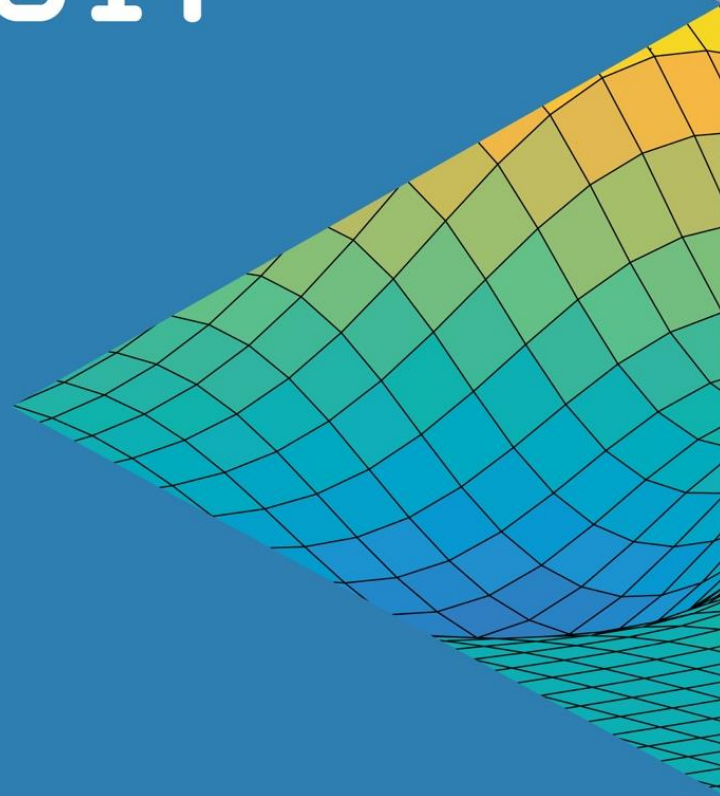


MATLAB EXPO 2017

Introduction to MATLAB

Lianne Crooks



Key Takeaways

- MATLAB can be used at all stages of your work.
- How to automate analysis.
 - Avoid repetition
 - Save time
- Many resources available to help you to learn basic and advanced MATLAB concepts.



MATLAB
The Language of Technical Computing

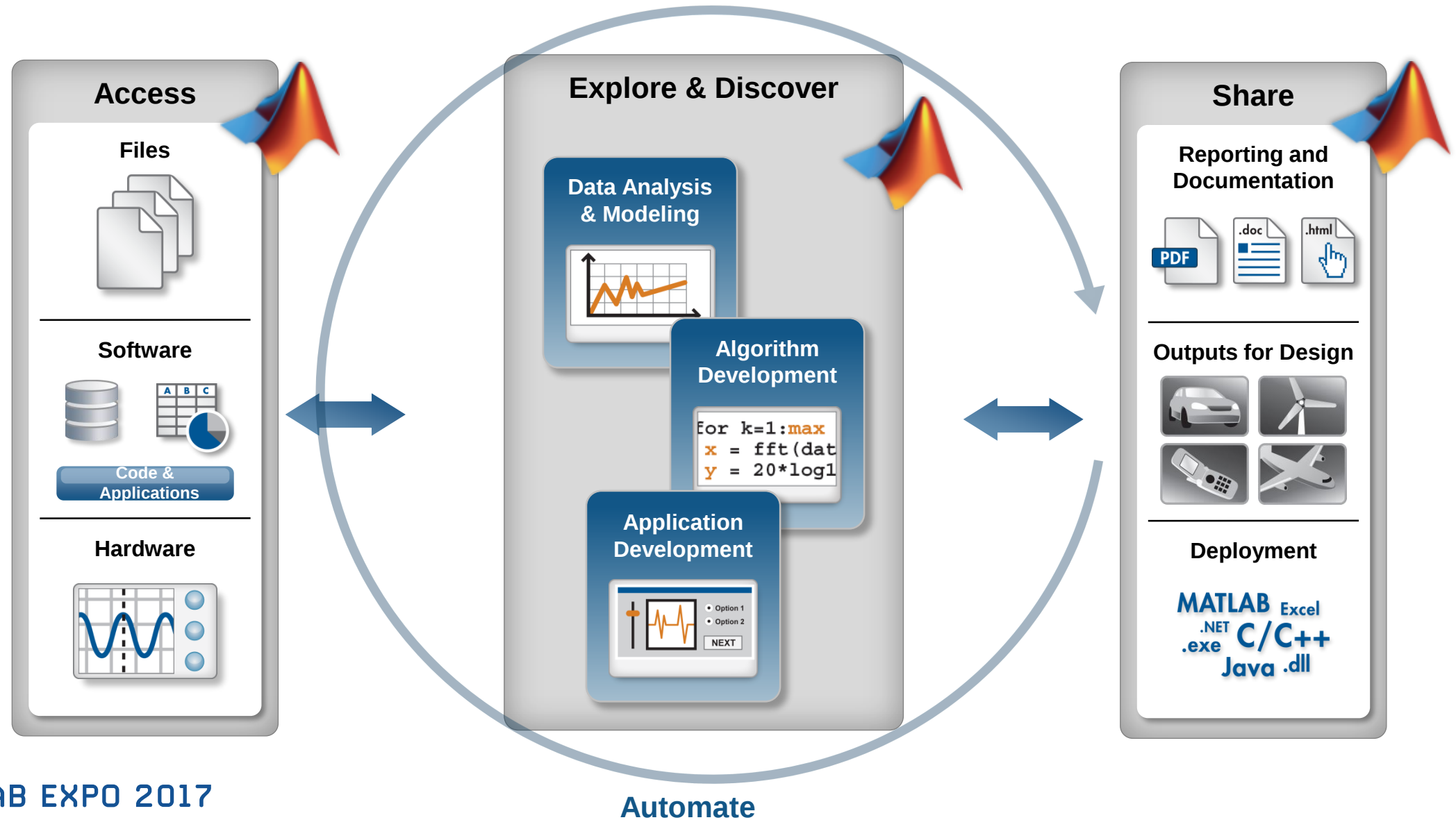
What is MATLAB?

