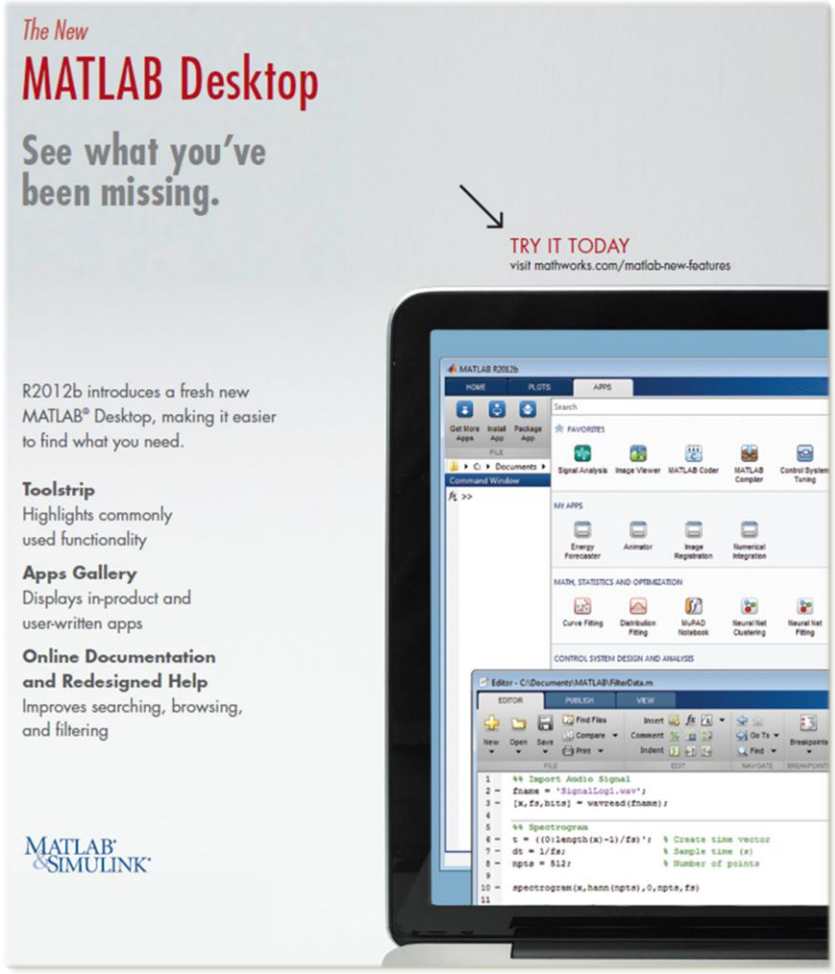
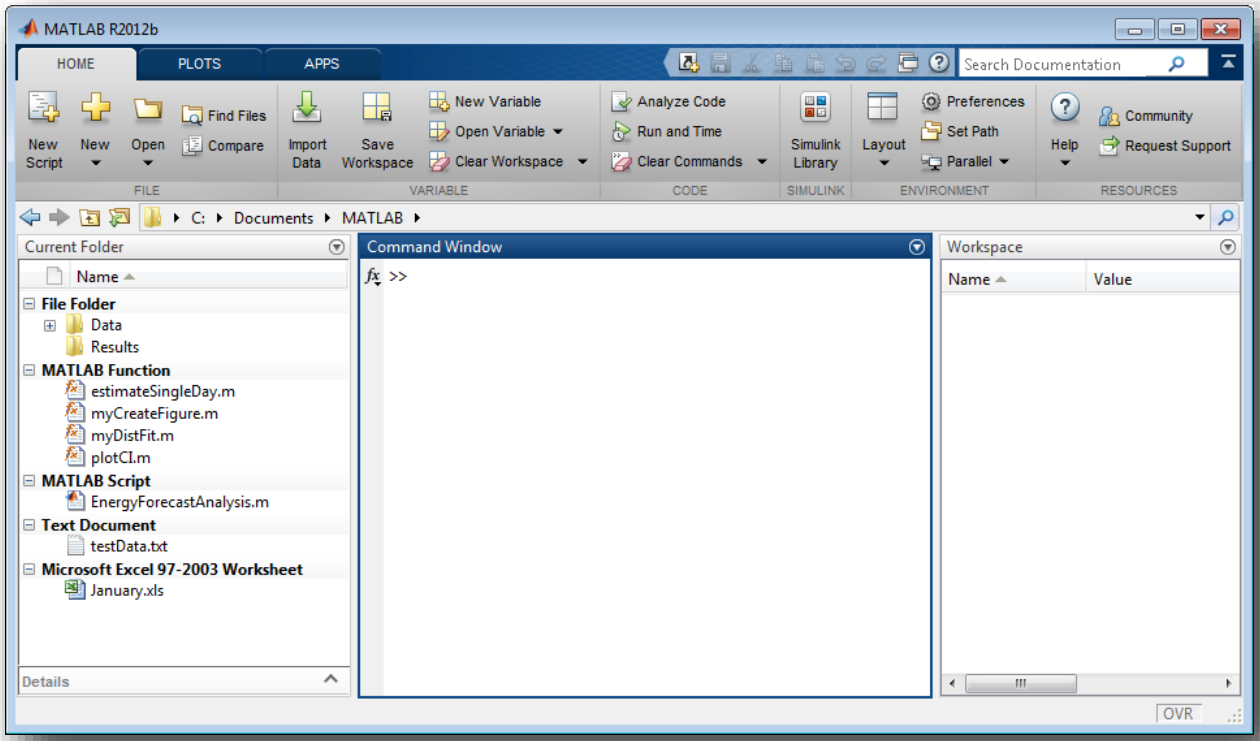
Agenda

- MATLAB
- Help System
- MATLAB for Production
- Parallel & GPU Computing
- Computational Finance
- Optim & Stats
- Connecting to Low Cost Hardware





MATLAB

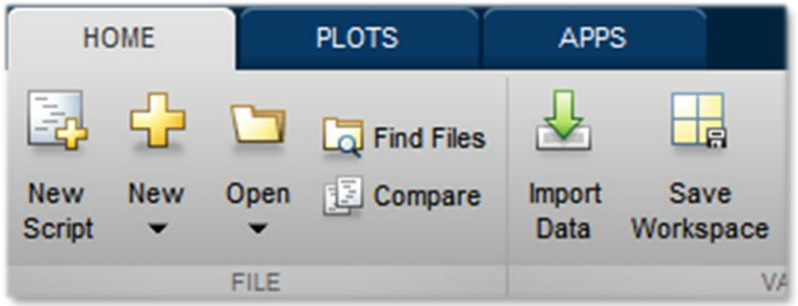
Introducing the New MATLAB Desktop

R2012b

MATLAB Toolstrip

Find what you need

- Tabs organize commonly used functionality
  - Key features placed up front
  - Design optimized for common tasks



- Functionality only appears when needed

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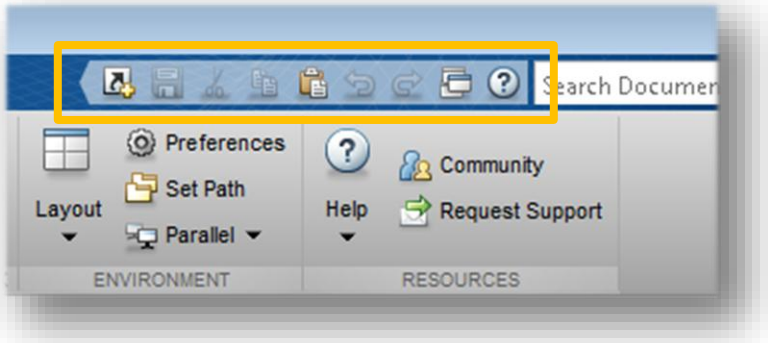
Quick Access Toolbar

