

Post Graduate Program in **AI and Machine Learning**

With dedicated live sessions on
the latest AI topics like

Generative AI,

Prompt Engineering,

ChatGPT and more.



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About the Program



Artificial Intelligence (AI) and Machine Learning (ML) are among the most sought after and highly compensated digital economy skills. In the past decade, AI has given us self-driving cars, practical speech recognition, effective web search, and a vastly improved understanding of the human genome. AI is so pervasive that we use it dozens of times a day without even realizing it. Many researchers also think it is the best way to make progress towards human-level AI.

Ride this wave and accelerate your career with this acclaimed AI and Machine Learning program. This program features a thorough mix of theory, projects, and extensive hands-on practice, while leveraging Caltech's academic excellence. More importantly, you'll learn about not only the theoretical underpinnings of AI and ML, but also gain the practical know-how to quickly and successfully apply these tools and techniques to new problems.

This program is a blend of self-paced online videos, live virtual classes, hands-on projects, labs and masterclasses. Mentorship sessions will provide you with a high-engagement learning experience and real-world applications, helping you master essential AI and ML skills. This program covers essential mathematical and statistical concepts, as well as Python programming, machine learning, deep learning, generative AI, prompt engineering, explainable AI, ChatGPT, computer vision, natural language processing, and more.

Key Features of the Program



Earn a program completion certificate from Caltech CTME



Curriculum delivered in live online sessions by industry experts



Earn a Caltech CTME Circle Membership



Earn up to 22 CEUs from Caltech CTME



Masterclasses delivered by distinguished Caltech CTME instructors



Live sessions on the latest AI trends, such as generative AI, prompt engineering, and more



Online convocation by Caltech CTME Executive Director



IBM certificates for IBM courses



Access to hackathons and Ask Me Anything sessions from IBM



Engage in 3 capstones and 25+ hands-on projects from various industry domains



Simplilearn career assistance services to help you get noticed by top hiring companies



Exposure to ChatGPT, Dall-E, Midjourney, TensorFlow and other prominent tools

About Caltech CTME

Founded in 1891, Caltech is a world-renowned science and engineering institute that marshals some of the world's brightest minds and most innovative tools to address fundamental scientific questions and pressing societal challenges. Caltech prizes excellence and ambition. The contributions of Caltech's faculty and alumni have earned national and international recognition, including 38 Nobel Prizes and nearly 60 National Medals of Science. The Institute manages the Jet Propulsion Laboratory (JPL) for NASA.

CTME is embedded in Caltech's Division of Engineering and Applied Science. Caltech CTME has a unique role to play in applying the capabilities of scientists and engineers to the challenges of today's technology-driven businesses. Caltech CTME applies executive education and professional development directly to real-world problems. Caltech CTME experts teach the tools and perspectives that elevate careers and help companies achieve their goals.

About Simplilearn

Simplilearn is the world's #1 online bootcamp provider, enabling learners around the globe with rigorous and highly specialized training offered in partnership with world-renowned universities and leading corporations. We focus on emerging technologies and skills, such as artificial intelligence, data science, cloud computing, programming, and more — transforming the global economy. Our hands-on and immersive training includes live virtual classes, integrated labs and projects, 24x7 support, and a collaborative learning environment. Over two million professionals and 2000 corporate training organizations across 150 countries have harnessed our award-winning programs to achieve their career and business goals.

Eligibility Criteria

For admission to this AI and Machine Learning program, candidates should have:

- ✓ A bachelor's degree with an average of 50% or higher marks
- ✓ Prior knowledge or experience in programming and mathematics
- ✓ Preferably 2+ years of formal work experience



Application Process

Candidates can apply to this program in 3 simple steps:



Submit an Application

Complete the application and include a brief statement of purpose. The latter informs our admissions counselors why you're interested and qualified for the program



Application Review

A panel of admissions counselors will review your application and statement of purpose to determine whether you qualify for acceptance.



