

MATLAB 前沿应用介绍与科研、教学资源分享

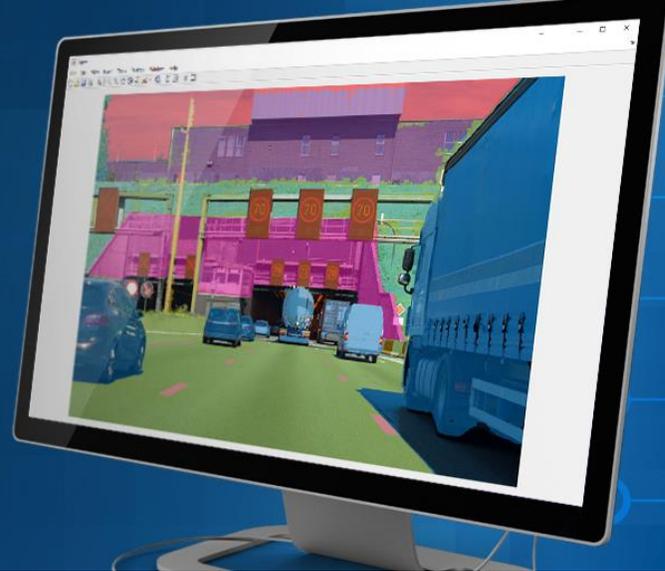
许悦伊

yueyixu@mathworks.com

MathWorks 中国

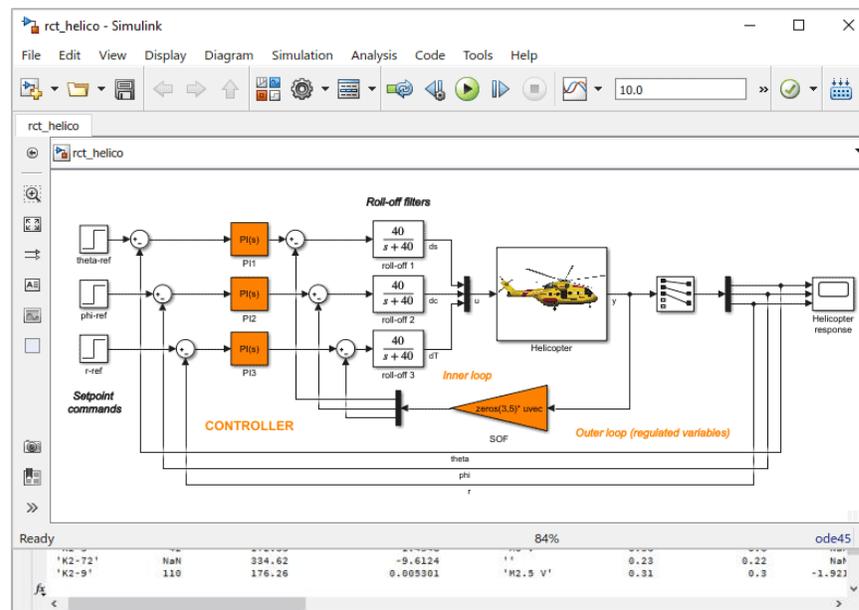
我们的产品

MATLAB® & SIMULINK®



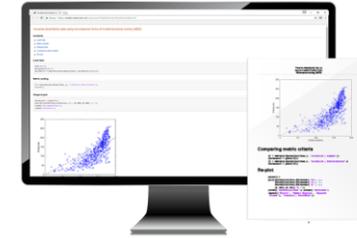
- MATLAB是一种用于算法开发、数据分析、可视化和数值计算的编程环境。
- Simulink是一个用于系统设计、仿真和测试的图形化环境。
- 为特定领域提供近100种附加产品。

Computer Vision System Toolbox

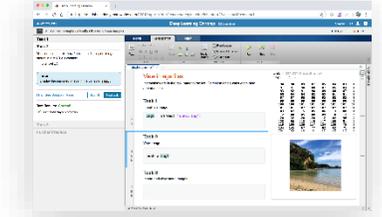


MATLAB 校园范围的许可证概述

- 所有学生、教职员工和研究人员都可以无限制地访问 MATLAB
- 获取所有工具箱及所有版本
- 独立安装：无需服务器端身份验证
- 所需要的只是一个官方电子邮件 ID
- 包括在线培训课程



机房和实验室计算机



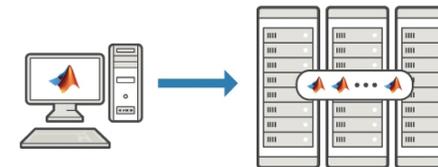
自定进度的在线学习



通过个人电脑、移动设备，或者浏览器使用



自动评分家庭作业

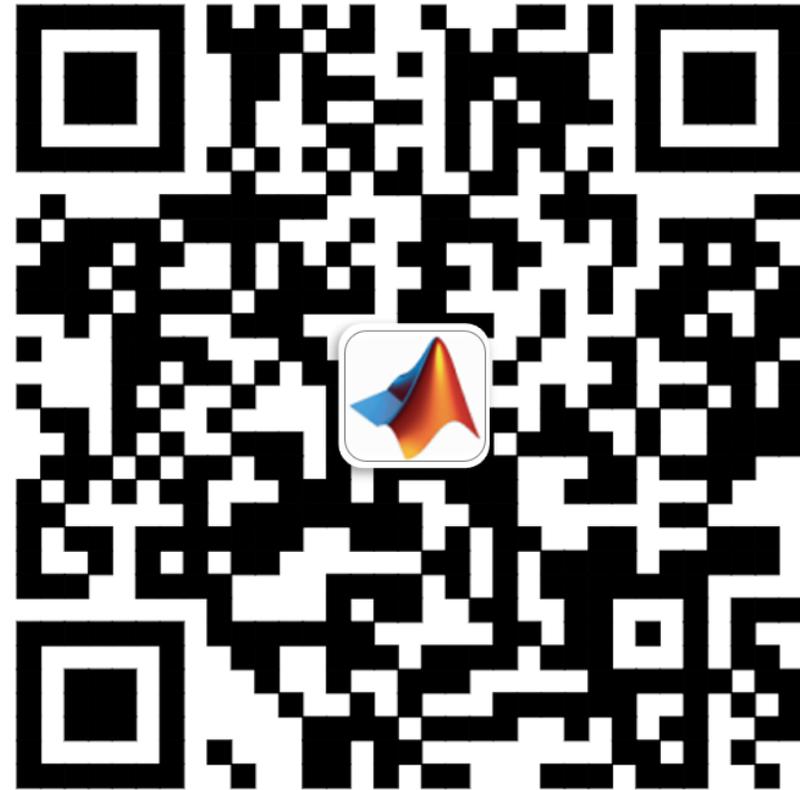


集群和高性能计算



低成本硬件支持

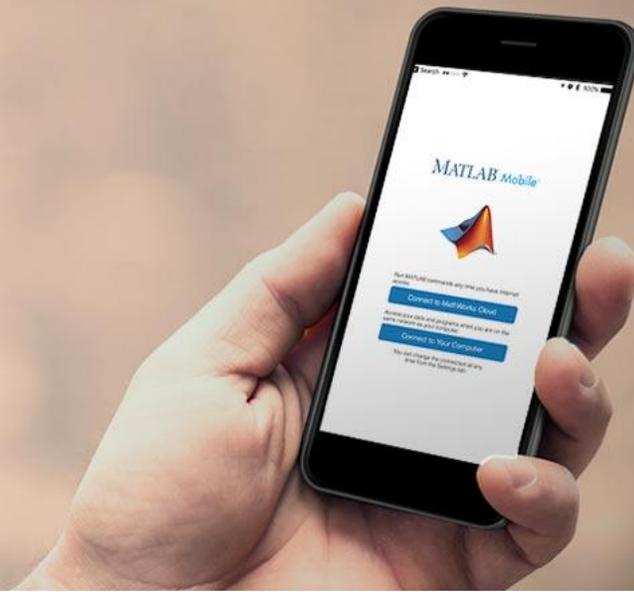
MATLAB 校园版客户端安装指南



扫描二维码获取南京大学专属
微信页面，获取安装指南及更
多学习资源

MATLAB Mobile

从 iPhone、iPad 或 Android 设备连接到 MATLAB



MATLAB Online

通过您的浏览器使用 MATLAB



Use MATLAB with no downloads or installations.



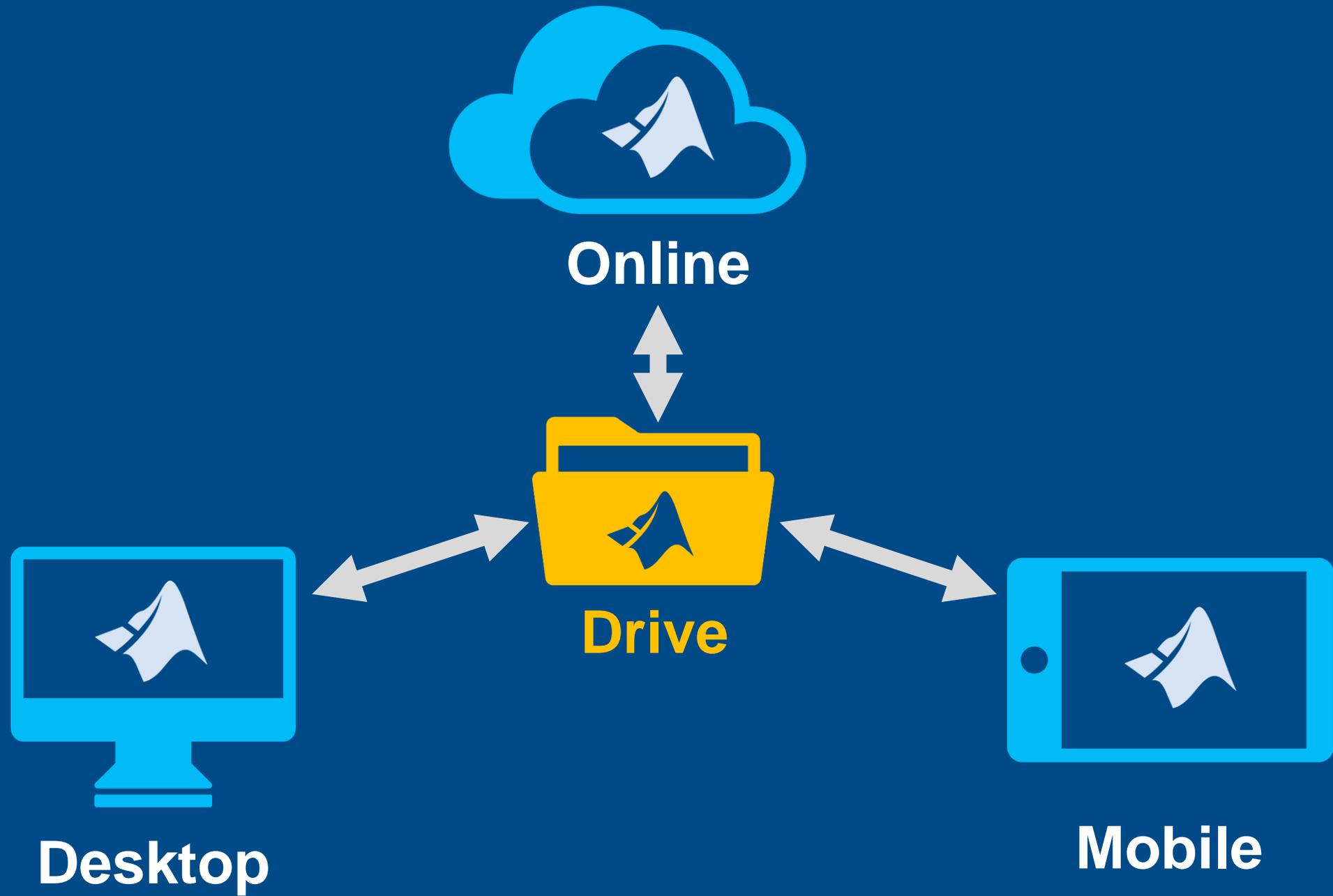
Store, manage, and access your files anywhere.



Collaborate with others through online sharing and publishing

<https://matlab.mathworks.com>

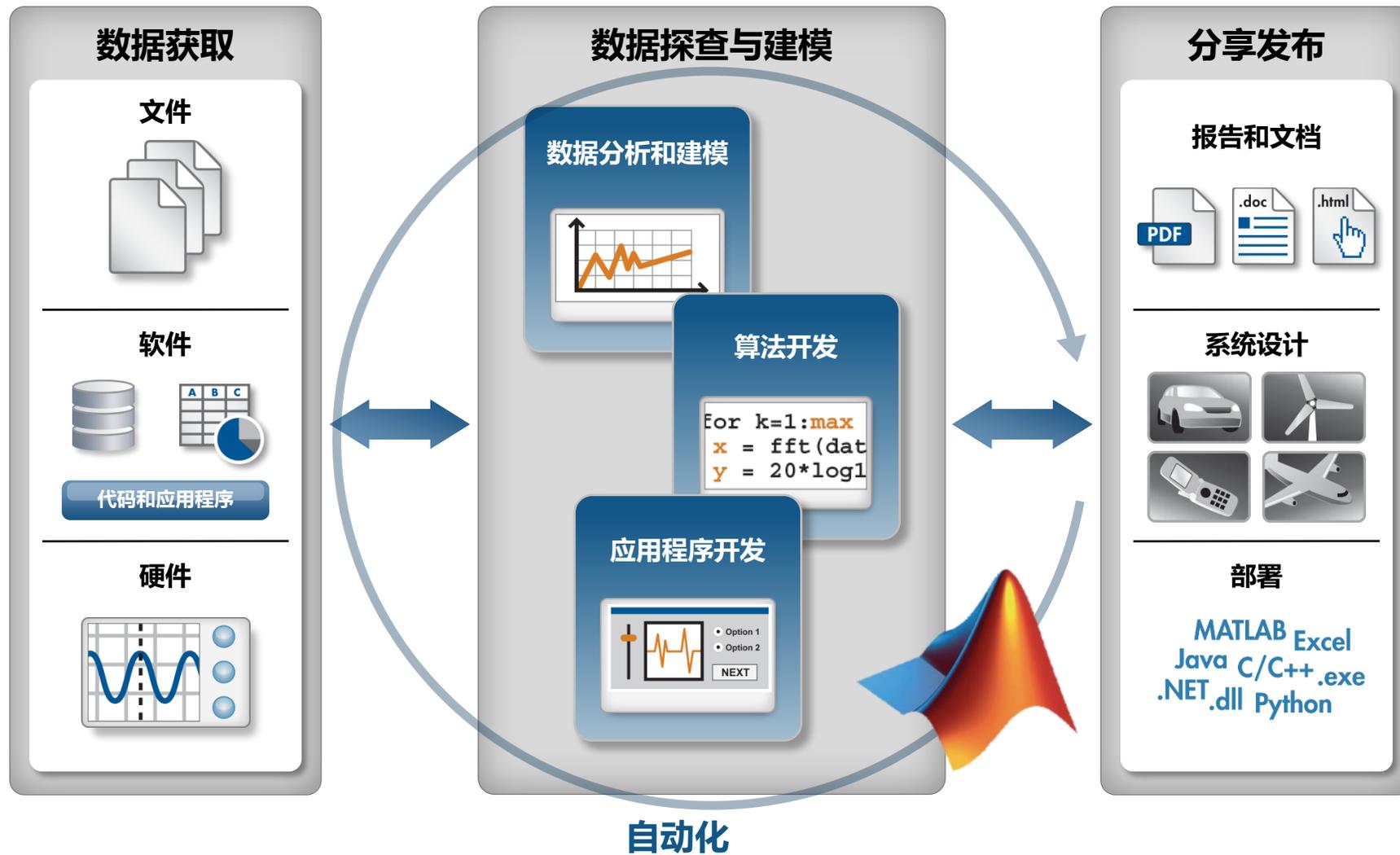
<https://drive.mathworks.com>



MATLAB 之于数据分析

关键词：探索性数据分析、数据可视化、大数据、应用程序开发

基于 MATLAB 的数据科学工作流程



示例：探索性数据分析

Import

```
t1 = readtimetable("s3://bucket_name/file.txt");
```

Preprocess

```
t = synchronize(t1,t2,t3);  
t = fillmissing(t,"linear");  
t = rmoutliers(t);  
t = smoothdata(t,"movmedian");  
t = normalize(t);
```

Explore

```
top5 = topkrows(t,5,"RH");  
byTime = groupsummary(t,"Time","year","mean");  
scaled = grouptransform(t,"State","rescale");  
chgpts = ischange(t,"variance","Threshold",20);
```

Visualize

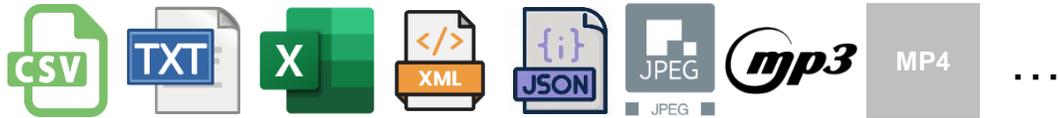
```
stackedplot(t);  
geoplot(t.Lat,t.Lon,t.RH);  
heatmap(t,"State","AQILabel");  
scatterhistogram(t.RH,t.DP);
```

1. 您的数据存放方式？

2. 如何在 MATLAB 中表示这些数据？

1. 您的数据存放方式?

