In collaboration with

FORE School of Management
New Delhi

THUMBAY INSTITUTE FOR AI IN HEALTHCARE

جامعة الخليج الطبية
GULF MEDICAL UNIVERSITY
ACADEMIC HEALTH CENTER

GenAI and ML in Healthcare

A no-code program

Online, live, hands-on classes on
analysing Healthcare Data
using Machine Learning & Gen AI

(56-hours: Saturday and Sunday classes)

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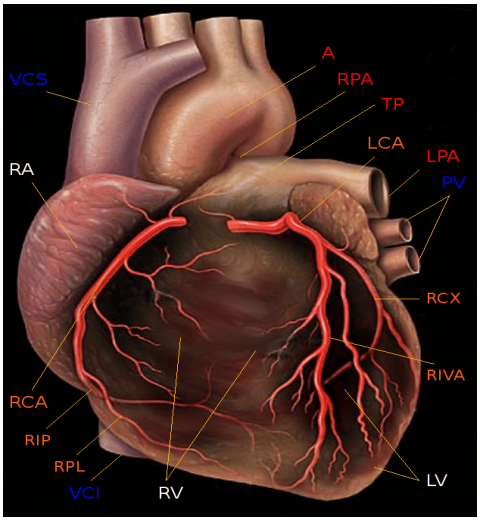


Since the outbreak of COVID-19 in 2019, AI technologies have experienced accelerated adoption and utilization across various domains within the healthcare sector. In response to the pandemic, AI has emerged as a valuable tool and is being used for disease detection and diagnosis, medical imaging and analysis, treatment planning and personalized medicine, drug discovery and development, predictive analytics, and risk assessment. Healthcare analytics is the process of analysing current and historical healthcare data to gain insights, draw conclusions, and support decision-making. It combines domain knowledge in healthcare with computer science,

Health sector has generally been generating large amount of data. Today, many hospitals are computerised leading to massive volumes of patient data, sensor data coming out of electronic instruments, claims and cost data, inventory & drugs data, pathology and X-ray data. Machine Learning, Deep Learning techniques and Generative AI offer a way to explore and make sense out of this data and make very useful predictions or rather assist in fast and accurate diagnosis. Some questions that we try to answer pertain to Clinical problems, pharmaceutical and research challenges, patient behaviour or insurance and costs and even related to many other aspects.

The program is divided into four modules. Details about the Modules and the Types of Questions answered are given below.

No-code Modelling

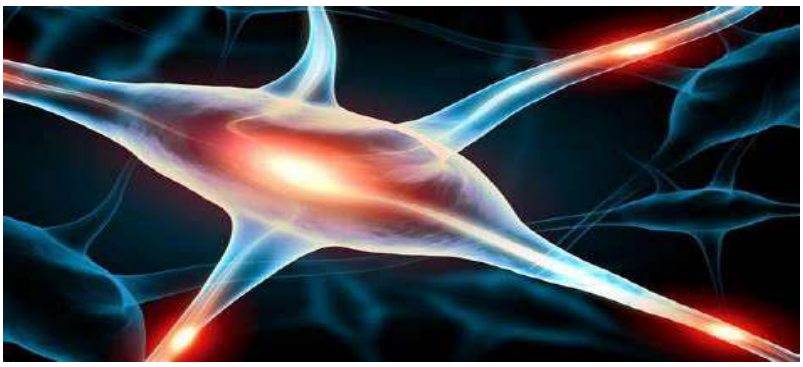
We would like to highlight, at the very outset, that we cover ML, DL &Gen AI techniques using 'No-code' approach. We use the best, highly reputed and industry standard Visual frameworks that generally use drag-and-drop approach to build ML and Gen AI workflows—to process data, build models, test them and then deploy for production use. All these tools are open source, have very liberal licencing policies and can be utilised even with very large data in production environment. We fully realise that many of our students are deeply busy in their core professional work and have little time to learn the intricacies of a programming language (such as python or R). And at the same time, they would like to apply power of analytics to assist them in their work. About the Visual frameworks used, please see below(here).

We avoid using commercial Gen AI models and software in preference to industry standard open-source models and software from HuggingFace and Ollama library.

