Programmed Electives - Jointly offered by Vizuara and SPIT

Program Duration: 1 Year

Key highlights

Generative AI Mastery

Live Lectures by IITians, MIT PhDs, Industry Experts

Capstone Project for Real-World Applications

Program Overview

The Programmed Electives program offers students in-depth knowledge and hands-on experience in cutting-edge topics related to Generative AI and Large Language Models (LLMs). Through live lectures by industry experts and hands-on projects, participants will gain advanced skills in building, deploying, and applying LLMs in real-world scenarios.

Certificate

Upon successful completion, participants will be awarded a **Programmed Electives** certificate from Vizuara and SPIT.

Program Structure

The Programmed Electives are divided into four key topics, each focusing on specific aspects of Generative AI and Large Language Models.

Minor in Artificial Intelligence							
Semester No.	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
5	Generative AI Fundamentals	3	0	0	3	6	3
5	Build your own GPT from Scratch	3	0	0	5	8	3
6	LLM Production and Deployment	2	0	1	5	8	3
6	LLM Capstone Project	2	0	1	6	9	3
Total		**10**	**0**	**2**	**19**	**31**	**12**

Table 1: Vizuara-SPIT Minor in Artificial Intelligence program structure

Program Benefits

- Certificate in Programmed Electives upon completion
- Live interaction with industry experts
- Hands-on learning through projects and labs
- Practical exposure through real-world capstone projects
- Networking opportunities with professionals in the field

Course 1: Generative AI Fundamentals (3 credits)

Module No.	Unit No.	Topics	Ref.	Hours
Title: Generative AI Introduction				
1	1.1	Introduction to Generative AI: Basic principles of generative models and their applications	1,2	2
	1.2	Overview of Generative Models: Introduction to GANs (Generative Adversarial Networks) and VAEs (Variational Autoencoders)	1,2	2
	1.3	Transformers for Generation: The role of transformers in generative AI	1,2	3
	1.4	Practical Session: Building a simple GAN or VAE model using TensorFlow or PyTorch	1,2	3
Title: Applications of Generative AI				
2	2.1	Real-World Use Cases: Generative AI in text generation, art creation, and synthetic data	3, 5	3
	2.2	Industry Applications: Generative AI in healthcare, entertainment, and creative industries	3, 5	2
	2.3	Practical Session: Exploring generative AI tools for art or text generation	3, 5	3
Title: What are industries in Generative AI doing?				
3	3.1	Role of Open source and Closed source Generative AI models	1	3
	3.2	Role of industries in advancing Generative AI: OpenAI, NVIDIA, Mistral, Perplexity	1	3
Title: Ethical Considerations in Generative AI				
4	4.1	Bias in Generative Models: Understanding how biases manifest in generative AI systems	4	3
	4.2	Ethical Considerations: The ethical implications of generative AI, including misuse, deepfakes, and copyright issues	4	3

Table 2: Detailed Module Breakdown for Generative AI Fundamentals Course

Course Objectives (CO): ***At the end of the course, students will be able to***	
CO 1	Understand the basic principles of generative models like GANs, VAEs, and Transformers.
CO 2	Explore and apply real-world use cases of generative AI, including art creation and text generation.
CO 3	Understand the role of key industry players like OpenAI, NVIDIA, and PERPLEXITY in AI development.
CO 4	Execute hands-on projects using generative AI techniques for image, text, and audio generation.
CO 5	Contribute to AI research by converting projects into research papers with a focus on impactful writing.

Table 3: Course Objectives for Generative AI Mastery Course

Pre-requisite Courses, if any
A basic understanding of machine learning techniques (supervised and unsupervised learning). Familiarity with Python programming, linear algebra, and probability theory is recommended.

