

# NPTEL Video Lecture Topic List - Created by LinuXpert Systems, Chennai

NPTEL Video Course - Electrical Engineering - NOC:Optimization Theory and Algorithms

Subject Co-ordinator - Prof. Uday K Khankhoje

Co-ordinating Institute - IIT - Madras

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

- Lecture 1 - Introduction to the course - 1 - Prerequisites, key elements
- Lecture 2 - Introduction to the course - 2 - Types of problems
- Lecture 3 - Introduction to the course - 3 - An optimization example to live longer
- Lecture 4 - Summary of background material - Linear Algebra - I
- Lecture 5 - Summary of background material - Linear Algebra - II
- Lecture 6 - Summary of background material - Analysis - I
- Lecture 7 - Summary of background material - Analysis - II
- Lecture 8 - Summary of background material - Analysis - III
- Lecture 9 - Summary of background material - Calculus - I
- Lecture 10 - Summary of background material - Calculus - II
- Lecture 11 - Summary of background material - Calculus - III
- Lecture 12 - Example of Multivariate Differentiation
- Lecture 13 - Gradient of Quadratic form and product rule
- Lecture 14 - Directional derivative, hessian, and mean value theorem
- Lecture 15 - Unconstrained optimization - 1 - Roadmap of the course and Taylor's theorem
- Lecture 16 - Unconstrained optimization - 2 - Identifying a local minima - 1st and 2nd order conditions
- Lecture 17 - Unconstrained optimization - 3 - Proof of 1st Order Condition
- Lecture 18 - Unconstrained optimization - 4 - overview of algorithms and choosing a descent direction
- Lecture 19 - Unconstrained optimization - 5 - properties of descent directions steepest descent direction
- Lecture 20 - Unconstrained optimization - 6 - properties of descent directions newton direction
- Lecture 21 - Unconstrained optimization - 7 - Trust Region Methods
- Lecture 22 - A MATLAB session
- Lecture 23 - Introduction to Line Search
- Lecture 24 - Wolfe Conditions
- Lecture 25 - Strong Wolfe Conditions
- Lecture 26 - Backtracking Line Search
- Lecture 27 - Line Search - Analysis
- Lecture 28 - Line Search - Convergence and Rate - 1
- Lecture 29 - Line Search - Convergence and Rate - 2

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- Lecture 30 - Convergence analysis of a descent algorithm - 1
- Lecture 31 - Convergence analysis of a descent algorithm - 2
- Lecture 32 - Implementation of an optimization algorithm in MATLAB
- Lecture 33 - Conjugate Gradient Methods - Introduction and Proof
- Lecture 34 - Visualizing Quadratic Forms
- Lecture 35 - Orthogonality and Conjugacy
- Lecture 36 - Conjugate Directions Method - Introduction and Proof
- Lecture 37 - Discussion on doubts
- Lecture 38 - More on Conjugate Directions Method
- Lecture 39 - Ways of Generating Conjugate Directions
- Lecture 40 - Expanding Subspace Theorem
- Lecture 41 - Discussion on doubts
- Lecture 42 - Conjugate Gradient Method
- Lecture 43 - MATLAB implementation on CGM
- Lecture 44 - Discussion on doubts
- Lecture 45 - Preconditioned Conjugate Gradient - Part 1
- Lecture 46 - Preconditioned Conjugate Gradient - Part 2
- Lecture 47 - Preconditioned Conjugate Gradient - Part 3
- Lecture 48 - Non Linear Conjugate Gradient method
- Lecture 49 - Intro to Newton methods
- Lecture 50 - Newton methods and convergence
- Lecture 51 - Checks for positive definite matrices
- Lecture 52 - Hessian Modification
- Lecture 53 - Quasi newton methods
- Lecture 54 - BFGS method
- Lecture 55 - Least squares problems
- Lecture 56 - Linear least squares - Part 1
- Lecture 57 - Linear least squares - Part 2
- Lecture 58 - Solving least squares using SVD
- Lecture 59 - Non linear least squares
- Lecture 60 - Constrained Optimisation
- Lecture 61 - Single equality constraint
- Lecture 62 - Single inequality constraint - Part 1
- Lecture 63 - Single inequality constraint - Part 2
- Lecture 64 - Two inequality constraints example
- Lecture 65 - Linearised feasible directions
- Lecture 66 - Feasible sequences and tangent cone
- Lecture 67 - LICQ conditions
- Lecture 68 - KKT conditions (First order necessary conditions)

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- Lecture 69 - Proof sketch for KKT conditions - Part 1
- Lecture 70 - Proof sketch for KKT conditions - Part 2
- Lecture 71 - Introduction to Projected gradient descent
- Lecture 72 - Projected gradient descent and proof of convergence
- Lecture 73 - Proof of convergence - Part 2
- Lecture 74 - Subgradients and Subdifferential
- Lecture 75 - Projection onto  $l_1$  ball
- Lecture 76 - Soft thresholding example
- Lecture 77 - Recap of Projection onto  $l_1$  ball
- Lecture 78 - KKT and duality introduction
- Lecture 79 - Intuition of duality and dual problem
- Lecture 80 - Proof of concavity of the dual problem - Part 1
- Lecture 81 - Proof of concavity of the dual problem - Part 2
- Lecture 82 - Proof of concavity of the dual problem - Part 3