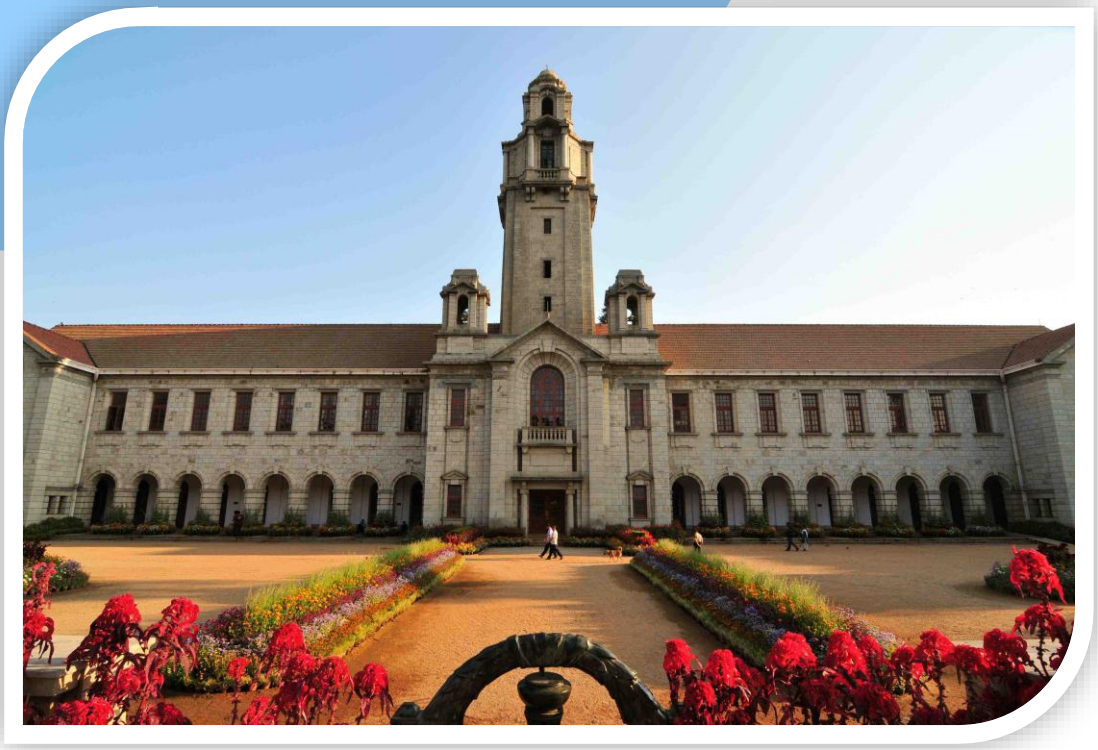
Kotak IISc AI-ML Centre

A Report of Activities

October to December 2023



INDIAN INSTITUTE OF SCIENCE
भारतीय विज्ञान संस्थान

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Executive Summary

The Kotak IISc AI-ML Centre (KIAC) was established at the Indian Institute of Science (IISc), Bengaluru with the vision to become one of the leading Centres in the world in artificial intelligence and machine learning. Since its inception in September 2022, it has been striving towards this vision with the support of the Kotak Mahindra Bank Limited (KMBL). Not only has KMBL provided financial support to the Centre, but also played an active role in decision making on the way forward.

During the year 2023, the Centre organised and supported various lectures, events, and workshops related to artificial intelligence (AI) and machine learning (ML). The research activities of many students were supported through the Kotak scholarship, the PhD top-up scholarship, and the Empower programme. A UG Computation Lab was set up for the benefit of the undergraduate students of the BTech (Mathematics and Computing) programme at IISc. AI-ML talks were organised primarily for IISc students. Faculty members and students of IISc were given financial support to attend leading AI conferences abroad. Distinguished KIAC professors, Viraj Kumar and C Pandu Rangan, have also conducted courses for students of the BTech (Mathematics and Computing) and MTech (AI) programmes.

