

Course Syllabus: AI Research Engineer

Course Title: Pioneering the Future: Cutting-Edge AI Research and Prototyping

Target Audience: Suitable for aspiring AI researchers, data scientists, engineers, and students interested in advancing AI technology. Basic programming knowledge (e.g., Python) and curiosity about AI innovation are helpful but not required.

Course Level: Comprehensive program covering Basic, Intermediate, and Advanced levels.

Duration: 12 weeks (flexible for self-paced learning).

Course Description:

This course trains students to become AI Research Engineers, exploring and developing cutting-edge AI techniques and prototypes. You'll learn to design experiments, implement novel algorithms, and push the boundaries of AI, like improving recommendation systems for platforms like Zomato. From foundational machine learning to advanced research in large language models (LLMs) and computer vision, you'll build skills to innovate and publish in AI.

Learning Objectives:

Upon completion, students will be able to:

- Understand core AI concepts and research methodologies.
- Design and conduct experiments to test new AI techniques.
- Implement and evaluate machine learning models using Python.
- Explore advanced AI topics (e.g., transformers, generative models).
- Address ethical considerations in AI research.
- Develop a portfolio of AI research prototypes and papers.

Course Structure:

Part 1: Basic Foundations (Weeks 1-4)

This section introduces AI research and foundational machine learning concepts.

- Week 1: Introduction to AI Research
 - What is an AI Research Engineer? Role and impact.
 - Overview of AI: ML, deep learning, generative AI.
 - Research process: Hypothesis, experimentation, evaluation.
 - Case Study: Improving Zomato's recommendation system.
- Week 2: Machine Learning Basics
 - Core concepts: Supervised, unsupervised, reinforcement learning.
 - Python tools: NumPy, pandas, scikit-learn.
 - Hands-on: Build a simple classifier (e.g., predict restaurant ratings).
- Week 3: Experiment Design
 - Formulating research questions and hypotheses.
 - Metrics: Accuracy, precision, recall, F1-score.
 - Exercise: Design an experiment to improve an AI model's performance.
- Week 4: Research Tools and Frameworks
 - Frameworks: TensorFlow, PyTorch, Hugging Face.
 - Data preprocessing and visualization.
 - Hands-on Project: Create a prototype to predict food delivery times.

Part 2: Intermediate Concepts (Weeks 5-8)

This section focuses on implementing and evaluating AI models.

- Week 5: Deep Learning Fundamentals
 - Neural networks: Architecture, layers, activation functions.
 - Training models: Backpropagation, gradient descent.
 - Hands-on: Build a neural network for image classification.
- Week 6: Advanced Model Architectures
 - Convolutional Neural Networks (CNNs) for vision tasks.
 - Recurrent Neural Networks (RNNs) for sequential data.
 - Case Study: Using RNNs for Zomato order tracking predictions.
- Week 7: Experimentation and Evaluation
 - A/B testing and cross-validation for model evaluation.
 - Overfitting and regularization techniques.
 - Hands-on: Evaluate a model's performance on a sample dataset.
- Week 8: Research Paper Analysis
 - Reading and summarizing AI research papers.
 - Reproducing results from a published paper.
 - Hands-on Project: Implement a simple transformer model from a paper.

Part 3: Advanced & Expert-Level Application (Weeks 9-12)

This section prepares students for cutting-edge AI research and publication.

- Week 9: Generative AI and Transformers
 - Transformers: BERT, GPT, and beyond.
 - Generative models: GANs, diffusion models.
 - Exercise: Fine-tune a transformer for text generation.
- Week 10: Multimodal AI Research
 - Combining vision, text, and audio (e.g., for restaurant reviews).
 - Research trends: CLIP, DALL-E, multimodal LLMs.
 - Hands-on: Prototype a multimodal AI for Zomato's menu analysis.
- Week 11: Ethics in AI Research
 - Bias in research: Data, model, and societal impacts.
 - Responsible AI: Transparency, reproducibility.
 - Exercise: Analyze ethical risks in an AI prototype.
- Week 12: Capstone Project & Publication
 - Capstone Project: Develop and evaluate a novel AI prototype (e.g., a new recommendation algorithm).
 - Writing a research paper: Structure, peer review process.
 - Career paths: Academia, industry research, startups.

Assignments & Grading:

- - Weekly Coding Labs & Exercises: 25%
- - Intermediate Projects (Weeks 4 & 8): 30%
- - Capstone Project: 35%
- - Class Participation & Paper Reviews: 10%