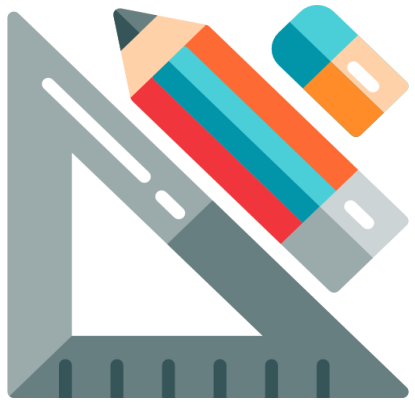


The background features a dark blue field on the left and a grey field on the right, separated by a diagonal line. In the upper right, there are white, stylized wave-like lines. In the lower right, there is a 3D wireframe plot with a color gradient from yellow at the top to blue at the bottom. Further down and to the right, there are faint blue circuit-like diagrams with lines and nodes.

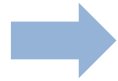
MATLAB EXPO 2017

Toolbox Development

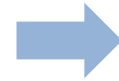
David Sampson & Amy Koh
MathWorks Consulting



Design



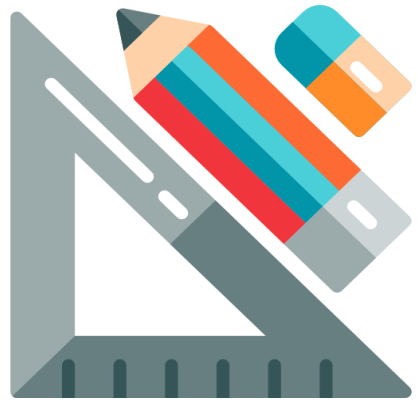
Implement



Package



Distribute



Design



Implement



Package



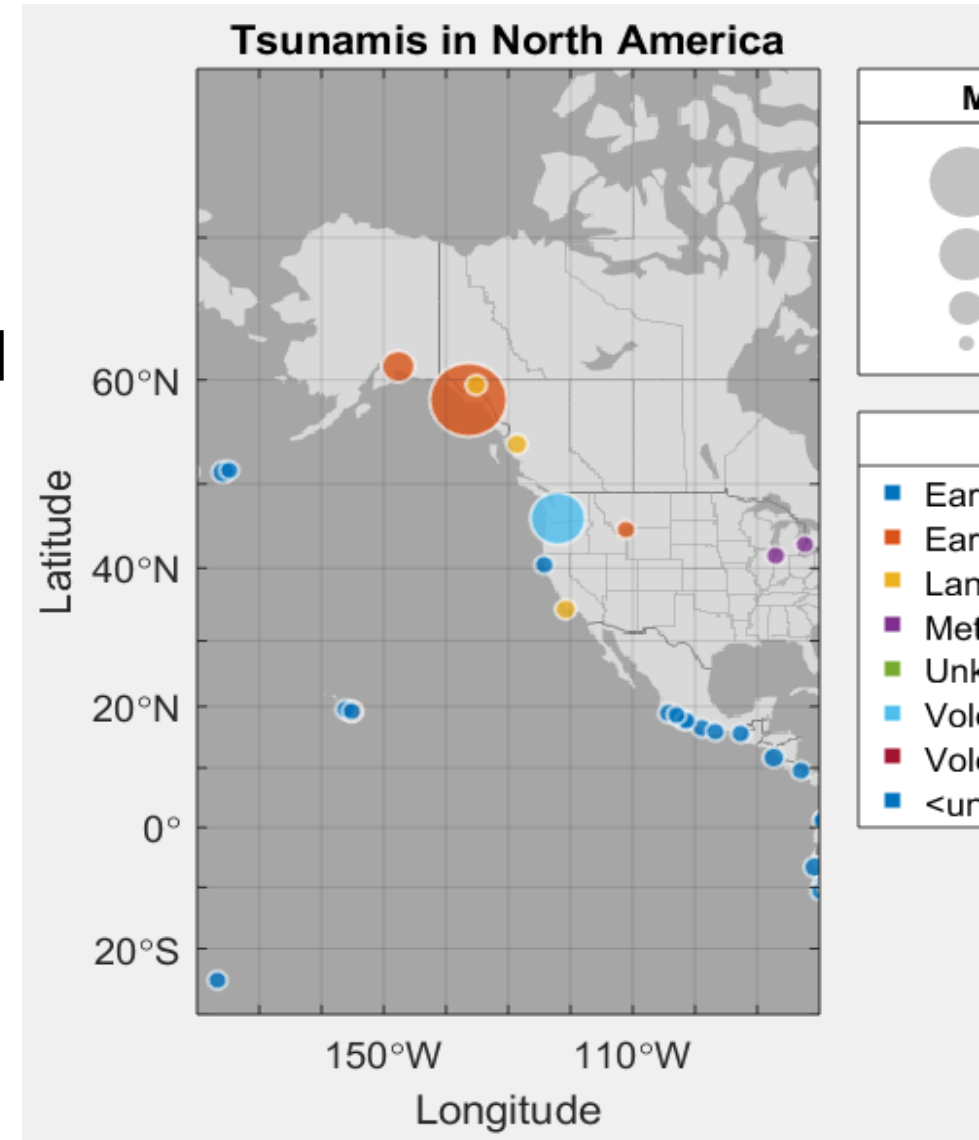
Distribute

Good names

```

    Basemap: 'colorterrain'
  BubbleColorList: [8x3 double]
  BubbleWidthRange: [5 20]
    ColorData: [162x1 categorical]
  ColorLegendTitle: 'Cause'
    ColorVariable: 'Cause'
    FontName: 'Helvetica'
    FontSize: 10
    GridVisible: 'on'
  HandleVisibility: 'on'
    LatitudeData: [162x1 double]
    ...

```



Bad names

- **Model**
- **foo_new**
- **calc**
- **ModelClass**
- **IModel**
- Indecipherable abbreviations
- Unconventional capitalisation

Naming class properties

- MixedCase full names
- Noun, noun phrase
 - ✓ Connection
 - ✓ CornerThreshold
- Verb, verb phrase
 - ✓ ShowLineNumber
 - ✓ Visible
- Avoid appending
 - ✗ ConnectionObject

MATLAB EXPO 2016

Naming classes

- lowercase short or camelCase full or MixedCase full names
- Noun, noun phrase (for things)
 - ✓ tf, ss, sym
 - ✓ griddedInterpolant
 - ✓ matlab.ui.eventdata.MouseData
- Adjective, adjective
 - ✓ Selectable
- Avoid prepending
- Avoid appending

MATLAB EXPO 2016

Naming functions and methods

- lowercase short or camelCase full names
- Verb, verb phrase (for actions)
 - ✓ delete, split
 - ✓ traverseGraph
- Noun, noun phrase (where the noun is the thing being returned)
 - ✓ eig, chebwin
- Avoid empty verbs: compute, get, display, perform, detect, retrieve, extract, return, do, does
 - ✗ computeFFT
- Conversion functions take the form foo2bar or fooToBar
- Readers and writers take the form fooread, barwrite

MATLAB EXPO 2016

Too many files

code

resources

doc

demos

- Border
- demoBrowser4
- EnableExample1
- GridFlex
- help_ex
- leftarrow
- why_layout_anno2
- colorbarexample
- gridflexpositioning
- minimizeexample
- bigicon_VBox
- DefaultsSystem2
- pagesicon
- ChildObserver
- Panel
- setPosition
- calcPixelSizes
- tab_NotSelected_NoEdge
- Box
- SelectionData
- HButtonBox
- TabPanel

- BoxInBox
- demoicon
- EnableExample2
- guide1
- help_fx
- pageicon
- info
- demoBrowser
- guideApp
- paneltabexample
- bigicon_VBoxFlex
- demoBrowser1
- reficon
- Empty
- FigureData
- tracking
- tab_NoEdge_Selected
- tab_NotSelected_NotSelected
- ButtonBox
- Empty
- VBox
- layoutRoot