These activities continued in the October–December 2023 quarter. The short course on Large Language Models for the second-year undergraduate students of IISc, which started in September 2023, was successfully completed in October. Similarly, the online workshop on Leveraging Generative AI for Teaching Programming Courses, conducted by KIAC faculty Viraj Kumar, concluded in October.

Three AI-ML talks, by speakers from various parts of the world, were organised; Amit Raj is a Research Scientist from Google Research, Upasana Sridhar is a PhD student from Carnegie Mellon University, and Mrigank Rochan is a faculty member from the University of Saskatchewan. Mohan Tunuguntla, Prinicpal Engineer in the Conversational AI team at the Kotak Mahindra Bank Limited, Bengaluru attended the talk by Mrigank Rochan.

Two of the five workshops that were organised/supported in this quarter were focused on collaborations between academia and industry; one was the Adobe–IISc GenAI workshop and the other was the workshop on Artificial Intelligence in Oral Cancer. Financial assistance was provided to three students and one faculty member to attend the International Conference on Computer Vision (ICCV23). Travel support was provided to C Pandu Rangan, faculty member at KIAC, to attend the 22nd International Conference on Cryptology and Network Security in Augusta, Georgia.

The Kotak scholarship to Sasmita Harini S and Shivey Ravi Guttal was continued. The second PhD top-up scholarship was awarded to Shubhankar Gupta, a student from the Robert Bosch Centre for Cyber-Physical Systems, IISc. Four new interns and five pre-doctoral fellows are being supported by the Centre. Calls have been released for the post-doctoral fellows and the international visiting chair professors, and they will be selected shortly.

Grace Mathew Abraham has joined the Centre as Program Manager.

These activities are described in the following pages. The report starts with a reiteration of the Centre's objectives, followed by an account of the activities during October–December 2023.

