Alex **Barrales-Araneda**

PhD Student in Biomedical, Electrical, and Systems Engineering
University of Bologna

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Education

M.Sc. in Industrial Engineering — **Concepción, Chile**
University of Bío-Bío — 2019–2022

Industrial Engineer — **Concepción, Chile**
University of Bío-Bío — 2013–2020

Bachelor of Engineering Science — **Concepción, Chile**
University of Bío-Bío — 2013–2017

Research Project

FONDEF IT23I0061, University of Bío-Bío — Concepción, Chile

Research Assistant — May 2024–Jul. 2024

- Scaling and validation of an integrated system for crime prosecution using advanced data analytics.

ISCI - ISCI Impact Fund, University of Chile — Concepción, Chile

Research Assistant — Oct. 2023–Mar. 2024

- Developed a specialized tool for processing large volumes of text to enhance the effectiveness of crime investigation through an intuitive and powerful interface.
- Created an AI-based system that translates natural language queries made by prosecutors into specific SQL queries, enabling efficient database searches.
- Developed a Minimum Viable Product (MVP) offering a clear and user-friendly interface. Integrated functionalities such as natural language querying and the visualization of structured data into a functional platform.

Public Prosecutor's Office, University of Chile — Concepción, Chile

Research Assistant — Apr. 2023–Mar. 2024

- Developed algorithms that employ optimization and machine learning to study cases related to both fraud and homicide, aiming to detect patterns or key evidence that can significantly contribute to investigations.

• Incorporated new data sources into the Fiscal Heredia system, enhancing analyses with a broader and more comprehensive perspective of the available information.

• Conducted training and update sessions on the developed tools for the Public Prosecutor's Office users to maximize their use and benefits. Maintained ongoing collaboration with institutional counterparts, actively participating in work meetings to ensure alignment of objectives, effective communication of progress, and proactive handling of project challenges.

FONDECYT 1221562, University of Chile **Concepción, Chile**

Research Assistant Apr. 2023–Mar. 2024

• Implemented the OCoDeDANet algorithm for identifying communities in dynamic graphs, surpassing the performance of previous methods.

• Conducted computational tests with reference benchmarks, evaluating the algorithm's ability to detect communities in complex networks.

• Collaborated in the preparation of the article "Finding Overlapping Communities in Temporal Node-Attributed Networks", contributing to the implementation of the algorithm and analysis of results.

Project 2160285 GI/EF, University of Bío-Bío **Concepción, Chile**

Research Assistant Mar. 2022–Present

• Collaborated on a joint project with AMDEL for the design and implementation of a logistics system for organic waste collection in six municipalities of the Biobío region, contributing to the optimization of this essential community service.

• Participated in the preparation and publication of scientific research in the field of Operations Research, with results presented at national and international conferences.

• Actively engaged in the formulation and development of transport and logistics projects, fostering effective connections between the university and public/private entities.

FONDEF ID20I10230, University of Bío-Bío **Concepción, Chile**

Research Assistant Nov. 2021–Mar. 2023

• Developed optimization models within the scope of social network analysis, focusing on the identification of criminal groups. This project innovated by providing tools that facilitate a detailed understanding of the complex structures characterizing these groups, significantly enhancing detection strategies.

• Developed and delivered to the Public Prosecutor's Office a TLR4 prototype known as "Fiscal Heredia," designed to efficiently identify criminal structures.

• Presented findings at prominent international conferences: CLAIO 2022, EURO 2022, and IFORS 2023, highlighting the importance of "Fiscal Heredia" in the fight against crime through network analysis.

Project UBB 2155, University of Bío-Bío **Concepción, Chile**

Research Assistant Jun. 2021–Dec. 2021

• Analyzed and processed public databases from the Ministry of Transportation and Telecommunications, focusing on the GPS data of public transport buses to understand traffic behavior in the city. The collected data was used to perform a comprehensive traffic analysis and identify congestion patterns.

• Evaluated and compared different student transportation policies in the city of Chillán, aiming to study existing school transport policies, analyze their effectiveness, and assess potential improvements.

FONDECYT 1181036, University of Chile — Concepción, Chile

Research Assistant — Mar. 2021–Mar. 2022

• Developed and implemented advanced algorithms for the detection of communities in social networks, with a focus on those that change dynamically over time.

• Submitted and evaluated results by a journal indexed in the Web of Science, verifying the algorithm's effectiveness in identifying communities within dynamic networks.

Project ING 2030 I+D 20-45, University of Bío-Bío — Concepción, Chile

Research Assistant — Aug. 2020–Mar. 2021

• Collaboration in the formulation and implementation of a MIP model for the School Bus Routing Problem (SBRP), considering multiple schools and time windows.

• Developed a mobile application to enable real-time communication between parents of students and the school bus driver. The application allows parents to know precisely when the bus will arrive at their home and helps the driver follow an optimal route to transport all users and arrive at the schools within the established times.

Research Group, GI 171411/EF, University of Bío-Bío — Concepción, Chile

Research Assistant — Aug. 2018–Dec. 2018

• Formulated a linear programming model to address the Generalized Median Tour Problem with Latency, combining location and transportation decisions using multi-objective optimization techniques.

• Implemented the model in C++ using the Cplex API. The use of exact algorithms facilitated the identification of optimal solutions, optimizing location and transportation within reasonable computation times.

