MATLAB 前沿应用介绍与科研、教学资源分享

许悦伊
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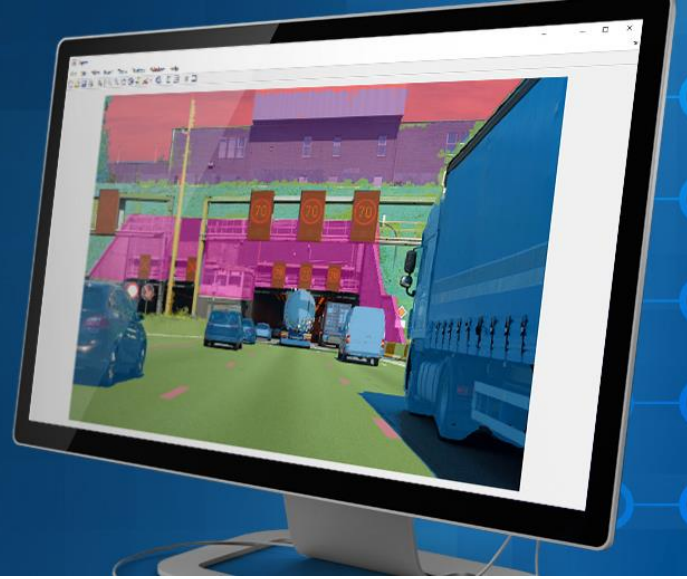
MathWorks 中国

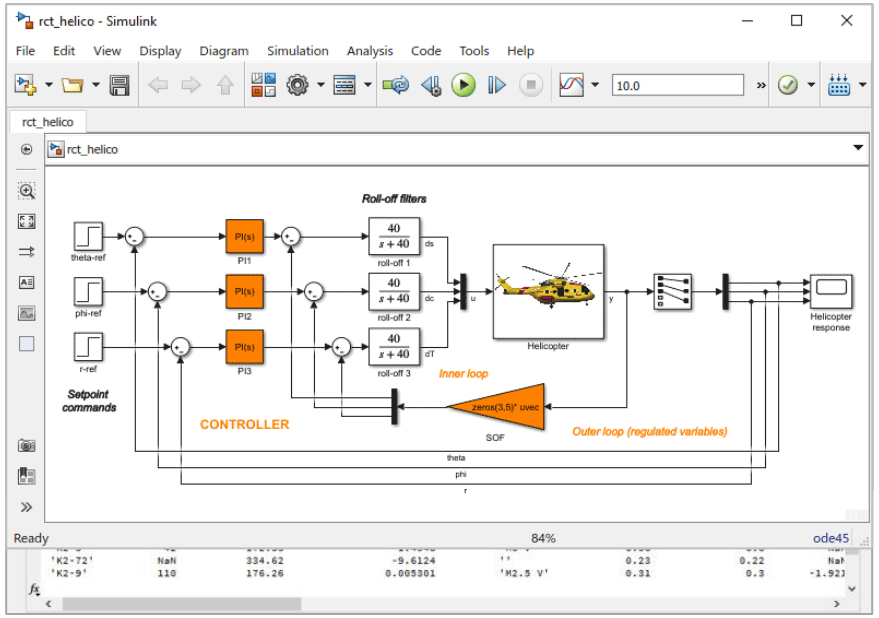
我们的产品

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。

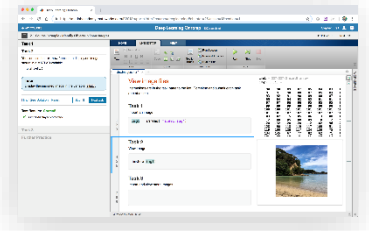
Computer Vision System Toolbox



MATLAB 校园范围的许可证概述

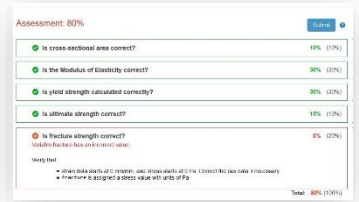
- 所有学生、教职员工和研究人员都可以无限制地访问 MATLAB
- 获取所有工具箱及所有版本
- 独立安装：无需服务器端身份验证
- 所需要的只是一个官方电子邮件 ID
- 包括在线培训课程

机房和实验室计算机

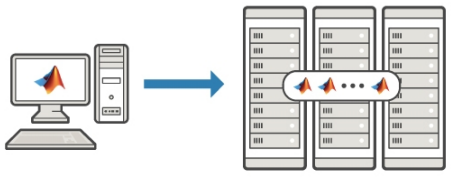


自定进度的在线学习

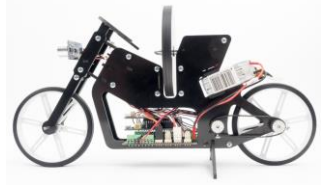
通过个人电脑、移动设备，或者浏览器使用



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

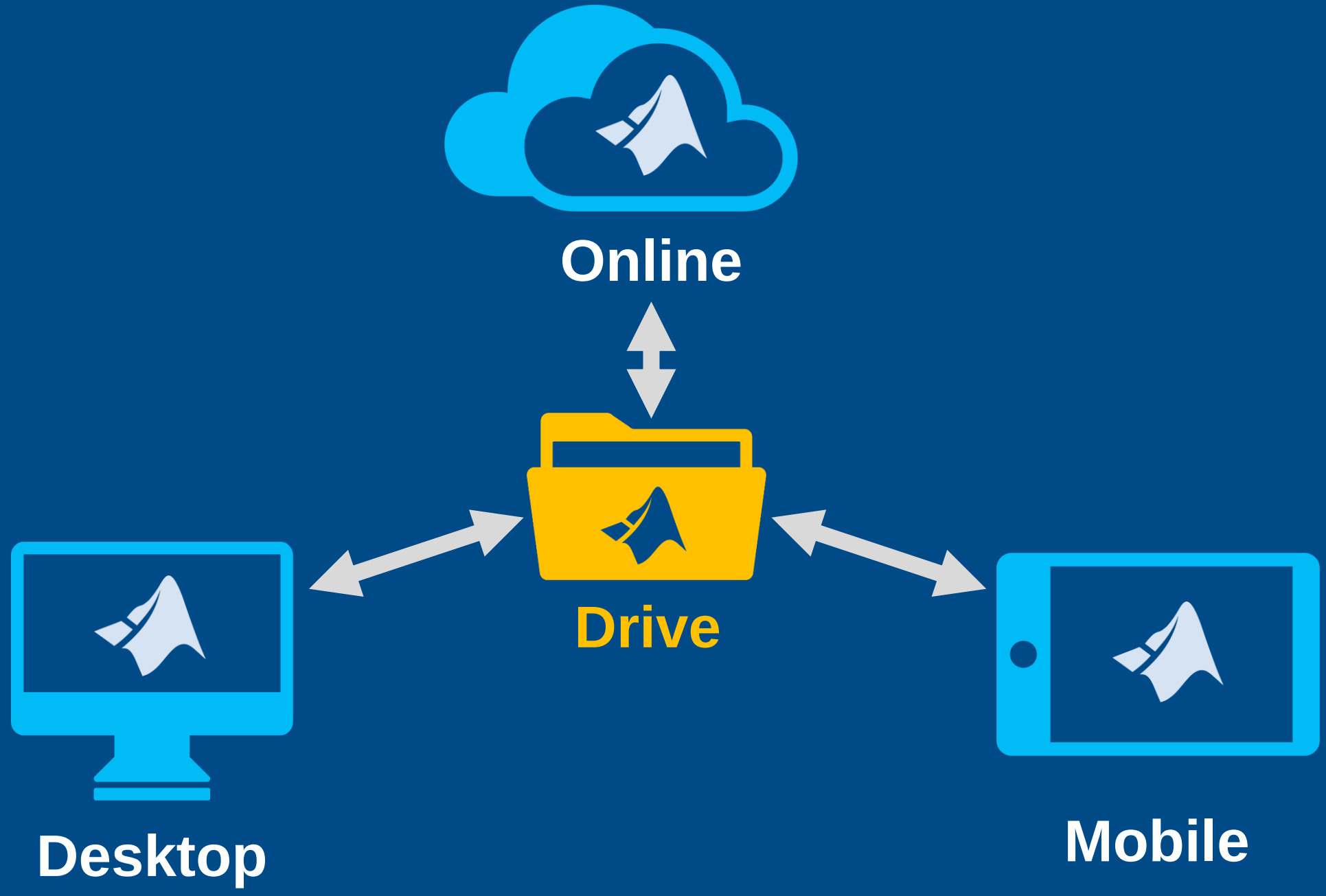
Use MATLAB with no downloads or installations.

Store, manage, and access your files anywhere.

