

Two-day Workshop/FDP on Next-Gen Computation: Harnessing AI and HPC for Biomedical and Bioinformatics Breakthroughs

(28-29/3/2026)

Abstract book

Day 1	
Talk 1 9:30 – 10:15 hrs	<p>Speaker: Prof. Shekhar Verma, IITA</p> <p>Title: Deep Learning in Medical Imaging</p> <p>Abstract: Deep learning has emerged as a transformative approach in medical imaging, enabling better analysis, enhanced diagnostic accuracy, and improved clinical decision-making. By leveraging convolutional neural networks and other deep architectures, large volumes of imaging data can be processed efficiently to detect patterns that may be imperceptible to the human eye. These models are being applied to tasks including image classification, segmentation, and detection of abnormalities. Recently, Generative AI is transforming medical imaging by enabling the synthesis, enhancement, and reconstruction of medical images. Generative AI also supports tasks like image super-resolution, modality translation, and anomaly detection.</p>
Talk 2 10:15 – 11:00 hrs	<p>Speaker: Dr. Shivram Dubey, IITA</p> <p>Title: Generative Diffusion Models in Medical Imaging and Analysis</p> <p>Abstract: Generative diffusion models have emerged as a powerful class of probabilistic frameworks for learning complex data distributions, offering state-of-the-art performance in image synthesis, reconstruction, and enhancement tasks. This talk presents an overview of diffusion-based generative modeling and its transformative impact on medical imaging and analysis. We begin by introducing the foundations of forward and reverse diffusion processes and their role in learning high-dimensional data representations. Building on this, we explore how these models enable medical applications such as image synthesis, data augmentation, anomaly detection, and image segmentation.</p>
Talk 3 11:30 – 12:15 hrs	<p>Speaker: Dr. Anwesha Khasnobish, TCS-Research</p> <p>Title: The Power of Invisible Sensing: Next-Generation Electromagnetic Frontiers in Healthcare</p> <p>Abstract: Electromagnetic (EM) sensing and imaging are transforming healthcare by enabling non-contact, unobtrusive monitoring of physiological signals. This talk highlights the scientific principles of EM wave propagation and RF signal interpretation, alongside AI techniques that convert raw EM data into meaningful health insights. Applications include radar-based monitoring of respiration and heartbeat, non-contact activity recognition, implant surveillance, and microwave-based detection of conditions such as oedema. By integrating EM sensing with intelligent analytics, we open new pathways for continuous, non-invasive diagnostics and remote patient monitoring. This session offers students, researchers, and engineers a glimpse into the future of invisible, AI-driven healthcare technologies.</p>
Talk 4 12:15 – 13:00 hrs	<p>Speaker: Dr. Ashwini Galande, GE Healthcare</p> <p>Title: When Physics Meets AI: Solving Inverse Problems in Biomedical Imaging</p> <p>Abstract: Modern biomedical imaging from computational microscopy, Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) to Positron Emission Tomography (PET) does not capture images directly. Instead, it reconstructs them by solving a challenging Inverse Problem from indirect measurements. While deep learning has revolutionized image reconstruction, purely data-driven models often lack robustness and physical consistency. This talk explores physics-informed deep learning in biomedical imaging, where neural networks learn alongside the laws of</p>

