

Machine and Deep Learning for Medical Signals



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MathWorks

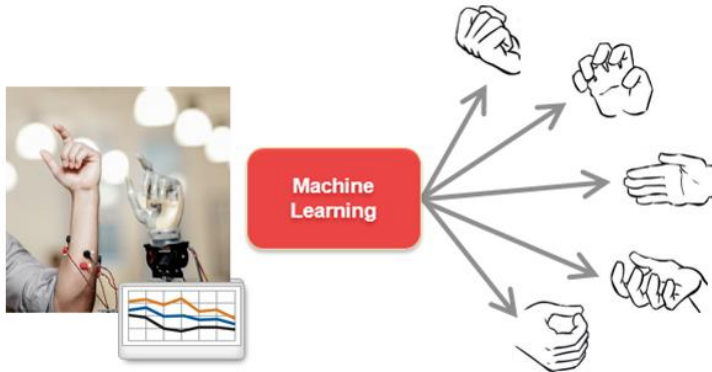
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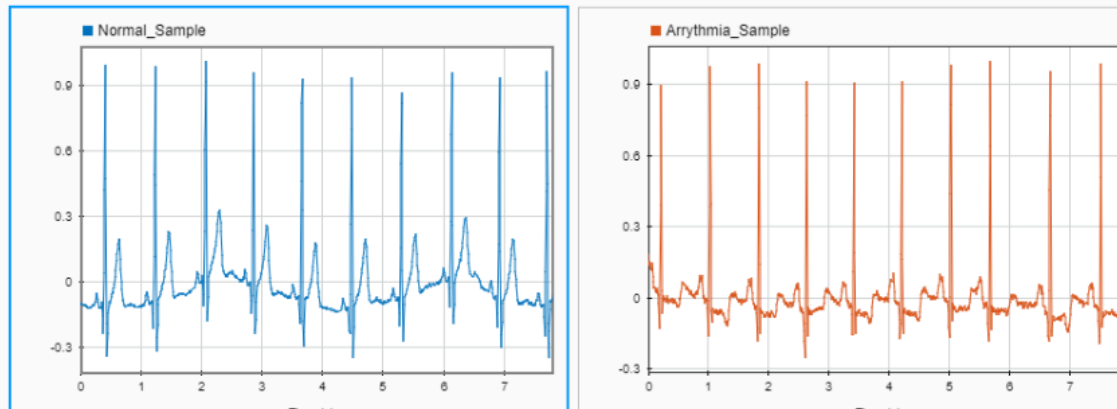


Overview

What will we see today?



- We will work with EMG and ECG data to perform classification tasks
- We will extract features (without writing much code)
 - We will also see how to generate code
 - Then use classical machine learning approach for classification
- We will then use deep learning for classification
 - We will see that we don't have to extract many features in this case



How to Access Materials

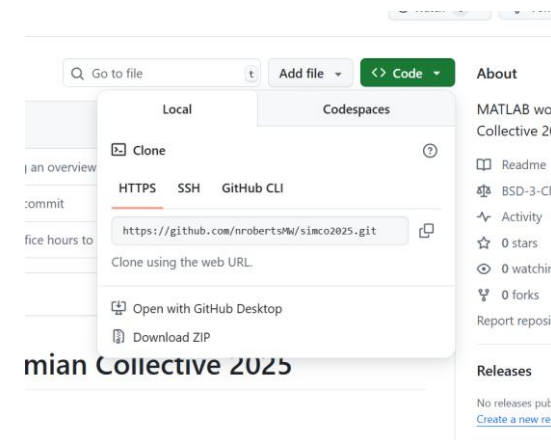
- Set up a MathWorks account if you don't have one
 - Go to <https://www.mathworks.com/mwaccount/>
- Workshop license (if you don't already have access to MATLAB)
 - <https://www.mathworks.com/licensecenter/classroom/4969700/>
- Open the GitHub Repository
 - <https://github.com/nrobertsMW/simco2025/>
 - You can either clone the repo or download all the material

Access MATLAB for your Machine Learning Workshop

MathWorks is pleased to provide a special license to you as a course participant to use for your Machine Learning Workshop. This is a limited license for the duration of your course and is intended to be used only for course work and not for government, research, commercial, or other organization use.

Course Name:	Simian Collective 2025 MATLAB Workshops
Organization:	MathWorks Machine Learning
Starting:	25 Aug 2025
Ending:	26 Aug 2025

Access MATLAB Online



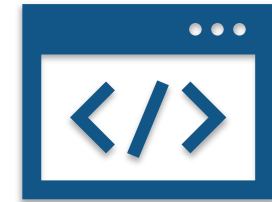
Learning Outcomes



Experience working with
example problems



Design and train AI models
with interactive tools

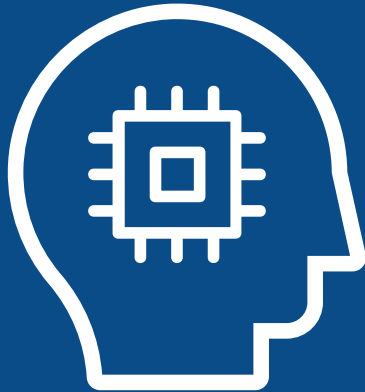


Automatically generate code
for reuse

What is AI?

