

# Sebastian Bernasek

Data Scientist | Computational Researcher

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## Overview

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Data scientist whose efforts to understand and predict the behavior of complex systems have yielded several academic publications and issued patents. Brings a unique blend of creativity, math and science literacy, and engineering pragmatism, all backed by strong python scripting skills and a healthy dose of common sense. Recently concluded 5 years of academic research preceded by 3 years working at a midstage startup, and is now seeking new opportunities to continue learning while contributing to something fun.

### Expertise includes:

- **Developing useful models** to analyze and simulate complex processes.
- **Empowering decisions with quantitative insight** backed by rigorous analysis.
- **Building rich data sets** by turning qualitative observations into quantitative measurements.
- **Hacking together data-driven solutions** to a wide variety of everyday problems.
- **Identifying and prototyping state of the art methods** derived from the research literature.
- **Collaborating with multidisciplinary teams** to coordinate multifaceted R&D efforts.
- **Bridging the gap between research, engineering, and business** by emphasizing broader implications of technical nuance.

## Education

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### Ph.D. in Chemical and Biological Engineering • 4.0 *Northwestern University*

2014 - 2019

- Advised by Luis Amaral, Neda Bagheri, and Rich Carthew.
- Center Scholar, NSF-Simons Center for Quantitative Biology
- Dissertation combined data science and chemical engineering to explore how cells make reliable decisions.

### B.S. in Chemical Engineering • 3.8 • High Honors *University of California, Santa Barbara*

2008 - 2012

- Exchange student at Imperial College London throughout 2010/2011.

## Experience

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### Consulting (while traveling!)

Present

- Built a database of 5k+ targeted B2B sales leads using a combination of web-scraping, commercial APIs, and machine learning.
- Provided data-driven insight that enabled a recruiting firm to boost their monthly revenue by focusing on more probable hires.
- Automated several text content extraction and parsing routines to save hundreds of hours of tedious labor.

### Researcher at Northwestern University *Evanston, IL*

2014 - 2019

- Published in high profile journals including *Cell* and *PLOS Computational Biology*.
- Designed, built, and deployed several simulation and analysis frameworks for the research community.
- Discovered a surprising link between expression dynamics and metabolism by developing a model that predicts developmental mistakes.
- Discovered a novel cell decision mechanism by using computer vision to derive insight from microscopy data.
- Increased data volume and quality by developing a computer vision pipeline for automated microscopy analysis.
- Mentored (and learned from) two inspiring young researchers in formulating their own projects.

### Day to day life entailed:

- Exploratory analysis and visualization of image and time series data.
- Developing creative strategies to tease insight out of noisy experiments.
- Building mathematical models to generate testable predictions.
- Conducting tens of thousands of parallel simulations on a distributed computing cluster.
- Frequent collaboration with wet labs to design more impactful experiments.
- Brainstorming & hackathons for data-driven projects of all flavors, from painting styles to political tweets.
- Communicating complex ideas to diverse audiences.
- Academic reading, writing, peer review, and grant proposals.
- Co-teaching undergraduate chemical engineering courses and data science bootcamps.
- Mentoring graduate, undergraduate, and high school students in formulating their own research.

## Process Engineer at LanzaTech *Chicago, IL*

2012 - 2014

- Developed renewable energy process design concepts, earning two granted patents and further pending applications.
- Designed and built the company's core process modeling framework, which was rapidly adopted by all engineers.
- Collaborated with technology providers to identify complementary value streams, leading to corporate partnerships.
- Modeled refinery-scale processes to predict and optimize economic and life-cycle performance.
- Advised executives and investors with technical analysis that directly inspired major strategic decisions.

