# Python Learning Roadmap for AI, ML, Deep Learning, and Generative AI

This roadmap provides a structured approach to learning Python for the key AI domains: **Artificial Intelligence, Machine Learning, Deep Learning, and Generative AI**. It includes recommended tools, libraries, and project ideas to help build expertise progressively.

## 1. Artificial Intelligence (AI)

Focus: Logic, reasoning, NLP, planning, and decision-making systems.

Recommended Python Tools & Libraries:  
- Numpy, Pandas: Data structures and computation  
- NLTK, spaCy: Natural Language Processing  
- OpenAI Gym: Reinforcement-learning environments  
- SymPy, PyDatalog: Symbolic logic and reasoning

Sample Project: Build a rule-based chatbot that can answer basic queries using logical rules and NLP.

## 2. Machine Learning (ML)

Focus: Building models that learn from data to make predictions or decisions.

Recommended Python Tools & Libraries:  
- scikit-learn: Core ML algorithms (regression, classification, clustering)  
- XGBoost, LightGBM: Gradient boosting models  
- Pandas, Matplotlib, Seaborn: Data analysis and visualization  
- MLflow, Optuna: Experiment tracking and hyperparameter tuning

Sample Project: Create a predictive model for customer churn using scikit-learn and visualize key features.

## 3. Deep Learning

Focus: Building neural networks to learn complex patterns from high-dimensional data.

Recommended Python Tools & Libraries:  
- TensorFlow, Keras, PyTorch: Deep learning frameworks  
- OpenCV: Image processing  
- Librosa: Audio feature extraction  
- Hugging Face Transformers: Pre-trained deep NLP models

Sample Project: Build a convolutional neural network (CNN) for handwritten digit recognition (MNIST).

## 4. Generative AI

Focus: Generating realistic content such as text, images, music, or code.

Recommended Python Tools & Libraries:  
- Transformers (Hugging Face): Large language models (e.g., GPT, BERT)  
- Diffusers: Image generation models (e.g., Stable Diffusion)  
- LangChain, LlamaIndex, Haystack: Building LLM applications  
- Gradio, Streamlit, FastAPI: Model prototyping and deployment

Sample Project: Create a web-based text-to-image generator using Stable Diffusion and Gradio.