

# Generative AI: Fundamentals to Advanced Techniques

 14 Weeks |  Online with Live Sessions

 Capstone Project

# Programme Summary

## Generative AI: Fundamentals to Advanced Techniques Programme



**Institute Name**  
National University  
of Singapore



**Programme Duration**  
14 weeks



**Cost**  
2,300 USD + GST



**Learning Mode**  
Online with live  
sessions from faculty



**Weekly Effort**  
8-10 hours



**Faculty**  
NUS School Of  
Computing



**Guest Faculty/  
Industry Expert**  
Senior Industry  
Practitioners



**Eligibility**  
Minimum Diploma or  
equivalent, having experience  
with modern object-oriented  
programming languages



**Certificate**  
Upon successful completion of the  
programme, participants will be  
awarded a verified digital certificate  
by NUS School Of Computing

## Learning Experience

- **Pre-recorded videos with NUS Faculty**  
Don't get worried about keeping up with the classes. Learn at your own pace
- **High-quality videos**  
Great learning experience, even while on the move
- **World-class faculty**  
Learn from the best faculty and industry practitioners
- **On-demand learning**  
Rewatch any lesson at your leisure

## Frequently Asked Questions

### How are the classes conducted with the institute faculty in this course?

Recorded and live sessions from world-renowned faculty

### Who grades/reviews assignments and projects?

Assignments will be graded by industry practitioners who support participants in their learning journey and/or by the Emeritus grading team.

### What if I miss the assignments for a particular week? Can I attempt them later?

An assignment that is not submitted by the due date is late. Late assignments will be accepted until one week after the programme end date, which is published on the programme homepage.

### Will the Institute/Emeritus help with placement services?

This programme is designed with some of the best faculty to cover relevant topics in a manner that creates positive career outcomes. As an additional service, we provide resume writing guidance, help with looking for jobs and interview preparation, but we do not offer placement services.

### What if I don't find the programme appropriate for me after starting the sessions? Can I seek a refund?

We encourage our learners to complete the programme to fully understand the concepts and derive valuable learning outcomes. Should you still feel the need to stop your learning journey, a refund request can be initiated within 14 days from the date of payment. However, after 14 days the programme fee becomes non-refundable.

### What type of certificate will I receive?

Upon successful completion of the programme, you will receive a smart digital certificate. This can be shared with friends, families, schools or potential employers. You can use it on your cover letter, resume and/or display it on your LinkedIn profile. The digital certificate will be sent approximately two weeks after the programme, once grading is complete.

### How long will I have access to the learning materials?

You will have access to the online learning platform and all the videos and programme materials for 12 months following the programme end date. Access to the learning platform is restricted to registered participants.

### Is this programme eligible for SFC (Skills Future Credit)?

No, this programme is not eligible for Skills Future Credit because our programmes are curated as per global market research which caters to global participation.

*This Programme Summary is provided only for your convenience. You are advised to refer to the Programme Brochure for more information.*

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# Accelerate Your Career with Generative AI

The world stands on the brink of a transformative revolution, powered by Generative AI—widely regarded as the defining technology of this century. GenAI has disrupted every industry, and upskilling to meet its pace is essential in the current tech landscape. **86%** of IT leaders expect Generative AI to soon play a prominent role in their organisations, according to a report by Salesforce in late 2024.

By specialising in Generative AI, professionals are likely to position themselves as leaders in a competitive global market, opening doors to cutting-edge projects, collaboration with international teams and contributions to pioneering research.

The NUS School of Computing (SoC) **Generative AI: Fundamentals to Advanced Techniques** offers an in-depth exploration of modern AI and machine learning concepts, designed to equip learners with essential knowledge and real-world skills.

From mastering the basics of programming and data manipulation to diving into neural networks and their applications, gaining hands-on experience with Python and TensorFlow to exploring cutting-edge techniques in Generative AI – **this programme is a deep dive into the world of GenAI**. This learning experience offers a blend of theoretical knowledge and practical experience, preparing participants for the evolving landscape of AI and machine learning.