We would also like to mention that very few Institutions offer program in Healthcare Analytics (though many do in Healthcare Management). And among those very few none offers a program using 'No-code' approach.

This program is also unique in its breadth of coverage. We cover Machine Learning, Deep Learning, Generative AI and LLMs, all in one program. Of the very few programs in Healthcare Analytics, none has this broad coverage.

About the Modules



We have four modules. The first one is Health System and Ethics. A Health System is an organization of people, institutions, and resources that delivers health care services to meet the health needs of a target population. There are a wide variety of health systems around the world, each reflecting the history, culture, and economics of the country in which it has evolved. We cover these in our lectures.

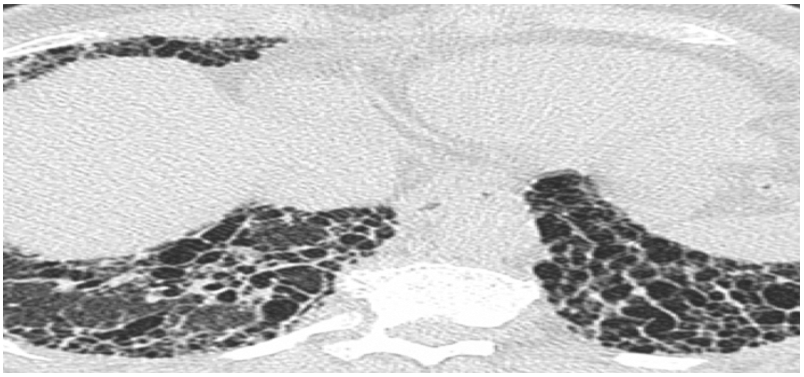
Machine Learning and Deep Learning are being used extensively in health sector. Generative AI and LLM are being developed as Clinical Decision Support Systems (CDSSs): AI-generated CDSSs can provide clinicians with real-time insights to inform treatment decisions and improve patient outcomes. These modules are **totally hands-on, and practise based.** These are online, live, and totally interactive **lab-oriented Modules** with the primary objective of disseminating techniques of Healthcare Analytics using Data Visualization, Machine Learning, Deep learning and Gen AI. These technologies enable a practitioner to apply them on data in numerous ways.

Primary Objectives

i. Learn about different Health Systems across the World
ii. Develop insights into healthcare data through visual analytics and optimize treatments
iii. Learn techniques to group/segment data and patients
iv. Improve patient outcomes through predictive analytics models
v. Building clinical decision support systems using Generative AI
vi. Developing Large Language Model products for medical applications

Types of questions answered

Here are several typical or atypical questions that we strive to answer in our classes. We will perform Segmentation analysis, Classification analysis, Regression analysis and use Gen AI for CDSS.



Clinical Problems

- Classify fetal health in order to prevent child and maternal mortality
- Predict lung function decline—Pulmonary Fibrosis Progression
- Predict Possibility of Heart Attack
- Classify Pulmonary Embolism cases in chest CT scans
- Predict the onset of diabetes based on diagnostic measures
- Predict Age from X-rays
- Predict if an infant is likely to develop autistic tendencies
- Predict severity of epileptic seizure
- Detect Malaria through Infected Cell Images
- Detect Autism from a facial image
- Identify acute intracranial haemorrhage and its subtypes
- MRI Imaging Comparisons of Demented and Nondemented Adults
- Create an accurate model to predict the stage of Alzheimer.
- Distinguishing Different Stages of Parkinson's Disease

Pharmaceutical and R&D Problems

- Predict a biological response of molecules from their chemical properties

Patient behaviour related

- Can you predict if a patient will keep his appointment?
- Prevalence and attitudes towards mental health among tech workers

Insurance and Costs related

- Can you accurately predict medical insurance costs?
- Healthcare Provider Fraud Detection Analysis
- Explore Health Insurance Marketplace
- Predict length of stay in hospital
- Predict medical insurance costs
- Predict hospital readmission for diabetes patients

Retail purchases and sale

- Forecast sales of drugs using store, promotion, and competitor data

Develop Clinical Decision Support Systems

- Develop CDSS in any field in medical sciences using modern day research

Course Modules

The plan for the four modules is as below. Teaching sequence will also be in this order. Details about each Module are given below under respective Module heads.