- High-level computer language **designed to be used by scientists and engineers** within an easy-to-use interactive environment.
- **Extendable** using toolboxes that provide targeted functionality for specific types of analysis or area of expertise.
- Large range of use cases from simple, **quick analysis** to in-depth programmes for **production** deployment.

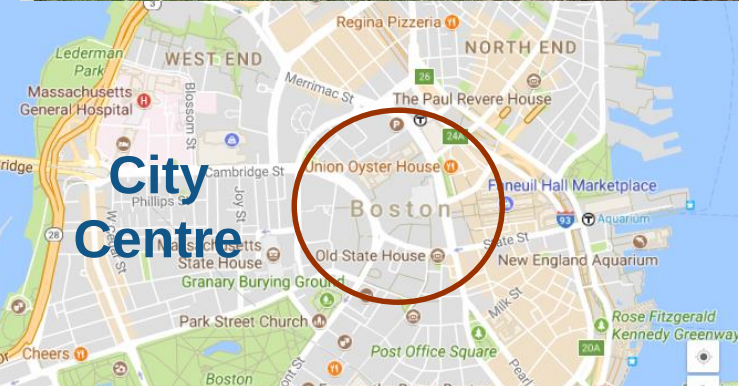
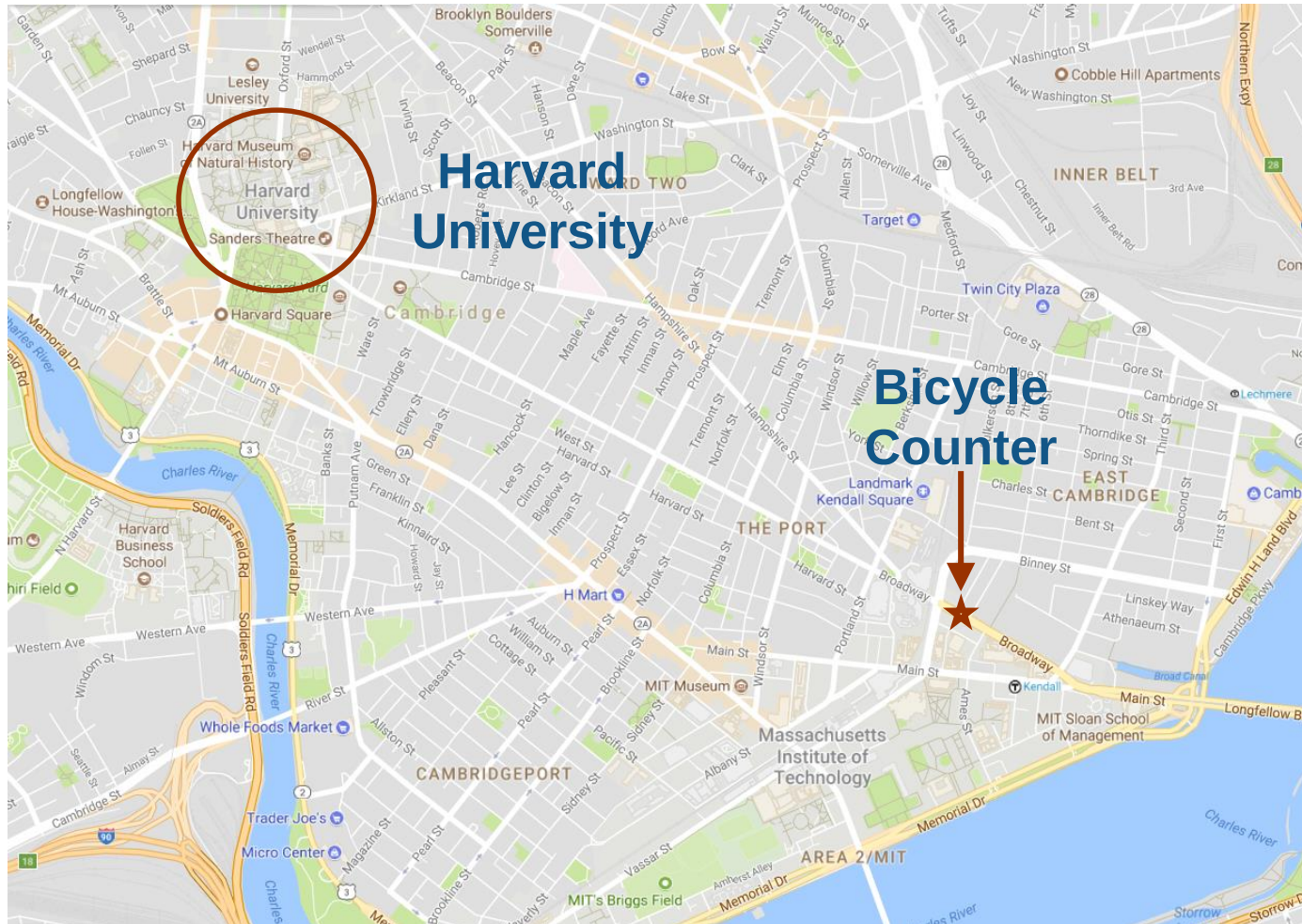