Collaborate with others through online sharing and publishing

https://matlab.mathworks.com

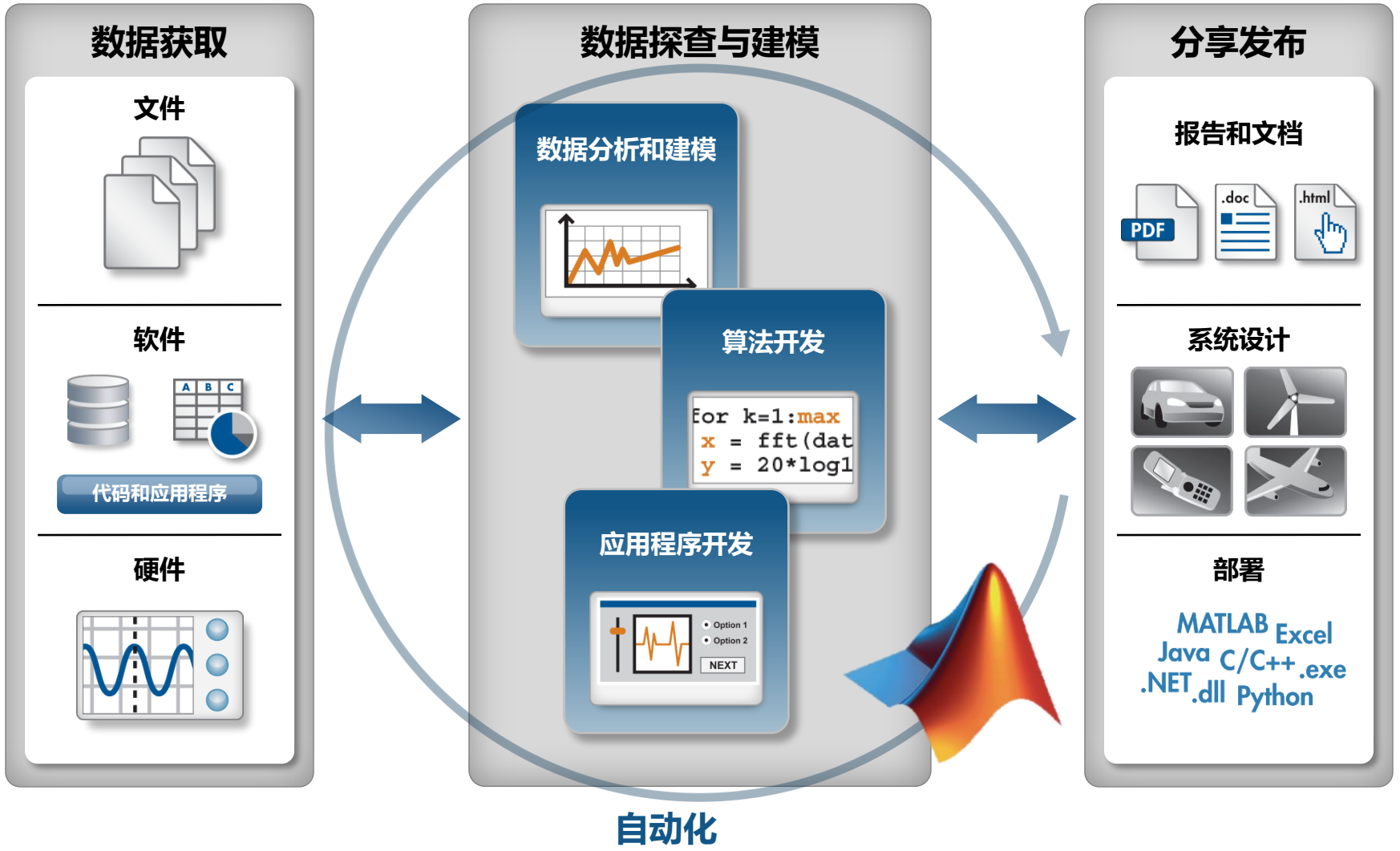
https://drive.mathworks.com


Online
Drive
Desktop
Mobile

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



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);
```

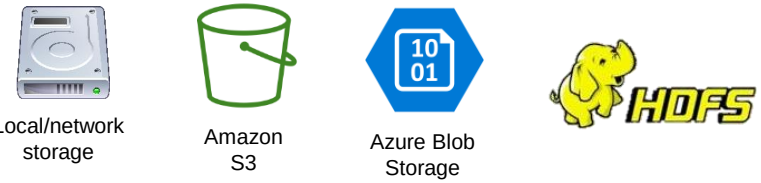
1. 您的数据存放方式？
2. 如何在 MATLAB 中表示这些数据？

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？

Numeric

double, single, ...

logical

R2013b

categorical

R2014b

datetime

duration

calendarDuration

R2016b

timetable

Heterogeneous

structure

cell

table

Text

char

cell string

string

tall

R2023a

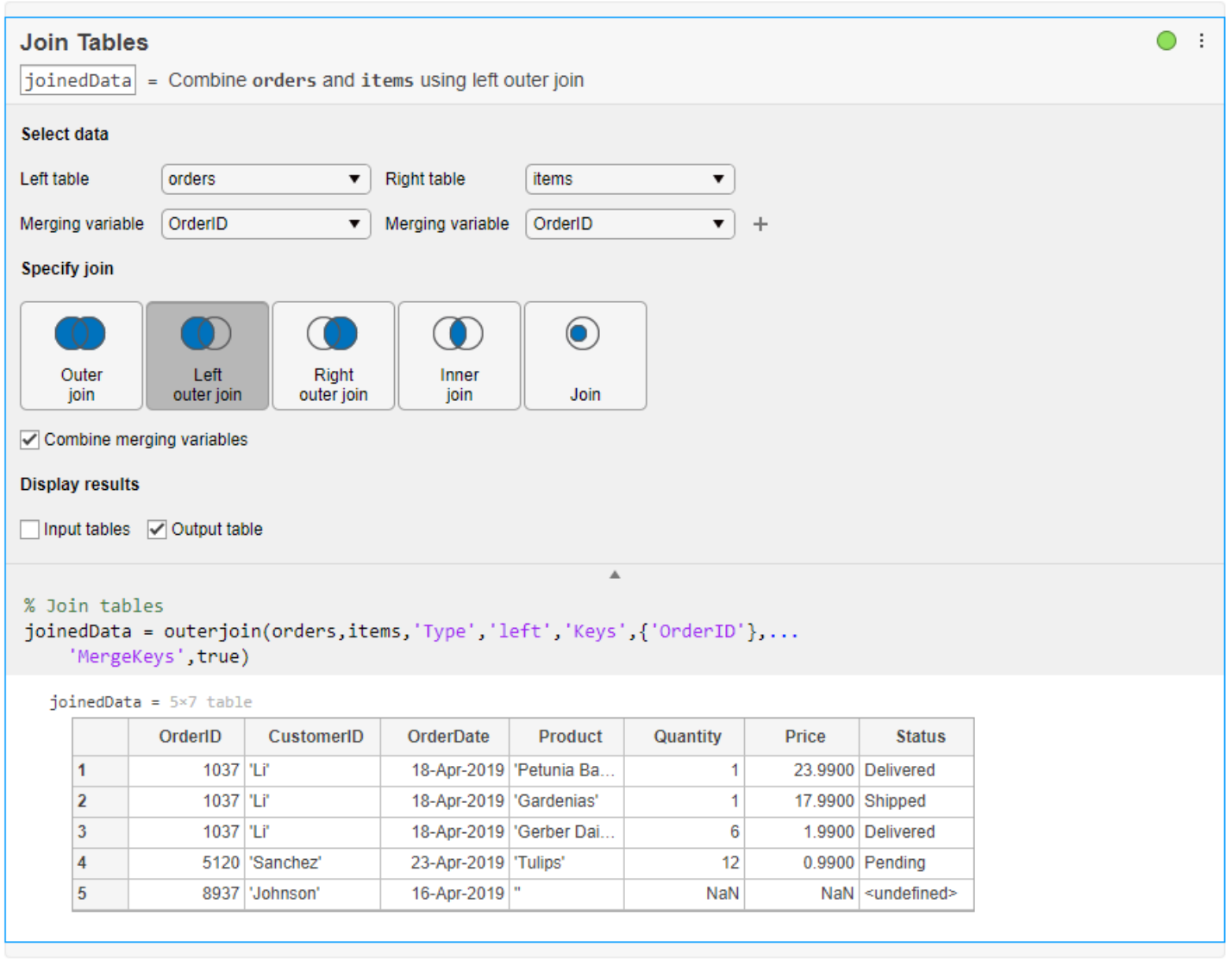
Timetable Events

R2022b

dictionary

Live Tasks 使表格/时间表处理更加简单

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



Join Tables Live Task

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1. 如何清理数据？
2. 数据中的潜在信息？

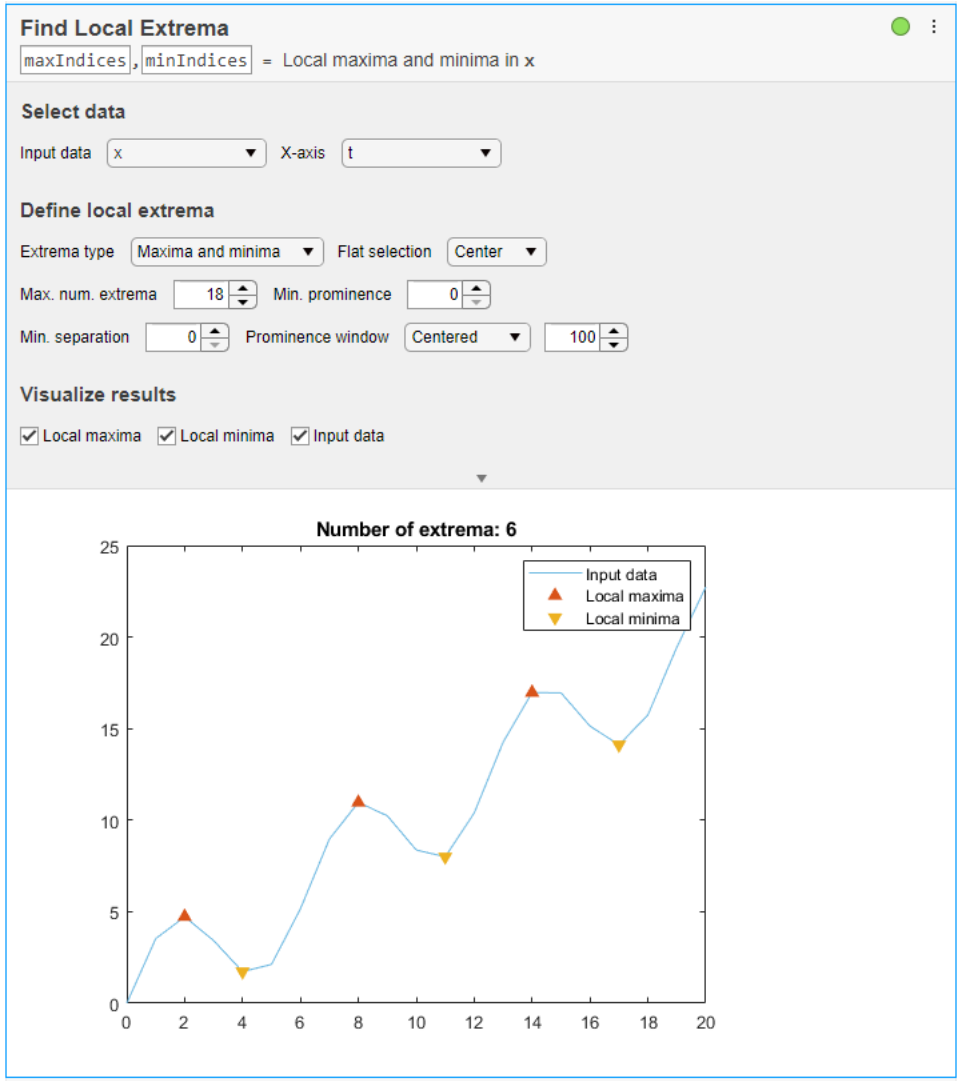
1. 如何清理数据？

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=5×3 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=2×3 table
     Gender      Smoker    GroupCount
    ________    ______    __________

    "female"    false          2
    "male"      true           3
```

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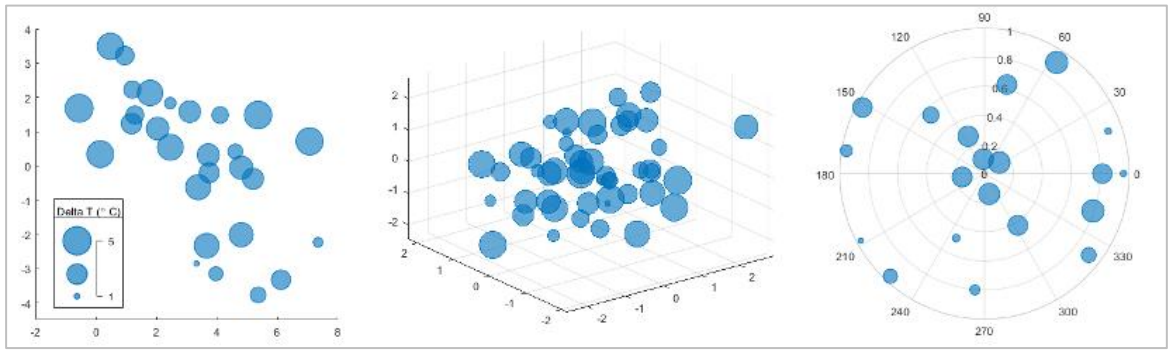
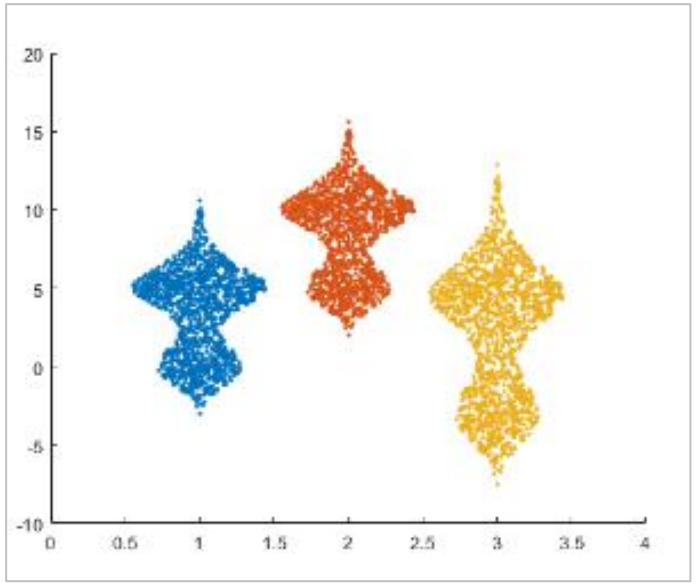
1. 如何可视化数据？
2. 如何分享可视化结果？

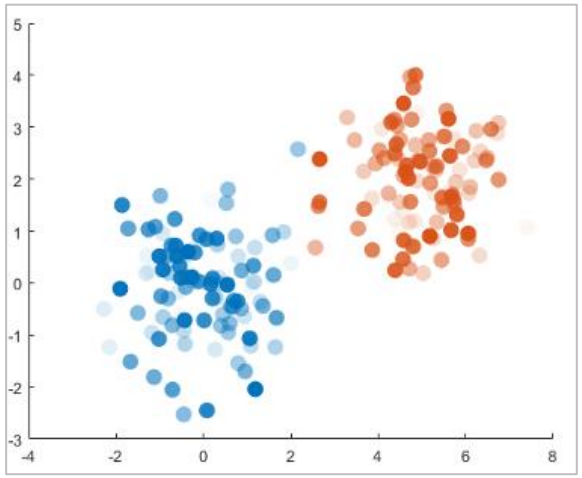
1. 如何可视化数据?