Table 4: Prerequisites for Generative AI Mastery Course

Sr. No.	Title	Creators	Publisher
1	Generative Deep Learning	David Foster	O'Reilly Media
2	Deep Learning	Ian Goodfellow, Yoshua Bengio, and Aaron Courville	MIT Press
3	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurelien Geron	O'Reilly Media
4	The Alignment Problem: Machine Learning and Human Values	Brian Christian	W.W. Norton
5	Transformer Models for NLP: Building AI Applications with Hugging Face	Denis Rothman	Packt Publishing

Table 5: Reference Materials for Generative AI Mastery Course

Course 2: Build your own GPT from Scratch (3 credits)

Module No.	Unit No.	Topics	Ref.	Hours
Title: Introduction				
1	1.1	Introduction to Language Models: Overview of Language Models, History of NLP, Introduction to Pre-trained Models (ELMo, GPT, BERT)	1,2	3
	1.2	Tokenization Techniques: Byte Pair Encoding (BPE), WordPiece, SentencePiece, Subword Units	1,2	4
	1.3	Practical Session: Tokenization and Embedding Implementation in Python using Hugging Face library	1,2	3
Title: Language Model Architectures				
2	2.1	Overview of Language Model Architectures: Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), Transformers	1,2	3
	2.2	Transformer Architecture: Multi-head Attention, Positional Encoding, Feed-Forward Networks, Layer Normalization	1,2	4
	2.3	Attention Mechanism: Self-Attention, Cross-Attention, Scaled Dot-Product Attention	1,2	5
	2.4	Practical Session: Building Transformer Architecture from Scratch using TensorFlow/PyTorch	1,2	3
Title: Training Large Language Models				
3	3.1	Data Collection: Sourcing Open-source Datasets, Dataset Preprocessing for Language Model Training	1,2	4
	3.2	Training Techniques: Mini-batch Gradient Descent, Adam Optimizer, Learning Rate Schedulers	1,2	5
	3.3	Overfitting and Generalization: Regularization Methods, Dropout, Early Stopping	1,2	4
	3.4	Practical Session: Training a GPT Model from Scratch using Open-source Datasets (WikiText, Common Crawl)	1,2	4

Table 6: Detailed Module Breakdown for Build your own GPT from Scratch Course

Course Objectives (CO): ***At the end of the course, students will be able to***	
CO 1	Explore and implement tokenization and embedding techniques like Word2Vec, BERT embeddings, and Byte Pair Encoding (BPE).
CO 2	Build and train a Transformer model from scratch using TensorFlow or PyTorch.
CO 3	Execute and evaluate a large language model (LLM) using open-source datasets like WikiText and Common Crawl.
CO 4	Students will learn how to build their own GPT!

Table 7: Course Objectives for Build your own GPT from scratch

Pre-requisite Courses, if any
Course 1 (Generative AI Fundamentals) needs to be completed. Strong knowledge of linear algebra, tensors, probability and machine learning fundamentals is recommended

Table 8: Prerequisites for Build your own GPT from scratch Course

Sr. No.	Title	Creators	Publisher
1	Build a LLM from Scratch	Sebastian Raschka	Manning publications
2	LLMs and Generative AI	Dr. Raj Dandekar, Dr. Rajat Dandekar and Dr. Sreedath Panat	Vizuara AI org
3	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurelien Geron	O'Reilly Media

Table 9: Reference Materials for Build your own GPT from scratch Course

Course 3: LLM Production and Deployment (3 credits)

Module No.	Unit No.	Topics	Ref.	Hours
Title: Fine-Tuning LLMs				
1	1.1	Introduction to Fine-Tuning: Importance of fine-tuning LLMs, methods for task-specific optimization	1	3
	1.2	Optimization for Faster Inference: Techniques for reducing latency, using model compression and quantization	1	3
	1.3	Hyperparameter Tuning: Exploring various hyperparameters to improve LLM performance on specific tasks	1	2
Title: Retrieval Augmented Generation (RAG) and Applications				
2	2.1	Introduction to RAG: How RAG integrates external knowledge bases with LLMs to enhance response accuracy	1	3
	2.2	Real-World Applications of RAG: Enhancing responses in industries like healthcare, finance, and customer support	1	3
	2.3	Practical Session: Implementing RAG in a healthcare or customer support scenario using publicly available knowledge bases	1	3
Title: Making LLM applications production ready				
3	3.1	Production-Ready LLMs: Overview of transforming a trained model into a production-ready application, best practices for deployment	1	4
	3.2	Workflow for Production: Setting up environments, handling model versioning, scaling up production systems	1	3
	3.3	Monitoring and Maintenance: Monitoring deployed LLMs for performance and drift, updating models post-deployment	1	3
	3.4	Practical Session: Steps to deploy a production-ready LLM using Docker and Kubernetes	1	3
Title: Deployment Techniques				
4	4.1	Cloud Deployment: Deploying LLMs in cloud environments (AWS, GCP, Azure), scaling models in the cloud	1	3
	4.2	Practical Session: Hands-on deployment in both cloud and on-premise environments	1	3

