Andrés Octavio ARAVENA DUARTE

andres.aravena@gmail.com ▪ +90 (507) 013 31 84 ▪ **Nationality:** Chilean

Applied Mathematical Engineer, Bioinformatics Researcher
Assistant Professor, Molecular Biology and Genetics Department, Istanbul University

Mathematical Engineer, University of Chile, Chile, 2002
PhD on Informatics, Inria-University Rennes I, France, 2013
PhD on Mathematical Modelling, University of Chile, 2013

Highlights

Scientific Researcher and Engineer, combines mathematical modeling and software development to solve complex problems in efficient and innovative ways. Self-motivated and autonomous. Good communicator with strong interpersonal skills delivers effective team motivation and project leadership. Product-oriented, balances timely-delivery with good quality results. Experienced University Teacher with high impact on the students.

- Bioinformatics & Systems Biology Research
- Applied Mathematician
- Software Developer
- Graduate level Universitary Teaching
- Interdisciplinary communication
- Good interpersonal skills
- Good abstraction capability
- Designs and manages SQL databases

- Modeling and Solving Complex Problems
- Product-oriented Project Management
- Good practices on productivity & Time mgmt.
- Team collaboration tools: git, wiki
- Experience in Data Mining & Machine Learning
- Proficient on Python, C++, R, etc.
- High performance computing
- Proficient on Unix/Linux environment

Most Relevant Experience

2014-Present **Assistant Professor.** Molecular Biology and Genetics Dept., Science Faculty, Istanbul University.

Created undergraduate and graduate level courses, and organized workshops to teach Unix command line, Data Science, Computational Thinking, Logic, Probabilities, and Analysis of Biological Networks.

- Established an international scientific collaboration (France, Sweden, Turkey) network researching methods for taxonomical classification of archeological DNA using machine learning techniques.
- Created the courses "Introduction to Scientific Computing", "Computing in Molecular Biology", "Methodology of Scientific Research" and "Systems Biology". Reformulated and updated the "Bioinformatics" course.

2011-2013 **PhD Thesist.** IRISA/Inria, U. Rennes 1, France, and Dept. Ingeniería Matemática, U. Chile.

Systems Biology thesis integrating genomic and transcriptomic data to build a regulatory network model. This method can be used when gene knock-out is not feasible, for example in the bioleaching heap extremophiles.

- Proposed a model using Answer Set Programming to enumerate all "minimal" regulatory networks compatible with experimental sequence and expression data.
- Received two simultaneous Ph.D. degrees from two world-class Universities.

2003-2010 **Chief Research Engineer.** Laboratory of Bioinformatics and Mathematics of Genome, Center for Mathematical Modeling, Universidad de Chile-CNRS.

Research collaboration with BioSigma S.A., a joint venture of Codelco (largest copper mining company worldwide) and Nippon Mining & Metals, focused on understanding the biology of bioleaching—an efficient and environmental friendly copper mining technique. Copper is the main economical resource in Chile, so this was a national strategic project.

- Executive direction of a research group, formed by 4 to 8 engineers
- Assembled and fully annotated 3 bacterial genomes.
- Analyzed results of transcriptomic experiments, finding biological insight.
- Built a prototype of GPU-based aligner for Mass Spectrometry chromatograms.
- Supervised the reconstruction and modeling of metabolic networks.
- Developed methods to design probes to detect and quantify biodiversity in complex environmental samples. These tools are currently used by BioSigma in Codelco mines.
- Co-autored five patents that have been granted in several countries.

2007-2008 **Project manager.** Project "Bioidentification system for industry-relevant microorganisms: application to avian and winery sectors".

Development of a Bioidentification kit for Wine Quality Control. Funded by Fundación Copec-Universidad Católica, in cooperation with Viña San Pedro.

- Designed a PCR-based kit for detection of contaminant yeasts in exported chilean wine. Supervised the experimental validation
- The kit is currently on the market for Chilean wine companies

2005-2006

Bioinformatics Researcher / Alzheimer's disease. Project "Information and Randomness", Center for Mathematical Modeling, Universidad de Chile-CNRS.
Collaboration with "Ageing and Regeneration Lab" directed by Dr. Nibaldo Inestroza

- Developed an *ad-hoc* machine learning method to find novel target genes of the WNT/β-catenin pathway.
- Predicted novel genes were validated experimentally.