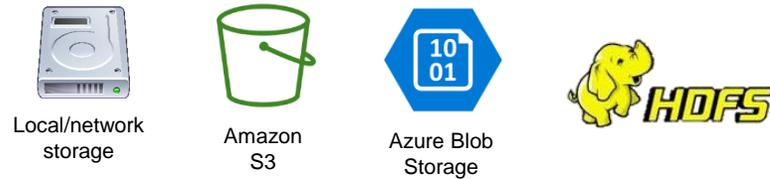
支持多种数据格式和数据源



常规文件格式



大数据格式



本地和云存储



特定行业

流数据



数据库和数据平台



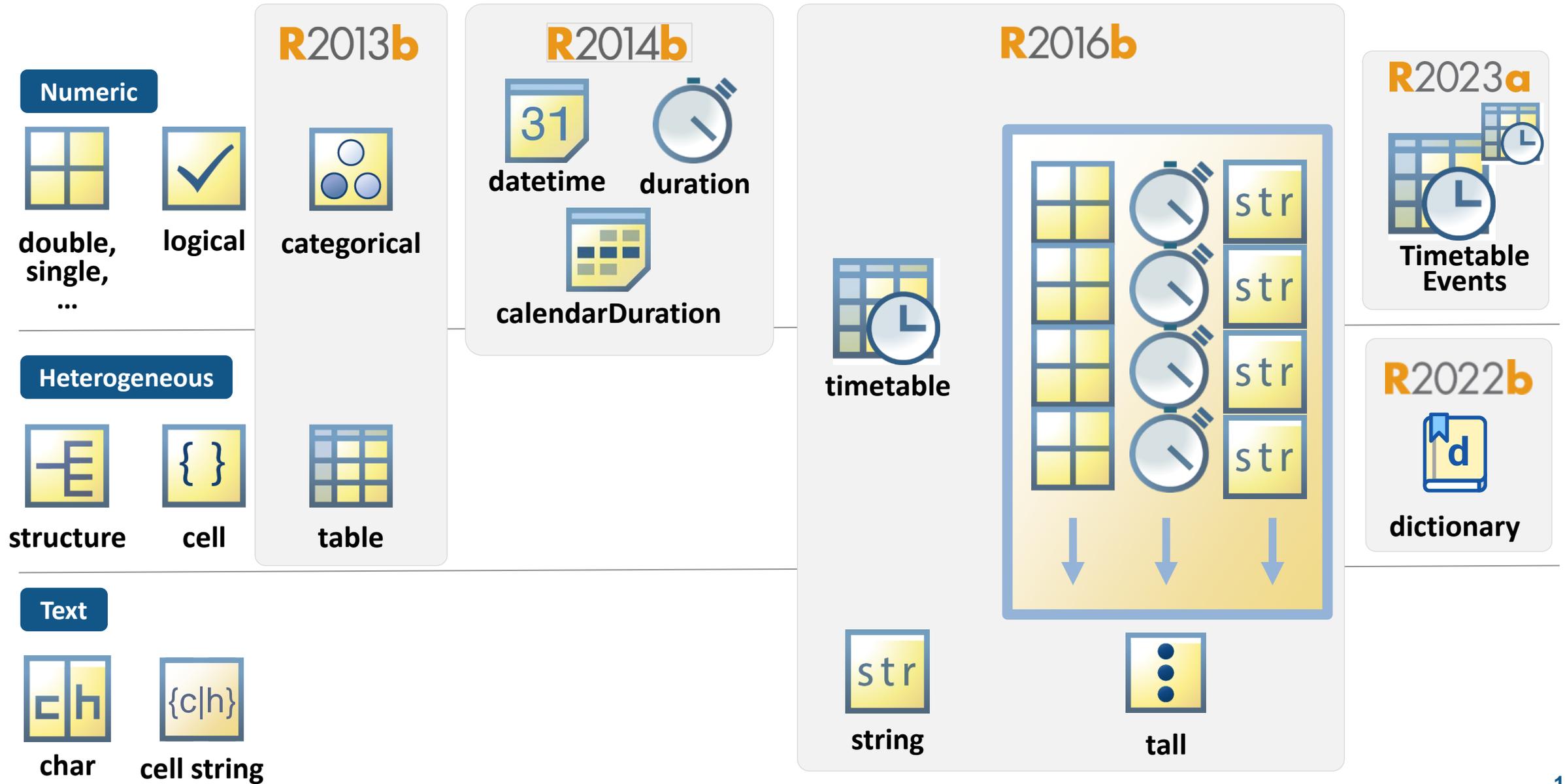
气候和科学数据

```
t = readtable('s3://bucketname/path_to_file/my_file.csv')
```

^ Toolbox required

* Support package required

2. 如何在 MATLAB 中表示这些数据？



Live Tasks 使表格/时间表处理更加简单

- Tables:
 - Join
 - Stack
 - Unstack
- Timetables
 - Retime (resample)
 - Synchronize

Join Tables

`joinedData` = Combine orders and items using left outer join

Select data

Left table: Right table:

Merging variable: Merging variable: +

Specify join


Outer join


Left outer join


Right outer join


Inner join


Join

Combine merging variables

Display results

Input tables Output table

```

% Join tables
joinedData = outerjoin(orders,items,'Type','left','Keys',{'OrderID'},...
'MergeKeys',true)

```

joinedData = 5x7 table

	OrderID	CustomerID	OrderDate	Product	Quantity	Price	Status
1	1037	'Li'	18-Apr-2019	'Petunia Ba...	1	23.9900	Delivered
2	1037	'Li'	18-Apr-2019	'Gardenias'	1	17.9900	Shipped
3	1037	'Li'	18-Apr-2019	'Gerber Dai...	6	1.9900	Delivered
4	5120	'Sanchez'	23-Apr-2019	'Tulips'	12	0.9900	Pending
5	8937	'Johnson'	16-Apr-2019	"	NaN	NaN	<undefined>

示例：探索性数据分析

Import

```
t1 = readtimetable("s3://bucket_name/file.txt");
```

Preprocess

```
t = synchronize(t1,t2,t3);  
t = fillmissing(t,"linear");  
t = rmoutliers(t);  
t = smoothdata(t,"movmedian");  
t = normalize(t);
```

Explore

```
top5 = topkrows(t,5,"RH");  
byTime = groupsummary(t,"Time","year","mean");  
scaled = grouptransform(t,"State","rescale");  
chgpts = ischange(t,"variance","Threshold",20);
```

Visualize

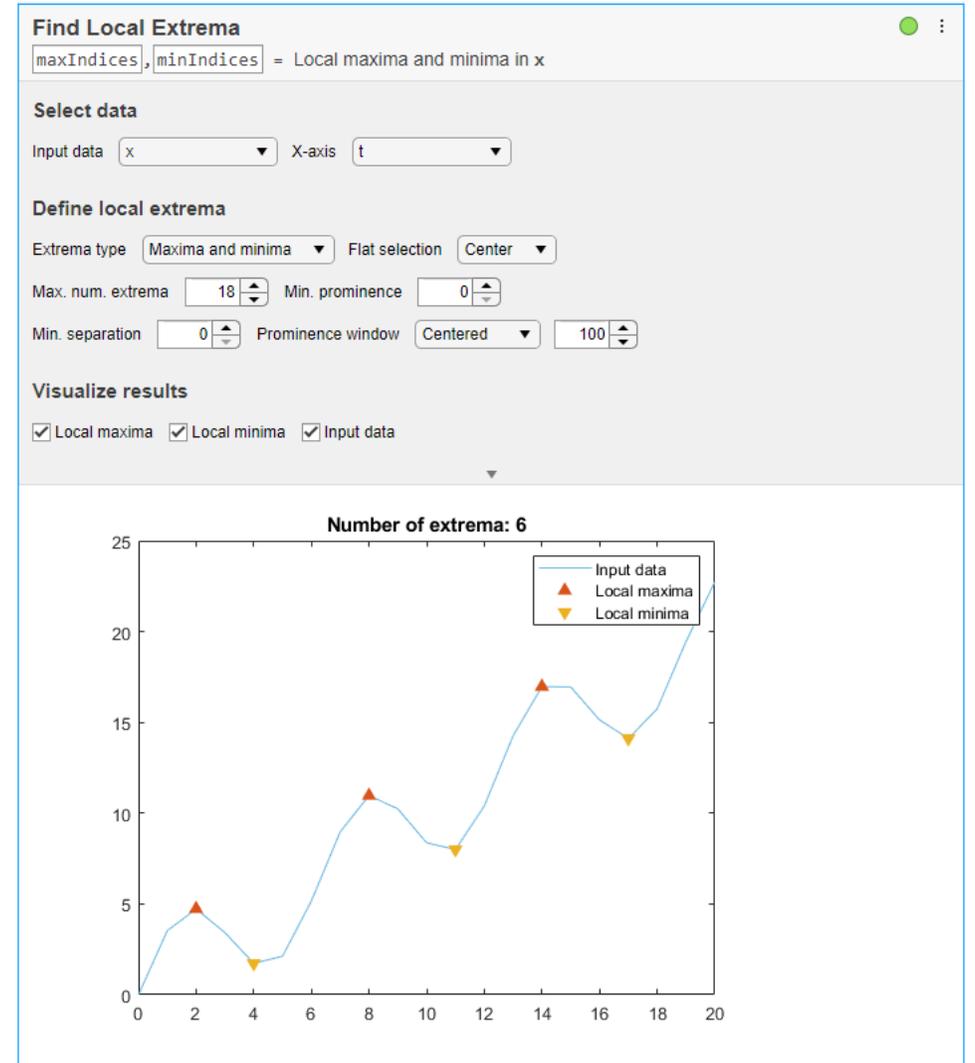
```
stackedplot(t);  
geoplot(t.Lat,t.Lon,t.RH);  
heatmap(t,"State","AQILabel");  
scatterhistogram(t.RH,t.DP);
```

1. 如何清理数据？
2. 数据中的潜在信息？

1. 如何清理数据？

Live Tasks 帮您简化预处理操作

- 缺失值
- 异常值
- 移除趋势
- 平滑
- 查找突变点
- 查找极值



Find Local Extrema Live Task

2. 数据中的潜在信息?

轻松分析分组数据

- **groupsummary** 汇总统计量
- **groupcounts** 分组计数
- **groupfilter** 按组过滤
- **grouptransform** 按组变换

```
T=5x3 table
  Gender      Smoker      Weight
  _____  _____  _____
  "male"      true         176
  "female"    false        163
  "male"      true         131
  "female"    false        133
  "male"      true         119
```

```
G2 = groupcounts(T,{'Gender','Smoker'})
```

```
G2=2x3 table
  Gender      Smoker      GroupCount
  _____  _____  _____
  "female"    false         2
  "male"      true          3
```

示例：探索性数据分析

Import

```
t1 = readtimetable("s3://bucket_name/file.txt");
```

Preprocess

```
t = synchronize(t1,t2,t3);  
t = fillmissing(t,"linear");  
t = rmoutliers(t);  
t = smoothdata(t,"movmedian");  
t = normalize(t);
```

Explore

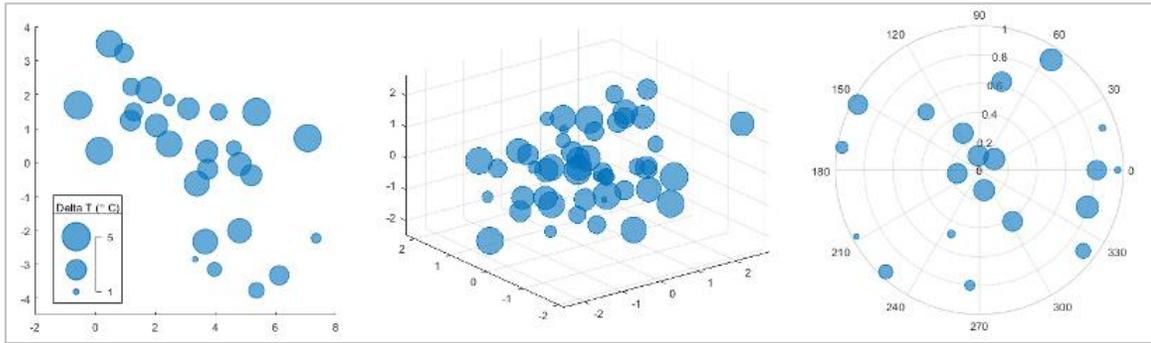
```
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scaled = grouptransform(t,"State","rescale");  
chgpts = ischange(t,"variance","Threshold",20);
```