- Place to put commonly used commands



- Any item from a tab or shortcuts can be added to the toolbar

- Remains visible when the toolstrip is minimized

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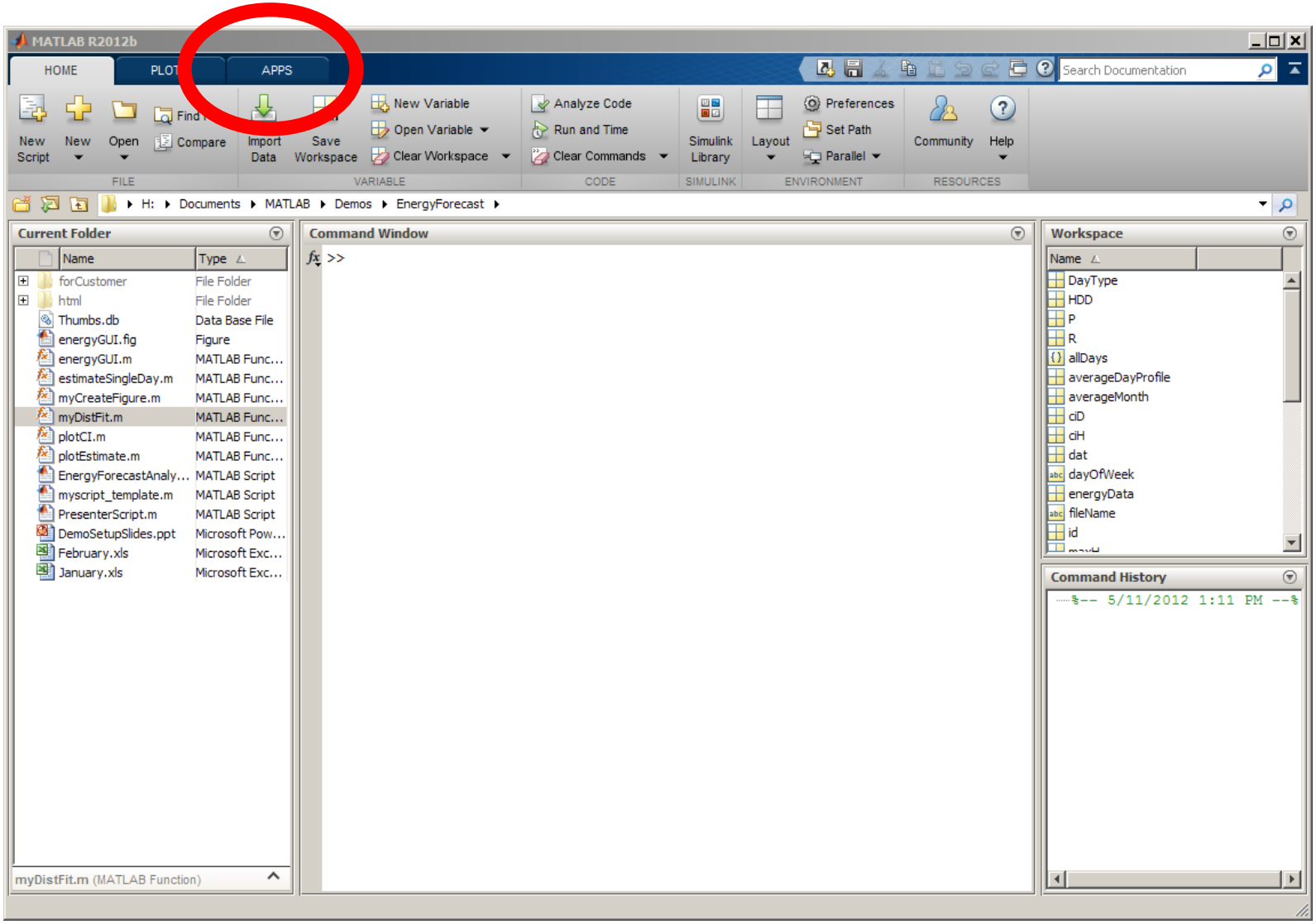
MATLAB Apps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Simulink Library
Layout
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energyGUI.fig Figure
energyGUI.m MATLAB Func...
estimateSingleDay.m MATLAB Func...
myCreateFigure.m MATLAB Func...
myDistFit.m MATLAB Func...
plotCI.m MATLAB Func...
plotEstimate.m MATLAB Func...
EnergyForecastAnaly... MATLAB Script
myscript_template.m MATLAB Script
PresenterScript.m MATLAB Script
DemoSetupSlides.ppt Microsoft Pow...
February.xls Microsoft Exc...
January.xls Microsoft Exc...
myDistFit.m (MATLAB Function)
Command Window
>>
Workspace
Name
DayType
HDD
P
R
allDays
averageDayProfile
averageMonth
ciD
ciH
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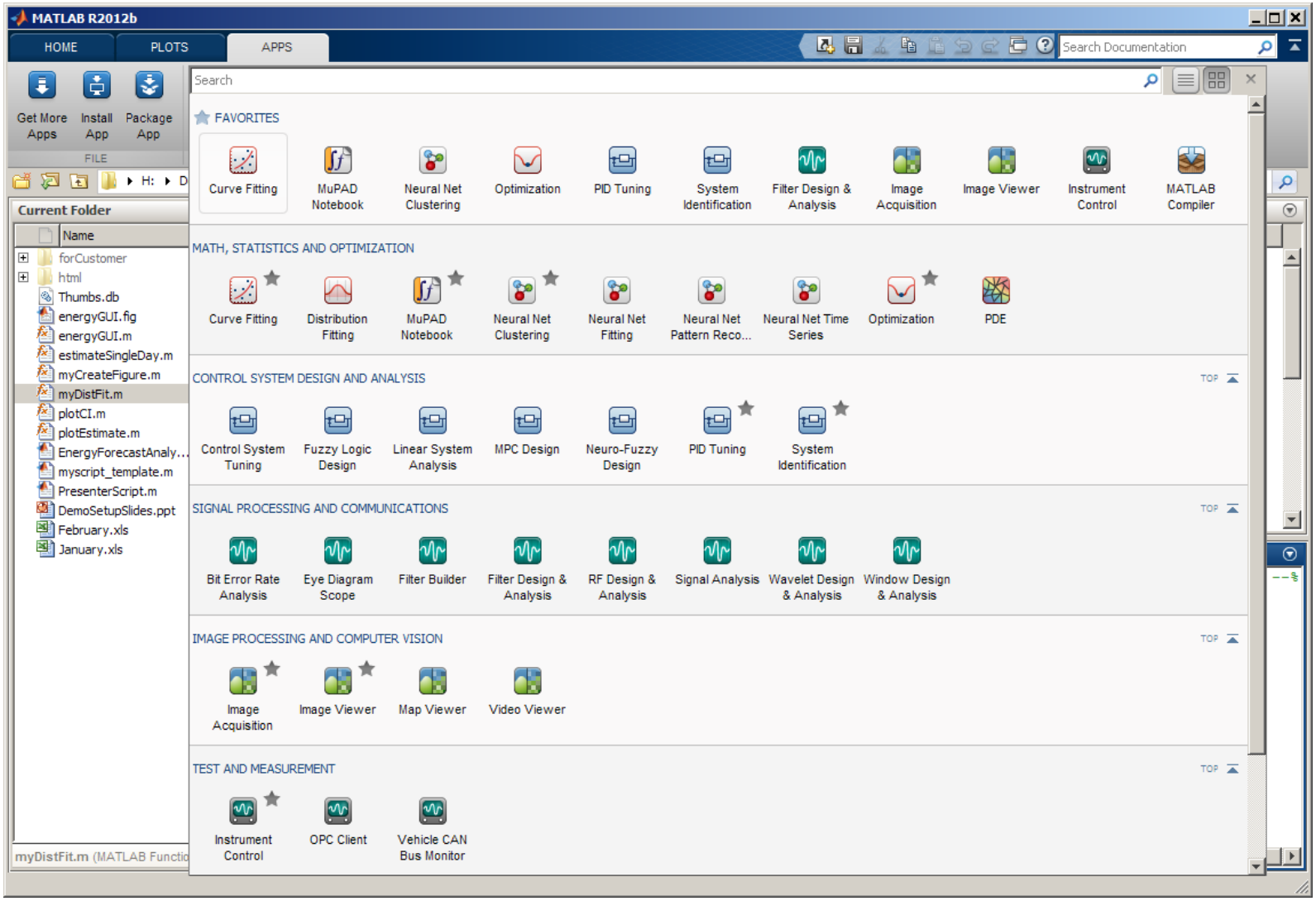
dayOfWeek
energyData
fileName
id
Command History
%-- 5/11/2012 1:11 PM --%

MATLAB Apps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PLOTS
APPS
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FAVORITES
Curve Fitting
MuPAD Notebook
Neural Net Clustering
Optimization
PID Tuning
System Identification
Filter Design & Analysis
Image Acquisition
Image Viewer
Instrument Control
MATLAB Compiler
MATH, STATISTICS AND OPTIMIZATION
Curve Fitting
Distribution Fitting
MuPAD Notebook
Neural Net Clustering
Neural Net Fitting
Neural Net Pattern Reco...
Neural Net Time Series
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CONTROL SYSTEM DESIGN AND ANALYSIS
TOP
Control System Tuning
Fuzzy Logic Design
Linear System Analysis
MPC Design
Neuro-Fuzzy Design
PID Tuning
System Identification
SIGNAL PROCESSING AND COMMUNICATIONS
TOP
Bit Error Rate Analysis
Eye Diagram Scope
Filter Builder
Filter Design & Analysis
RF Design & Analysis
Signal Analysis
Wavelet Design & Analysis
Window Design & Analysis
IMAGE PROCESSING AND COMPUTER VISION
TOP
Image Acquisition
Image Viewer
Map Viewer
Video Viewer
TEST AND MEASUREMENT
TOP
Instrument Control
OPC Client
Vehicle CAN Bus Monitor
Current Folder
Name
forCustomer
html
Thumbs.db
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energyGUI.m
estimateSingleDay.m
myCreateFigure.m
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plotEstimate.m
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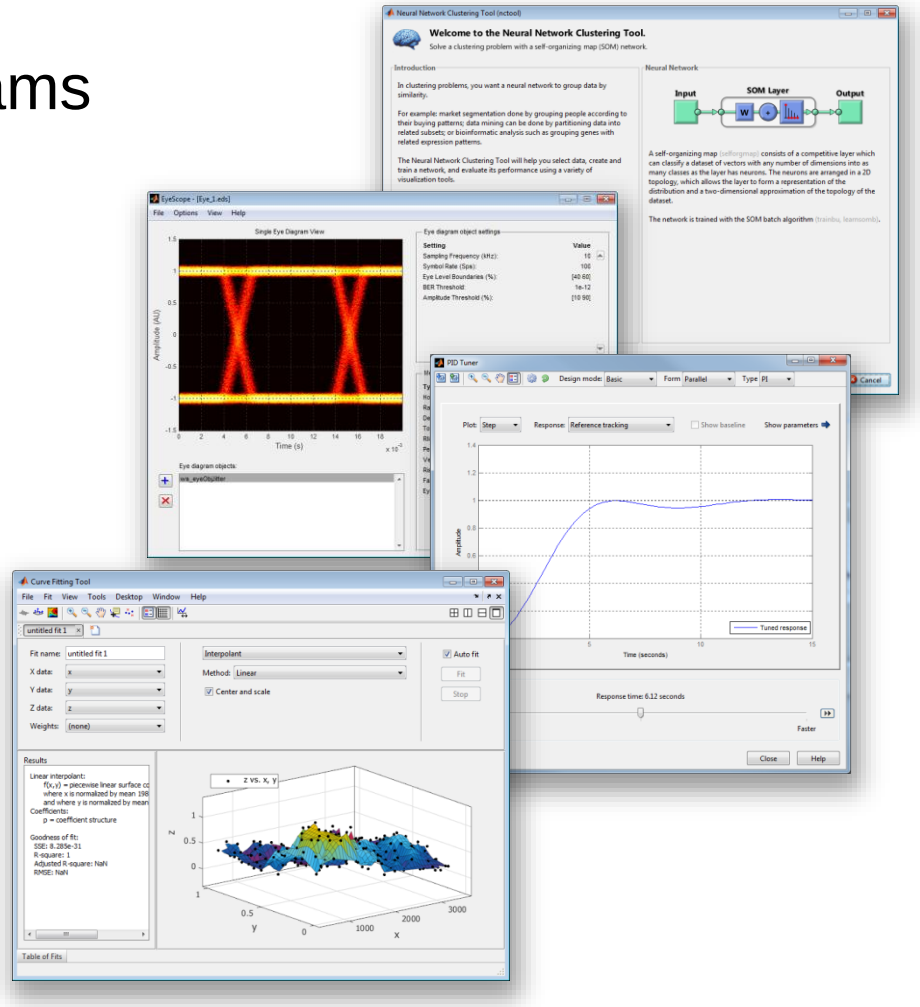
myscript_template.m
PresenterScript.m
DemoSetupSlides.ppt
February.xls
January.xls
myDistFit.m (MATLAB Functio

What are MATLAB Apps?

