

MATLAB at King Saud University

Accelerating the Pace of Engineering and Science



Dr. Joachim Levelt

Agenda Introduction

1. MATLAB, a short introduction
2. Resources and services for you

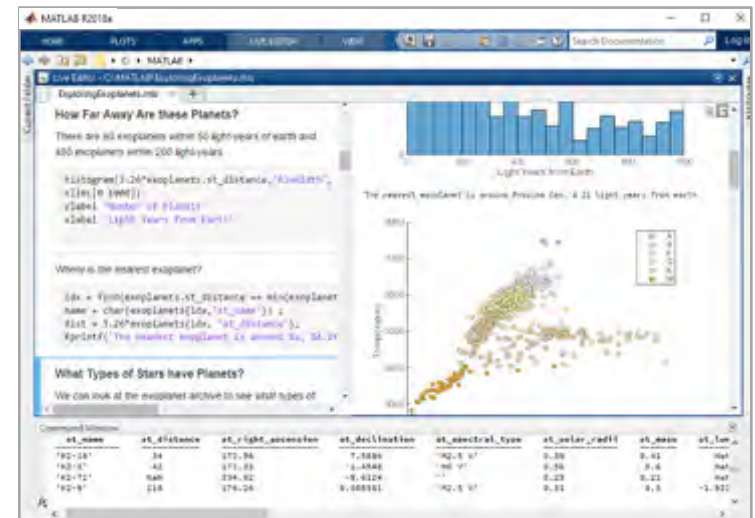
MATLAB® & SIMULINK®



Our Products

- MATLAB is a programming environment for algorithm development, data analysis, visualization, and numeric computation.
- Simulink is a graphical environment for designing, simulating, and testing systems.
- Nearly 100 add-on products for specialized tasks.

MATLAB





Our Customers

Millions of engineers and scientists worldwide use MATLAB and Simulink.



90,000+ business, government, and university sites



All of the top 10 auto manufacturers¹

¹OICA: 2016 World Motor Vehicle Production



All of the top 10 aerospace companies²

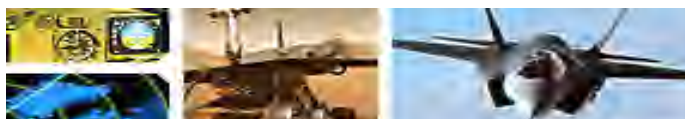
²PwC: Aerospace and Defense 2017 Year in Review



Three of the top five internet companies

MATLAB & Simulink | Applications & Industries

Mathematical Modeling



Aerospace and Defense

Signals and Communications



Automotive

Control Systems



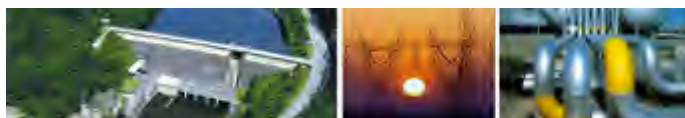
**Communications, Electronics,
Semiconductors**

Data Analytics



**Industrial Automation and
Machinery**

**Computer Vision and Image
Processing**



Energy and Chemical Production

Physical Modeling



Financial Services

Internet of Things



Biotech and Pharmaceuticals

How is industry using MATLAB?

Eurocopter: Helicopters
 Eaton: Hybrid Delivery Truck
 Caterpillar: Construction Machine

IAV: CNG/LPG EMS
 GM: HVAC
 Delphi: Common Rail Diesel

Dongfeng: BMS
 Honeywell: Flight Controls
 GM: Hybrid Powertrain

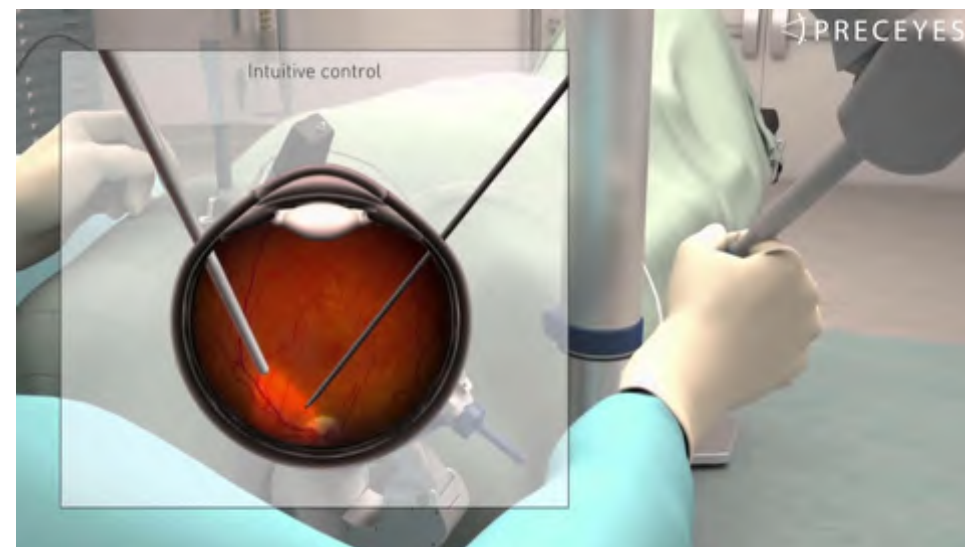
Daimler: Vehicle Controller
 Lear: BCM
 Vodafone: Telematics



How is industry using MATLAB?