Module	Theme	Hours
Module---I	Health Systems & Ethics	8
Module---II	Machine Learning	15
Module---III	Deep Learning	15
Module---IV	Generative AI and LLMs	18
Total Hours		56

About Visual Tools used

Software	Applied in
KNIME	Machine Learning & Deep Learning
H_2O	Machine Learning & Deep Learning
Flowise	Generative AI & LLM
Ollama/anythingLLM	Generative AI & LLM

All these have highly intuitive user interface to perform analytics.

Detailed Contents

Module—I is the foundation module. Concepts taught here are universally used in ML and AI. Modules--II and III differ in their approach to Machine Learning. Module--II pertains to what may be called Traditional Machine Learning, Module-III pertains to Deep-Learning, Module-IV pertains to Generative AI and Large Language Models. Classical ML techniques require much less data than Deep-Learning or GenAI techniques. Both approaches have their pros and cons. Traditional ML techniques generally deal with tabular data sets while deep learning/GenAI techniques also process unstructured data as text, images or video datasets.

Module—I

Health Systems and Ethics

This foundational module introduces the concept of health systems, their structure, and the ethical considerations that govern healthcare practices. The course covers various health systems across the world, their evolution, and their role in delivering healthcare services. It also delves into the ethical issues prevalent in healthcare, particularly in the context of emerging technologies like AI and machine learning. The content covered in the module includes but not limited to:

1. **Introduction to Health Systems**:
    - Definition and components of a health system
    - Historical evolution of health systems globally
    - Comparison of health systems in different countries (e.g., U.S., U.K., India, UAE)
    - Role of health systems in public health and healthcare delivery
2. **Types of Health Systems**:
    - Public vs. Private Health Systems
    - Universal Health Coverage (UHC)
    - Health financing models (e.g., National Health Service, insurance-based systems)
    - Challenges in health systems: Accessibility, affordability, and quality
3. **Ethics in Healthcare**:
    - Basic principles of medical ethics: Autonomy, Beneficence, Non-Maleficence, and Justice
    - Informed consent and patient autonomy
    - Ethical dilemmas in healthcare: End-of-life care, resource allocation, and confidentiality
    - Case studies on ethical challenges in clinical practice
4. **AI and Ethics in Healthcare**:
    - Ethical implications of AI and machine learning in healthcare
    - Bias and fairness in AI algorithms
    - Data privacy and security in health informatics
    - The role of ethics in the deployment of AI-driven Clinical Decision Support Systems (CDSS)

Module—II

Machine Learning

We practice those modelling algorithms that consistently garner high performance, are relatively fast and are well known in ML community. Thus, these will be of immense use in many predictive applications.

1. Introduction to Machine Learning Technology
2. Data visualization and discovering structure in data. (Techniques include t-sne, parallel coordinates, mosaic plots) and Feature importance
3. Unsupervised learning techniques
    1. K-means clustering
    2. Expectation-Maximization algorithm
    3. T-SNE & UMAP manifold learning technique
    4. Dimensionality reduction & PCA
4. Supervised learning techniques for Classification and Regression
    1. Decision trees
    2. Ensemble modelling using Random Forest
    3. Gradient Boosting Techniques
        a. Gradient Boosting Learner
        b. XGBoost
        c. LightGBM
    4. Performance measures: Accuracy, Precision and Recall, F-measure; Area Under the Curve, Cohen's Kappa, Sensitivity, Specificity
5. Hyper-parameter optimisation techniques
6. Interpreting Machine Learning Models

Module—III

Deep Learning

In Module-III we practise Deep-learning techniques. Deep Learning techniques are especially useful for image datasets, for example, chest-X-rays and CAT-Scans. These techniques are also used with sensor data (for example, ECG). If tabular data is sufficiently large, deep learning techniques can also be applied for making predictions:

1. Introduction to Neural Networks (NN)
2. Experiments with MLP networks
3. Regularising NN
    a. Dropouts
    b. Batch-normalization
    c. l1 and l2 regularization
    d. Starting weight initialization
4. Deep Learning with Convolution Neural Networks
    a. Data Augmentation
5. Using very Deep Convolution Networks
    a. Transfer learning with VGG16
    b. Transfer learning with ResNet50
    c. Transfer learning with InceptionV3
6. Recurrent Neural Networks

a. LSTM, GRUs and Bi-directional LSTM

Module—IV

Generative AI and LLMs

Generative AI and Large Language Models (LLMs) are integral components of the AI landscape, each with distinct roles and capabilities. Generative AI encompasses a range of tools that leverage information from LLMs and other AI models to create new content through machine learning. On the other hand, LLMs are a specific type of AI model that utilizes machine learning with billions of parameters to understand and generate text.

Generative AI and Large Language Models (LLMs) are increasingly being utilized in healthcare for various applications. A survey conducted in 2024 revealed insights into the adoption and impact of these technologies in the healthcare industry. The survey highlighted the importance of healthcare-specific, task-oriented language models, particularly in improving patient interactions, streamlining clinical processes, and advancing research. Respondents expressed a preference for LLMs in applications like transcribing doctor-patient conversations, medical chatbots, and answering patient questions, indicating their potential transformative impact on patient-facing tasks.

Furthermore, the integration of generative AI and LLMs in healthcare is seen as a significant advancement that can revolutionize the industry. These technologies can assist in tasks such as clinical note documentation and transcription, enhancing patient engagement through chatbots and virtual assistants, synthesizing biomedical literature, and optimizing clinical trials. Despite challenges related to data privacy and regulatory compliance, the benefits of generative AI in healthcare are evident, with applications that can streamline operations, improve patient care, and drive innovation in the field.

We may mention that we avoid using commercial LLMs in preference to highly reputed models available on HuggingFace and Ollama library. Benefits of these open-source LLMs are that these are fully customizable, can be fine-tuned on one's data and totally take care of privacy and secrecy concerns—so important in medical field.

1. General Architecture of Transformers
2. Zero-shot classification and few-shot learning
3. Ollama and anythingLLM installation
4. Embedding, vector databases and search
5. Prompt Engineering
6. Developing knowledge products in healthcare using web-UIs for LLM
7. Using Flowise to develop RAG applications for biomedical applications

Modules Pedagogy:

We strongly believe that a course in Healthcare Analytics can only be practice-based rather than pure theory based. We also believe that a practice-based course requires constant interaction with the teacher during lecture hours in real time. Our teaching pedagogy is like this: First, the algorithm (or theory part) is conceptually explained without getting into mathematics and then a project is undertaken to implement the techniques. Healthcare datasets for implementation are made available in advance. During the lecture, we go through one of the visual frameworks such as KNIME workflow and explain the steps. At his end, the student goes through the same steps on his laptop. Consequently, results are available at our end as also with the students immediately. In short, both the teacher and students are working on their respective laptops simultaneously; students solve their problems and ask any questions to clarify. The whole experience is just as if everyone is sitting in a laboratory and working together. Students are required to have a laptop with a minimum of 16GB of RAM, 32GB would be preferable—RAM is cheap and existing RAM can easily be upgraded.

Who Should Attend?

The healthcare industry generates lots of data and this data is analyzed by professionals specializing in numerous fields. The program would be very useful for Medical Practitioners, Bio-technologists, bio-informatics or in general, students of Life–Sciences-- Biology, Biotechnology, Biochemistry, Bioinformatics, Cell biology (cytology), Ecology, Molecular biology, Microbiology, Marine Sciences —will find the program very useful.

Officers Managing Hospitals, Data Scientists or programmers or Engineers, Doctors or those in academics or Healthcare workers will find program extremely beneficial.

Program Timings and Duration

Total Duration for all Modules is 56 hours spread over 8-weeks. Program will be delivered on Saturdays and Sundays. There are 8 hours of teaching per week. Students are expected to perform exercises. This methodology of “learning concept->performing class projects-->Do self-exercises” leads to better and stress-free absorption.