CONTENTS

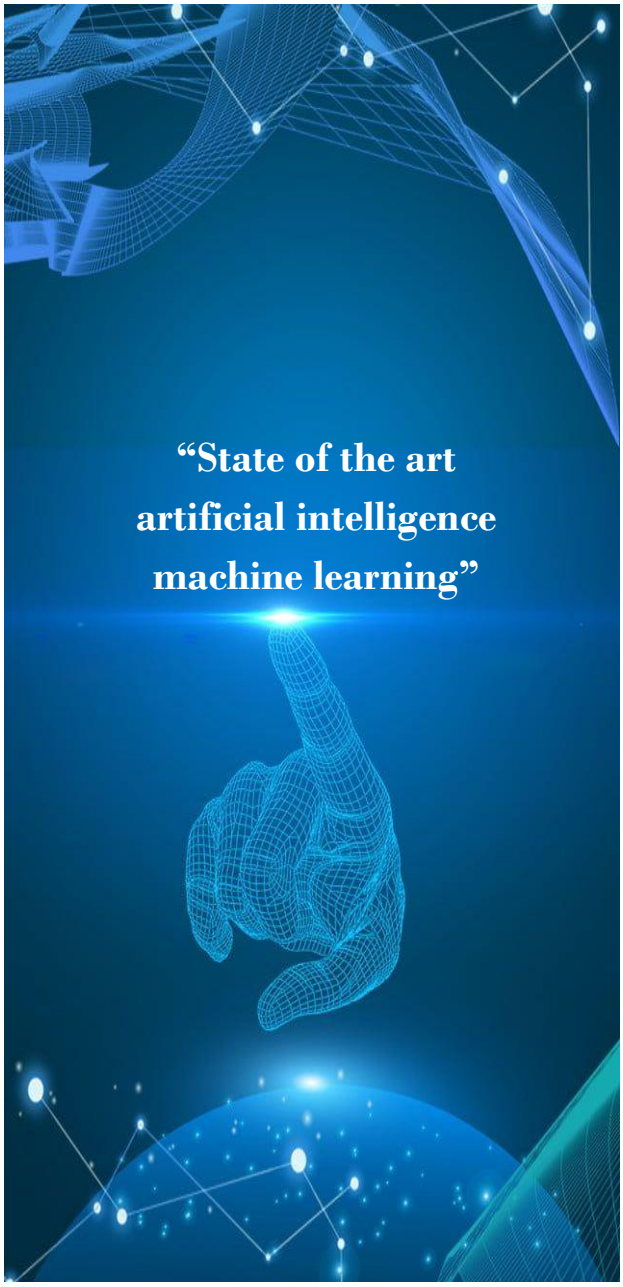
Objectives

The Kotak IISc AI–ML Centre at the Indian Institute of Science was conceived of with the objective of creating a state-of-the-art artificial intelligence–machine learning Centre at IISc to

(i) develop rigorously-trained human resources who will become future leaders of this technology and champion India's surge in this area,

(ii) conduct cutting-edge research in this area, leading to international visibility of the highest order, and

(iii) develop innovative, deep-tech solutions to meet the current and emerging requirements of the industry.



Governance

The governance of the Centre is overseen by the following structure: The Convenor and Co-convenor are responsible for creating technical programmes that are in-line with the memorandum of understanding (MoU). These programmes are presented to the Scientific Advisory Board (SAB) to ensure that the conceived programmes are compatible with the MoU. The SAB reports to the Governing Board (GB). The Project Review Committee (PRC) also reports to the GB and reviews the overall functioning of the Centre.

Members of the Governing Board

Govindan Rangarajan, IISc (Chair)
Navakanta Bhat, IISc
Yadati Narahari, IISc
Kaushal Verma, IISc
Milind Nagnur, KMBL
Himanshu Nivsarkar, KMBL

Members of the Scientific Advisory Board

Rajesh Sundaresan, IISc (Chair)
Chiranjib Bhattacharyya, IISc
Venkatesh Babu Radhakrishnan, IISc
Srikanth Krishnan Iyer, IISc
Bhaskar Kumar, KMBL

Members of the Project Review Committee

S K Satheesh, IISc (Chair)
P S Anil Kumar, IISc
Rajesh Sundaresan, IISc
Himanshu Nivsarkar, KMBL
Amit Dhalwade, KMBL

Members of the KIAC Team

Convenor: Chiranjib Bhattacharyya
Co-convenor: Venkatesh Babu Radhakrishnan
Chair Visiting Professor: C Pandu Rangan
Visiting Professor: Viraj Kumar
Program Manager: Grace Mathew Abraham
Systems Administrator: Neetha Ashtakar
Senior Editorial Assistant: Geethanjali Monto
Secretary: Sudha Aithal

Grace Mathew Abraham joined the Centre as Program Manager in December 2023.

Key achievements
Oct-Dec 2023

The Kotak IISc AI-ML Centre undertook multiple activities during October-December 2023 in keeping with its objectives. These activities have been described in the following pages. We first give an overview of the activities, followed by the progress as compared to the plan for the quarter.

Activities at a glance

The activities undertaken during October–December 2023 are presented in the table below, along with the beneficiaries and output indicators for each.

OCTOBER–DECEMBER 2023 ACTIVITIES				
Category	**Activity**	**Date**	**Number of participants/ beneficiaries**	**Output indicators**
Student support	Continuation of Kotak scholarship to Sasmita Harini S and Shivey Ravi Guttal	Oct–Dec 2023	2	education
	PhD top-up scholarship to Shubhankar Gupta	Oct–Dec 2023	1	education
Research support	Internship to Tushar Ojha, Aditya Gandhamal, Sai Harsha Mupparaju, and Navaneeth Sivakumar	Oct–Dec 2023	4	education, skill development
	Pre-doctoral fellowship to Rankit Kachroo, Venkatesh T, Saksham Bhutani, Ayman Un Nisa, and Ashish Ramayee Asokan	Oct–Dec 2023	5	education, skill development
Workshop support	AI-ML Systems 2023	25–28 Oct 2023	269	education, skill development, capacity building
	Tensor Computation and Machine Learning	17–18 Nov 2023	41	
	Adobe–IISc GenAI workshop	20 Nov 2023	51	
	Artificial Intelligence in Oral Cancer	7 Dec 2023	32	
Support to attend AI conferences	Shankhanil Mitra	Oct 2023	4	skill development, visibility, enabling publications in prestigious journals and participation in top-level conferences
	Harsh Rangwani			
	Abhipsa Basu			
	Venkatesh Babu Radhakrishnan			
Support to KIAC faculty to present their work at international conferences/workshops	C Pandu Rangan	31 Oct–2 Nov 2023	1	education, skill development, visibility
Recruitment of staff	Grace Mathew Abraham, Program Manager	11 Dec 2023	1	personnel development for the Centre

