AI CERTs™

# AI+ Engineer™ (5 Days)

Program Detailed Curriculum


## Executive Summary

The AI+ Engineer certification program offers a structured journey through the foundational principles, advanced techniques, and practical applications of Artificial Intelligence (AI). Beginning with the Foundations of AI, participants progress through modules covering AI Architecture, Neural Networks, Large Language Models (LLMs), Generative AI, Natural Language Processing (NLP), and Transfer Learning using Hugging Face. With a focus on hands-on learning, students develop proficiency in crafting sophisticated Graphical User Interfaces (GUIs) tailored for AI solutions and gain insight into AI communication and deployment pipelines. Upon completion, graduates are equipped with a robust understanding of AI concepts and techniques, ready to tackle real-world challenges and contribute effectively to the ever-evolving field of Artificial Intelligence.

## Course Prerequisites

- AI+ Data or AI Developer course should be completed
- Basic understanding of Python
- Basic Math: Familiarity with high school-level algebra and basic statistics
- Python Programming: Proficiency in Python is mandatory for hands-on exercises and project work.
- Computer Science Fundamentals: Understanding basic programming concepts (variables, functions, loops) and data structures (lists, dictionaries).

Module 1

## Foundations of Artificial Intelligence

### 1.1 Introduction to AI

- **Historical Perspective:** Brief exploration of the historical evolution of Artificial Intelligence, tracing key developments and milestones that have shaped the field.
- **What is AI?** : Definition and fundamental concepts of Artificial Intelligence, setting the stage for a deeper exploration of its applications and implications.

### 1.2 Core Concepts and Techniques in AI

- **Machine Learning Fundamentals**: Introduction to the core principles of Machine Learning (ML), covering its different types (supervised, unsupervised, reinforcement) and highlighting common applications in the engineering domain.
- **Introduction to Deep Learning**: Clarification of the relationship between Deep Learning and Machine Learning. Insight into the use of Deep Learning in various AI applications, emphasizing its advantages and limitations.

- **Data: The Fuel of AI** : Discussion on the critical importance of data in AI development. Highlights include the role of data in influencing model performance, along with an overview of data collection, cleaning, and preparation processes.

### 1.3 Ethical Considerations

- **Bias, Fairness, Transparency, and Accountability**: Examining ethical dimensions in AI focuses on potential biases, fairness issues, transparency, and the importance of accountability in AI systems.
- **Hands-on: Evaluating an AI System for Ethical Considerations**: Interactive session guiding participants in evaluating an AI system for ethical considerations. This hands-on exercise involves analyzing a case study, identifying potential biases, and proposing solutions to enhance ethical standards.

Module 2

## Introduction to AI Architecture

### 2.1 Overview of AI and its Various Applications

- **Historical Perspective**: Examine the historical evolution of AI, highlighting pivotal moments that have shaped its development over the years.
- **Contemporary Applications Across Industries**: Explore real-world applications of AI across diverse industries, showcasing how AI revolutionizes processes and creates new possibilities.

### 2.2 Introduction to AI Architecture

- **Key Components and Structures:** Delve into the fundamental components and structures constituting AI architecture, providing a comprehensive understanding of its building blocks.
- **Role in Solving Real-world Problems**: Analyze the role of AI architecture in addressing practical challenges, emphasizing its impact on solving complex problems across various domains.

### 2.3 Understanding the AI Development Lifecycle

- **Phases: Planning, Data Collection, Model Building, Deployment, and Monitoring:** Explore the distinct phases of the AI development lifecycle, from initial planning through data collection, model building, deployment, and ongoing monitoring.
- **Best Practices in Each Phase**: Highlight best practices for each phase of the AI development lifecycle, ensuring participants gain insights into industry standards and effective methodologies.

### 2.4 Hands-on: Setting up a Basic AI Environment

- **Environment Setup Using Popular AI Frameworks:** Guide participants through setting up a basic AI environment using popular frameworks such as TensorFlow and PyTorch, ensuring familiarity with essential tools.
- **Basic Coding Exercises to Understand the Setup**: Engage participants in hands-on coding exercises, allowing them to apply their knowledge and gain practical experience in setting up and configuring a basic AI environment.