Visualize

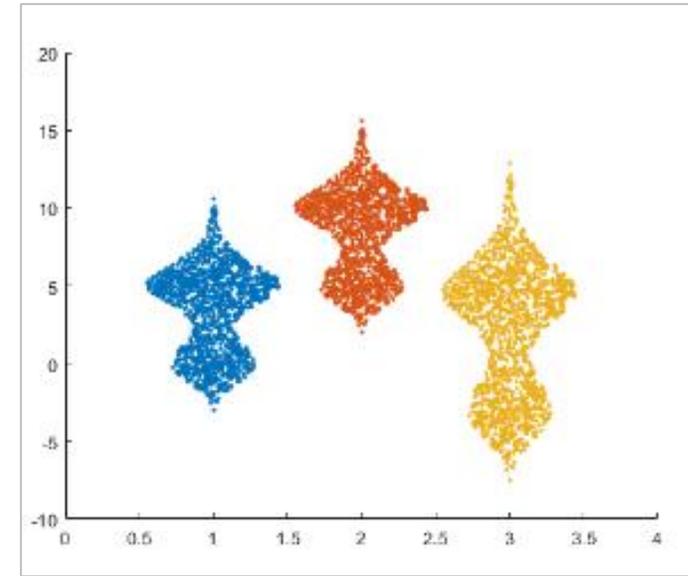
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stackedplot(t);  
geoplot(t.Lat,t.Lon,t.RH);  
heatmap(t,"State","AQILabel");  
scatterhistogram(t.RH,t.DP);
```

1. 如何可视化数据？
2. 如何分享可视化结果？

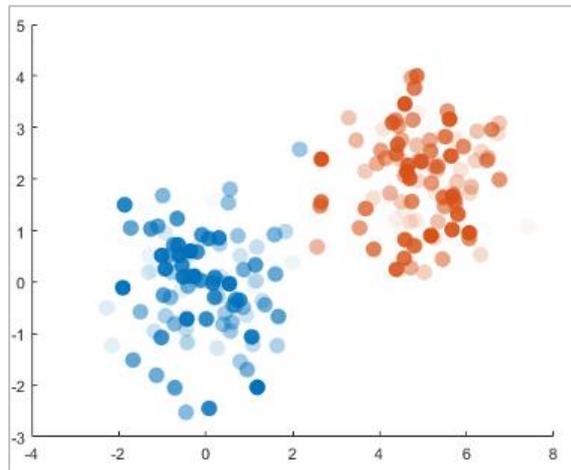
1. 如何可视化数据?



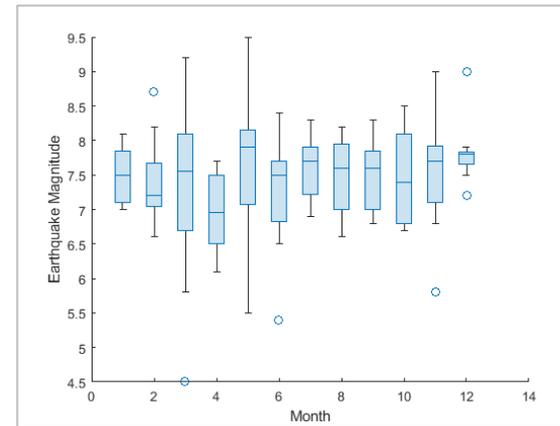
Bubble charts



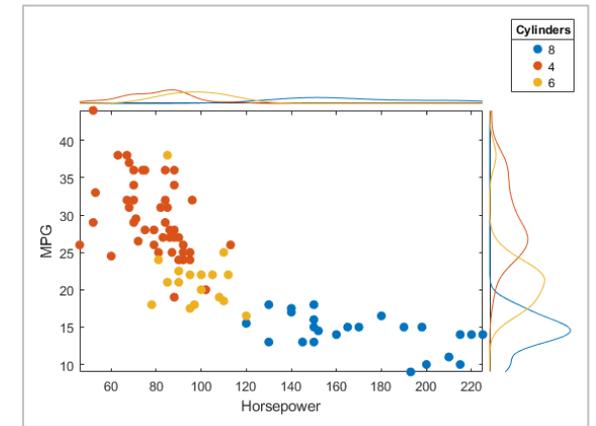
swarmchart



scatter transparency & jitter



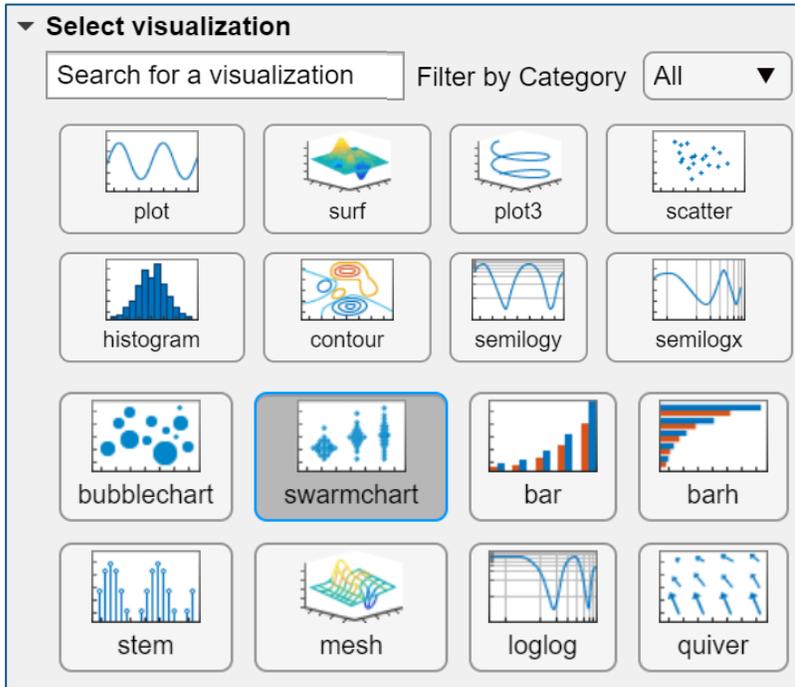
boxchart



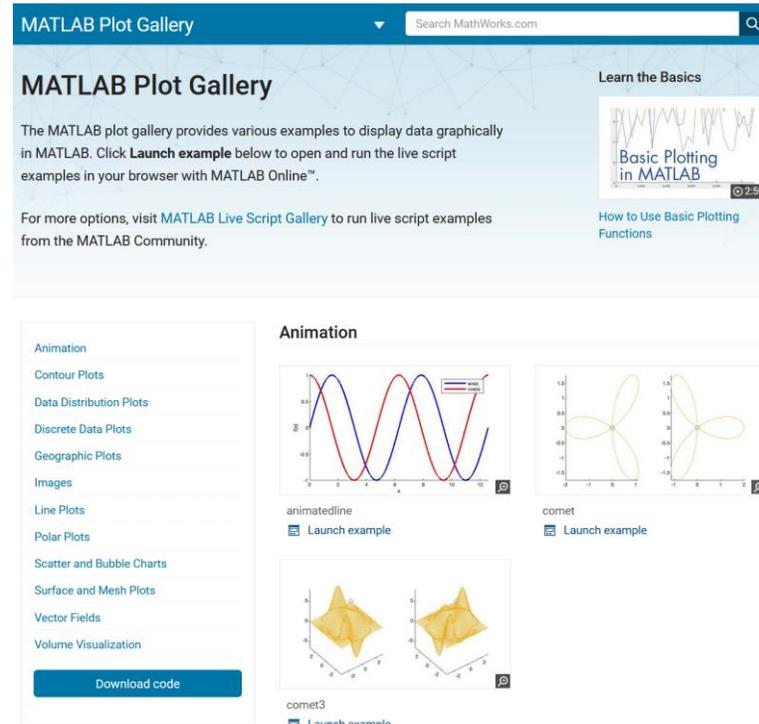
scatterhistogram

MATLAB versions of toolbox plots

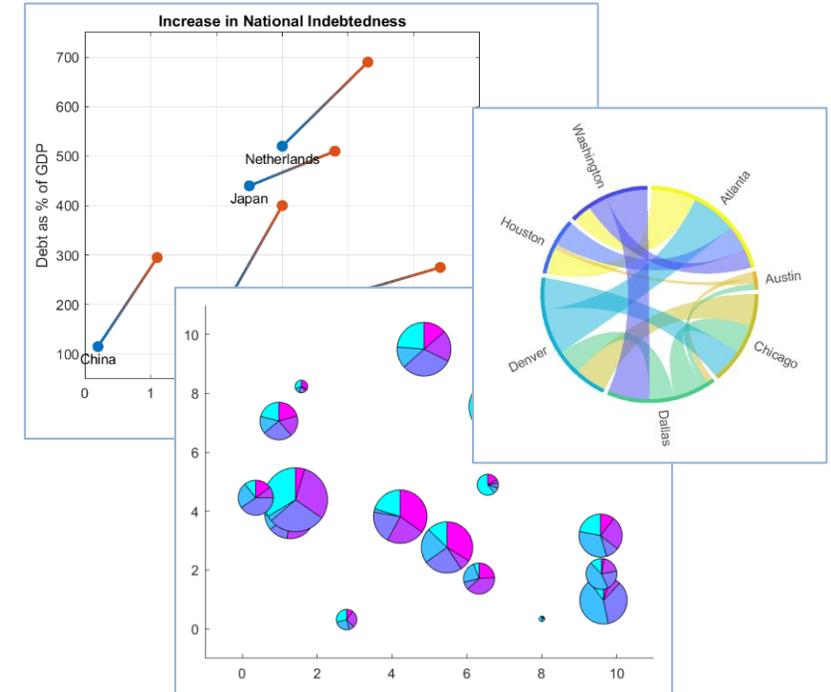
探索新的图表和可视化效果



创建绘图实时任务



[MATLAB Plot Gallery](https://www.mathworks.com/matlabcentral/fileexchange?q=Tag%3Achartcontainer)

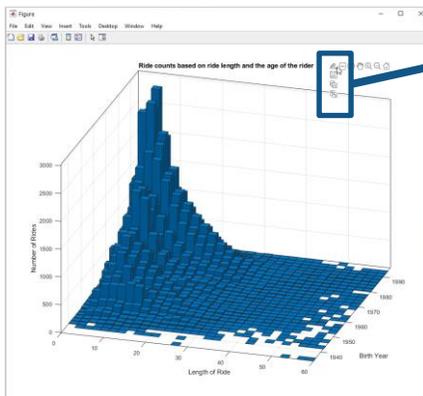


社区贡献
自定义可视化效果

<https://github.com/MATLAB-Graphics-and-App-Building>
<https://www.mathworks.com/matlabcentral/fileexchange?q=Tag%3Achartcontainer>

2. 如何分享可视化结果？

- 以交互方式保存或复制轴的内容作为图像



Save As



Copy as Image



Copy as Vector

- 以编程方式保存和复制图片

- `exportgraphics` 函数

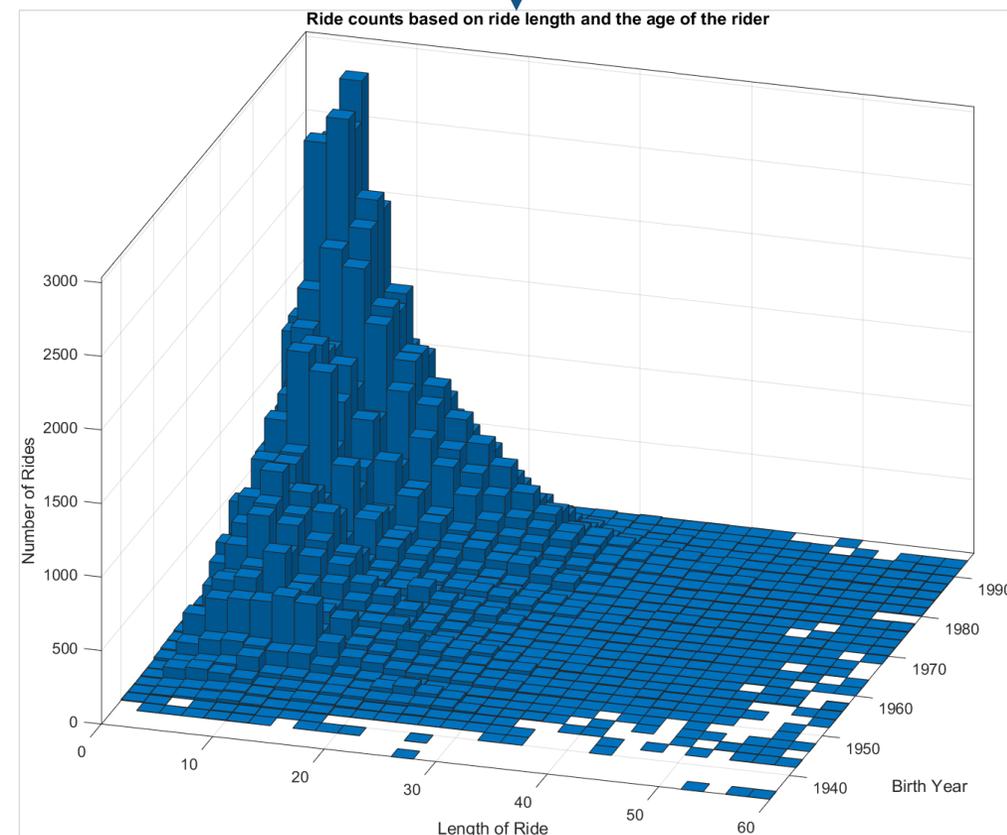
- 捕获图形并将其附加到现有 PDF
 - 创建动画 GIF 文件

R2022a

- `copygraphics` 函数

- 捕获并保存 App 中的图像

- `exportapp` 函数



示例：探索性数据分析

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```

Preprocess

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Explore

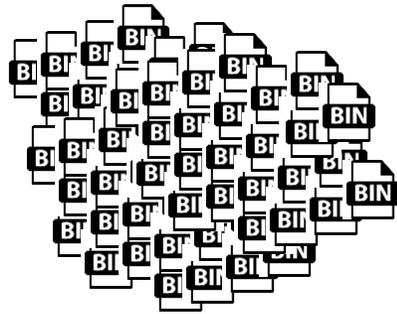
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Visualize

```
stackedplot(t);  
geoplot(t.Lat,t.Lon,t.RH);  
heatmap(t,"State","AQILabel");  
scatterhistogram(t.RH,t.DP);
```

1. 如果数据量太大无法直接读入内存？

大数据处理



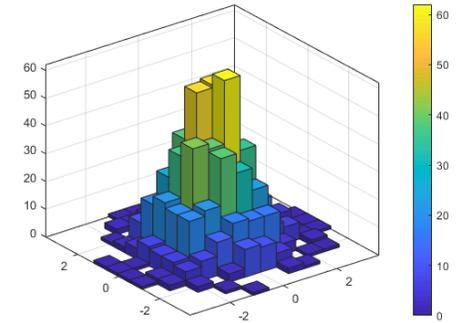
A bunch of inconvenient files

数据工程



A more manageable set of files

数据分析