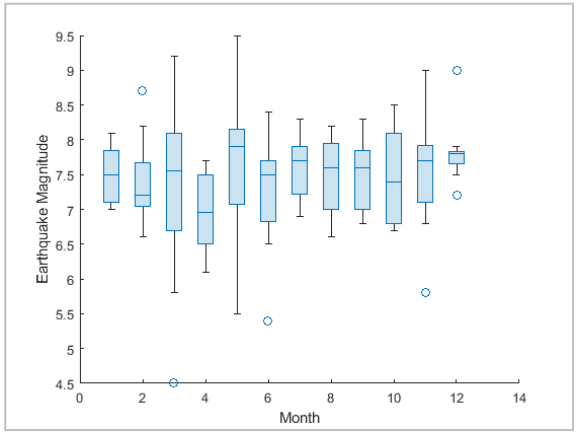
Bubble charts



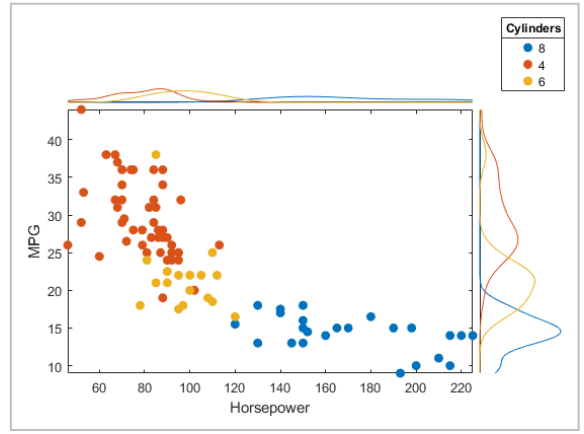
swarmchart



scatter transparency & jitter



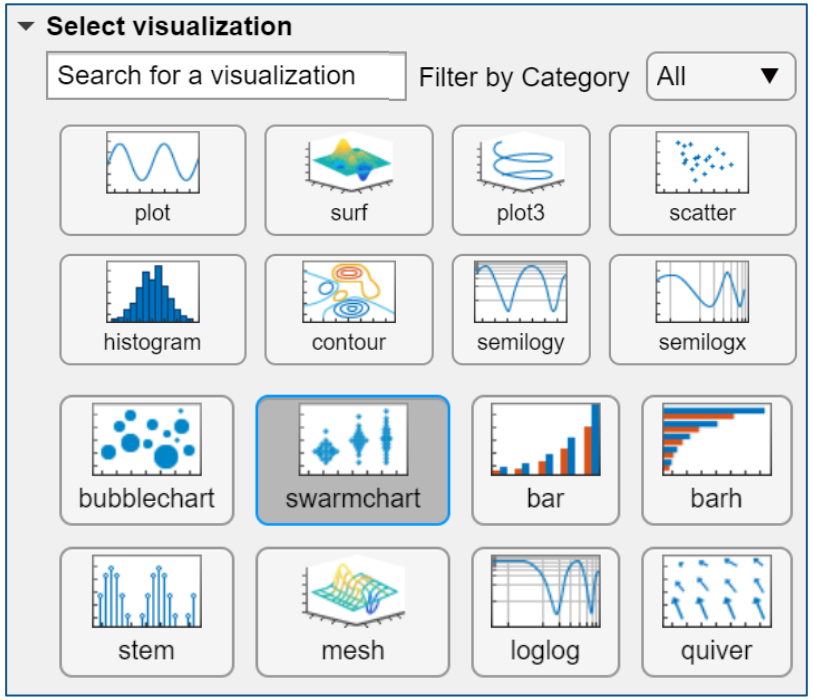
boxchart



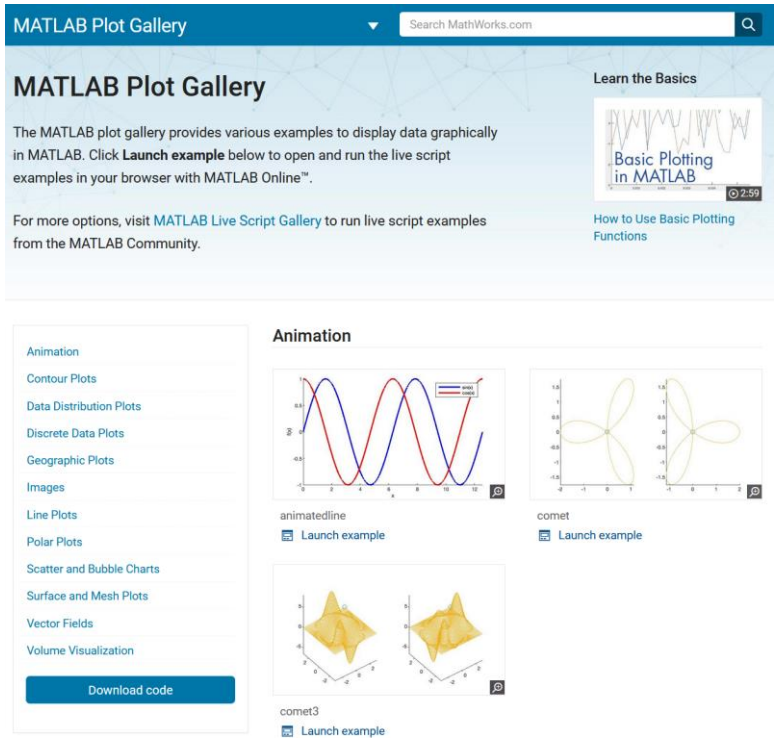
scatterhistogram

MATLAB versions of toolbox plots

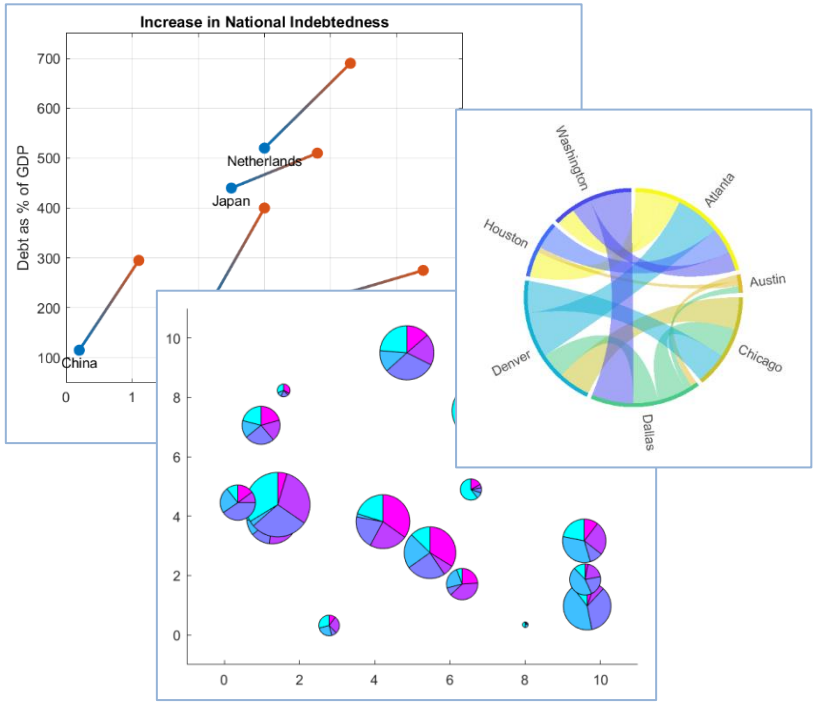
探索新的图表和可视化效果



创建绘图实时任务



MATLAB Plot Gallery



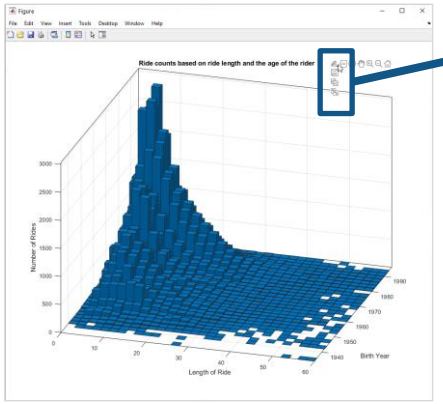
社区贡献

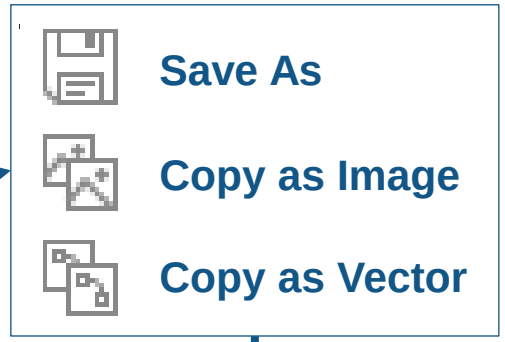
自定义可视化效果

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？



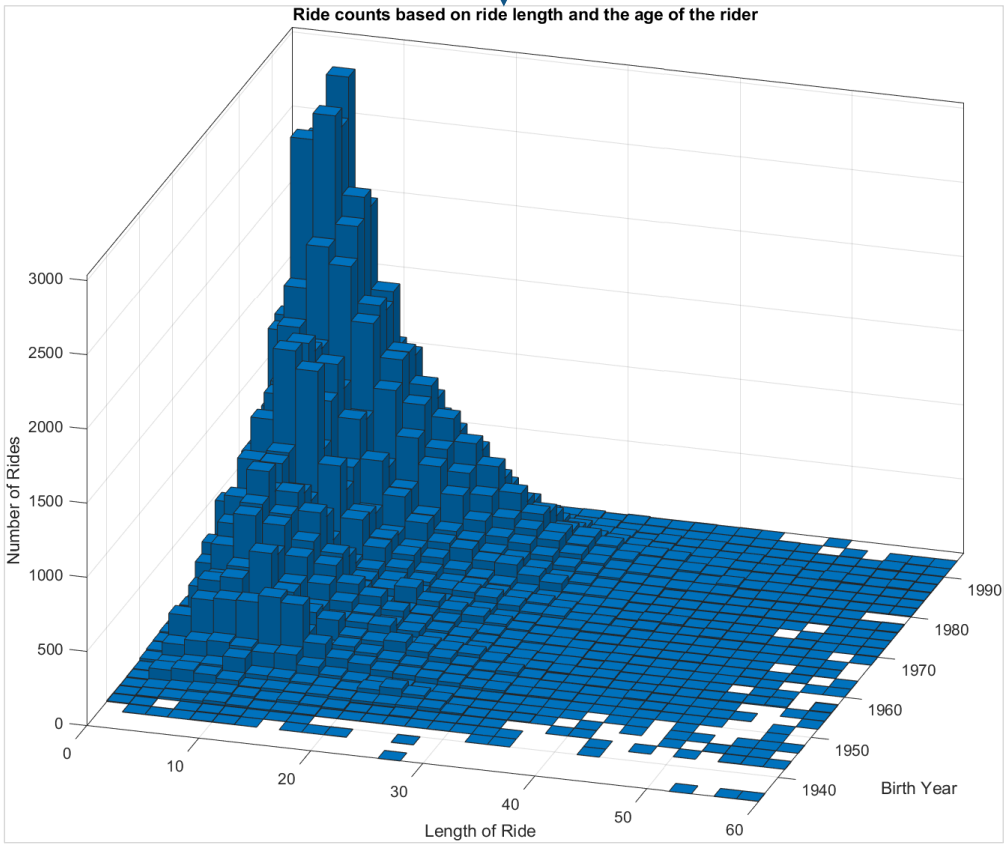


- 以交互方式保存或复制轴的内容作为图像

- 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



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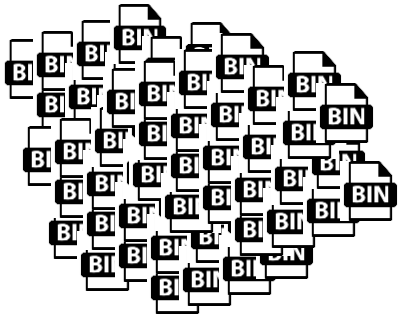
```

1. 如果数据量太大无法直接读入内存？

大数据处理

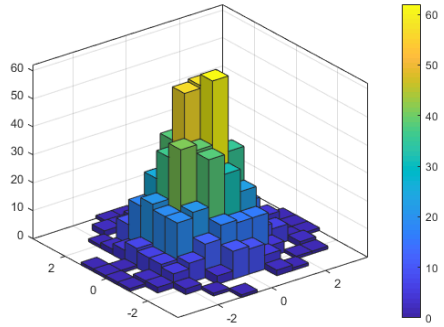


A bunch of inconvenient files

数据工程

A more manageable set of files

数据分析



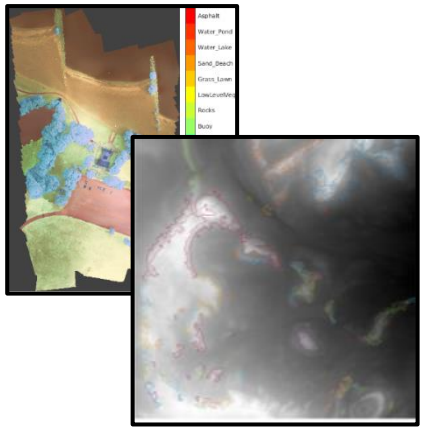
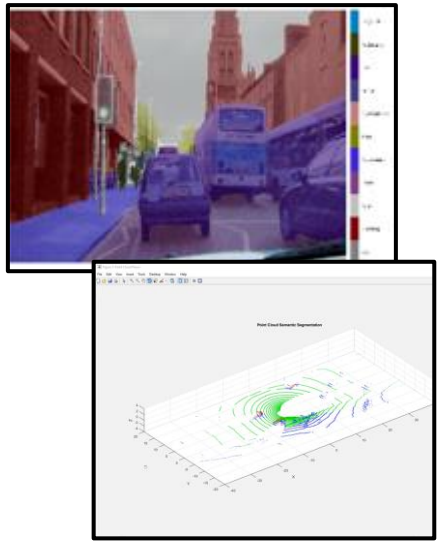
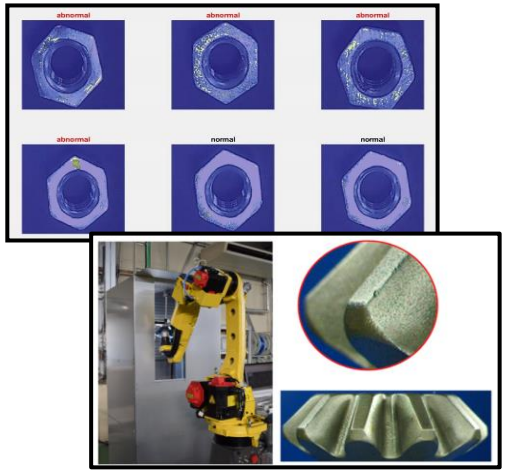
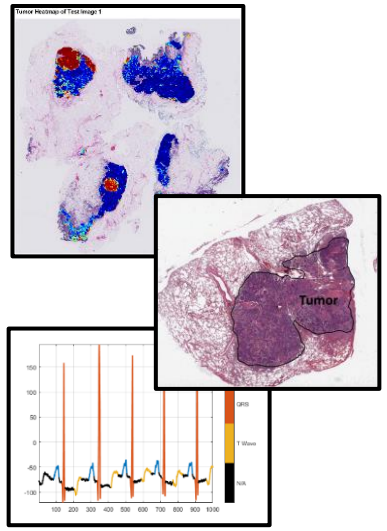
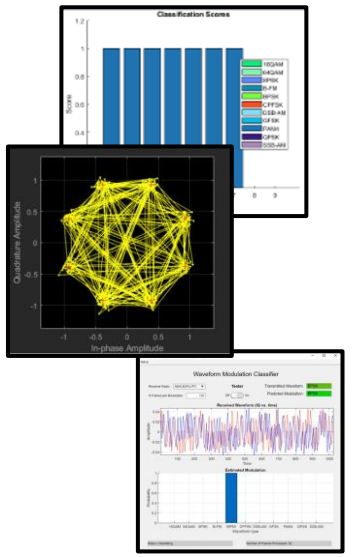
`datastores()` + `writeall()`

`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
应用场景	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
					

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

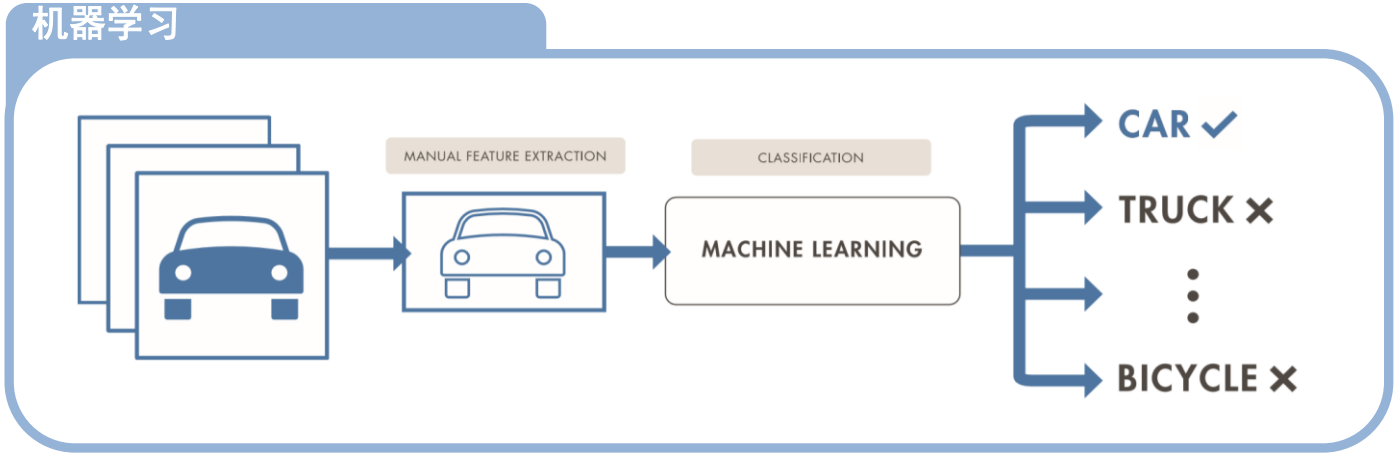
仿真和测试

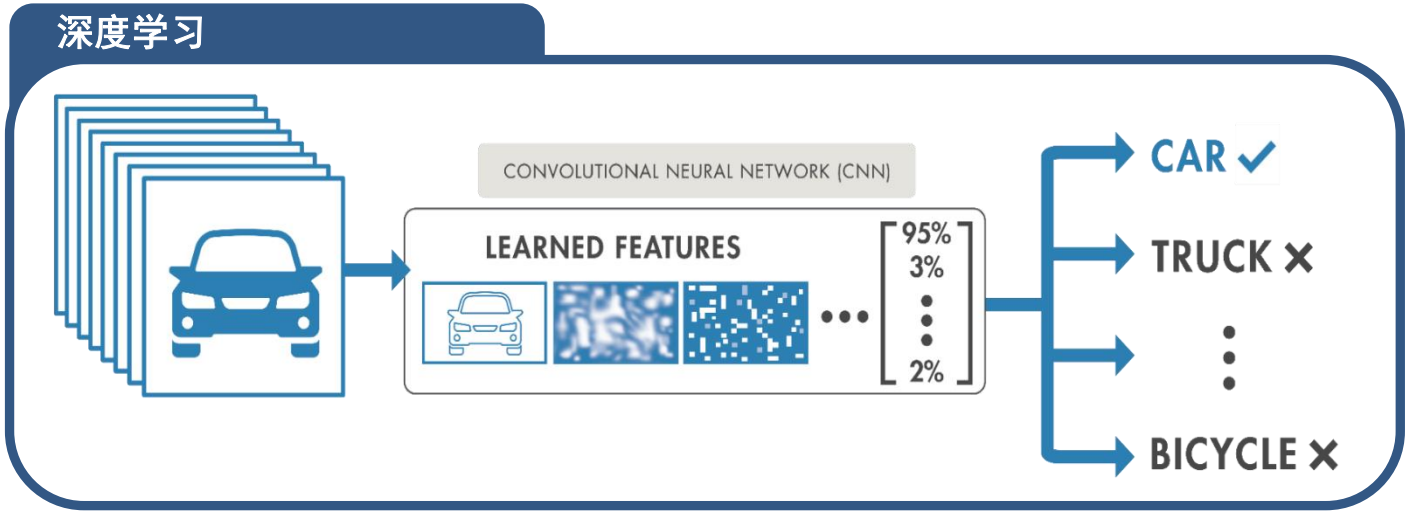
- 复杂系统集成
- 系统仿真
- 系统测试验证

部署

- 嵌入式硬件
- 企业系统
- 边缘、云端、桌面

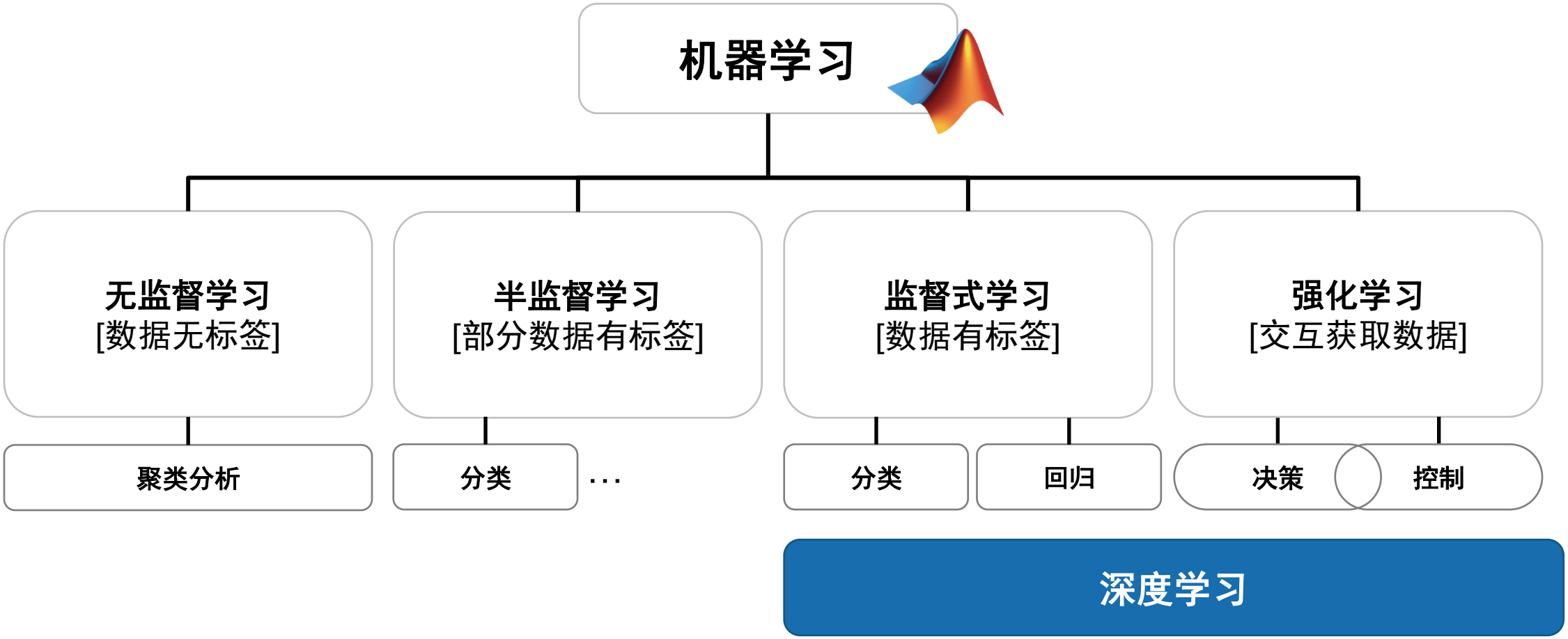
机器学习、深度学习





- 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**

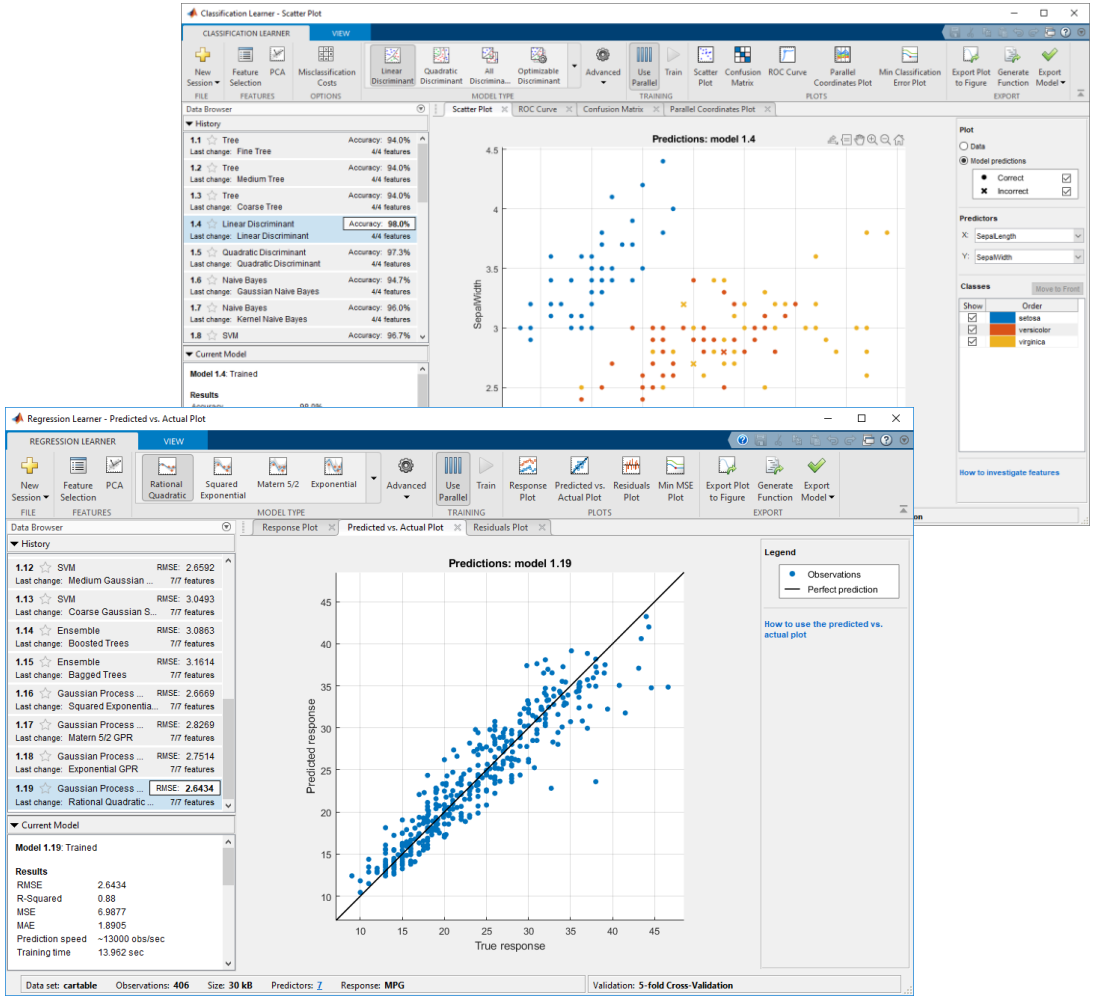
机器学习、深度学习、强化学习



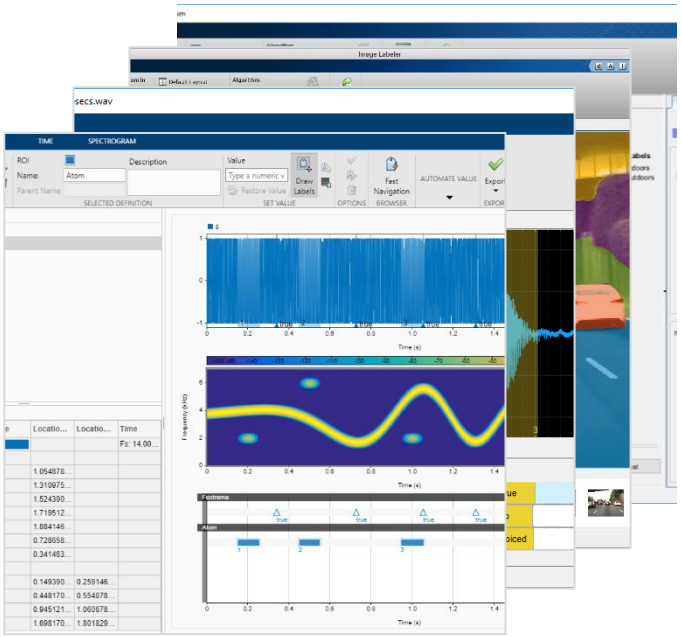
统计和机器学习工具箱

- 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

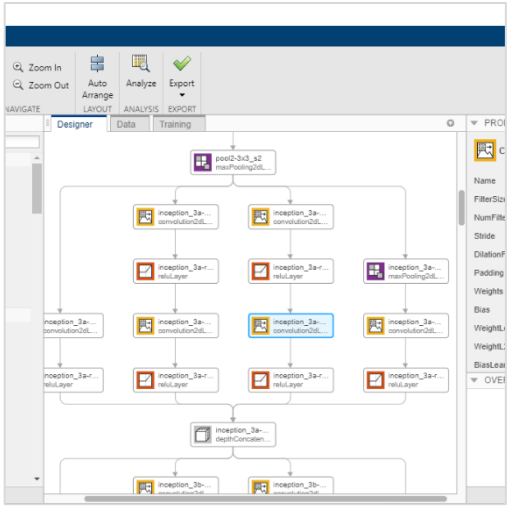


深度学习工具箱



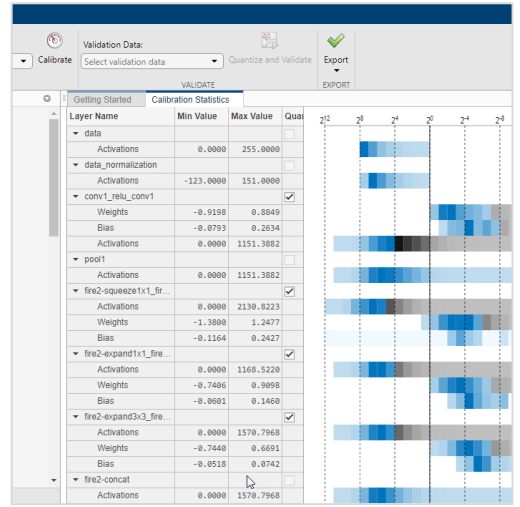
Labelers

Image, Video, Signal, Audio