- Interactive MATLAB programs that include a GUI
- Apps are included in many MATLAB products
- There are also many user-written apps



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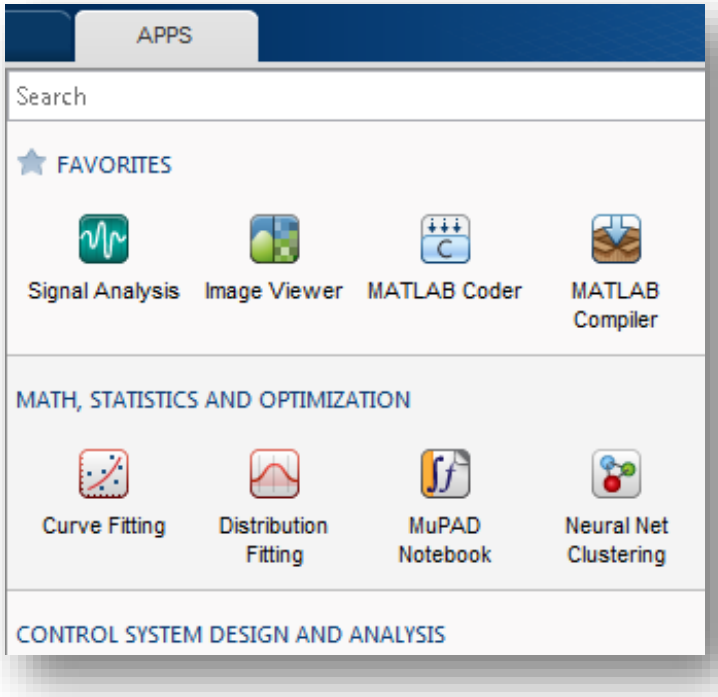
MATLAB Apps Gallery

- Tab within the MATLAB Toolstrip
- Prominently displays both user-written apps and apps included in MATLAB products
- Makes it easy to find and launch MATLAB apps



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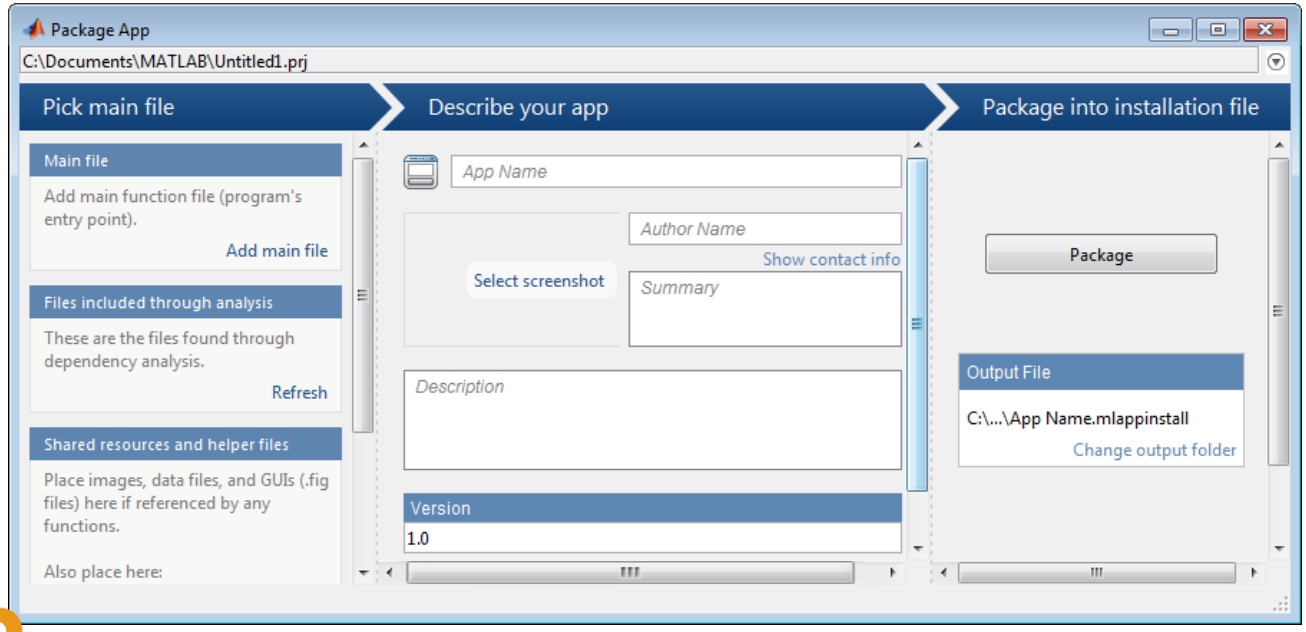
Packaging and Sharing MATLAB Apps

- Automatically includes all necessary files
- Documents required products
- Creates single installation file for easy distribution and installation into the MATLAB apps gallery



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Command Line Suggestions

- Suggested corrections offered for mistyped functions and variables in the command window
- Press Enter to execute the suggested command, or Esc to delete it

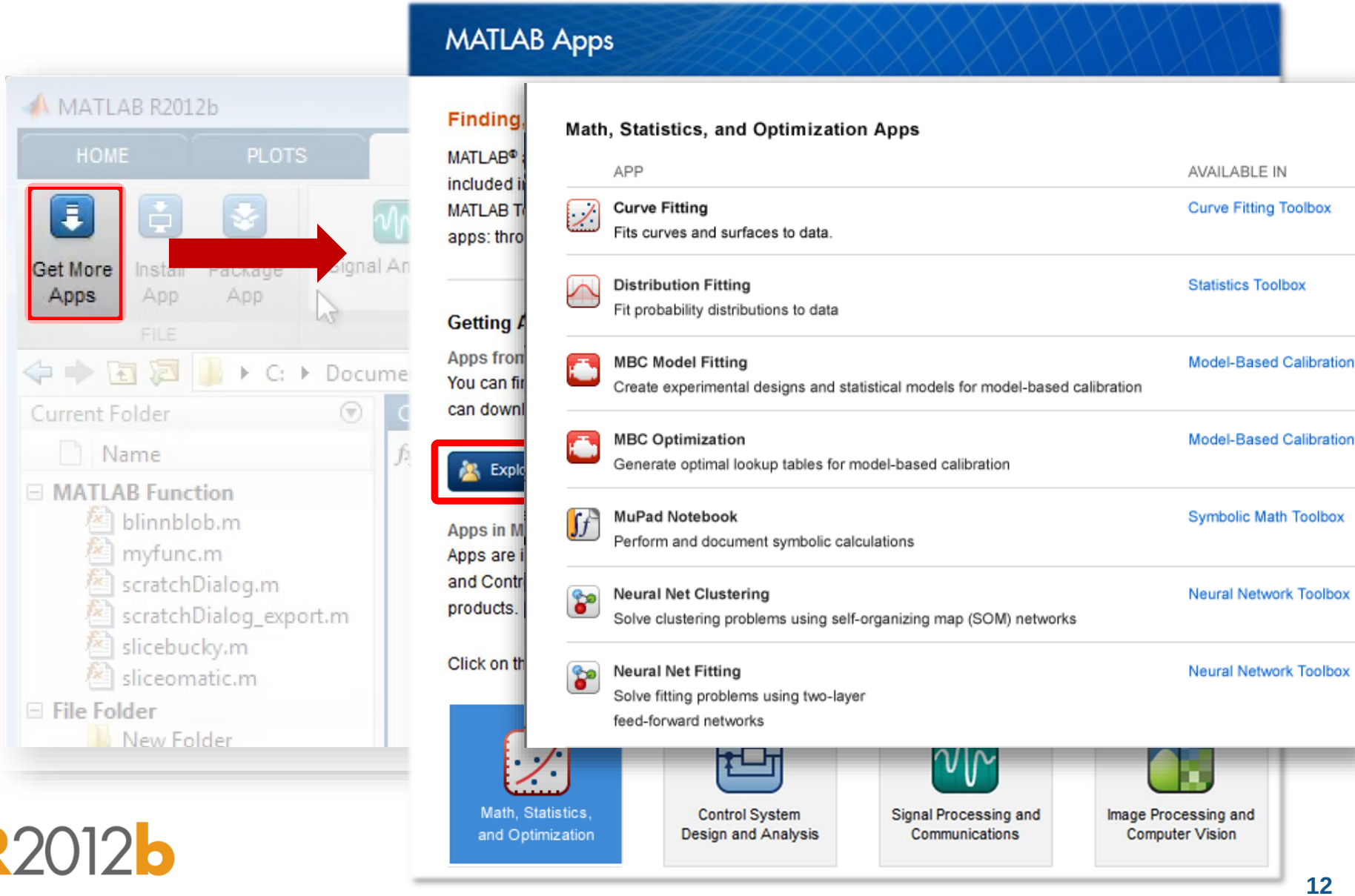
```
>> datstr(Date(1))
Undefined function 'datstr' for input
arguments of type 'double'.

Did you mean:
>> datestr(Date(1))

ans =

01-Jan-2005 01:00:00
```

Getting More Apps



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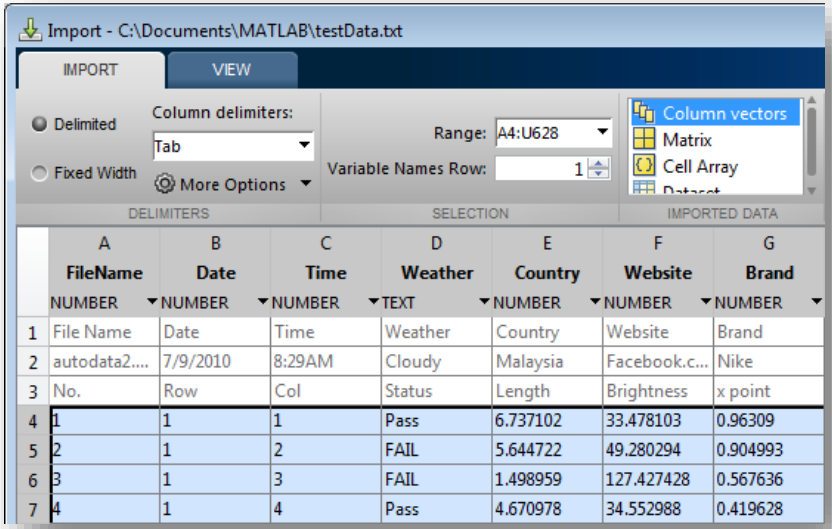
Import Tool

- Interactive import of delimited and fixed-width text files
- Improved handling of:
  - Mixed numeric and text data
  - Dates
- Define rules for handling nonnumeric values



- Automatically generate MATLAB code (scripts and functions) to automate the process