Admission

An offer of admission will be made to qualified candidates. You can accept this offer by paying the program fee.

Talk to an Admissions Counselor

We have a team of dedicated admissions counselors here to help guide you in the application process and related matters. They are available to

- ✓ Address questions related to the application
- ✓ Assist with financial aid (if required)
- ✓ Help you better understand the program and answer your questions

Who is this Program Ideal for?



This program caters to professionals from a variety of industries and backgrounds. The diversity of our students adds richness to class discussions and interactions. Roles in this space require a combination of experience and an understanding of tools and technologies. This program is ideal for professionals looking for a career transition into the field of AI and ML, who have knowledge or prior experience in programming and mathematics, and an analytical frame of mind.

Professionals eager to develop AI and ML expertise with the objective of:

- ✓ Enhancing effectiveness in their current role
- ✓ Transitioning to AI and ML roles in their organization
- ✓ Seeking to advance their career in the industry
- ✓ Giving shape to entrepreneurial aspirations

Program Outcomes



Gain insights into the latest AI trends like generative AI, prompt engineering, ChatGPT, and much more.



Learn how to apply effective prompt engineering techniques to improve the performance and control the behavior of generative AI models.



Master AI and ML comprehensively, understanding their meaning, purpose, scope, stages, applications, and effects.



Learn to navigate data science intricacies with expertise, encompassing processes, wrangling, exploration, visualization, hypothesis building, and testing.



Be able to conduct scientific and technical computing seamlessly using the SciPy package, including sub packages like Integrate, Optimize, Statistics, IO, and Weave.



Excel in mathematical computing using the NumPy and scikit-learn package.



Gain expertise in supervised and unsupervised learning, recommendation engines, and time series modeling.



Validate machine learning models effectively, decoding various accuracy metrics.



Appreciate and apply deep learning across various applications.



Navigate the layers of data abstraction with Neural Networks, gaining unparalleled insights into data.



Utilize tools like Keras for building computer vision applications.



Execute distributed and parallel computing efficiently, leveraging high-performance GPUs.



Master natural language understanding and generation, delving into the fundamentals of NLP using Python's Natural Language Toolkit (NLTK).



Conduct text-to-speech conversion with automated speech recognition.



Master ways to solve reinforcement learning problems through various industry-standard strategies.



Become well-versed with generative adversarial networks (GANs).



Comprehend natural language understanding and natural language generation.



Know how to apply Machine Learning and Deep Learning seamlessly with NLP.



Learn how to apply reinforcement learning theory using Python and TensorFlow.

Learning Path

Core Courses



Electives

- ✓ Advanced Deep Learning and Computer Vision
- ✓ Reinforcement Learning
- ✓ Advanced Generative AI
- ✓ Natural Language Processing and Speech Recognition
- ✓ Academic Masterclass
- ✓ Industry Masterclass

Essentials of Generative AI, Prompt Engineering & ChatGPT

STEP

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This comprehensive course thoroughly explains generative AI models, specifically focusing on ChatGPT. Participants will understand the fundamentals of generative AI and its scope, prompt engineering, explainable AI, conversational AI, ChatGPT, other large language models, and much more.

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Learning Outcomes:

Upon completing the course, participants will be able to:

- ✓ Understand the fundamentals of generative AI models, including various types and working principles
- ✓ Comprehend the concept of explainable AI, recognize its significance, and identify different approaches to achieve explainability in AI systems
- ✓ Apply effective prompt engineering techniques to enhance the performance and control the behavior of generative AI models
- ✓ Develop a deep understanding of ChatGPT, including its mechanisms, notable features, and limitations
- ✓ Identify and explore diverse applications and use cases where ChatGPT can be leveraged
- ✓ Gain exposure to fine-tuning techniques to customize and optimize ChatGPT models for specific tasks and domains
- ✓ Recognize the ethical challenges of generative AI models and ChatGPT, and develop strategies for responsible data usage, mitigating bias, and preventing misuse
- ✓ Understand the potential of generative AI to revolutionize industries and delve into prominent generative AI tools