MATLAB
The Language of Technical Computing

Technical Computing Workflow



Example: Bicycle Traffic Analysis



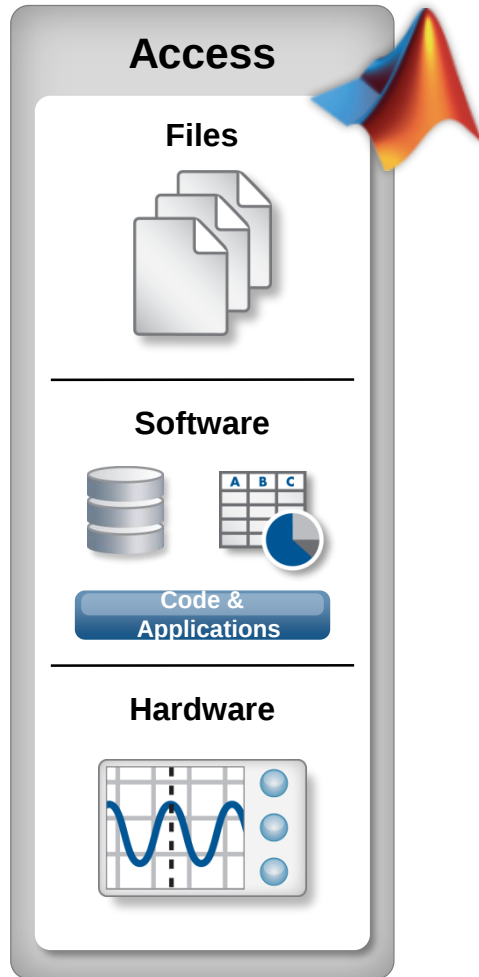
Example: Bicycle Traffic Analysis

- Bicycle count for journeys toward Harvard (**Westbound**) and toward City Centre (**Eastbound**).
- Counts recorded every 15 minutes between 01/01/17 – /09/17.
- Data contains:
 - Timestamp
 - Day of the week
 - Total bicycle counts per 15 minutes
 - Counts separated by journey direction