- demoBrowser2
- deploy
- EnableExample3
- guide2
- help_gs
- uparrow
- axesexample
- displayEndOfDemoMessage
- guideApp
- visibleexample
- DefaultsFigure
- greenarrowicon
- rightarrow
- loadIcon
- FigureObserver
- Contents
- tab_Selected_NoEdge
- tab_NotSelected_Selected
- ChildEvent
- Grid
- VButtonBox
- BoxPanel

fresh

stale

public

internal

Organising your files

`/layout`

`/+uix`

`/+internal`

`/+uiextras`

`/resources`

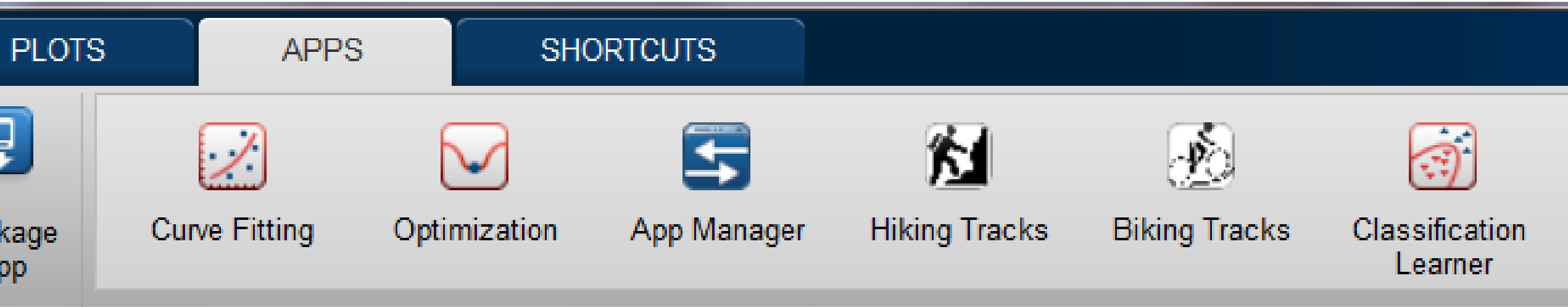
`/layoutdoc`

`/examples`

`/images`



MATLAB Apps



Classification Learner - Scatter Plot

CLASSIFICATION LEARNER VIEW

Import Data Feature Selection

DECISION TREES

Complex Tree Medium Tree Simple Tree

SUPPORT VECTOR MACHINES

Linear SVM Quadratic SVM Cubic SVM Fine Gaussian ... Medium Gaussian ... Coarse Gaussian ...

NEAREST NEIGHBOR CLASSIFIERS

Fine KNN Medium KNN Coarse KNN Cosine KNN Cubic KNN Weighted KNN

ENSEMBLE CLASSIFIERS

Boosted Trees Bagged Trees Subspace Discriminant Subspace KNN RUSBoost...

Current model

Type: Support Vector Machine
Preset: < Custom >
Data Transformation: 1 of 7 predictors excluded
Status: Trained

Show Classifier Results

Classifier Results

Color of misclassified points represents:

True class

Scatter Plot

Confusion Matrix

RCC Curve

Export Model

Scatter Plot of CreditRating for: Sup

Binning Explorer - Overview

Selected Predictor: CustID Predictor Type: Numeric

Apply Monotone Algorithm Options Manual Binning

No labels Odds Entropy WOE curve WOE Members InfoValue Export Scorecard

Overview

CustID

CustAge

TmAtAddress

ResStatus

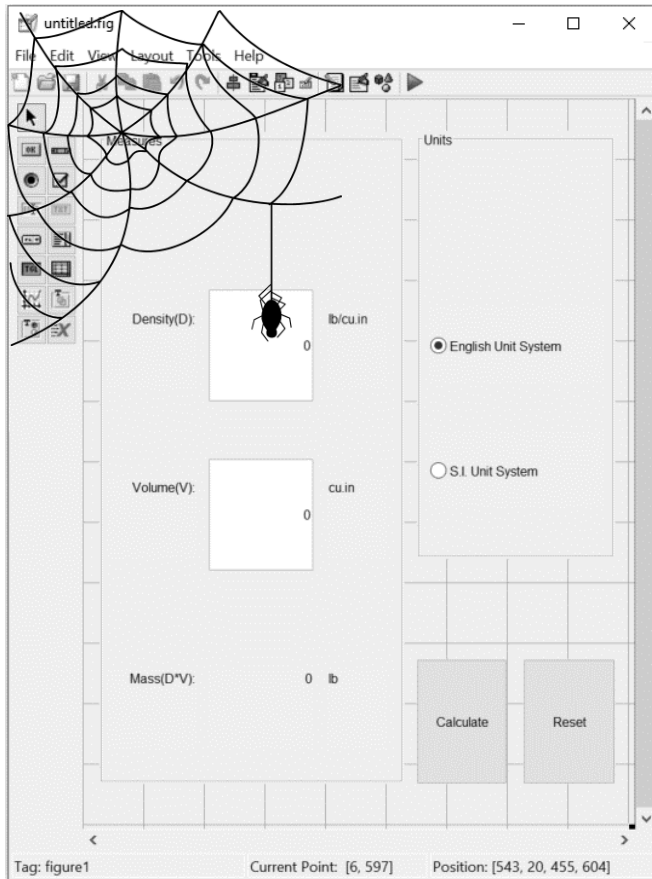
Bin Information: CustID

	Good	Bad	Odds	WOE	InfoValue
[-Inf,121)	84	36	2.3333	0.1429	0.0020
[121,241)	82	38	2.1579	0.0647	4.1412e-04
[241,1081)	559	281	1.9893	-0.0166	1.9398e-04
[1081,Inf]	78	42	1.8571	-0.0854	7.3819e-04
Totals	803	397	2.0227		0.0033