Program Requirements (for students)

Participating students should be having a laptop or desktop with minimum 16gb of RAM. More RAM is advisable. Preferably the processor should be not lower than i5.

Program Faculty

Prof. Vinaytosh Mishra
Director
Thumbay Institute for
AI in Healthcare

Dr. Vinaytosh Mishra is the Director of the Thumbay Institute for AI in Healthcare at Gulf Medical University in Ajman, UAE. He holds a PhD in Healthcare Management and a Bachelor of Technology in Electronics Engineering from the Indian Institute of Technology (BHU), India. Dr. Mishra has over 19 years of experience across various industries, including Information Technology, Manufacturing, Finance, Healthcare, and Education.

He has postdoctoral fellowships in AI in Healthcare from the University of Arizona, USA, and in Ethical AI in Healthcare from the University of Ben Gurion, Israel.

Dr. Mishra is actively involved in academic and research projects, including the development of the Master in Artificial Intelligence and Health Informatics (MAIHI) program at Gulf Medical University and leading a research project on "Artificial Intelligence (AI) as Diabetes Educator Using Large Language Model Based Digital Therapeutics (DTx)."Dr. Mishra has authored various papers and holds patents in AI in Healthcare, including a German patent for a "System Dynamics Based Digital Twin for Diabetes Management." He is also known for his contributions to AI in Sustainable Development Goals (SDGs) and digital health in developing countries.

Prof. Ashok Kumar Harnal

Professor, Information Technology,
FORE School of Management
New Delhi, India

Prof Ashok Kumar Harnal has worked extensively at multiple facets of Big Data Systems--Machine Learning, Generative AI and LLM, Big-Data storage systems (Hadoop and NoSQL databases), Graph Databases, Streaming Analytics using Apache Spark, Apache Kafka, Confluent and Reinforcement Learning.

He has been teaching Big Data technology since around last twelve years. Since last nine years Prof Harnal has been collaborating closely with University of California, Riverside, in a program on taking sessions on Big Data for Executives from around the World.

We have trained officers from several organizations including RITES, NABARD, TechMahindra, Punjab National Bank, Central Bank of India and Union Bank of India Presently we are training officers in one another Bank. What is a matter of pride for us is that many of our students are at very high positions in Industry. My GitHub site is here. We have successfully conducted three programs on Healthcare Analytics; two programs were of three months duration and one of nine months duration. During his stay in Min of Defence, he has executed three country-wide projects on Information Systems: (a) Raksha-Bhoomi to computerize land records (as old as 150 years); (b) Knowledge Management of land-title related files/maps in all Defence Estates offices; and (c) Setting up of a Disaster Management organization: Archival Unit and Resource Center (AU&RC), at Delhi and Pune for safe storage of land-title related records in paper and digital forms.

He has published two books (both by Tata McGraw-Hill); One on How to program games on Computers and the other on Linux Administration and Applications.

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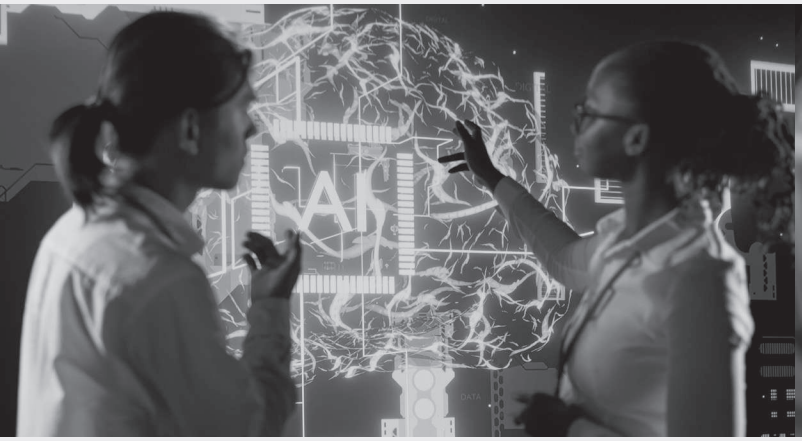

Classes are 8 hours per week on weekends (Saturday & Sunday)

Program Fee: AED 2,000

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