OCTOBER–DECEMBER 2023 ACTIVITIES (contd)				
Category	**Activity**	**Date**	**Number of participants/ beneficiaries**	**Output indicators**
Kotak IISc AI-ML talk series	Talk by Amit Raj	18 Oct 2023	45	education
	Talk by Upasana Sridhar	21 Nov 2023	19	
	Talk by Mrigank Rochan	5 Dec 2023	33	
Courses and training sessions	A Very Short Course on Large Language Models	30 Sep, 8 Oct 2023	31	education, skill development, teaching
	Leveraging Generative AI for Teaching Programming Courses	Sep–Oct 2023	141	
Workshops	Adobe–IISc GenAI workshop	20 Nov 2023	51	education, skill development, capacity building
	Artificial Intelligence in Oral Cancer	7 Dec 2023	32	

Student support

Financial support is provided to students through the Kotak Scholarship and the KIAC PhD top-up scholarship.

Kotak scholarship

The Kotak Scholarship is awarded to the woman student with the highest JEE Advanced Rank joining the undergraduate BTech (Mathematics and Computing) programme at IISc. This scholarship covers the tuition fees and other fees for the entire programme.

Sasmita Harini S

Shivey Ravi Guttal

Sasmita Harini S received the award for the academic year 2022–23 and Shivey Ravi Guttal for the 2023–24.

KIAC PhD top-up scholarship

The KIAC PhD top-up scholarship is a 100% top-up fellowship from KIAC. This award is for registered PhD students of IISc who fulfil the following criteria:

(i) who have not completed five years,

(ii) who are currently not availing any PhD fellowship other than the MHRD stipend from IISc, and

(iii) who have at least one regular paper published/accepted in the indicated fora (AAAI, IJCAI, CVPR, ECCV, ICCV, ICLR, ICML, NeurIPS, KDD, ACL, EMNLP, NAACL, SIGIR, WWW) between 1 January—30 September 2023.

SHUBHANKAR GUPTA

In the second round, the scholarship was awarded to Shubhankar Gupta, a student from the Robert Bosch Centre for Cyber-Physical Systems, IISc.

Research Support

Research support is provided to through internships, pre-doctoral fellowships, post-doctoral fellowships, and international visiting chair professorships.

KIAC internship

The one-year KIAC internships are for students pursuing any relevant branch of engineering. The call was released on 25 September 2023, and four interns are on board.

TUSHAR OJHA

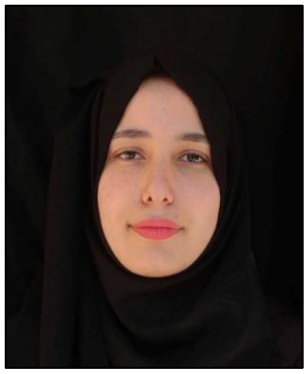
SAI HARSHA MUPPARAJU

NAVANEETH SIVAKUMAR

ADITYA GANDHAMAL

KIAC pre-doctoral fellowship

The one-year pre-doctoral fellowships are for students who have recently completed their undergraduate/postgraduate degree in any relevant branch of Engineering and would like to pursue research in artificial intelligence–machine learning. The call was released on 25 September 2023, and five pre-doctoral fellows are on board.