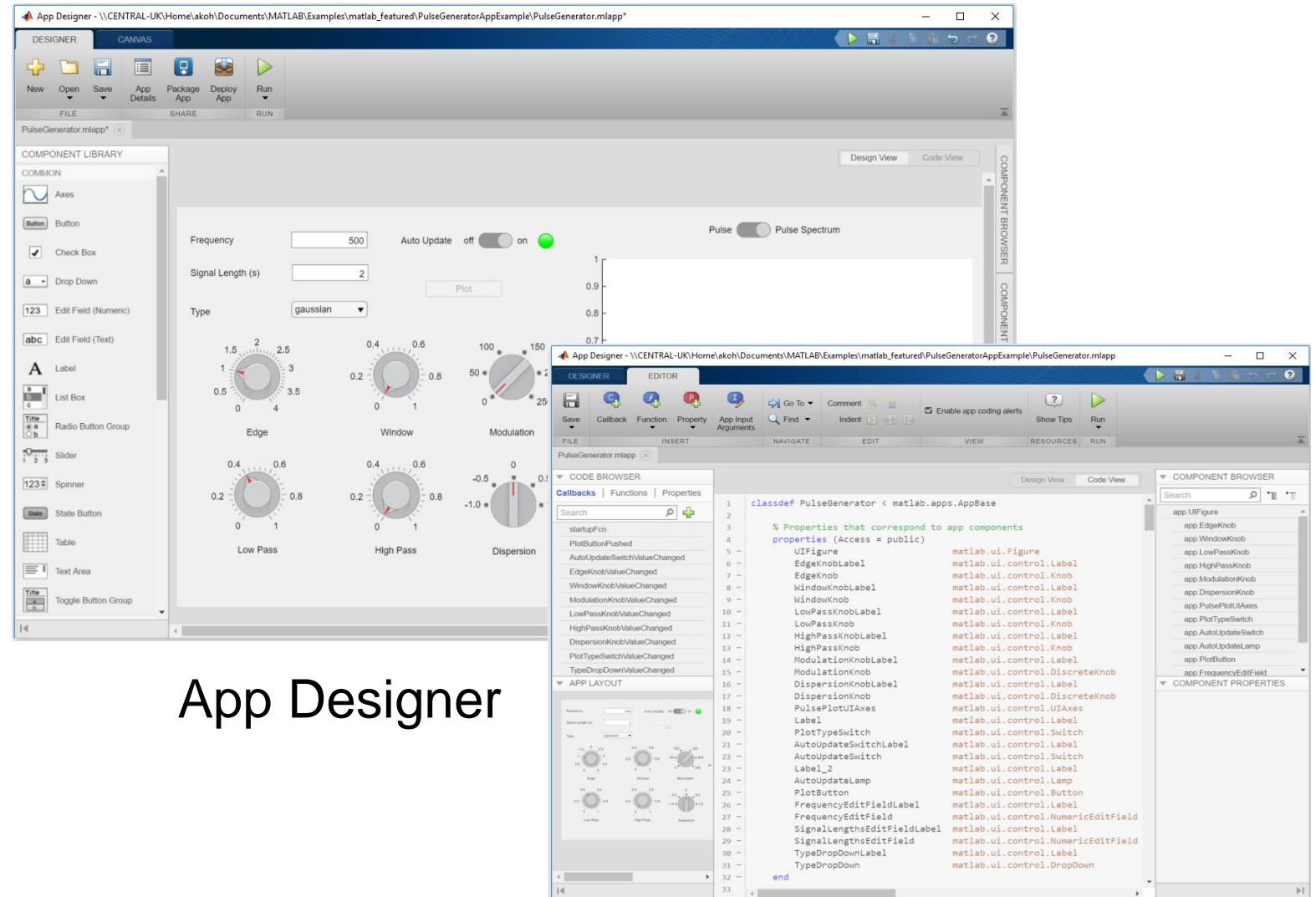
Predictor Information: CustID

Value	Value
Min	1
Max	1200
Mean	600.5000
Std	346.5545

App building tools

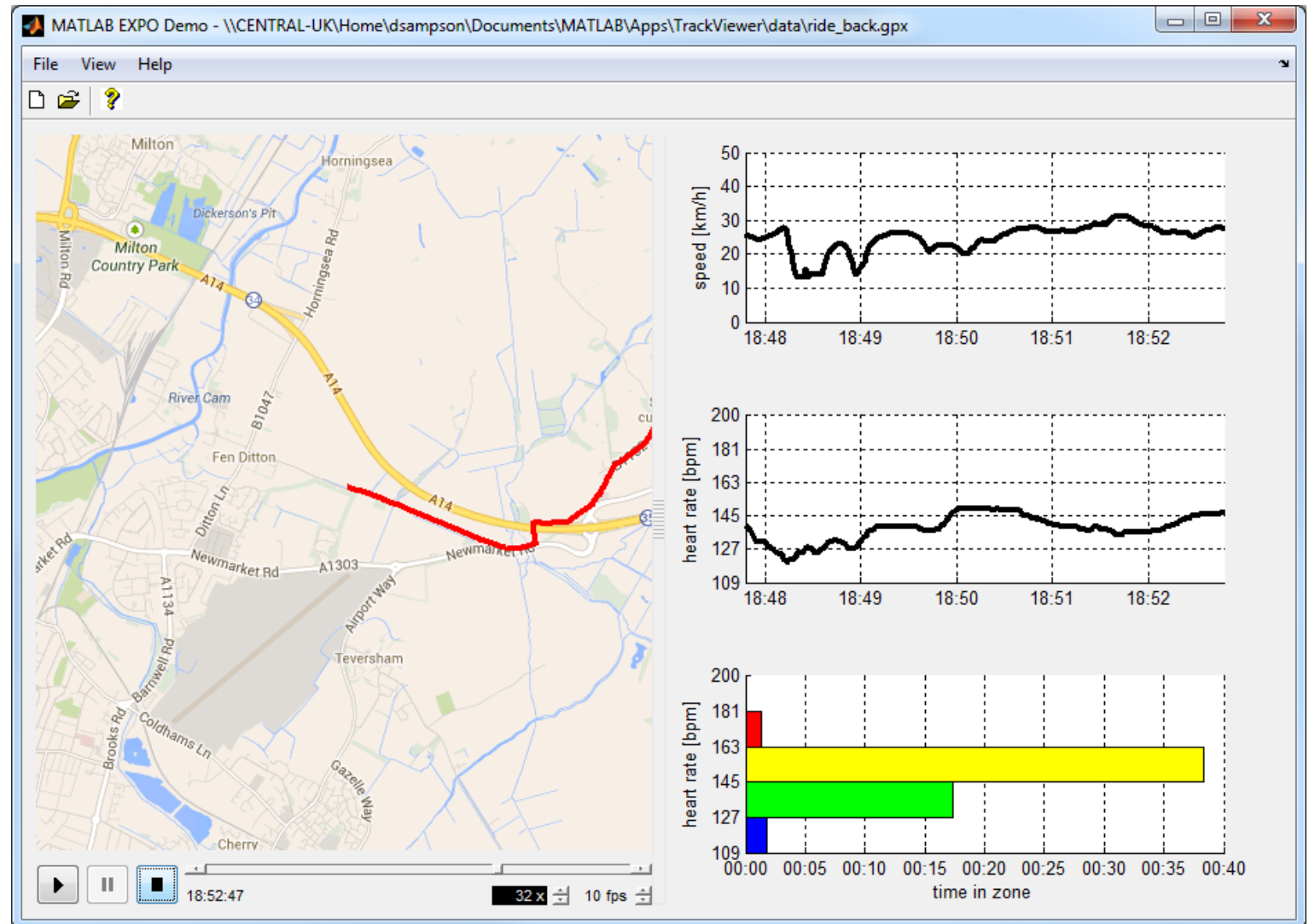
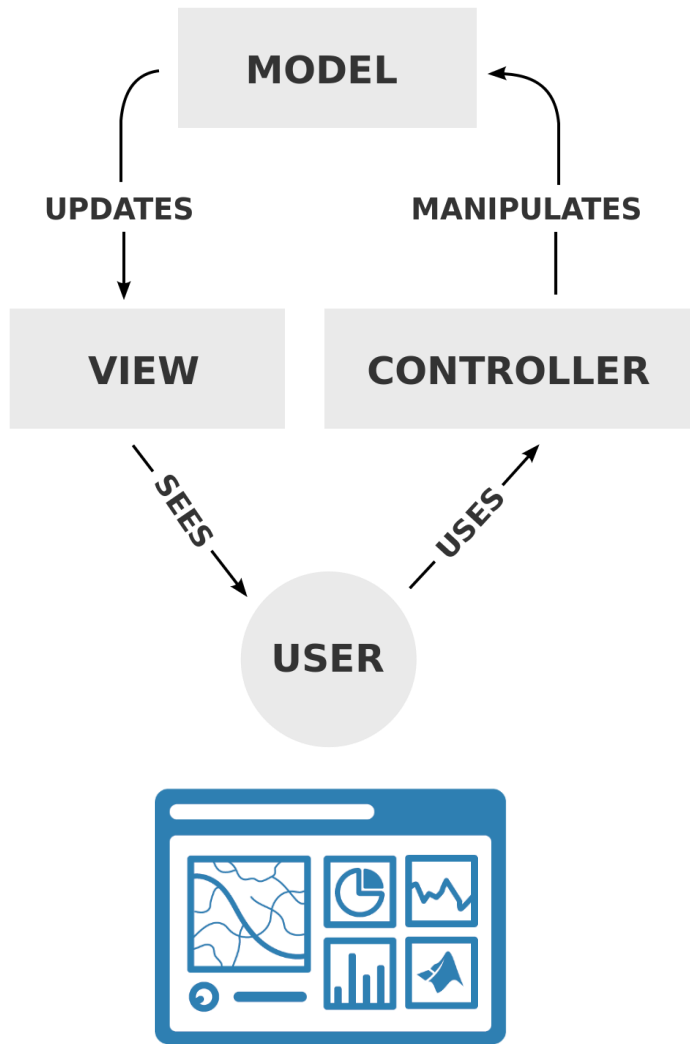