Module 3

## Fundamentals of Neural Networks

### 3.1 Basics of Neural Networks

- **Neurons, Layers, and Architectures**: This section covers the foundational elements of neural networks, including neurons, layers, and different architectures, providing a solid understanding of the structure of neural networks.
- **Feedforward and Backpropagation Concepts**: It explains the concepts of feedforward and backpropagation, outlining how neural networks process information and learn from data.

### 3.2 Activation Functions and Their Role

- **Common Activation Functions**: Sigmoid, ReLU, Tanh Explore popular activation functions such as Sigmoid, ReLU, and Tanh, elucidating their mathematical properties and practical implications.
- **Importance in Shaping the Network's Behavior**: Discuss the crucial role of activation functions in shaping the behavior of neural networks and influencing the learning process.

### 3.3 Backpropagation and Optimization Algorithms

- **Understanding the Backpropagation Process**: Provide a detailed understanding of the backpropagation process, the mechanism by which neural networks learn from errors and adjust their weights.
- **Popular Optimization Algorithms (Gradient Descent, Adam, RMSprop)**: Introduce popular optimization algorithms such as Gradient Descent, Adam, and RMSprop, explaining their use in fine-tuning neural network parameters.

### 3.4 Hands-on: Building a Simple Neural Network Using a Deep Learning Framework

- **Practical Implementation of a Basic Neural Network:** Hands-on Example: Building a Simple Neural Network for Handwritten Digit Recognition In this practical session, participants will be guided through the process like Setting Up the Environment, Loading and Preparing Data, Defining the Neural Network Architecture, Compiling the Model, Training the Neural Network, Evaluating the Model, Fine-tuning and Iteration for creating a basic neural network to recognize handwritten digits.
- **Training and Evaluating the Model on a MNIST Dataset**: Engage participants in hands-on exercises, involving the training and evaluation of the constructed neural network on a sample dataset.

Module 4

## Applications of Neural Networks

### 4.1 Introduction to Neural Networks in Image Processing

- **Understanding How Neural Networks Process Images**: Examine the role of neural networks in image processing, covering key concepts and techniques for image recognition and computer vision.
- **Real-world Applications in Image Recognition and Computer Vision**: Explore practical applications of neural networks in image recognition and computer vision, showcasing their significance in real-world scenarios.

### 4.2 Neural Networks for Sequential Data

- **Introduction to Handling Sequential Data Using Neural Networks**: Provide an introduction to the application of neural networks for handling sequential data, with a focus on natural language processing and time series analysis.

- **Applications in Natural Language Processing and Time Series Analysis**: Highlight the role of neural networks in processing sequential data for tasks such as natural language processing and time series analysis.

### 4.3 Practical Implementation of Neural Networks

- **Hands-on Exercises**: Applying Neural Networks to Image and Sequential Data Tasks Engage participants in practical exercises, applying neural networks to image and sequential data tasks, reinforcing theoretical knowledge through hands-on experience.
- **Utilizing Transfer Learning with Pre-trained Models for Practical Applications**: Explore the concept of transfer learning and guide participants in utilizing pre-trained models for practical applications, demonstrating the versatility of neural networks.

Module 5

## Significance of Large Language Models (LLM)

### 5.1 Exploring Large Language Models (LLMs)

- **Understanding the Role of LLMs in Natural Language Understanding**: Examine the pivotal role of Large Language Models in natural language understanding, emphasizing their impact on enhancing language-related tasks.
- **Implications for Various Practical Applications**: Explore the practical implications of LLMs across diverse applications, including but not limited to chatbots, sentiment analysis, and language translation.

### 5.2 Popular Large Language Models

- **Overview of Widely Used Large Language Models (BERT, GPT, and Others)**: Provide an overview of popular Large Language Models such as BERT, GPT, and others, highlighting their unique features and capabilities.
- **Unique Features and Use Cases in Real-world Scenarios Examine**: The unique features of each model and their specific use cases in real-world scenarios, showcasing their versatility.