Deep Network Designer

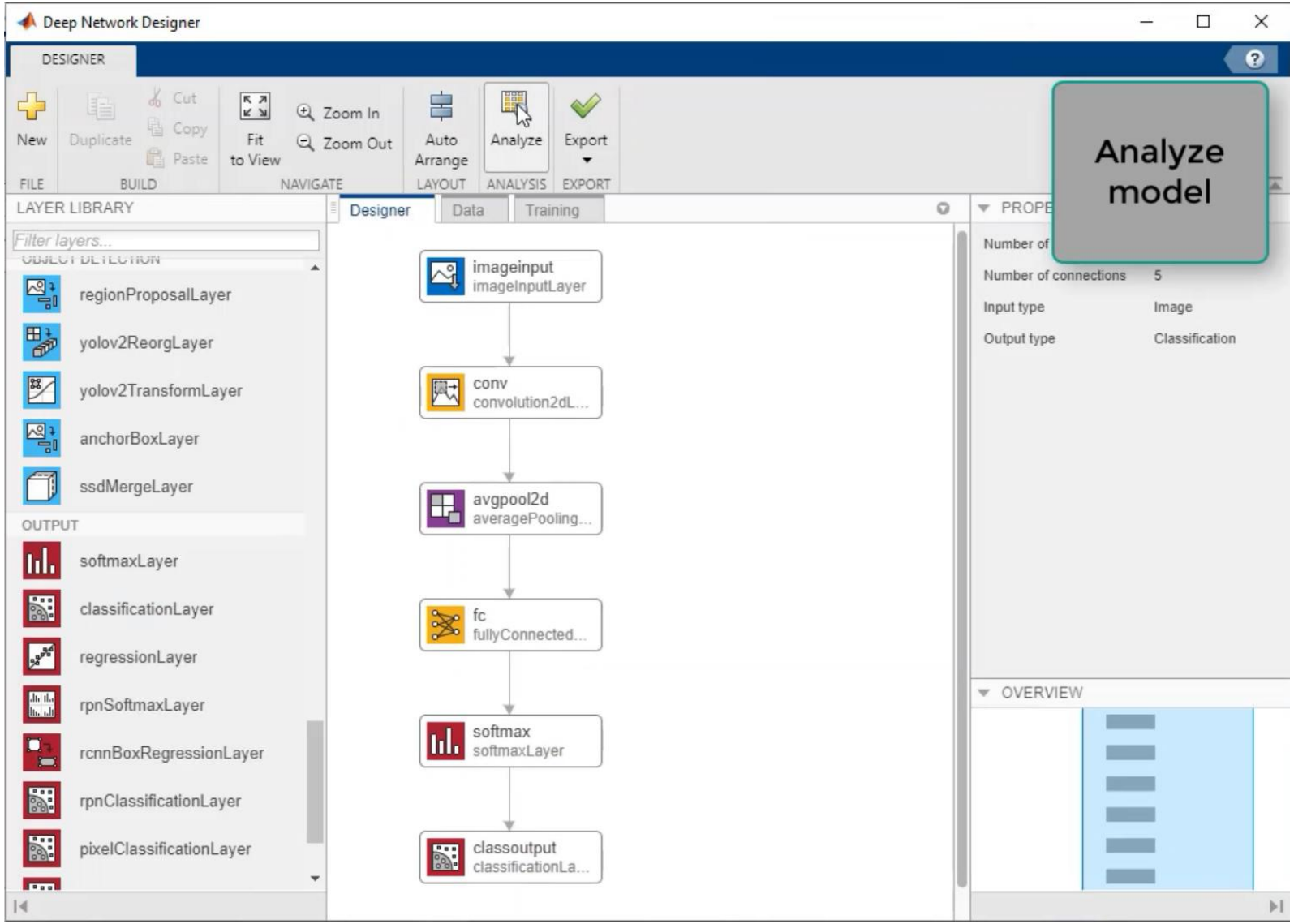
Design, visualize, and train networks



Deep Network Quantizer

Optimize and generate GPU code

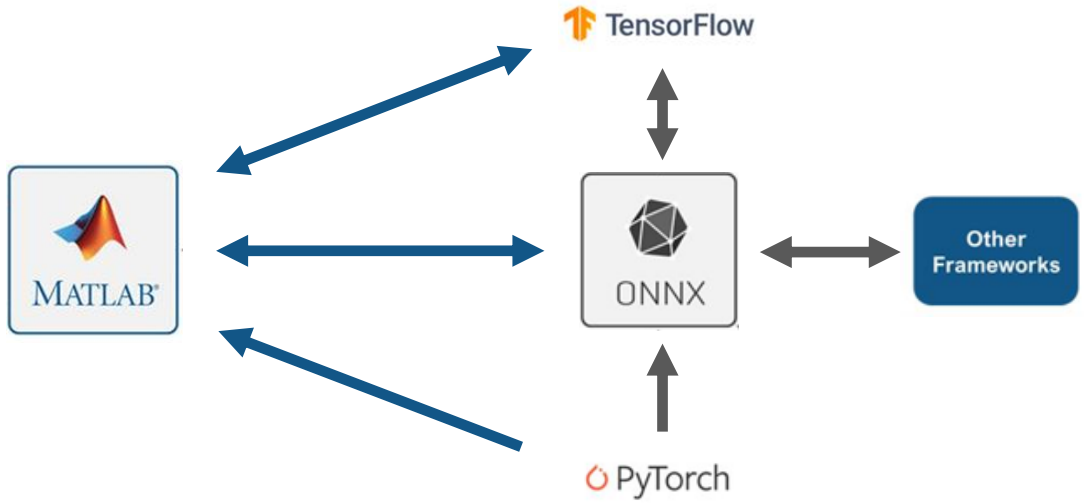
深度网络设计器


Deep Network Designer
DESIGNER
New
Duplicate
Cut
Copy
Paste
FILE
BUILD
Fit to View
Zoom In
Zoom Out
NAVIGATE
Auto Arrange
LAYOUT
Analyze
ANALYSIS
Export
EXPORT
Analyze model
LAYER LIBRARY
Filter layers...
regionProposalLayer
yolov2ReorgLayer
yolov2TransformLayer
anchorBoxLayer
ssdMergeLayer
OUTPUT
softmaxLayer
classificationLayer
regressionLayer
rpnSoftmaxLayer
rcnnBoxRegressionLayer
rpnClassificationLayer
pixelClassificationLayer
Designer
Data
Training
imageinput
imageInputLayer
conv
convolution2dL...
avgpool2d
averagePooling...
fc
fullyConnected...
softmax
softmaxLayer
classoutput
classificationLa...
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

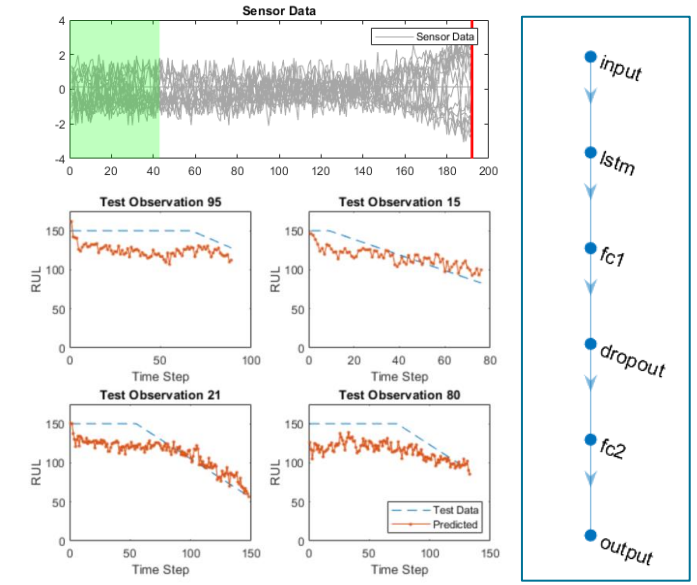
目标检测

[Object Detection Using SSD Deep Learning]

Computer Vision Toolbox™

Deep Learning Toolbox™

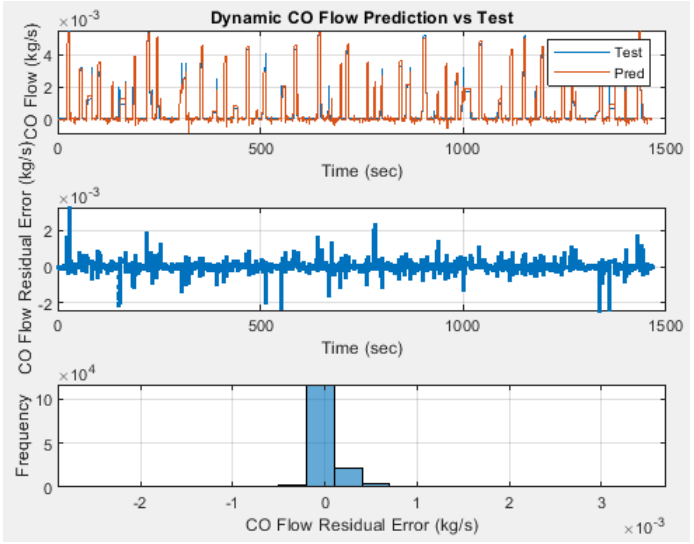
时间序列预测



[Sequence-to-Sequence Regression Using Deep Learning]

Deep Learning Toolbox™

模型降阶

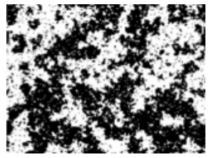


[Generate a Deep Learning SI Engine Model]

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
查看许可证

+关注 下载

总览 函数 示例 版本历史记录 评论 (14) 讨论 (4)

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).

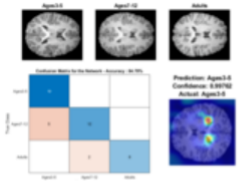
Open in MATLAB Online

Copy Command

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 exa



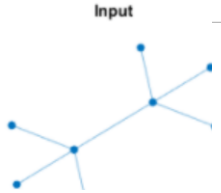
Brain-MRI-Age-Classification-using-Deep-Learning

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 GitH



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 Massachussets Institute of Technology (MIT), and are available for download via the OpenNEURO platform:
https://openneuro.org/datasets/ds000228/versions/1.1.0

需要

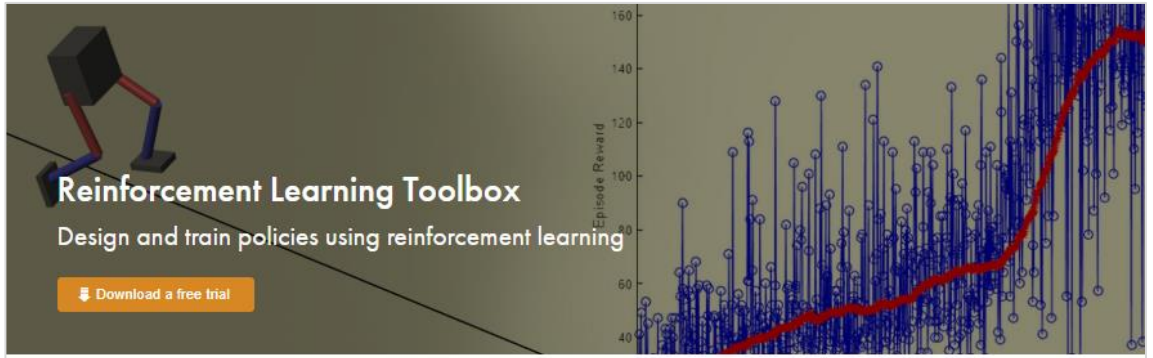
MATLAB
Deep Learning Toolbox
Image Processing Toolbox

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

强化学习工具箱

R2019a

- 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

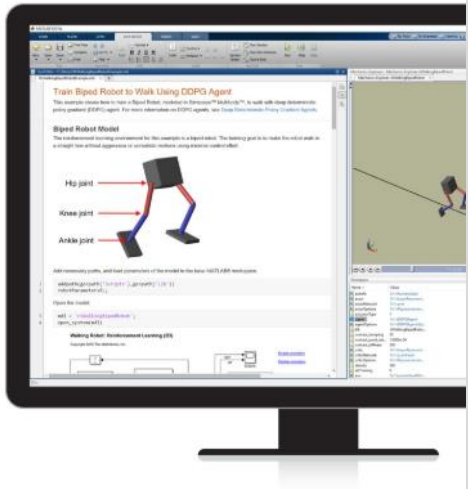


Reinforcement Learning Toolbox™ provides functions and blocks for training policies using reinforcement learning algorithms including DQN, A2C, and DDPG. You can use these policies to implement controllers and decision-making algorithms for complex systems such as robots and autonomous systems. You can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

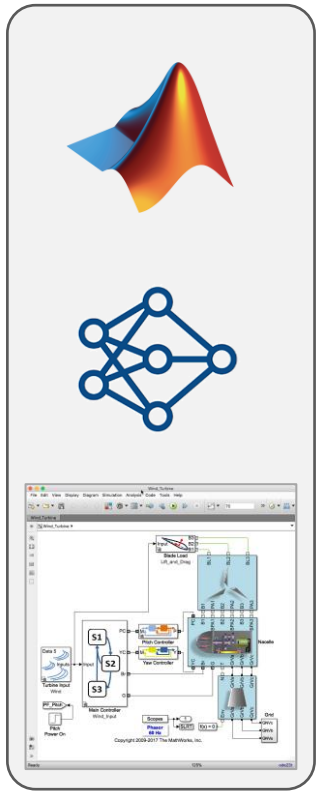
36

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

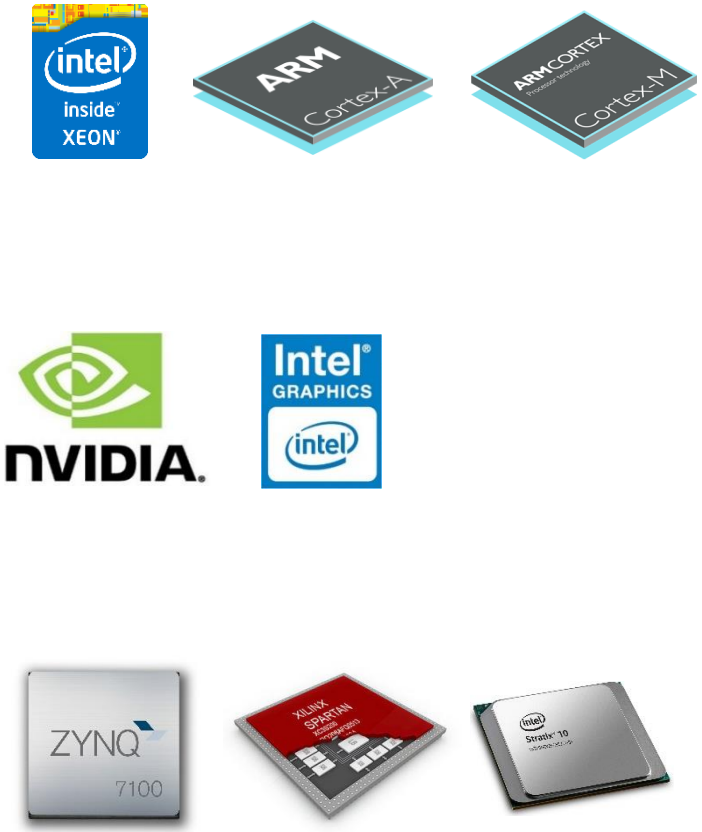


Code Generation

CPU

GPU

FPGA



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信号处理主题：
基于信号的 MATLAB 处理与分析

MathWorks®

使用 MATLAB 进行教学

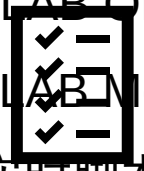
使用 MATLAB 进行数据分析可视化教学

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

课程

示例

教学演示

MATLAB Grader


QUEEN

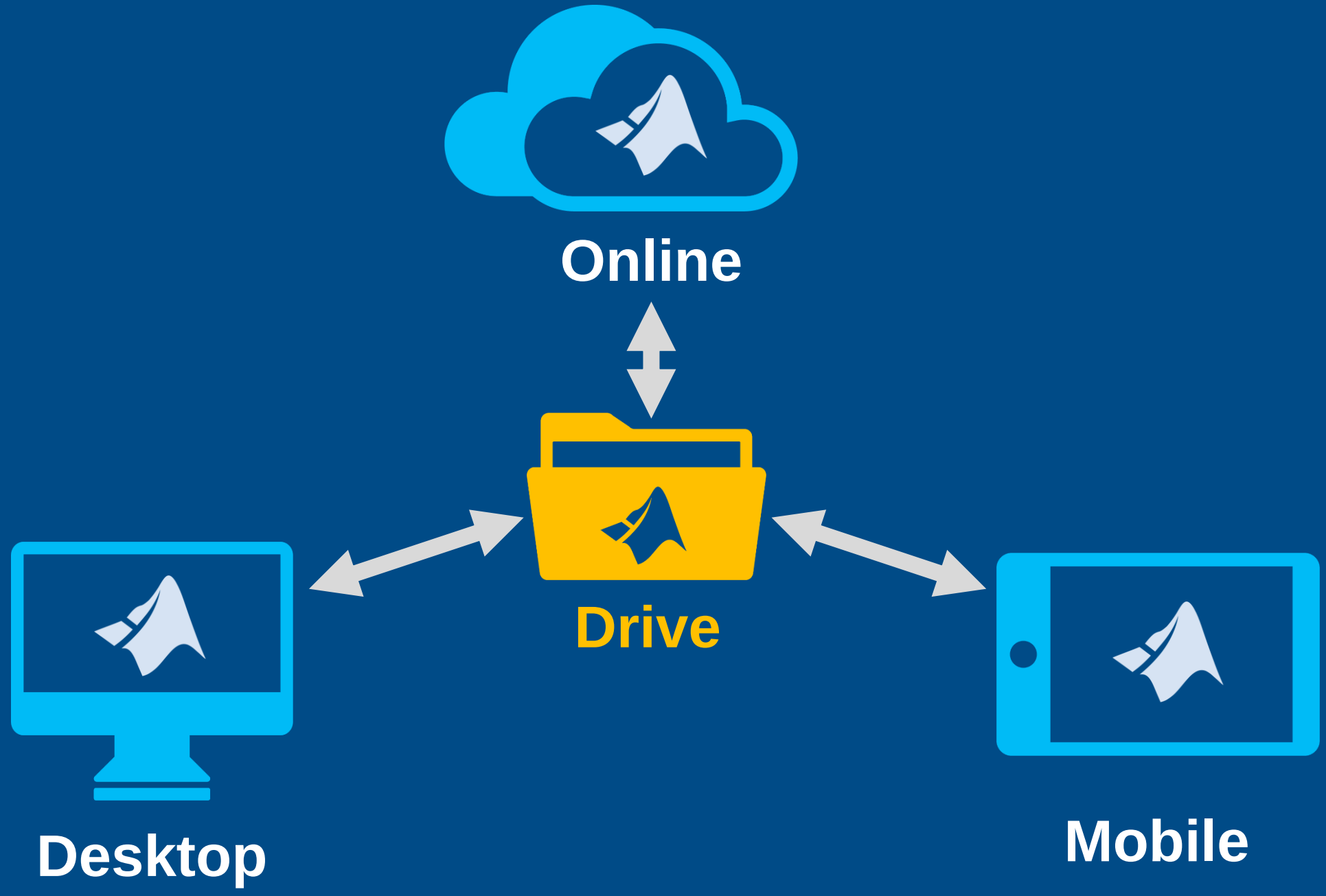
使用 MATLAB 进行数据分析可视化教学

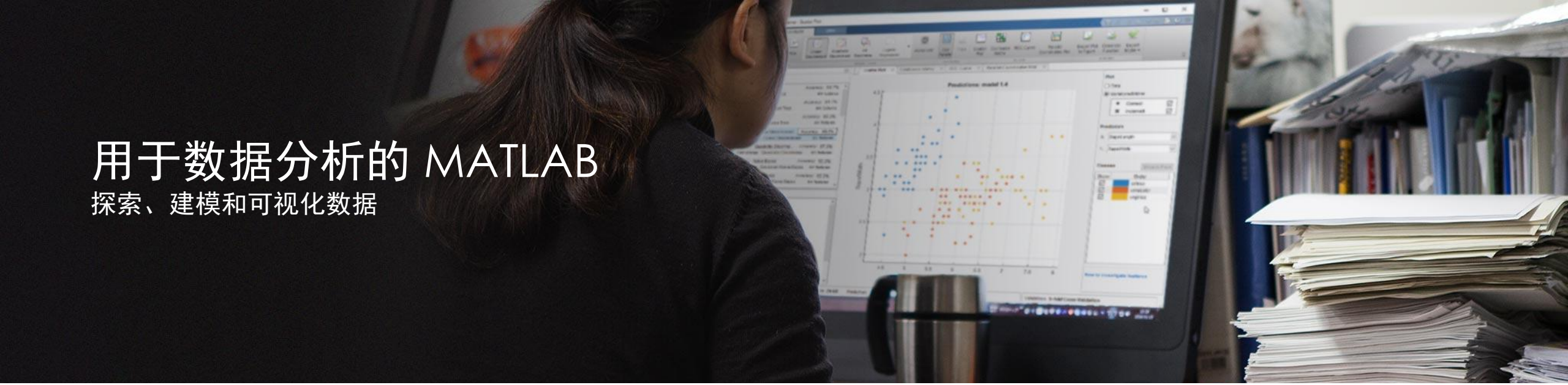
使用环境

材料

自学

示例


Online
Drive
Desktop
Mobile



用于数据分析的 MATLAB

探索、建模和可视化数据

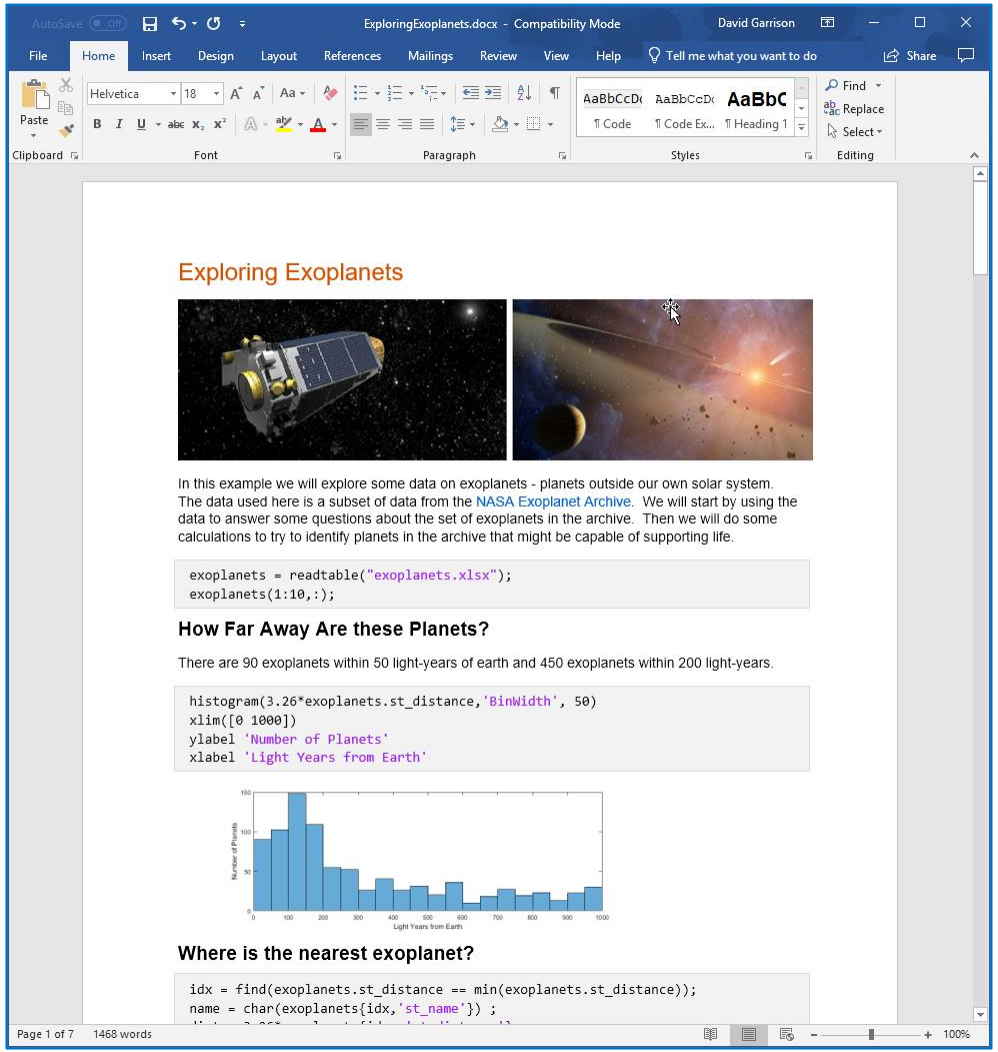
- 专为工程和科学数据而设计的功能
- 交互式和可自定义的数据可视化
- 数以千计的预构建函数用于数据分析
- 包含代码示例的大量文档
- 无需大量代码更改即可扩展到大数据

MATLAB 实时编辑器

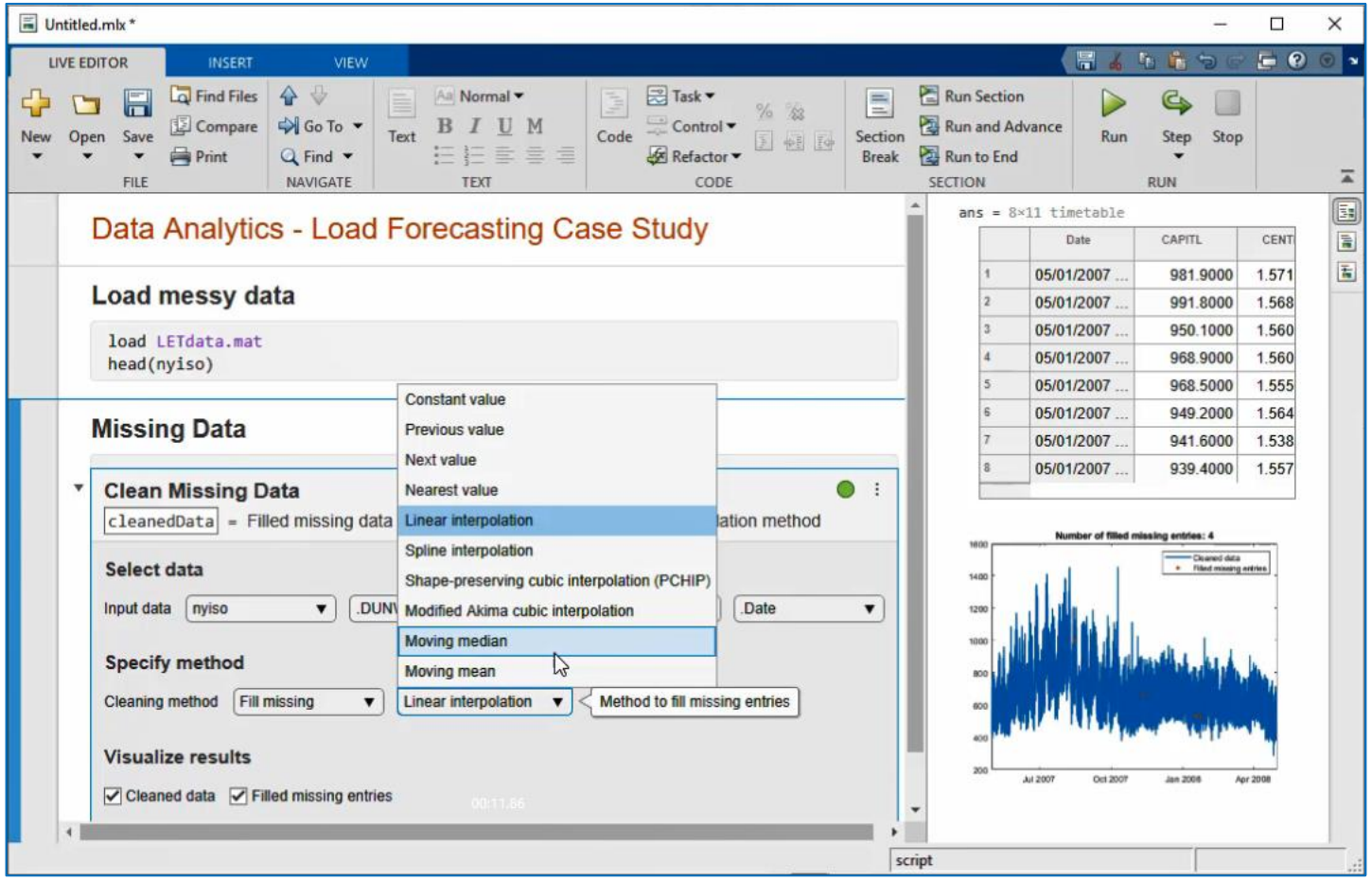
创建在可执行笔记本中组合代码、输出和格式化文本的脚本。

- 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



MATLAB 实时编辑器 – 编码功能



使用 MATLAB 进行数据分析可视化教学

使用环境

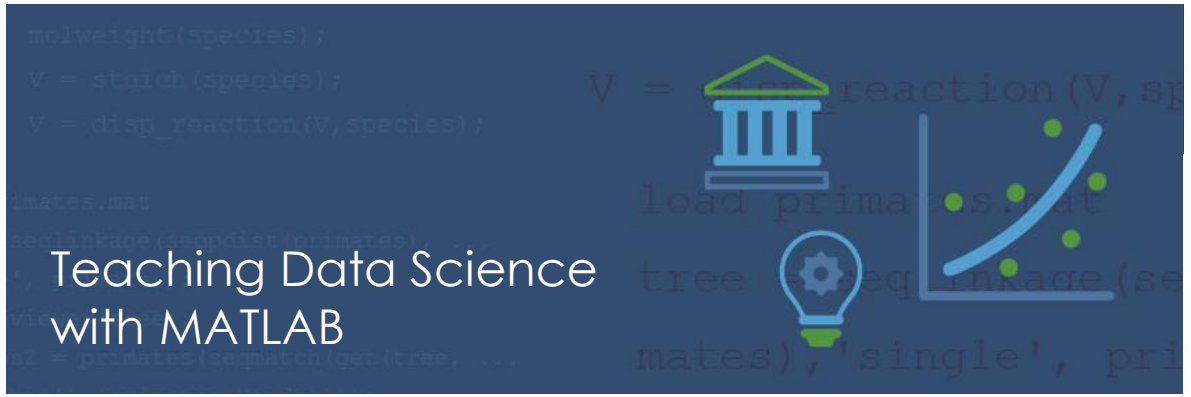
材料

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



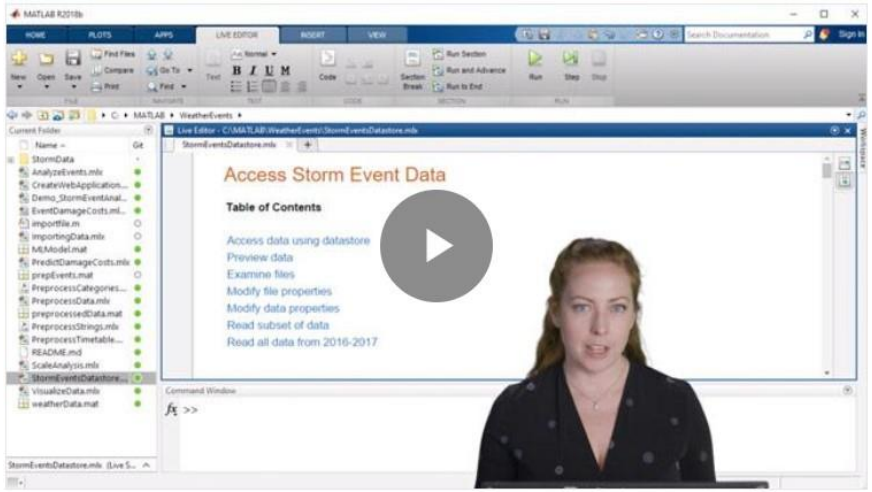
- 课程示例
  - *“Teaching Environmental Data Analysis Fundamentals in MATLAB, City University of New York”*