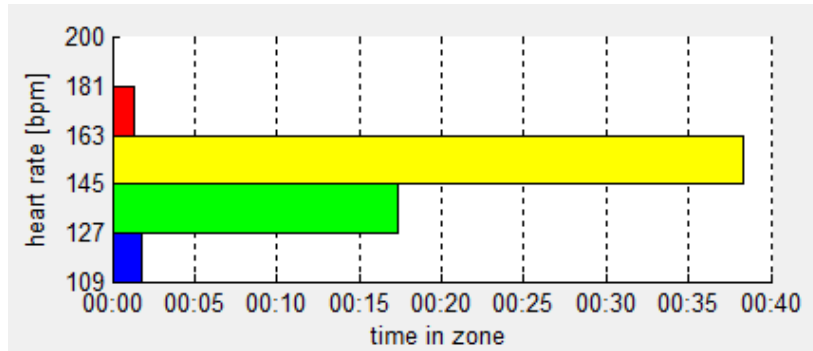
GUIDE



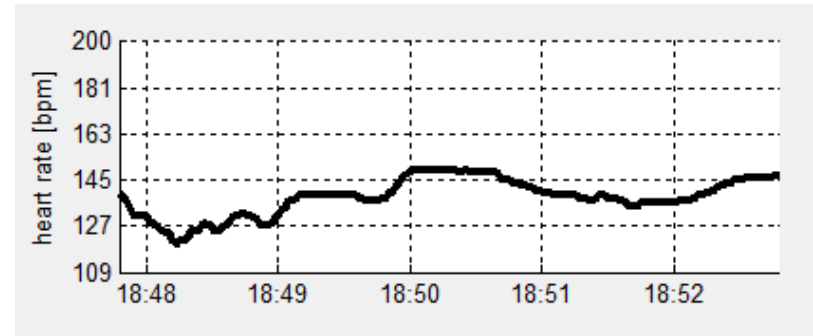
App Designer

Model-view-controller architecture





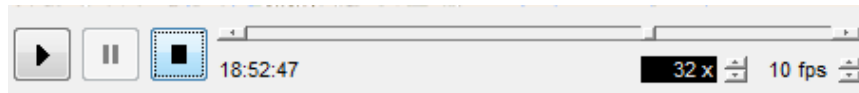
HeartRateHistogramView



StripChartView



Player



MapView



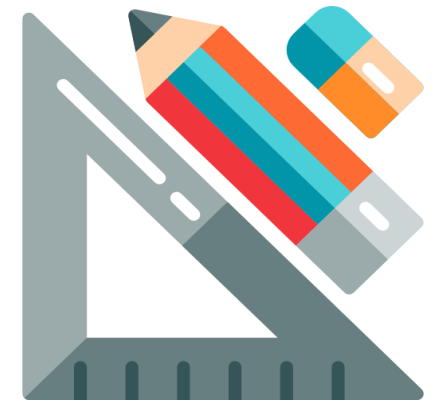
-  Event notification
-  Property access, method call

Design tips

1. Review your APIs
2. Organise your files
3. Include some apps

Resources:

- [“Best Practices – Adapt, then Adopt!”](#) on Developer Zone
- MATLAB naming guidelines
- Model-View-Controller example code from previous MATLAB EXPO proceedings





Design



Implement



Package



Distribute

```
>> y = myfunc( 1:5 )
```

Index exceeds matrix dimensions.

Error in mypkg1.mypkg1a.mypkg1ab.myfunc1 (line 9)

```
y(idx) = u(idx)*log(u_hat(idx))+(1-u(idx))*log(1-u_hat(idx));
```

Error in mypkg2.mypkg2a.myfunc2 (line 5)

```
y = mypkg1.mypkg1a.mypkg1ab.myfunc1( myVar1 .* myVar2 );
```

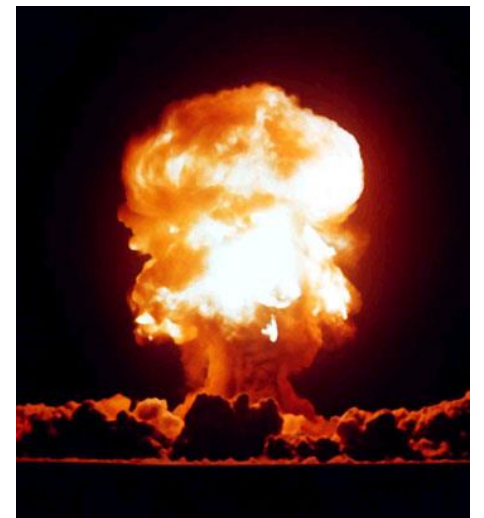
Error in mypkg3.mypkg3a.myfunc3>@(x)mypkg2.mypkg2a.myfunc2(x) (line 4)

```
y = arrayfun( @(x) mypkg2.mypkg2a.myfunc2( x ), myVar );
```

Error in mypkg3.mypkg3a.myfunc3 (line 4)

```
y = arrayfun( @(x) mypkg2.mypkg2a.myfunc2( x ), myVar );
```

Error in myfunc (line 10)



Validate inputs

- `assert`
- `validateattributes`
- `isempty`, `isnan`, `isfinite` ...
- `narginchk`
- `inputParser`

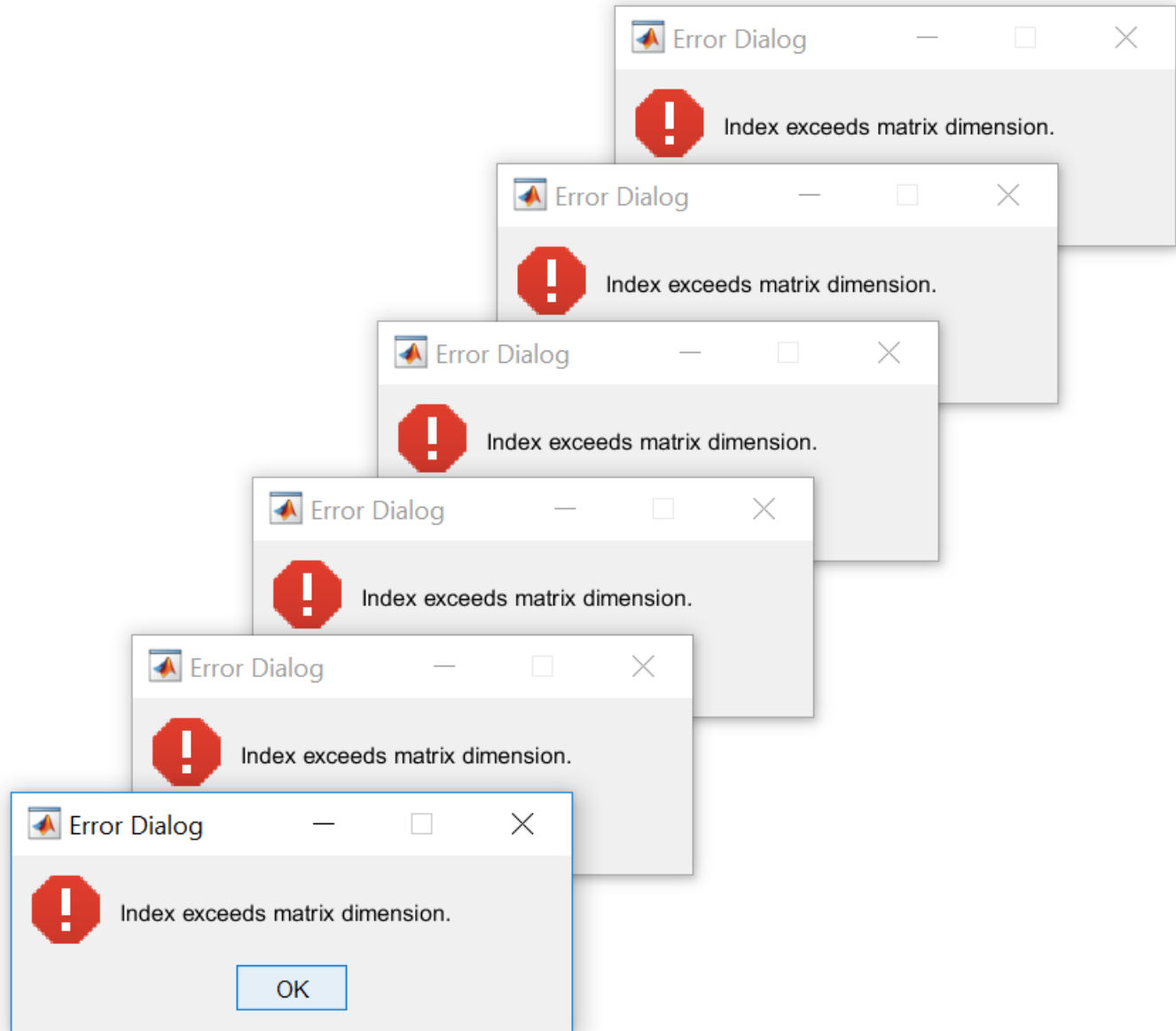
```
1 function y = timesTwo( x )
2
3     % Validate
4     validateattributes( x, {'double'}, {'size',[1 3], 'increasing'} );
5
6     y = x * 2;
7
8     end
```

```
>> timesTwo( [2 3 1] )
Error using timesTwo (line 4)
Expected input to be increasing valued.
```

```
>> timesTwo( 1:5 )
Error using timesTwo (line 4)
Expected input to be of size 1x3, but it is of size 1x5.
```


Handling errors

- error **and** warning
- Use identifiers
- MException
- try/catch
- `errordlg` **and** `warndlg`



Managing many changes: bugs, enhancements, tasks, ...

