EXPLORATORY WORKSHOP ON
MATH, THEORY, AND CANCER BIOLOGY

March 11-12, 2024

NATIONAL CANCER INSTITUTE
TERRACE LEVEL, SEMINAR ROOM 110, SHADY GROVE CAMPUS
ROCKVILLE, MARYLAND 20850

INTRODUCTION TO THE WORKSHOP

The NCI extensively supports applied math methods development and statistical methods develop, predominantly as software development research. However, mathematical theory development itself is less supported by NCI, despite cancer biology (both phenomena and data) providing complex and unique constraints that may prompt novel mathematical theory development and application toward cancer biology.

In order to understand the underlying mechanisms behind cancer initiation, development, and response to therapy, cancer researchers generate, analyze, and interact with vast amounts of data from across a wide variety of sources and biological scales. Performing data analyses, constructing mathematical models of complex biology, visualizing multi-scale datasets, and generating insights and "aha moments" requires an understanding of data bounds, embedded manifolds, and the transformations necessary to unravel biological knowledge.

Meeting topics will include manifold learning, topological data analysis, random matrix theory, high dimensional probability, and geometric measure theory, with an eye toward developing opportunities for expanded use and application of such areas in cancer biology research.

GOALS OF THE WORKSHOP

This meeting's goal is to identify scientific and collaborative bridges between the communities of mathematical theory development and computational cancer biology research by bringing together mathematical theorists and cancer biologists from across various subfields.

Through talks, group discussions, and breakouts, the workshop is expected to result in insights addressing the following questions:

- What collaborative barriers and opportunities exist across mathematical theoretical methods development and cancer biology research?
- How can these communities more effectively find each other and collaborate?
- What are opportunities for NCI to address functional gaps (communication, education/research silos, pace of research) between these communities?

ORGANIZING COMMITTEE

Raul Rabadan	Gerald & Janet Carrus Professor, Dept. of Systems Biology, Columbia University
Shmuel Weinberger	Andrew MacLeish Professor, Dept. of Mathematics, The University of Chicago
David Miller	Program Directors, Division of Cancer Biology, National Cancer Institute
Hannah Dueck	
Eric Johnson Chavarria	

AGENDA: MONDAY, MARCH 11, 2024

9:00 am – 9:15 am   **Welcome and Introduction to the Workshop**
David Miller
Program Director, Division of Cancer Biology, NCI

Dan Gallahan
Director, Division of Cancer Biology, NCI

Raul Rabadan
Gerald & Janet Carrus Professor, Department of Systems Biology
Columbia University

Shmuel Weinberger
Andrew MacLeish Professor, Deptment of Mathematics
The University of Chicago

9:15 am – 10:45 am   **Participant Introductions & Overview**
Raul Rabadan, Columbia University
Shmuel Weinberger, The University of Chicago

3-minute introductions from all participants

Co-Chairs: An introductory talk on current research and methods use in math and cancer biology

Discussion

10:45 am – 11:00 am   **Coffee break**

11:00 am – 12:00 pm   **Topic Session I – Geometry and Topology (1)**
Discussion-focused session on consideration of Geometry, Manifold Learning & Embeddings

Short Talks:
Smita Krishnaswamy
Tatiana Toro

Discussion

12:00 pm – 1:30 pm   **Lunch**

1:30 pm – 2:30 pm   **Topic Session II – Cancer Data to Biological Knowledge**
Discussion-focused session on opportunities for abstract math to advance cancer biology

Short Talks:
Sylvia Plevritis
Ben Greenbaum

Discussion

2:30 pm – 2:45 pm	**Coffee break**
2:45 am – 3:45 pm	**Topic Session III – Geometry and Topology (2)**
	Discussion-focused session on consideration of Geometry, Manifold Learning & Embeddings

Short Talks:
Andrew Blumberg
Bei Wang

Discussion

3:45 pm – 4:45 pm	**Topic Session IV – Dynamics**
	Discussion-focused session on dynamic systems and models

Short Talks:
Sandy Anderson
Konstantin Mischaikow

Discussion

5:00 pm	**Adjourn Day 1**

AGENDA: TUESDAY, MARCH 12, 2024

9:00 am – 10:00 am	**Topic Session V – Scale, High dimensions, Universality**
	Discussion-focused session on analyses across scale and in high dimensions

Short Talks:
Antonio (Tuca) Auffinger
Gunnar Carlsson
Carlos Lopez

Discussion

10:00 am – 10:15 am	**Coffee break**
10:15 am – 11:15 am	**GAPS AND OPPORTUNITIES**
	Raul Rabadan, Columbia University
	Shmuel Weinberger, The University of Chicago

Discussion

11:15 am – 12:00 pm	**Topic Breakouts**
12:00 pm – 1:00 pm	**Lunch**

1:00 pm – 3:00 pm   **Reports & Outlook**
Raul Rabadan, Columbia University
Shmuel Weinberger, The University of Chicago

Summary of the workshop, with breakout reports.

Call to put insights and action items into a form that math and cancer bio research communities can use and disseminate, on the intersection of mathematical theory development and cancer biology, along with needs and opportunities identified during the workshop.

3:00 – 3:15 pm   **Adjourn Day 2**