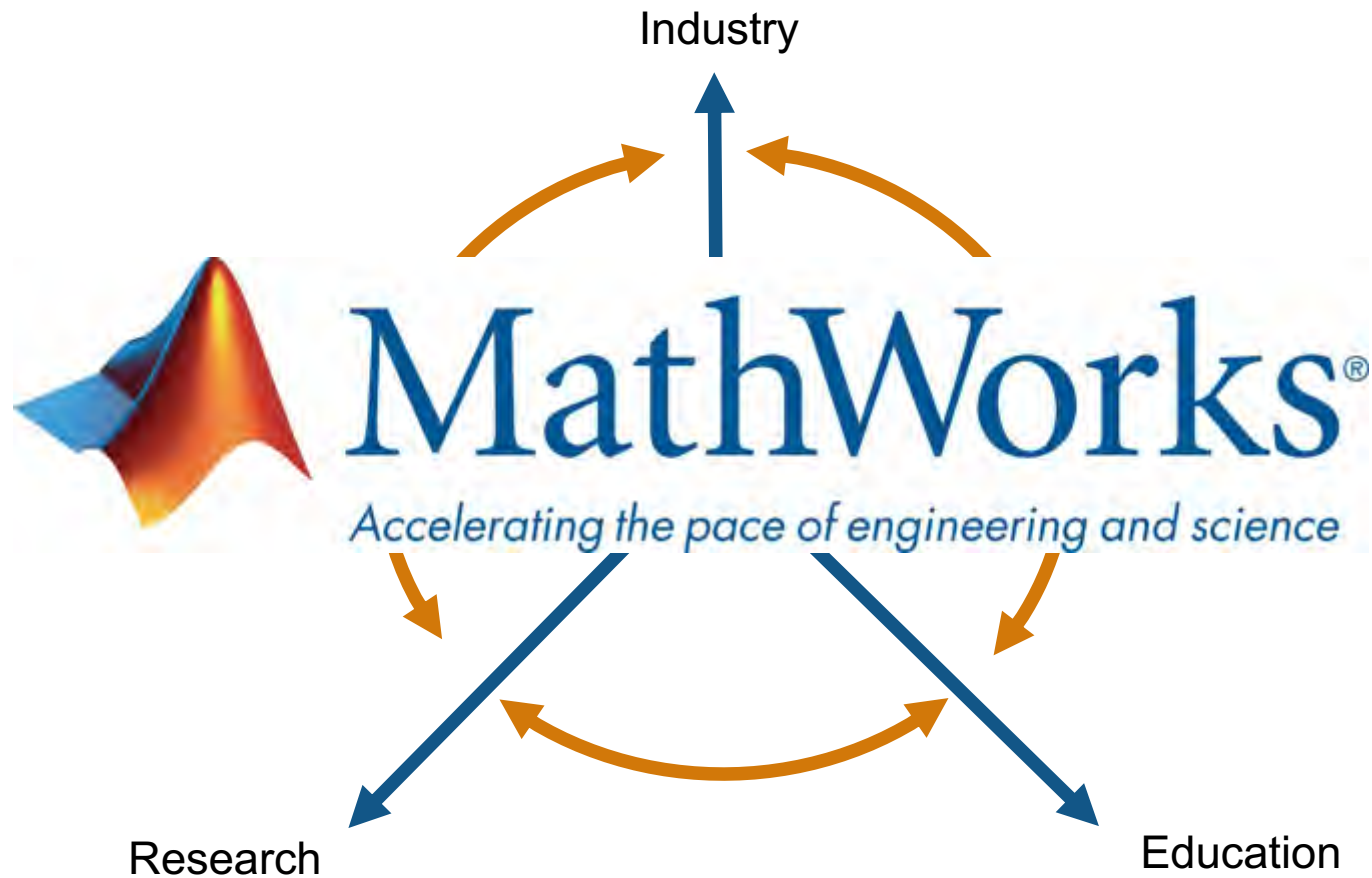


Search: **NASA 7 minutes of terror**



World's first robot-assisted surgery inside a human eye saves sight
removes a membrane one hundredth of a millimeter thick

Software helps everyone speak the same language



A Computational Thinking Infrastructure for...

**Over 1100 universities have a
MATLAB TAH Campus License
Enabling over 4 million students**



TAH Campus License offers an international ecosystem that is a fundamental component of the infrastructure for teaching, researching and collaborating with industry

TAH at 16 out of top 20 of the Times Higher Education ranking

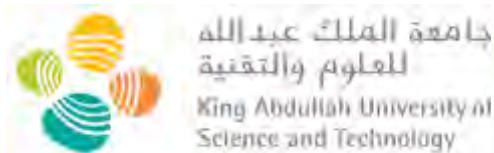
101 out of the top 168 ranked have a TAH



- 1 University of Oxford
- 2 University of Cambridge
- 3 Imperial College
- 4 ETH Zurich
- 5 University College London
- 6 London School of Economics
- 7 University of Edingburgh
- 8 Karolinska Institute
- 9 EPFL
- 10 LMU Munich
- 11 Kings College London
- 12 KU Leuven
- 13 Heidelberg University
- 14 Technical University of Munich
- 15 University of Manchester
- 16 Humboldt University of Berlin
- 17 Delft University of Technology
- 18 University of Amsterdam
- 19 Wagening University & Research
- 20 Ecole Normale Superiour