Record	Type	Summary	Status
1003744	Task	Deprecate uiextras.TabPanel	Waiting for vendor
1019459	Enhancement	Improve handling of axes with illustrations	Waiting for vendor
1100294	Bug	Plotting to axes on hidden tab shows if visible tab has axes	Waiting for vendor
1129702	Enhancement	Improve handling of 3D-rotatable axes	Waiting for vendor
1155591	Enhancement	Add comments on HandleVisibility to GUI Layout Toolbox	Unreviewed
1214592	Task	Update GUI Layout Toolbox documentation style	To consider
1218686	Enhancement	Implement partial redraw for uix.BoxPanel	To consider
1338793	Enhancement	Refresh the documentation for deploying GUIs for Compiler etc.	Unreviewed
1344383	Enhancement	Support different tab widths for different title lengths	To consider
1400079	Enhancement	Provide a mechanism for deferring redraws during GUI creation	To consider
1422529	Enhancement	Add expandable, collapsible flex containers	To consider
1426213	Bug	Arrow up and down in documentation are not rendered properly.	Need more info
1497458	Enhancement	Improve test coverage for uix.ScrollingPanel	To consider
1499525	Bug	Using data cursors on axes inside GLT containers reorders contents	Investigating
1508772	Bug	HBoxFlex not spanning complete figure in Mac R2015b	Unreviewed

Test early, test often, test automatically

- Function and class-based tests
- Setup and teardown
- Parameterised tests
- Select and run tests
- Analyse test results



```

classdef ExampleTest < matlab.unittest.TestCase
    methods(Test)
        function testA(testCase)
            testCase.verifyTrue(true)
        end
        function testB(testCase)
            testCase.assertEqual(0,1)
            % remaining test code is not exercised
        end
        function testC(testCase)
            testCase.verifyFalse(true)
        end
    end
end
end

```

Verification

verifyTrue

verifyFalse

verifyEqual

verifyNotEqual

verifySameHandle

verifyNotSameHandle

verifyReturnsTrue

verifyFail

verifyThat

Write unit tests in MATLAB

```
1  classdef Rectangle < handle
2      %RECTANGLE A simple rectangle class
3
4  properties
5      Height double
6      Width  double
7  end
8
9  methods
10
11     function obj = Rectangle(height,width) ... %constructor
20
21     function obj = resize(obj, height, width )
22         %RESIZE Resize rectangle.
23
24         obj.Height = height;
25         obj.Width = width;
26
27     end %resize
28
29 end
30
31 end
```

Write unit tests in MATLAB

```

1  classdef RectangleTest < matlab.unittest.TestCase
2      %RECTANGLETEST A simple unit test.
3
4      methods(Test)
5          function testResize(testCase)
6
7              % Create rectangle object
8              r = Rectangle(2,3);
9
10             % Resize
11             r.resize( 5, 6 );
12
13             % Verify
14             testCase.verifyEqual( r.Height, 5, ...
15                 'Height is incorrect. ');
16             testCase.verifyEqual( r.Width, 6, ...
17                 'Width is incorrect. ');
18
19         end
20     end
21
22 end

```

```

>> tc = RectangleTest;
>> tc.run

```

Running RectangleTest

```

.
Done RectangleTest

```

```
ans =
```

TestResult with properties:

```

Name: 'RectangleTest/testResize'
Passed: 1
Failed: 0
Incomplete: 0
Duration: 0.5770
Details: [1x1 struct]

```

Totals:

```

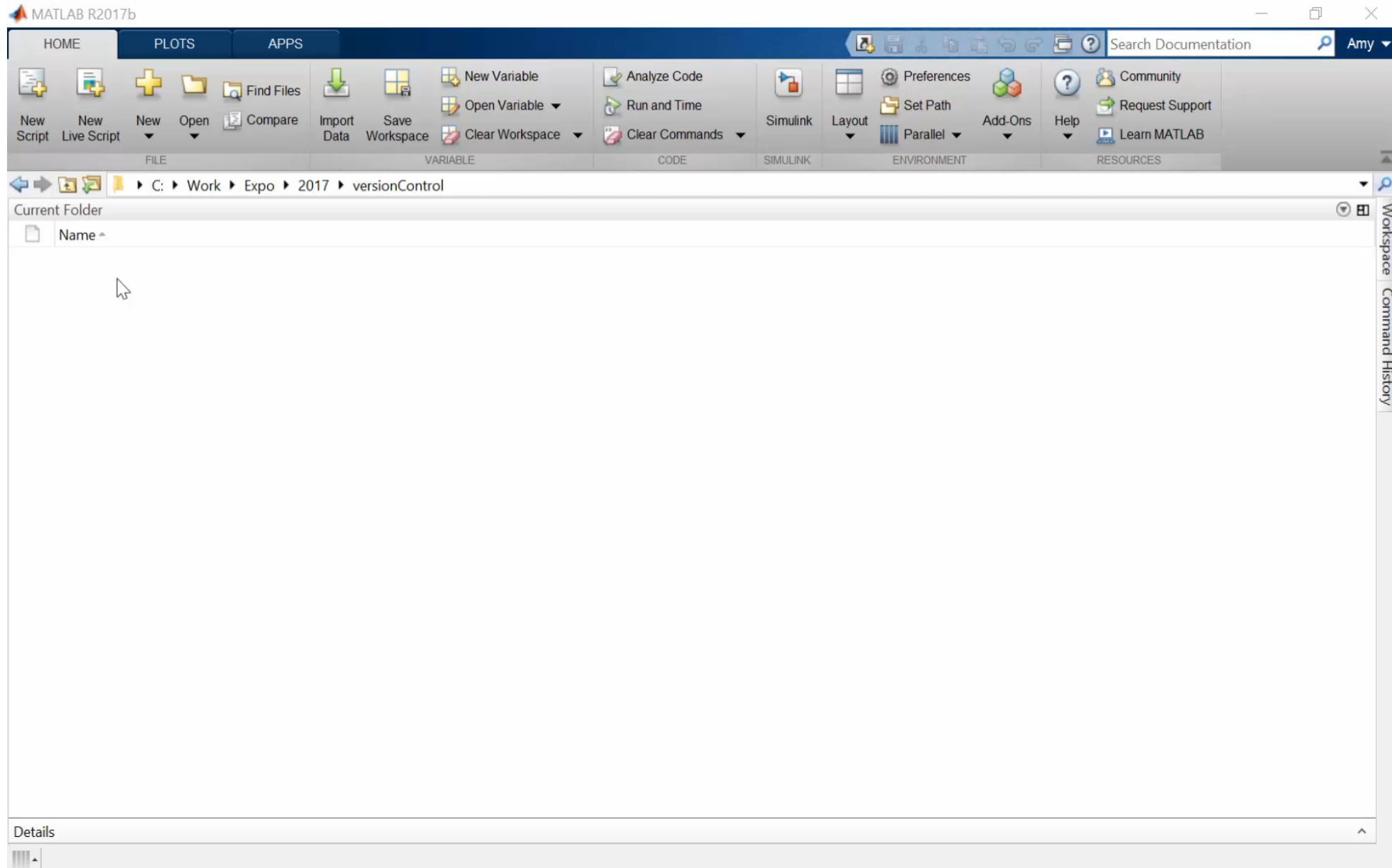
1 Passed, 0 Failed, 0 Incomplete.
0.57699 seconds testing time.