- ✓ Identify and implement security measures to protect ChatGPT from unauthorized access and ensure safe and non-offensive content generation
- ✓ Learn techniques to monitor ChatGPT for performance issues and identify and debug incorrect or unexpected outputs
- ✓ Understand how to maintain and update ChatGPT models with the latest features and improvements
- ✓ Gain insights into the future of generative AI, its challenges, and the necessary steps to unlock its full potential

Topics Covered

The course covers the following topics:

- ✓ Introduction to Generative AI Models
- ✓ Explainable AI
- ✓ Prompt Engineering
- ✓ ChatGPT
- ✓ Fine-tuning ChatGPT
- ✓ Ethical Considerations in Generative AI Models & ChatGPT
- ✓ The Future of Generative AI
- ✓ Deploying and Scaling ChatGPT
- ✓ Security and Privacy Considerations
- ✓ Monitoring and Debugging ChatGPT
- ✓ Maintaining ChatGPT

Programming Refresher

STEP

1

This course provides you with essential Python programming skills that will serve as the building blocks for your entire program journey. You will learn how to implement artificial intelligence and machine learning algorithms, conduct data analysis, and construct intelligent systems effectively using Python.

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Learning Outcomes:

- ✓ Learn about procedural and object-oriented programming
- ✓ Understand the benefits and advantages of utilizing Python
- ✓ Install Python and its Integrated Development Environment (IDE)
- ✓ Familiarize yourself with Jupyter Notebook and its usage
- ✓ Implement Python identifiers, indentation, and comments effectively
- ✓ Identify Python's data types, operators, and string functions
- ✓ Learn about different types of loops in Python
- ✓ Explore the scope of variables within functions
- ✓ Explain the concepts of Object-Oriented Programming (OOP) and its characteristics
- ✓ Describe methods, attributes, and access modifiers in Python
- ✓ Gain an understanding of multi-threading

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Topics Covered

- ✓ Fundamentals of Programming
- ✓ Introduction to Python Programming
- ✓ Python Data Types and Operators
- ✓ Conditional Statements and Loops in Python
- ✓ Python Functions
- ✓ Object-Oriented Programming Concepts with Python
- ✓ Threading

Python for Data Science (IBM)

STEP

1

Developed by IBM, this course equips students with the skills to leverage Python for data science. By the end of the course, participants will be proficient in writing Python scripts and performing hands-on data analysis using a Jupyter-based lab environment.

2

Learning Outcomes:

Upon completion of the course, participants will be able to:

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- ✓ Create their first Python program using variables, strings, functions, loops, and conditions
- ✓ Understand and apply concepts related to lists, sets, dictionaries, conditions, branching, objects, and classes in Python
- ✓ Utilize the pandas library to load, manipulate, and save data, as well as read and write files in Python

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Topics Covered

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The course covers the following topics:

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- ✓ Python Basics
- ✓ Python Data Structures
- ✓ Python Programming Fundamentals
- ✓ Working with Data in Python
- ✓ Working with NumPy Arrays

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Applied Data Science with Python

STEP

1

This course provides comprehensive coverage of key concepts in data science, encompassing essential topics such as data preparation, model development, and evaluation. Throughout the course, you will develop a strong understanding of fundamental Python concepts such as strings, Lambda functions, and lists. Additionally, you will explore various important tools and libraries, including NumPy for efficient array manipulation, linear algebra for mathematical foundations, and statistical concepts such as measures of central tendency and dispersion, skewness, covariance, and correlation. The course also delves into hypothesis testing methods such as the Z-test, T-test, and ANOVA while emphasizing Pandas' data manipulation techniques. Furthermore, you will acquire data visualization skills using popular libraries like Matplotlib, Seaborn, Plotly, and Bokeh.

