Sebastian **Bernasek**

Data Scientist | Complex Systems Researcher

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Overview

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 and impactful.

Expertise includes:

- **Developing mathematical 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.
- **Prototyping state of the art methods** from the research literature.
- **Collaborating with multidisciplinary teams** to coordinate R&D efforts.
- **Bridging the gap between research, engineering, and business** by focusing on the bigger picture.

Education

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

Consulting (while traveling!)   Present

- Built a database of 5k+ targeted B2B sales leads using a combination of web-scraping, commercial APIs, and machine learning.
- Boosted a recruiting firm's bottom line by leveraging data-driven insight to focus resources on more probable hires.
- Saved hundreds of hours of tedious labor by automating several PDF content extraction and parsing routines.

Student Researcher at Northwestern University   *Evanston, IL*   2014 - 2019

- Published in high profile journals including *Cell* and *PLOS Computational Biology*.
- Discovered a surprising link between gene expression and metabolism by predicting the emergence of developmental mistakes.
- Discovered a novel cell decision mechanism by using computer vision to derive quantitative insight from microscopy data.
- Achieved >100x speedup of a common technique by developing an algorithm to annotate patch patterns in microscopy data.
- Designed, built, and deployed several python frameworks to help the research community analyze and simulate various biological processes.
- Mentored (and learned from) two inspiring young researchers in formulating their own research.

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
- Invented two patented processes for converting waste CO2 to valuable lipid products.
- 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

Scientific Computing python / cython / numpy, scipy, pandas, etc. / jupyter / git / unix shell / latex / HTML & CSS
Data Engineering feature selection / dimensionality reduction / image processing / structured text / NLP / web scraping
Analysis hypothesis testing / unsupervised learning / time series analysis / pattern detection / visualization (matplotlib, seaborn, graphviz, etc.)
Computer Vision feature extraction / image segmentation / spatial analysis / quantitative microscopy
Modeling dynamical systems / stochastic processes / nonlinear processes / process simulation / LTI systems & control theory
Machine Learning classical methods (scikit-learn, statsmodels, etc.) / basic familiarity with deep learning architectures & pytorch (eager to practice)
Research project conception / experimental design / scientific literacy / technical communication / inter-disciplinary collaboration

Publications

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

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

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

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

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

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

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