```

Version control

- Giant 'UNDO' key
- Change management
- Software release management
- Collaborative development
- Git and Subversion Integration





Implementation tips

1. Catch errors early and provide actionable feedback
2. Write some unit tests
3. Use version control

Resources:

- [MATLAB Testing framework](#)
- [MATLAB Source Control Integration](#)





Design



Implement



Package



Distribute

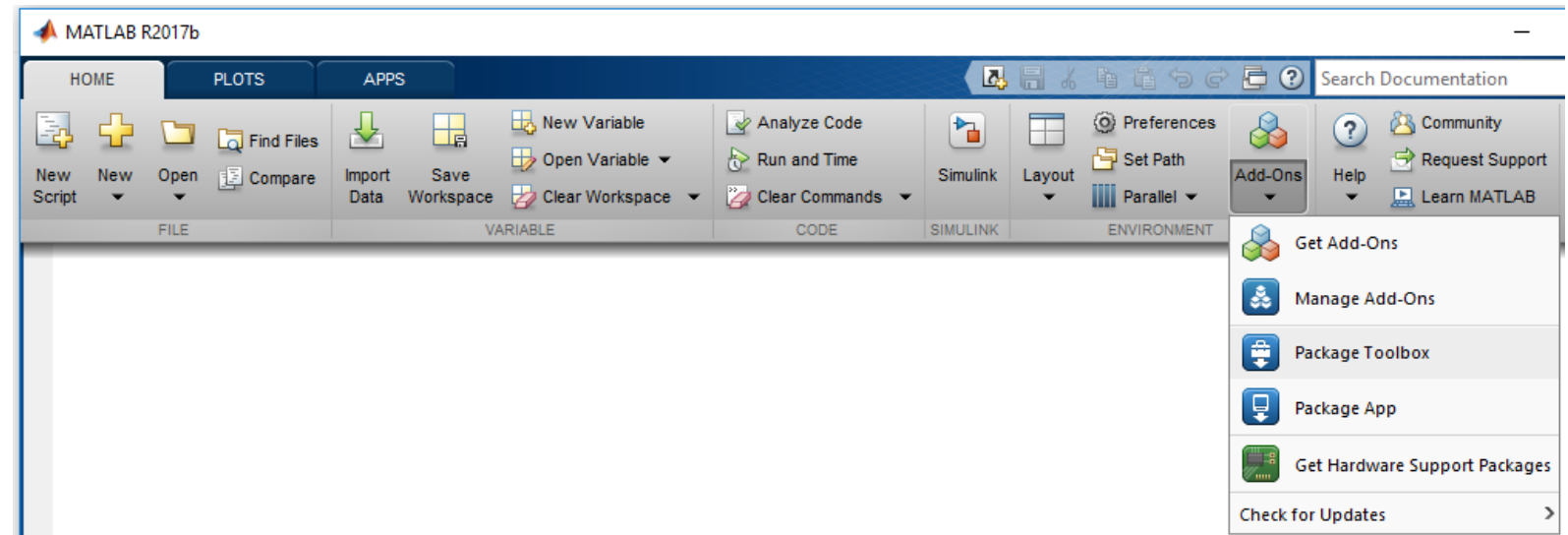
The bad old days

1. Unzip the zip file
2. Find the instructions and release notes
3. Decide whether you want the thing
4. Remove folders from old versions from the path
5. Add folders to the path
6. Save the path for next time
7. Find the documentation
8. Do work



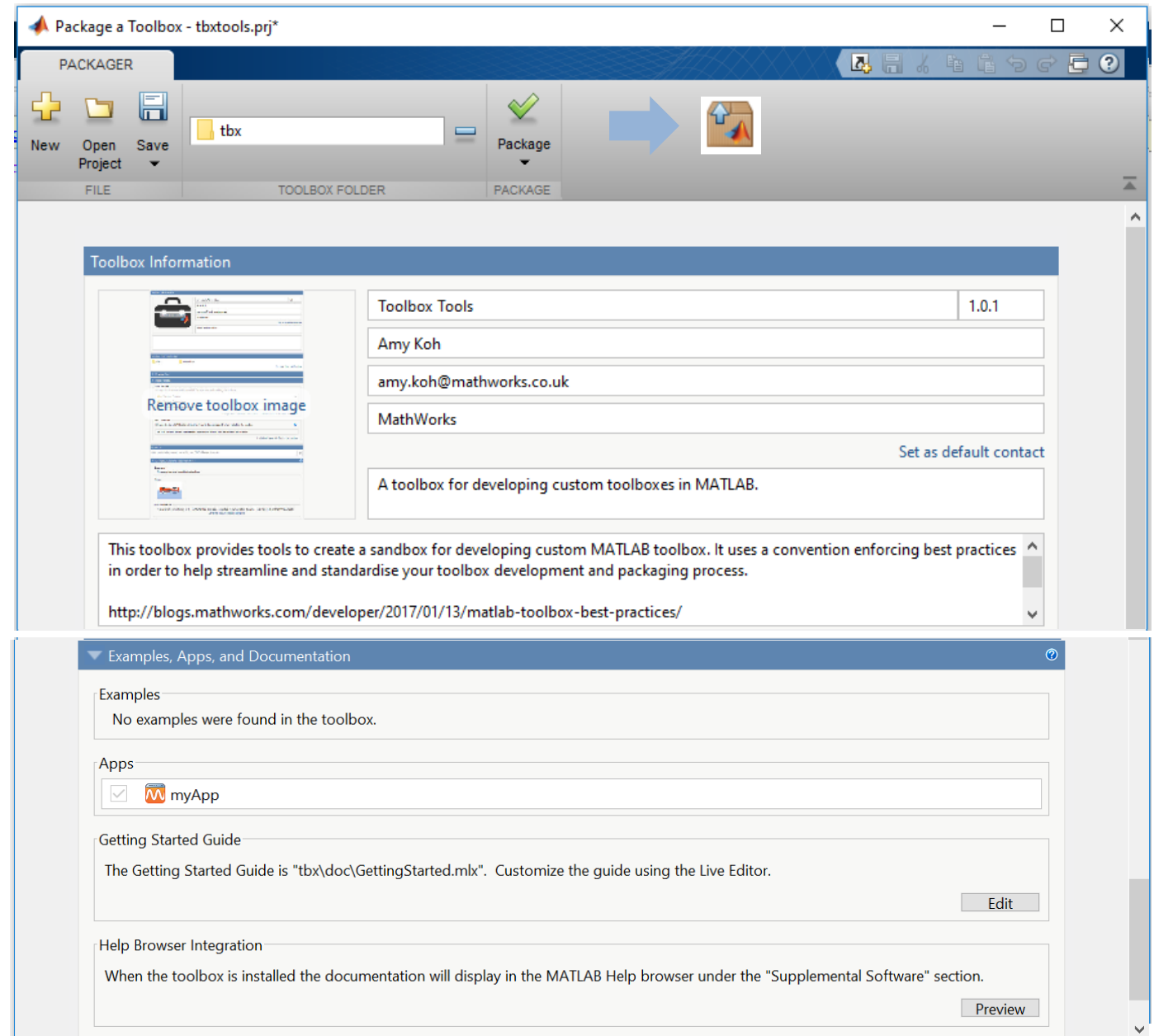
MATLAB Toolbox

- Single toolbox installer (.mltbx)
- Toolbox metadata
- External dependencies
- Examples, apps, custom doc
- MATLAB path management
- Toolbox upgrade management

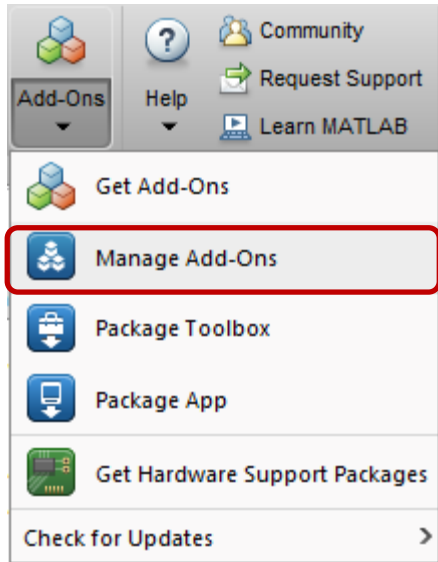


MATLAB Toolbox

- Toolbox metadata
- External dependencies
- MATLAB path management
- Examples, apps, custom doc
- Single toolbox installer (.mltbx)
- Toolbox upgrade management



Add-On Manager



Add-On Manager (Installed (92))

Get Add-Ons | Import

Name	Type	Author	Install Date
Toolbox Tools version 1.0.1	Toolbox	Amy Koh	20 September 2017
GUI Layout Toolbox version 2.3.1	Toolbox	David Sampson	20 September 2017
Embedded Coder Support Package for AUTOSAR Standard version 17.2.0	Hardware Support Package		5 September 2017
WLAN System Toolbox version 1.4	MathWorks Toolbox		25 August 2017
Wavelet Toolbox version 4.19	MathWorks Toolbox		25 August 2017
Vision HDL Toolbox version 1.5	MathWorks Toolbox		25 August 2017
Vehicle Network Toolbox version 3.4	MathWorks Toolbox		25 August 2017
Trading Toolbox version 3.3	MathWorks Toolbox		25 August 2017
Text Analytics Toolbox version 1.0	MathWorks Toolbox		25 August 2017
System Identification Toolbox version 9.7	MathWorks Toolbox		25 August 2017

Context menu for 'Toolbox Tools':

- Open Documentation
- Open Folder
- View Details
- View in Add-On Explorer
- Enabled
- Uninstall...