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Learning Outcomes:

- ✓ Explain the fundamental principles and applications of data science
- ✓ Explore the processes involved in data preparation, model building, and evaluation
- ✓ Apply Python concepts, including strings, Lambda functions, and lists
- ✓ Develop a strong understanding of NumPy and its application in array indexing and slicing
- ✓ Gain familiarity with linear algebra principles and their relevance in data science
- ✓ Understand the role of calculus in linear algebra applications
- ✓ Calculate and interpret measures of central tendency and dispersion

- ✓ Grasp statistical concepts such as skewness, covariance, and correlation
- ✓ Describe the concepts of the null hypothesis and alternate hypothesis
- ✓ Examine different hypothesis tests, including the Z-test and T-test
- ✓ Understand the concept of ANOVA (Analysis of Variance)
- ✓ Work effectively with pandas' primary data structures: Series and DataFrame
- ✓ Utilize pandas to load, index, reindex, and merge data
- ✓ Prepare, format, normalize, and standardize data using techniques like data binning
- ✓ Construct visually appealing and informative graphs using Matplotlib, Seaborn, Plotly, and Bokeh

Topics Covered

- ✓ Introduction to Data Science
- ✓ Essentials of Python Programming
- ✓ NumPy
- ✓ Linear Algebra
- ✓ Statistics Fundamentals
- ✓ Probability Distributions
- ✓ Advanced Statistics
- ✓ Working with Pandas
- ✓ Data Analysis
- ✓ Data Wrangling
- ✓ Data Visualization
- ✓ End-to-End Statistics Application in Python

Machine Learning

STEP

1

This course comprehensively covers various types of machine learning and their practical applications. You will explore the machine learning pipeline and delve into supervised learning, regression models, and classification algorithms. You will also study unsupervised learning, including clustering techniques and ensemble modeling. Evaluate machine learning frameworks like TensorFlow and Keras and build a recommendation engine with PyTorch.

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Learning Outcomes:

- ✓ Examine the different types of machine learning and their characteristics
- ✓ Analyze the machine learning pipeline and understand the operations involved in MLOps (Machine Learning Operations)
- ✓ Learn about supervised learning and its real-world applications
- ✓ Understand the concepts of overfitting and underfitting, and learn how to detect and prevent both
- ✓ Analyze different types of regression models and their applications
- ✓ Identify linearity between variables and create correlation maps
- ✓ List various types of classification algorithms and understand their applications
- ✓ Master different types of unsupervised learning techniques
- ✓ Determine when to use unsupervised algorithms and explore different clustering methods
- ✓ Examine various ensemble modeling techniques such as bagging, boosting, and stacking

- ✓ Evaluate different machine learning frameworks, including TensorFlow and Keras
- ✓ Build a recommendation engine using the PyTorch library

Topics Covered

- ✓ Machine Learning Fundamentals
- ✓ Supervised Learning
- ✓ Regression Models and Applications
- ✓ Classification Models and Applications
- ✓ Unsupervised Learning
- ✓ Ensemble Learning
- ✓ Recommendation Systems

Deep Learning with TensorFlow (IBM)

STEP

1

Elevate your machine learning skills to the next level with this comprehensive course on deep learning using TensorFlow. Gain a thorough understanding of deep learning concepts, empowering you to construct artificial neural networks and navigate through complex data abstraction layers. By harnessing the potential of data, this course prepares you to venture into new artificial intelligence frontiers.

