Carnegie Mellon University

Graduate Certificate in AI Engineering
Machine Learning & AI for Engineers (24-887)
Course Resources

The following is material designed to help prepare you for the upcoming Machine Learning & AI for Engineers course. We encourage you to review prior to the course to familiarize yourself with the concepts.

1. Fundamental Material

1.1 Mulit-variable Calculus

1.1.1 Higher Order Derivatives

https://machinelearningmastery.com/higher-order-derivatives/

1.1.2 Partial Derivatives and Gradients

https://machinelearningmastery.com/a-gentle-introduction-to-partial-derivatives-and-gradient-vectors/

1.1.3 Basic Optimization, Maxima, Minima, Gradient Descent

https://machinelearningmastery.com/a-gentle-introduction-to-optimization-mathematical-programming/

https://machinelearningmastery.com/a-gentle-introduction-to-gradient-descent-procedure/

1.2 Linear Algebra

1.2.1 Matrices and Matrix Arithmetic - Matrix Multiplication, Vector Dot Products

https://machinelearningmastery.com/introduction-matrices-machine-learning/

1.2.2 Matrix Operations - Transpose, Inverse, Determinant

https://machinelearningmastery.com/matrix-operations-for-machine-learning/

1.2.3 System of Linear Equations

https://en.wikipedia.org/wiki/System of linear equations

1.3 Probability & Statistics

1.3.1 Continuous and Discrete Random Variables

https://en.wikipedia.org/wiki/Continuous or discrete variable

1.3.2 Probability and Cumulative Distribution Functions

https://machinelearningmastery.com/what-are-probability-distributions/

1.3.3 1D and 2D Gaussian Functions

https://en.wikipedia.org/wiki/Gaussian function

1.3.4 Covariance Matrices

https://en.wikipedia.org/wiki/Covariance matrix

1.3.5 Conditional Independence

https://machinelearningmastery.com/joint-marginal-and-conditional-probability-for-machine-learning/

1.3.6 Bayes Theorem

https://machinelearningmastery.com/bayes-theorem-for-machine-learning/

1.3.7 Linear Correlation

https://machinelearningmastery.com/how-to-use-correlation-to-understand-the-relationship-between variables/

1.3.8 Maximum Likelihood Estimation

https://machinelearningmastery.com/what-is-maximum-likelihood-estimation-in-machine-learning/

1.4 Python Programming

1.4.1 NumPy, Arrays, Array indexing

https://numpy.org/doc/stable/user/quickstart.html

1.4.2 For loops

https://www.learnpython.org/en/Loops

1.4.3 Simple arithmetic

https://numpy.org/doc/stable/user/quickstart.html#basic-operations

1.4.4 Inner and outer products of vectors

https://www.geeksforgeeks.org/calculate-inner-outer-and-cross-products-of-matrices-and-vectors-using-numpy/

https://numpy.org/doc/stable/reference/generated/numpy.dot.html

1.4.5 Matrix - vector stacking

https://numpy.org/doc/stable/reference/routines.array-manipulation.html#joining-arrays

https://note.nkmk.me/en/python-numpy-concatenate-stack-block/

1.4.6 File I/O for data

https://likegeeks.com/numpy-loadtxt-tutorial/

https://numpy.org/doc/stable/reference/generated/numpy.loadtxt.html

1.4.7 Plotting

https://matplotlib.org/stable/tutorials/introductory/pyplot.html

https://machinelearningmastery.com/data-visualization-in-python-with-matplotlib-seaborn-and-bokeh/

2. Optional Material

2.1 Optimization

2.1.1 Constrained Optimization

https://en.wikipedia.org/wiki/Constrained optimization

2.1.2 Unconstrained Optimization with Lagrange Multipliers

https://en.wikipedia.org/wiki/Lagrange multiplier

2.1.3 KKT Conditions

https://en.wikipedia.org/wiki/Karush-Kuhn-Tucker conditions

2.2 Statistics

2.2.1 Binomial, Bernoulli, Multinomial Probability Distributions

https://machinelearningmastery.com/discrete-probability-distributions-for-machine-learning/

2.2.2 Maximum A Posteriori Estimation

https://en.wikipedia.org/wiki/Maximum a posteriori estimation

3 Helpful Video Series

- Statistical Fundamentals - StatQuest with Josh Starmer
- Machine Learning - StatQuest with Josh Starmer
- Essence of Linear Algebra - 3B1B
- Essence of Calculus - 3B1B
- Neural Networks - 3B1B