Help | MATLAB Documentation

Documentation

Search Help

CONTENTS Close

Explore Examples | Explore Add-Ons

My Products

Edit Preferences

Supplemental Software

[MATLAB Minimart](#)
[MATLAB Web Maps](#)

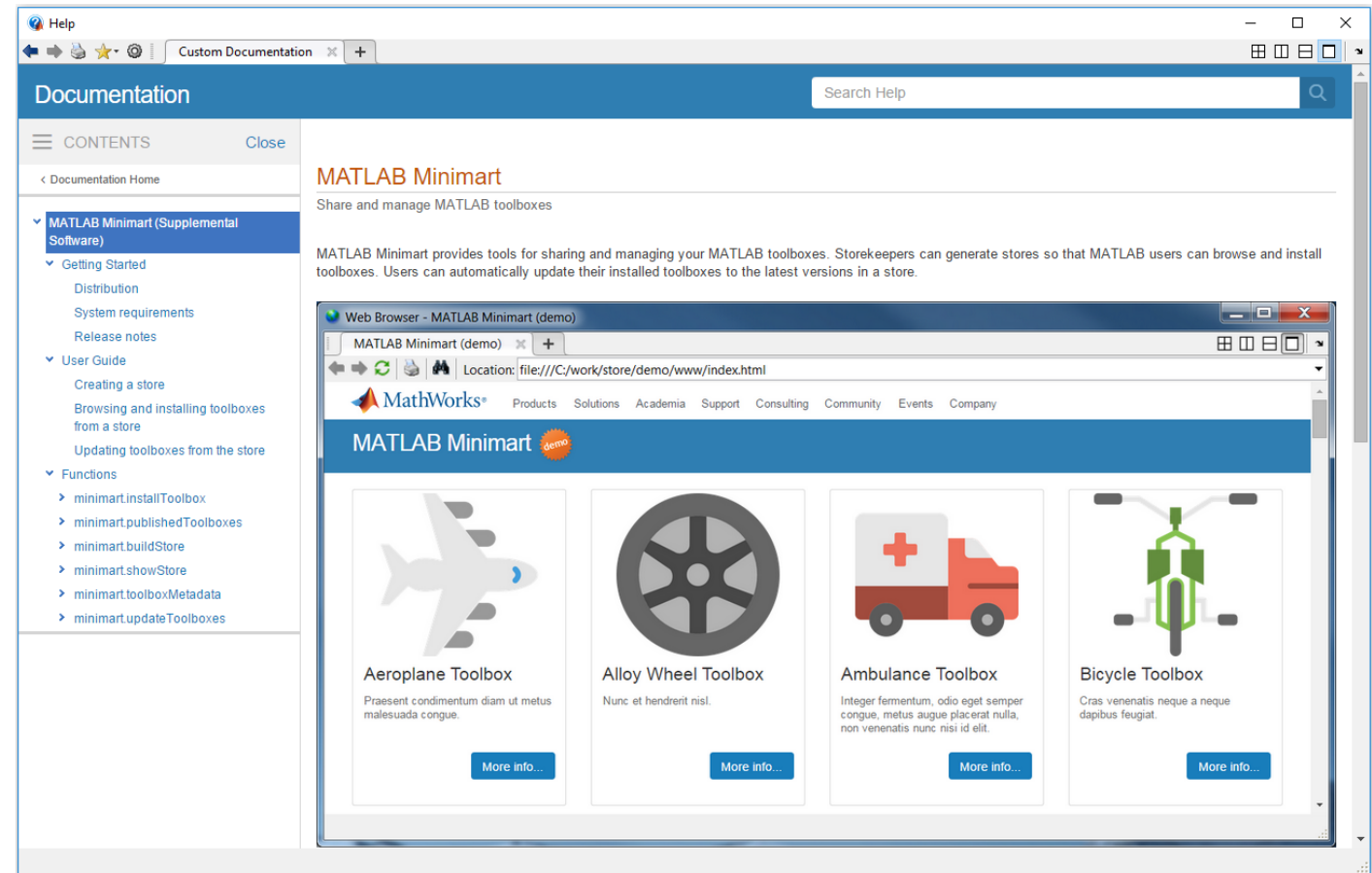
- MATLAB
- Simulink
- Aerospace Blockset
- Aerospace Toolbox
- Audio System Toolbox
- Automated Driving System Toolbox
- Bioinformatics Toolbox
- Communications System Toolbox
- Computer Vision System Toolbox
- Control System Toolbox
- Curve Fitting Toolbox
- Data Acquisition Toolbox
- Database Toolbox
- Datafeed Toolbox
- DO Qualification Kit (for DO-178)
- DSP System Toolbox
- Econometrics Toolbox
- Embedded Coder
- Financial Instruments Toolbox
- Financial Toolbox
- Fixed-Point Designer

Supplemental Software

- [MATLAB Minimart](#)
- [MATLAB Web Maps](#)

Where is the doc?

- `info.xml`
 - toolbox information and help location
- `helptoc.xml`
 - documentation files and structure
- `demos.xml`
 - custom examples



Don't fall into these pitfalls

- Path issues
- Resources missing
- Add-on identifier (“GUID”) reset
- Copy of dependencies included



Packaging tips

1. Package to .mltbx
2. Bundle documentation and examples with your code
3. Automate the packaging process

Resources:

- [“Give Them A Care Package”](#) on Developer Zone
- [“Packaging Pitfalls”](#) on Developer Zone
- [MATLAB Toolbox Tools](#) on File Exchange





Design



Implement



Package



Distribute

The image shows a desktop browser window displaying the Google Play Store's 'Top Charts' page. The browser's address bar shows the URL <https://play.google.com/store/apps/top>. The page features a navigation bar with 'Apps', 'Categories', 'Home', 'Top Charts', and 'New Releases'. The 'Top Apps' section lists:

- 1. WhatsApp Messenger (WhatsApp Inc.)
- 2. Messenger - Text (Facebook)
- 3. Football Strike - Mini (Miniclip.com)
- 4. Wish - Shopping (Wish Inc.)

Below this is the 'Top Selling Apps' section. An overlay from the Android phone's 'My apps & games' screen is visible on the right, showing 8 updates available. The updates list includes:

- reddit is fun GP (unofficial) (6.1 MB)
- Dropbox (13 MB)
- Instagram (15 MB)
- Messenger (32 MB)
- Chrome Canary (Unstable) (7.7 MB)
- Yelp: Food, Shopping, Services (6.2 MB)
- Slack (5.1 MB)
- Android Pay