AYMAN UN NISA

RANKIT KACHROO

SAKSHAM BHUTANI

VENKATESH T

ASHISH RAMAYEE ASHOKAN

KIAC post-doctoral fellowship

The pre-doctoral fellowships are offered to candidates who have recently completed their doctorates and wish to pursue cutting-edge research in artificial intelligence. He/she should have a good research record evidenced by publications in top-tier premier conferences (such as A* ranked conferences) in artificial intelligence/machine learning.

The call was released on 5 October 2023, and applications have been received. The selection of candidates will be done, if found suitable.

KIAC international visiting chair professorship

The international visiting chair professorships are offered to distinguished researchers every year to enable them to visit IISc for a minimum period of three weeks each, to engage in research interactions with IISc faculty members and graduate students. The candidate is expected to be working in core AI-ML related areas and publishing impactful works in top AI-ML venues.

The call was released on 1 December 2023, and applications have been received. The selection of candidates will be done, if found suitable.

Workshop Support

Financial support was extended for four workshops during October–December 2023. In addition, organisational support was extended to two of them.

AI–ML Systems 2023

Date: 25–28 October 2023

Participants: 269

The aim of this conference was to examine how immense strides in AI/ML techniques are made possible through advances in computational systems; how the use of AI/ML can help in data-driven explorations of the design space of the computational systems; and how new breeds of AI/ML Systems enable new forms of socio-techno-economic systems and they in turn generate new requirements for research in AI/ML techniques.

Tensor Computation and Machine Learning
Date: 17–18 November 2023

Participants: 41

The aim of this workshop was to provide a platform for researchers from academia and industry to present their original work and exchange ideas, information, techniques, and applications in the field of machine learning and tensor computing, including, but not limited to artificial neural network, applied linear and multilinear algebra, parallel and distributed deep learning, scientific machine learning, soft computing, data security, image processing, and other emerging areas of research.

Adobe-IISc GenAI workshop
Date: 20 November 2023

Participants: 51

The objective of this workshop was to understand the work done by Adobe Research and IISc, to foster new collaborations and partnerships, and to find PhD students from IISc who could intern with Adobe Research over the summer.

Artificial Intelligence in Oral Cancer
Date: 7 December 2023

Participants: 32

The objective of this workshop was to bring together partners and stakeholders who could contribute to the call from the Ministry of Education for consortium-based proposals from higher education institutions on Artificial Intelligence (AI) for Healthcare, and to identify tangible, demonstrable improvements and targets for a successful proof-of-concept on oral cancer.

Support to attend AI Conferences

Four candidates were financially supported to attend the International Conference on Computer Vision (ICCV23).

- Shankhanil Mitra (student), presenting the paper ‘Test Time Adaptation for Blind Image Quality Assessment’.
- Harsh Rangwani (student), presenting the paper ‘Strata-NeRF: Neural Radiance fields for Stratified Scenes’.
- Abhipsa Basu (student), presenting the paper ‘Inspecting the Geographical Representativeness of Images from Text-to-Image Models’.
- Venkatesh Babu Radhakrishnan (professor), presenting the paper ‘Domain-Specificity Inducing Transformers for Source-Free Domain Adaptation’.

Support to KIAC faculty

to present their work at international conferences/workshop

Distinguished KIAC faculty, C Pandu Rangan, was financially supported to attend the conference '22nd International Conference on Cryptology and Network Security' during 31 October–2 November 2023 in Augusta, Georgia. Professor Pandu Rangan presented his paper entitled 'Forward Security under Leakage Resilience, Revisited' and also chaired the session on 'Block chain'.

Recruitment of Staff

Grace Mathew Abraham has joined KIAC as Program Manager from 11 December 2023.

