6. Online Course on Data-Driven Modelling and Optimization (3+0)

Objectives:

The course is designed to train students and upskill professionals in different data-driven modelling approaches and optimization techniques needed to succeed in industry and research. At the end of the course, participants would be able to use data-driven approaches to recognize, model, and solve optimization problems that arise in engineering and related (e.g., data science, finance, business) contexts.

Syllabus:

Data-Driven Modelling Concepts: Mathematical (linear algebra, calculus, probability) and programming (python, data exploration) foundation, Computational Thinking; Unconstrained Optimization: Linear and nonlinear least squares, regression, regularization, conjugate gradient, quasi-newton; Machine Learning and Neural Networks: Classification models, single layer perceptrons, deep networks, optimization algorithms in ML and big data; Constrained Optimization: Linear Programming Problems, Quadratic Programming, Lagrangian Methods; Bayesian Optimization and Genetic Algorithms.

Target Group:

Any industry/R&D professional; Research students in engineering and sciences; Aspiring data scientists looking for upskilling

Faculty:

Dr. Deepak N Subramani
Assistant Professor,
Dept. of Computational and Data Sciences,
IISc., Bengaluru.
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Reference Books:

1. J Nocedal and S Wright
   Numerical Optimization,
   Springer Series in Operations Research and Financial Engineering, (2nd Edition) 2006.
2. C. Shah
   A Hands-on Introduction to Data Science,
   Cambridge University Press 2020.
3. C. Balaji
   Essentials of Thermal System Design and Optimization,
   Ane Book Pvt. Ltd. 2011.

Who can apply?

B.E/B.Tech. or M.E/M.Tech/MCA/M.Sc.

Pre-requisites:

Basic Mathematics and Programming

Course Fee: Rs. 15,000/- + 18% GST

Online Seats are Limited to 100

Online Classes using Microsoft Teams/Google Meet

Schedule: Tuesday & Thursday 6.00 pm - 7.30 pm

Check eligibility and Enroll at CCE-IISc - http://cce.iisc.ac.in/prof-courses.html

Detailed Weekly Plan

Module	Name	Topics	Lectures	Hours	Week
1	Mathematical and Programming Foundation	Computational thinking, linear algebra, calculus, python programming, data exploration and visualization, Types of data-driven models.	8	12	1,2,3,4
2	Unconstrained Optimization	Linear and nonlinear LS, regularization, conjugate gradient, quasi-newton, time-series models.	6	9	5,6,7, 8 (Mid Term)
3	Machine Learning and Neural Networks	Classification algorithms, single layer perceptrons, deep neural networks, optimization algorithms for ML (SGD, ADAM).	6	9	9,10,11
4	Constrained Optimization	Constrained optimization theory and KKT conditions, Linear programming formulation and algorithms, Quadratic Programs	4	6	12,13
5	Bayesian Optimization and Genetic Algorithms	GA, simulated annealing, Bayesian optimization.	4	6	14,15, 16 (Final)