Timestamp						
	A	B	C	D	E	F
1	Timestamp	Day	Total	Westbound	Eastbound	
38	01/01/2017 09:00	Sunday	1	0	1	
39	01/01/2017 09:15	Sunday	1	0	1	
40	01/01/2017 09:30	Sunday	1	0	1	
41	01/01/2017 09:45	Sunday	0	0	0	
42	01/01/2017 10:00	Sunday	2	1	1	
43	01/01/2017 10:15	Sunday	1	0	1	
44	01/01/2017 10:30	Sunday	2	0	2	
45	01/01/2017 10:45	Sunday	3	2	1	
46	01/01/2017 11:00	Sunday	2	0	2	
47	01/01/2017 11:15	Sunday	4	0	4	
48	01/01/2017 11:30	Sunday	1	0	1	
49	01/01/2017 11:45	Sunday	1	1	0	
50	01/01/2017 12:00	Sunday	2	1	1	
51	01/01/2017 12:15	Sunday	1	0	1	

Importing Data: Interactive or Generate Code

- Interactively import data with the Import Tool:



IMPORT VIEW

Delimited ☐ Column delimiters: Comma Range: A2:E18337 Output Type: Table ☐ Replace unimportable cells with NaN

Fixed Width ☐ Variable Names Row: 1

DELIMITERS SELECTION IMPORTED DATA UNIMPORTABLE CELLS

BicycleCounts2017.csv BicycleCounts2015.csv

bikeData

	Timestamp	Day	Total	Westbound	Eastbound
	Datetime	Categorical	Number	Number	Number
1	Timestamp	Day	Total	Westbound	Eastbound
2	24/06/2015 00:00:00	Wednesday	4	1	3
3	24/06/2015 00:15:00	Wednesday	3	3	0
4	24/06/2015 00:30:00	Wednesday	4	3	1
5	24/06/2015 00:45:00	Wednesday	2	2	0
6	24/06/2015 01:00:00	Wednesday	2	2	0
7	24/06/2015 01:15:00	Wednesday	0	0	0
8	24/06/2015 01:30:00	Wednesday	0	0	0
9	24/06/2015 01:45:00	Wednesday	1	1	0
10	24/06/2015 02:00:00	Wednesday	1	1	0
11	24/06/2015 02:15:00	Wednesday	0	0	0
12	24/06/2015 02:30:00	Wednesday	0	0	0
13	24/06/2015 02:45:00	Wednesday	0	0	0
14	24/06/2015 03:00:00	Wednesday	1	1	0
15	24/06/2015 03:15:00	Wednesday	0	0	0
16	24/06/2015 03:30:00	Wednesday	0	0	0
17	24/06/2015 03:45:00	Wednesday	0	0	0
18	24/06/2015 04:00:00	Wednesday	0	0	0
19	24/06/2015 04:15:00	Wednesday	1	1	0
20	24/06/2015 04:30:00	Wednesday	0	0	0
21	24/06/2015 04:45:00	Wednesday	0	0	0

Import Data
Generate Script
Generate Function

Compare with Weather Data



Data Tools: Find a Station

Retrieve weather records from observing stations by entering the desired location, data set, data range, and data category. Location can be specified as city, county, state, country, or ZIP code.