## Research Assistant at UC Santa Barbara *Santa Barbara, CA*

2011 - 2012

- Conducted first ever dynamic measurement of interaction forces between vesicles. Published in *Soft Matter*

## Skills

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**Programming** python / cython / pandas, scipy, sklearn, etc. / visualization / package development / git / LaTeX / HTML & CSS / Unix shell

**Research** project conception / experimental design / scientific literacy / technical communication / inter-disciplinary collaboration

**Data Engineering** feature selection / dimensionality reduction / images / natural language / structured text / web scraping

**Analysis** hypothesis testing / Bayesian inference / signal detection / clustering / time series / networks

**Modeling** dynamical systems / stochastic processes / nonlinear regression / classification / reduced-order models / process simulation

**Computer Vision** feature extraction / image segmentation / spatial analysis / quantitative microscopy

**Process Engineering** conceptual design / process simulation / PFD optimization / cost estimation / LCA

## Publications

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### Ratio-based sensing of two transcription factors regulates the transit to differentiation.

*Under Revision*

Sebastian Bernasek\*, J.F. Lachance\*, N. Peláez\*, R. Bakker, H. Navarro, L. Amaral, N. Bagheri, I. Rebay, R. Carthew

*Expected 2020*

### Fly-QMA: Automated analysis of mosaic imaginal discs in *Drosophila*.

Published in *PLOS Comp. Biology*

Sebastian Bernasek, N. Peláez, R. Carthew, N. Bagheri, L. Amaral

**2020**

### Repressive gene regulation synchronizes neural development with cellular metabolism.

Published in *Cell*

J. Cassidy\*, Sebastian Bernasek\*, R. Bakker, R. Giri, N. Peláez, B. Eder, A. Bobrowska, N. Bagheri, L. Amaral, R. Carthew

**2019**

### Quantitative analysis of cell fate decisions.

Doctoral Dissertation

Sebastian Bernasek

**2019**

### Direct measurement of interaction forces between charged multilamellar vesicles.

Published in *Soft Matter*

J. Frostad, M. Seth, Sebastian Bernasek, L.G. Leal

**2014**

## Patents

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### US Patent 10,570,427, Fermentation process for the production of lipids.

LanzaTech

Sean Simpson, Sebastian Bernasek, and Deepak Tuli

**Granted 2020**

### US Patent 9,783,835, Method for producing a lipid in a fermentation process.

LanzaTech

Sean Simpson and Sebastian Bernasek

**Granted 2017**

### US Patent App. 62/872,869, Methods for Optimizing Gas Utilization.

LanzaTech

Sebastian Bernasek & Co-inventors

**Filed 2019**

## Software

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### FlyQMA

On PyPI

Python package for automated mosaic analysis of *Drosophila* imaginal discs. Facilitates high-throughput segmentation, bleedthrough correction, and annotation of raw microscope images in order to accelerate experimental pipelines while improving reproducibility.

### FlyEye Analysis

On PyPI

Python platform for analyzing gene expression dynamics in the developing fly eye. Ascribes quantitative rigor to a popular experimental technique by supporting dynamic analysis, spatial analysis, model fitting, and visualization of the resultant trends.

### **TFBinding**

[On GitHub](#)

Python package for simulating the statistical mechanics of cooperative binding events between transcription factors and their target promoters. Leverages a novel and highly-parallelizable microstate enumeration algorithm to dramatically outperform the existing state of the art in terms of both memory footprint and simulation scale.

### **GeneSSA**

[On GitHub](#)

A python framework for exact stochastic simulation of Markov processes, with a particular emphasis on gene regulatory networks. Simulates many classes of large networks faster and more efficiently than all other available software.

## **Mentorship**

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### **Simran Khunger** *High school student*

Summer 2017

Project: Designing synthetic benchmarks for 3D segmentation of cell membranes in the larval *Drosophila* eye.

### **Darshan Patel** *Chemical engineering undergraduate*

Summer 2016

Project: Probing tradeoffs between efficiency and robustness via in silico evolution of GRN topologies.

## **Teaching**

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### **Chemical Engineering Methods and Analysis**

Spring 2018

### **Reaction Engineering and Kinetics**

Spring 2017

### **Process Engineering and Design**

Spring 2016

### **Data Science Bootcamp**

Summer 2015

### **Reaction Engineering and Kinetics**

Spring 2015