1. **Calculus for Machine Learning**
   * **Introduction to Derivatives**[**Introduction to Derivatives**](https://www.youtube.com/watch?v=N2PpRnFqnqY)
   * **Partial Derivatives**[**Partial Derivatives Introduction**](https://www.youtube.com/watch?v=AXqhWeUEtQU)
   * **Chain Rule in Calculus**

[**Chain Rule**](https://www.youtube.com/watch?v=0T0QrHO56qg)[**Visualizing the Chain Rule and Produce Rule**](https://www.youtube.com/watch?v=YG15m2VwSjA)

**[Essence of Calculus](https://www.youtube.com/watch?v=WUvTyaaNkzM)**

* + **Auto-Differentiation in Deep Learning**[**What is Automatic Differentiation**](https://www.youtube.com/watch?v=wG_nF1awSSY)

[**What's Automatic Differentiation(Hugging Face)**](https://huggingface.co/blog/andmholm/what-is-automatic-differentiation)

* + **机器学习-数学基础 （第一章，第二章,第三章）**

[**https://www.bilibili.com/video/BV1VA4y1d78D/?spm\_id\_from=333.337.search-card.all.click**](https://www.bilibili.com/video/BV1VA4y1d78D/?spm_id_from=333.337.search-card.all.click)

1. **Linear Algebra Basics**
   * **Vectors, Matrices, and Tensors**[**Introduction to Vectors, Matrices & Tensors**](https://www.youtube.com/watch?v=z-w8G5GkTtU)

[**The Geometry of Linear Equations**](https://www.youtube.com/watch?v=J7DzL2_Na80&list=PL221E2BBF13BECF6C&index=4)

[**Multiplication and Inverse Matrices**](https://www.youtube.com/watch?v=FX4C-JpTFgY&list=PL221E2BBF13BECF6C&index=10&t=2s)

* + **Essence of Linear Algebra**
    - [**Vectors**](https://www.youtube.com/playlist?list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab)
    - [**Linear combinations, span, and basis vectors**](https://www.youtube.com/watch?v=k7RM-ot2NWY&list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab&index=3)
    - [**Linear transformations and matrices**](https://www.youtube.com/watch?v=kYB8IZa5AuE&list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab&index=3)
    - [**Matrix multiplication as composition**](https://www.youtube.com/watch?v=XkY2DOUCWMU&list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab&index=6)
    - [**Eigenvectors and eigenvalues**](https://www.youtube.com/watch?v=PFDu9oVAE-g&list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab&index=14)
  + **Matrix Decomposition (SVD, Eigenvalue Decomposition)**[**Singular Value Decomposition (SVD): Overview**](https://www.youtube.com/watch?v=gXbThCXjZFM)

[**Singular Value Decomposition (SVD): Mathematical Overview**](https://www.youtube.com/watch?v=nbBvuuNVfco&list=PLMrJAkhIeNNSVjnsviglFoY2nXildDCcv&index=3)

[**Singular Value Decomposition (SVD): Matrix Approximation**](https://www.youtube.com/watch?v=xy3QyyhiuY4)

[**Singular Value Decomposition (SVD) and Image Compression**](https://www.youtube.com/watch?v=QQ8vxj-9OfQ&list=PLMrJAkhIeNNSVjnsviglFoY2nXildDCcv&index=6)

* + **Matrix-Vector Calculus(Optional)**[**Matrix Differentiation - Derivatives With Respect to Scalars**](https://www.youtube.com/watch?v=YQ3YmbXHR5M&list=PLhcN-s3_Z7-YS6ltpJhjwqvHO1TYDbiZv&index=2)
  + **机器学习-数学基础 （第四章）**

[**https://www.bilibili.com/video/BV1VA4y1d78D/?spm\_id\_from=333.337.search-card.all.click**](https://www.bilibili.com/video/BV1VA4y1d78D/?spm_id_from=333.337.search-card.all.click)

1. **Probability & Statistics**
   * **Probability Introduction**

[**Introduction to Probability, Basic Overview**](https://www.youtube.com/watch?v=SkidyDQuupA)

[**Probability Bootcamp**](https://www.youtube.com/playlist?list=PLMrJAkhIeNNR3sNYvfgiKgcStwuPSts9V)

* + **Bayes' Theorem**[**Bayes theorem, the geometry of changing beliefs**](https://www.youtube.com/watch?v=HZGCoVF3YvM)
  + **Bayesian Statistics(Optional)**

[**Introduction to Bayesian statistics, part 1**](https://www.youtube.com/watch?v=0F0QoMCSKJ4)

[**Introduction to Bayesian statistics, part 2**](https://www.youtube.com/watch?v=OTO1DygELpY)

* + **机器学习-数学基础 （第五章，第六章）**

[**https://www.bilibili.com/video/BV1VA4y1d78D/?spm\_id\_from=333.337.search-card.all.click**](https://www.bilibili.com/video/BV1VA4y1d78D/?spm_id_from=333.337.search-card.all.click)

1. **Optimization Techniques**
   * **Convex Optimization**[**What Is Mathematical Optimization?**](https://www.youtube.com/watch?v=AM6BY4btj-M)
   * **Understanding Gradient Descent**[**Understanding Gradient Descent in AI/ML**](https://gogradientdescent.com/gradient-descent-in-ai-ml/)

[**Gradient Descent Explained**](https://www.youtube.com/watch?v=i62czvwDlsw)

[**STOCHASTIC Gradient Descent (in 3 minutes)**](https://www.youtube.com/watch?v=UmathvAKj80)

* + **Optimizers in Gradient Descent**

[**Optimizers - EXPLAINED!**](https://www.youtube.com/watch?v=mdKjMPmcWjY)

[**Optimization for Deep Learning (Momentum, RMSprop, AdaGrad, Adam)**](https://www.youtube.com/watch?v=NE88eqLngkg)

* + **梯度下降算法**

https://www.bilibili.com/video/BV1oY411N7Xz/?spm\_id\_from=333.337.search-card.all.click

<https://www.bilibili.com/video/BV14h4y1E71v/?spm_id_from=333.337.search-card.all.click>

1. **PyTorch**
   * **PyTorch Basics**[**Pytorch - Learn the Basics**](https://pytorch.org/tutorials/beginner/basics/intro.html#learn-the-basics)

[**Pytorch Beginner Series Videos**](https://www.youtube.com/playlist?list=PL_lsbAsL_o2CTlGHgMxNrKhzP97BaG9ZN)

* + **Neural Networks Models in PyTorch**[**Defining a Neural Network in PyTorch**](https://pytorch.org/tutorials/recipes/recipes/defining_a_neural_network.html#defining-a-neural-network-in-pytorch)

[**Models and pre-trained weights**](https://pytorch.org/vision/main/models.html#models-and-pre-trained-weights)

[**Building a Neural Network with PyTorch in 15 Minutes**](https://www.youtube.com/watch?v=mozBidd58VQ)

* + **Automatic Differentiation in PyTorch**[**Autograd Mechanism (Optional)**](https://www.youtube.com/playlist?list=PL_lsbAsL_o2CTlGHgMxNrKhzP97BaG9ZN)