  - *“Modeling and Data Analysis in Life Sciences, University of California, Davis”*
  - *“Boot Camp in Quantitative Methods, Harvard University”*

www.mathworks.com/academia/courseware

数据科学教程 – 视频系列

- 数据科学工作流详解

- 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



www.mathworks.com/videos

使用 MATLAB 进行教学

吸引学生并扩展您的教学

Access to MATLAB through your web browser

MATLAB integrated file sharing

Hands-on exercises with automated assessments and feedback

Ready-to-use resources to enhance your instruction

www.mathworks.com/learn/teaching-with-matlab

使用 MATLAB 进行数据分析可视化教学

使用

材料

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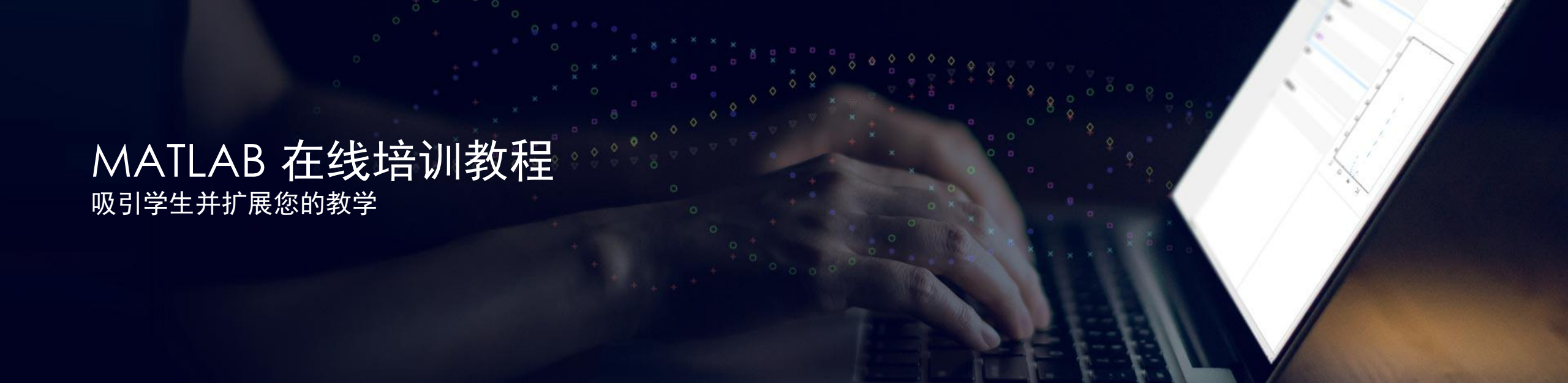
示例



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Ready-to-use resources to enhance your instruction

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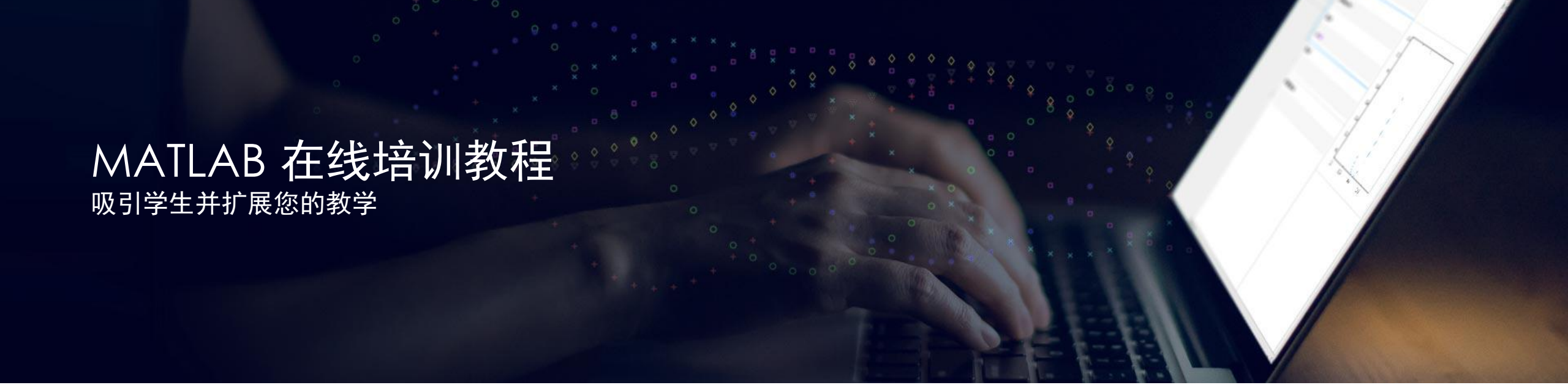

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MATLAB 在线培训教程

吸引学生并扩展您的教学

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

www.mathworks.com/AcademicTraining

MATLAB 在线培训教程

吸引学生并扩展您的教学

使用 MATLAB 进行教学

Access to MATLAB through your web browser

MATLAB integrated file sharing

Hands-on exercises with automated assessments and feedback

Ready-to-use resources to enhance your instruction

www.mathworks.com/academic-training-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

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

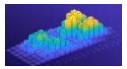

Power Systems Simulation Onramp


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

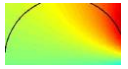

Signal Processing with MATLAB

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

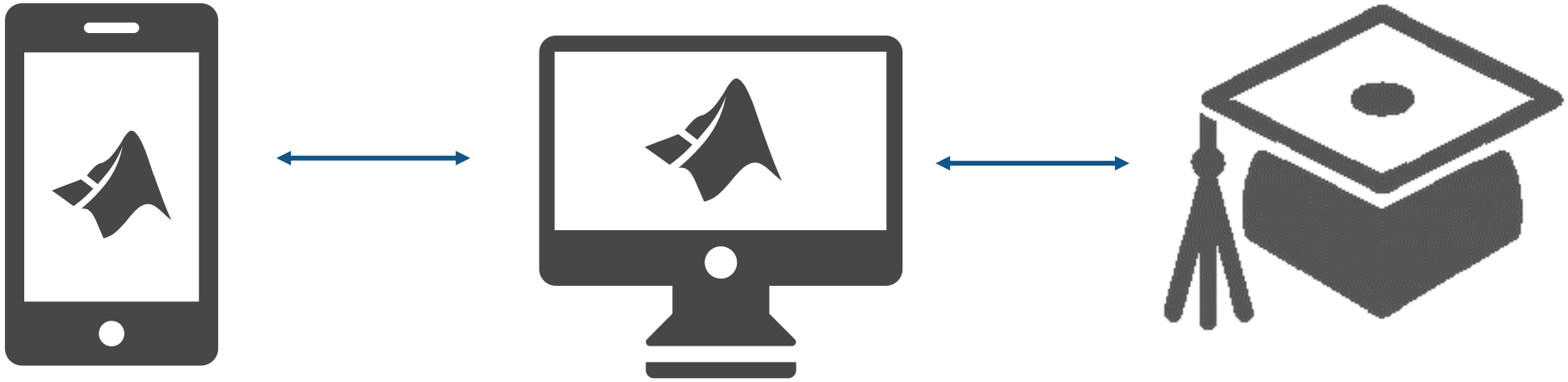
现代教学的挑战

您如何远程教授编程？

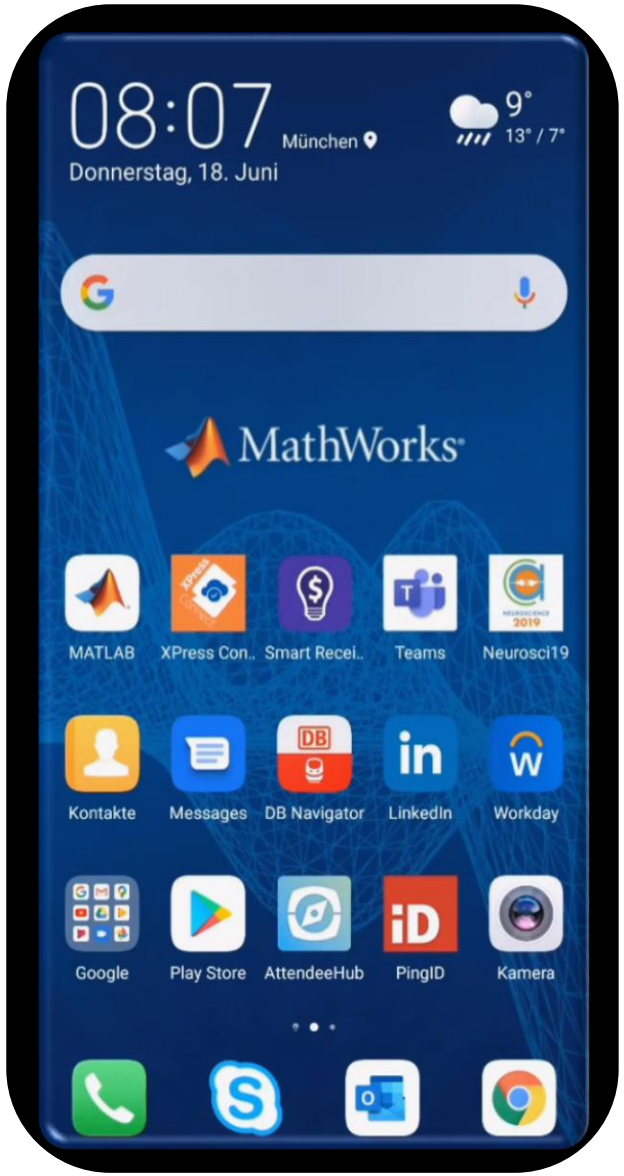
您如何提起学生的兴趣？

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