ARTIFICIAL INTELLIGENCE

Any technique that enables machines to mimic human intelligence



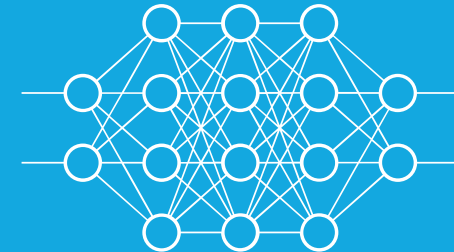
MACHINE LEARNING

Statistical methods that enable machines to “learn” tasks from data without explicitly programming



DEEP LEARNING

Neural networks with many layers that learn representations and tasks “directly” from data

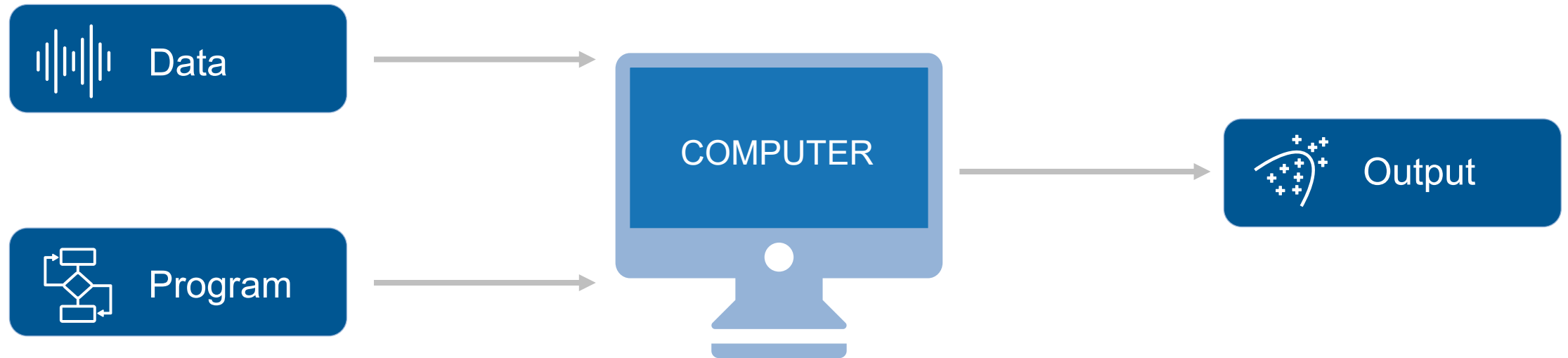


1950s

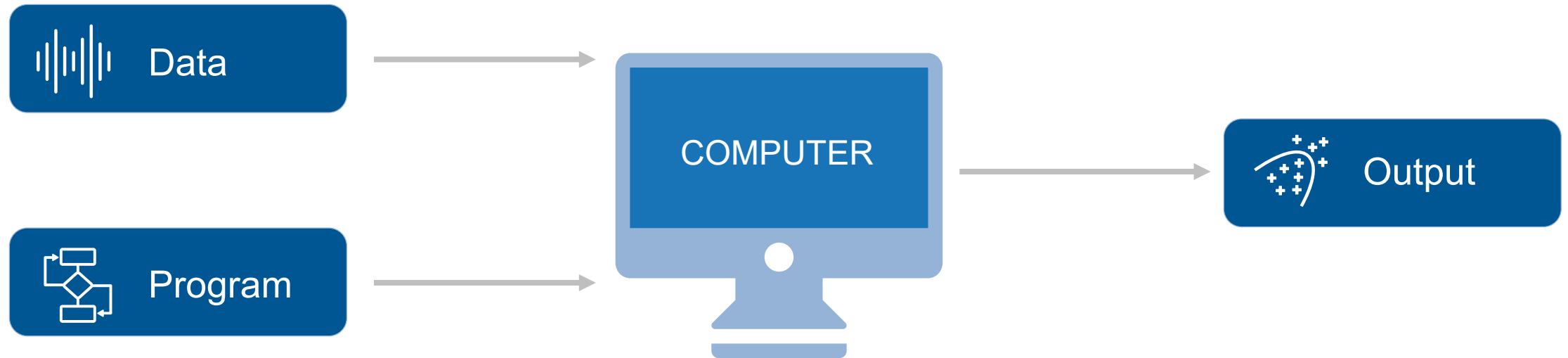
1980s

2010s

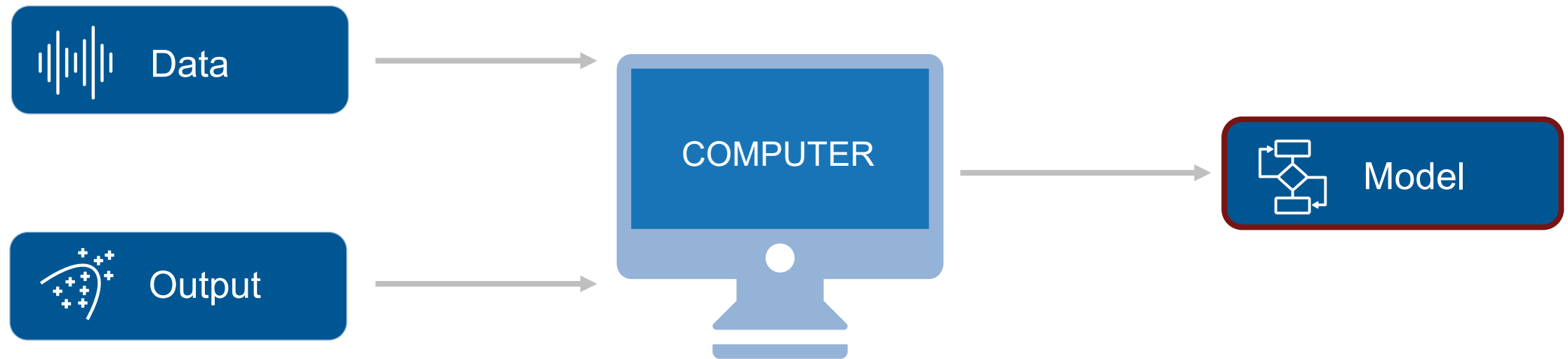
Traditional Programming



Traditional Programming

