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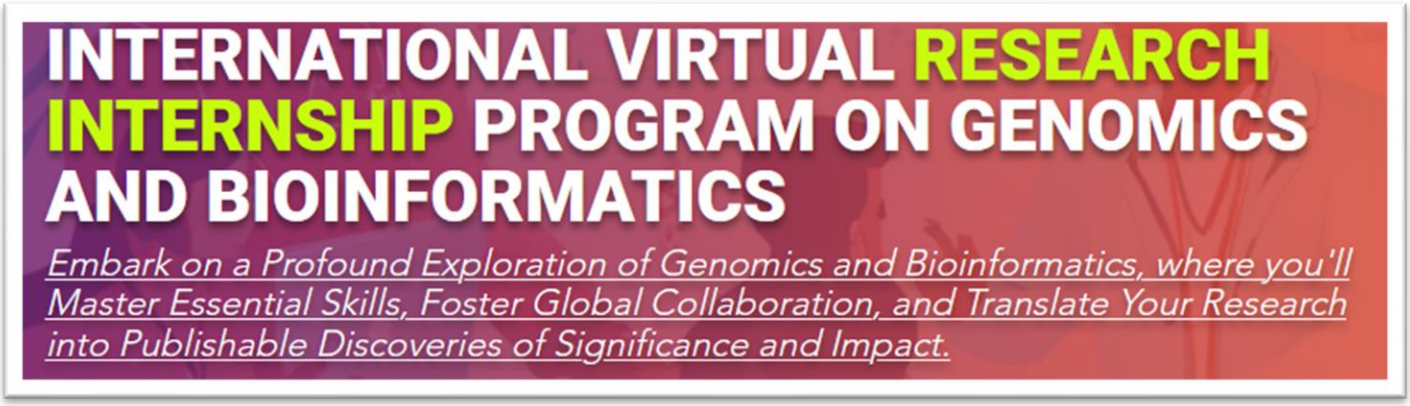

*We envision inspiring and empowering life scientists to leverage **GENOMICS AND BIOINFORMATICS** to tackle critical challenges, drive innovation, and promote sustainable progress across the globe.*

Research Domain: Cancer Research
Research Focus: Clinical Genomics on Cancer Research
Research Topic: Genomic Characterization of Tumor-Associated Microbiota and Antimicrobial Resistance Genes in Colorectal Cancer
Research Aim: To analyze the microbial populations and antimicrobial resistance genes associated with colorectal tumors, aiming to identify potential microbial biomarkers and understand their influence on tumorigenesis.
Research Objectives:

- **Characterize Tumor-Associated Microbiota**: Investigate the composition and diversity of microbial populations within colorectal tumors using genomic sequencing techniques.
- **Identify Antimicrobial Resistance Genes**: Analyze the presence and abundance of antimicrobial resistance genes within the tumor-associated microbiota to assess their potential impact on treatment outcomes.
- **Evaluate Microbial Biomarkers**: Identify potential microbial biomarkers associated with colorectal cancer by comparing the microbiota composition between tumor and healthy tissue samples.

LEARNING OBJECTIVES

- **Understand Tumor Microbiota Genomics**: Develop knowledge of genomic sequencing techniques used to characterize microbial populations associated with colorectal tumors.
- **Analyze Antimicrobial Resistance Genes**: Acquire skills in identifying and analyzing antimicrobial resistance genes within microbial genomes using bioinformatics tools and databases.
- **Interpret Microbiota Composition**: Gain proficiency in interpreting microbial community composition data and identifying potential biomarkers associated with colorectal cancer.
- **Evaluate Tumorigenesis Mechanisms**: Understand the mechanisms by which tumor-associated microbiota and antimicrobial resistance genes may influence colorectal cancer development and progression.

- **Conduct Comparative Genomics Studies**: Learn how to design and conduct comparative genomics studies to assess the relationship between microbial populations, antimicrobial resistance genes, and colorectal cancer.
- **Craft Research Papers for Publication:** Learn how to synthesize and present your findings coherently, culminating in the preparation of research papers suitable for publication, contributing to the broader understanding of the evolution and dissemination of cancer tumorigenesis.

EXPECTATIONS WHILE UNDERTAKING THIS INTERNSHIP 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

CLASSES	TOPICS/FOCUS	SCHEDULE & DELIVERABLES
General Classes	Overview of genomics, bioinformatics, and their applications in various fields	
	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	**Week 1**
	Genomics Data and its Analysis using cutting-edge tools (Practical DNA, RNA and Protein samples)	
Specialized Classes	Introduction to clinical genomics of infectious diseases	
	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 WGS (NGS) Genomic Data:** Gather whole-genome sequencing data of multi-drug resistant pathogenic bacteria strains from relevant sources and databases.	**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.	
	Quality Control: Assess data quality, perform trimming, and filter out low-quality reads to ensure reliable results.	
	Write Up 1: Reads Processing and Genome Assembly	
Comprehensive Genome Analysis	**Functional Annotation:** **Gene prediction, Protein features, Specialty features, Chromosomal properties, and Circus-view, among others.**	**Week 3**
	Write Up 2: Functional Genome Annotation	
	Table 2: Construction of Chromosomal Genome Properties: CDS, Genes, RNA, Hypothetical Protein, Functional Protein, Go assignments, PGfam, Cripsr, etc.	
Microbial Drug Resistance and Mechanisms of Adaptation in Pancreatic Cancer Promotion and Progression	**Resistome Profile Study on individual samples and plasflow files:** Understanding this can shed light on potential challenges in treatment approaches, i.e., antibiotic resistance genes in the microbial communities (tumor microenvironment) could impact the effectiveness of cancer treatments that involve antibiotics.	**Week 4**
	Write Up 4: Resistome Profiling Analysis	
	Statistical Analysis:	**Week 5**

	• **Figure 2:** Heatmap of antibiotic resistance genes (ARG) types between cancerous and non-cancerous tissues (Antibiotic Class) • **Figure 3:** Prevalence of AMR genes across cancerous and non-cancerous tissues • **Figure 4:** Percentage distribution of ARG resistance mechanism between cancerous and non-cancerous tissues • **Figure 5:** Relative distribution of AMR genes in antibiotics • **Table 3:** Shared resistance genes and their putative functions in cancerous and non-cancerous tissues • **Table 4:** ARG, RM, ATB and their putative functions	
Insights into Cancer-Associated Microbiota	**Taxonomic Analysis:** Unveiling Microbial Taxonomic Composition and Abundance Profiles in the Pancreatic Tumor Microenvironment.	
	Figure 10: Taxonomic Classification: The use of Kraken to compare the sequences with the reference database and assign taxonomic labels (e.g., species, genus, family, etc.) to each sequence **Table 8: Abundance Calculation:** Compile the relative abundance values for each taxonomic group across all samples (comparative analysis). **Figure 11: Differential Abundance Analysis (if applicable):** Compare the abundance profiles between cancerous and non-cancerous samples using statistical methods to identify taxonomic groups that are significantly differentially abundant. **Figure 12:** Others including alpha diversity etc.	**Week 6**
	Result Writing	
	Discussion and Conclusion	
	References and Abstract	**Week 7 - 8**
Round Up	Certification and Recommendation Letter	
	Follow-up and Publication	**Week 9**

NOTE THE FOLLOWING:

- CLASS TIME: 3 PM GMT.
- ASSIGNMENT: is to be done within 5 days after class and must be submitted before the next class
- Absent from classes should not be more than 3 consecutive times with a genuine excuse, else you lose your spot in the internship program.