## USD 208 billion

will be the market value for Generative AI by 2032, expanding at a compound annual growth rate of 35.3% between 2024 and 2032.

Source: *Generative AI Market Size 2024, Acumen Research & Consulting*

## 5 hours

per week is the estimated time saved by Generative AI according to marketers.

Source: *Generative AI Stats 2024, Forbes*

## 91%

of organisations expect their productivity to increase due to GenAI.

Source: *The State of Generative AI in the Enterprise, Q1 Report 2024, Deloitte*

# Programme Highlights



## Live faculty sessions

Participants will get an opportunity to learn via live sessions from esteemed faculty.



## Capstone project

Progressive capstone project during the programme will help participants apply concepts learned in a real-world scenario.



## Prestigious certification

Earn a certificate from Asia's highest-ranking institute



## Tool-based learning

Equips participants with practical, hands-on experience, preparing them for real-world problem-solving.



## Pre-recorded video lectures

From NUS faculty for self-paced learning



## Growing domain

Participants will gain an in-depth understanding of advanced technical concepts, keeping them up-to-date with the rapid evolution of AI.

### Note:

- This is a self-paced asynchronous programme. Post-session video recordings will be available for up to 12 months after programme completion.
- Assignments are graded by industry practitioners who are available to support participants in their learning journey and/or by the Emeritus grading team.
- The final number of quizzes, assignments and discussions will be confirmed closer to the programme's start date.



# Explore Cutting-Edge Tools

Gain hands-on experience by exploring industry-relevant tools



## Note:

- All product and organisation names mentioned in these materials are trademarks or registered trademarks of their respective holders. Their use does not imply any affiliation with or endorsement by them.
- The tools will be taught by teaching faculty, industry practitioners, by linking to relevant knowledge bases for your reference and self-guided learning.
- Apart from the tools mentioned above, learners will get to experience other industry related tools.

# Ranking

1<sup>st</sup>

ranking of NUS in Asia

*(QS World University Rankings 2024)*

6<sup>th</sup>

ranking of NUS in the world  
for Data Science and AI

*(QS World University Rankings 2024)*

## High-Level Programme Outcomes



Develop a foundation in Python programming and a thorough understanding of machine learning concepts, including supervised, unsupervised and reinforcement learning.



Explore neural networks and deep learning principles, utilising frameworks such as TensorFlow and Keras to build and optimise models for various AI tasks.



Gain expertise in Transformer architectures, attention mechanisms and state-of-the-art models such as BERT and GPT, focusing on their design, customisation and application.



Learn to implement and leverage Generative AI methods, including diffusion models and multimodal systems, to develop creative and innovative AI solutions.



Understand the ethical implications of AI technologies and their impact on society while exploring practical applications across different industries and domains.

# Modules

## Module 1: Overview of Python

- Introduction to Python and Programming
- Python Data Types
- Variables and Operators
- Python Programming Constructs: Conditionals, Loops, Functions, Exception Handling
- Object-Oriented Programming: Classes and Objects/Instances, Attributes, Methods
- Python Libraries: Pandas, Matplotlib

## Module 2: Machine Learning Fundamentals

- Introduction to Machine Learning
- Different Learning Approaches
- Unsupervised Learning: Correlation Analysis
- Unsupervised Learning: Clustering, K-Means Algorithm
- Supervised Learning: Regression, Linear Regression
- Supervised Learning: Classification, KNN Algorithm
- Introduction to Artificial Neural Networks
- Supervised Learning: ANN as a Classifier
- ANN's Advantages and Disadvantages

## Module 3: Deep Learning Fundamentals and GenAI Intro

- Introduction to Deep Learning
- Review of ANNs
- Deep Convolutional Neural Networks
- DCNN: Regression with Tabular Data
- DCNN: Classification with Tabular Data
- DCNN: Classification with Images
- Other Deep Models
- Introduction to Generative AI and Transformers