```
datastores ()
+
writeall ()
```

```
datastores ()
+
tall ()
```

MATLAB 之于人工智能

关键词：机器学习、深度学习、强化学习、特征工程、自动代码生成

人工智能已被广泛应用于各行各业

行业

航空和国防

汽车

工业自动化

医疗仪器

通信

机载图像分析

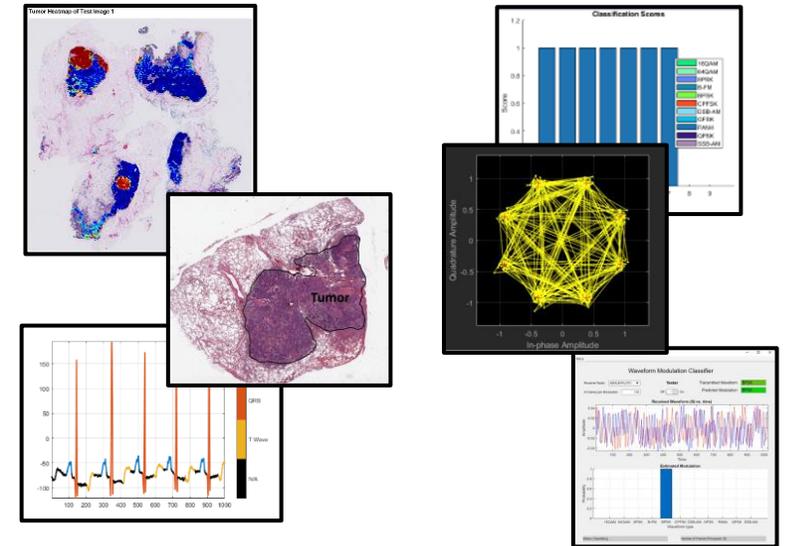
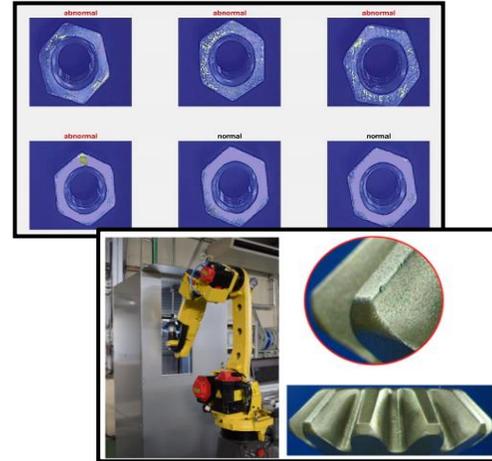
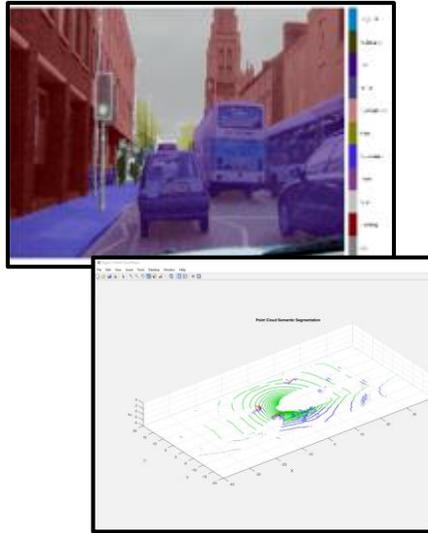
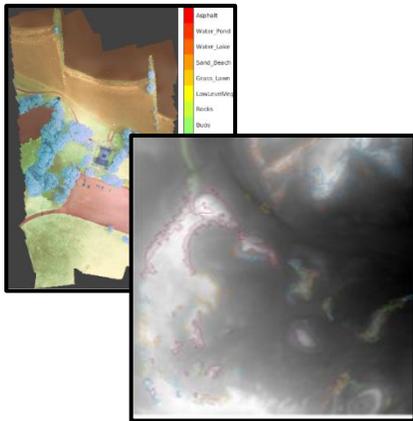
自动驾驶

加工缺陷检测

医疗图像和信号分割

调制类型识别

应用场景



人工智能驱动的系统设计

准备数据

 数据清洗和标注

 领域经验和见解

 仿真生成数据

AI建模

 模型设计和调试

 硬件加速训练

 互操作

仿真和测试

 复杂系统集成

 系统仿真

 系统测试验证

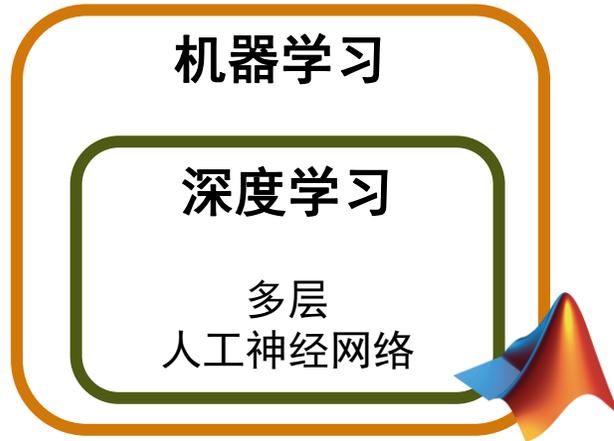
部署

 嵌入式硬件

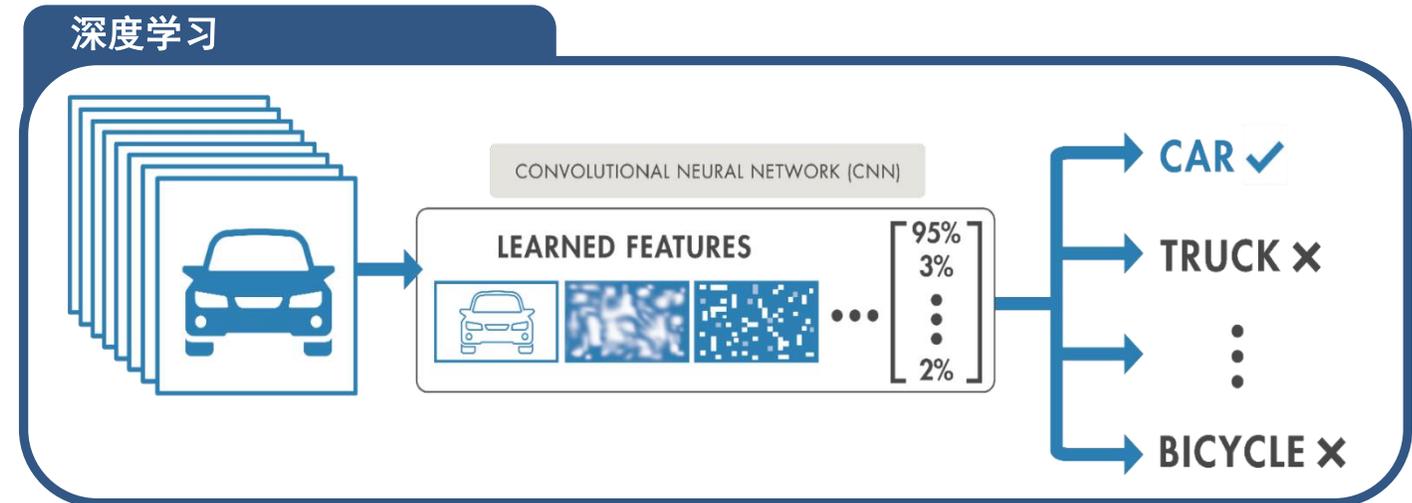
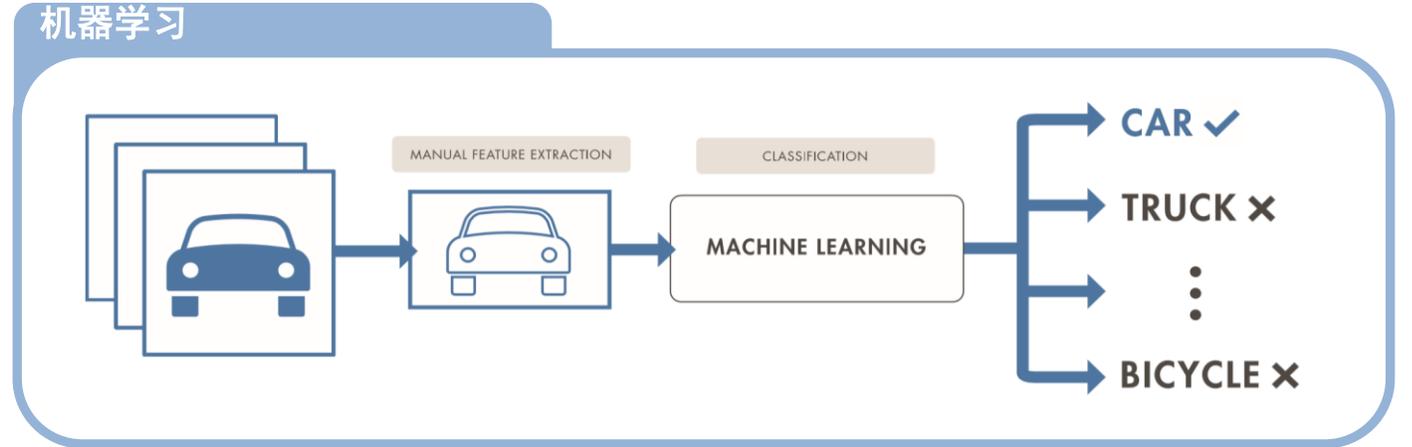
 企业系统

 边缘、云端、桌面

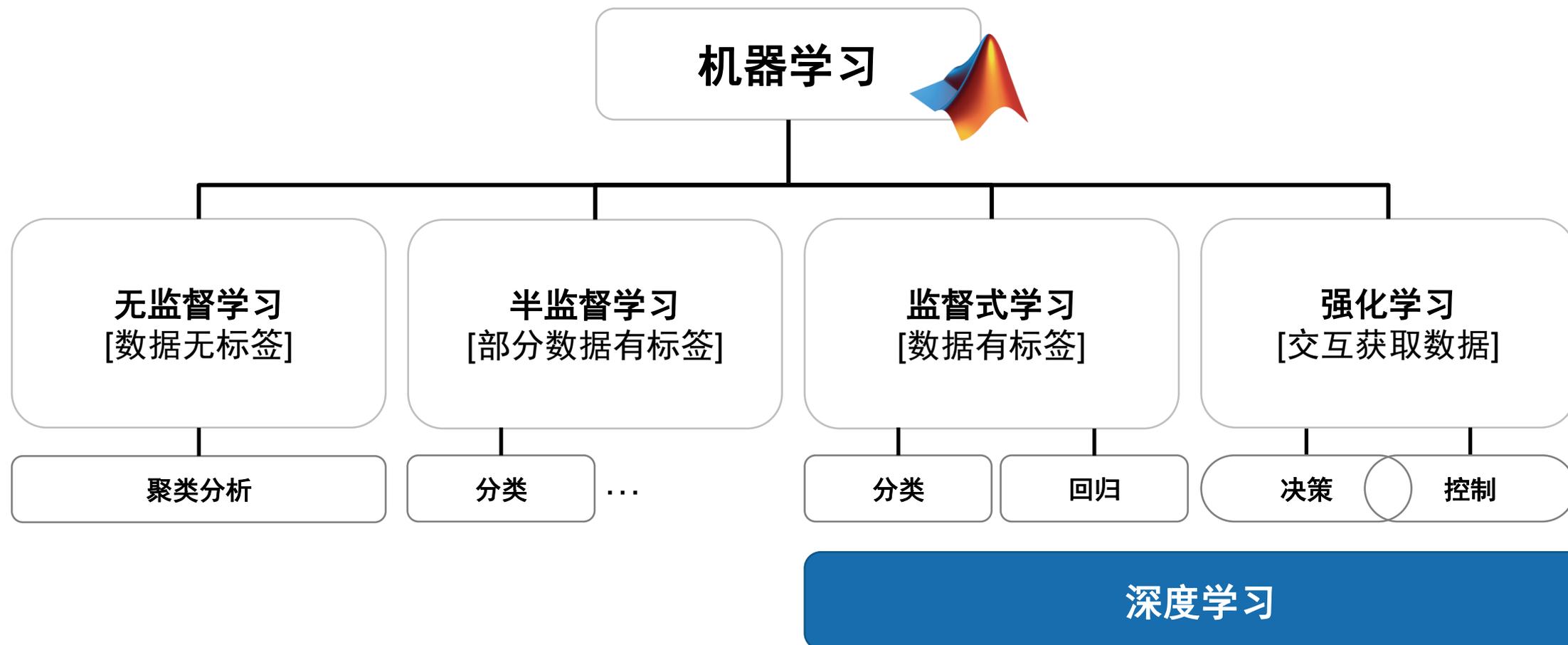
机器学习、深度学习



- 直接从数据中学习
- 更多数据 = 模型更好
- 计算密集型
- 无法直接解析

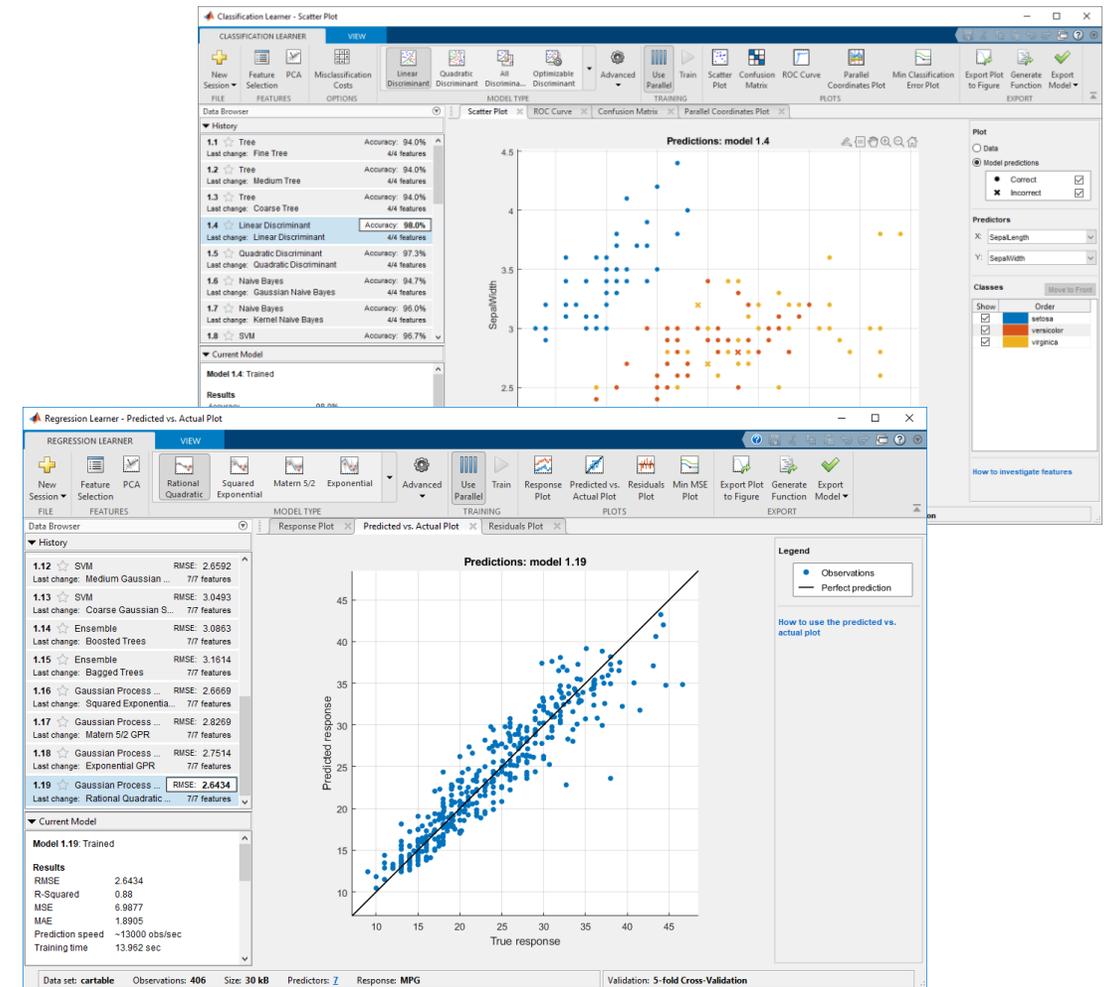


机器学习、深度学习、强化学习

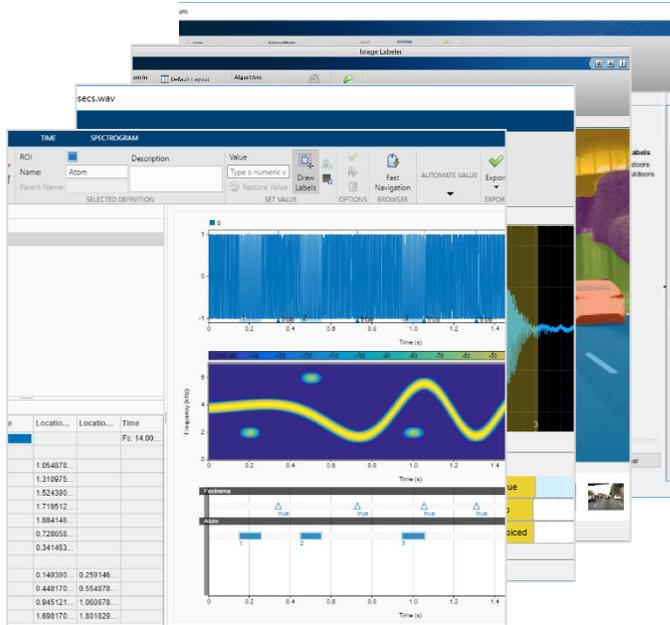


统计和机器学习工具箱

- 通过交互式应用程序查看数据、选择算法、训练并验证模型，比较结果
 - Classification Learner app
 - Regression Learner app
- Automated Machine Learning (**AutoML**)
 - 使用贝叶斯优化方法优化模型超参数

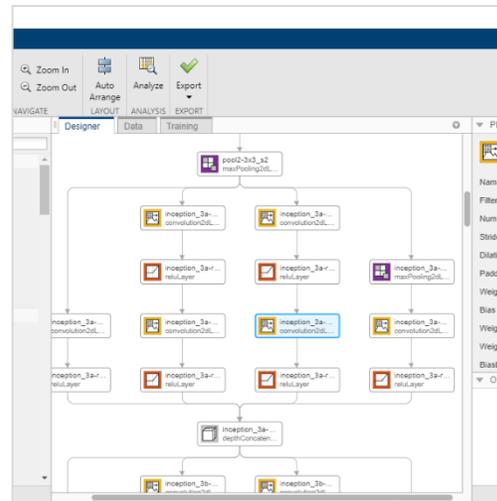


深度学习工具箱



Labelers

Image, Video, Signal, Audio



Deep Network Designer

Design, visualize, and train networks

The screenshot displays the Deep Network Quantizer interface. It shows a table of calibration statistics for various layers in a neural network. The table includes columns for 'Layer Name', 'Min Value', 'Max Value', and 'Quant'. The layers listed include 'data', 'data_normalization', 'conv1_relu_conv1', 'pool1', 'fire2-squeeze1x1_fire...', 'fire2-expand1x1_fire...', 'fire2-expand3x3_fire...', and 'fire2-concat'. The 'Quant' column shows the quantization level for each layer.

Layer Name	Min Value	Max Value	Quant
data	0.0000	255.0000	
data_normalization	-123.0000	151.0000	
conv1_relu_conv1	-0.0108	0.8849	✓
Weights	-0.8793	0.2634	
Bias	0.0000	1151.3882	
pool1	0.0000	1151.3882	
fire2-squeeze1x1_fire...	0.0000	2130.8223	✓
Activations	-1.3998	1.2477	
Weights	-0.1164	0.2427	
Bias	0.0000	1168.5220	
fire2-expand1x1_fire...	-0.7406	0.9898	✓
Activations	-0.6691	0.1460	
fire2-expand3x3_fire...	0.0000	1578.7968	✓
Activations	-0.7448	0.6691	
Weights	-0.8518	0.8742	
Bias	0.0000	1578.7968	
fire2-concat	0.0000	1578.7968	
Activations			

Deep Network Quantizer

Optimize and generate GPU code

深度网络设计器

The screenshot displays the Deep Network Designer interface. The main workspace shows a vertical flow of layers: imageinput, conv, avgpool2d, fc, softmax, and classoutput. A callout box labeled "Analyze model" points to the Analyze button in the top toolbar. The left sidebar contains a Layer Library and an Output section. The right sidebar shows the Properties panel for the selected layer.

DESIGNER

FILE BUILD NAVIGATE LAYOUT ANALYSIS EXPORT

Layer Library:

- OBJECT DETECTION
 - regionProposalLayer
 - yolov2ReorgLayer
 - yolov2TransformLayer
 - anchorBoxLayer
 - ssdMergeLayer
- OUTPUT
 - softmaxLayer
 - classificationLayer
 - regressionLayer
 - rpnSoftmaxLayer
 - rcnnBoxRegressionLayer
 - rpnClassificationLayer
 - pixelClassificationLayer

Network Architecture:

- imageinput (imageInputLayer)
- conv (convolution2d...)
- avgpool2d (averagePooling...)
- fc (fullyConnected...)
- softmax (softmaxLayer)
- classoutput (classificationLa...)

Properties Panel:

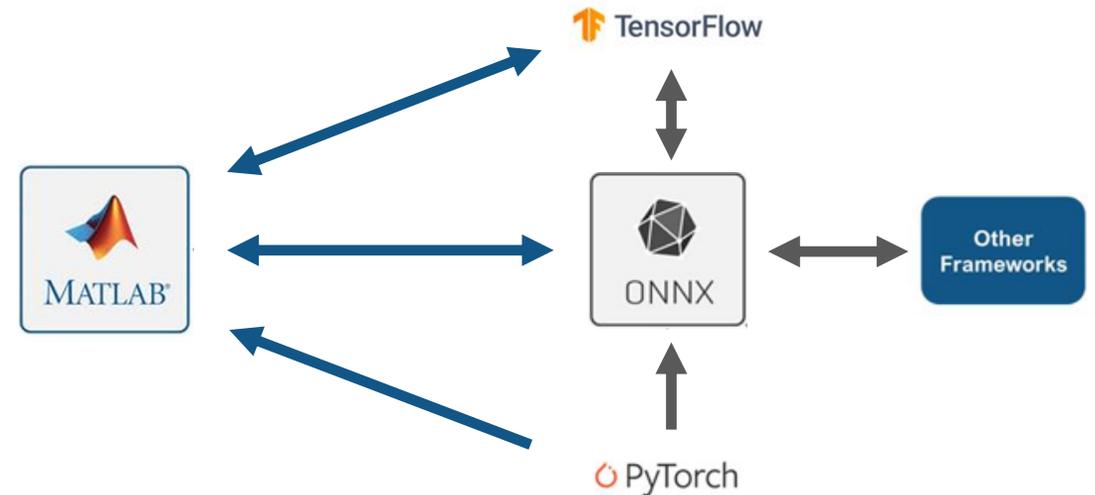
Number of	
Number of connections	5
Input type	Image
Output type	Classification

OVERVIEW

与基于 Python 的框架的互操作性

使用深度网络设计器从 PyTorch 和 TensorFlow 导入模型

ONNX Converter (Import & Export)	R2018a
TensorFlow Converter (Import)	R2021a
TensorFlow Converter (Export)	R2022b
PyTorch Converter (Import)	R2022b
New functions for importing networks from ONNX and TensorFlow to dlnetwork	R2023b
Import networks from PyTorch and TensorFlow in Deep Network Designer	R2023b



深度学习工具箱示例

目标检测



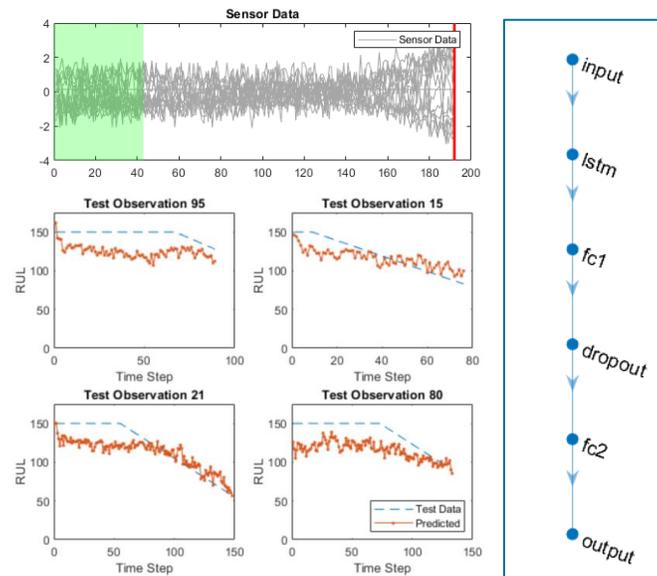
Object Detection Using SSD

Deep Learning

Computer Vision Toolbox™

Deep Learning Toolbox™

时间序列预测

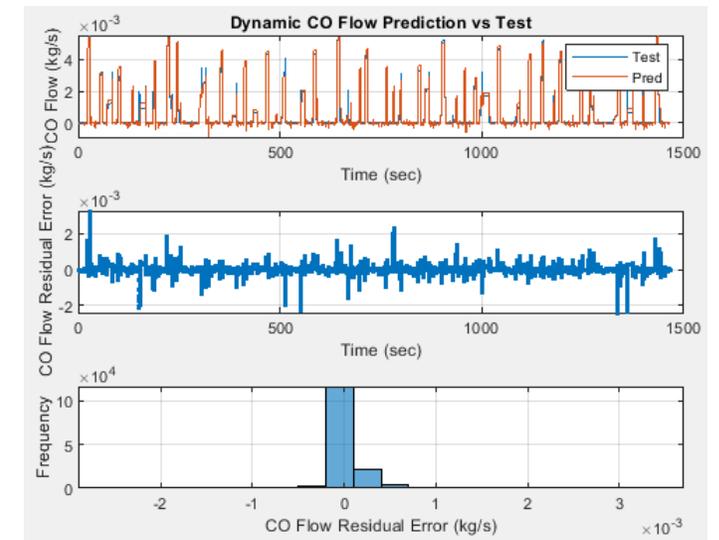


Sequence-to-Sequence Regression

Using Deep Learning

Deep Learning Toolbox™

模型降阶



Generate a Deep Learning

SI Engine Model

Deep Learning Toolbox™

Powertrain Blockset™

特定领域的 AI 应用示例



Ising Model and Metropolis Algorithm

版本 1.2.0.0 (4.7 MB) 作者: [MathWorks Physics Team](#) **STAFF**

Learn how to use the Metropolis algorithm to simulate the Ising model of a ferromagnet in MATLAB.

★★★★★ (14)
3.2K 次下载 ⓘ
更新时间 2017/6/6
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This example integrates computation into a ph end. Students learn how to implement the Met for-loops in parallel, and develop machine lear configuration of spins.

Note on required products:
MATLAB is the only required product to run th Learning Toolbox, Parallel Computing Toolbox,

Node Classification Using Graph Convolutional Network

R2023b

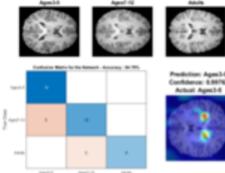
This example shows how to classify nodes in a graph using a graph convolutional network (GCN).

To predict categorical labels of the nodes in a graph, you can use a GCN [1]. For example, you can use a GCN to predict types of atoms in a molecule (for example, carbon and oxygen) given the molecular structure (the chemical bonds represented as a graph).

A GCN is a variant of a con

1. An N -by- C feature ma
2. An N -by- N adjacency

This figure shows some ex:



Brain-MRI-Age-Classification-using-Deep-Learning

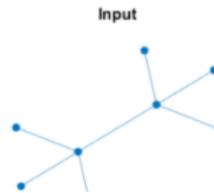
版本 1.1 (74.2 MB) 作者: [Vijay Iyer](#) **STAFF**

MATLAB example using deep learning to classify chronological age from brain MRI images
<https://github.com/matlab-deep-learning/Brain-MRI-Age-Classification-using-Deep-Learning>

更新

在 GitHub

[Open in MATLAB Online](#)
[Copy Command](#)



[总览](#) [函数](#) [示例](#) [版本历史记录](#) [评论 \(4\)](#) [讨论 \(2\)](#)

Brain MRI Age Classification Using Deep Learning

This example shows how to work with an MRI brain image dataset and how to use transfer learning to modify and retrain ResNet-18, a pretrained convolutional neural network, to perform image classification on that dataset.

The MRI scans used in this example were obtained during a study [1] of social brain development conducted by researchers at the Massachusetts Institute of Technology (MIT), and are available for download via the OpenNEURO platform:
<https://openneuro.org/datasets/ds000228/versions/1.1.0>

需要

[MATLAB](#)

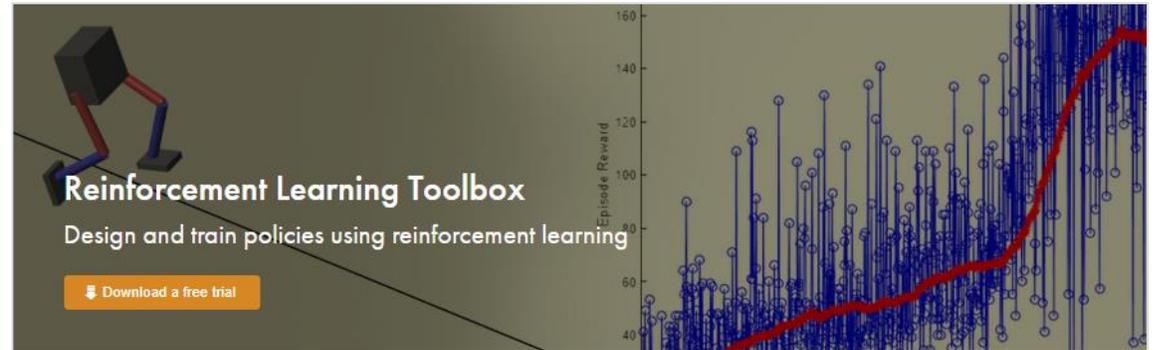
[Deep Learning Toolbox](#)

[Image Processing Toolbox](#)

For the fastest training times, ar GPU can be utilized with the Par Computing Toolbox