### 5.3 Practical Finetuning of Language Models

- **Adapting Pre-trained Models for Domain-specific Tasks**: Practical Context Guide participants in the practical fine-tuning of pre-trained language models for domain-specific tasks, focusing on effective adaptation strategies.
- **Techniques for Effective Finetuning of Language Models**: Explore techniques for effective finetuning, addressing challenges and ensuring optimal performance for specific applications.

### 5.4 Hands-on: Practical Finetuning for Text Classification

- **Real-world Exercises on Adapting Language Models for Specific Text Classification Tasks**: Engage participants in hands-on exercises, allowing them to apply practical finetuning techniques for text classification tasks.

Module 6

## Application of Generative AI

### 6.1 Introduction to Generative Adversarial Networks (GANs)

- **Understanding the Basic Concept and Structure of GANs**: Introduce the fundamental concepts and structure of Generative Adversarial Networks (GANs), emphasizing their role in generating realistic data.

- **Real-world Applications in Image Generation and Data Augmentation**: Explore real-world applications of GANs in image generation and data augmentation, showcasing their impact on creating synthetic but realistic content.

### 6.2 Applications of Variational Autoencoders (VAEs)

- **Understanding VAEs and Their Applications for Generative Tasks**: Provide an overview of Variational Autoencoders (VAEs) and their applications in generative tasks, focusing on data synthesis and representation.
- **Use Cases in Image Synthesis and Data Representation**: Examine specific use cases where VAEs are employed for image synthesis and efficient data representation.

### 6.3 Generating Realistic Data Using Generative Models

- **Practical Techniques for Creating Synthetic Data**: Explore practical techniques for generating synthetic data using generative models, addressing challenges related to data scarcity in practical scenarios.
- **Addressing Challenges Related to Data Scarcity in Practical Scenarios** : Discuss strategies and solutions for overcoming challenges related to data scarcity when utilizing generative models.

### 6.4 Hands-on: Implementing Generative Models for Image Synthesis

- **Real-world Implementation of a GAN for Image Generation**: Engage participants in a hands-on session where they implement a Generative Adversarial Network (GAN) for image generation.
- **Training and Evaluating the Model on Practical Datasets**: Guide participants through the training and evaluation of the implemented model using practical datasets, reinforcing the application of generative models in real-world scenarios.

Module 7

## Natural Language Processing

### 7.1 NLP in Real-world Scenarios

- **Practical Applications of NLP in Various Industries**: Explore real-world applications of Natural Language Processing (NLP) across diverse industries, showcasing its impact on enhancing processes.
- **Real-world Scenarios in Sentiment Analysis, Chatbots, and Language Translation**: Examine practical scenarios where NLP is applied, emphasizing its role in sentiment analysis, chatbots, and language translation.

### 7.2 Attention Mechanisms and Practical Use of Transformers

- **Emphasizing the Practical Importance of Attention Mechanisms in NLP**: Highlight the significance of attention mechanisms in NLP and their practical implications for improving model performance.
- **Overview and Practical Use of Transformer Models in Real-world Contexts**: Provide an overview of transformer models and their practical applications in real-world NLP contexts, showcasing their efficiency.

### 7.3 In-depth Understanding of BERT for Practical NLP Tasks

- **Practical Insights into BERT (Bidirectional Encoder Representations from Transformers)**: Delve into the details of BERT, providing practical insights into its architecture and how it revolutionizes NLP tasks.
- **Real-world Applications in Various NLP Tasks**: Explore real-world applications of BERT across various NLP tasks, including but not limited to text classification, named entity recognition, and question-answering systems.

### 7.4 Hands-on: Building Practical NLP Pipelines with Pretrained Models

- **Implementing an End-to-End NLP Pipeline with a Practical Focus**: Guide participants in implementing a comprehensive NLP pipeline with a hands-on focus, covering preprocessing, model integration, and post-processing.
- **Utilizing Hugging Face Transformers for Efficient and Practical NLP Solutions**: Demonstrate using Hugging Face Transformers to streamline the development of efficient and practical NLP solutions.