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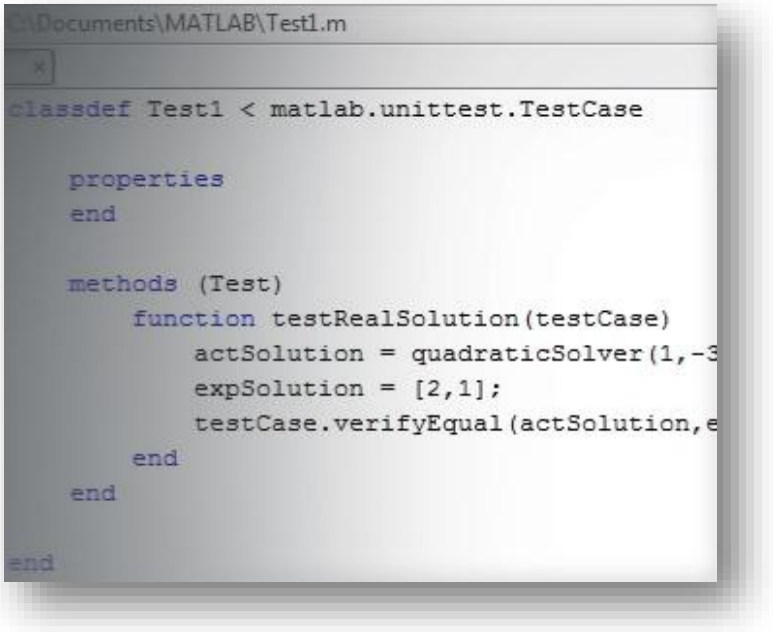
MATLAB

Unit Testing Framework

- `matlab.unittest` package

- xUnit-style testing framework for the MATLAB language
  - Allows writing and running unit tests, and analyzing test results
  - Includes a set of readily available qualification methods
  - Supports automation, and provides easy reuse of test-cases



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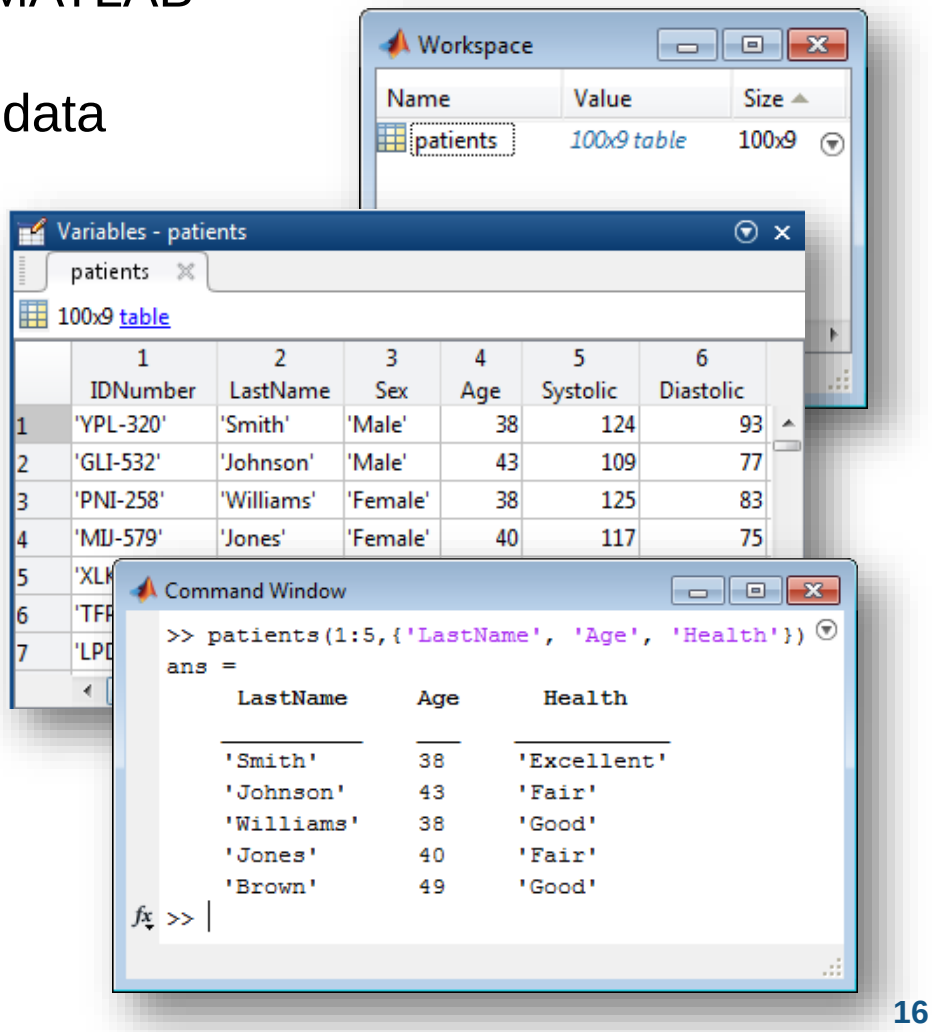
MATLAB

`table` Data Type

- A new fundamental data type in MATLAB
- Container for mixed-type tabular data
  - Holds both data and metadata
- Supports flexible indexing
- Built-in functionality (merge, sort, etc.)




```
>> tableDataImp
```

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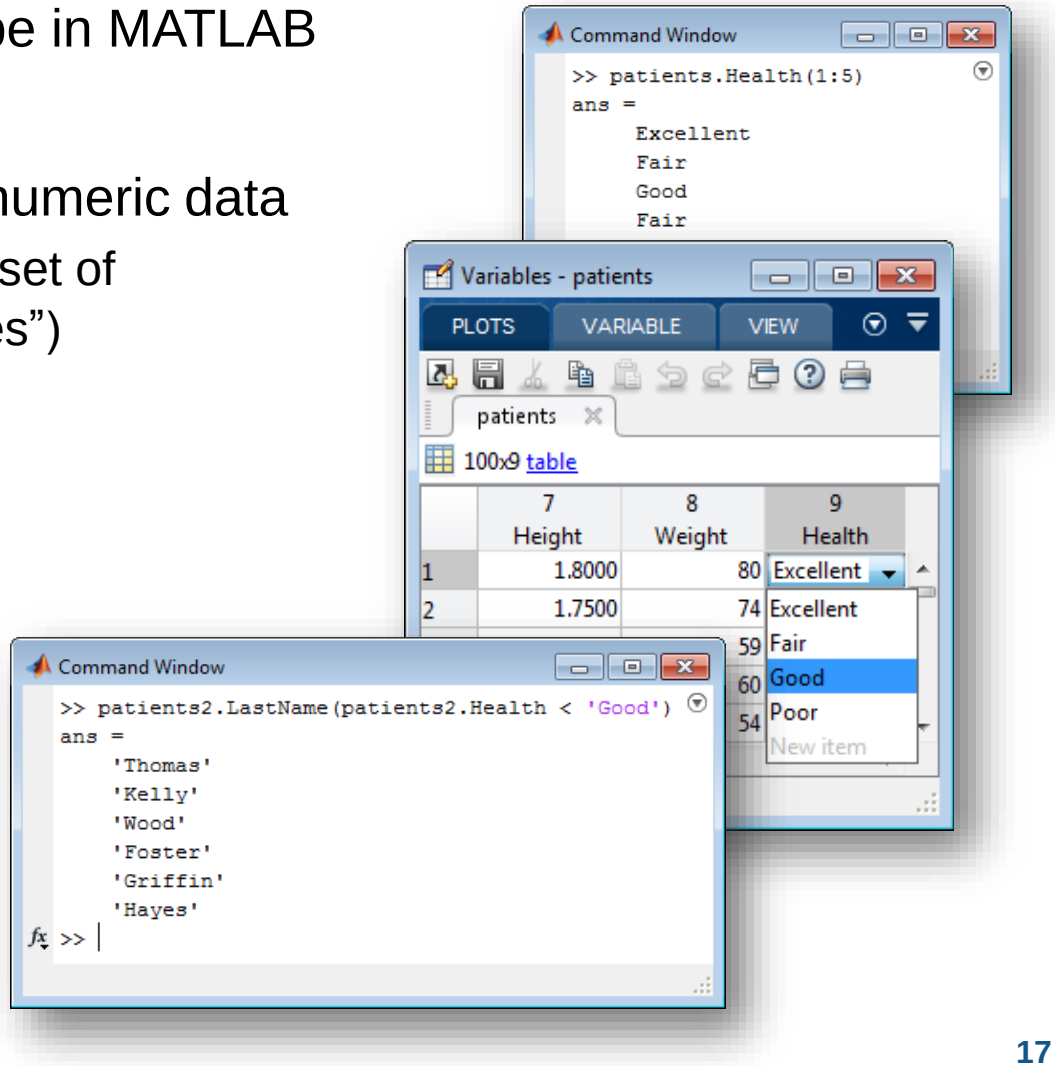
MATLAB

Categorical Arrays

- A new fundamental data type in MATLAB
- Container for discrete non-numeric data
  - Values drawn from a finite set of possible values ("categories")
- More memory efficient than a cell array of strings
- Can be compared using logical operators
  (similar to numeric arrays)