Enter Location

Boston, MA, United States

Select Dataset

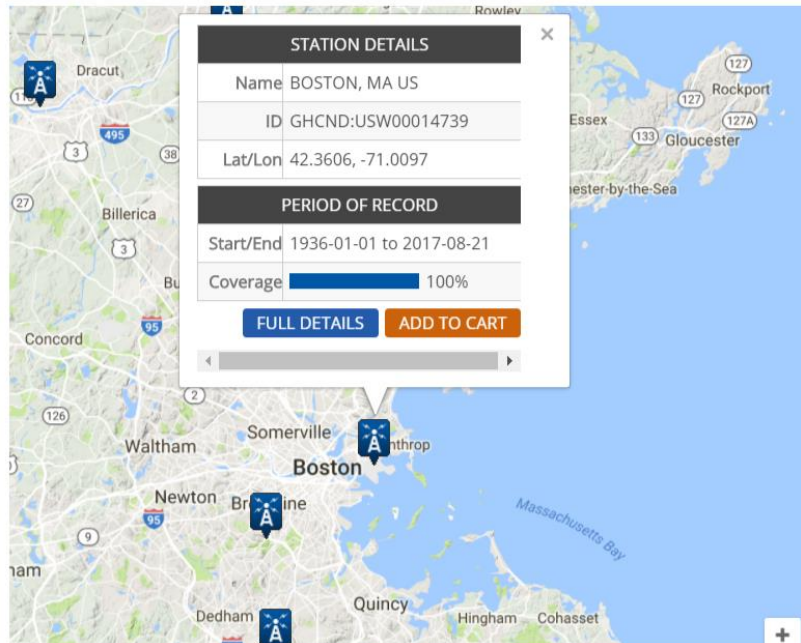
Daily Summaries

Select Date Range

2017-08-21

Data Categories

- ☐ Air Temperature
- ☐ Evaporation
- ☐ Land
- ☐ Precipitation



- Historical weather data for Boston, MA.

	A	B	C	D	E	F	G
1	DATE	AvWindSpeed	Precipitation	TAVG	TMAX	TMIN	
2	01/01/2017	14.09	0.07	40	44	33	
3	02/01/2017	4.47	0	35	41	28	
4	03/01/2017	18.12	0.89	41	44	40	
5	04/01/2017	12.53	0.06	43	48	33	
6	05/01/2017	14.76	0	32	34	27	
7	06/01/2017	8.05	0.06	29	31	24	
8	07/01/2017	14.32	0.53	23	24	17	
9	08/01/2017	13.42	0.01	18	22	13	
10	09/01/2017	11.10	0	15	20	11	

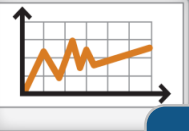
- Same time period as bicycle traffic data.
- We have data for:
 - Average wind speed (MPH)
 - Precipitation (inches per day)
 - Average daily temperature (°F)
 - Maximum daily temperature (°F)
 - Minimum daily temperature (°F)

Are bicycle counts related to the weather?

- Live Editor allows for quick and easy exploration of data

Explore & Discover

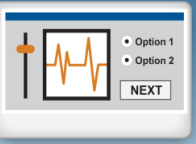
Data Analysis & Modeling



Algorithm Development

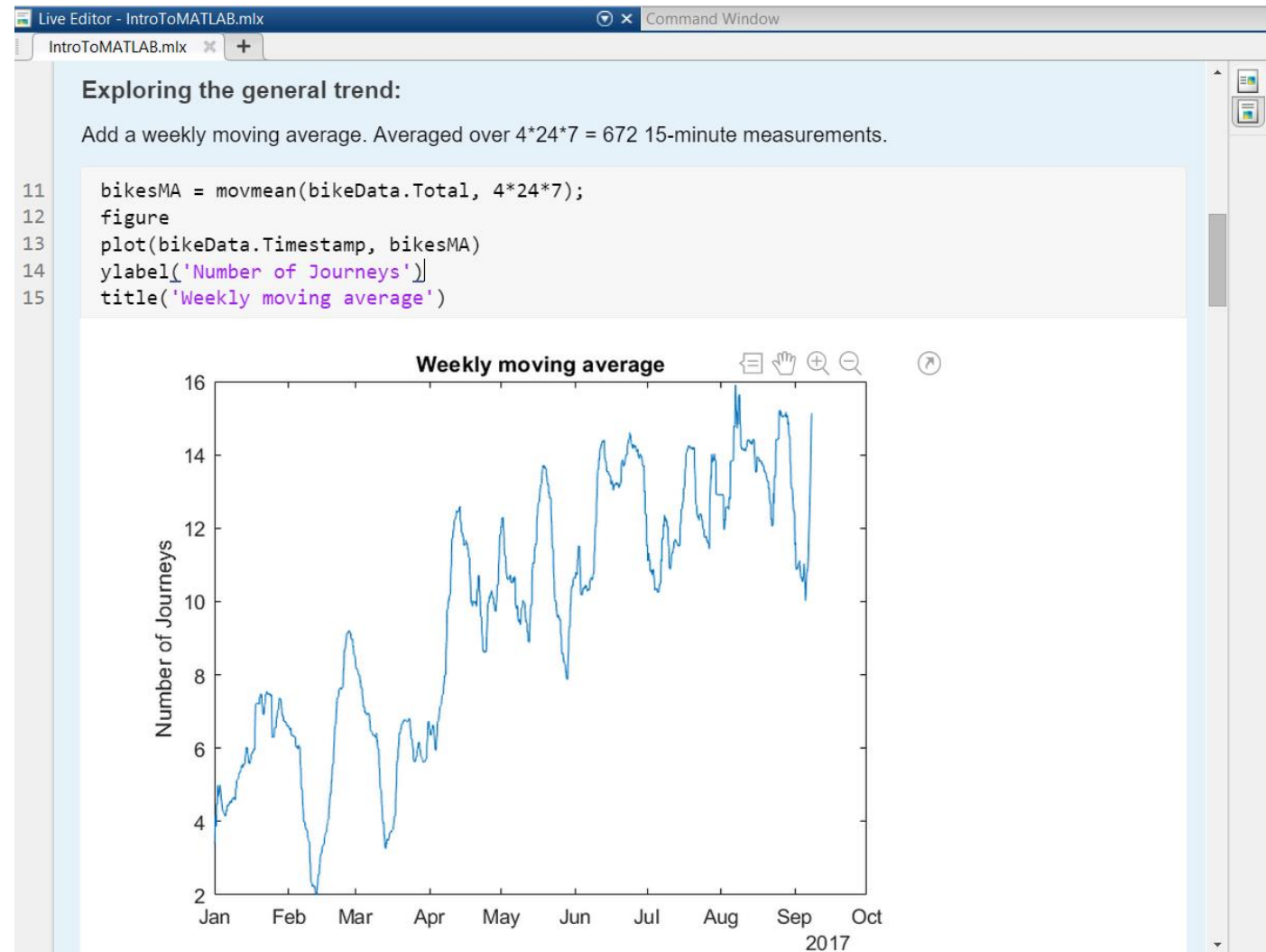
```
for k=1:max
    x = fft(dat
    y = 20*log1
```

