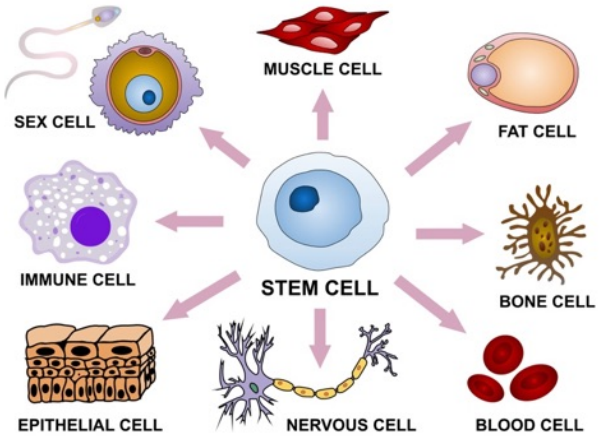
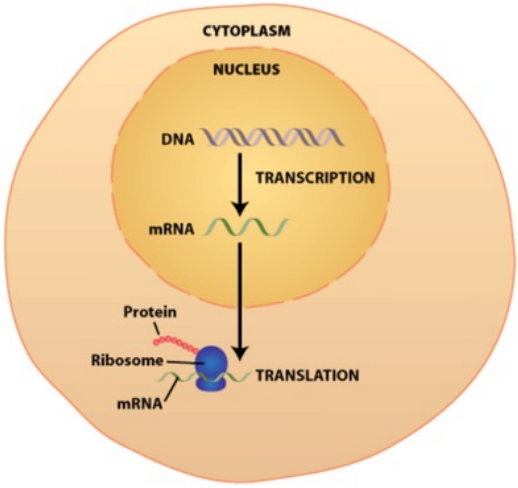
Math 612: Topics in Mathematical Biology
2019W Term 1

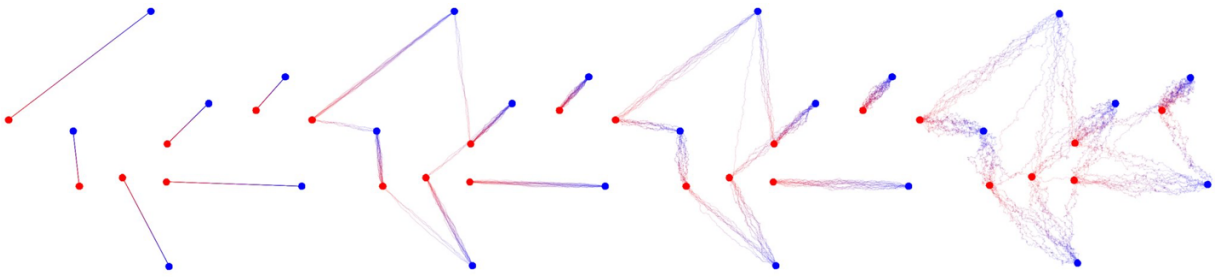
Single Cell Analysis

Prof. Geoffrey Schiebinger





New measurement technologies like single-cell RNA sequencing are bringing 'big data' to biology. This course introduces a mathematical framework for thinking about questions like: *How does a stem cell transform into a muscle cell, a skin cell, or a neuron*? *How do cell types destabilize in diseases like cancer? Can we reprogram a skin cell into a stem cell?* We will learn how to model developing organisms as stochastic processes in gene expression space. We will cover *random matrices • stochastic processes • entropy • optimal transport • convex optimization • duality • gradient flows • geodesic interpolation • and developmental genetics*.



Math 612: Topics in Mathematical Biology: Single Cell Analysis
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Time and Location: Tues & Thurs 9:30-11am in Math 126
Office Hours: TBA

Grading: The course grade will mainly be determined by homework and a final project. A small portion of the grade will be based on scribing of lecture notes.

Homework (45%):
There will be three homework assignments and students will be given two weeks to complete each one. The homework will involve a combination of theoretical exercises and programming challenges (in python).

Final project (50%):
The final project consists of three stages for a total of 50%. The first stage is a short written proposal of a research idea, which will be due in late October and count for 10%. The second stage is an oral presentation to the class in mid-November. This presentation will count for 20%. The third is a written report (20%).

Scribing (5%):
Each lecture will have an assigned scribe who will be responsible for taking notes and writing them up nicely in latex. I will be the scribe for the first few lectures, and then students will sign up for their desired date.

Text
We will cover material from the book *Computational Optimal Transport* by G. Peyré and M. Cuturi and from selected papers. This book is available for free on arxiv.org!