Prior to this, she was working at Centre for Cellular and Molecular Platforms (C-CAMP) as Program Manager, where she was responsible for planning, overseeing, and implementing projects of Biotechnology Industry Research Assistance Council (BIRAC) for start-up companies. She also worked at Centre for Nano Science and Engineering (CeNSE), Indian Institute of Science (IISc) as a Program Coordinator and was responsible for organizing National and International workshops, conferences, and training programs for the faculties of Rajiv Gandhi University of Health Sciences and for researchers across the country. She was instrumental in setting up a biology lab and confocal microscopy set-up at CeNSE. She has authored papers in Elsevier, Nature's Scientific reports and delivered presentations at various conferences. She holds an MPhil in Biotechnology and a Master's degree in Biotechnology from Mahatma Gandhi University. She also holds a P G Diploma in Bioinformatics.

Kotak IISc AI-ML talk series

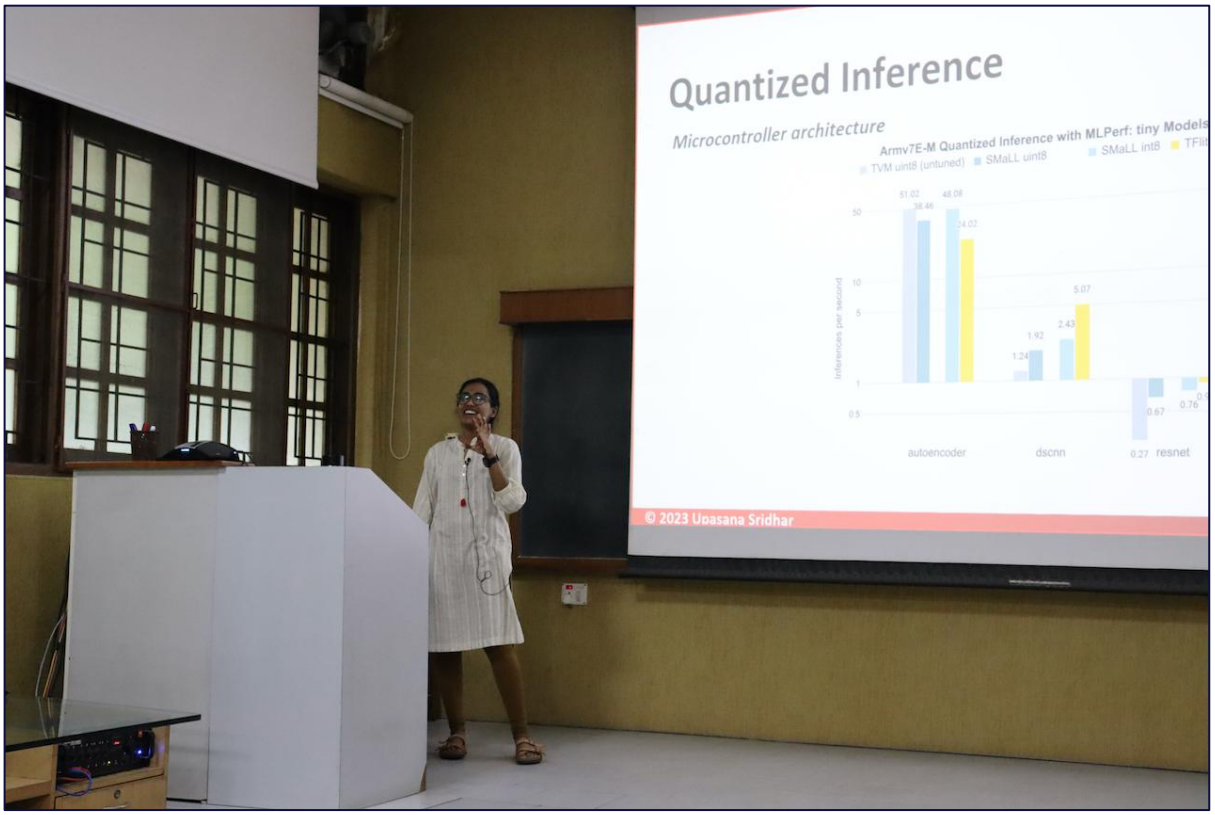
The Kotak IISc AI-ML talk series facilitates exposure of students to the research work and state-of-the-art in their respective fields of expertise. It includes talks by eminent scientists and researchers (academia and industry) from all over the world, with whom students can interact and collaborate on various projects.

