AI Engineer Roadmap for Beginners

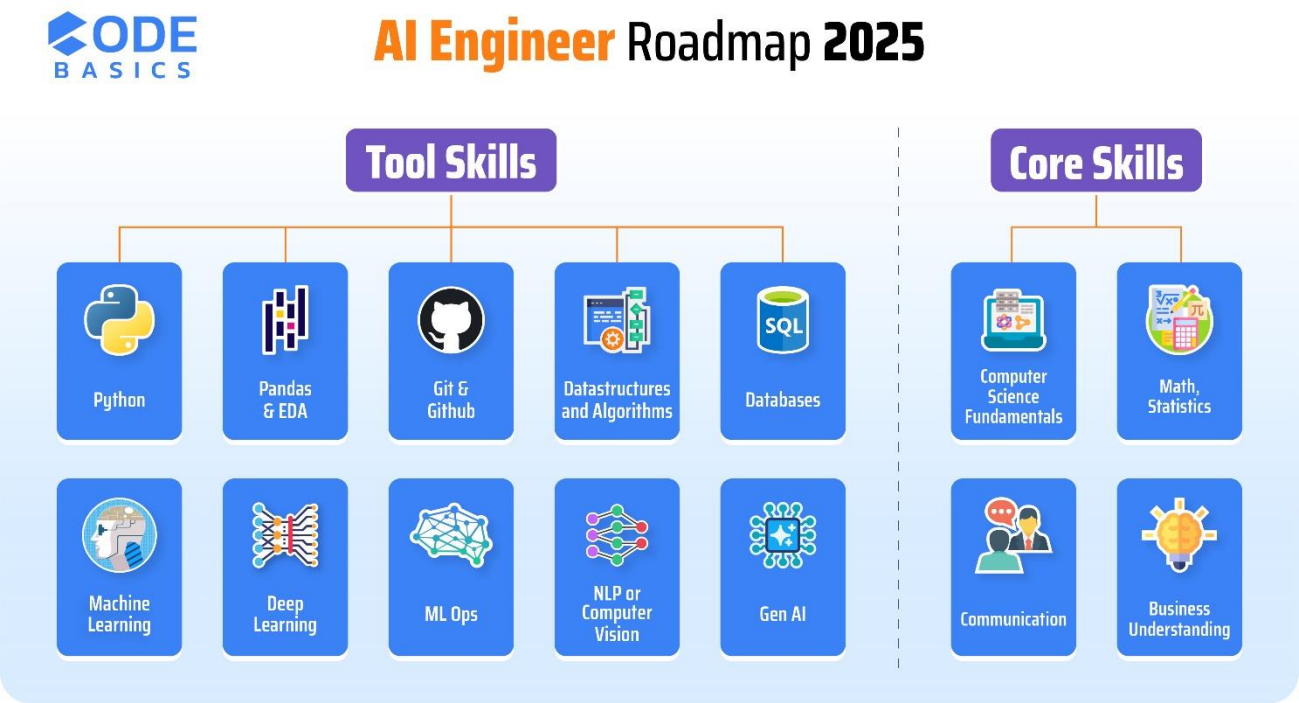
Following is the roadmap to learning **AI Engineer** (also known as **ML Engineer**) skills for a total beginner. It includes FREE learning resources for technical skills (or tool skills) and soft (or core) skills 🏃

Find Your Suitability: Before you start your learning journey, it is important you find out if AI engineering career really suits your natural abilities and interests. Take this test to know your suitability: https://codebasics.io/survey/find-your-match-ds

Proceed further if the results show that this career role matches you.

Total Duration: **8 Months** (**4 hours** of study every day, 6 days a week)

Also, **AI Engineer = Data Scientist + Software Engineer**



Week 0: Do Proper Research and protect yourself from SCAMS.

Unfortunately, a lot of systematic scams are happening in ed tech, especially in the data field where aspirants are provided with false promises like a 100% job guarantee or trapped into “Masterclasses” which are nothing but sales pitches to upsell their low-grade courses at exorbitant prices. You need to do complete research about the market and mentors before starting your journey. Providing you the links to a few posts that we have made in this regard which will support your research.

Even though these posts are **NOT** sufficient, do additional research.