University in blue has TAH

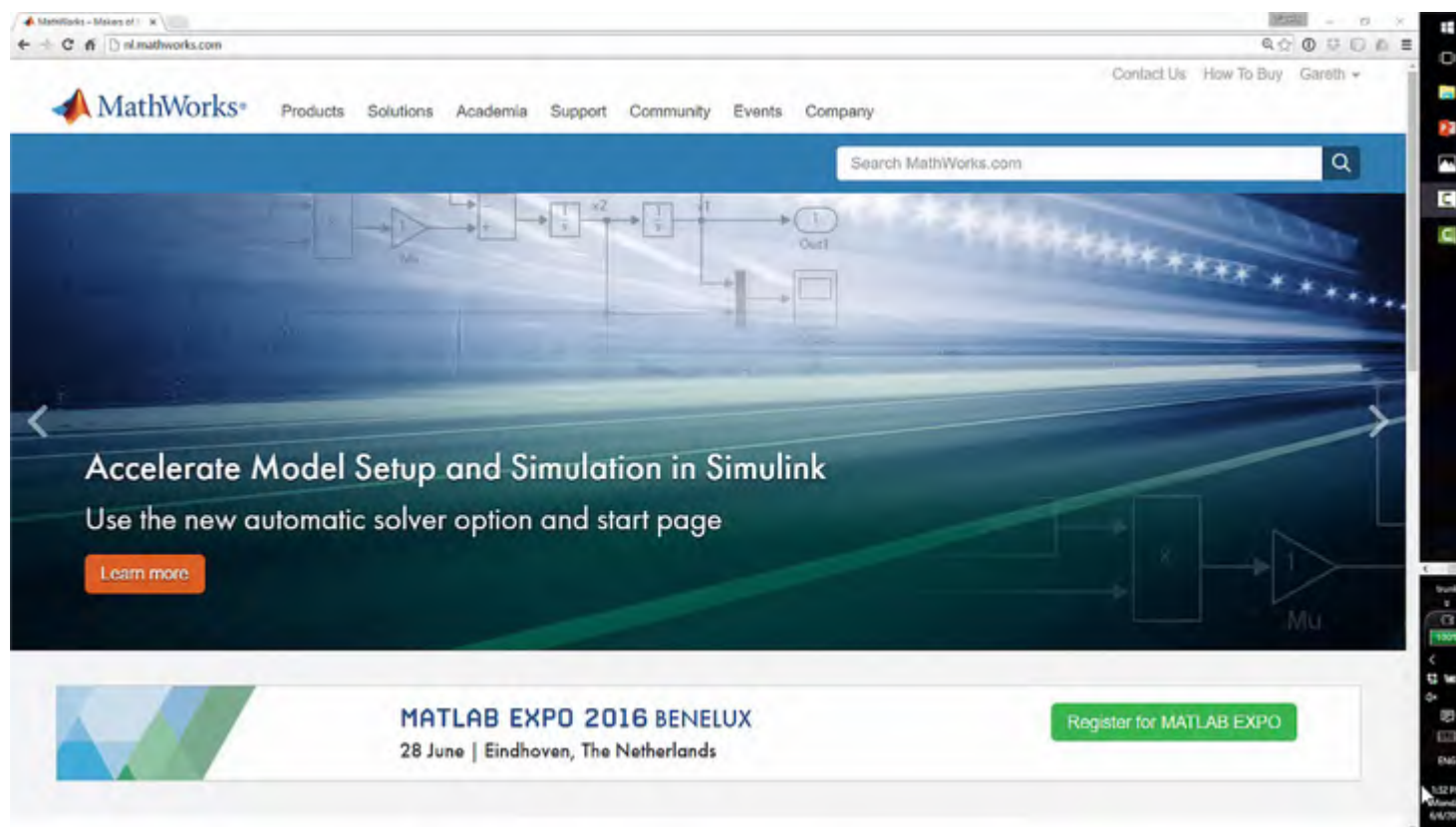
TAH Universities in the Middle East



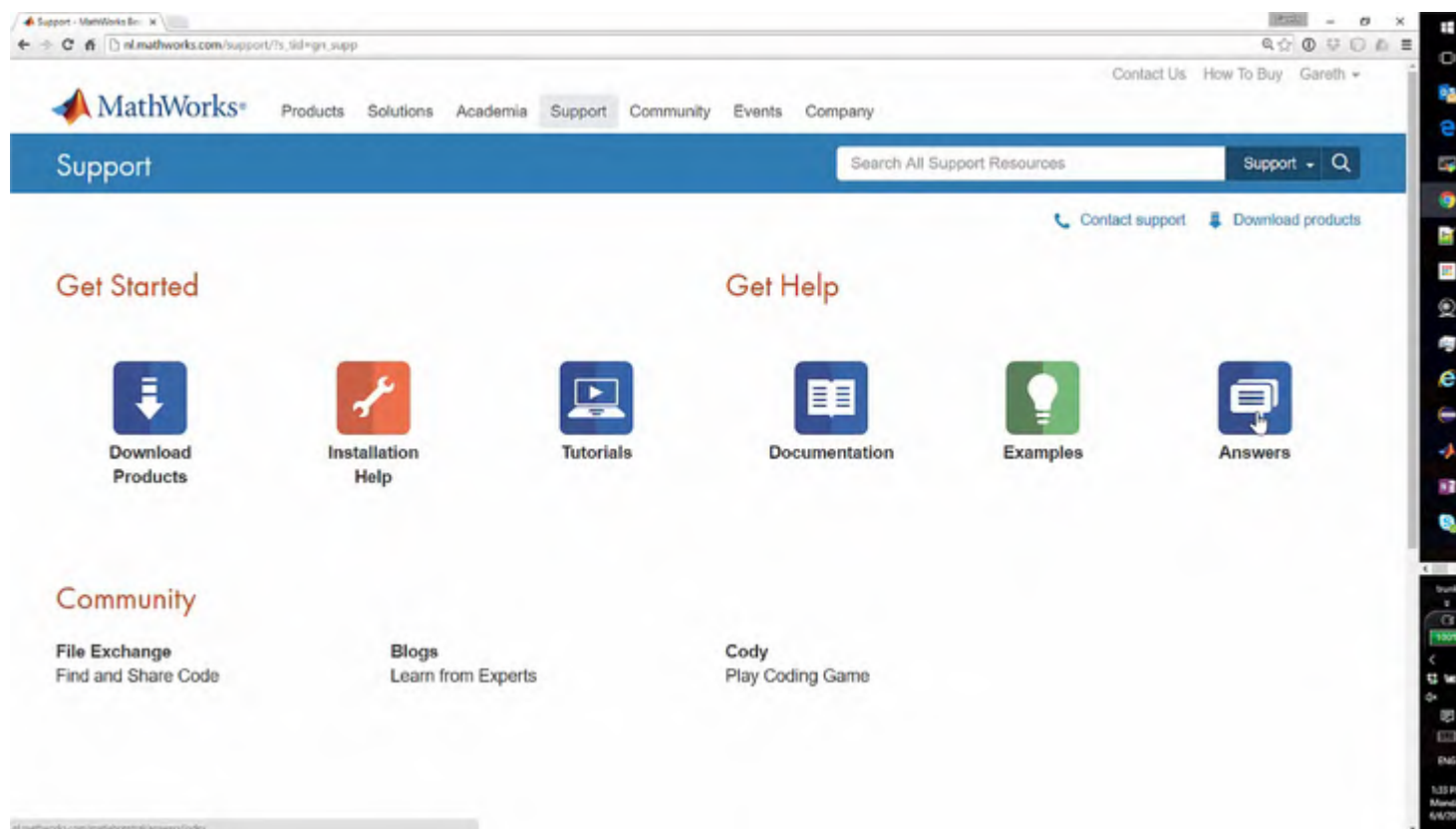
Resources and services for you

#1 MATLAB Examples

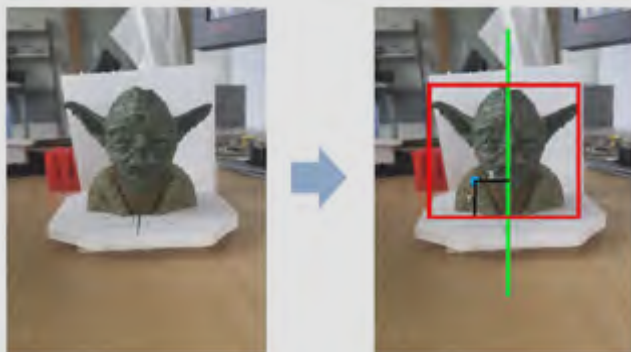
Guaranteed to be reproduceable produced by MathWorks and community



#2 MATLAB Answers



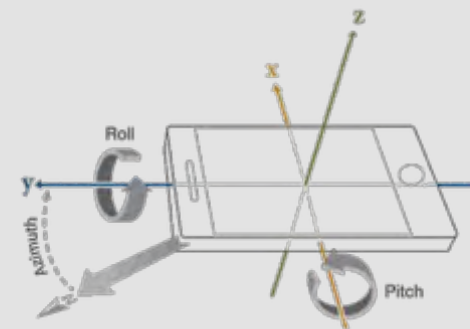
#3 Support for low-cost hardware and mobile sensors



MATLAB based 3D Scanner using
Raspberry Pi



Self-balancing robots using
LEGO and Arduino



Sensor support for
Android and iOS devices

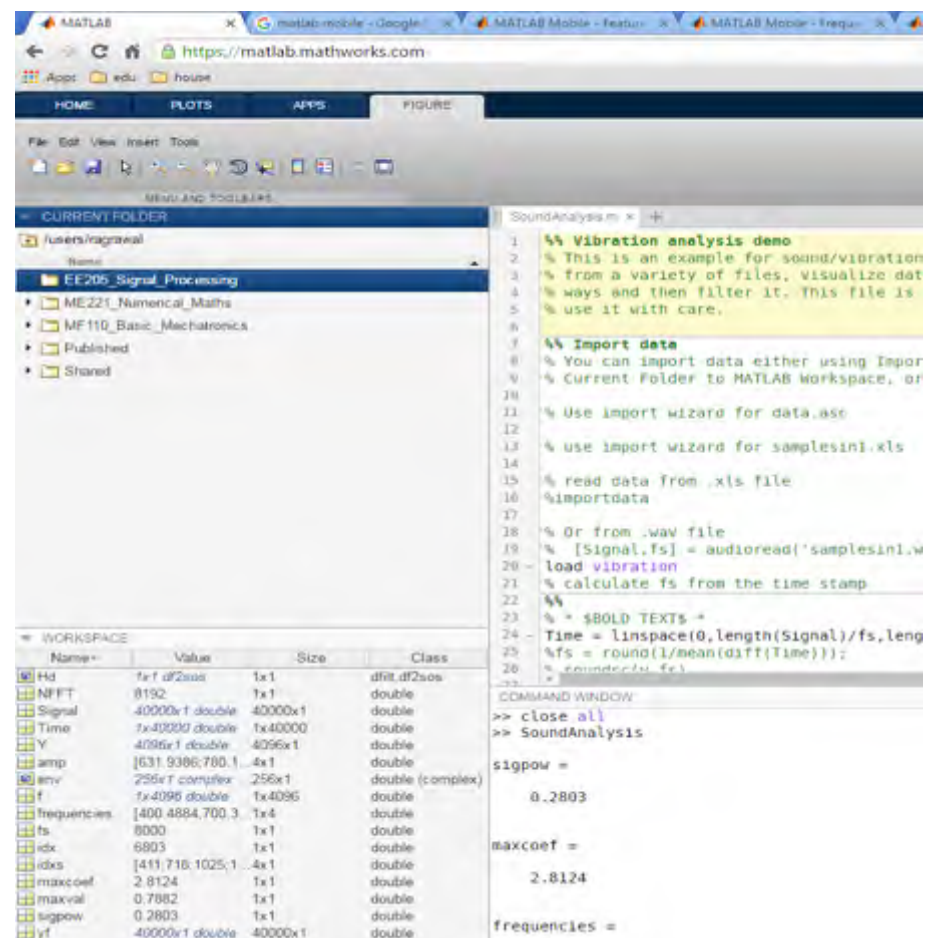
#4 Software Access: MATLAB Online

Use *MATLAB* from a web browser

No Download/Installation

Version Consistency

Everywhere Access




The screenshot displays the MATLAB Online web interface. The top navigation bar includes 'HOME', 'PLOTS', 'APPS', and 'FIGURE'. Below this is a menu bar with 'File', 'Edit', 'View', 'Insert', and 'Tools'. The main area is divided into three panes:

- CURRENT FOLDER:** Shows a file tree structure with folders like 'ME221_Numerical_Maths', 'MF110_Basic_Mechatronics', and 'Shared'.
- WORKSPACE:** A table listing variables in the workspace.

Name	Value	Size	Class
Hd	fs f d2sos	1x1	dfilt.d2sos
NFFT	8192	1x1	double
Signal	40000x1 double	40000x1	double
Time	1x40000 double	1x40000	double
Y	4096x1 double	4096x1	double
amp	[631.9386;780.1	4x1	double
env	256x1 complex	256x1	double (complex)
f	1x4096 double	1x4096	double
frequencies	[400 4884.700 3	1x4	double
fs	8000	1x1	double
idx	6803	1x1	double
idxs	[411 716 1025 1	4x1	double
maxcoef	2.8124	1x1	double
maxval	0.7882	1x1	double
sigpow	0.2803	1x1	double
yt	40000x1 double	40000x1	double
- COMMAND WINDOW:** Shows the execution of MATLAB code. The code includes comments and commands like 'close all' and 'SoundAnalysis'. The output shows 'sigpow = 0.2803' and 'maxcoef = 2.8124'.

#5 MATLAB Academy


Getting Started



MATLAB Onramp

Get started quickly with the basics of MATLAB.

[Launch](#) [Details](#)



Deep Learning Onramp

Get started quickly using deep learning methods to perform image recognition.

[Launch](#) [Details](#)

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Task 1

Background

Info: You can calculate the shuttle's velocity by finding the total change in height, Δh , and dividing by the total change in time, Δt .

$$v = \frac{\Delta h}{\Delta t}$$

The vector `h` contains the shuttle's altitude data. Find the total change in height by subtracting the first element of `h` from the last element of `h`. Assign the result to the variable `deltaH`.

Hint See Solution

[Course Quick Reference](#)

Task 2

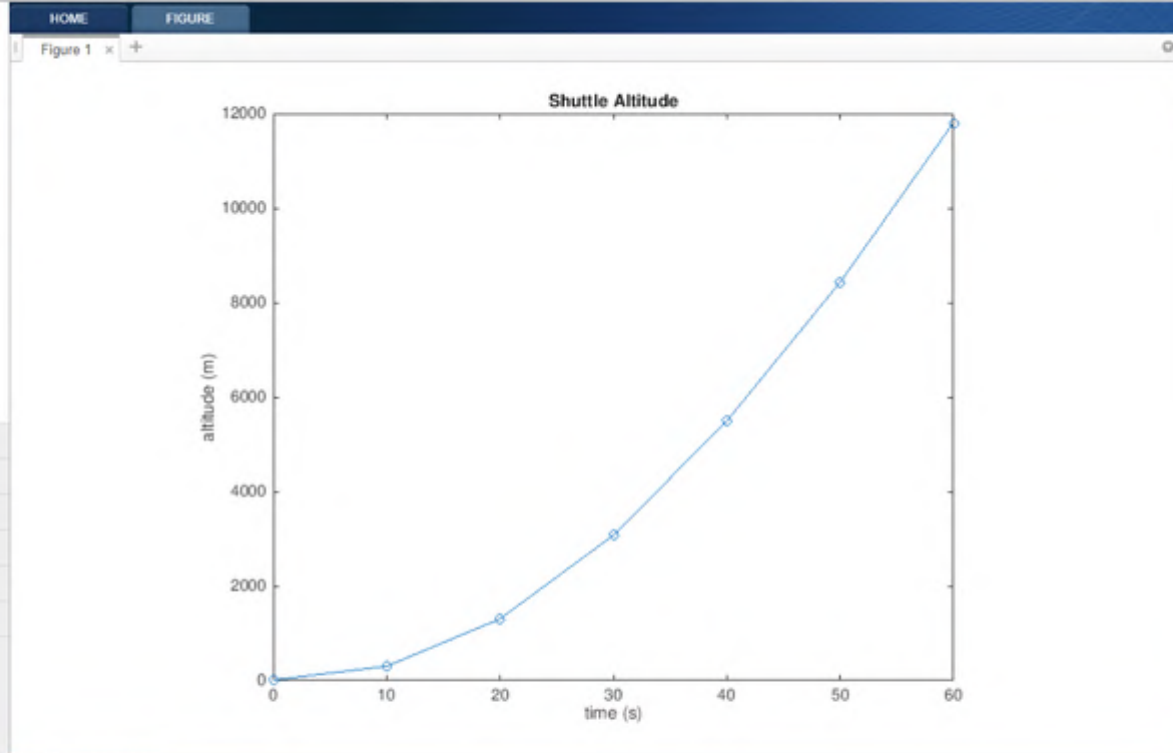
Task 3

Task 4

Task 5

Task 6

Further Practice



WORKSPACE

NAME	VALUE	SIZE	CLASS
h	[2 2000.293...]	1x7	double
t	[0 10.20.30.4...]	1x7	double

COMMAND WINDOW

```
>> plot(t,h,'o-')
>> title('Shuttle Altitude')
>> xlabel('time (s)')
>> ylabel('altitude (m)')
Task 1
>> |
```

Task 1

Background

Info: You can calculate the shuttle's velocity by finding the total change in height, Δh , and dividing by the total change in time, Δt .