	<p>physics. Using computational microscopy as an example, it shows how integrating physics with AI can produce more reliable, interpretable, and generalizable imaging solutions.</p>
<p>Talk 5 14:30 – 15:15 hrs</p>	<p>Speaker: Prof. Krishna Pratap Singh, IITA Title: Federated Learning and Its Applications in Bioinformatic and Biomedical Problems Abstract: Federated Learning (FL) enables collaborative model training across distributed biomedical and bioinformatics data sources without sharing sensitive data. This talk introduces core FL concepts, key algorithms such as FedAvg and its variants, and major paradigms including Horizontal, Vertical, and Personalized FL. It highlights how machine learning and deep learning models—such as CNNs, RNNs, Transformers, and GNNs—are applied in federated settings for tasks like medical imaging, EHR analysis, genomics, and drug discovery. The session also discusses challenges like data heterogeneity, and security, along with emerging solutions for building privacy-preserving and scalable healthcare AI systems.</p>
<p>Talk 6 15:15 – 16:00 hrs</p>	<p>Speaker: Prof. Naren Naik, IIT Kanpur Title: An optical fluorescence based functional biomedical imaging alternative: Pharmacokinetic fluorescence photoacoustic tomography Abstract: We give an overview of and our contribution towards a major non-ionizing alternative to current gold-standard nuclear medicine modalities for physiological(functional) imaging for early cancer detection and metabolic imaging, such as static and dynamic(pharmacokinetic) PET; namely, optical fluorescence and photoacoustic based pharmacokinetic tomography. In the current talk, we motivate and present solutions to the problem of obtaining time-varying concentrations and pharmacokinetic rates of transfer of an injected fluorophore between the plasma, extra-cellular extra-vascular and elimination compartments in a tissue model. We review the fully non-linear dynamic pharmacokinetic fluorescence photoacoustic tomography (PK-FPAT) frameworks for shape-based and pointwise reconstructions for this upcoming modality in biomedical imaging.</p>
<p>Hands-on 16:30 – 18:30 hrs</p>	<p>Dr. Anshu S Anand + PhD students Hands-on High Performance Computing Abstract: In an era where biological data is growing at an exponential rate, traditional computing resources often hit a "brick wall" in terms of memory, power, and processing speed. This session will cover a comprehensive introduction to High-Performance Computing (HPC) and intends to provide a foundational understanding of how to leverage high performance computing resources to accelerate your research, turning weeks/months of computation into hours. It will enable the audience to understand the core benefits of HPC and, more importantly, identify exactly when a research problem necessitates the jump from a local workstation to a supercomputer/HPC Cluster.</p>
<p>Day 2</p>	
<p>Talk 1 9:30 – 10:15 hrs</p>	<p>Speaker: Prof. Tapobrata Lahiri, IITA Title: IDG: An Integrated Data Geography approach to strengthen theoretical basis of Bioinformatics Applications Abstract: From the early years of Bioinformatics studies, the gap between the theoretical findings and their acceptance by the experimentalists is still remaining quite wide. In this regard, it is observed that multiple experimental outcomes that are currently present in various reputed publications, in spite of absence of their direct connections with an intended target investigation, may give generalized and robust solutions to resolve the desired problem through the application of inductive logic. Because of its special nature of application, it is introduced as an "Integrated Data Geography (IDG)" approach that is beyond the concept of simple inductive</p>

	<p>logic. Consequently, the application of IDG in Computational Structural Proteomics is discussed to show its utility beyond the scope of Google Deepmind based AlphaFold approach.</p>
<p>Talk 2 10:15 – 11:00 hrs</p>	<p>Speaker: Dr. Anup Som, University of Allahabad Title: Harnessing Transcriptional Regulatory Networks in Human Embryonic Stem Cells Abstract: The development and use of human embryonic stem cells (hESCs) in regenerative medicine have been revolutionary, offering significant advancements in treating various diseases. However, navigating the ethical, legal, and regulatory landscapes is crucial for the continued advancement and responsible application of hESC research in the medical field. The regulatory landscapes is an interplay between mRNAs, miRNAs and lncRNAs, and consists of two distinct states — naive state and primed state. Both naive and primed state can give rise to tissues of all the three germ layers in vitro but differ in their potential to generate germline chimera in vivo. Understanding the transcriptional regulatory circuitry that govern these two states of pluripotency in human can open a plethora of opportunities for studying early embryonic development and in biomedical applications. Utilizing RNA-Seq and miRNA-Seq data with weighted gene co-expression network analysis (WGCNA) method was used to identify the key molecular makers and their interactions that define the two distinct pluripotency states. Our analysis revealed two sets of genes that are involved in the establishment and maintenance of naive and primed states. The naive state genes were associated with metabolic processes while primed state genes were associated with systems development. We further filtered these lists to identify the intra-modular hubs and the hub transcription factors (TFs) for each state. We finally reported a list of 52 and 33 TFs as the set of core TFs that are responsible for the induction and maintenance of naive and primed states of pluripotency in human, respectively. Furthermore lncRNA DANT1 was found to be a crucial as it formed a bridge between the naive and primed state-specific networks. Analysis also revealed the crucial ceRNA circuitry between DANT1 and the miRNAs miR-30c-2-3p, miR-210-3p and let-7b-5p.</p>
<p>Talk 3 11:30 – 12:15 hrs</p>	<p>Speaker: Dr. Swaraj Basu, Strandls Title: Scaling Genomics with Intelligent Computing: From Single Cells to Clinical Decisions Abstract: Translating genomic data into clinical action requires integrating biological insight with scalable computation. At Strand, we combine genetic perturbation frameworks, multimodal genomics, and AI-driven computational engines to identify disease mechanisms and actionable targets. By integrating signals from whole-genome sequencing, transcriptomics, and epigenomics, our platforms model regulatory interactions underlying disease. These insights power applications in precision diagnostics, biomarker discovery, and therapy stratification, enabling genomic data to directly inform clinical decision-making.</p>
<p>Talk 4 12:15 – 13:00 hrs</p>	<p>Speaker: Dr. Abhishek Kumar Mehta, DBT Title: Artificial Intelligence in Biomedical Research: Ecosystem strengthening by DBT Abstract: Artificial intelligence (AI) is emerging as a crucial tool in drug development, disease diagnosis, treatment and monitoring of human health and enabling personalized medicine through advanced machine learning and data analysis. The Department of Biotechnology (DBT), is actively strengthening the biomedical research ecosystem by integrating Artificial Intelligence (AI) with genomics and biotechnology, shifting from traditional research to AI-driven precision medicine. The Department is supporting development and application of AI tools to address various problem statement in areas of Biomolecular Design, Sustainable Agriculture, Synthetic Biology, Ayurveda and Genomics Diagnostics, etc.</p>
<p>Talk 5</p>	<p>Speaker: Dr. Anjil Kumar Srivastava, University of Dundee, UK</p>

