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# Machine Learning

## MATLAB Essentials

# MATLAB

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- High level language, designed for scientific and engineering computing
- MATLAB stands for “MATrix LABoratory”
- Operations on vectors and multi-dimensional arrays are a core strength of MATLAB
  - Compact syntax
  - Efficient underlying implementations of matrix algebra
- Rich libraries of mathematical functions
  - Statistics
  - Signal processing
  - Optimization
  - Machine learning

# MATLAB

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- Interpreted language, with built-in precompiled modules for compute-intensive operations
- Great flexibility in programming
  - Interactive
  - Scripts
  - Functions (scripts with defined inputs and outputs)
  - Object-oriented programming
  - Supports complex, hierarchical data structures with mixed types
  - Easy to interface with C / C++
  - Moderately loose typing
- Good for both exploratory work and large-scale structured programming

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- Ubiquitous *vectorization*

- Vectorization: use of single-operator syntax to signify uniform application of the operator on all elements of one or several vectors and/or matrices
- Circumvents need for explicit loops to process elements of vectors and matrices
- Syntax very compact and highly readable, akin to mathematical formulae

- Examples:

add two matrices

$C = A + B;$

multiply matrix by scalar

$C = 2 * B;$

multiply two matrices

$C = A * B;$

logarithm of every element in matrix

$B = \log( A );$

# MATLAB

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- Powerful visualization capabilities
  - Histograms, bar charts
  - 2D and 3D line plots
  - 2D and 3D scatter plots
  - Heat maps
  - Contour plots
  - Mesh plots
  - Colored and shaded surface plots