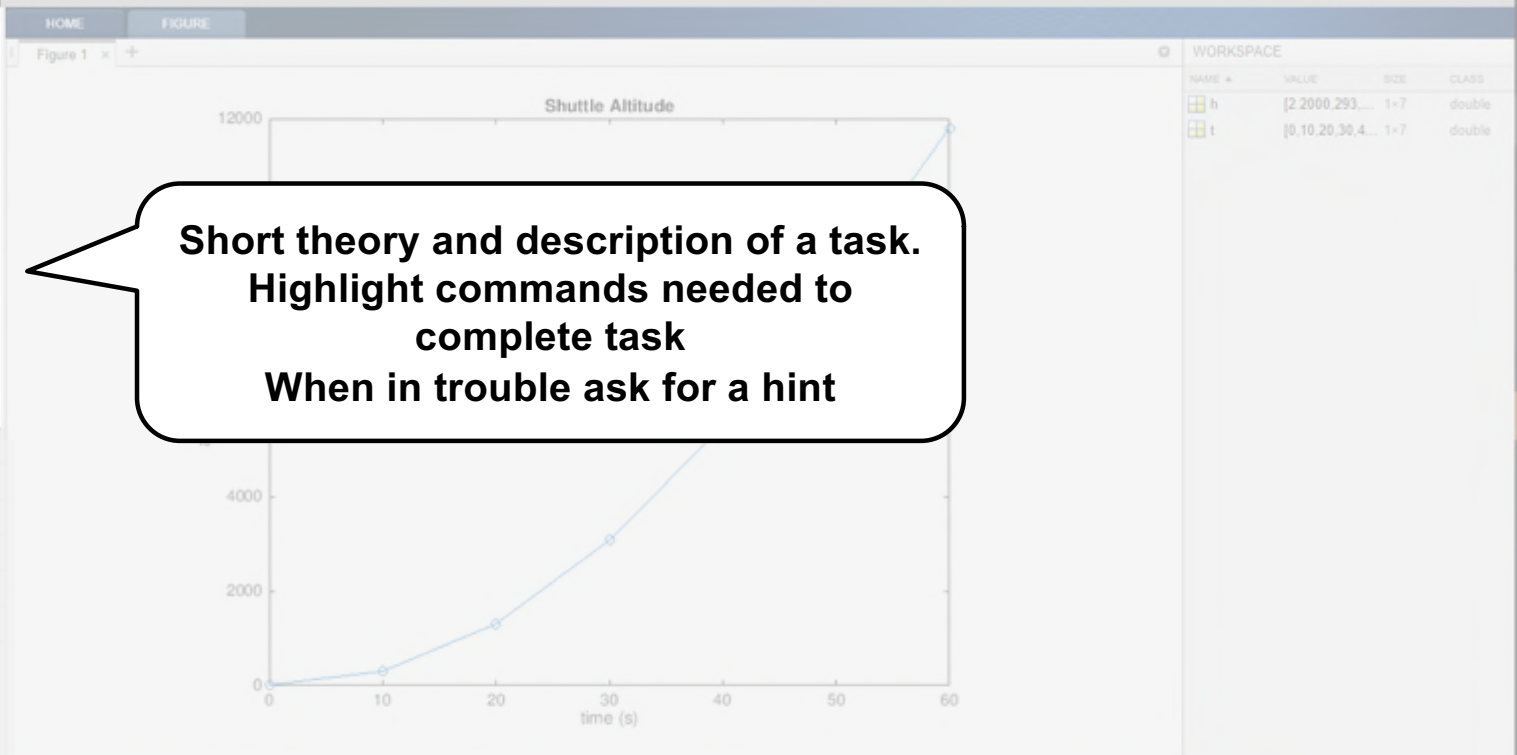
$$v = \frac{\Delta h}{\Delta t}$$

The vector `h` contains the shuttle's altitude data. Find the total change in height by subtracting the first element of `h` from the last element of `h`. Assign the result to the variable `deltaH`.

[Hint](#) [See Solution](#)

[Course Quick Reference](#)

- Task 2
- Task 3
- Task 4
- Task 5
- Task 6
- Further Practice



```
COMMAND WINDOW
>> plot(t,h,'o-')
>> title('Shuttle Altitude')
>> xlabel('time (s)')
>> ylabel('altitude (m)')
Task 1
>> |
```

**Short theory and description of a task.
Highlight commands needed to
complete task
When in trouble ask for a hint**

Task 1

Background

Info: You can calculate the shuttle's velocity by finding the total change in height, Δh , and dividing by the total change in time, Δt .

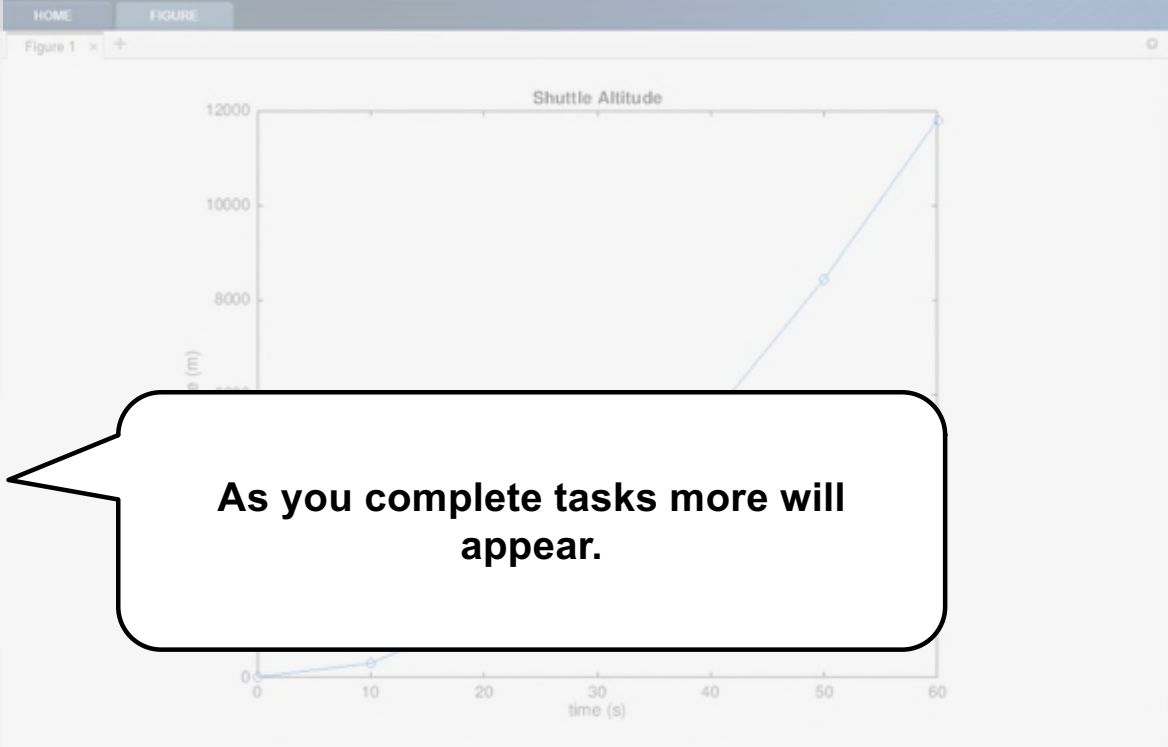
$$v = \frac{\Delta h}{\Delta t}$$

The vector `h` contains the shuttle's altitude data. Find the total change in height by subtracting the first element of `h` from the last element of `h`. Assign the result to the variable `deltaH`.

[Hint](#) [See Solution](#)

[Course Quick Reference](#)

- Task 2
- Task 3
- Task 4
- Task 5
- Task 6
- Further Practice



As you complete tasks more will appear.

```
COMMAND WINDOW
>> plot(t,h,'o-')
>> title('Shuttle Altitude')
>> xlabel('time (s)')
>> ylabel('altitude (m)')
Task 1
>> |
```

NAME	VALUE	SIZE	CLASS
h	[2 2000 2930 ...	1x7	double
t	[0 10 20 30 40 ...	1x7	double

Secure | https://matlabacademy.mathworks.com/R2017b/portal.html?course=odes#chapter=2&lesson=1§ion=1

< My Courses Solving Ordinary Differential Equations with MATLAB 100% complete Gareth Thomas

2.1 Course Example - The Shuttle Launch: (1/3) Estimating the Space Shuttle's velocity < previous next >

Task 1

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Info: You can calculate the shuttle's velocity by finding the total change in height, Δh , and dividing by the total change in time, Δt .