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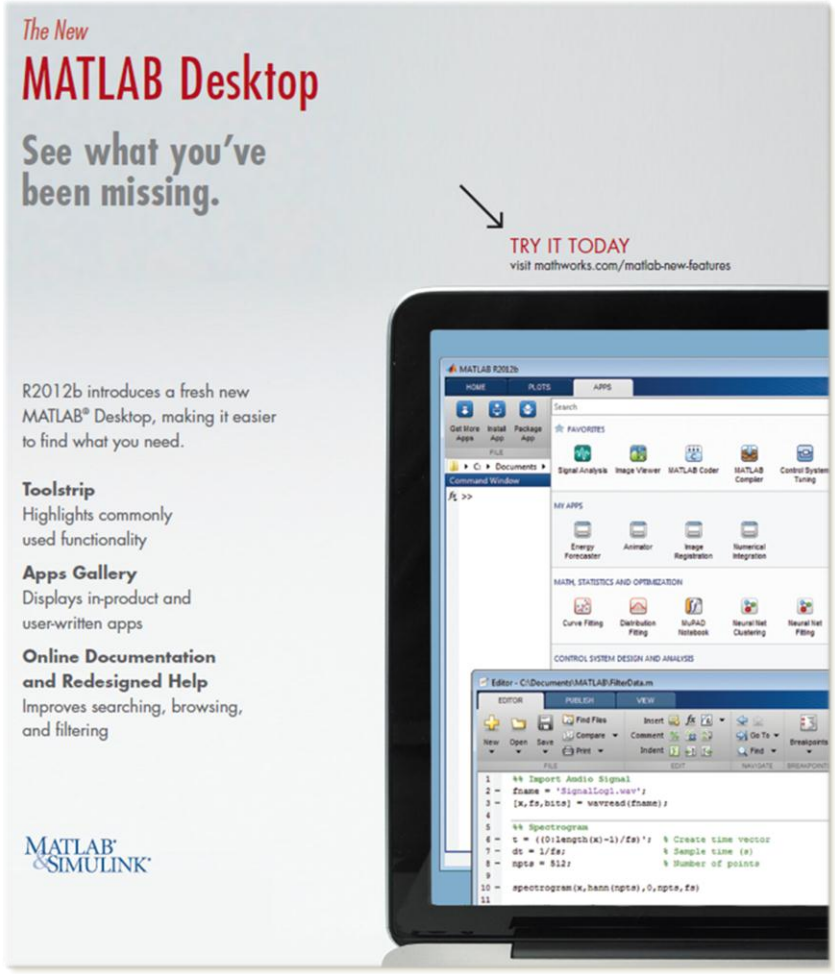
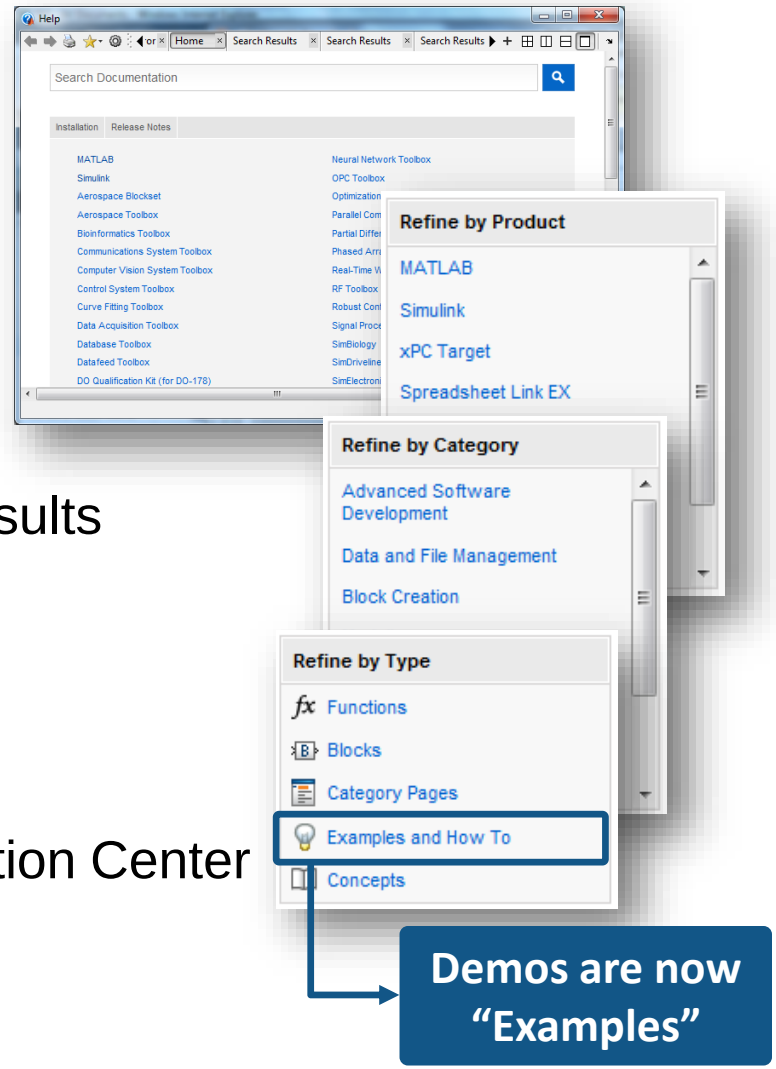


Documentation Center and Redesigned Help

- Content organized by topic rather than content type
- Browser-like interface, with improved search
  - Facets allow users to filter search results
  - Multiple tabs
- Documentation installed locally
  - Option to use the online Documentation Center



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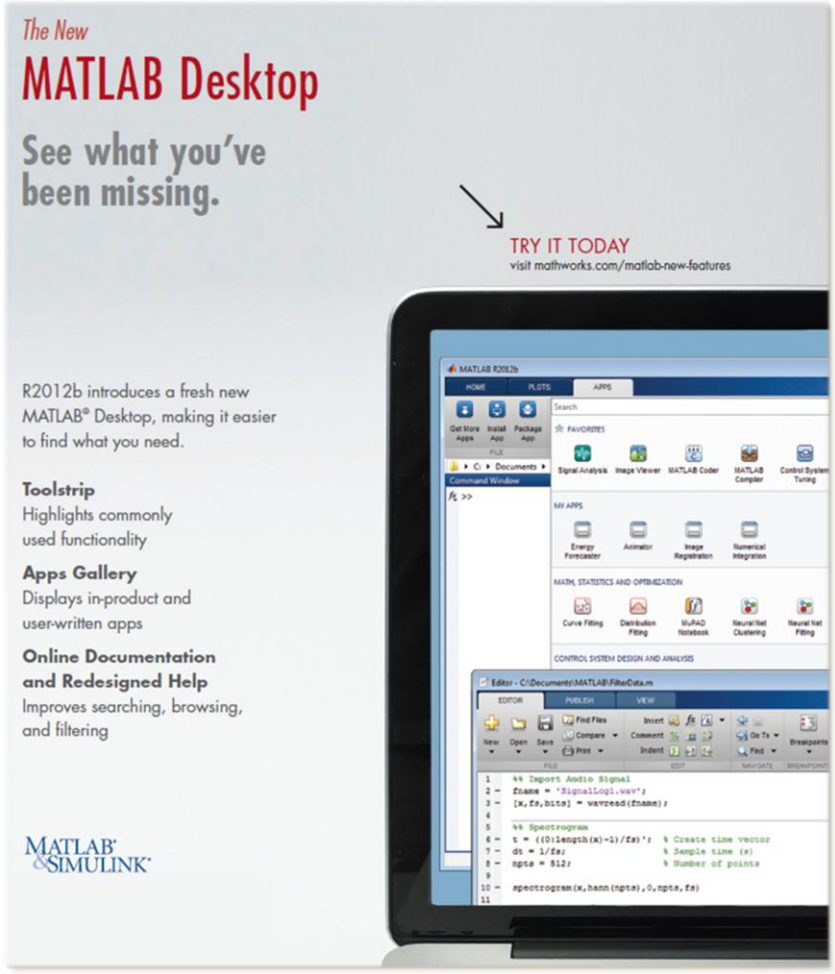
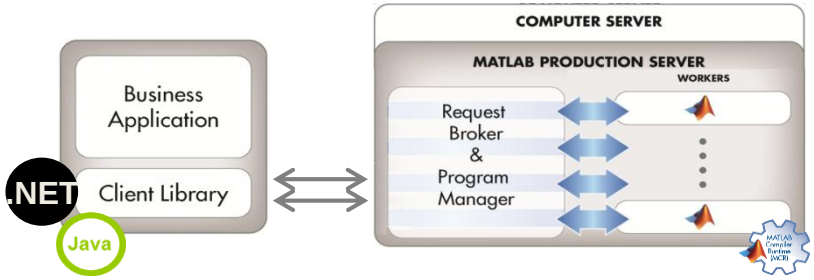


MATLAB Production Server

New Product

- Incorporate numerical analytics (as packaged MATLAB programs) into enterprise applications



- Framework contains:
  - Server software
    - Manages packaged MATLAB programs and worker pool
  - Runtime libraries
    - MATLAB Compiler Runtime (MCR)
  - Lightweight client library (.NET & Java)
    - Make requests of MATLAB Production Server

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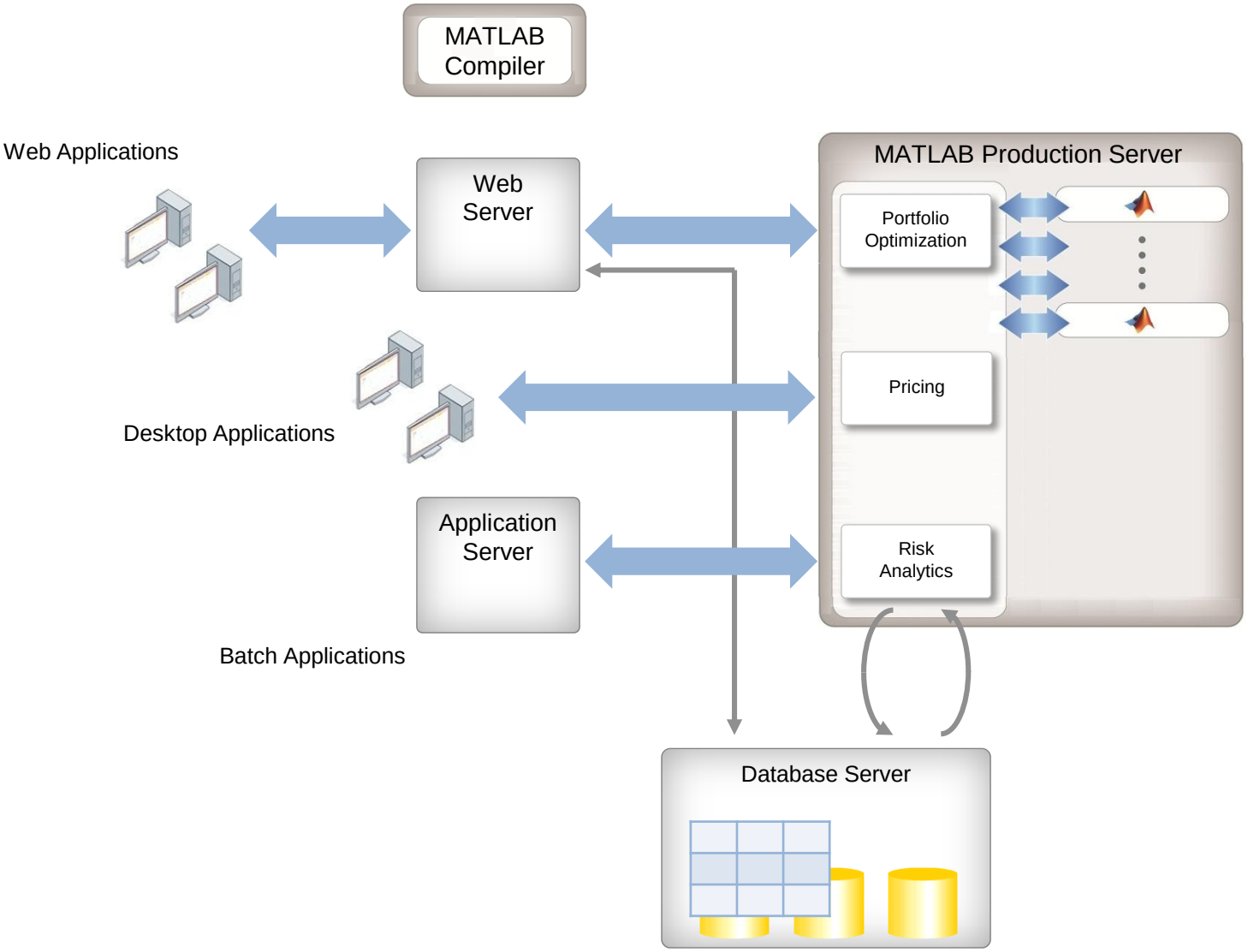
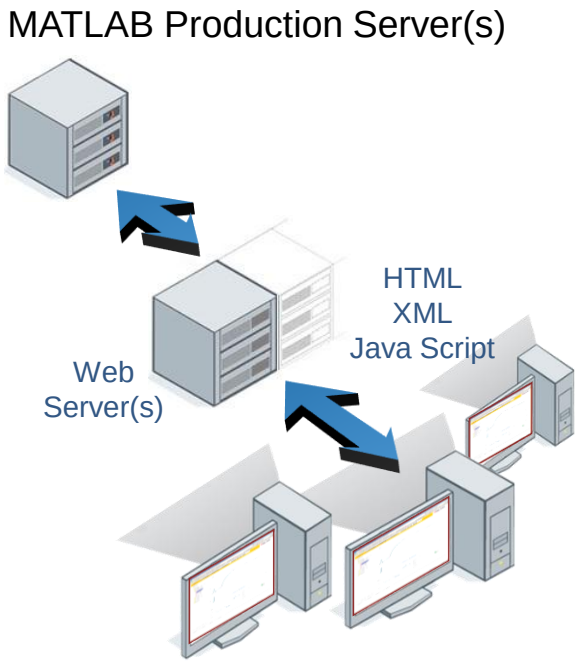
Centralizing Analytics with MPS