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Learning Outcomes:

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Upon completion of the course, participants will be able to:

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- ✓ Develop a deep understanding of neural networks and effectively apply them in deep learning scenarios
- ✓ Acquire proficiency in TensorFlow and Keras, which are indispensable tools for deep learning
- ✓ Explore the practical applications of Convolutional Neural Networks (CNNs)
- ✓ Familiarize yourself with Recurrent Neural Networks (RNNs) and autoencoders
- ✓ Optimize the performance of neural networks using techniques such as L2 regularization and dropout layers
- ✓ Create autoencoder models to detect anomalies in data

Topics Covered:

The course covers the following topics:

- ✓ Introduction to Artificial Intelligence and Deep Learning
- ✓ Artificial Neural Network
- ✓ Deep Neural Network and Tools
- ✓ Optimization, Tuning, and Interpretability of Deep Neural Networks
- ✓ Convolutional Neural Networks (CNN)
- ✓ Recurrent Neural Networks
- ✓ Autoencoders

Deep Learning Specialization

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This comprehensive course provides you with the necessary skills to deploy deep learning tools using AI/ML frameworks. You will explore the fundamental concepts and applications of deep learning and understand the distinctions between deep learning and machine learning. The course covers a range of topics, including neural networks, forward and backward propagation, TensorFlow 2, Keras, performance improvement techniques, model interpretability, Convolutional Neural Networks (CNNs), transfer learning, object detection, Recurrent Neural Networks (RNNs), autoencoders, and creating neural networks in PyTorch. By the end of the course, you will have a solid foundation in deep learning principles and the ability to effectively build and optimize deep learning models using Keras and TensorFlow.

Learning Outcomes:

- ✓ Gain an understanding of the differences between deep learning and machine learning.
- ✓ Learn about the practical applications of deep learning.
- ✓ Understand different types of neural networks
- ✓ Master the concepts of forward propagation and backward propagation in Deep Neural Networks (DNN)
- ✓ Get introduced to modeling and performance improvement techniques in deep learning
- ✓ Comprehend hyperparameter tuning and model interpretability
- ✓ Learn about dropout and early-stopping techniques and their implementation
- ✓ Master Convolutional Neural Networks (CNNs) and object detection

- ✓ Grasp the fundamentals of Recurrent Neural Networks (RNNs)
- ✓ Understand the basics of PyTorch and learn how to create a neural network using PyTorch

Topics Covered:

- ✓ Introduction to Deep Learning
- ✓ Artificial Neural Networks
- ✓ Deep Neural Networks
- ✓ TensorFlow
- ✓ Model Optimization and Performance Improvement
- ✓ Convolutional Neural Networks (CNNs)
- ✓ Transfer Learning
- ✓ Object Detection
- ✓ Recurrent Neural Networks (RNNs)
- ✓ Transformer Models for Natural Language Processing (NLP)
- ✓ Getting Started with Autoencoders
- ✓ PyTorch

Capstone Project

STEP



The capstone project allows you to implement the skills you will learn throughout this program. You will solve industry-specific challenges by leveraging various AI and ML techniques. The capstone project is the final step in the core learning path and will help you showcase your expertise to employers.



Learning Outcomes:



- ✓ The capstone project will enhance your understanding of the artificial intelligence decision cycle, including performing exploratory data analysis, building and fine-tuning a model with cutting-edge AI-based algorithms and representing results.



Electives

Advanced Deep Learning and Computer Vision

In this advanced course, you will gain in-depth knowledge and practical skills in computer vision and deep learning techniques. The course covers various topics, including image formation and processing, Convolutional Neural Networks (CNNs), object detection, image segmentation, generative models, optical character recognition, distributed and parallel computing, Explainable AI (XAI), and deploying deep learning models. By the end of the course, you will have the expertise to tackle complex computer vision challenges and successfully deploy deep learning models.

Natural Language Processing and Speech Recognition

This advanced course comprehensively explores applying machine learning algorithms to process vast amounts of natural language data. It focuses primarily on natural language understanding, feature engineering, natural language generation, automated speech recognition, speech-to-text conversion, text-to-speech conversion, voice assistance devices, and building Alexa skills. By the end of the course, you will have a deep understanding of the science behind natural language processing and speech recognition, enabling you to develop advanced applications in these areas.