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Hint See Solution

[Course Quick Reference](#)

Task 2
Task 3
Task 4
Task 5
Task 6
Further Practice

HOME FIGURE

Figure 1 x +

time (s)	altitude (m)
0	0
10	1000
40	5500
50	8500
60	11800

WORKSPACE

NAME	VALUE	SIZE	CLASS
h	[2 2000 2930 ...	1x7	double
t	[0 10 20 30 40 ...	1x7	double

Same look and feel as MATLAB desktop

COMMAND WINDOW

```
>> plot(t,h,'o-')
>> title('Shuttle Altitude')
>> xlabel('time (s)')
>> ylabel('altitude (m)')
Task 1
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Secure | https://matlabacademy.mathworks.com/R2017b/portal.html?course=odes#chapter=2&lesson=1§ion=1

< My Courses Solving Ordinary Differential Equations with MATLAB 100% complete Gareth Thomas

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[Hint](#) [See Solution](#)

Course Quick Reference

Task 2
Task 3
Task 4
Task 5
Task 6
Further Practice

HOME FIGURE

Figure 1

Time (s)	Altitude (m)
0	0
10	~1000
20	~3000
30	~5500
40	~8500
50	~11798

WORKSPACE

NAME	VALUE	SIZE	CLASS
deltaH	1.1798e+04	1x1	double
h	[2.2000, 293, ...]	1x7	double
t	[0, 10, 20, 30, 4, ...]	1x7	double

Same look syntax errors as MATLAB gives.

```
>> ylabel('altitude (m)')
Task 1 X
>> p + 1
Undefined function or variable 'p'.
Task 1 X
>> deltaH = h(end)--h(1)
deltaH =
1.1798e+04
```

The right input to the subtraction operator was expected to be h(1).

Try again

Secure | https://matlabacademy.mathworks.com/R2017b/portal.html?course=odes#chapter=2&lesson=1§ion=1

< My Courses Solving Ordinary Differential Equations with MATLAB 100% complete Gareth Thomas

2.1 Course Example - The Shuttle Launch: (1/3) Estimating the Space Shuttle's velocity < previous next >

Task 1

Background

Info: You can calculate the shuttle's velocity by finding the total change in height, Δh , and dividing by the total change in time, Δt .

$$v = \frac{\Delta h}{\Delta t}$$

The vector `h` contains the shuttle's altitude data. Find the total change in height by subtracting the first element of `h` from the last element of `h`. Assign the result to the variable `deltaH`.

[Hint](#) [See Solution](#)

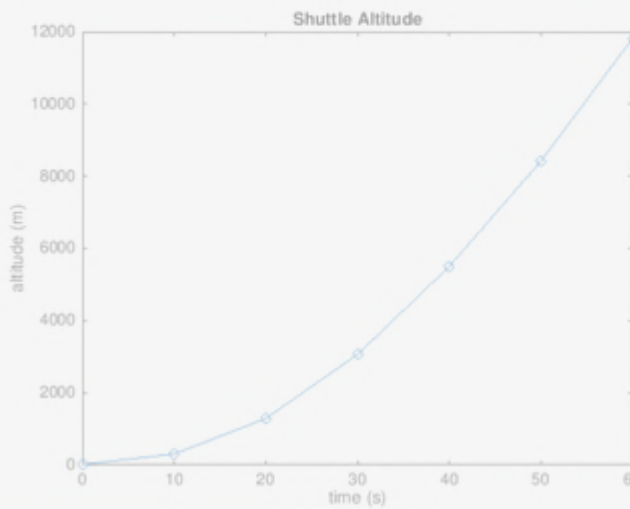
Course Quick Reference

- Task 2
- Task 3
- Task 4
- Task 5
- Task 6

Further Practice

HOME FIGURE

Figure 1



time (s)	altitude (m)
0	0
10	500
20	1500
30	3000
40	5500
50	8500
60	11500

WORKSPACE

NAME	VALUE	SIZE	CLASS
deltaH	1.1798e+04	1x1	double
h	[2.2000, 2.93...]	1x7	double
t	[0, 10, 20, 30, 4...]	1x7	double

COMMAND WINDOW

```
>> plot(t,h,'o-')
>> title('Shuttle Altitude')
>> xlabel('time (s)')
>> ylabel('altitude (m)')
Task 1 X
>> p + 1
Undefined function or variable 'p'.
Task 1 X
>> deltaH = h(end)-h(1)
deltaH =
1.1798e+04
The right input to the subtraction operator was expected to be h( 1 ).
[Esc] Try again
```

Virtual Tutor giving hints to help guide students to the correct answer

Secure | https://matlabacademy.mathworks.com/R2017b/portal.html?course=odes#chapter=2&lesson=1§ion=1

< My Courses Solving Ordinary Differential Equations with MATLAB 100% complete Gareth Thomas

2.1 Course Example - The Shuttle Launch: (1/3) Estimating the Space Shuttle's velocity

Task 1

Background

Info: You can calculate the shuttle's velocity by finding

Course Quick Reference

Task 2
Task 3
Task 4
Task 5
Task 6
Further Practice

HOME FIGURE

Figure 1 x +

WORKSPACE

NAME	VALUE	SIZE	CLASS
h	[2 2000.293...]	1x7	double
t	[0 10.20.30.4...]	1x7	double

Shuttle Altitude

altitude (m)

time (s)

COMMAND WINDOW