Application Development



Option 1
Option 2
NEXT

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Sharing Code and Applications

- Export as PDF/HTML/LaTeX

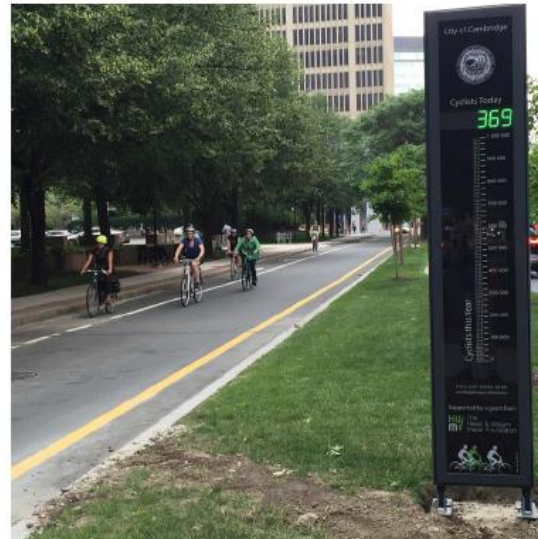


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Introduction to MATLAB

In this script, we will import in data from .csv files interactively, and then generate code to bring in the data programmatically.

The bicycle counts data comes from sensors on Broadway, Cambridge, Massachusetts, and counts the number of bikes travelling toward *Harvard* (**Westbound**) and toward the *city centre* (**Eastbound**) every 15 minutes.