## Module 4: Transformer Architecture and Attention Mechanisms

- Introduction to Transformer Architecture
- Neural Networks, Encoder-Decoder Structure
- Introduction and Types of Attention Mechanisms
- Mathematical Foundations of Transformers
- Transformer Components: Embedding Layers
- Transformer Components: Self-Attention Mechanism
- Transformer Components: Multi-Head Attention
- Transformer Components: Feedforward Networks
- Transformer Training: Data Preparation and Training Strategies
- Applications: NLP, CV and Others
- Transformer Model Extensions and Hybrid Models
- Recent Innovations and Future Trends

## Module 5: Transformer-Based Models (BERT and GPT)

- Introduction to Transformer-Based Models: BERT and GPT
- BERT: Model Architecture
- BERT: Pre-training and Fine-tuning
- BERT: Applications and Case Studies
- GPT: Model Architecture
- GPT: Pre-training and Fine-tuning
- GPT: Applications and Case Studies
- BERT and GPT: Implementation and Best Practices
- Model Combinations and Extensions for Specialisation
- Performance Optimisation

## Module 6: Reinforcement Learning for Generative AI

- Basics of Reinforcement Learning: Markov Decision Process, Value Function, Value-State Function, Policy
- Exploration vs Exploitation Dilemma
- Bellman Equations
- Dynamic Programming
- Monte Carlo Learning and Temporal Difference Learning
- SARSA and Expected SARSA
- Q-Learning and Function Approximation
- Policy Gradient (PPO)
- Reinforcement Learning for Human Feedback (RLHF)
- RLHF Implementation and Case Study; ChatGPT
- Direct Preference Optimisation (DPO)

## Module 7: Early Image Generation Models (VAEs and GANs)

- Gen AI Model Mechanics
- Autoencoders
- Variational Autoencoders (VAEs)
- GANs
- Training VAEs
- Training GANs
- VAEs and GANs for Image Generation

## Module 8: Image Generation Using Diffusion Models

- Introduction to Diffusion Processes
- Diffusion Model Architecture
- Training Diffusion Models
- Sampling from Diffusion Models
- Performance Optimisation for Diffusion Models
- Applications of Diffusion Models



## Module 9: Transformer for Vision (ViT and CLIP)

- Introduction to Computer Vision Models
- Transformer Architecture in Computer Vision
- Vision Transformer (ViT)
- Contrastive Language-Image Pre-Training (CLIP)

## Module 10: Multimodal Models: Text to Image (DALL-E and Stable Diffusion)

- Fundamentals of Multi-Modal AI
- Text-to-Image Generation Models
- DALL-E and Stable Diffusion
- API Integration
- Prompt Engineering for Image Generation
- Fine-Tuning for Specialised Tasks
- Model Combination
- Real World Applications and Case Studies
- Ethical Considerations
- Model Limitations

## Module 11: Generative AI Applications I (LLMs and RAG)

- Fundamentals of LangChain
- Using LangChain for Conversational AI
- Implementing Chains in LangChain
- Introduction to Retrieval Augmented Generation (RAG)
- Integrating RAG for Performance Optimisation
- Working with Documents and Vector Embeddings

## Module 12: Generative AI Applications II (Multi-Agents)

- Introduction to Multi-Agent Systems
- Types of Multi-Agent Systems
- Communication Protocols
- Coordination Strategies
- Multi-Agent Reinforcement Learning
- LLMs as Agents
- Task Planning and Execution
- Problem-Solving Applications
- Challenges and Future Trends

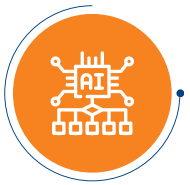




# Who Is This Programme For?



Early to mid-level professionals looking to start a career in or switch to a high-growth field and gain exposure to Generative AI



Mid-level professionals looking to gain technical understanding of Generative AI and its technologies and explore the application of AI



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# Faculty



**Dr Amirhassan Monajemi**

Senior Lecturer

Department of Computer Science



**Dr Ai Xin**

Lecturer

Department of Computer Science



**Dr Justin Chan**

Instructor

NUS Advanced Computing for  
Executives



**Mr Mario Favails**

Executive Education Fellow

NUS Advanced Computing for  
Executives



**Mr Uli Hitzel**

Executive Education Fellow

NUS Advanced Computing for  
Executives



**Dr Yeo Wee Kiang**

Senior Lecturer

Department of Information  
Systems & Analytics

# Learning Journey



## Orientation week

The first week is orientation week. During this week, you will be introduced to other participants in the class from across the world and will learn how to use the learning management system, discussion boards and other learning tools.