14:30 – 15:15 hrs	<p>Title: m⁶A modification: Mapping at single-base resolution</p> <p>Abstract: N6-methyladenosine (m⁶A) is the most abundant post-transcriptional modification in mRNA and plays a key role in regulating multiple processes across mRNA metabolism. Recent advances in direct RNA sequencing now enable the simultaneous detection of canonical bases and m⁶A modifications within individual RNA molecules. However, the development of accurate computational methods has been limited by the lack of biologically realistic training datasets with modification labels at single-molecule resolution. In this talk, I will discuss how m⁶A dysregulation shapes plant immune responses and highlight how m⁶A site prediction can be leveraged to engineer climate-resilient crops.</p>
Talk 6 15:15 – 16:00 hrs	<p>Speaker: Prof. Vatsala Misra/Dr. Ishan Pandey, MLN Medical College, Prayagraj</p> <p>Title: Role of Artificial Intelligence (AI)/Machine Learning (ML) in Health Care</p> <p>Abstract: From improving diagnostics, customizing treatments, and optimizing procedures, artificial intelligence (AI) and machine learning (ML) are transforming the healthcare industry. AI systems in medical imaging use X-rays, MRIs, and CT scans to identify abnormalities or tumors with amazing accuracy. In the meantime, ML models that are powered by genomic data and electronic health records forecast illness risks and optimize treatments for specific individuals. AI's value in diagnostics, notably molecular pathology and microbiology. In this case, ML supports pathology training and improves PCR testing and image analysis to identify microbial infections. The topic emphasizes how data insights and education from AI support clinical decisions. These technologies are numerous, ranging from natural language processing (NLP)-powered telemedicine bots to quicker drug discovery and more intelligent clinical trials. AI opens the door for proactive, cost-effective care.</p>
Hands-on 16:30 – 18:30 hrs	<p>Prof. Pritish Varadwaj + PhD students</p> <p>Hands-on Next Generation Sequencing</p> <p>Abstract: This workshop session will introduce the basic workflow of next-generation sequencing (NGS) analysis using human gut microbiome data using an open-source platform designed for reproducible bioinformatics. NGS has revolutionized microbiome research by enabling high-throughput sequencing of microbial communities, many of which cannot be cultured in the laboratory. Technologies such as Illumina sequencing generate millions of short reads, allowing researchers to study microbial diversity, functional potential, and host–microbe interactions at scale. The session begins with the motivation for NGS, core terminology, and the kinds of biological questions sequencing can address, such as identifying microbial composition or detecting dysbiosis. Participants will be introduced to FASTQ files, which store raw reads and Phred quality scores that indicate the probability of base-calling errors. Because sequencing instruments can introduce artifacts, raw reads must be checked before interpretation. Quality control to provide diagnostic plots of per-base quality, GC content, and adapter contamination etc, will be discussed.</p>