- https://bit.ly/3Fl7cEh
- https://bit.ly/4at9Jaw
- https://bit.ly/477IOOs
- https://bit.ly/3GPD7dp

We have also made a mini course on scam awareness: https://codebasics.io/courses/scam-awareness-course

Week 1: Computer Science Fundamentals 💻

- **Topics**
  - Data representation: Bits and Bytes, Storing text and numbers, Binary number system.
  - Basics of computer networks, IP addresses, Internet routing protocol
  - UDP, TCP, HTTP, and The World Wide Web
  - Programming basics: variables, strings, and numbers, if condition, loops
  - Algorithm basics

- **Learning Resources**
  - Khan Academy course: https://bit.ly/42DUXtW
  - In the above course, only follow the first 4 sections (1) Digital Information (2) The Internet (3) Programming (4) Algorithms. Completing the remaining sections is optional. Do it if you have time and interest.
  - **EXTREMELY IMPORTANT**: Use ChatGPT 😎 as your personal tutor in case you have doubts and you need clarity on anything

Skip this section if you are already a software engineer, computer science student or know the above fundamentals due to whatever reason.

Week 2: Beginners Python

- **Topics**
  - Variables, Numbers, Strings
  - Lists, Dictionaries, Sets, Tuples
  - If condition, for loop
  - Functions, Lambda Functions
  - Modules (pip install)
  - Read, Write files
  - Exception handling
  - Classes, Objects

- **Learning Resources**
  - Track A (Free)
    - Python Tutorials (Codebasics) on YouTube (first 16 videos) - https://bit.ly/3X6CCC7
    - Corey's Python Tutorials: https://bit.ly/3uqUgaZ
    - Codebasics python HINDI tutorials - https://bit.ly/3vmXrgw
    - **EXTREMELY IMPORTANT**: Use ChatGPT as your personal tutor in case you have questions or facing issues
  - Track B (Affordable Fees)
    - AI Bootcamp: https://codebasics.io/bootcamps/ai-data-science-bootcamp-with-virtual-internship

- **LinkedIn - Core Skill**

  ✔☐ Create a professional-looking LinkedIn profile.
    - Have a clear profile picture and banner image.
    - Add tags such as: Open to work etc.

  ✔☐ Use this LinkedIn Checklist to create a profile: Click here.

- **Assignment**

  ✔☐ Track A: Finish all these exercises: https://bit.ly/3k1mof5
  ✔☐ Track B: Finish exercises and quizzes for relevant topics
  ✔☐ Create a professional-looking LinkedIn profile.

Week 3 and 4: Data Structures and Algorithms in Python

- **Topics**
  - Data structures basics, Big O notation
  - Data structures: Arrays, Linked List, Hash Table, Stack, Queue
  - Data structures: Tree, Graph
  - Algorithms: Binary search, Bubble sort, quick sort, merge sort
  - Recursion

- **Learning Resources**
  - DSA YouTube Playlist: https://bit.ly/3uiW2Lf

- **Motivation**
  - ML Engineer after 12th**:** https://bit.ly/3DqwLTY
- **Assignment**

  ☐ Finish all these exercises in this same playlist: https://bit.ly/3uiW2Lf

Week 5: Advance Python

- **Topics**
  - Inheritance, Generators, Iterators
  - List Comprehensions, Decorators
  - Multithreading, Multiprocessing

- **Learning Resources**
  - Python Tutorials (Codebasics) on YouTube (17th to 27th video) - https://bit.ly/3X6CCC7

- **Assignment**

  ☐ Finish all these exercises in this same playlist: https://bit.ly/3X6CCC7

- **Core/Soft Skills**
  - **Linkedin**
    - Start following prominent AI influencers.
      - Yann LeCun: https://www.linkedin.com/in/yann-lecun/
      - Daliana Liu: https://www.linkedin.com/in/dalianaliu/
      - Nitin Aggarwal: https://www.linkedin.com/in/ntnaggarwal/
      - Steve Nouri: https://www.linkedin.com/in/stevenouri/
      - Dhaval Patel: https://www.linkedin.com/in/dhavalsays/

    - Increase engagement.
      - Start commenting meaningfully on AI and career-related posts.
      - Helps network with others working in the industry build connections.
      - Learning and brainstorming opportunity.

    - Remember ***online presence is a new form of resume***

  - **Business Fundamentals - Soft Skill**
    - Learn business concepts from ThinkSchool and other YT Case Studies
    - Example: How Amul beat competition: https://youtu.be/nnwqtZiYMxQ

  - **Discord**
    - Start asking questions and get help from the community. This post shows how to ask questions the right way: https://bit.ly/3I70EbI
    - Join codebasics discord server: https://discord.gg/r42Kbuk

- **Assignment**

  ☐ Write meaningful comments on at least **10 AI related LinkedIn posts**

  ☐ Note down your key learnings from **3 case studies** on ThinkSchool and share them with your friend.