```
>> plot(t,h,'o-')
>> title('Shuttle Altitude')
>> xlabel('time (s)')
>> ylabel('altitude (m)')
Task 1
>> |
```

Same plots and workspace as in MATLAB Desktop

Share your learning with professors and community

MathWorks | Training Services

Progress Report

Name: Joachim Levelt
 Course: MATLAB Onramp
 Progress: 100% complete (as of 25-Aug-2017)

Chapters

1. Course Overview 100%	12. Logical Arrays 100%
2. Commands 100%	13. Programming 100%
3. Vectors and Matrices 100%	14. Final Project 100%
4. Importing Data 100%	15. Survey 100%
5. Indexing into and Modifying Arrays 100%	
6. Array Calculations 100%	
7. Calling Functions 100%	
8. Obtaining Help 100%	
9. Plotting Data 100%	
10. Review Problems 100%	
11. MATLAB Scripts 100%	

Release: R2017a | Language: English

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 Accelerating the pace of Engineering and Science at Universities in Eastern Europe, Middle East and Africa.
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MATLAB Onramp Certificate
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- Mulders' PhD students** 9 members
- Aino Alumni** 197 members

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#5 MATLAB Academy

Getting Started

MATLAB Onramp
Get started quickly with the basics of MATLAB.

Deep Learning Onramp
Get started quickly using deep learning methods to perform image recognition.

4 hours getting started from zero knowledge

Computational Mathematics

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

Solving Nonlinear Equations with MATLAB
Use root finding methods to solve nonlinear equations.

Solving Ordinary Differential Equations with MATLAB
Use MATLAB ODE solvers to numerically solve ordinary differential equations.

Introduction to Linear Algebra with MATLAB
Use matrix methods to solve systems of linear equations and perform eigenvalue decomposition.

Introduction to Statistical Methods with MATLAB
Get started quickly with basic descriptive statistics and data fitting.

>7 hours of solving Computational Mathematics with MATLAB available with Campus License

Core MATLAB

MATLAB Fundamentals
Learn core MATLAB functionality for data analysis, modeling, and programming.

MATLAB for Data Processing and Visualization
Create custom visualizations and automate your data analysis tasks.

MATLAB Programming Techniques
Improve the robustness, flexibility, and efficiency of your MATLAB code.

MATLAB for Financial Applications
Learn MATLAB for financial data analysis and modeling.

Data Science

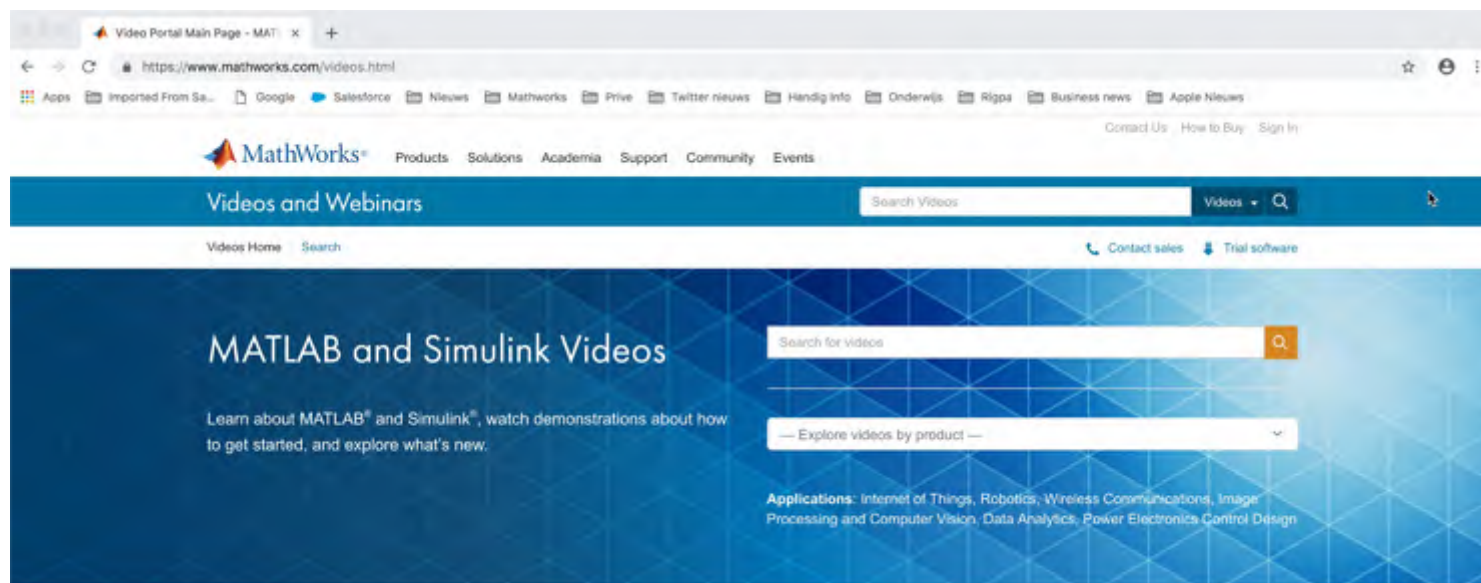
Machine Learning with MATLAB
Explore data and build predictive models.

Deep Learning with MATLAB
Learn the theory and practice of building deep neural networks with real-life image and sequence data.

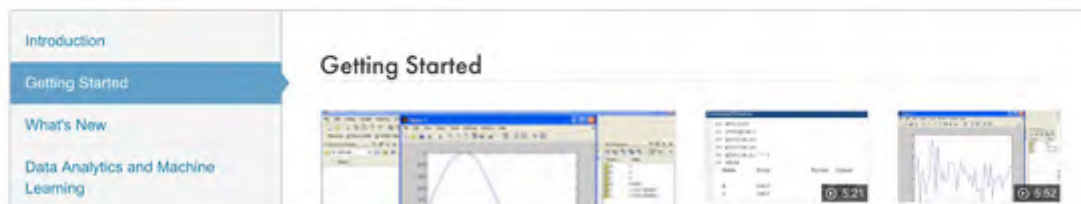
>80 hours of learning how to improve MATLAB skills available with Campus License

#6 MathWorks Videos

Every day we launch a new video



MATLAB Videos



#7 Cody

Join the community, earn badges by solving MATLAB challenges



