DEPARTMENT OF PEDIATRICS
COLLEGE OF MEDICINE

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

FOR APPLICATION YEAR: 2027

PROJECT TITLE: Decoding the Genome's Switches: Computational Regulatory Genomics of Development and Disease

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Project Description

Nearly every cell in your body carries the same DNA, yet a liver cell, a fat cell, and a facial bone cell behave completely differently. The difference lies in which genes are turned on or off, and when. Our lab uses computational approaches to study the DNA "switches" (regulatory regions called enhancers and promoters) that control gene activity, the proteins that flip them, called transcription factors (TFs), which bind to these regions to turn genes on or off, and how errors in this system contribute to disease during development. We focus on several biological systems, including craniofacial (face and skull) development, liver cancer, fat-tissue metabolism, and how cells change identity during differentiation and reprogramming.

What you will do: UPRISE students will work on their own defined project using large genomic datasets, such as RNA-seq (which genes are active), ATAC-seq (which DNA regions are accessible), ChIP-seq (where TFs bind on the DNA), and single-cell data. For example, a student might identify the genes and regulatory regions that become active as cells change into a different cell type or state, or compare gene activity between healthy and diseased tissue to find the TFs that drive these differences.

Skills you will build:
• Programming in Python and/or R, and working in a Linux/high-performance computing environment
• Using AI coding assistants effectively and responsibly: writing clear prompts, checking and debugging generated code, and making sure your analyses are correct and reproducible
• Analyzing and visualizing genomic data for effective presentation
• Reading scientific papers and interpreting results in a biological context

• Presenting your work through lab meetings and a final poster or talk

Mentoring: You will be part of a collaborative team, with day-to-day guidance from lab members and weekly one-on-one meetings with the faculty mentor.

Who should apply: Students interested in biology, computer science, data science, or medicine who are curious about how genes are controlled. A basic understanding of gene expression (e.g., from an introductory biology course) is helpful. No prior programming experience is required, though coding experience is a plus.

This project is entirely computational and uses publicly available, in-house, and/or de-identified human data, so no IRB/IACUC protocol is required.

Lab website: https://www.computbio.org