• Presented the results at renowned conferences such as ICCL 2019 and OPTIMA 2019. These presentations served to share the findings with the scientific community, promoting academic exchange and advancing research in the field.

Spatial Economics Laboratory, University of Bío-Bío — Concepción, Chile

Research Assistant — Aug. 2017–Aug. 2018

• Project AT 17-47 "Sustainable mobility plan for the metropolitan area of Concepción": Analyzed sociodemographic data of the municipalities within the Metropolitan Area of Concepción and processed results from the Origin-Destination Survey.

• Project AT 17-03 "National Congress Study": Processed logistical cost data for the National Congress.

Past Positions

Teaching Assistant — **Concepción, Chile**
Linear Optimization, University of Bío-Bío — Sep. 2019–Dic. 2019
- Industrial Engineering Department, University of Bío-Bío

Teaching Assistant — **Concepción, Chile**
Network Optimization, University of Bío-Bío — Mar. 2019–Ago. 2019
- Industrial Engineering Department, University of Bío-Bío

Teaching Assistant — **Concepción, Chile**
Integer Linear Programming, University of Bío-Bío — Sep. 2018–Dic. 2018
- Industrial Engineering Department, University of Bío-Bío

Teaching Assistant — **Concepción, Chile**
Microeconomics, University of Bío-Bío — Ago. 2015–Jul. 2016
- Industrial Engineering Department, University of Bío-Bío

Internship

Academic Internship — **Santiago, Chile**
Pontificia Universidad Católica de Chile — Jul. 2018–Ago. 2018
- An academic internship supervised by PhD. Vladimir Marianov Kluge.

Skills

Programming	Python, C/C++, Bash, JavaScript, Java, LaTeX
Data Analysis and Machine Learning	Numpy, Pandas, PyTorch, Scikit-Learn, Jupyter, Matplotlib
Optimization and Modeling	CPLEX, Gurobi, AMPL, SCIP, GLPK
Database Management	SQL, PostgreSQL, MySQL, SQL Server, MongoDB

Conferences

2019 **A. Barrales-Araneda**, C. Obreque. Formulation for the median tour problem generalized with cumulative time. ICCL 2019 — *Barranquilla Colombia*

2019 **A. Barrales-Araneda**, C. Obreque. Formulation for the median tour problem generalized with cumulative time. ICCL 2019 — *Barranquilla Colombia*

2024	R. Weber, C. Vairetti, F. Troncoso, S. Maldonado, A. Barrales-Araneda, V. Reyes, P. Pincheira. Optimization models for crime analytics applied to social networks. EURO 2024	*Copenhagen Denmark*
2023	R. Weber, A. Barrales-Araneda, F. Troncoso. Optimization models for crime analytics applied to social networks. IFORS 2023	*Santiago Chile*
2022	R. Riffo-Sandoval, C. Obreque, G. Latorre-Nuñez, P, Álvarez , A. Barrales-Araneda, C. Bizama. El problema del ruteo de un furgón escolar, generalizado, selectivo, con carga mixta y ventanas de tiempo. CLAIO 2022	*Buenos Aires Argentina*
2022	N. Villanueva, C. Obreque, G. Latorre-Nuñez, P, Álvarez , A. Barrales-Araneda, C. Bizama. The Multiperiod Set Team Orienteering Problem with Time Windows. CLAIO 2022	*Buenos Aires Argentina*
2022	M. Villagra-Aguayo, C. Obreque, G. Latorre-Nuñez, P, Álvarez , A. Barrales-Araneda, C. Bizama. El problema del ruteo de furgones escolares selectivo, con carga mixta, flota heterogénea y ventanas de tiempo. CLAIO 2022	*Buenos Aires Argentina*
2022	C. Obreque, G. Latorre-Nuñez, P, Álvarez , A. Barrales-Araneda, C. Bizama, M. Villagra-Aguayo. Ruteo de furgones escolares selectivo, con carga mixta, flota homogénea y transbordo. CLAIO 2022	*Buenos Aires Argentina*
2022	F. Troncoso, R. Weber, A. Barrales-Araneda. Finding Criminal Groups in Suspect Networks Using a Steiner Tree Approach. EURO 2022	*Espoo Finland*
2020	A. Barrales-Araneda, C. Obreque. Un modelo de programación lineal entera para el Median Tour Problem Generalizado con Tiempo Acumulado. VIII Encuentro de Investigación de Estudiantes de Postgrado UBB 2020.	*Concepción Chile*
2019	A. Barrales-Araneda, C. Obreque. Formulación y solución para el median tour problem generalizado con tiempo acumulado. OPTIMA 2019	*Santa Cruz Chile*
2019	A. Barrales-Araneda, C. Obreque. Formulation for the median tour problem generalized with cumulative time. ICCL 2019	*Barranquilla Colombia*

Honors and awards

2022	**Industrial Engineering Department Award** University of Bío-Bío	**Concepción, Chile**
2017	**1st Place Academic Performance** Faculty of Engineering, University of Bío-Bío	**Concepción, Chile**
2017	**1st Place National Final** Hackathon 2017 Y4PT, Active Mobility Challenge	**Santiago, Chile**
2017	**3rd Place Regional Final** Hackathon 2017 Y4PT	**Concepción, Chile**