**Optimization for machine learning**

Unit-1:

**Introduction to Optimization:** Introduction to optimization problems and applications in machine learning, Convexity, convex functions, and convex optimization

**Unconstrained optimization**: Gradient descent, Newton's method, and their variants, Stochastic gradient descent

Unit-2:

**Constrained Optimization:** Linear programming and its applications in machine learning, Quadratic programming and its applications in machine learning, Nonlinear programming and its applications in machine learning

**Convex Optimization:** Convex optimization algorithms: sub gradient methods, projected gradient methods, interior point methods**.** Duality theory and its applications in machine learningConvex relaxation and its applications in machine learning

Unit-3:

**Large Scale Optimization**: Mini-batch gradient descent and stochastic gradient descent, Distributed optimization algorithms, Optimization for online learning

**Regularization and Sparsity:** L1 and L2 regularization**,** Elastic net regularization and its applications in machine learning**,** Group sparsity and its applications in machine learning

Unit-4:

**Advanced Optimization Techniques:** Conjugate gradient methods and their variants**,** Quasi-Newton methods and their variants**,** Trust region methods and their variants

**Optimization for Deep Learning:** Backpropagation and optimization in deep learning**,** Optimization for recurrent neural networks and long short-term memory networks**,** Optimization for generative models, such as variational autoencoders and generative adversarial networks

Text Books:

1. "Convex Optimization" by Stephen Boyd and Lieven Vandenberghe
2. "Optimization for Machine Learning" by Suvrit Sra, Sebastian Nowozin, and Stephen Wright
3. "Numerical Optimization" by Jorge Nocedal and Stephen J. Wright
4. "Stochastic Gradient Descent and Beyond" by Martin Jaggi
5. "Sparse Modeling: Theory, Algorithms, and Applications" by Irina Rish and Genady Grabarnik