The screenshot shows the MathWorks website interface. At the top, there is a navigation menu with links for Products, Solutions, Academia, Support, Community, Events, and Company. A search bar is located in the top right corner. The main banner features a photograph of hands working with electronic components like Arduino boards and Raspberry Pi. The text on the banner reads "MATLAB Speaks Hardware" and "Use Arduino, Raspberry Pi, and LEGO MINDSTORMS without writing code". Below this text is an orange button labeled "Download support packages". At the bottom of the page, there is a white box containing the text "MATLAB EXPO 2016 BENELUX" and "28 June | Eindhoven, The Netherlands", with a green button labeled "Register for MATLAB EXPO".

#8 MATLAB Grader supports Teaching

Online Autograding of MATLAB Code

Autograding: Saves time

Instant Feedback: Better student engagement

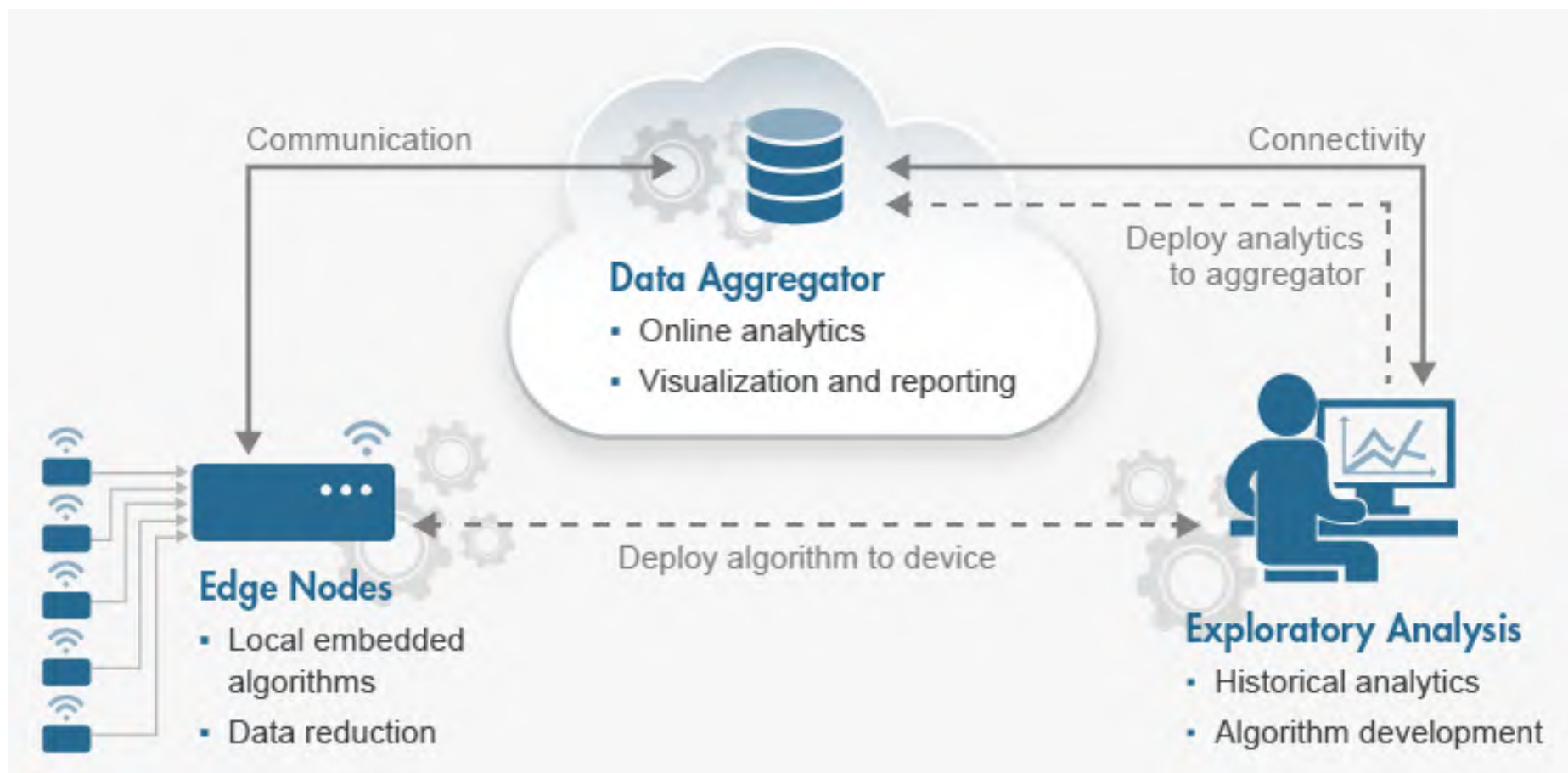
Student Analytics: Teacher gets a report

The screenshot displays the Cody Coursework interface. At the top, there's a navigation bar with 'Cody Coursework' and 'Catalog'. Below this is a blue header with 'Log In' and 'Sign Up' buttons. A central area shows a scatter plot titled 'Size' vs 'Order of Arrival'. The plot has a legend with 'Incorrect' (red), 'Correct' (green), and 'Leading' (blue). Below the plot are buttons for 'Swap', 'Move to Left Box', and 'Previous | Next'. At the bottom, there's a 'Cody Coursework Catalog' section with 'Popular Courses' listed as follows:

Course Name	Copies	Assignments
Cody Problems	43	2
Introduction to Programming	20	5
Differential Equations using MATLAB	12	2
Optimization and Curve Fitting	5	2

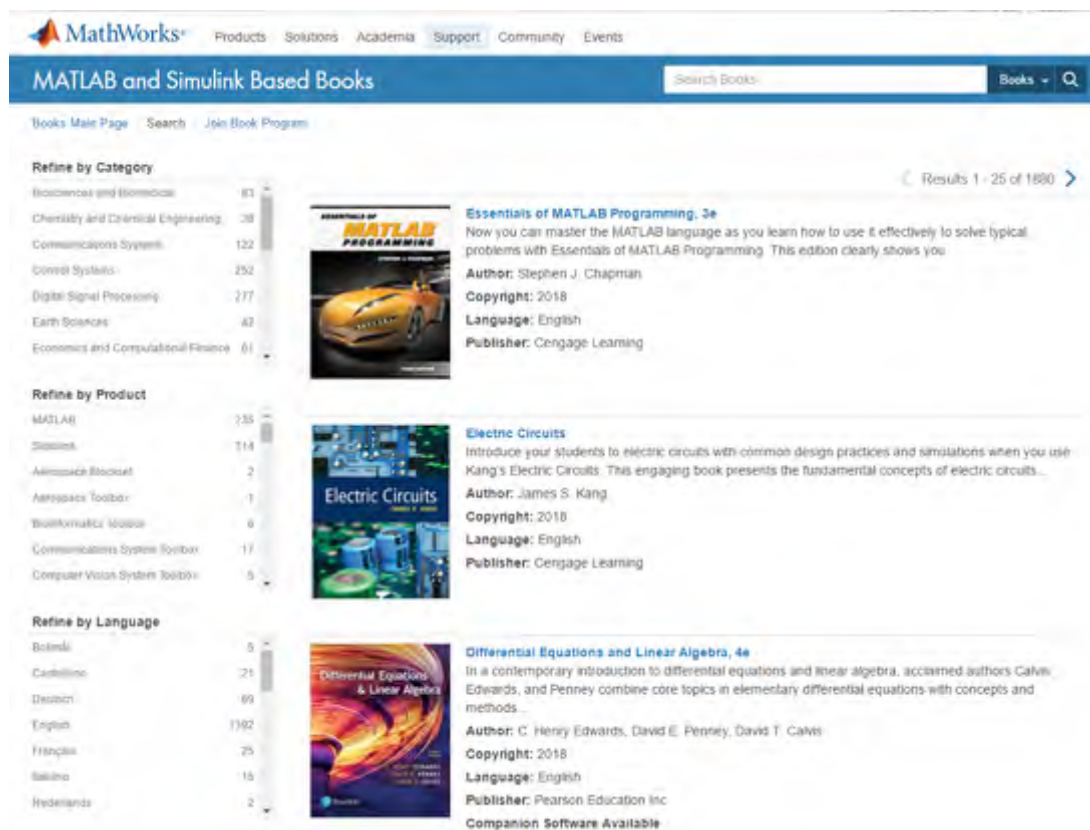
#9 ThingSpeak

MathWorks IoT platform



#10 MathWorks Book Program

There are over 1800 different books written with MATLAB examples.



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MATLAB and Simulink Based Books Search Books Books + Q

Books Main Page Search Join Book Program

Refine by Category

Bioinformatics and Biomedical	83
Chemistry and Chemical Engineering	38
Communications Systems	122
Control Systems	252
Digital Signal Processing	277
Earth Sciences	42
Economics and Computational Finance	61

Refine by Product

MATLAB	235
Simulink	114
Aerospace Toolbox	2
Aerospace Toolbox	1
Bioinformatics Toolbox	0
Communications System Toolbox	17
Computer Vision System Toolbox	5

Refine by Language

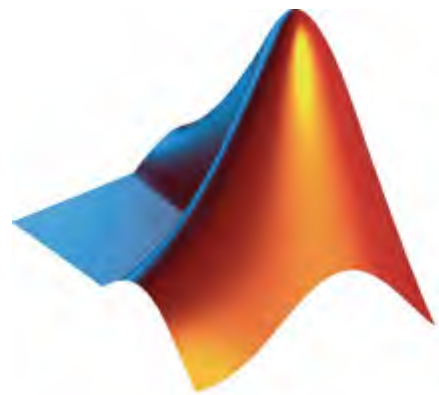
Botani	5
Castellano	21
Deutsch	69
English	1392
Francia	25
Italiano	15
Hollandse	2

Results 1 - 25 of 1880

Essentials of MATLAB Programming, 3e
 Now you can master the MATLAB language as you learn how to use it effectively to solve typical problems with Essentials of MATLAB Programming. This edition clearly shows you
 Author: Stephen J. Chapman
 Copyright: 2018
 Language: English
 Publisher: Cengage Learning

Electric Circuits
 Introduce your students to electric circuits with common design practices and simulations when you use Kang's Electric Circuits. This engaging book presents the fundamental concepts of electric circuits...
 Author: James S. Kang
 Copyright: 2018
 Language: English
 Publisher: Cengage Learning

Differential Equations and Linear Algebra, 4e
 In a contemporary introduction to differential equations and linear algebra, acclaimed authors Calvis, Edwards, and Penney combine core topics in elementary differential equations with concepts and methods...
 Author: C. Henry Edwards, David E. Penney, David T. Calvis
 Copyright: 2018
 Language: English
 Publisher: Pearson Education Inc
 Companion Software Available



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