Importing Data

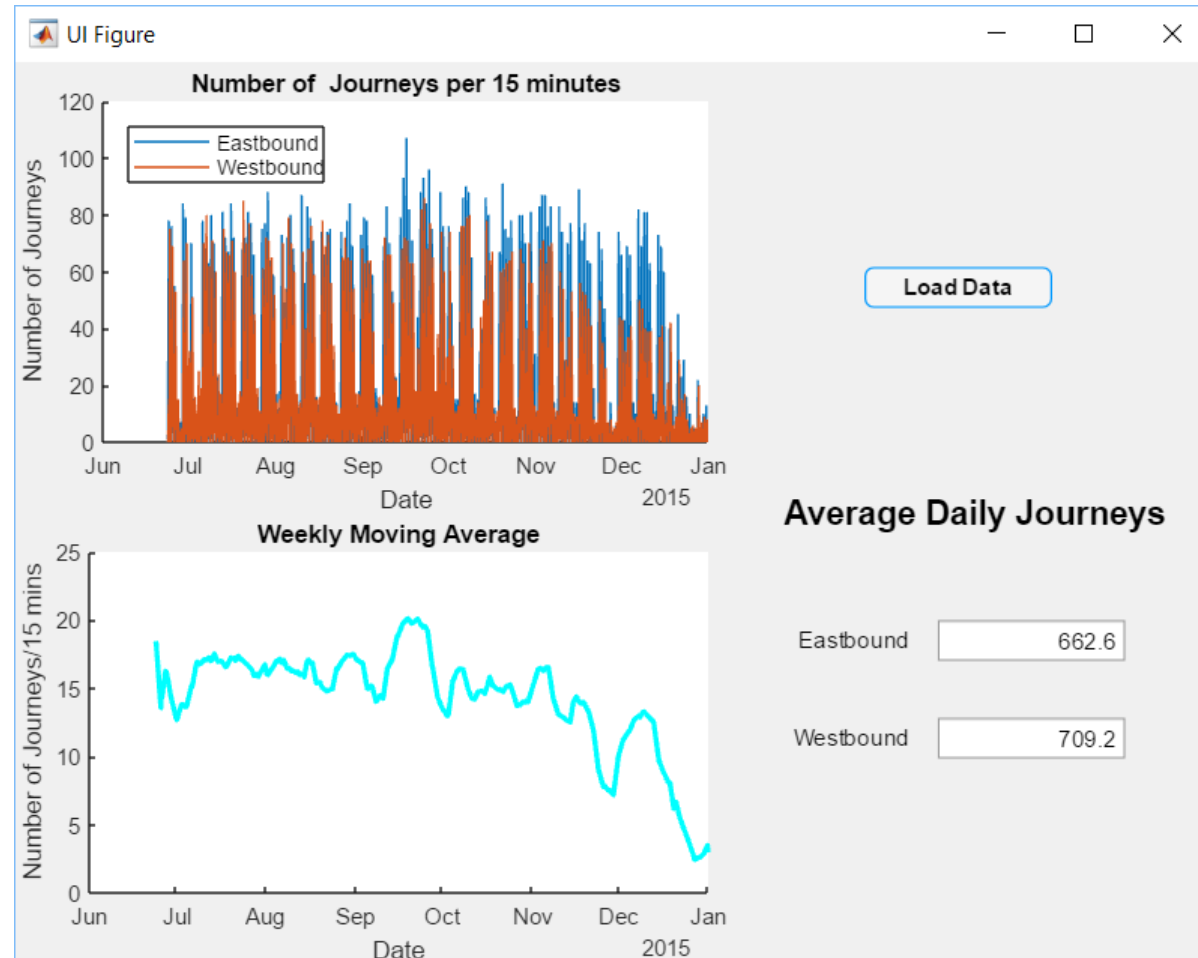
Data can be imported interactively using the Import Tool.

Sharing Code and Applications

- Create stand-alone application for MATLAB and Non-MATLAB users.



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MATLAB Onramp

- Get started with MATLAB for free
- Two-hour interactive training course
 - Hands-on experience.
 - Work through examples and exercises
 - Immediate feedback.
- Access directly from MATLAB:

MATLAB Onramp 15% complete » MATLAB academy

Chapter 9.1 Plotting Vectors

Practice
Complete the tasks below.

Task 1

Info: Two vectors of the same length can be plotted against each other using the `plot` function.

```
>> plot(x,y)
```

Try creating a plot with `sample` on the x-axis and `mass1` on the y-axis.

[Hint](#) [Get solution](#)

Task 2
Task 3
Task 4
Task 5
Task 6
Task 7
Task 8
Further practice

Figure 1

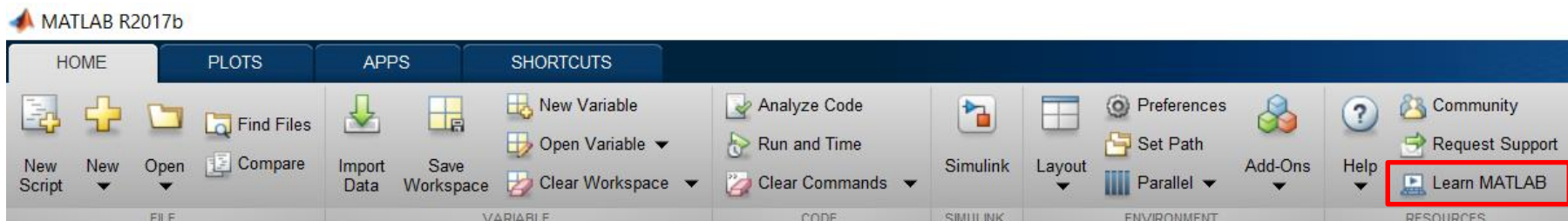
```
>> load datafile
>> sample = data(:,1);
>> density = data(:,2);
>> v1 = data(:,3);
>> v2 = data(:,4);
>> mass1 = density.*v1;
>> mass2 = density.*v2;
```