## Weekly goals



As you begin the programme, you will learn to meet your learning goals set for the week. The goals include completion of the assignments, which have weekly deadlines.



## Support and guidance from industry expert

The industry expert is a subject matter expert who guides participants through their learning journey. The industry expert conducts office hours to clarify participants' queries related to the learning content and grades a few designated assignments.



## Follow-up

The Emeritus support team follows up over emails and phone calls with participants who are unable to submit their assignments.



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# About the NUS School of Computing

The NUS School of Computing traces its roots back to the Nanyang University Department of Computer Science that was established in 1975 - the first of its kind in Singapore. Since then, we have developed into one of the top 10 computing schools in the world, with faculty members who are both internationally recognised researchers and inspiring teachers.

We offer outstanding undergraduate and graduate degree programmes across the full spectrum of the field of computing, including computer science, information systems, computer engineering, business analytics and information security, as well as specialisations in emerging areas of importance such as Artificial Intelligence, Fintech, Blockchain, Financial Analytics and Cybersecurity.

Correspondingly, we attract excellent students and produce talented graduates who are making their mark in the world. The exceptional education that students experience here, coupled with the demand for computing talent in all fields and industries, make NUS School of Computing graduates highly sought after.

We instil our students with leadership qualities and a spirit of entrepreneurship through mentorship, community service initiatives and special programmes, including The Furnace, a start-up incubator that offers funding, infrastructure and management support to bring original ideas to commercial fruition.

The NUS School of Computing Advanced Computing for Executives (ACE) centre was established to help business leaders and computing professionals learn about emerging technologies and leverage it for digital transformation and business competitiveness. Our three-pronged raison d'être is to

- Partner with industry and government to upskill and re-skill the workforce in Information and Communications Technology (ICT),
- Collaborate closely with NUS School of Computing faculty members in launching Continuing Education and Training (CET) programmes for adult learners and
- Support and empower organisations to embark on digital transformation projects.



We are pleased to have been educating and training Singapore and the world's business leaders and computing professionals for the past four decades and are proud to count many locally and internationally prominent leaders in the field among our large and accomplished family of alumni.

# Certificate

Upon successful completion of the programme, participants will be awarded a verified digital certificate by the NUS School of Computing.



*Note: - All certificate images are for illustrative purposes only and may be subject to change at the discretion of NUS School of Computing.*



# Admission Requirements



## Programme Fee

USD 2,300 + GST



## Programme Duration

14 Weeks, online  
8-10 Hours/week



## Programme Start

28 March 2025





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# About Emeritus

NUS School of Computing is collaborating with online education provider Emeritus to offer a portfolio of high-impact online programmes. Working with Emeritus gives NUS School of Computing the advantage of broadening its access beyond its on-campus offerings in a collaborative and engaging format that stays true to the quality of NUS School of Computing.

Emeritus' approach to learning is built on a cohort-based design to maximise peer-to-peer sharing and includes video lectures with world-class faculty and hands-on project-based learning. More than 300,000 students from over 200 countries have benefitted professionally from Emeritus' programmes.







[www.emeritus.org](http://www.emeritus.org)

Apply for the programme here

[APPLY NOW](#)

Schedule a call with a programme advisor to learn how this programme can help you

[SCHEDULE A CALL](#)

E-mail: [info@emeritus.org](mailto:info@emeritus.org)

Call: +6531296111 (11:30 AM - 6:30 PM SGT)

We hope to respond to your enquiry in less than 24 hours.

Our responses may take up to 72 hours during weekends and holidays.

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 [WhatsApp an Advisor on +6531382485\\*](https://wa.me/6531382485)

*\*This number does not accept any calls. Please message your queries.*