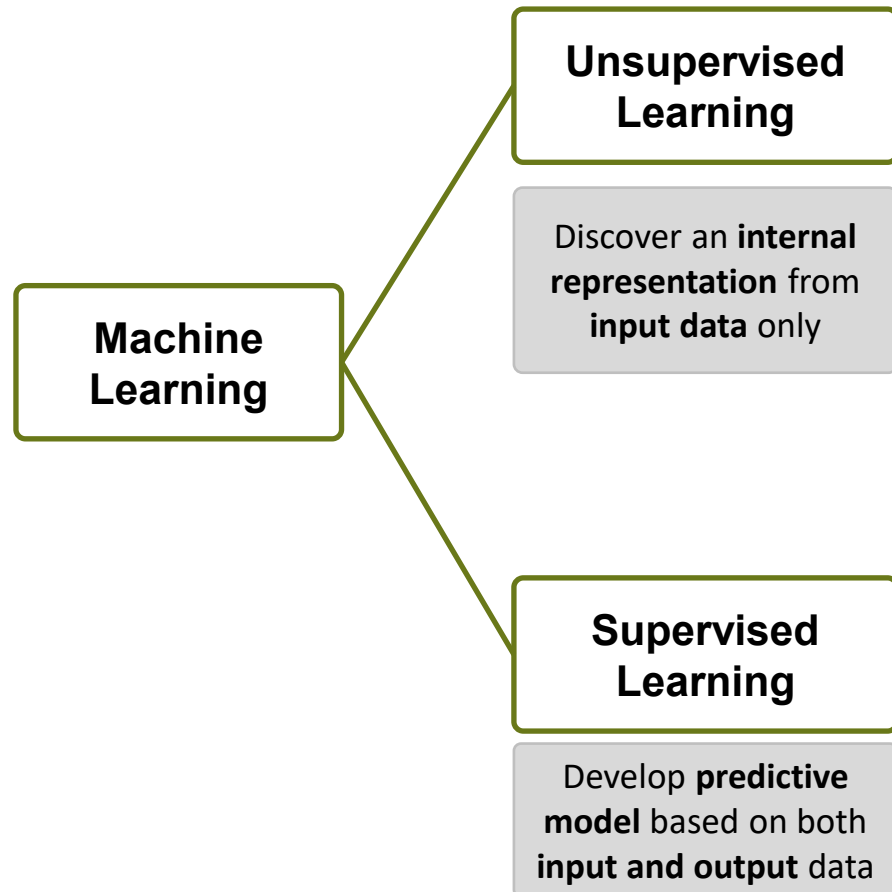


Machine Learning

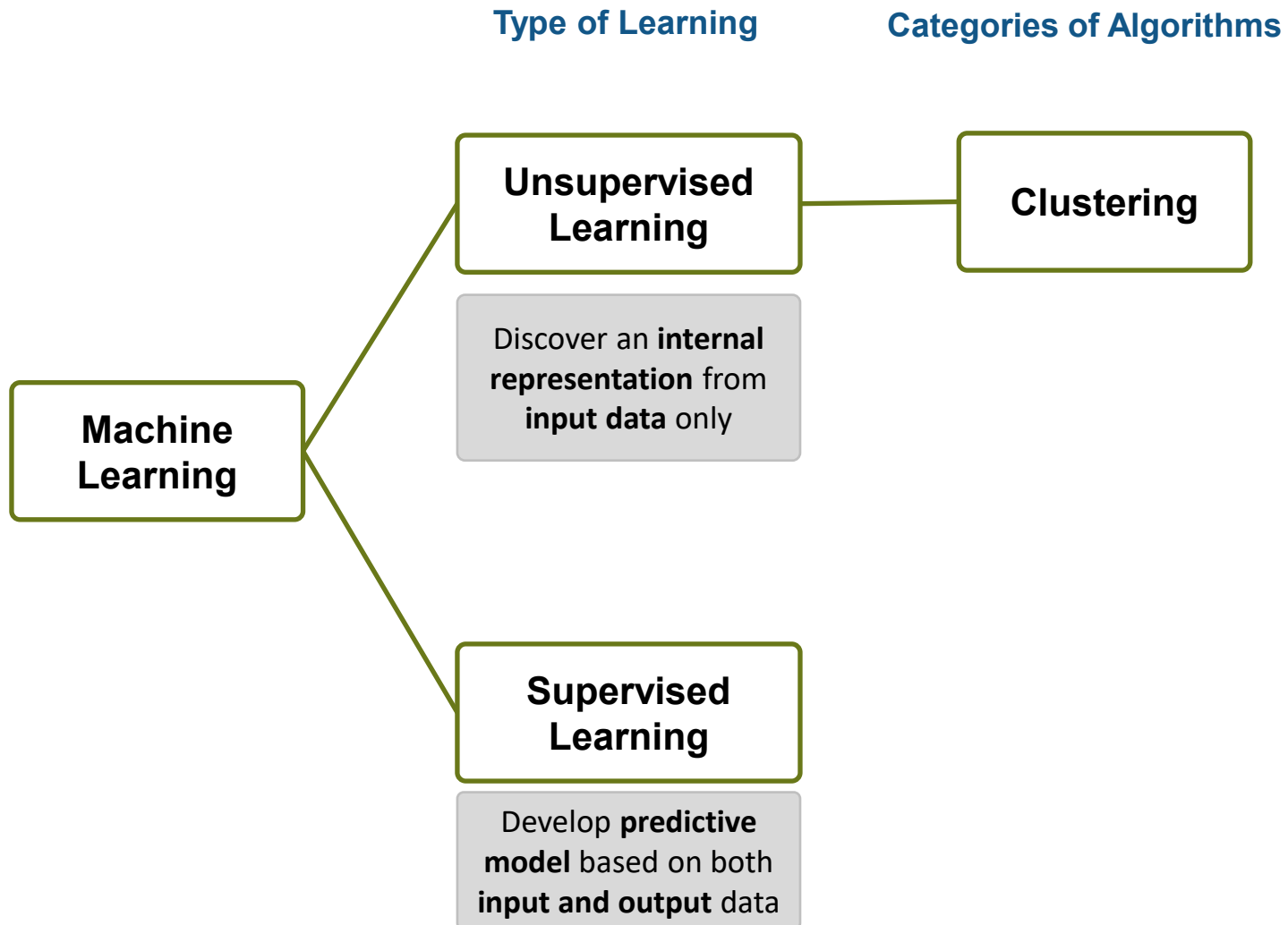


Types of Machine Learning

Type of Learning

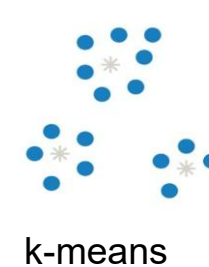


Types of Machine Learning

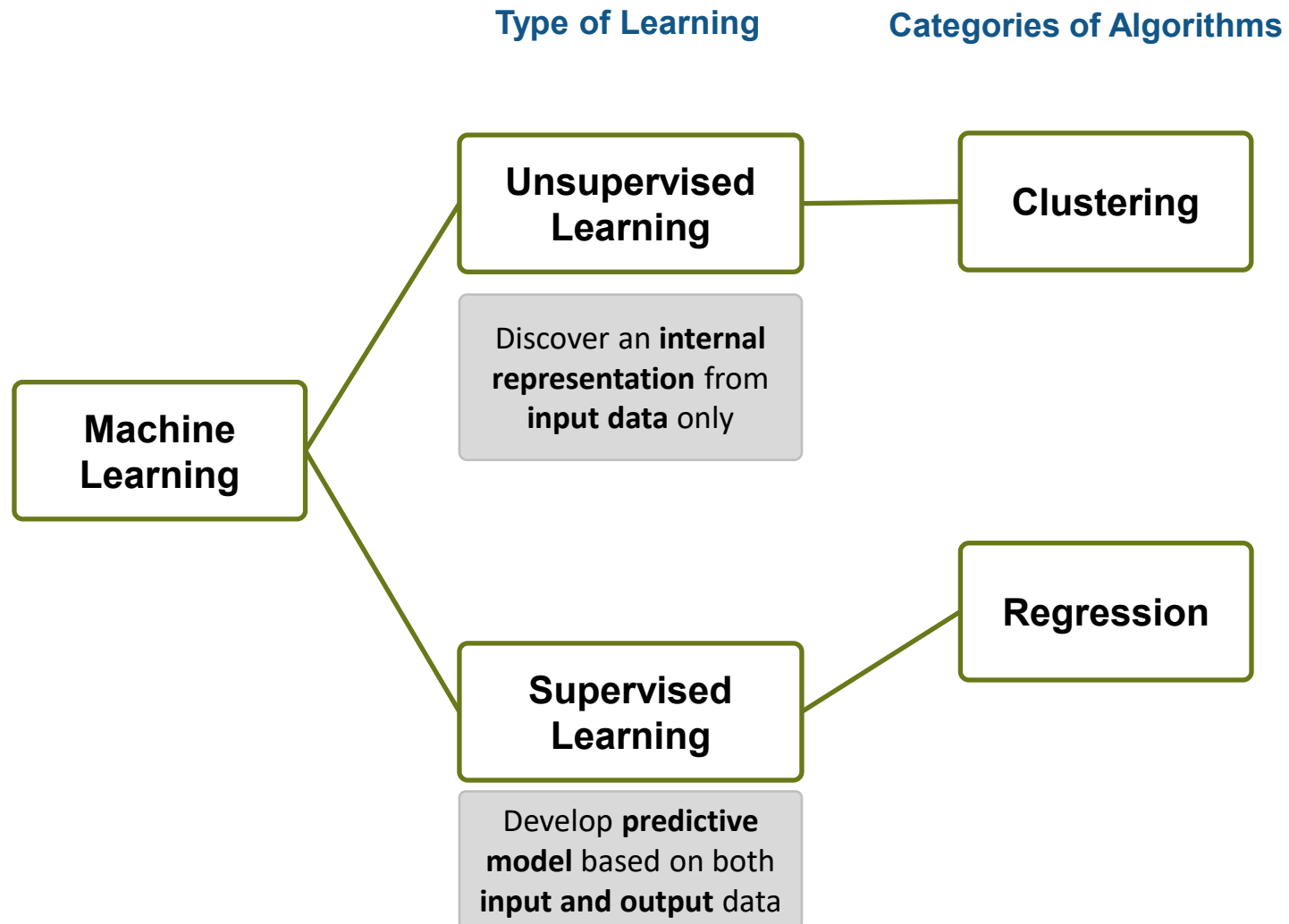


Clustering:

- Segmenting data into groups based on data similarity
- Hard clustering models (e.g. k-means)
- Soft clustering models (e.g. Gaussian mixture models)
- To discover patterns, identify possible features, check for outliers

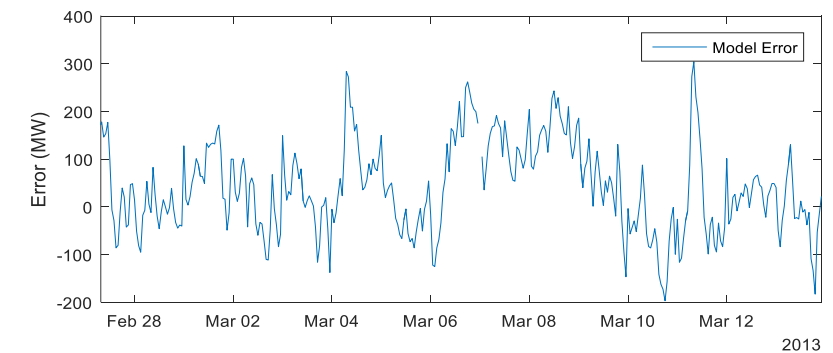
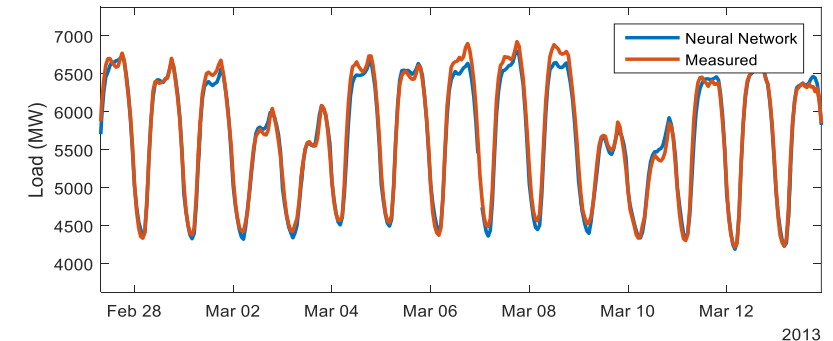