SMaLL: A framework for rapidly generating ML Libraries

Speaker: Upasana Sridhar, PhD student, Department of Electrical and Computer Engineering, Carnegie Mellon University, Pittsburgh

Date: 21 November 2023

Attendees: 19



There is much interest in deploying deep neural networks (DNNs) on edge devices such as microcontrollers, Raspberry Pis, and smartphones. However, embedded devices are often resource constrained, making high-performance machine learning (ML) libraries critical to enable DNN deployment.

These high-performance libraries are typically hand-tuned for very specific hardware features and are difficult to port across even generations of the same hardware architecture. The rapid development of new edge devices, combined with the high implementation effort required by high performance libraries, leads to sparse support for the high-performance libraries required.

The SMaLL framework is an open-source solution to rapidly port high-performance machine learning libraries to new CPU (central processing unit) architectures. The key insight is that the operations used in DNNs can be expressed using a shared abstraction. This allows performance-specific optimisations to be isolated to a small section of code, called a kernel, with support for a new architecture requiring only a few hundred lines of new code. Further, the resulting libraries frequently have better performance than the state-of-the-art ML framework on each target hardware.

In this talk, Upasana Sridhar focused on the specific problems of developing libraries for edge devices and highlighted the lessons learnt from constructing abstractions for performance.

The promise of 3D representation for controllable content generation

Speaker: Amit Raj, Research Scientist, Google Research

Date: 18 October 2023

Attendees: 45

Neural image synthesis has seen enormous advances in recent years, led by innovations in generative adversarial networks (GANs) that generate high-resolution, photo-realistic images. However, a major limitation of these methods is that they tend to capture texture statistics of an image with no explicit understanding of geometry. Additionally, GAN-only pipelines are notoriously hard to train. In contrast, recent trends in neural and volumetric rendering have demonstrated compelling results by incorporating three-dimensional (3D) information into the synthesis pipeline using classical rendering

techniques. Additionally, diffusion models represent another class of generative models that have recently seen great success in high-quality image generation.

Amit Raj leverages ideas from both classical graphics rendering and neural image synthesis to design 3D guided image generation pipelines that are photo-realistic, controllable, and easy to train.

Advancing Visual Intelligence: Innovations Across Images, Videos, and Point Clouds

Speaker: Mrigank Rochan, Assistant Professor in the Department of Computer Science at the University of Saskatchewan, Canada

Date: 5 December 2023

Attendees: 33

As the demand for advanced computer vision applications continues to grow, there is a pressing need to improve the understanding and interpretation of visual data. In this talk, Mrigank Rochan presented his group's efforts to push the boundaries of visual intelligence across multiple modalities, including images, videos, and point clouds, enabling more accurate and efficient analysis of diverse visual content. Firstly, he

introduced their method, which can automatically localise the object in an image associated with a user-generated textual tag. Secondly, he described their work towards the automatic creation of a short visual summary or highlight of a long input video, allowing users to easily preview, search, and edit ever-growing video data. Thirdly, he discussed their research on robust visual perception systems in autonomous driving, focusing specifically on LiDAR point cloud semantic segmentation. Finally, he concluded with some interesting future directions.

Mohan Tunuguntla, Prinicpal Engineer in the Conversational AI team at the Kotak Mahindra Bank Limited, Bengaluru attended the event.