Reinforcement Learning

This course delves into the core concepts of Reinforcement Learning (RL), providing you with the knowledge and skills to solve RL problems using various strategies in Python and TensorFlow. You will learn the theoretical foundations of RL and gain practical experience in applying RL algorithms as a problem-solving strategy. By the end of the course, you will be equipped with the skills to use reinforcement learning in diverse applications and scenarios effectively.

Advanced Generative AI

Immerse yourself in cutting-edge generative AI concepts through this advanced course. Throughout the program, you'll extensively investigate neural networks, LLMs, their structures, and various generative model variations, including VAEs, GANs, autoencoders, and transformer-based models. Explore well-known gen AI models like GPT, BERT, and T5, learning how to evaluate their performance effectively. Engage in practical learning experiences, gaining first-hand proficiency in constructing and launching a conversational chatbot capable of meaningful dialogue interactions.

Academic Masterclass

Attend online interactive Master Classes conducted by the instructor from the Caltech CTME and get insights about advancements in the AI domain.

Tools Covered



Projects

Project 1

Ecommerce

Develop a shopping app for an ecommerce company using Python

Project 2

Food Service

Using data science techniques, such as time series forecasting, to help a data analytics company forecast demand for different restaurant items.

Project 3

Retail

Use exploratory data analysis and statistical techniques to understand the factors contributing to a retail firm's customer acquisition.

Project 4

Production

Perform feature analysis to understand the features of water bottles using EDA and statistical techniques to understand their overall quality and sustainability.

Project 5

Real Estate

Use feature engineering to identify the top factors that influence price negotiations in the homebuying process.

Project 6

Entertainment

Perform cluster analysis to create a recommended playlist of songs for users based on their user behavior.

Project 7

Human Resources

Build a machine learning model that predicts employee attrition rate at a company by identifying patterns in their work habits and desire to stay with the company.

Project 8

Shipping

Use deep learning concepts, such as Convolutional Neural Networks (CNN), to automate a system that detects and prevents faulty situations resulting from human error and identifies the type of ship entering the port.

Projects

Project 9

BFSI

Use deep learning to construct a model that predicts potential loan defaulters and ensures secure and trustworthy lending opportunities for a financial institution.

Project 10

Healthcare

Use distributed training to construct a CNN model capable of detecting diabetic retinopathy and deploy it using TensorFlow Serving for an accurate diagnosis.

Project 11

Healthcare

Leverage deep learning algorithms to develop a facial recognition feature that helps diagnose patients for genetic disorders and their variations.