Types of Machine Learning

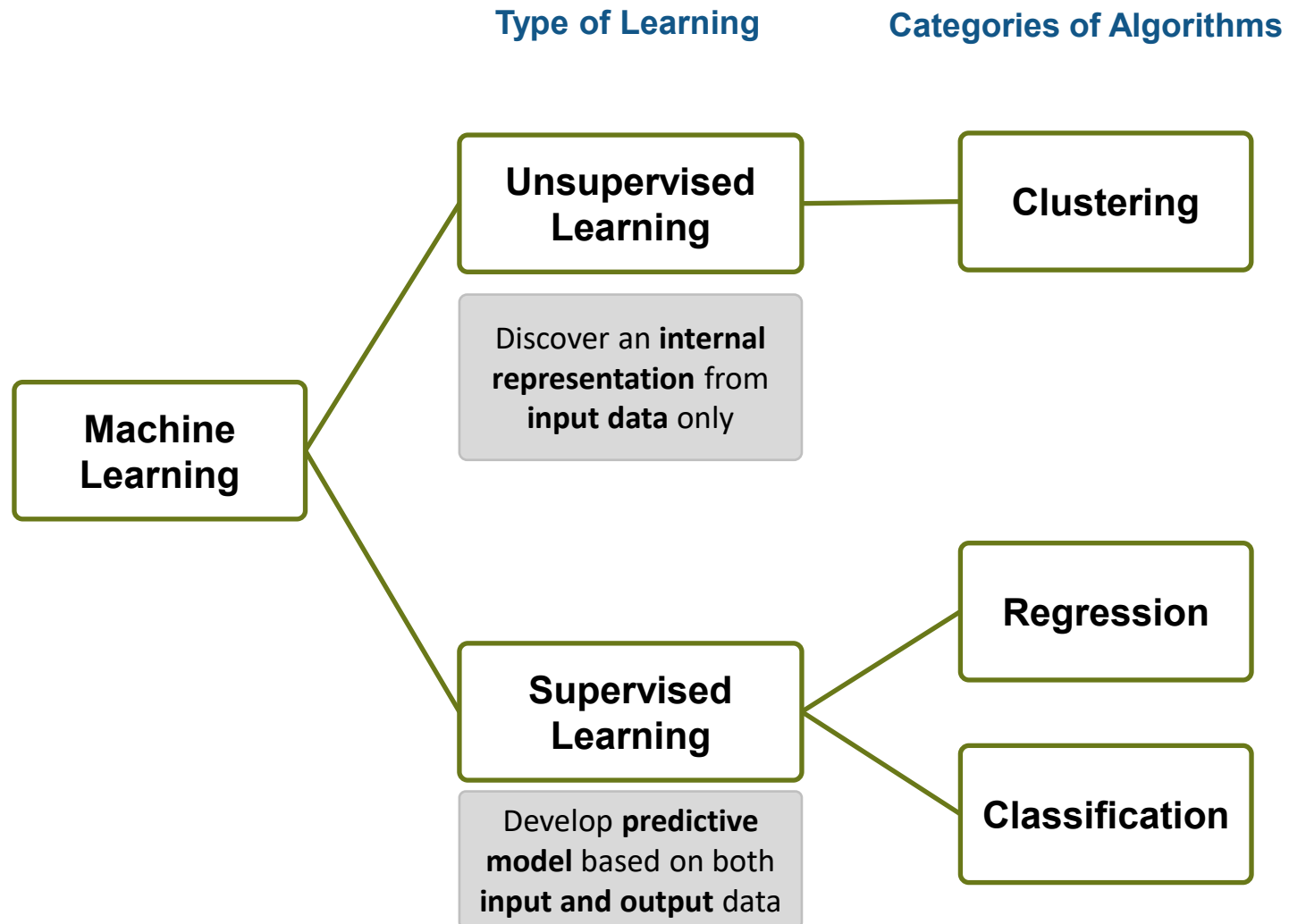


Regression:

Predicted variable (response) is continuous (number)





Types of Machine Learning



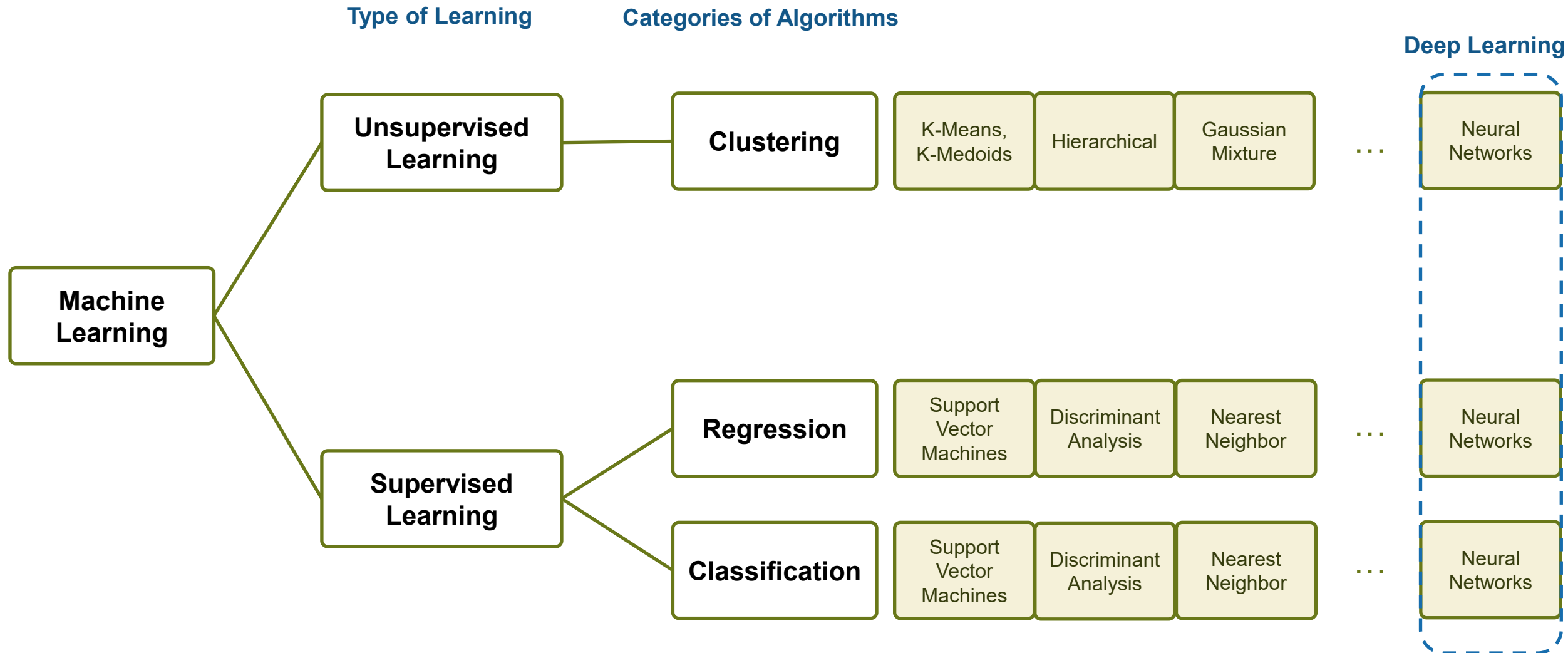
Classification:

Predicted variable (response) is discrete (class)

Data:

Inputs	3-axial Accelerometer 3-axial Gyroscope	
Outputs		

Types of Machine Learning

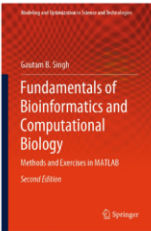


Let's jump into some exercises

Relevant textbooks and doc examples

MATLAB and Simulink Based Books

[Books Main Page](#) [Search](#) [Join Book Program](#)



Fundamentals of Bioinformatics and Computational Biology: Methods and Exercises in MATLAB, 2nd edition

Gautam B. Singh, *Oakland University*
Springer International Publishing, 2025
ISBN: 978-3-031-75694-8; Language: English


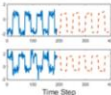

Fundamentals of Bioinformatics and Computational Biology covers all the core bioinformatics topics and includes practical examples completed using the MATLAB [Bioinformatics Toolbox](#) and [Statistics and Machine Learning Toolbox](#). It is primarily intended as a textbook for engineering and computer science students attending advanced undergraduate and graduate courses in bioinformatics and computational biology. The book develops bioinformatics concepts from the ground up, starting with an introductory chapter on molecular biology and genetics to enable physical science students to appreciate the challenges in biological data management, sequence analysis, and systems biology. The book is divided into five parts. The first one includes a survey of existing biological databases and tools that have become essential in today's biotechnology research. The second part covers methodologies for retrieving biological information, including



Pascal Wainwright, *New York University*; Mike Lusignea, *University of Chicago*; Marc Benayoun, *University of Chicago*; Tanya I. Baker, *The Salk Institute*; Adam S. Dickey, *University of Chicago*; Nicho G. Hatsopoulos, *University of Chicago*
Academic Press, 2014
ISBN: 978-0-12-383836-0; Language: English

Written for students and researchers, *MATLAB for Neuroscientists: An Introduction to Scientific Computing in MATLAB* provides a comprehensive introduction to MATLAB and its use within the fields of neuroscience and psychology. The book aims to empower users of MATLAB to design and implement their own analytical tools. Topics include stimulus generation, experimental control, data collection, data analysis, and modeling.

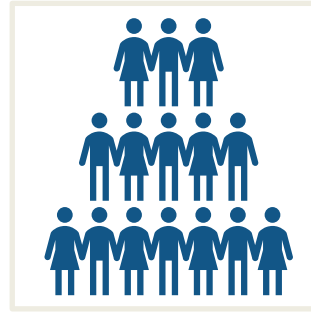
[MATLAB](#) is used throughout the book to solve many application examples. In addition, a set of MATLAB code files is available for download.

	Example Workflow	Learn More
	Apply deep learning to image data tasks. For example, use deep learning for image classification and regression.	Get Started with Transfer Learning Pretrained Deep Neural Networks Create Simple Deep Learning Neural Network for Classification Train Convolutional Neural Network for Regression Preprocess Images for Deep Learning
	Apply deep learning to sequence and time series tasks. For example, use deep learning for sequence classification and time series forecasting.	Sequence Classification Using Deep Learning Time Series Forecasting Using Deep Learning
	Apply deep learning to computer vision applications. For example, use deep learning for semantic segmentation and object detection.	Get Started with Semantic Segmentation Using Deep Learning (Computer Vision Toolbox) Recognition, Object Detection, and Semantic Segmentation (Computer Vision Toolbox)

