NPTEL Video Course - Mechanical Engineering - NOC:Inverse Methods in Heat Transfer

Subject Co-ordinator - Prof. Balaji Srinivasan

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to the Inverse Methods in Heat Transfer Course
Lecture 2 - Inverse Problems - Definition, History and Applications
Lecture 3 - The inverse problem solving process
Lecture 4 - Review of Basic Heat Transfer for this course
Lecture 5 - Introduction to Week - 2
Lecture 6 - Introduction to Linear Regression for Inverse Problems
Lecture 7 - Example Application of Linear regression for an inverse conduction problem
Lecture 8 - Goodness of Fit and Coefficient of Determination
Lecture 9 - Linear Regression with Quadratic Model
Lecture 10 - Summary of Week - 2
Lecture 11 - Introduction to Week - 3
Lecture 12 - Introduction to Normal Equations for linear models
Lecture 13 - Normal Equations for linear models (Continued...)
Lecture 14 - Parity Plots
Lecture 15 - Programming Inverse Methods using Normal Equations
Lecture 16 - Variants on the Linear Model for inverse problems
Lecture 17 - Summary of Week - 3
Lecture 18 - The General Inverse Methods Process
Lecture 19 - Simple nonlinear inverse problem - Transient Heat transfer
Lecture 20 - Review of required calculus results
Lecture 21 - Gradient Descent Algorithm
Lecture 22 - Gradient Descent - Simple Example
Lecture 23 - Gradient Descent for Nonlinear Inverse Problem - Theory
Lecture 24 - Gradient Descent for Nonlinear Inverse Problem - Coding Example
Lecture 25 - Newton Algorithm for a System of Equations
Lecture 26 - Gauss Newton Algorithm - Derivation and Code
Lecture 27 - Overfitting and Regularization for Linear Models
Lecture 28 - Tikhonov Regularization and Levenberg-Marquardt - Theory
Lecture 29 - Tikhonov and Levenberg-Marquardt - Example Code

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Lecture 30 - Introduction to Probability for Inverse Methods
Lecture 31 - Sum and Product Rules of Probability
Lecture 32 - Bayes Theorem - Simple Examples
Lecture 33 - Independence and Expectation
Lecture 34 - Variance and Covariance
Lecture 35 - Gaussian distribution and the standard normal table
Lecture 36 - Maximum Likelihood Estimate
Lecture 37 - MLE, MAP estimates
Lecture 38 - Introduction to Bayesian Methods for Inverse Problems
Lecture 39 - Offline Bayesian Estimation
Lecture 40 - Offline Bayesian Estimation - MATLAB Demo
Lecture 41 - MHMCMC for Inverse Problems
Lecture 42 - MHMCMC for Inverse Problems - MATLAB Demo
Lecture 43 - Why Machine Learning in Inverse Heat Transfer ?
Lecture 44 - Overview of AI and ML
Lecture 45 - Supervised Machine Learning as an Inverse Problem
Lecture 46 - Introduction to Week 9 - From Linear Models to Neural Networks
Lecture 47 - Gradient Descent - Batch, Stochastic and Mini Batch
Lecture 48 - Logistic Regression - The Forward Model
Lecture 49 - Logistic Regression - Binary Entropy Cost Function and Gradient
Lecture 50 - Multiclass Classification
Lecture 51 - Linear Separability and Neural Networks
Lecture 52 - Introduction to Week 10 - XOR and Deeper networks
Lecture 53 - Forward pass through a simple neural network
Lecture 54 - Backprop in a scalar chain
Lecture 55 - Backprop in a MLP
Lecture 56 - Introduction to Week 11 - ANNs as Surrogate models
Lecture 57 - Physics Informed Neural Networks - Introduction
Lecture 58 - Physics Informed Neural Networks - an intuitive explanation
Lecture 59 - Physics Informed Neural Networks - BC incorporation
Lecture 60 - PINNs for inverse problems
Lecture 61 - Introduction to Week 12 - Sensitivity Analysis
Lecture 62 - Code Examples of Logistic Regression - OR and AND gates
Lecture 63 - Code Example of shallow neural network - XOR gate
Lecture 64 - Code walkthrough for PINNs in Burgers equation
Lecture 65 - Formulation of a PINN based inverse problem in unsteady conduction
Lecture 66 - Formulation of a surrogate model based inverse solution in unsteady conduction
Lecture 67 - Summary of course
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