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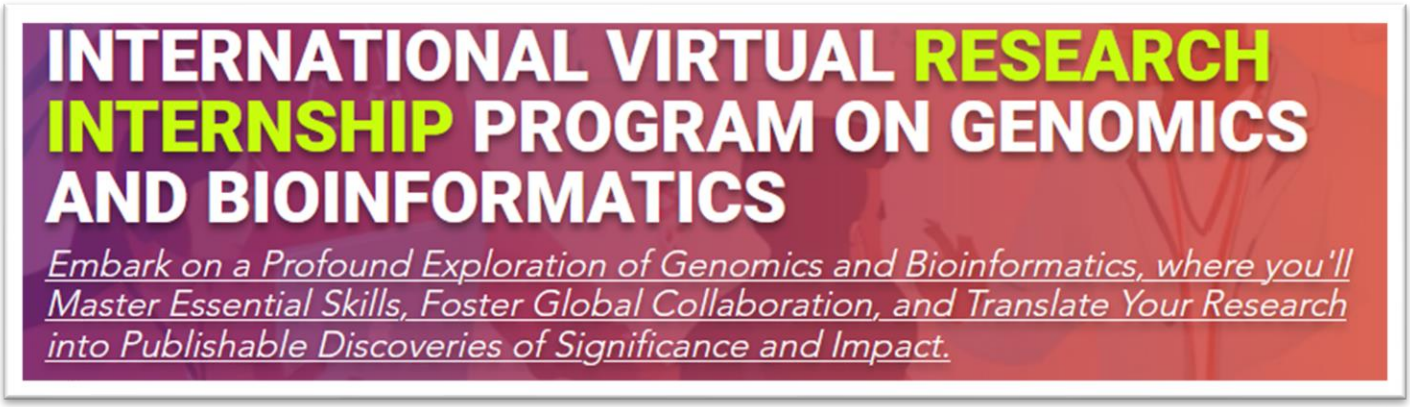

*We envision inspiring and empowering life scientists to leverage **GENOMICS AND BIOINFORMATICS** to tackle critical challenges, drive innovation, and promote sustainable progress across the globe.*

Research Domain: Human Genomics
Research Focus: Human Genomics Cancer Research
Research Topic: Genomic Profiling and Variant Analysis Across Different Cell Lines: Investigating Mutational Signatures and Impact on Tumor Progression for Improved Clinical Outcomes
Research Aim: To conduct comprehensive genomic profiling and variant analysis across various cancer cell lines, with the objective of investigating mutational signatures and their impact on tumor progression, ultimately aiming to enhance clinical outcomes through improved understanding and targeted therapies.
Research Objectives:

- Profile Genomic Variants and Mutational Signatures: Perform genomic sequencing of different cancer cell lines to identify and catalog genetic variants, and analyze mutational signatures to understand their origins and implications for tumorigenesis and tumor progression.
- Correlate Genomic Data with Tumor Progression and Clinical Outcomes: Investigate the relationship between specific genetic variants, mutational signatures, and tumor progression, and integrate this data with clinical information to identify potential biomarkers for disease prognosis and therapeutic targets.

LEARNING OBJECTIVES

- **Master Genomic Sequencing Techniques**: Gain proficiency in using whole genome and exome sequencing to identify genetic variants in cancer cell lines.
- **Interpret Mutational Signatures**: Develop skills in analyzing and interpreting mutational signatures, understanding their significance in cancer development and progression.
- **Evaluate Functional Impact of Genetic Variants**: Learn to assess the functional impact of genetic variants on gene expression, protein function, and cellular pathways, and their implications for tumor biology.

- **Integrate and Analyze Multidimensional Data**: Develop expertise in integrating genomic and clinical data, performing comprehensive analyses to derive insights into the roles of genetic variants and mutational signatures in cancer, ultimately informing personalized treatment strategies.
- **Craft Research Papers for Publication:** Learn how to synthesize and present your findings coherently, culminating in preparing research papers suitable for publication, contributing to the broader understanding of the evolution and dissemination of infectious diseases.