Key takeaways



Ease-of-use through
interactive tools



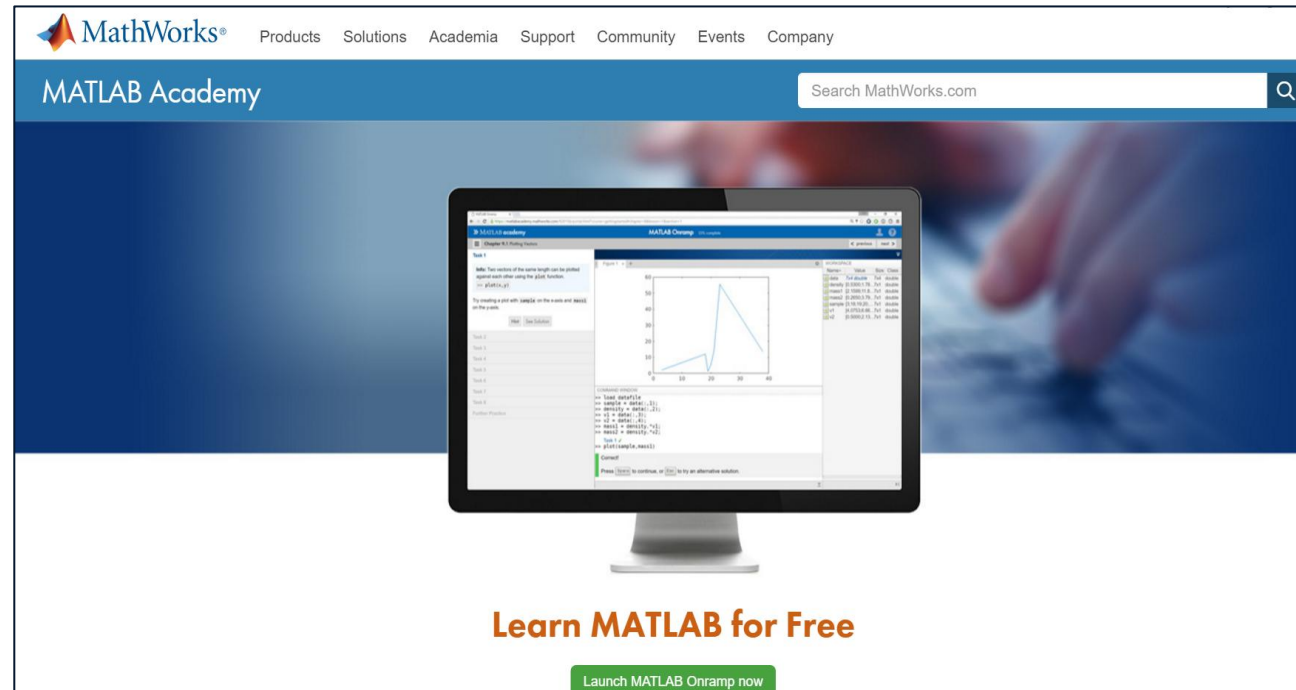
AI accessible to everyone



Interactive tools can
enhance programming skills

Supporting *Your* Success

Self-Paced Online Trainings



OVERVIEW COURSES (2-3 hours)


MATLAB Onramp
Simulink Onramp
Stateflow Onramp
Simscape Onramp

[Machine Learning Onramp](#)
[Deep Learning Onramp](#)
[Reinforcement Learning Onramp](#)
Control Design with Simulink Onramp
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Signal Processing Onramp
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Self-Paced Courses

FREE “getting started” content – available for everyone



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0%

Learn the basics of practical machine learning for classification problems in MATLAB®. Use a machine learning model that extracts information from real-world data to group your data into predefined categories.

Course modules


- [Overview of Machine Learning](#) 10 min
- [Import Data](#) 10 min
- [Extract Features](#) 15 min
- [Split Data for Validation](#) 10 min
- [Train Models](#) 10 min
- [Evaluate Performance](#) 10 min
- [Improve Performance](#) 5 min
- [Conclusion](#) 5 min

About this course



Format: [Self-paced](#)
Length: About 1 hour
Language: English ([change](#))

Recommended prerequisites




MATLAB Onramp
3%

Features


- Hands-on exercises with automated feedback
- Access to MATLAB through your web browser
- Shareable progress report and course certificate

Authored By:




[Andrea Bayas](#)
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Related Learning



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Learn the basics of deep learning for image classification problems in MATLAB®. Use a deep neural network that experts have trained and customize the network to group your images into predefined categories.

Course modules


- [Introduction](#) 5 min
- [Use Pretrained Networks](#) 15 min
- [Manage Collections of Image Data](#) 0.5 hours
- [Prepare Inputs for Transfer Learning](#) 25 min
- [Perform Transfer Learning](#) 20 min
- [Conclusion](#) 5 min

About this course



Format: [Self-paced](#)
Length: About 1.5 hours
Language: English ([change](#))

Recommended prerequisites




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 - (link also in GitHub Repository!)



[Link](#)

Thank you!



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