MATLAB Production Server

- Directly deploy MATLAB programs into production
  - Centrally manage multiple MATLAB programs & MCR versions
  - Automatically deploy updates without server restarts
- Scalable & reliable
  - Service large numbers of concurrent requests
  - Add capacity or redundancy with additional servers
- Use with web, database & application servers
  - Lightweight client library isolates MATLAB processing
  - Access MATLAB programs using native data types



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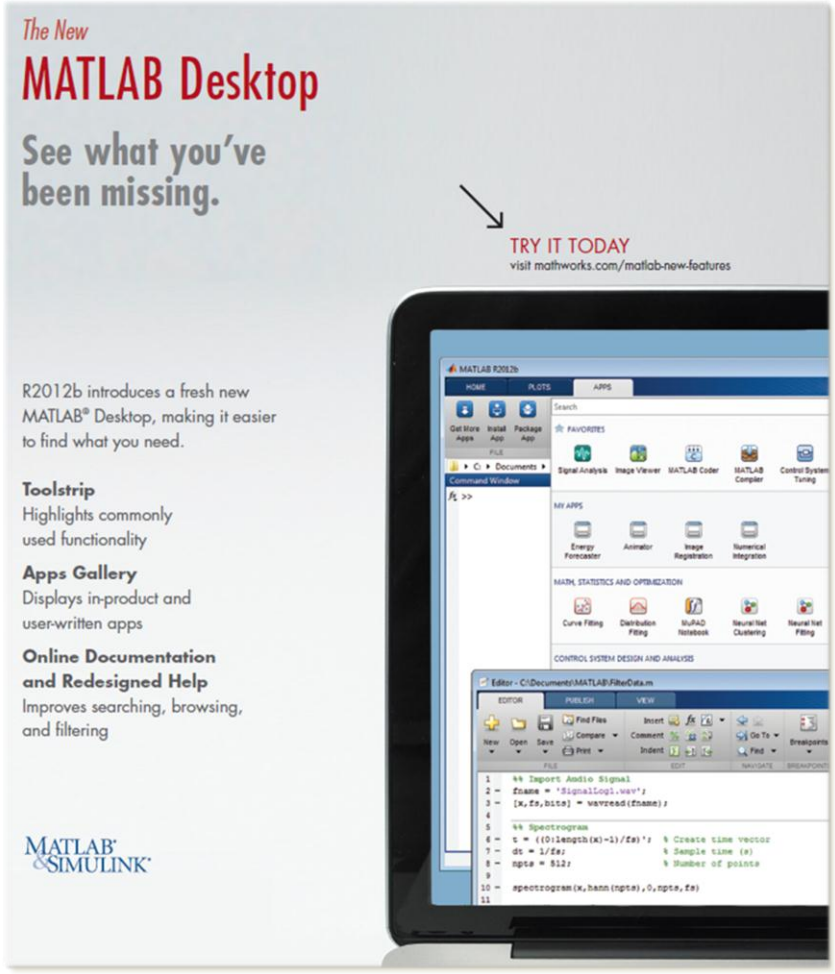
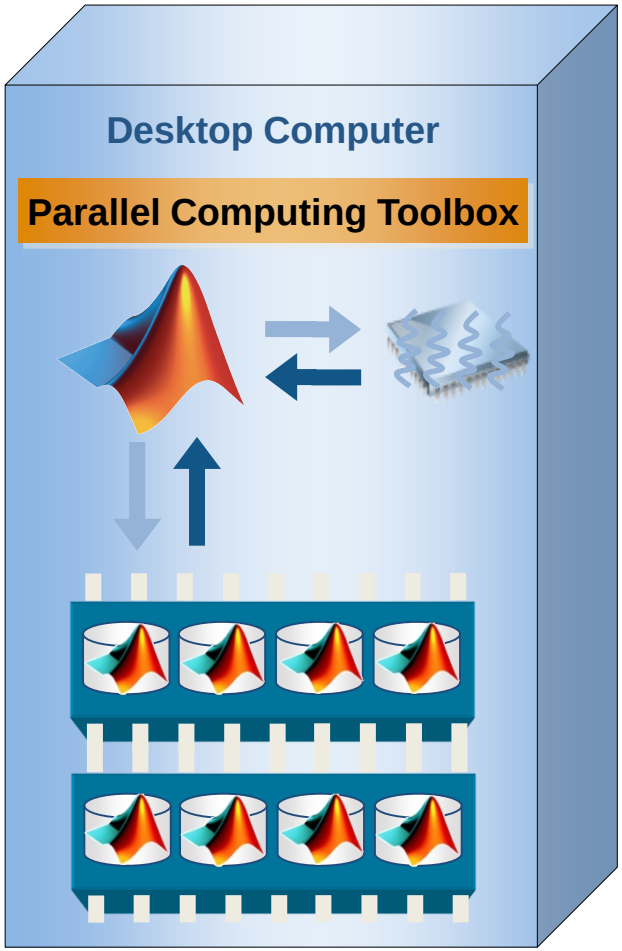


Parallel Computing toolbox

- Supports unlimited workers
  - Previously 12



R2014a

GPU Support with Parallel Computing Toolbox

- NVIDIA GPUs with compute capability 1.3 or greater
  - (e.g., NVIDIA Tesla C2075 or K20)
  - http://www.nvidia.com/object/cuda_gpus.html

- Why we require compute capability 1.3
  - Support doubles (base data type in MATLAB)
  - Guarantee IEEE compliance
  - Provide cross-platform support

- Evolving rapidly –use the latest MATLAB release

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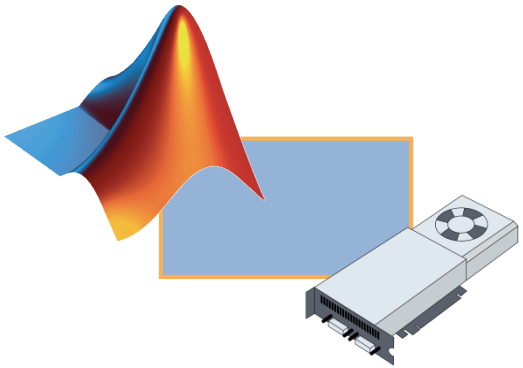
New for GPU Computing with MATLAB

- Performance
  - Improvements to GPU-enabled MATLAB functions (e.g., random number generation for Monte Carlo simulations)

- More GPU-enabled functions
  - Including `convn`, `cov`, and `normest`
  - Additional support for toolboxes



http://www.mathworks.com/products/parallel-computing/builtin-parallel-support.html

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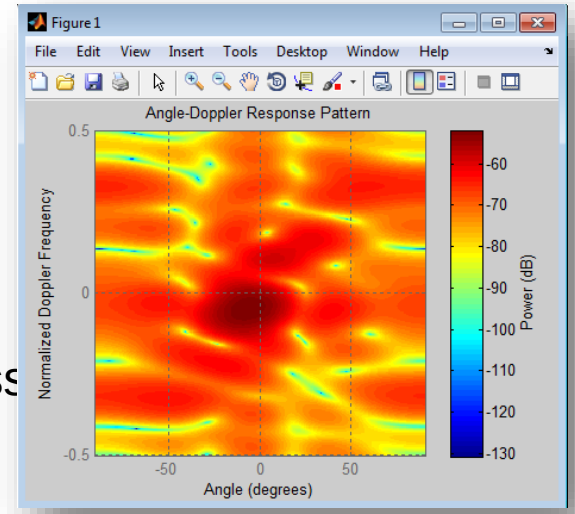
New Built-in Parallel Support

- Neural Networks Toolbox
  - Speedup training and simulation with multicore processors, clusters, or using a GPU
  - Distributed training of large datasets on clusters
- Signal Processing Toolbox
  - GPU acceleration for `xcorr`, `xcorr2`, `fftfilt`, `xcov`, and `cconv`
- Statistics Toolbox
  - Parallel support in `kmeans` for multicore process