EXPECTATIONS WHILE UNDERTAKING THIS FELLOWSHIP PROGRAM:

- **Knowledge of Genomics and Bioinformatics:** Develop a solid foundation in genomics and bioinformatics, including an understanding of key concepts, methodologies, and technologies used in the program
- **Proficiency in Data Analysis:** Gain proficiency in analyzing genomic data using bioinformatics tools and software. This includes skills in data preprocessing, quality control, data visualization, and statistical analysis.
- **Research Skills:** Acquire research skills necessary for conducting genomics and bioinformatics studies. This includes formulating research questions, designing experiments, collecting and analyzing data, and interpreting research findings.
- **Critical Thinking and Problem-Solving:** Develop critical thinking skills to analyze complex genomic and bioinformatics problems and propose creative solutions. You would be able to evaluate scientific literature, identify research gaps, and contribute to the advancement of knowledge in the field.
- **Computational Skills:** Gain proficiency in software and applications commonly used in bioinformatics, such as Geneious software, web servers etc. to analyze genomics data and interpret results
- **Communication Skills:** You would be able to effectively communicate your research findings and scientific concepts to both technical and non-technical audiences. This includes writing scientific reports, presenting research orally, and participating in scientific discussions and collaborations.
- **Collaboration and Teamwork:** Be able to develop skills in collaborating with peers and professionals in multidisciplinary research teams. This includes effective communication, teamwork, and the ability to contribute constructively to group projects.
- **Professional Development:** You would be able to develop a professional mindset, including skills in time management, organization, and project management. They should also be aware of current trends and advancements in genomics and bioinformatics, and actively seek opportunities for professional growth and development.
- **Publication and Dissemination:** Contribute to the scientific community by publishing their research findings in peer-reviewed journals

PROGRAM OUTLINE AND SCHEDULE

CLASSES	TOPICS/FOCUS	SCHEDULE & DELIVERABLES
General Classes	Overview of genomics, bioinformatics, and their applications in various fields	**Week 1**
	Understanding the central dogma of molecular biology	
	Introduction to genomics technologies and data generation	
	Data formats in Genomics and Bioinformatics (Practical)	
	Internet tools and Databases (Practical on data retrieval, Blast etc.)	
	Introduction to software tools and their installation, web servers, and pipeline tools (Practical), Basic Linux Command Line Interface	
	Genomics Data and its Analysis using cutting-edge tools (Practical DNA, RNA and Protein samples)	
Specialized Classes	Introduction to Cancer Genomics **(Breast, Colon, Leukemia…)**	
	The experimental application of each of these in your field of study	
	Problem identification relative to the above area in the healthcare, industrial, and other life science research space	
	The use of critical thinking and problem-solving tools to design a hypothesis in solving identified problems	
PRACTICAL SESSIONS		
Data Acquisition and Preprocessing	**Collection of DNA Data:** Collect genomic datasets containing genetic information of the cancer case study in patients, including SNP data and clinical outcomes. **(For both Reference and Query)**	**Week 2**
	Table 1: Construction of General Sequence Properties: via data table based on genome information which includes accession number, raw data size, sources, geographical regions platform, genome type, layout, file types, etc.	
	Write Up 1: Data Collections	
DNA Sequence Alignment	**Mapping to Reference:** Aligning Reads to Reference Sample	**Week 3**
	Write Up 2: Mapping to Reference	
Comprehensive Genome Analysis	**Variant Calling Analysis:** Call variants (SNPs and INDELs) by comparing sequenced reads to the reference genome i.e., performing variant analysis to identify variants specific to identify relevant SNP-associated variations of the disease in the patients **Effect Prediction and Functional Analysis:** Annotate SNP variants to determine their genomic location, potential functional effects, and allele frequencies (i.e., focus on variants affecting protein-coding genes, regulatory elements, and non-coding RNAs).	**Week 4**

	Write Up 3: Variant Calling Analysis, Effect Prediction and Functional Analysis	**Week 5**
	• **Table 3:** Construction of SNPs or Indels • **Figure 1:** Mapping View • **Figure 2:** Variant Calling View	
	Comparative Variant Analysis: • Compare the identified variants between samples treated and untreated • Identify unique and shared variants, as well as those specific to each sample	
	Statistical Analysis: • **Table 4:** General information on all predicted SNPs • **Table 5:** Identify unique and shared variants, as well as those specific to each sample	
	Write Up 6: Variant Annotation and Functional Prediction	**Week 6**
	Statistical Analysis: • **Table 6:** Annotated SNPs and their functions • **Figure 3:** Percentage abundance of all SNPs covering nonsynonymous, synonymous, and regulatory regions. • **Figure 4:** Ratio of SNPs with effect on protein or functional genes • **Figure 5:** Classification of variants based on their effect types • **Figure 6:** Significantly enriched or depleted variants in both sample subtypes • **Figure 7:** Pathway enrichment analysis	
RESEARCH PROJECT OUTLINE FOR PUBLICATION		
Research Outline	Finalizing Materials and Method	**Week 7 - 8**
	Result Writing	
	Discussion and Conclusion	
	References and Abstract	
Round Up	Certification and Recommendation Letter	**Week 9**
	Follow-up and Publication	