- **Motivation**
  - How Kaggle helped this person become ML engineer**:** https://bit.ly/3RFVruy

Week 6: Version Control (Git, Github) 📊

- **Topics**
  - What is the version control system? What is Git and GitHub?
  - Basic commands: add, commit, push.
  - Branches, reverting change, HEAD, Diff and Merge
  - Pull requests.

- **Learning Resources**
  - YT playlist (codebasics): https://bit.ly/3SECQQ7
  - YT playlist (Corey): https://bit.ly/3T0Yrmb

- **Core/Soft Skills**
  - Presentation skills
    - Death by PowerPoint: https://youtu.be/lwpi1Lm6dFo

Week 7, 8: Databases: Relational DB and SQL 🎲

- **Topics**
  - Basics of relational databases.
  - Basic Queries: SELECT, WHERE LIKE, DISTINCT, BETWEEN, GROUP BY, ORDER BY
  - Advanced Queries: CTE, Subqueries, Window Functions
  - Joins: Left, Right, Inner, Full
  - Database creation, indexes, stored procedures.

- **Learning Resources**
  - Track A
    - Khan academy SQL course: https://bit.ly/3WFku20
    - https://www.w3schools.com/sql/
    - https://sqlbolt.com/
    - YT video: https://youtu.be/Rm0xH2Vpfi0?si=6ZLK8A5LvGqN4NmT

- Track B
  - AI Bootcamp: https://codebasics.io/bootcamps/ai-data-science-bootcamp-with-virtual-internship

- **Assignment**
  - ☐ Participate in SQL resume project challenge on https://codebasics.io/
    - Link: https://codebasics.io/challenge/codebasics-resume-project-challenge/7
    - These challenges help you improve technical skills, soft skills and business understanding.
  - ☐ Make a LinkedIn post with a submission of your resume project challenge
    Sample post: https://bit.ly/48Bg5mB

Week 9: Databases: NoSQL DB 🎲

- **Topics**
  - NoSQL Fundamentals: Why NoSQL became popular – scalability challenges, unstructured data, real-time analytics etc.
  - Data Modeling in NoSQL
  - Base vs. ACID, Data Partitioning and Sharding, Replication, CAP Theorem

- **Learning Resources**
  - How do NoSQL DB work: https://bit.ly/3XMIKmF
  - MongoDB Tutorial: https://bit.ly/3DKf9ST

- **Motivation**
  - Mechanical to Deep Learning Engineer: https://bit.ly/48IX9aR

Week 10: Numpy, Pandas, Data Visualization 📊

- **Tech Skills**
  - **Numpy**
    - numpy YouTube playlist: https://bit.ly/3GTppa8

- **Pandas, Matplotlib, Seaborn**
  - Go through chapter 5 in this course (entire chapter is free): https://codebasics.io/courses/math-and-statistics-for-data-science

Week 11, 12, 13: Math & Statistics for AI

- **Math and Statistics for AI**
  - Topics to Learn
    - Basics: Descriptive vs inferential statistics, continuous vs discrete data, nominal vs ordinal data
    - Linear Algebra: Vectors, Metrices, Eigenvalues and Eigenvectors
    - Calculus: Basics of integral and differential calculus
    - Basic plots: Histograms, pie charts, bar charts, scatter plot etc.
    - Measures of central tendency: mean, median, mode
    - Measures of dispersion: variance, standard deviation
    - Probability basics
    - Distributions: Normal distribution
    - Correlation and covariance
    - Central limit theorem
    - Hypothesis testing: p value, confidence interval, type 1 vs type 2 error, Z test
  - Learning Resources
    - Track A (Free)
      - Learn the above topics from this excellent Khan academy course on statistics and probability.
      - Course link: https://www.khanacademy.org/math/statistics-probability
      - While doing khan academy course, when you have doubts, use statquest YouTube channel: https://www.youtube.com/@statquest
      - Use this free YouTube playlist: https://bit.ly/3QrSXis
      - Another great youtube channel: https://www.youtube.com/@3blue1brown

        - Track B (Affordable Fees)
            - Learn the key concepts of Math and Statistics that lay the foundations for a strong data science career: https://codebasics.io/courses/math-and-statistics-for-data-science

- **Assignment**
    - ☐ Finish all exercises in this playlist: https://bit.ly/3QrSXis
    - ☐ Finish all exercises in Khan academy course.
    - ☐ Track B: Finish exercises and quizzes for relevant topics.