Project 12

Automobile

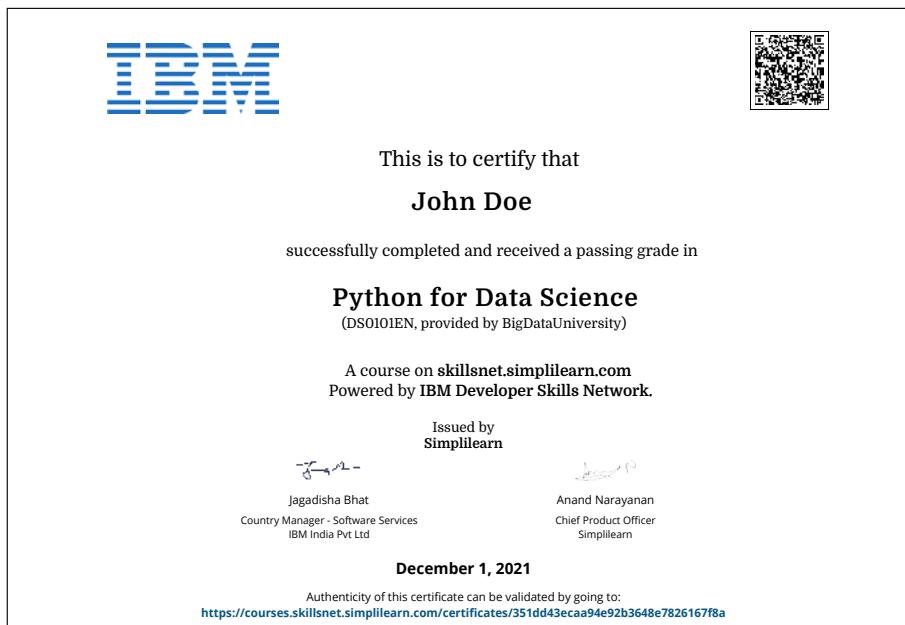
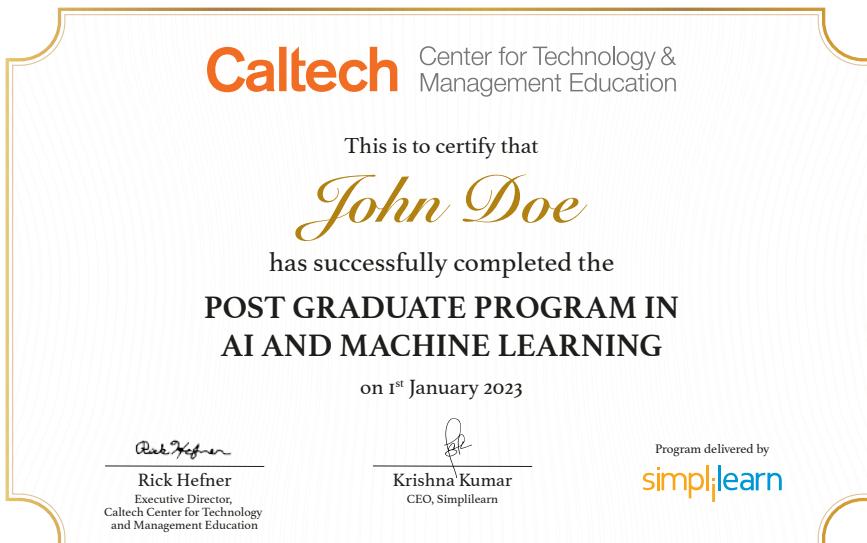
Examine accident data involving Tesla's auto-pilot feature to assess the correlation between road safety and the use of auto-pilot technology.

Project 13

Tourism

Use AI to categorize images of historical structures and conduct exploratory data analysis (EDA) to build a recommendation engine that improves marketing initiatives for historic locations.

Certificates



Upon successful completion of this program, you will receive a certificate of completion from Caltech CTME. You will also receive IBM certificates (sample IBM certificate shown above) for all IBM courses, along with certificates from Simplilearn for the courses completed in the learning path. These certificates will testify to your skills as an AI and ML expert.

Program Advisor

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Rick Hefner, PhD, specializes in systems development and maintenance; project management; Lean Six Sigma; process improvement, technology transfer; and risk management. His experience spans over 35 years. Dr. Hefner recently served as Director of Process Management at Northrop Grumman Corporation, where he managed corporate process initiatives related to Lean Six Sigma and program management.

Previous positions at Northrop Grumman (formerly TRW) included managing technology process initiatives and helping to establish the corporate engineering and program management processes. Previously, at Aerospace Corporation, Dr. Hefner was the Director of their Software Development department. He served as an engineer, technical specialist, project manager, and section manager.

Dr. Hefner has also worked with companies in the communications, electronics, and health sciences industries, including Applied Physics Laboratory, Ares Management, Boeing, DRS Technologies, Herbalife, Honeywell, Jet Propulsion Laboratory, John Deere, L-3 WESCAM, Maytag, Motorola, Pacific Bell, Raytheon, Schlumberger, Southern California Edison, St. Jude Medical, Toshiba, U.S. Navy, and Xerox. Dr. Hefner is credited with over 200 publications and presentations. He earned his PhD from the University of California, Los Angeles, in applied dynamic systems control. He received his MS and BS from Purdue University in interdisciplinary engineering.



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