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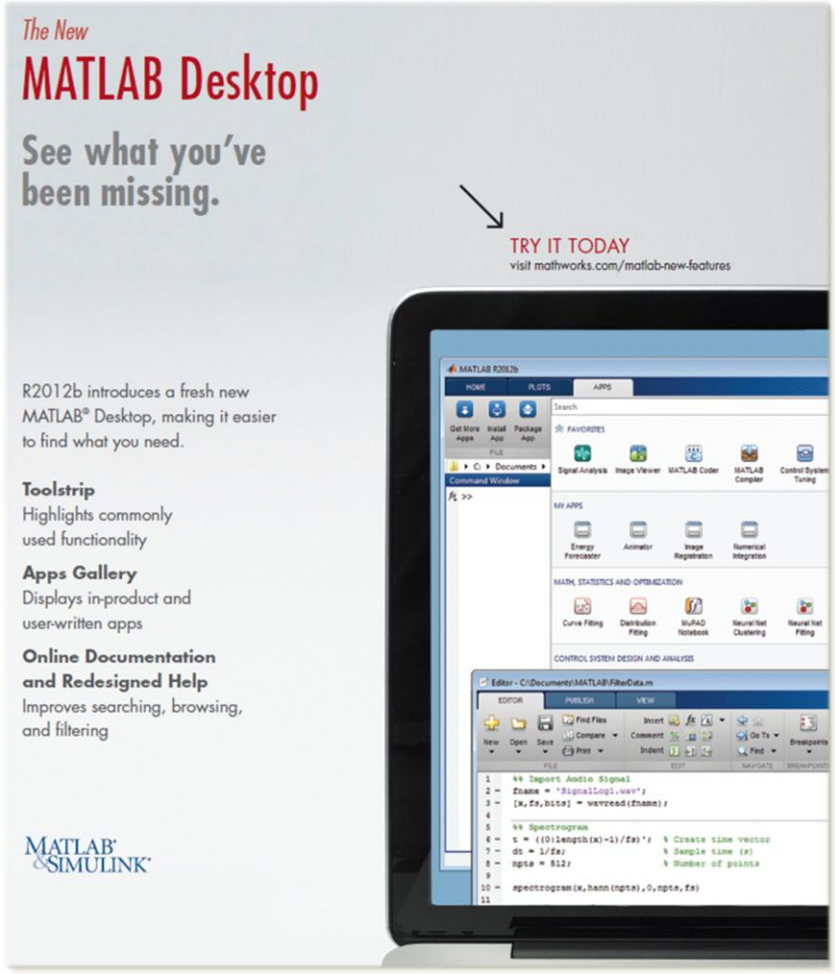
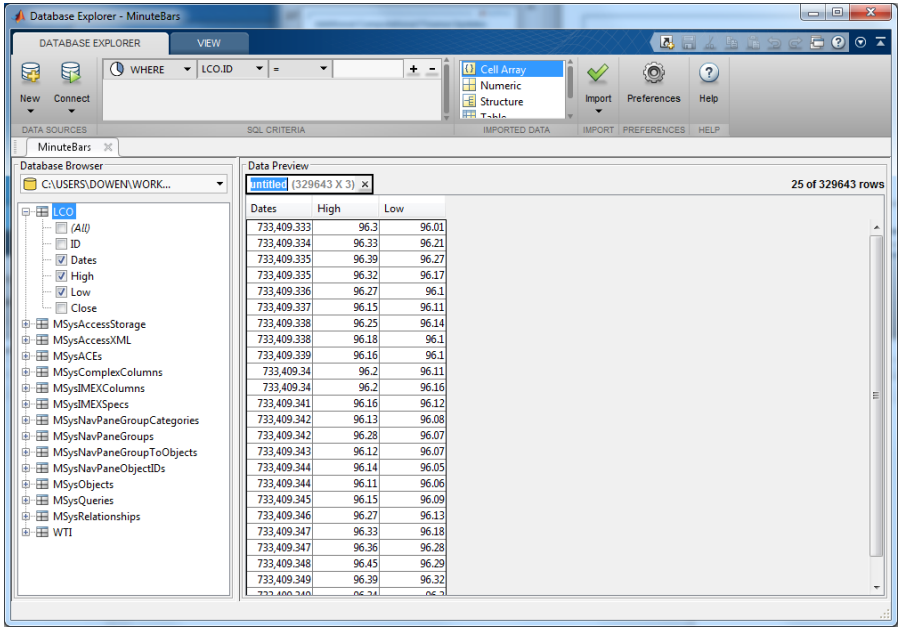


Database Explorer

- Replaces querybuilder

```
>> dexplore
```

- Native ODBC driver
  - Fast access to ODBC
  - R2013b



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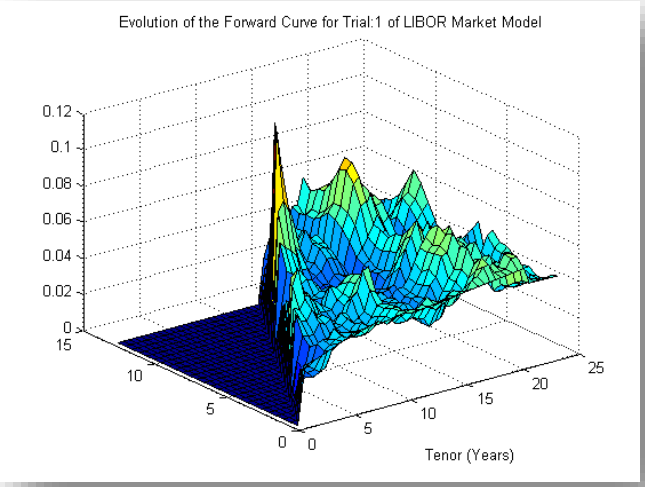
Financial Instruments Toolbox

Design, price, and hedge complex financial instruments

New Product

- Merger of:
  - Financial Derivatives Toolbox + Fixed-Income Toolbox

- New features:
  - Cap and floor floating-rate note pricing using trees
  - Forward-swap pricing using trees or term structure
  - LIBOR market model example



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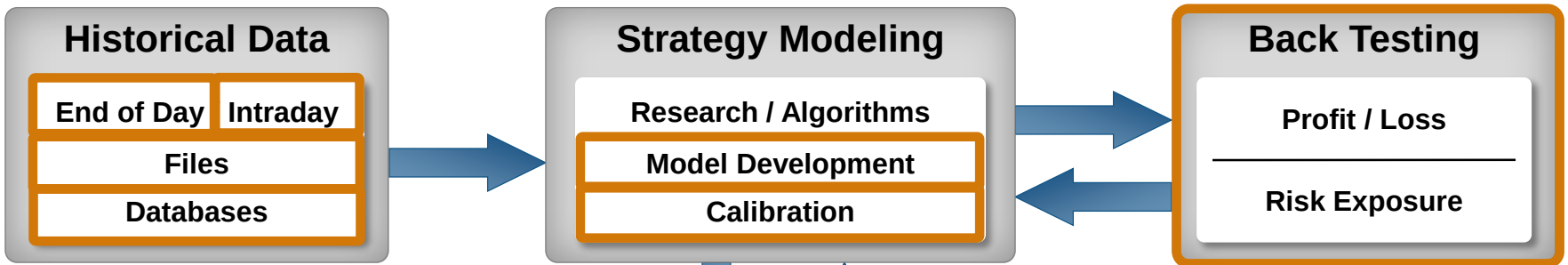
Trading Toolbox

- Submit, Monitor, Modify orders
- Supported Brokers
  - X_Trader, EMSX, CQG,Interactive Brokers

New Product

Development and testing



Implementation

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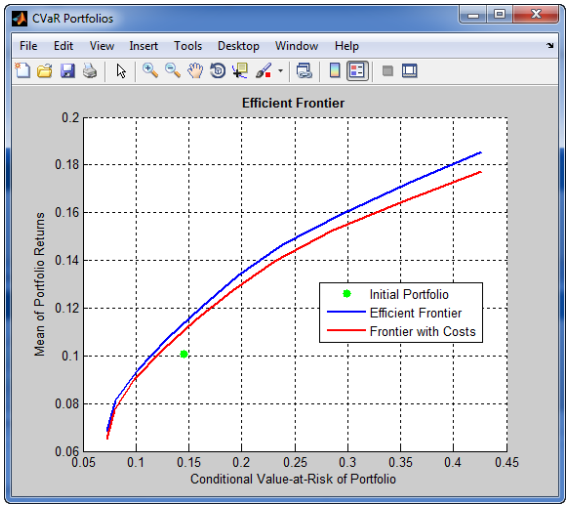
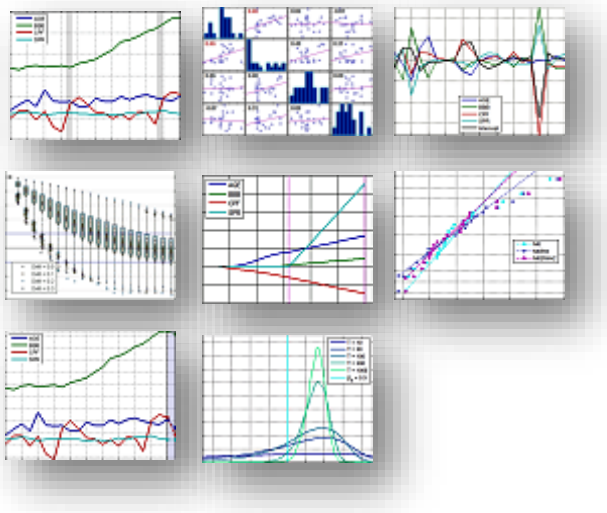
Additional Computational Finance Updates

- Financial Toolbox
  - Conditional Value at Risk (CVaR) portfolio solver
  - Mean-absolute deviation (MAD) portfolio optimization (R2013b)
- Econometrics Toolbox
  - ARIMA modeling regression objects
- Datafeed Toolbox
  - Added support for IQFEED
- Financial Instruments Toolbox
  - Calibration and Monte Carlo simulation for Hull-White, Linear Gaussian & LIBOR market models (R2013a)





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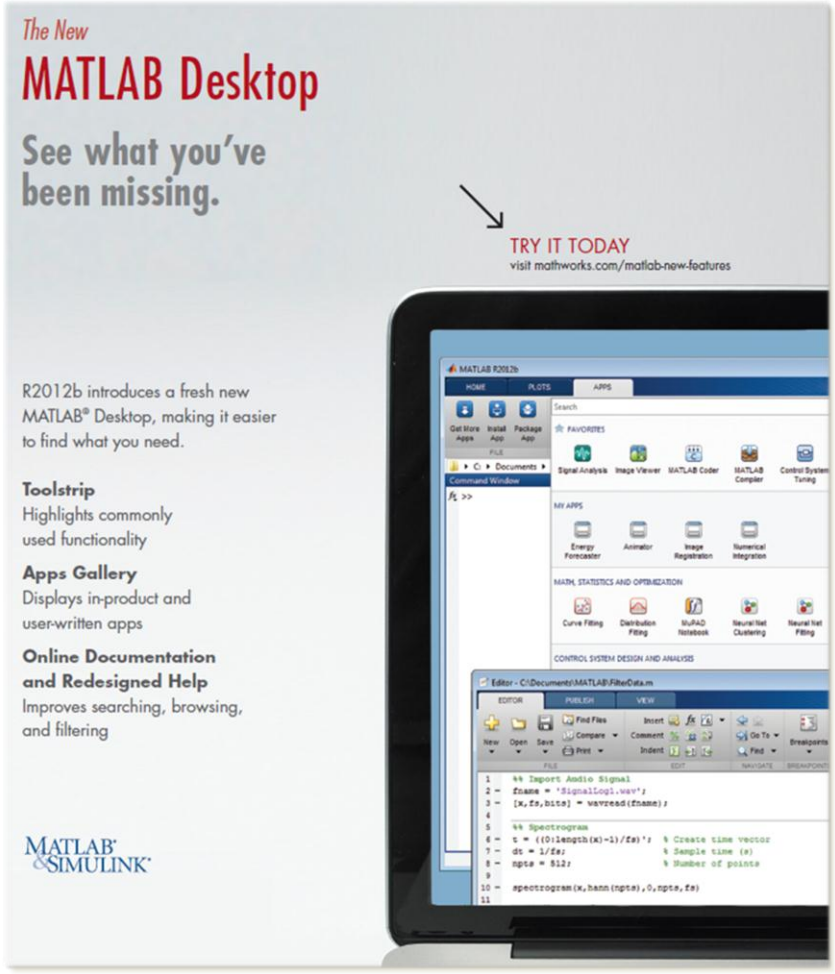


Optimization Toolbox

Mixed Integer Linear Programming MILP

Power Generation

Portfolio Management

Manufacturing / Supply Chain

R2013b

Modeling case study

- Overview

Item	Requirements: Nuts	Requirements: Bolts	Revenue per Item
Gadget	5	2	$ 3.00
Widget	3	8	$ 10.00

- Challenge
  - Current inventory
  - ➔ 29 nuts / 34 bolts
  - How many gadgets / widgets to make to maximize revenue?