1996-2001 Chief Engineer. Network and Computing Services, Universidad Arturo Prat, Chile.

- Designed, built and managed a nationwide network connecting all campuses.
- Increased the Internet access speed by 2560%.
- Leader of the team that upgraded the telephone system to a robust digital PABX.
- Represented the University at the National University Network Consortium, as a personal delegate of the Rector.
- Installed the first email and web servers, and promoted their usage.
- Leader of team that reorganized and expanded the computer labs from 25 to 384 machines, servicing over 4000 students.

Publications

Published 11 papers in peer-reviewed journals: BMC Bioinformatics (2016), BMC Cancer (2016), Frontiers in Microbiology (2016), Bioresource technology (2016), Scientific Reports (2016), Acta Horticulturae (2014), Database : the journal of biological databases and curation (2011), BMC genomics (2010), Journal of cellular physiology (2009), Mechanisms of Development (2009), Advanced Materials Research (2009)

Patents

Biotechnological tools for taxonomical identify and quantification of complex microbiological samples have been patented in several countries: Argentina (3), Australia (5), Chile (3), China (1), Mexico (5), Peru (2), South Africa (5), USA (4)

Other Experiences

2013-2014 Postdoctoral Researcher. Center for Genome Regulation, Center of Mathematical Modeling, Universidad de Chile-CNRS.

2011-2013 Part-time Lecturer. Departamento de Ingeniería Matemática, Universidad de Chile.

2009-2011 Bioinformatics Researcher / Salmon Nutriogenomics. Funded by the Chilean Agency for Industrial Transfer, INNOVA-CORFO grant 07CN13PBT-41.

2008-2012 Bioinformatics Researcher / Grape Genomics. INIA, Chilean National Agriculture Research Institute. Funded by FONDEF G07I1002.

2010 Statistical Analyst / Breast Cancer Research. Funded by National Cancer Institute, USA.

2007-2011 Co-Principal Investigator / Copper Homeostasis in *E.faecalis*. Funded by FONDECYT N17071083, National Fund for Science and Technology.

2002 Chief Engineer. Network and Computing Services, Center for Mathematical Modeling, Universidad de Chile.

1999-2001 Part-time Lecturer. Engineering Dept., Universidad Arturo Prat, Chile.

References

- Dr. Pilar Parada, Executive Director of Center for Systems Biotechnology at Fraunhofer-Chile. Former CEO of BioSigma S.A., `pilar.parada@fraunhofer.cl`.
- Dr. Alejandro Maass, Director of Center of Mathematical Modeling at the University of Chile, `amaass@dim.uchile.cl`.
- Dr. Anne Siegel, Research director of Dyliss team, University of Rennes 1, Inria, CNRS, IRISA, `anne.siegel@irisa.fr`.
- Dr. Nazlı Arda, Director of Molecular Biology and Genetics Department, Istanbul University, `narda@istanbul.edu.tr`.
- Mr. Gustavo Soto, Rector, Universidad Arturo Prat, Chile, `gustavo.soto@unap.cl`.

Languages

Speaks, reads and writes Spanish (native), English (spoken, written), French (spoken, written), Italian (basic), Portuguese (basic), Turkish (basic).

Online Presence

Blog	`https://anaraven.bitbucket.io/`
LinkedIn	`https://www.linkedin.com/in/andresaravena/`
Google Scholar	`https://scholar.google.com/citations?user=G565iJIAAAAJ`

Hobbies

- DIY electronics.
- Development of inexpensive instrumentation to teach science.
- Amateur science.

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January 30, 2019

Selection Committee
ACT2019 Summer School
Oxford
United Kingdom

Dear Members of Selection Committee

Please receive my application to the "Applied Category Theory 2019 School". As your announcement says, this is a great opportunity for me to grasp the subject, and get a higher level tool for my research. I'm an engineer, a mathematician, and a teacher. Category theory intersects the three roles.