Table 10: Detailed Module Breakdown for LLM Production and Deployment Course

Course Objectives (CO): ***At the end of the course, students will be able to***	
CO 1	Fine-tune LLMs for task-specific applications, optimizing for performance and reducing latency through techniques like model compression and quantization.
CO 2	Apply Retrieval-Augmented Generation (RAG) to enhance LLMs using external knowledge bases, and understand its applications in various industries.
CO 3	Set up workflows for production, including environment setup, versioning, and scaling production systems.
CO 4	Deploy LLMs in cloud and on-premise environments, exploring best practices and hardware considerations.

Table 11: Course Objectives for LLM Production and Deployment

Pre-requisite Courses, if any
Course 2 (Build your own GPT from Scratch) should be completed

Table 12: Prerequisites for LLM Production and Deployment Course

Sr. No.	Title	Creators	Publisher
1	LLMs and Generative AI	Dr. Raj Dandekar, Dr. Rajat Dandekar and Dr. Sreedath Panat	Vizuara AI org
2	Building LLMs for production	Louis-Francois Bouchard, Louie Peters	O'Reilly

Table 13: Reference Materials for LLM Production and Deployment Course

Course 4: LLM Capstone Project (3 credits)

Module No.	Unit No.	Topics	Ref.	Hours
Title: LLM Capstone Project Introduction				
1	1.1	Project Planning: Defining objectives, timelines, and deliverables based on industry needs	1,2	6
	1.2	Data Collection: Sourcing and preprocessing data for the project, ensuring data quality	1,2	4
	1.3	Project Design: Architecting the LLM pipeline, selecting the model, and defining the workflow	1,2	5
Title: Model Implementation				
2	2.1	Model Selection: Choosing the appropriate LLM architecture (e.g., GPT, BERT) for the project	1,2	5
	2.2	Model Training: Implementing the entire LLM training pipeline using open-source datasets	1,2	6
	2.3	Deployment Setup: Setting up the environment for deploying the LLM in production	1,2	4
	2.4	Practical Session: End-to-end implementation of the model pipeline (training to deployment)	1,2	6
Title: Testing and Optimization				
3	3.1	Testing LLMs: Creating test cases and evaluating model performance on different datasets	1,2	5
	3.2	Optimization: Techniques to optimize for scalability, accuracy, and speed (pruning, quantization)	1,2	4
	3.3	Practical Session: Testing and optimizing the LLM for real-world scalability and performance	1,2	6
Title: Project to Publication				
4	4.1	Report Writing: Structure and components of a comprehensive project report (abstract, methodology, results, discussion)	1,2	5
	4.2	Presentation of Results: Visualizing key findings, creating slides for presenting the project	1,2	4
	4.3	Practical Session: Submit paper to an appropriate journal or conference	1,2	6

Table 14: Detailed Module Breakdown for LLM Capstone Project Course

Course Objectives (CO): ***At the end of the course, students will be able to***	
CO 1	Plan, design, and execute a comprehensive capstone project by defining objectives, sourcing data, and architecting an LLM pipeline.
CO 2	Select, train, and implement the appropriate LLM architecture for real-world use cases, from model training to deployment.
CO 3	Test and optimize the LLM for scalability, accuracy, and performance using industry-standard techniques like pruning and quantization.
CO 4	Prepare a detailed project report and submit to a journal for publication.

Table 15: Course Objectives for LLM Capstone Project

Pre-requisite Courses, if any
Course 2 (Build your own GPT from scratch) and Course 3 (LLM Production and Deployment) should be completed.

Table 16: Prerequisites for LLM Capstone Project Course

Sr. No.	Title	Creators	Publisher
1	LLMs and Generative AI	Dr. Raj Dandekar, Dr. Rajat Dandekar and Dr. Sreedath Panat	Vizuara AI org

Table 17: Reference Materials for LLM Capstone Project course