强化学习工具箱

- 内置和自定义强化学习算法
- 使用 MATLAB 和 Simulink 进行环境建模
- 基于深度学习的复杂策略设计
- 通过 GPU 或云计算实现训练加速
- 部署到嵌入式设备或生产系统
- 参考示例助您快速起步

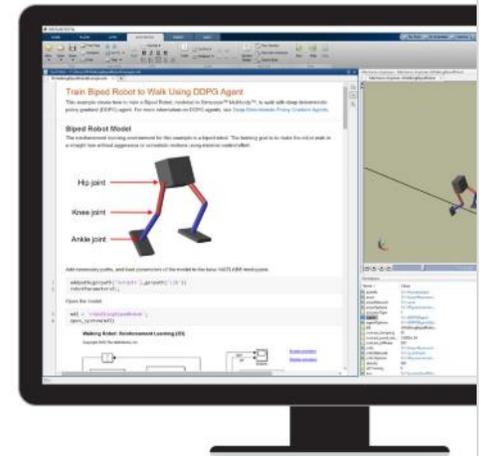


Reinforcement Learning Toolbox™ provides functions and blocks for training policies using reinforcement learning algorithms including DQN, A2C, and DDPG. You can use these policies to implement controllers and decision-making algorithms for complex systems such as robots and autonomous systems. You can implement the policies using deep neural networks, polynomials, or look-up tables.

The toolbox lets you train policies by enabling them to interact with environments represented by MATLAB® or Simulink® models. You can evaluate algorithms, experiment with hyperparameter settings, and monitor training progress. To improve training performance, you can run simulations in parallel on the cloud, computer clusters, and GPUs (with Parallel Computing Toolbox™ and MATLAB Parallel Server™).

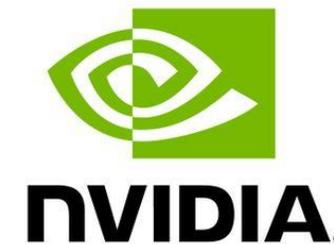
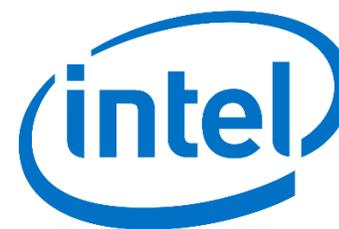
Through the ONNX™ model format, existing policies can be imported from deep learning frameworks such as TensorFlow™ Keras and PyTorch (with Deep Learning Toolbox™). You can generate optimized C, C++, and CUDA code to deploy trained policies on microcontrollers and GPUs.

The toolbox includes reference examples for using reinforcement learning to design controllers for robotics and automated driving applications.



硬件加速和扩展训练

MATLAB可加速AI模型的训练，将计算扩展至GPU，云端和数据中心，无需额外编程。



AI建模



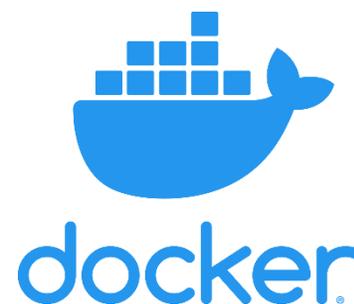
模型设计和调试



硬件加速训练



互操作

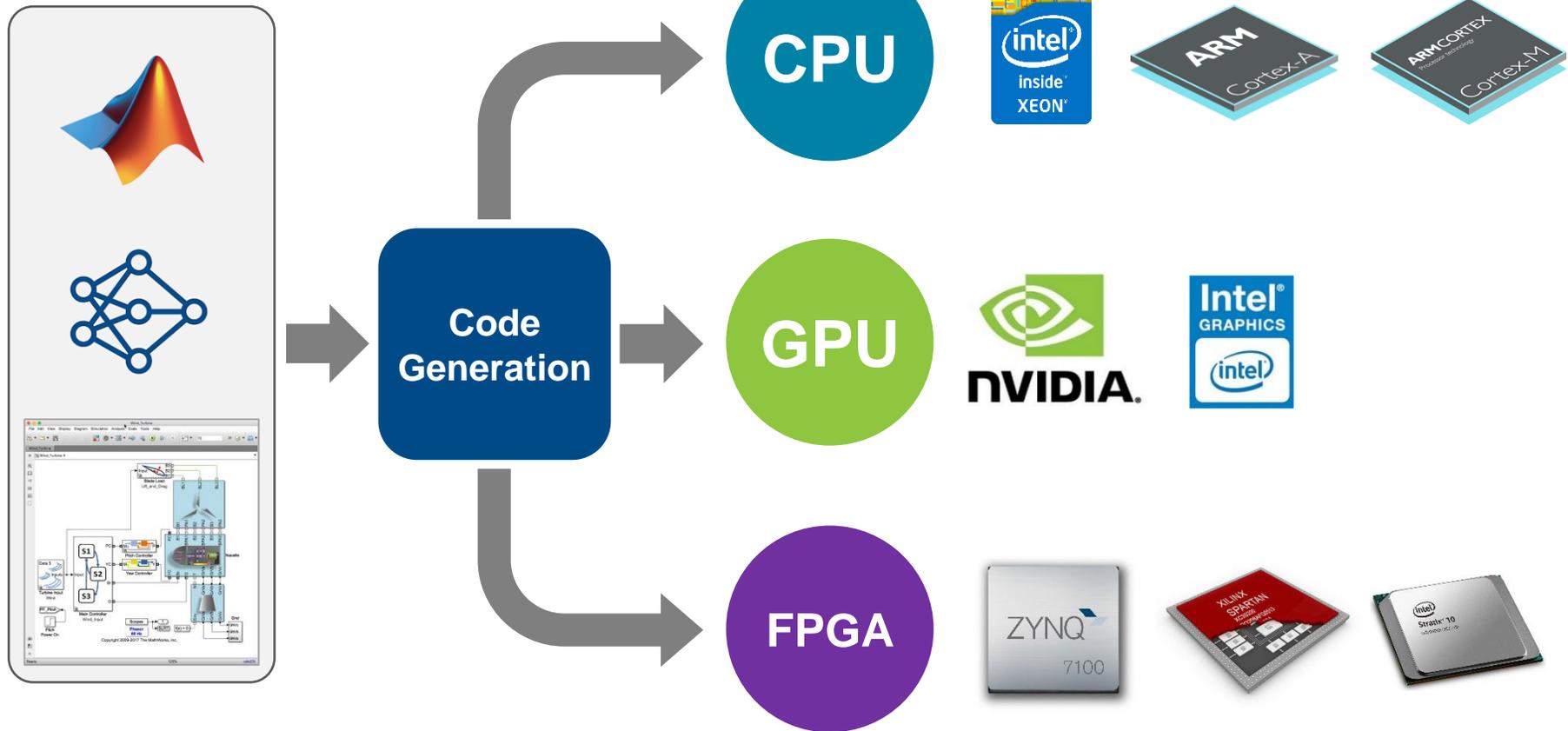


以最佳性能部署到任意处理器

基于MATLAB和Simulink的AI模型，可以部署到嵌入式设备，边缘计算平台，企业系统，云端以及桌面环境

部署

- 嵌入式硬件
- 企业系统
- 边缘、云端、桌面



信号处理主题：

基于信号的 MATLAB 处理与分析

使用 MATLAB 进行教学

使用 MATLAB 进行数据分析可视化教学

使用环境

MATLAB Online

MATLAB Mobile

实时脚本



材料

教学资源

视频和网络研讨会



自学

在线自定义进度培



示例

教学演示

MATLAB Grader





使用 MATLAB 进行数据分析可视化教学

使用环境



材料

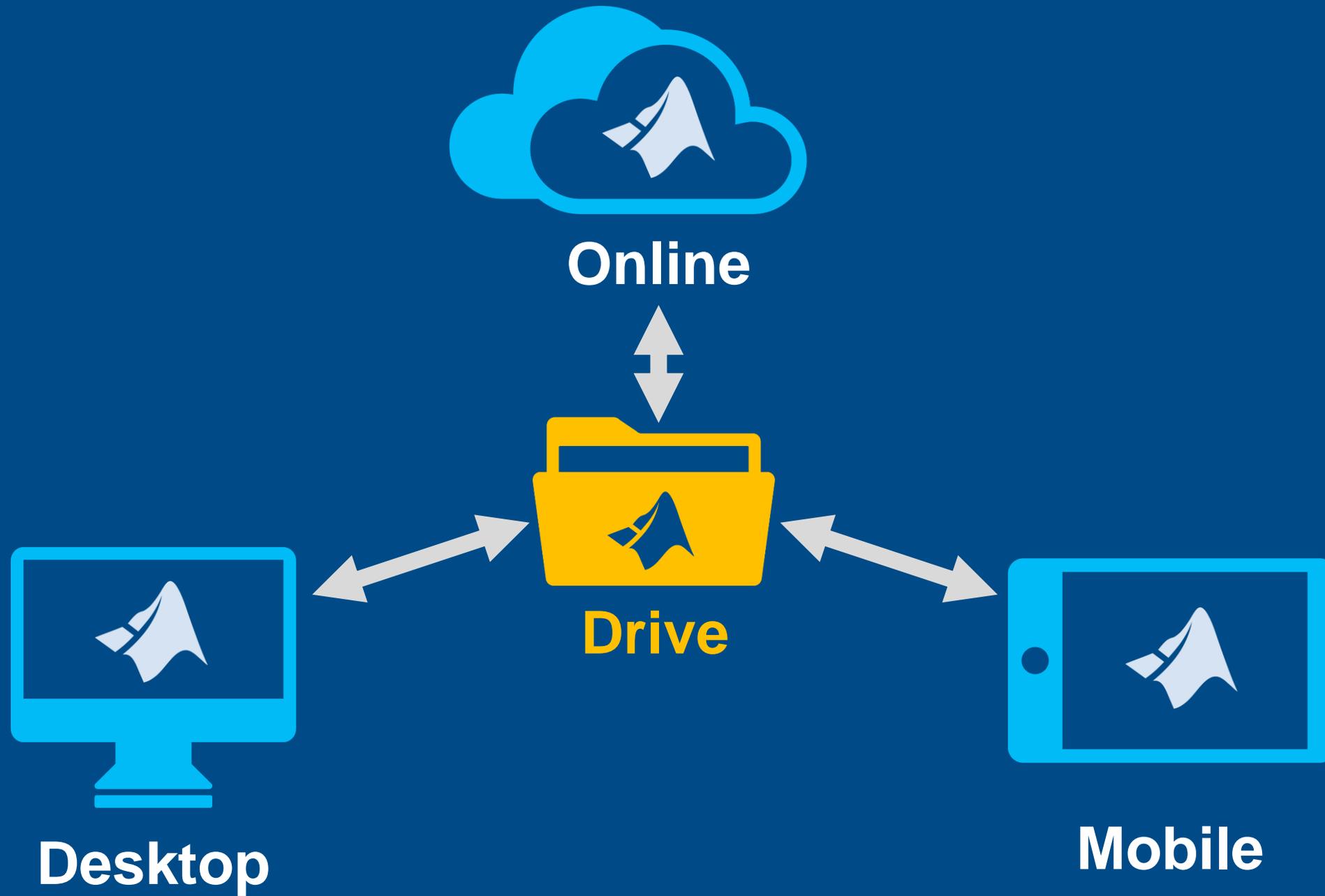


自学



示例





用于数据分析的 MATLAB

探索、建模和可视化数据

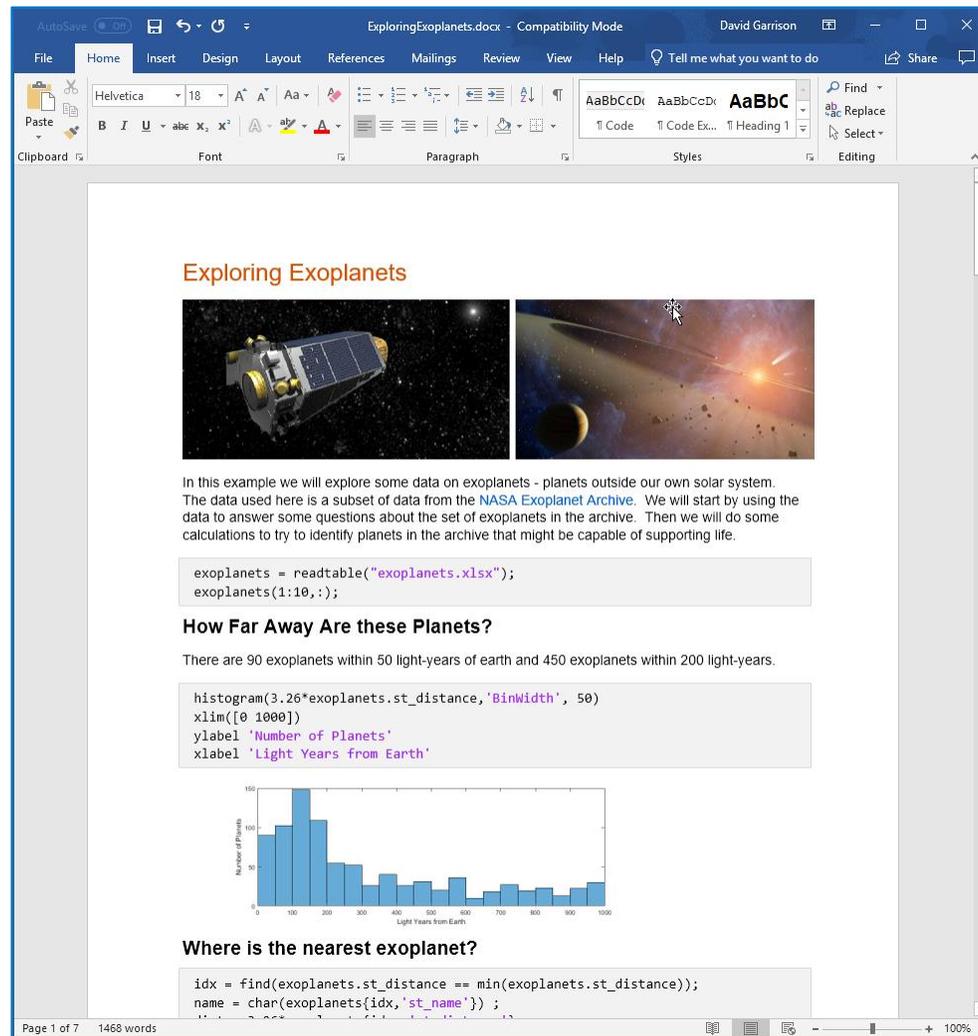
- 专为工程和科学数据而设计的功能
- 交互式和可自定义的数据可视化
- 数以千计的预构建函数用于数据分析
- 包含代码示例的大量文档
- 无需大量代码更改即可扩展到大数据

MATLAB 实时编辑器

创建在可执行笔记本中组合代码、输出和格式化文本的脚本。

- 创建可执行脚本
- 更快地获得结果
- 以交互方式完成步骤
- 共享和发布结果
- 使用实时脚本进行教学

MATLAB 实时编辑器 – 笔记本功能



The screenshot displays the MATLAB Live Editor interface. At the top, the title bar shows "ExploringExoplanets.docx - Compatibility Mode" and the user name "David Garrison". The ribbon includes tabs for File, Home, Insert, Design, Layout, References, Mailings, Review, View, and Help. The Home tab is active, showing options for Paste, Clipboard, Font, Paragraph, Styles, and Editing. The main content area contains a notebook with the following elements:

Exploring Exoplanets



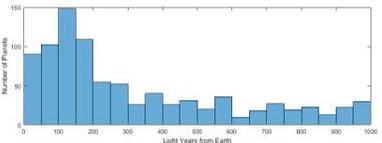
In this example we will explore some data on exoplanets - planets outside our own solar system. The data used here is a subset of data from the [NASA Exoplanet Archive](#). We will start by using the data to answer some questions about the set of exoplanets in the archive. Then we will do some calculations to try to identify planets in the archive that might be capable of supporting life.