Task 1 ✓

```
>> plot(sample,mass1,'*-')
```

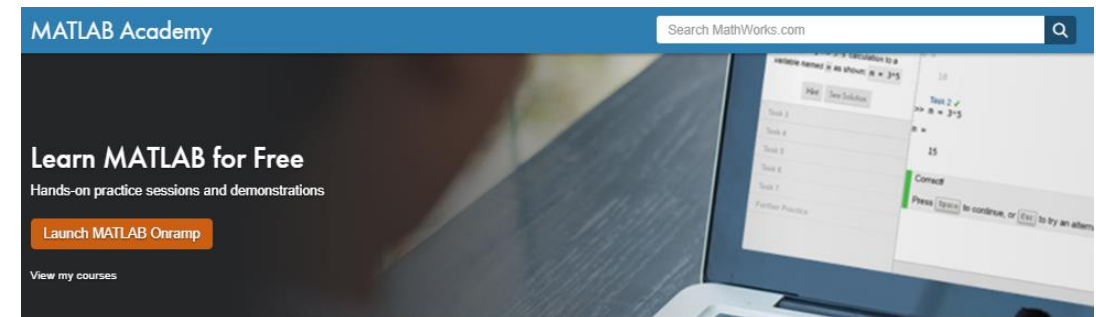
Correct!

Press [Space](#) to continue, or [Esc](#) to try an alternative solution.



MATLAB Training – Online and in the Classroom

- Free MATLAB Onramp training.
 - Get started with MATLAB
 - Interactive training course
- Other self-paced, online courses:
<https://matlabacademy.mathworks.com/>
- Classroom training available:
 - You come to us, or we come to you.



Course Offerings

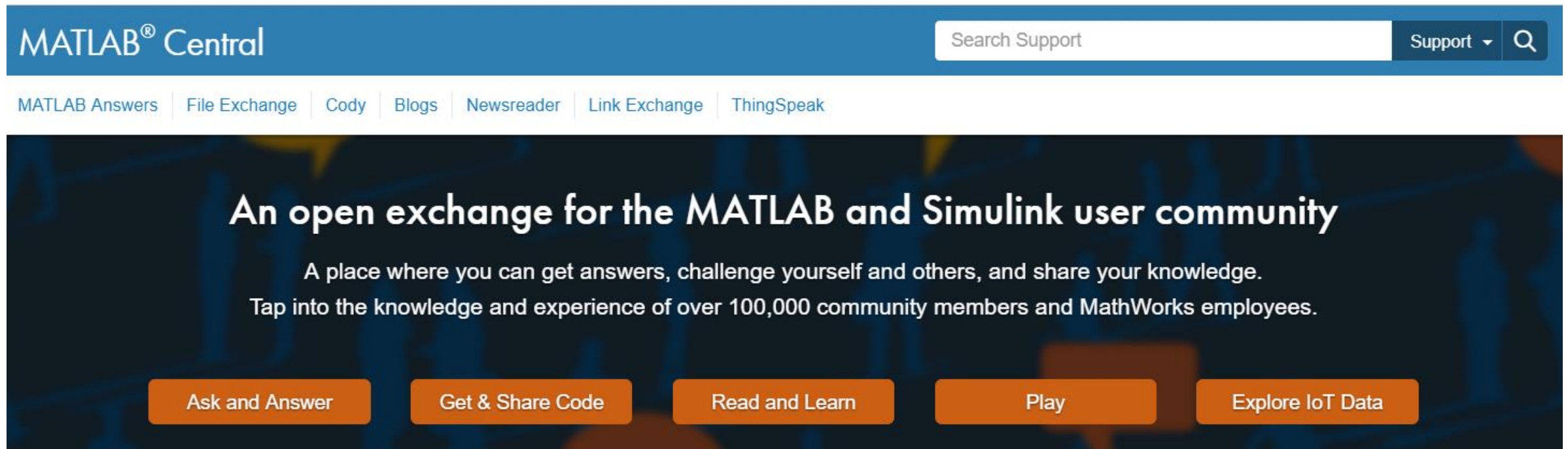


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Summary and Benefits

- Easy and fast to explore ideas.
- Automatic code generation.
- Single software for entire workflow.
- Numerous resources for learning and getting help in MATLAB.