Week 14: Exploratory Data Analysis (EDA) 👨‍🎓

- **Exploratory Data Analysis (EDA)**
    - Online retail analysis tutorial: https://bit.ly/420JrtT
    - https://www.kaggle.com/code?searchQuery=exploratory+data+analysis
    - Use the above link to search for exploratory data analysis notebooks.
    - Practice EDA using at least 3 datasets.
        - e.g. https://www.kaggle.com/datasets/rishabhkarn/ipl-auction-2023/data

- **Assignment**
    - ☐ Perform EDA (Exploratory data analysis on **at least 2 additional datasets** on Kaggle)

Week 15, 16, 17, 18: Machine Learning ⚒️

- **Machine Learning: Preprocessing**
    - Handling NA values, outlier treatment, data normalization
    - One hot encoding, label encoding
    - Feature engineering
    - Train test split
    - Cross validation

- **Machine Learning: Model Building**
  - Types of ML: Supervised, Unsupervised
  - Supervised: Regression vs Classification
  - Linear models
    - Linear regression, logistic regression
    - Gradient descent
  - Nonlinear models (tree-based models)
    - Decision tree
    - Random forest
    - XGBoost
  - Model evaluation
    - Regression: Mean Squared Error, Mean Absolute Error, MAPE
    - Classification: Accuracy, Precision-Recall, F1 Score, ROC Curve, Confusion matrix
  - Hyperparameter tunning: GridSearchCV, RandomSearchCV
  - Unsupervised: K means, Hierarchical clustering, Dimensionality reduction (PCA)

- **Learning Resources**
  - Track A
    - YouTube playlist (more than 2 million views): https://bit.ly/3io5qqX
    - First 21 videos
    - Feature engineering playlist: https://bit.ly/3IFa3Yf
  - Track B (Affordable Fees)
    - AI Bootcamp: https://codebasics.io/bootcamps/ai-data-science-bootcamp-with-virtual-internship

- **Core/Soft Skills**
  - **Project Management**
    - Scrum: https://scrumtrainingseries.com/
    - Kanban: https://youtu.be/jf0tlbt9lx0
    - Tools: JIRA, Notion

- **Assignment**
  - ☐ Complete all exercises in ML playlist: https://bit.ly/3io5qqX
  - ☐ Work on **2 Kaggle ML notebooks**
  - ☐ Write **2 LinkedIn posts** on whatever you have learnt in ML
  - ☐ Discord: Help people with **at least 10 answers**
  - ☐ Track B: Finish exercises and quizzes for relevant topics

Week 19: ML Ops ☸

- **Topics**
  - What is ML Ops? Experiment Tracking with MLFlow
  - What is API? FastAPI for Python server development
  - DevOps Fundamentals: CI/CD pipelines, containerization (Docker, Kubernetes)
  - Familiarity with at least one cloud platform (AWS, Azure etc.)

- Learning Resources
  - Track A:
    - What is ML Ops: https://bit.ly/3R4uGA0
    - FastAPI tutorial: https://bit.ly/497p6Ex
    - MLFlow Tutorial: https://bit.ly/497p6Ex
    - Docker Tutorial: https://bit.ly/3uCNpeE
  - Track B (Affordable Fees):
    - AI Bootcamp: https://codebasics.io/bootcamps/ai-data-science-bootcamp-with-virtual-internship

Week 20, 21: Machine Learning Projects 🎯

- You need to finish **two** end to end ML projects. One on **Regression**, the other on **Classification**

- Regression Project: Bangalore property price prediction
  - YouTube playlist link: https://bit.ly/3ivycWr

    - Project covers the following
        - Data cleaning
        - Feature engineering
        - Model building and hyper parameter tuning
        - Write flask server as a web backend
        - Building website for price prediction
        - Deployment to AWS

- Classification Project: Log Classification System
    - YouTube link: https://bit.ly/4hu5EoL
    - Project covers the following
        - How to use hybrid approach (regex, BERT, Logistic Regression and LLM) for classification)
        - DB Scan clustering
        - Building FastAPI Backend

- **ATS Resume Preparation**
    - Resumes are dying but not dead yet. Focus more on online presence.
    - Here is the resume tips video along with some templates you can use for your data analyst resume: https://www.youtube.com/watch?v=buQSI8NLOMw
    - Use this checklist to ensure you have the right ATS Resume: Check here.