88 bytes	14.5 KB	14.6 KB
Aeroplane Toolbox 1.2 MATLAB Toolbox 14.8 KB	Aeroplane Toolbox 1.3 MATLAB Toolbox 14.6 KB	Aeroplane Toolbox 2.0 MATLAB Toolbox 14.5 KB
Aeroplane Toolbox 2.1 MATLAB Toolbox 14.8 KB	Aeroplane Toolbox 2.2 MATLAB Toolbox 14.8 KB	Aeroplane Toolbox 3.1 MATLAB Toolbox 14.5 KB
Aeroplane Toolbox 3.2 MATLAB Toolbox 15.0 KB	Aeroplane Toolbox 3.3 MATLAB Toolbox 15.2 KB	Alloy Wheel Toolbox 1.0 MATLAB Toolbox 16.5 KB
Alloy Wheel Toolbox 1.2 MATLAB Toolbox 16.3 KB	Alloy Wheel Toolbox 2.0 MATLAB Toolbox 16.1 KB	Alloy Wheel Toolbox 2.1 MATLAB Toolbox 16.7 KB
Alloy Wheel Toolbox 3.1 MATLAB Toolbox 16.6 KB	Alloy Wheel Toolbox 3.2 MATLAB Toolbox 16.4 KB	Alloy Wheel Toolbox 3.3 MATLAB Toolbox 16.6 KB
Ambulance Toolbox 1.0 MATLAB Toolbox 11.6 KB	Ambulance Toolbox 1.1 MATLAB Toolbox 11.7 KB	Ambulance Toolbox 1.2 MATLAB Toolbox 11.5 KB
Ambulance Toolbox 1.4 MATLAB Toolbox 11.9 KB	Bicycle Toolbox 1.0 MATLAB Toolbox 10.3 KB	Bicycle Toolbox 1.1 MATLAB Toolbox 10.0 KB
Bicycle Toolbox 1.3 MATLAB Toolbox 10.7 KB	Bus Toolbox 1.0 MATLAB Toolbox 15.6 KB	Bicycle Toolbox 1.2 MATLAB Toolbox 10.1 KB
Cable Car Toolbox 1.0 MATLAB Toolbox 12.8 KB	Cable Car Toolbox 1.1 MATLAB Toolbox 12.3 KB	Bus Toolbox 1.1 MATLAB Toolbox 14.9 KB
		Bus Toolbox 1.2 MATLAB Toolbox 15.1 KB
		Cable Car Toolbox 2.0 MATLAB Toolbox 12.5 KB
		Cable Car Toolbox 2.1 MATLAB Toolbox 13.0 KB

The screenshot shows a browser window with the URL `file:///C:/Visits/general/uk/seminars/expo16/mathworks/demo/stores/large/www/index.html`. The page header includes the MathWorks logo and navigation links: Products, Solutions, Academia, Support, Community, Events, and Company. The main heading is "MATLAB Store (demo)".

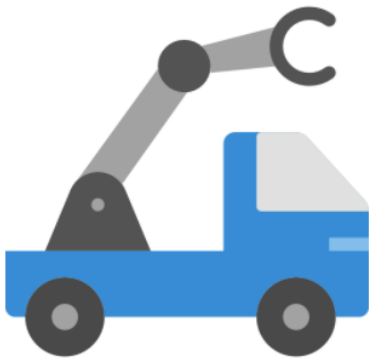
The main content area features a grid of eight toolbox categories, each with an icon, a title, a short description, and a "More info..." button:

- Forklift Toolbox**: Quisque eget erat tempor, sodales enim efficitur, malesuada ligula.
- Aeroplane Toolbox**: Ut sodales augue nec imperdiet fermentum.
- Ship Toolbox**: Integer auctor ultricies maximus.
- Helicopter Toolbox**: Maecenas euismod placerat euismod.
- Wheel Toolbox**: Suspendisse aliquam velit at urna consequat dapibus.
- Drone Toolbox**: Mauris commodo sapien tortor, id faucibus dolor pharetra nec.
- Concrete Mixer Toolbox**: Maecenas euismod placerat euismod.
- Dump Truck Toolbox**: Fusce fermentum sem tellus, eget convallis tellus rhoncus eu.



MATLAB
Minimart

MATLAB Minimart demo



Crane Toolbox

Etiam ut nisi eget sem vehicula hendrerit nec viverra sapien.

Nullam venenatis libero lectus, at ultricies erat dictum nec. Quisque sit amet ullamcorper tellus. Fusce molestie elit massa, sagittis congue metus rutrum et. Pro
 consectetur in arcu id, dictum sagittis dolor. Duis velit odio, convallis eu nulla et, elementum porta lectus. Phasellus vitae auctor eros. Integer non eros metus.
 nulla laoreet ullamcorper. Nullam feugiat sem lacinia, dignissim ex sed, bibendum justo. Sed at iaculis justo.







Nam gravida iaculis mauris, eu molestie purus finibus a. Duis rutrum arcu arcu. Sed fringilla est nisi, a convallis velit tempor id. Ut efficitur leo in consequat mo
 tincidunt nunc id velit venenatis, at ultrices mi porta. Duis blandit gravida mauris, malesuada elementum leo finibus vitae. Donec efficitur ex fermentum, eleme
 interdum mi. Cras ornare lorem orci, ac dictum leo molestie eu. Etiam pretium risus non arcu posuere interdum nec ut neque. Vivamus molestie sodales blandi
 ac vehicula ante, eget rutrum ante. In venenatis euismod justo, a eleifend nisi pulvinar vel. Curabitur ut condimentum felis. Praesent purus dolor, viverra vel sa
 pretium vehicula nunc. Duis porta aliquam tortor, ut lobortis velit sollicitudin sed. Vivamus lorem nibh, tincidunt ut bibendum sed, sodales ut tellus.

Vivamus non lacinia ante, non aliquet tellus. Morbi in ex sed diam placerat venenatis at a nibh. Sed luctus dui vitae lacus ullamcorper maximus. In ac cursus n

- 2.2 ▼
- 3.4
- 3.3
- 3.2
- 3.1
- 3.0
- 2.3
- 2.2
- 2.1
- 2.0
- 1.3
- 1.2
- 1.1
- 1.0

Updating toolboxes

```
>> minimart.updateToolboxes( 'stores\huge' )
Upgrade 'Badminton Toolbox' from version 2.0 to version
2.4? (y/n) y
Upgrade 'Archery Toolbox' from version 1.1 to version
2.1? (y/n) y
Upgrade 'Bottle Toolbox' from version 1.4 to version 3.2?
(y/n) y
```

	Name	Type	Author	Install D..
	Bottle Toolbox version 3.2	Toolbox	Darth Vader	23 Septem
	Archery Toolbox version 2.1	Toolbox	Richard Kimble	23 Septem
	Badminton Toolbox version 2.4	Toolbox	Wile E. Coyote	23 Septem
	MATLAB Minimart version 1.2.2	Toolbox	David Sampson	23 Septem
	Vehicle Network Toolbox version 3.4	 MathWorks		21 Septem




MATLAB Store



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Author X

- Abhishek Singhal
- Anni Piirainen
- Anthony Bobbie
- Arun Raveendran
- Azam Din
- Ben Tordoff
- David Sampson

Type X

- App
- Toolbox

Tag X



Vehicle Feedback XML Analyser Application

by Simulation Group

This application is intended to import Vehicle Diagnostic Data (DTCs/DIDs) from various XML file formats from around the business

Version 1.0

1 rating

0 comments - 4 tags

194 downloads



Engineering Data Toolbox

by Simulation Group


Toolbox providing importers for JLR engineering data files and a set of common data preparation methods. Type edtDoc to get started.

Version 1.3.0 1.2.0 more ...

3 ratings

5 comments - 4 tags

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App Manager

by Mathworks

Tool for managing installed apps and toolboxes

Version 3.4 3.3 more ...

3 ratings

1 comment - 1 tag

162 downloads

The App Manager allows you to:

- Connect to a MATLAB Store, either local or in a SharePoint site
- Check for new versions of installed apps and toolboxes
- Check for app and toolbox recommendations
- Update and downgrade apps and toolboxes to a specified version

The App Manager uses MATLAB release compatibility information when suggesting and

Download

Share

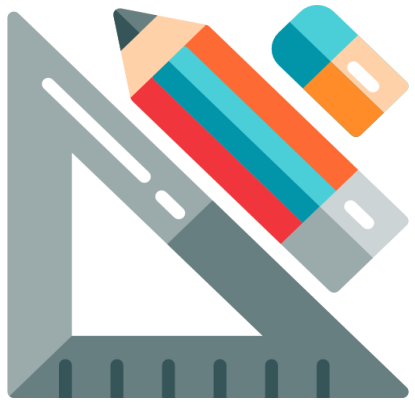
Distribution tips

1. Corral your toolboxes
2. Help users browse and update
3. Start simple and scale up

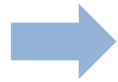
Resources:

- [MATLAB Minimart](#) on File Exchange
- [“Jaguar Land Rover Standardizes on MATLAB for Developing, Packaging, and Sharing Engineering Tools”](#) on User Stories

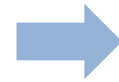




Design



Implement



Package



Distribute

Thank you.

Questions?