Courses and Training sessions

A Very Short Course on Large Language Models

Instructors: Monojit Choudhury (Principal Applied Scientist) and Aditi Khandelwal, Kumar Tanmay, Utkarsh Agarwal (research scholars), Microsoft Corporation

Date: 30 September 2023 and 8 October 2023

Participants: 31

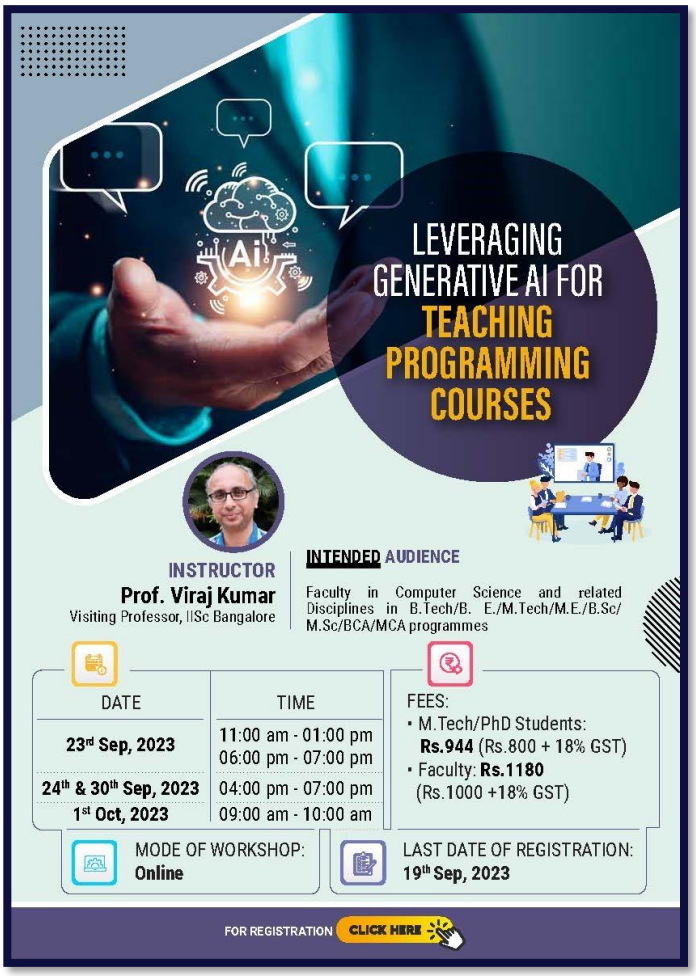
The course aimed to provide students with an accelerated understanding of building practical engineering natural language processing (NLP) systems and prompt engineering using the most advanced large language models (LLMs).

Leveraging Generative AI for Teaching Programming Courses

Instructor: Viraj Kumar, Visiting Professor, KIAC

Date/Period: September–October 2023

Participants: 141



The workshop provided faculty with hands-on exposure to a new style of code-writing problems that cannot be solved by merely copy-pasting solutions produced by Generative AI tools. The workshop provided faculty with both the student perspective (solving these problems) and the faculty perspective (evaluating student solutions).

Upcoming Events

Category	Title	Speaker/Organiser	Date
Kotak IISc AI-ML talk series	Multimodal Generative LLMs: Unification, Interpretability, Evaluation	Mohit Bansal, Director, MURGe-Lab (UNC-NLP Group), Department of Computer Science, UNC Chapel Hill	8 January 2024
	Object-centric 3D scene understanding from videos	Yash Bhalghat, PhD student, Visual Geometry Group, University of Oxford	11 January 2024
	LLMs for everybody: How inclusive are the LLMs today and Why should we care?	Monojit Choudhury, Professor of Natural Language Processing, Mohamed bin Zayed University of Artificial Intelligence (MBZUAI), Abu Dhabi	12 January 2024
	Teaching LLMs the Value of Cooperation	Tanmoy Chakraborty, Associate Professor of Electrical Engineering and Associate Faculty Member of the Yardi School of Artificial Intelligence, Indian Institute of Technology Delhi	2 February 2024
Workshops	Present and Future Computing Systems	Sumit Kumar Mandal, Assistant Professor, Department of Computer Science and Automation, IISc	12–15 January 2024
	Neuromorphic Sensing and Computing Architecture for Next-Gen AI Hardware	Chetan Singh Thakur, Associate Professor, Department of Electronic Systems Engineering, IISc	19–20 January 2024
	Recent Trends in Quantitative Finance	Shashi Jain, Associate Professor, Department of Management Studies, IISc	13 February 2024

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