Submit homework

Wait 1-2 weeks

Get feedback

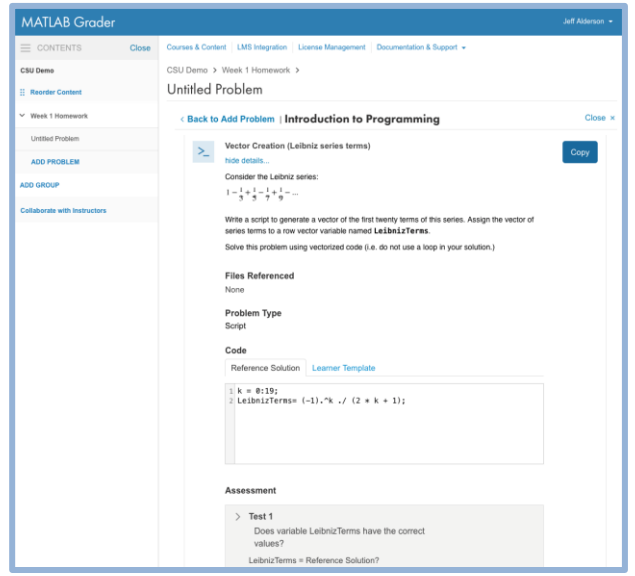
Read it??

Work on next homework

Autograding

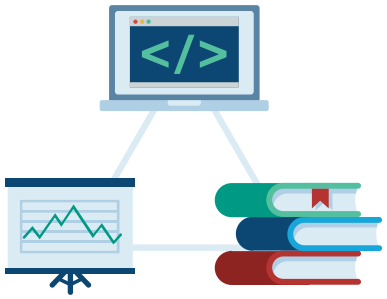
Submit homework

Instant feedback

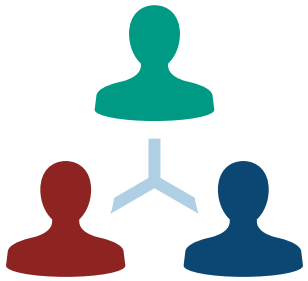


Improve and Learn

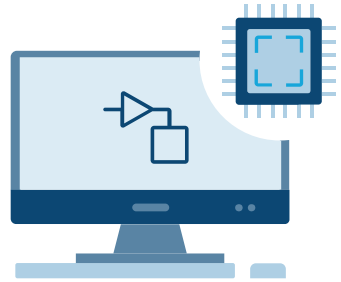
人工智能+X 教学



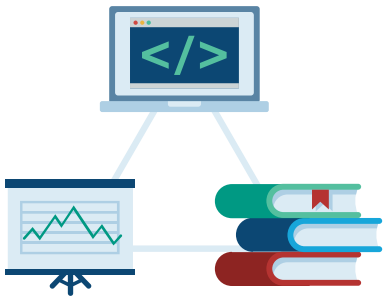
课程



合作



数字化



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

WARWICK
THE UNIVERSITY OF WARWICK

工科数据科学教学核心模块

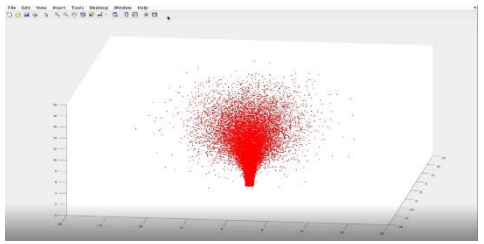
系统建模、仿真和计算

工程数学与数据分析

高级模块

大一

- 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。

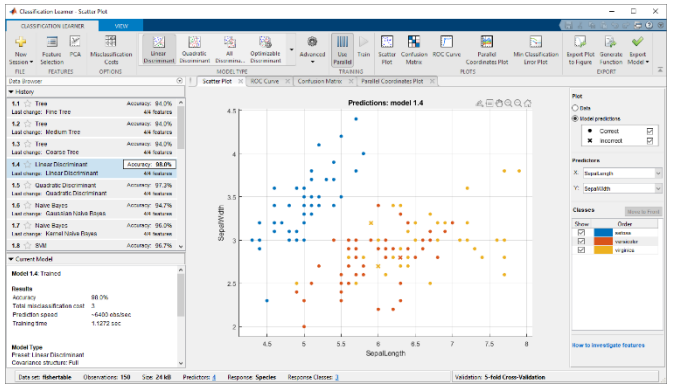


大二

- 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。

大三

- 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

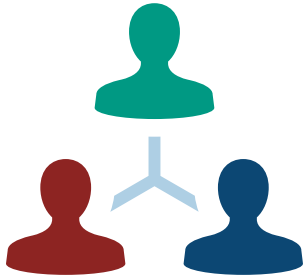
In collaboration with Dr. Oge Marques

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 5	Textbook – Chapter 7 Reference book – Recipes 5-6 Textbook – Chapter 8 Reference book – Recipes 11-14	A1 due A2 out
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

https://github.com/mathworks/MathWorks-Excellence-in-Innovation

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

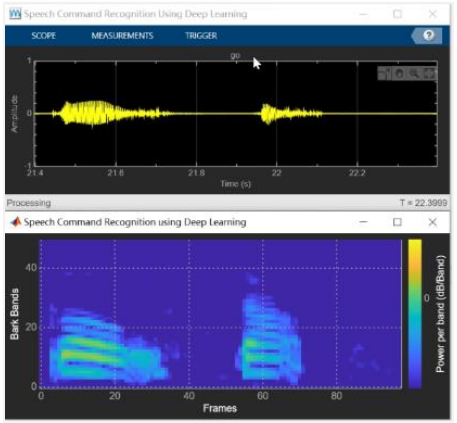
*《工程实践与科技创新》*课程中采用了 Excellence in Innovation 项目，同学们以分组形式完成深度学习相关项目。

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。

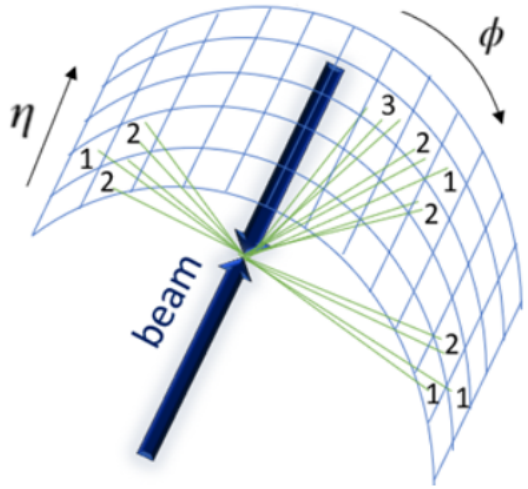
“MathWorks公司提供的 Excellence in Innovation 项目，为我们电子工程系卓越工程师班的工程实践类课程提供了与企业合作，了解行业发展趋势和 AI 等前沿知识的一个很好的途径，而且，同学们之前对 MATLAB 编程只有较为浅显的应用，没有使用过 Simulink 和许多很好的工具箱，通过项目的实践过程，了解并使用了它们，较好的完成了项目，增强了工程实践能力。”

—— 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。

MATLAB-Simulink-Challenge-Project-Hub / projects / Top Quark Detection with Deep Learning and Big Data / ↑ Top



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

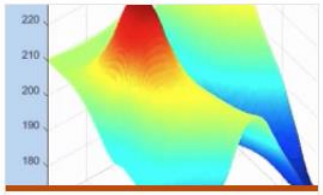