- **Portfolio Building Resources:**
  You need a portfolio website in 2025. You can build your portfolio by using these free resources.

    - GitHub
        - Upload your projects with code on github and using github.io create a portfolio website
        - Sample portfolio website: http://rajag0pal.github.io/
        - Codebasics bootcamp student portfolio: https://codebasics.io/portfolio/Rachana-Hadke

    - Linktree
        - Helpful to add multiple links in one page.

- **Assignment**
  - In above two projects make following changes

    ☐ Use **FastAPI** instead of **flask**. FastAPI tutorial: https://youtu.be/Wr1JjhTt1Xg

    ☐ **Regression project**: Instead of property prediction, take any other project of your interest from Kaggle for regression

    ☐ **Classification project**: Instead of log classification, take any classification project using a Kaggle dataset and build end to end solution along with **deployment to AWS or Azure**

    ☐ Add a link of your projects in your resume and LinkedIn.

    (Tag Codebasics, Dhaval Patel and Hemanand Vadivel with the hashtag #dsroadmap24 so we can engage to increase your visibility)

Week 22, 23, 24, 25: Deep Learning 🤖

- **Topics**
  - What is a neural network? Forward propagation, back propagation
  - Building multilayer perceptron
  - Special neural network architectures
    - Convolutional neural network (CNN)
    - Sequence models: RNN, LSTM
    - Transformers

- **Learning Resources**
  - Track A (Free)
    - Deep Learning playlist (tensorflow): https://bit.ly/3vOZ3zV
    - End to end potato disease classification project: https://bit.ly/3QzkVJi
  - Track B (Affordable Fees):
    - AI Bootcamp: https://codebasics.io/bootcamps/ai-data-science-bootcamp-with-virtual-internship

- **Assignment**

  ☐ Instead of potato plant images use tomato plant images or some other image classification dataset.

  ☐ Deploy to Azure instead of GCP.

  ☐ Create a presentation as if you are presenting to stakeholders and upload video presentation on LinkedIn.

Week 26, 27, 28: NLP or Computer Vision

- Many AI engineers choose a specialized track which is either NLP or Computer vision. You don't need to learn both.

- **Natural Language Processing (NLP)**
  - Topics
    - Regex
    - Text presentation: Count vectorizer, TF-IDF, BOW, Word2Vec, Embeddings
    - Text classification: Naïve Bayes
    - Fundamentals of Spacy & NLTP library
    - One end to end project
  - Learning Resources
    - NLP YouTube playlist: https://bit.ly/3XnjfEZ

- **Computer Vision (CV)**
  - Topics
    - Basic image processing techniques: Filtering, Edge Detection, Image Scaling, Rotation
    - Library to use: OpenCV
    - Convolutional Neural Networks (CNN) – Already covered in deep learning.
    - Data preprocessing, augmentation – Already covered in deep learning.

- **Assignment**
  - ☐ NLP Track: Complete exercises in this playlist: https://bit.ly/3XnjfEZ

Week 29, 30: Gen AI (Including AI Agents)

- Topics
  - What is LLM, Vector database, Embeddings?
  - RAG (Retrieval Augmented Generation)
  - Langchain framework
  - AI Agents, Agno (previously called phidata) framework

- Learning Resources
    - Gen AI crash course: https://bit.ly/3Fn7Zoh
    - AI Agents Tutorial: https://bit.ly/4io8YD5

Week 31, 32: Gen AI Projects 📃

- Topics
    - Projects that include using LLMs, RAG, Agents to solve real life problems
- Learning Resources
    - Gen AI project playlist: https://bit.ly/4ilzEnX

Week 33 onwards... 😃 😃 😃

- More projects 📽️
- Online brand building through LinkedIn, Kaggle, Discord, Opensource contribution 👯
- Job application and Success 🚀

Tips of effective learning 🔥

- **Spend less time in consuming information, more time in**
    - Digesting
    - Implementing
    - Sharing
- **Group learning**
    - Use **partner-and-group-finder** channel on codebasics discord server for group study and hold each other accountable for the progress of your study plan. Here is the discord server link: https://discord.gg/r42Kbuk