Module 8

## Transfer Learning with Hugging Face

### 8.1 Overview of Transfer Learning in AI

- **Principles and Advantages of Transfer Learning**: Examine the principles and advantages of transfer learning in AI, highlighting its potential to enhance model performance with limited data.
- **Applications in Various Domains**: Explore diverse applications of transfer learning across different domains, showcasing its versatility in solving various tasks.

### 8.2 Transfer Learning Strategies and Techniques

- **Different Approaches to Transfer Learning**: Discuss various approaches to transfer learning, including fine-tuning, feature extraction, and domain adaptation.
- **Choosing the Right Strategy for Specific Tasks**: Guide participants in choosing the most suitable transfer learning strategy based on the characteristics of specific tasks.

### 8.3 Hands-on: Implementing Transfer Learning with Hugging Face Models for Various Tasks

- **Practical Exercises**: Using Hugging Face Models for Transfer Learning Engage participants in hands-on exercises, implementing transfer learning with Hugging Face models for various tasks.
- **Adapting Pre-trained Models**: Guide participants through the process of applying transfer learning techniques to adapt pre-trained models to new applications.

Module 9

## Crafting Sophisticated GUIs for AI Solutions

### 9.1 Overview of GUI-based AI Applications

- **Importance of User-Friendly Interfaces**: Highlight the significance of user-friendly interfaces in AI applications, emphasizing the impact on user experience and adoption.
- **Various Ways for Implementing GUI**: Explore different approaches for implementing Graphical User Interfaces (GUIs) in AI solutions, considering diverse application scenarios.

### 9.2 Web-based Framework

- **Streamlit: A Python Library for Interactive Web Applications**: Introduce Streamlit, a Python library facilitating the creation of interactive web applications, particularly suitable for building GUIs for AI models.
- **Dash (Plotly): Creating Interactive Web-based Dashboards with Python**: Explore Dash, a framework based on Plotly, enabling the creation of interactive, web-based dashboards in Python, ideal for showcasing AI models.

### 9.3 Desktop Application Framework

- **Tkinter (Python): Standard GUI Library for Python**: Introduce Tkinter, a standard GUI library for Python, often used for creating simple desktop applications, suitable for smaller AI projects.
- **PyQt and PySide (Python): Python Bindings for the Qt Framework**: Explore PyQt and PySide, Python bindings for the Qt framework, providing extensive tools for building cross-platform applications with rich GUIs.
- **Electron (JavaScript, HTML, CSS): Cross-platform Desktop Applications**: Introduce Electron, a framework enabling the creation of cross-platform desktop applications using web technologies.

Module 10

## AI Communication and Deployment Pipeline

### 10.1 Communicating AI Results Effectively to Non-Technical Stakeholders

- **Strategies for Clear and Concise Communication**: Discuss effective strategies for communicating AI results to non-technical stakeholders, ensuring clear understanding and decision-making.
- **Visualizations and Storytelling with AI Results**: Explore the use of visualizations and storytelling techniques to effectively convey AI results, making complex concepts accessible to a wider audience.

### 10.2 Building a Deployment Pipeline for AI Models

- **Key Components of a Robust Deployment Pipeline**: Examine the essential components of a robust deployment pipeline for AI models, ensuring efficiency, scalability, and maintainability.
- **Continuous Integration and Continuous Deployment (CI/CD) Practices**: Introduce CI/CD practices in the context of deploying AI models, emphasizing automation and continuous improvement.

### 10.3 Developing Prototypes Based on Client Requirements

- **Understanding Client Needs and Expectations**: Explore methods for understanding and interpreting client needs and expectations when developing AI prototypes.
- **Prototyping Approaches and Methodologies**: Discuss various approaches and methodologies for prototyping AI solutions based on client requirements.

### 10.4 Hands-on: Deployment

- **Creating an End-to-End Deployment Pipeline for an AI Model**: Engage participants in a hands-on session where they create an end-to-end deployment pipeline for an AI model, integrating concepts learned throughout the module.