This is an optimization problem

- Linear Programming (LP)
  - `linprog` provides the following answer:
    - 3.8235 gadgets
    - 3.2941 widgets
  - Could attempt to round up/down
    - 4 gadgets
    - 3 widgets
- Mixed-Integer Linear Programming (MILP)
  - `intlinprog` provides the following answer:
    - 1 gadgets
    - 4 widgets

→ **$44.11** (but not possible)

→ **$42.00**

→ **$43.00**

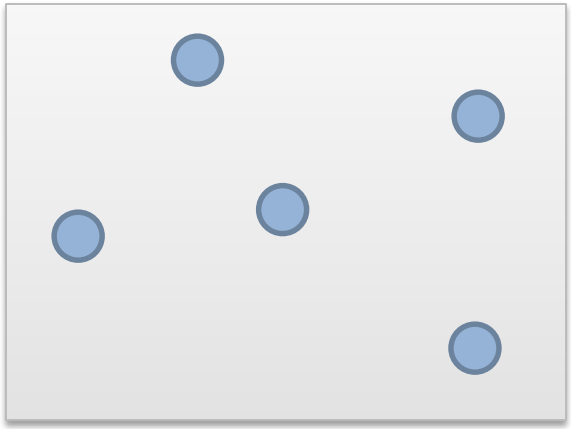
Traveling Salesman Problem

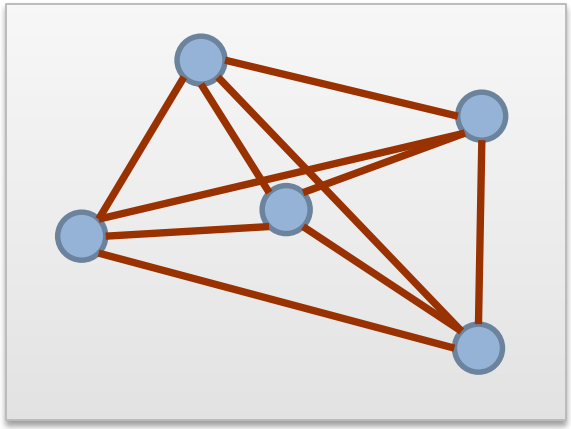
Problem

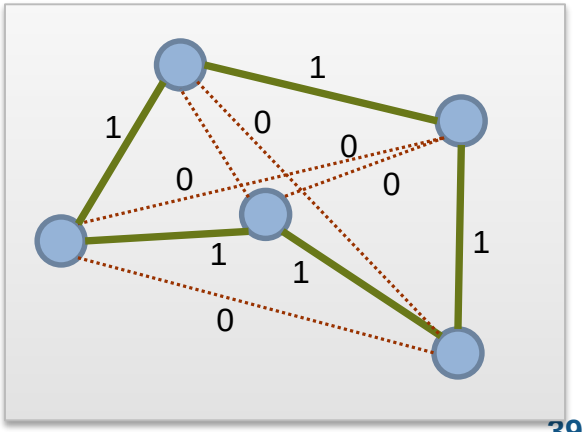
- How to find the shortest path through a series of points?

Solution

- Calculate distances between all combinations of points
- Solve an optimization problem where variables correspond to trips between two points







Other Updates

- Statistics Toolbox
  - Support vector machines (SVMs) for binary classification, PCA algorithms for missing data, and Anderson-Darling goodness-of-fit test (R2013a)
  - Linear mixed-effects regression models

- Financial Toolbox

R2013b

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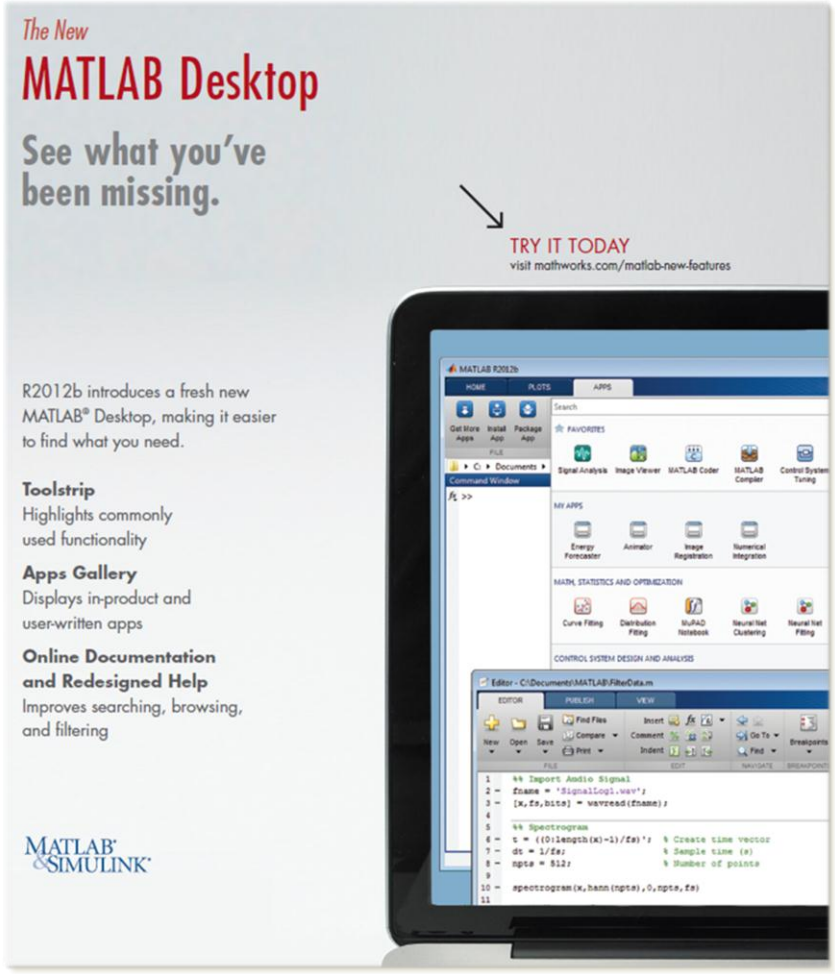
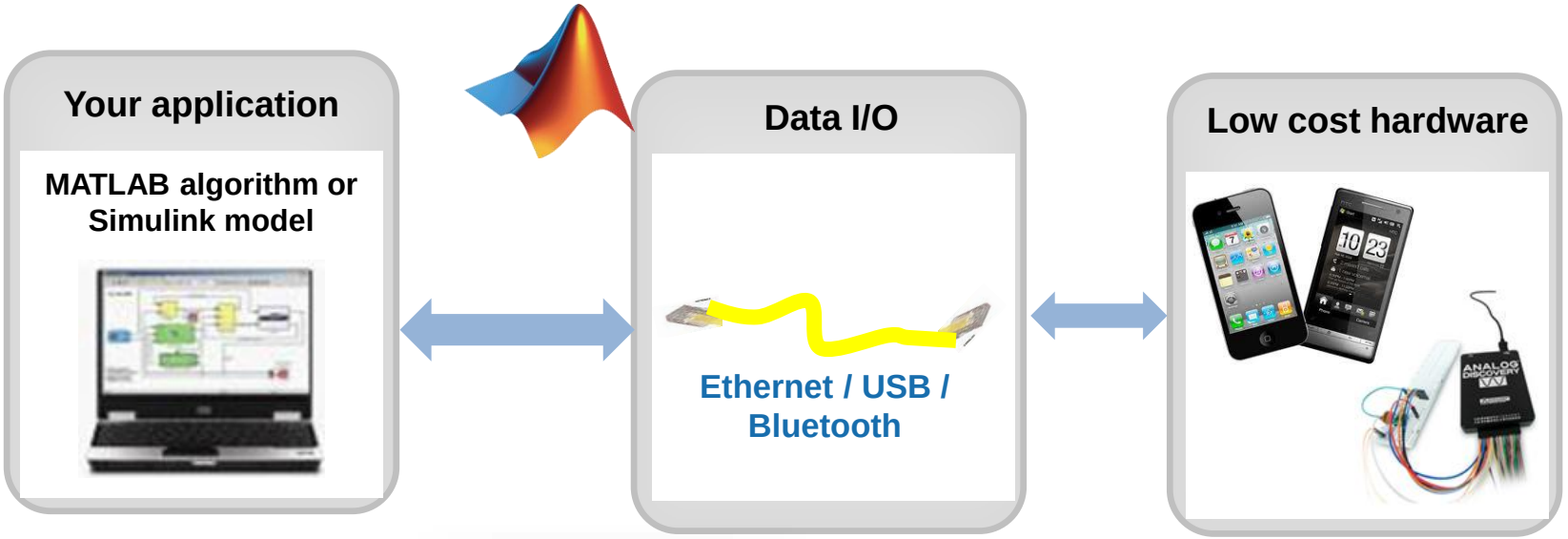


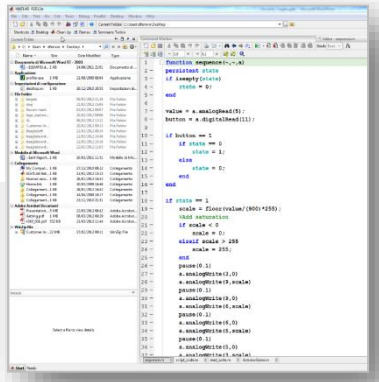
Connecting to Low Cost Hardware



- MATLAB Support Package for Raspberry Pi™
- Webcam support package
- iPhone/Android support

TETHERED

Write code and communicate with the board



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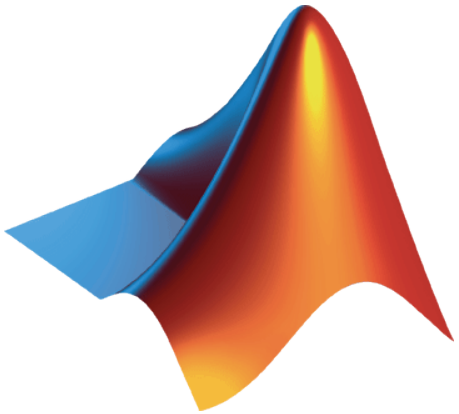

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