Background

I'm an applied mathematician, bioinformatician and university professor. My undergraduate degree is in Mathematical Engineering at the University of Chile. I worked as a Research Engineer in Bioinformatics for eleven years. After that, I got into a doctoral plan that resulted in two simultaneous degrees, one in Mathematical Modeling at Universidad de Chile, and a second one in Informatics at Inria-Université Rennes 1, France.

My thesis dealt with a model integrating genomic and transcriptomic data to find plausible transcriptional regulation networks, translating the parsimony principle into a logic-constrained optimization problem. I defended this thesis in December 2013.

My research has focused on two areas. I've done several works on models to understand biodiversity in complex microbial samples, doing metagenomics for industrial applications, as well as in environmental and archeological studies. On the other side, I've worked on systems biology models that help us to make sense of the experimental data. Recent technological advances have changed the focus of molecular biology. Data extraction used to be expensive and limiting, today data is cheap but extracting relevant knowledge is hard. This tendency will probably continue for the next decade.

My long term goal is to contribute new mathematical models to unveil meaning from biological big data.

About ACT2019

My interests go backward with your announcements. I am strongly interested in *autopoiesis* (David Spivak). This is certainly in the interface between math and biology.

I'm also interested in *methods to reason about dialogue and discourse* (Mehrnoosh Sadrzadeh) and *traversal optics and profunctors* (Bartosz Milewski), in that order. After those, my preferences are the subjects of Pieter Hofstra, Tobias Fritz, and Miriam Backens.

If I'm accepted to this school, I can commit to attending to ACT2019. Timing is fine since my teaching commitments will be finished. I can probably get funding from my university, albeit limited given the weak condition of the Turkish economy.

Endorsement

I apologize for not submitting a letter of recommendation, for the following reasons:

- People who can endorse me are hard to reach in this period. My former advisor lives in Chile and is currently on holidays. Most of my colleagues here are also in the inter-semester break.
- I'm old enough to vouch for tor the relevance of ACT2019 School in my research and my career. I do not feel comfortable to ask my peers to endorse this kind of life decisions.
- My background and research experience are properly confirmed by my papers and patents listed in the attached CV.

I beg you to overlook the lack of this third-person letter. I appreciate your understanding.

Motivation

I have been stumbling on category theory in different ways in the last few years. First, while I was finishing my Ph.D. thesis, a colleague suggested me that category theory was a good way to understand the complexity of living systems. I found "Category Theory for Scientists (Old Version)" by David I. Spivak. The first page shows a simplified version of the scientific method, with the question "How can mathematics make this diagram meaningful?". That was also the question I was asking myself, as I try to teach science to undergrad students of molecular biology. I read Spivak's book, but I couldn't make sense of it on my own.

My research is usually very applied, based on computers and programming. Reading about functional programming and the mathematical abstractions behind it, I stumbled again onto category theory.

While looking for ways to improve my teaching of mathematics for biologists, I read Eugenia Chang. I stumbled again into category theory in her book, and I was surprised to see a mention to the work of John Baez. I had earlier read "Quantum Techniques for Stochastic Mechanics" while working on DNA thermodynamics. This book impressed me with the clean approach of creation and annihilation operators, and doing strategic algebra instead of tactical calculus. This throws me into reading about quantum mechanics, just to understand this book. There is a brief mention of category theory on this book, but enough to make me a follower of Baez's work.

Essentially, my career so far has been more *engineering* than *philosopher*. After finishing my Ph.D. I was looking forward to having a higher-level vision on the interface between biology and mathematics. I think that category theory can provide that high-level philosophical view.

My goal, as a foreign academic in Turkey, is to contribute to the formation of young scientists and professionals and provide them with the tools that will enable to contribute to our society, local and global. I've already helped to prepare a few students with classical tools, based on my previous experience as research engineer. I hope that this school will help me to have a quantum leap in my research and my teaching.

Please receive my sincere salutations

Andrés ARAVENA
Researcher in Bioinformatics
Ph.D. Mathematical Modeling, Chile
Ph.D. Informatics, France
Dr. Öğr. Üyesi, Istanbul University