```
exoplanets = readtable("exoplanets.xlsx");  
exoplanets(1:10,:);
```

How Far Away Are these Planets?

There are 90 exoplanets within 50 light-years of earth and 450 exoplanets within 200 light-years.

```
histogram(3.26*exoplanets.st_distance,'BinWidth', 50)  
xlim([0 1000])  
ylabel 'Number of Planets'  
xlabel 'Light Years from Earth'
```



The histogram shows the number of planets (y-axis, 0 to 150) versus light years from Earth (x-axis, 0 to 1000). The distribution is skewed to the right, with a peak around 100 light years.

Where is the nearest exoplanet?

```
idx = find(exoplanets.st_distance == min(exoplanets.st_distance));  
name = char(exoplanets{idx,'st_name'});
```

Page 1 of 7 1468 words

MATLAB 实时编辑器 – 编码功能

The screenshot displays the MATLAB Live Editor interface for a script titled "Data Analytics - Load Forecasting Case Study". The script contains the following code:

```
load LETdata.mat
head(nyiso)
```

The "Missing Data" section is active, showing the "Clean Missing Data" configuration. The "Input data" is set to "nyiso" and the "Specify method" dropdown is open, listing various options. The "Method to fill missing entries" is currently set to "Linear interpolation".

Missing Data

- Constant value
- Previous value
- Next value
- Nearest value
- Linear interpolation
- Spline interpolation
- Shape-preserving cubic interpolation (PCHIP)
- Modified Akima cubic interpolation
- Moving median
- Moving mean
- Linear interpolation

Clean Missing Data

`cCleanedData` = Filled missing data

Select data

Input data: nyiso .DUN Date

Specify method

Cleaning method: Fill missing Method to fill missing entries

Visualize results

Cleaned data Filled missing entries 00:11.66

ans = 8x11 timetable

	Date	CAPITL	CENT
1	05/01/2007 ...	981.9000	1.571
2	05/01/2007 ...	991.8000	1.568
3	05/01/2007 ...	950.1000	1.560
4	05/01/2007 ...	968.9000	1.560
5	05/01/2007 ...	968.5000	1.555
6	05/01/2007 ...	949.2000	1.564
7	05/01/2007 ...	941.6000	1.538
8	05/01/2007 ...	939.4000	1.557

Number of filled missing entries: 4

使用 MATLAB 进行数据分析可视化教学

使用环境



材料



自学



提问



MATLAB Courseware

- 面向教育工作者的可下载、精选的课程材料

- 课件
- 教科书
- 在线课程
- 行业应用和案例研究

- 课程示例

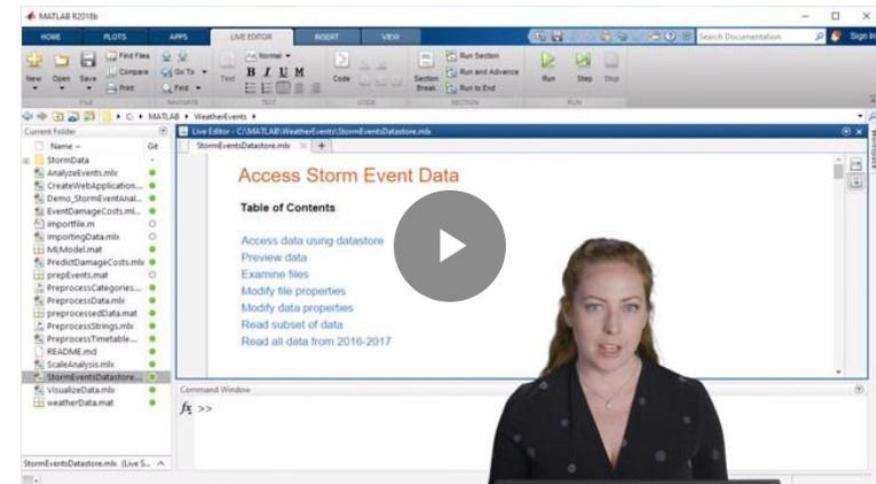
- “*Teaching Environmental Data Analysis Fundamentals in MATLAB, City University of New York*”
- “*Modeling and Data Analysis in Life Sciences, University of California, Davis*”
- “*Boot Camp in Quantitative Methods, Harvard University*”



www.mathworks.com/academia/courseware

数据科学教程 – 视频系列

- 数据科学 workflows 详解
- 主题
 - 导入数据
 - 预处理数据
 - 分析数据
 - 可视化数据
 - 预测建模
 - 使用大数据
 - 部署模型
- 提供代码和文件



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使用 MATLAB 进行数据分析可视化教学

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示例



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FREE



MATLAB Onramp

Get started quickly with the basics of MATLAB.

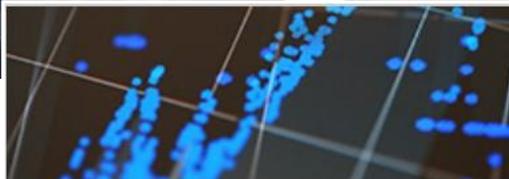
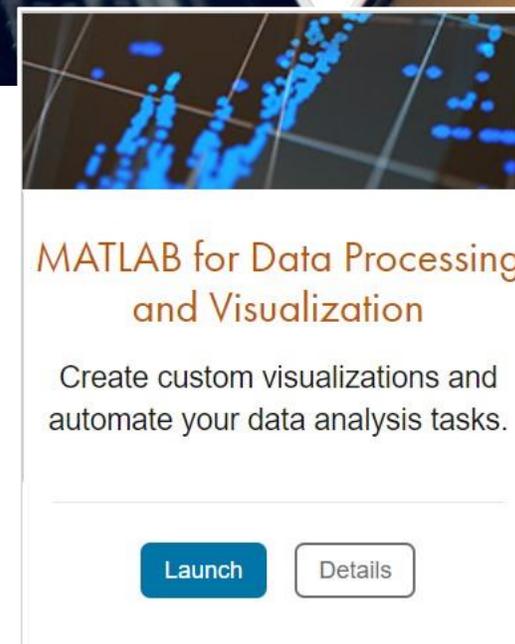
[Launch](#) [Details](#)



MATLAB Fundamentals

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

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



MATLAB for Data Processing and Visualization

Create custom visualizations and automate your data analysis tasks.

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

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and feedback



Ready-to-use resources to enhance your instruction

www.mathworks.com/On/Arad/academic/imagi-wirth-matlab

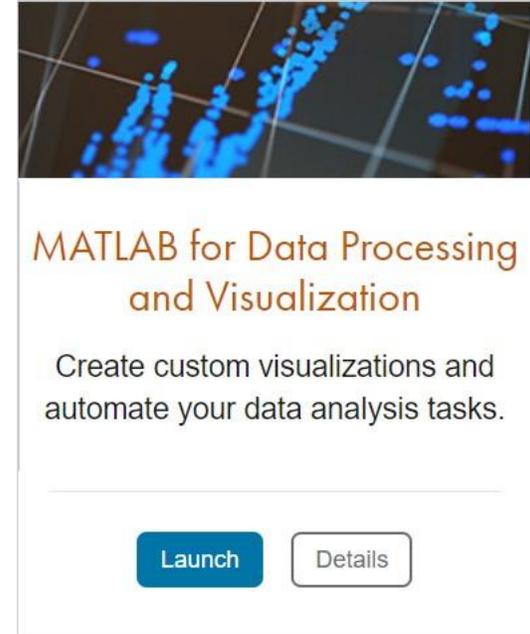
MATLAB 数据可视化课程

概述

- 了解如何创建自定义可视化效果并自动执行数据导入和分析
- 约8小时内容，分成简短的模块
- 在浏览器中学校，包括动手活动、阅读材料和短视频演示
- 课程结业证书

主题

- 自动从多个文件导入数据
- 预处理数据
- 分析数据中的组
- 创建自定义可视化效果
- 创建图像和 3D 可视化



The image shows a promotional card for the MATLAB course. At the top is a dark image with blue data points and grid lines. Below it, the title 'MATLAB for Data Processing and Visualization' is written in orange. Underneath, a grey text block says 'Create custom visualizations and automate your data analysis tasks.' At the bottom, there are two buttons: a blue 'Launch' button and a white 'Details' button with a grey border.

MATLAB for Data Processing and Visualization

Create custom visualizations and automate your data analysis tasks.

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

<https://matlabacademy.mathworks.com/cn/details/matlab-for-data-processing-and-visualization/mlvi>

自定义进度课程

入门级课程

Get Started with MATLAB

-  MATLAB Onramp
-  Deep Learning Onramp
-  Machine Learning Onramp
-  Image Processing Onramp
-  Signal Processing Onramp
-  Statistics Onramp

-  App Building Onramp
-  Optimization Onramp
-  Computer Vision Onramp
-  Reinforcement Learning Onramp
-  Object Oriented Programming Onramp
-  Wireless Communications Onramp

Get Started with Simulink

-  Simulink Onramp
-  Simscape Onramp
-  Stateflow Onramp
-  Circuit Simulation Onramp
-  Power Systems Simulation Onramp
-  Power Electronics Simulation Onramp
-  Control Design Onramp with Simulink

进阶课程

MATLAB and Simulink

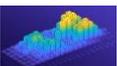
-  MATLAB Fundamentals
-  Simulink Fundamentals
-  MATLAB Programming Techniques
-  MATLAB for Data Processing and Visualization

Image and Signal Processing

-  Image Processing with MATLAB
-  Signal Processing with MATLAB

Data Science and AI

-  Deep Learning with MATLAB
-  Machine Learning with MATLAB

Computational Mathematics

-  Solving Nonlinear Equations with MATLAB
-  Solving Ordinary Differential Equations with MATLAB
-  Introduction to Symbolic Math with MATLAB
-  Introduction to Linear Algebra with MATLAB
-  Introduction to Statistical Methods with MATLAB

使用 MATLAB 进行数据分析可视化教学

使用



材料



自学



示例



现代教学的挑战

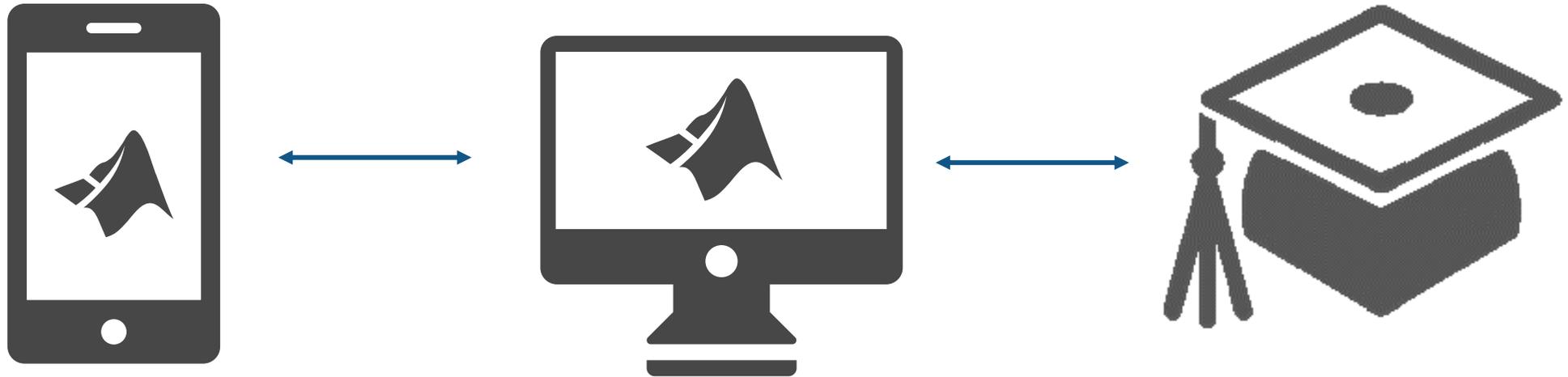


您如何远程教授编程？

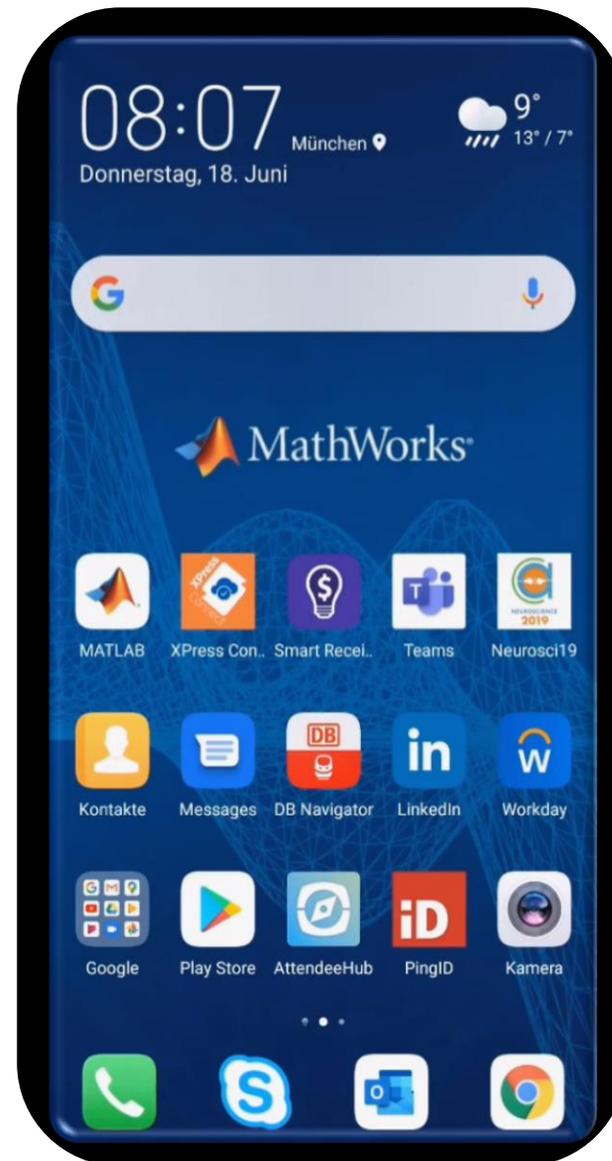
您如何提起学生的兴趣？

您如何衡量教学进展和发现问题？

教学示例 – 分析 GPS 数据



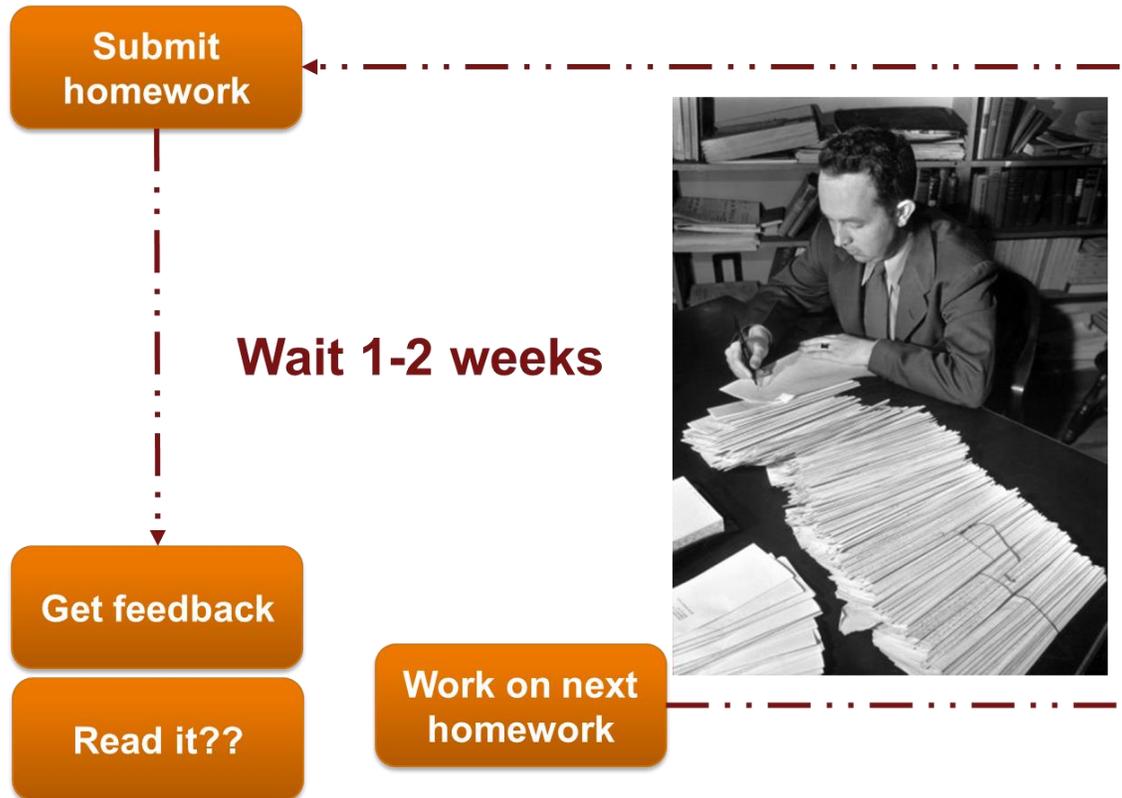
教学示例 – 使用 MATLAB 移动版进行数据采集



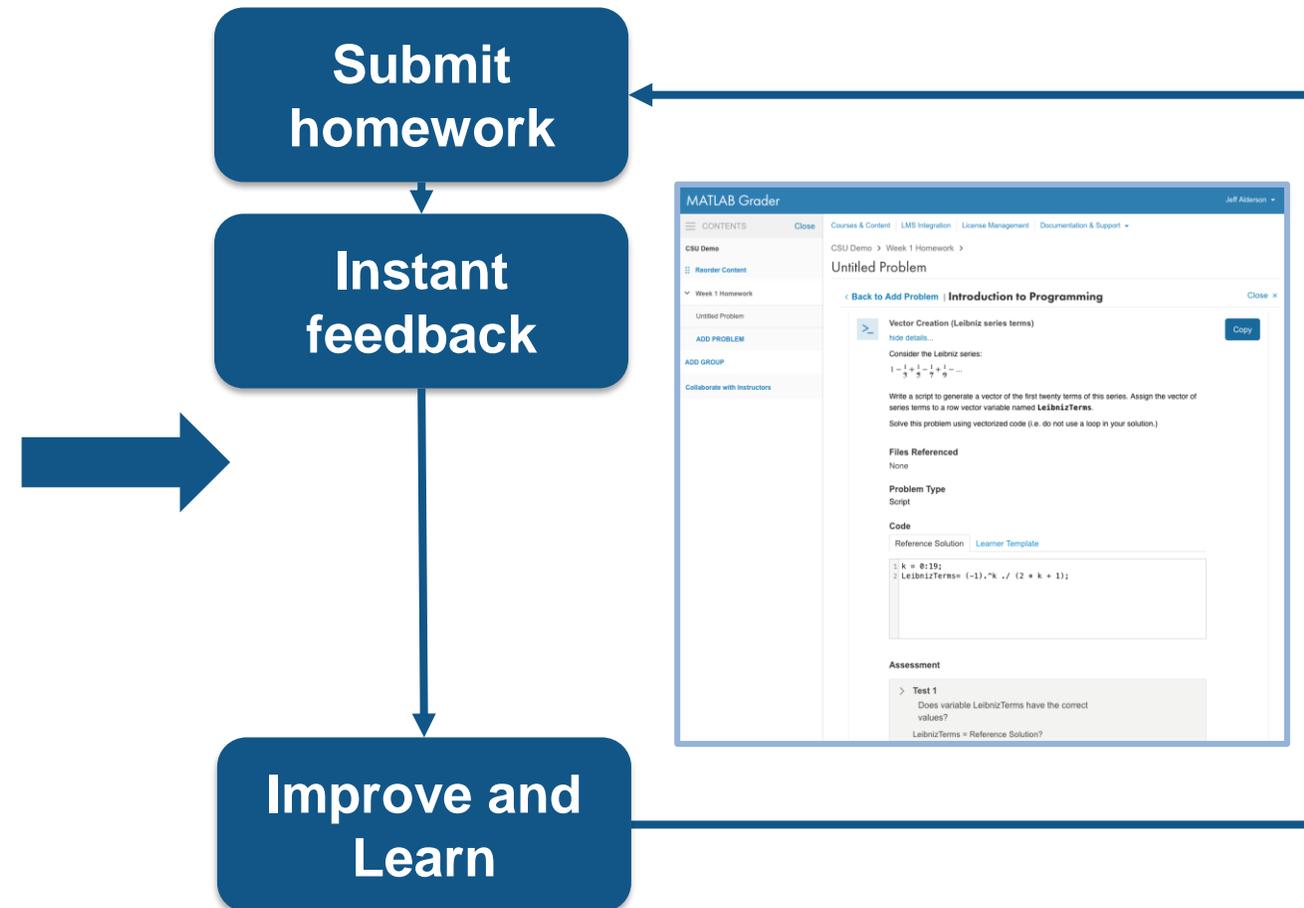
什么是 MATLAB Grader?

可节省对 MATLAB 代码进行评分并为学生提供即时反馈的时间

