WEEK 01 -
Foundations of Applied Mathematics - Part 01

Mathematics Curriculum - Overview

- Courses offer mathematical foundations necessary to become a good
    - Problem Solver
    - Computer science professional
    - Data scientist
    - Engineer or Scientist
- Emphasis laid on mathematical understandings and interpretations, while less emphasis is laid on manipulations.
- No abstract mathematics, no focus on mathematical rigor through theorems and proofs.
- Unlike conventional methods, courses designed to learn mathematics through programming and real-life examples.

Mathematical Curriculum and Roadmap

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1. Foundations of Applied Mathematics - Part 1

- Real life applications mathematical modeling
- Data observations, recording, representation and visualization
- Algebra and Trigonometry
- Functions
- Basic probability and Statistics

2. Foundations of Applied Mathematics - Part 2

- Introduction to calculus, limits
- Differential calculus
- Integral calculus
- Differential equations
- Elementary Liner algebra

3. Discrete mathematics

- Logic and Counting
- Sets and relations
- Graph Theory
- Group
- Number Theory

4. Linear Algebra and Optimization for Data Science

- System of linear equations
- Vector Spaces
- Eigen Value Problem
- Decomposition
- Optimization

5. Probability and Statistics for Data Science

- Introduction to Probability
- Exploratory data analysis
- Probability distributions
- Data and Sampling distributions
- Significance testing

6. Machine Learning

- History of AI and ML
- Feature engineering
- Linear and kernel methods
- Tree-based models
- Unsupervised Methods

7. Deep learning

- History of Deep Learning
- Neural networks
- Vision applications
- test and speech processing
- Recommendation systems and Deep reinforcement learning

Course plan for semester

Unit 1 -> mathematical modeling -> Week 1,2

- Week 01 - Roadmap of the mathematical curriculum, Real life applications
- Week 02 - Why learn mathematics, mathematical modeling

Unit 2 -> Description of data, learning computational tools -> Week 3,4,5,6

- Week 03 - Introduction to python/jupiter, Introduction to Excel
- Week 04 - Simple data structures, learning mathematical libraries (Matplotlib, Sympy, Numpy)
- Week 05 - Data observations, recording, representations and visualization - Part 1
- Week 06 - Data observations, recording, representations and visualization - Part 2

Unit 3 -> Algebra and Trigonometry -> Week 7,8,9

- Week 07 - Order of operations, variables and expressions, bases and exponents, evaluation of algebraic expressions
- Week 08 - Linear equations inequalities, system of linear equations
- Week 09 - Trigonometry, degrees and Radians

Unit 4 -> Functions -> Week 10,11,12

- Week 10 - Definition of functions, independent and dependent variables, functions visualization, algebraic functions, polynomial functions.
- Week 11 - Exponential functions, Logarithmic functions, Trigonometric functions, inverse functions.
- Week 12 - Arithmetic operations on functions, composition of functions, functional transformation

Unit 5 -> Probability and Statistics -> Week 13,14

- Week 13 - Description of data with Statistics, measures of central tendencies, basics of probability
- Week 14 - Random numbers, probability density functions, normal distributions, central limit theorem.

Prerequisites for this course

- Only high school mathematics is needed (12th grade preferable, but 10th grade sufficient)
- Courses aimed at complete beginners. No experience in any programming language is required.

Course evaluation and grading

- Quiz - every week - 5% weightage
- Assignment - Once in two weeks - 25% weightage
- Final Exam - 70% Weightage
- letter grade as per university standards
- All submissions through LMS

Introduction to Real Life Applications

Objective: Motivate learning mathematics!

1. Search Engines -
    - Linear Algebra and optimization of Data Science
        - Eigen value problem
        - Decomposition
    - Probability and statistics for Data Science
    - Machine learning
    - Deep learning
2. Ride Share -
    - Foundations of applied mathematics - Part 2
    - Linear algebra and optimization of Data Science
        - Optimization
    - Probability and statistics for Data Science
3. GPS Navigation-
    - Foundations of applied mathematics - part 2
    - Linear algebra and optimization of Data Science
4. Epidemic modeling & analysis -
    - Foundations of applied mathematics - part 1
        - Functions
        - Basic probability and statistics
    - Foundations of applied mathematics - part 2
    - Probability and statistics for Data Science
5. Weather forecasting -
    - Foundations of applied mathematics - part 2
        - Differential equations
        - Integral calculus
        - Differential equations
    - Probability and statistics for Data Science
6. Cryptography, Cryptocurrency -
    - Foundations of applied mathematics - part 1
        - Basic probability and statistics
    - Discrete mathematics
        - Number theory

7. Recommendation systems -
    - Probability and statistics for Data Science
    - Machine learning
    - Deep learning
        - Recommendation systems and deep reinforcement learning