Comprehensive Machine Learning & AI Engineering Resources

FREE RESOURCES (Priority Order)

1. Mathematics & Statistics Foundations

Linear Algebra & Calculus:

- Mathematics for Machine Learning: Linear Algebra - Imperial College London (Coursera) - FREE audit
- Mathematics for Machine Learning: Multivariate Calculus - Imperial College London (Coursera) - FREE audit
- Linear Algebra for Machine Learning - freeCodeCamp
- Khan Academy - Linear Algebra
- Khan Academy - Multivariable Calculus

Statistics & Probability:

- Khan Academy - Statistics and Probability
- Probability & Statistics for Machine Learning & Data Science - DeepLearning.AI (Coursera) - FREE audit
- MIT OpenCourseWare - Introduction to Probability and Statistics

2. Python Programming & Data Manipulation

Python Fundamentals:

- Python.org Official Tutorial
- freeCodeCamp - Python for Everybody
- Codecademy - Learn Python 3 - FREE tier available
- Programming MOOC - University of Helsinki - Highly recommended by developers

NumPy & Pandas:

- Kaggle Learn - Python - FREE with certificates
- Kaggle Learn - Pandas - FREE with certificates
- NumPy Official Documentation - Learn
- Pandas Official Documentation - 10 Minutes to Pandas

- W3Schools - Pandas Tutorial

Data Visualization:

- Kaggle Learn - Data Visualization - FREE with certificates
- Matplotlib Official Tutorials
- Seaborn Official Tutorial

3. Core Machine Learning

Beginner to Intermediate:

- Google's Machine Learning Crash Course - FREE, interactive, updated 2025
- Kaggle Learn - Intro to Machine Learning - FREE with certificates
- Kaggle Learn - Intermediate Machine Learning - FREE with certificates
- Machine Learning by Andrew Ng - Stanford (Coursera) - FREE audit
- Machine Learning with Python - IBM (Coursera) - FREE audit
- Scikit-learn Official Tutorials

Advanced Topics:

- Kaggle Learn - Feature Engineering - FREE with certificates
- Machine Learning Explainability - Kaggle - FREE with certificates
- Time Series - Kaggle - FREE with certificates

4. Deep Learning & Neural Networks

Fundamentals:

- Kaggle Learn - Intro to Deep Learning - FREE with certificates
- Neural Networks - 3Blue1Brown YouTube Series - FREE, excellent visual explanations
- Deep Learning Specialization - DeepLearning.AI (Coursera) - FREE audit

Framework-Specific:

- TensorFlow & Keras Free Course - OpenCV University - FREE, 3 hours
- PyTorch Bootcamp - OpenCV University - FREE, 5 hours
- Introduction to PyTorch - Udacity - FREE
- Practical Deep Learning for Coders - Fast.ai - FREE, highly practical

Computer Vision:

- Kaggle Learn - Computer Vision - FREE with certificates

- CS231n: Convolutional Neural Networks - Stanford (YouTube) - FREE

5. Natural Language Processing (NLP)

Fundamentals:

- Natural Language Processing Specialization - DeepLearning.AI (Coursera) - FREE audit
- CS224n: Natural Language Processing - Stanford (YouTube) - FREE
- Hugging Face NLP Course - FREE

Large Language Models:

- Google's Machine Learning Crash Course - Large Language Models - FREE, updated 2025
- LLM Agents MOOC 2024 - FREE

6. AI Engineering & MLOps

Production Systems:

- Google's Machine Learning Crash Course - Production ML Systems - FREE
- MLOps Specialization - DeepLearning.AI (Coursera) - FREE audit
- ML Zoomcamp 2025 - DataTalks.Club - FREE, 4-month course

Cloud Platforms:

- Google Cloud Skills Boost - Machine Learning - FREE tier available
- AWS Machine Learning Learning Path - FREE tier available
- Microsoft Learn - AI and Machine Learning - FREE

7. Ethics & Responsible AI

- Kaggle Learn - Intro to AI Ethics - FREE with certificates
- AI For Everyone - DeepLearning.AI (Coursera) - FREE audit
- Elements of AI - University of Helsinki - FREE

8. Practical Projects & Datasets

Project Platforms:

- Kaggle Competitions - FREE, real-world problems
- GitHub - Awesome Machine Learning Projects - FREE
- Papers With Code - FREE, state-of-the-art implementations

Datasets:

- Kaggle Datasets - FREE
- UCI Machine Learning Repository - FREE
- Google Dataset Search - FREE

9. YouTube Channels (FREE)

- 3Blue1Brown - Mathematical concepts with excellent visualizations
- StatQuest with Josh Starmer - Statistics and ML concepts explained simply
- Two Minute Papers - Latest AI research summaries
- Sentdex - Python programming and ML tutorials
- Machine Learning Explained - Comprehensive ML tutorials

10. Books (FREE Online)

- The Elements of Statistical Learning - FREE PDF
- Pattern Recognition and Machine Learning - Bishop - FREE PDF
- Hands-On Machine Learning (selected chapters) - FREE GitHub repository
- Deep Learning - Ian Goodfellow - FREE online

LOW-COST RESOURCES ($10-$50)

1. Comprehensive Courses

Udemy (Frequent Sales - $10-$15):

- Machine Learning A-Z: Hands-On Python & R In Data Science
- Deep Learning A-Z: Hands-On Artificial Neural Networks
- Python for Data Science and Machine Learning Bootcamp

Coursera Plus ($39/month - can complete multiple specializations):

- Access to all courses with certificates
- Can complete 2-3 specializations in one month

2. Books (Physical/Kindle)

- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow - ~$35
- Python Machine Learning - ~$30
- The Hundred-Page Machine Learning Book - ~$25

3. Platforms with Premium Features

DataCamp ($25/month):

- Interactive coding environment
- Structured learning paths
- Projects and assessments

Pluralsight ($29/month):

- Comprehensive tech courses
- Skill assessments
- Learning paths

CERTIFICATION OPTIONS

FREE Certificates:

- Kaggle Learn courses
- Google's Machine Learning Crash Course
- Elements of AI
- Fast.ai courses

LOW-COST Certificates ($39-$79):

- Coursera Specializations (with Coursera Plus)
- Google Cloud Professional ML Engineer (exam fee ~$200)
- AWS Certified Machine Learning - Specialty (exam fee ~$300)

RECOMMENDED LEARNING SEQUENCE

1. **Start with FREE resources in this order:**
    - Mathematics foundations (Khan Academy)
    - Python & Pandas (Kaggle Learn)
    - Machine Learning basics (Google ML Crash Course)
    - Deep Learning (Fast.ai or Kaggle)
    - Specialization areas (NLP, Computer Vision, etc.)

2. **Supplement with low-cost resources only if needed:**
    - For more structured learning (Coursera Plus)
    - For specific deep-dive topics (Udemy courses)
    - For reference materials (books)
3. **Focus on practical projects throughout:**
    - Use Kaggle competitions
    - Build GitHub portfolio
    - Apply to real-world problems

This resource list prioritizes free, high-quality content that will provide you with comprehensive knowledge without financial barriers.