理工科教学资源

Teaching Biology with MATLAB

» Integrate MATLAB into your Biology curriculum

Teaching Chemistry with MATLAB

» Integrate MATLAB into your Chemistry curriculum

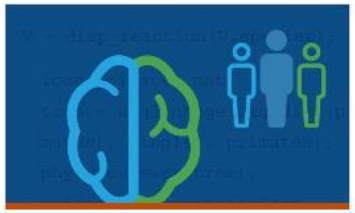


Teaching Geoscience with MATLAB

» 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

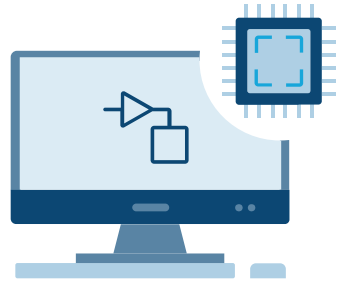
Teaching Computational Science Using MATLAB

» 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

Search MathWorks.com

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 S
Use MATLAB with your

FPGA, ASIC, and S Development
Automate your workflo algorithm development design and verification

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

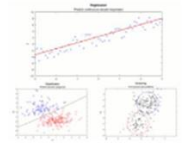
Internet of Things
Connect embedded de Internet and gain insigh

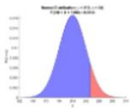
Machine Learning
Train models, tune para deploy to production or

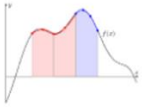
Mechatronics
Design, optimize, and verify mechatronic systems

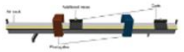
communications systems

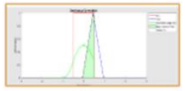
Modular Courseware

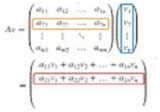

Machine Learning


Statistics


Numerical Integration


Lab: Air Track


Convolution


Matrix Methods


Qualitative Analysis of ODEs

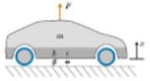
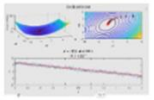

Mass-Spring-Damper


Image Processing


Dynamic Systems

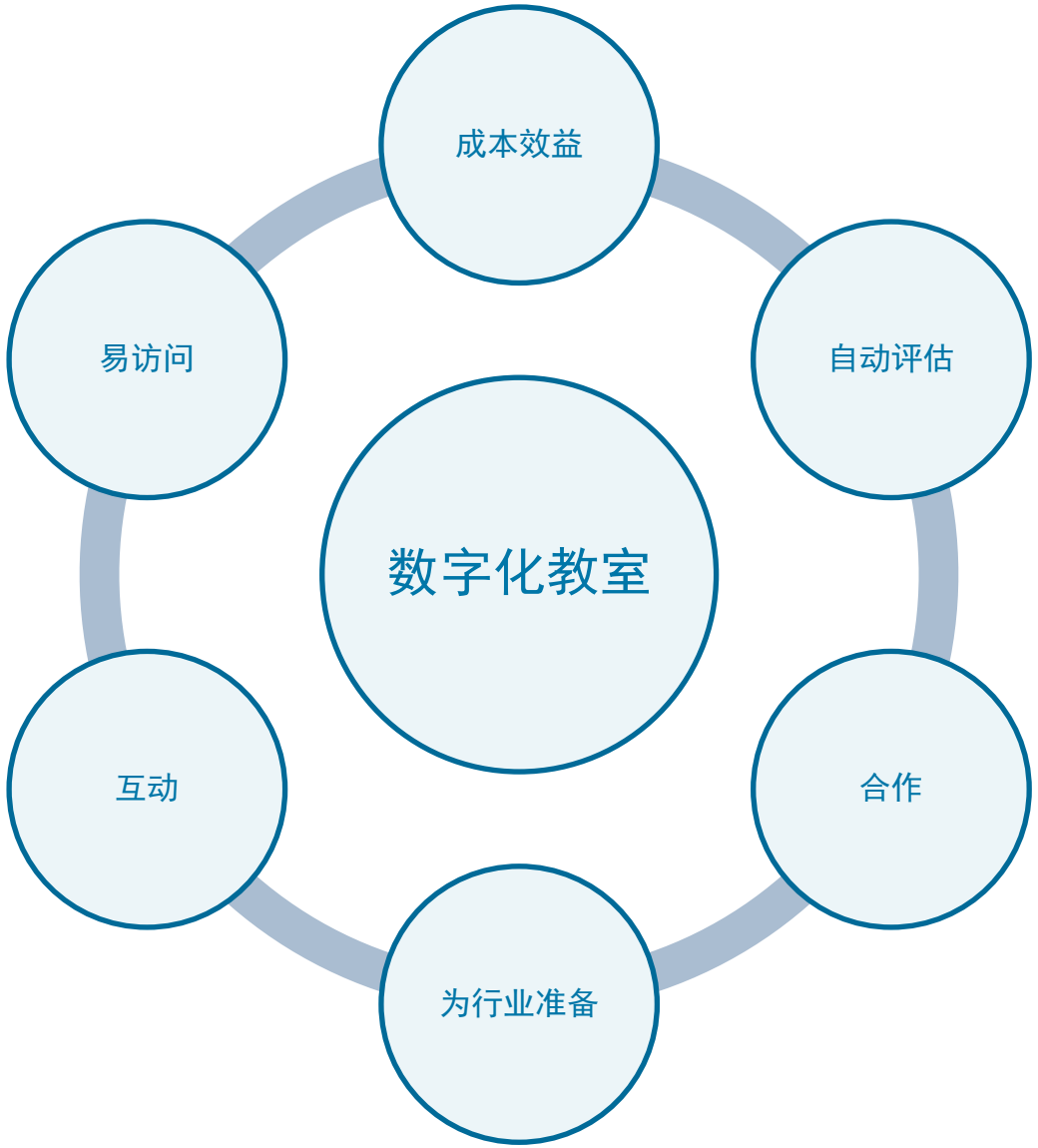

Vectors


Lab: Virtual e/m Measurement


Regression

github.com/MathWorks-Teaching-Resources

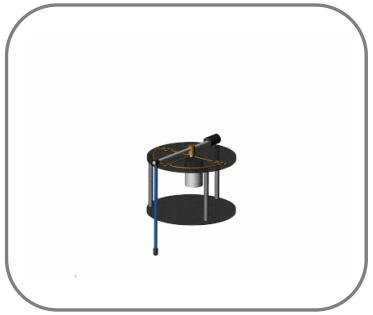
数字化工具对教与学的影响



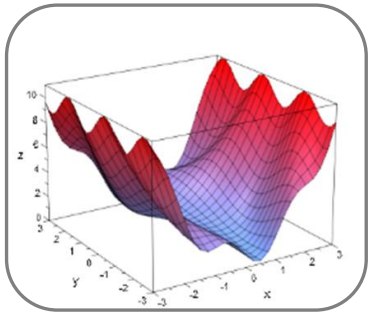
数字化工具对教与学的影响

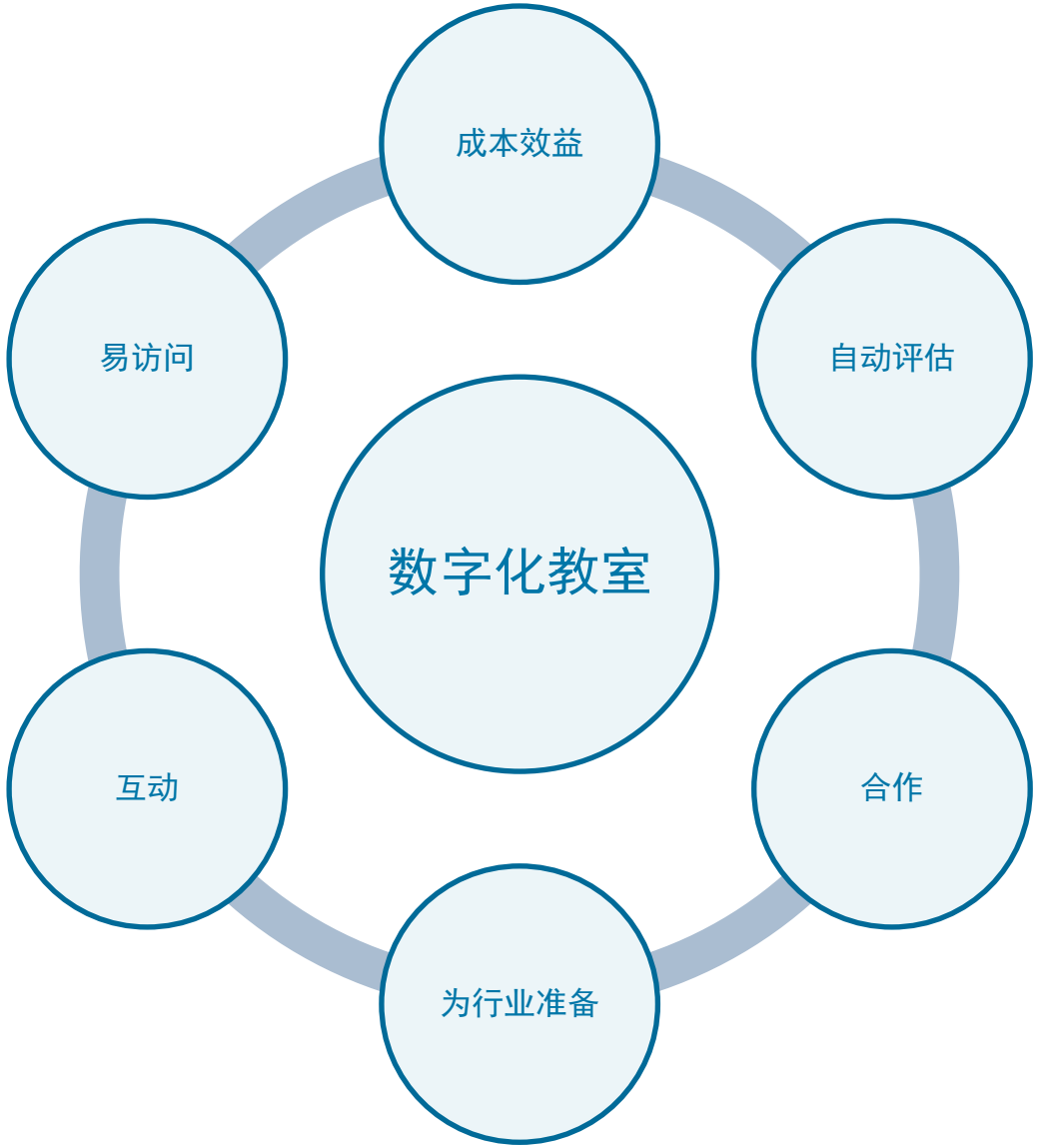
MATLAB Online

虚拟实验室



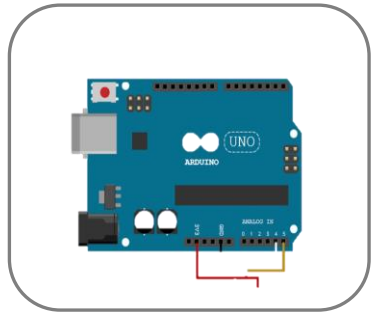
MATLAB 实时脚本





MATLAB 在线课程

MATLAB Grader



基于项目学习