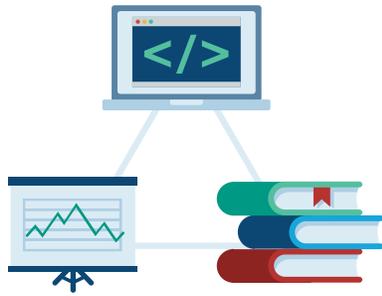
Traditional Grading



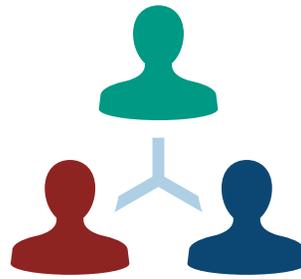
Autograding



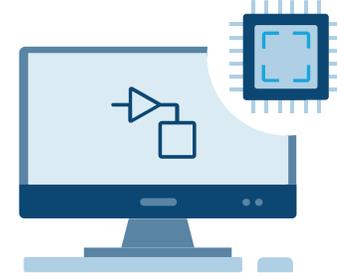
人工智能+X 教学



课程



合作



数字化



针对特定领域教授 AI – AI + X

培养“双语”学生：“人工智能+X领域”

现有 X 课程

音频处理

信号处理

图像处理

医疗/生物医学

计算机视觉

控制

人工智能部分

讲座

- 1 – 2 场讲座
- 理论概述
- 特定领域的应用

前期工作

- 进行 2 小时的深度学习/机器学习
入门在线入门

作业

- 在 MATLAB/MATLAB Online 中完成作业
- 在课程领域处理 ~3 个 AI 示例中的 1 个

为工科学生提供数据科学技能

Dr Thomas Popham, 工程学院



工科数据科学教学核心模块

系统建模、仿真和计算

工程数学与数据分析

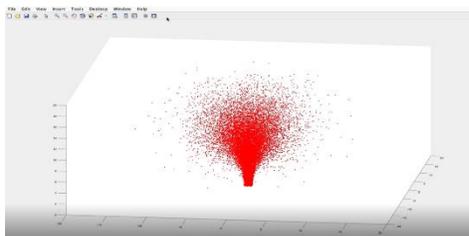
高级模块

大一

大二

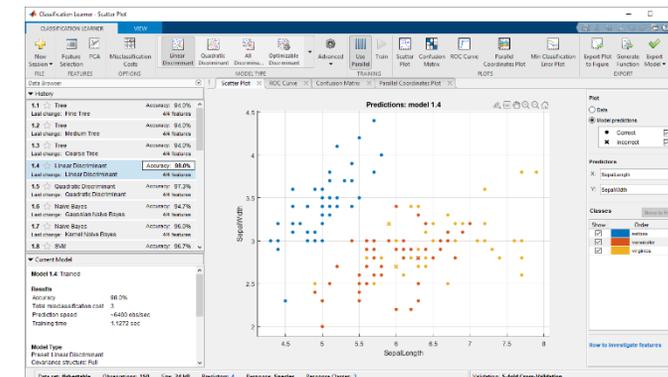
大三

- 学习物理和简单的数据驱动方法。
- 介绍使用 MATLAB 基础课程进行编程。



- 解决回归、分类和聚类问题。
- 小组项目：学习如何使用真实数据，这些数据可能以不同的格式提供，包含异常值等。

- 从网络摄像头收集数据。
- 创建手势识别应用。



示例：用于图像处理的深度学习

佛罗里达大西洋大学



In collaboration with
Dr. Oge Marques

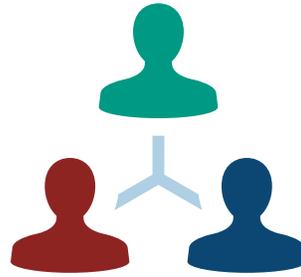
按主题划分的课程大纲：

1. 图像处理和分析简介
2. 图像处理基础
3. MATLAB 和相关工具箱
4. 几何运算
5. 强度转换
6. 图像和直方图处理的汇总统计
7. 图像过滤和增强
8. 深度学习基础知识
9. 图像去噪
10. 彩色图像处理
11. 图像分割
12. 全局特征检测和提取
13. 局部特征检测、提取和匹配
14. 图像分类
15. 应用、案例研究和正在进行的研究主题

Week	Topic	Required reading	Assignments
1	1	Textbook – Chapter 1	
2	2	Textbook – Chapters 2, 5, and 6, and Appendix A	
3	3	Textbook – Chapters 3 and 4 Reference book – Recipes 1-4 MathWorks "MATLAB Onramp"	A1 out
4	4	Textbook – Chapter 7 Reference book – Recipes 5-6	A1 due A2 out
	5	Textbook – Chapter 8 Reference book – Recipes 11-14	
5	6	Textbook – Chapter 9 Reference book – Recipes 7-10	A2 due A3 out
6	7	Textbook – Chapters 10 and 11 Reference book – Recipes 15-16	
7	8	MathWorks Deep Learning eBooks MathWorks " Deep Learning Onramp"	A3 due A4 out
8	9	Textbook – Chapter 12	
9	10	Textbook – Chapter 16 Reference book – Recipes 25-28	A4 due A5 out
10	11	Textbook – Chapter 15 Reference book – Recipes 17-19	A5 due Term Project out
11	12	Textbook – Chapter 18 Reference book – Recipes 20, 21, 24, 35-36	
12	13	Reference book – Recipes 37-42	
13	14	Textbook – Chapter 19	Exam
14	15	N/A	Term Project due



课程



合作



数字化

MathWorks 卓越创新项目：基于项目学习



MATHWORKS
EXCELLENCE IN INNOVATION

- 了解技术趋势
- 解决与实际工业界相关的项目
- 为科学计算和基于模型的设计的进步做出贡献
- 获得技术领军者对您解决问题能力的官方认可
- 涵盖包括5G, AI, 机器人等方向的几十个项目



上海交通大学师生借助 Excellence in Innovation 了解工业 AI 应用

挑战

在“卓越工程师培养计划”中，同学们迫切需要贴近业界的校企合作项目，以了解前沿知识、行业发展趋势。

解决方案

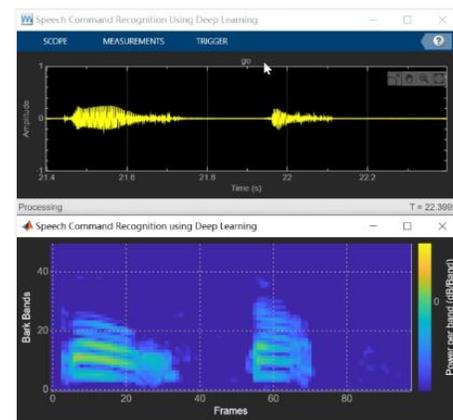
《工程实践与科技创新》课程中采用了 Excellence in Innovation 项目，同学们以分组形式完成深度学习相关项目。

结果

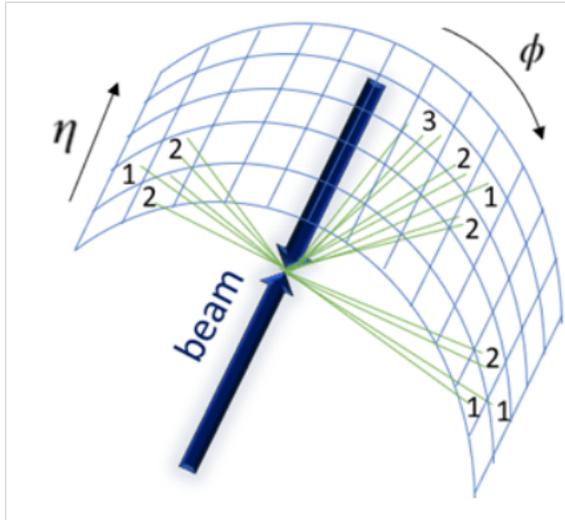
- 同学们在短短4个月内成功完成了3个项目，积累了深度学习应用的业界真实经验；
- 同学们通过 GitHub 分享了项目成果，促进了项目交流。

“MathWorks公司提供的 Excellence in Innovation 项目，为我们电子工程系卓越工程师班的工程实践类课程提供了与企业合作，了解行业发展趋势和 AI 等前沿知识的一个很好的途径，而且，同学们之前对 MATLAB 编程只有较为浅显的应用，没有使用过 Simulink 和许多很好的工具箱，通过项目的实践过程，了解并使用了它们，较好的完成了项目，增强了工程实践能力。”

—— 杨宇虹 教授， 上海交通大学



同学们在项目中使用 MATLAB实现语音指令识别。



Top Quark Detection with Deep Learning and Big Data [↗](#)

Develop a predictive classifier model able to discriminate jets produced by top quark decays from the background jets

Motivation [↗](#)

Ability to detect and retain only interesting particle jets (that usually are rare events) and throw away all the boring jets (that are produced within well understood standard model) is crucial in searching for new physics (rare events), especially when high luminosity upgrade on Large Hadron Collider (LHC) will generate petabytes of data daily.

<https://github.com/mathworks/MATLAB-Simulink-Challenge-Project-Hub/tree/main/projects/Top%20Quark%20Detection%20with%20Deep%20Learning%20and%20Big%20Data>

理工科教学资源



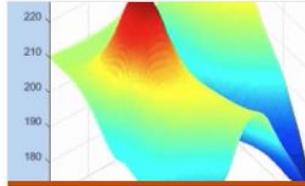
Teaching Biology with MATLAB

- » Integrate MATLAB into your Biology curriculum



Teaching Chemistry with MATLAB

- » Integrate MATLAB into your Chemistry curriculum



Teaching Geoscience with MATLAB

- » Integrate MATLAB into your Geoscience curriculum



Teaching Physics with MATLAB

- » Integrate MATLAB into your Physics curriculum



Teaching Psychology and Neuroscience with MATLAB

- » Integrate MATLAB into your Psychology and Neuroscience curriculum



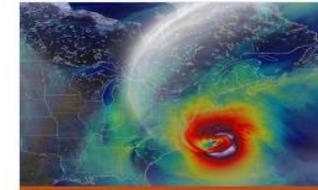
Teaching Data Science with MATLAB

- » Integrate MATLAB into your Data Science curriculum



Teaching Deep Learning with MATLAB

- » Integrate MATLAB into your Deep Learning curriculum



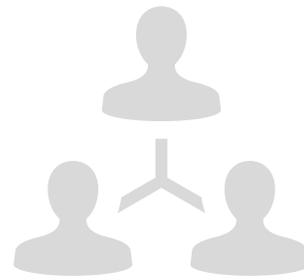
Teaching Computational Science Using MATLAB

- » Integrate MATLAB into your robust data analysis, data visualization and exploration curriculum

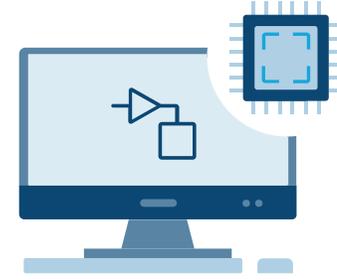
<https://ww2.mathworks.cn/academia/courseware/teaching-science-with-matlab.html>



课程



合作



数字化

MathWorks 提高学生的数字化技能

Solutions

Automated Driving Systems
Design, simulate, and test automated driving systems

Computational Biology
Analyze, visualize, and model biological data and systems

Control Systems
Design, test, and implement control systems

Data Science
Explore data; build machine learning models; do predictive analytics

Deep Learning
Data preparation, design, simulation, and deployment for deep neural networks

Electrification
Develop electrical technology from components to systems

Embedded Systems
Design, code, and verify embedded systems

Enterprise and IT
Use MATLAB with your...

FPGA, ASIC, and SoC Development
Automate your workflow algorithm development design and verification

Image Processing Computer Vision
Acquire, process, and analyze images and video for algorithm system design

Internet of Things
Connect embedded devices to the Internet and gain insights

Machine Learning
Train models, tune parameters, and deploy to production or edge devices

Mechatronics
Design, optimize, and verify mechatronic systems

Modular Courseware

Machine Learning

Statistics

Numerical Integration

Lab: Air Track

Matrix Methods

Convolution

Qualitative Analysis of ODEs

Image Processing

Mass-Spring-Damper

Dynamic Systems

Lab: Virtual e/m Measurement

Vectors

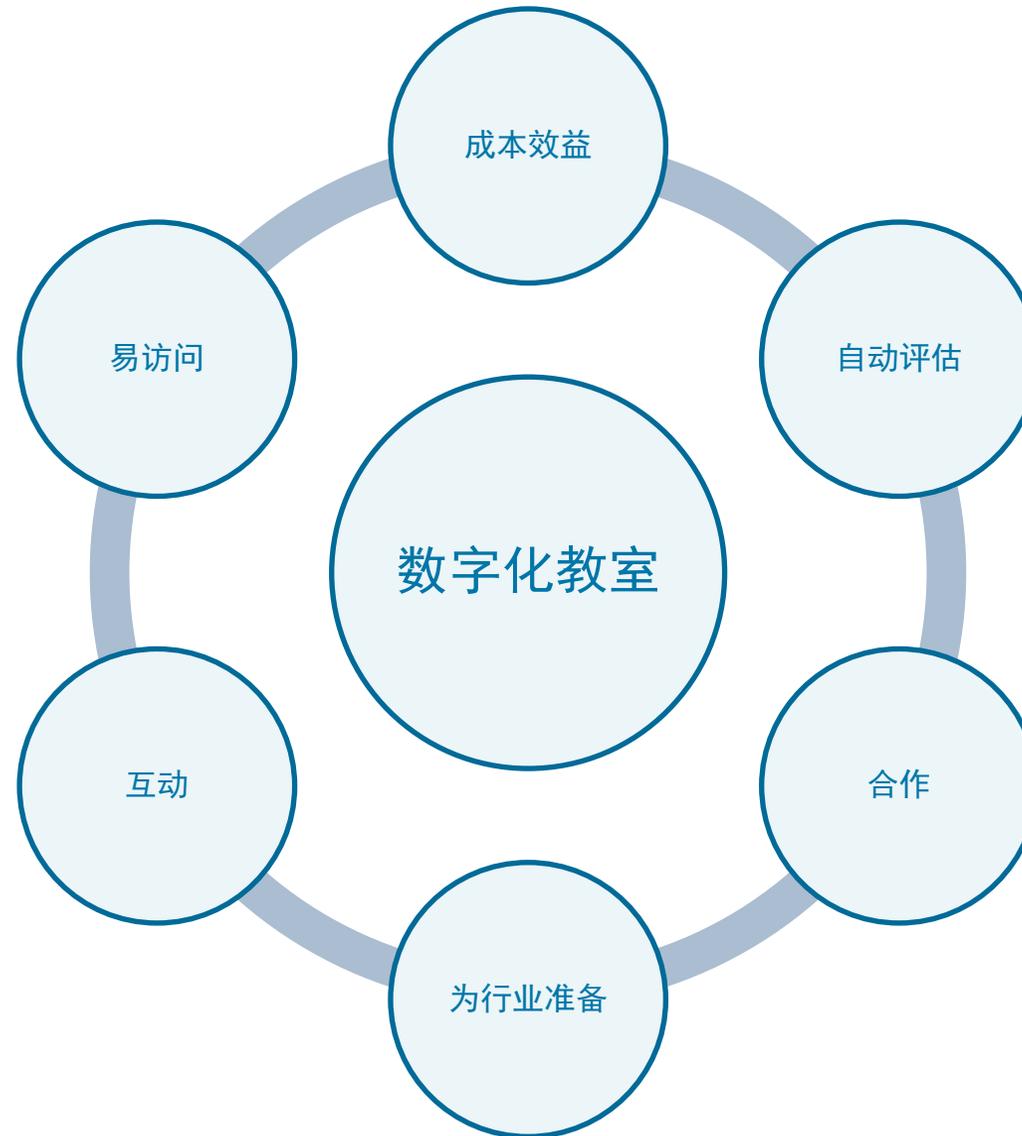
Regression

github.com/MathWorks-Teaching-Resources

communications systems

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数字化工具对教与学的影响



数字化工具对教与学的影响

