Maths Handbook

California Coffee

Contents

Version: 0.1

Logs:

11-11-2021: initial version

---

1 Introduction

This book is to track MATH knowledges for research and engineering applications. It mainly include below sections.

- Fundamentals
- Optimization
- Statistics
- Machine Learning
- Signal Processing

1.1 Books and Links

TBD

2 Math Fundamentals

2.1 Calculus

Calculus is a fundamental class during under-graduate study. There are some open source websites about basic calculus:

1. https://openstax.org/books/calculus-volume-1/pages/5-3-the-fundamental-theorem-of-calculus

One of the key knowledge in this area is **integral table**. Below list some useful public websites/docs about integral tables.

1. https://link.springer.com/content/pdf/bbm%3A978-1-4612-1520-2%2F1.pdf
2. https://github.com/biomathman/integral-table.com

2.1.1 Theorems in Calculus

Fundamental Theorem of Calculus

- https://www.khanacademy.org/math/in-in-grade-12-ncert/xd340c21e718214c5:integrals/xd340c21e718214c5:fundamental-theorem-of-calculus-chain-rule/a/fundamental-theorem-of-calculus-review
- Also see: https://www.dummies.com/education/math/calculus/useful-calculus-theorems-formulas-and-definitions/

2.2 Complex Analysis

For complex analysis, below is a public book from Stanford Math class (but I have not yet fully read it).

- http://virtualmath1.stanford.edu/~eliash/Public/116-2019/116text-2019.pdf

3 Optimization

3.1 Stochastic Approximation

SA (stochastic-approxmization) is a method dealing with (some) optimization problems under stochastic environment. Typical appliations of SA include: **(1) finding the root of a random function; (2) estimate the mean value of a random variable/function**. To some extent, it can be seen as a subset of stochastic optimization.

A beginning introduction for SA, including typical algorithms in this area, can be found in **wiki** page:

https://en.wikipedia.org/wiki/Stochastic_approximation

Meanwhile, there are public slide-decks about SA:

- https://www.ntnu.edu/documents/1279751014/1285341555/Uday+Shanbhag_
  d1af-406d-8861-77d713008f56
- https://webee.technion.ac.il/shimkin/LCS11/ch5_SA.pdf