

# Gonzalo A. Ruz

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## Description

Over fifteen years of experience in machine learning and data mining with participation in scientific and applied research projects. Scientific projects include: new learning algorithms for Bayesian networks for data mining tasks such as classification, clustering and data visualization, swarm intelligence techniques for network reconstruction, Boolean network modeling of gene regulatory networks, dynamics in Boolean networks, neuro-fuzzy image segmentation techniques. Applied projects: fraud detection systems using neural networks, optimization of the operation of an electronic chip-mounting machine using genetic algorithms and simulated annealing (Sony Manufacturing), job performance prediction in a call center using Bayesian networks, mineral exploration in the north of Chile using data mining (project leader). A total of 15 guided theses (1 PhD, 1 M.Sc., and 13 Undergraduate), currently guiding 6 Ph.D. students and 1 M.Sc. student. Director of the iUAI Complexity Center and Sub-Director of the Complex Systems in Engineering PhD program (DISC) at the UAI.

## Education

- Ph.D.** Machine Learning, Cardiff University, 2008.
- M.Sc.** Electrical Engineering, Universidad de Chile, 2003.
- P.E.** Electrical Engineering, Universidad de Chile, 2003.
- B.Sc.** Electrical Engineering, Universidad de Chile, 2002.

## Experience

- Facultad de Ingeniería y Ciencias, Universidad Adolfo Ibáñez, Associate Professor, November 2013–present.
- Facultad de Ingeniería y Ciencias, Universidad Adolfo Ibáñez, Assistant Professor, October 2011–October 2013.
- Facultad de Ingeniería y Ciencias, Universidad Adolfo Ibáñez, Postdoc, September 2009–September 2011.
- Sonda S. A., Business Intelligence engineer, 2004–2005.

## Fields of Research Interest

Machine learning, Bayesian networks, neural networks, data mining, evolutionary computation, Boolean networks, gene regulatory networks, digital image processing, neuro-fuzzy systems and fraud detection systems.

## Publications

### *Thesis*

Bayesian networks for classification, clustering, and high-dimensional data visualisation. (PhD thesis, Cardiff University, 2008)

Nuevo método de segmentación de imágenes a color basado en redes neuronales min-max difusas. (P.E. and M.Sc. in Electrical Engineering thesis, Universidad de Chile, 2003)

### *Papers (ISI)*

1. Rodríguez-Valdecantos, G., Manzano, M., Sánchez, R., Urbina, F., Hengst, M.B., Lardies, M.A., Ruz, G.A., González, B. Early successional patterns of bacterial communities in soil microcosms reveal changes in bacterial community composition and network architecture, depending on the successional condition, *Applied Soil Ecology*, 2017, Accepted.
2. Zúñiga, A., Donoso, R.A., Ruiz, D., Ruz, G.A., González, B. Quorum-sensing systems in the plant growth-promoting bacterium *Paraburkholderia phytofirmans* PsJN exhibit cross-regulation and are involved in biofilm formation, *Molecular Plant-Microbe Interactions*, Vol. 30, 2017, 557-565.
3. Valle, M.A., Ruz, G.A., Masías, V.H. Using self-organizing maps to model turnover of sales agents in a call center, *Applied Soft Computing*, 2017, Accepted.
4. Henríquez, P.A., Ruz, G.A. Extreme learning machine with a deterministic assignment of hidden weights in two parallel layers. *Neurocomputing*, Vol. 226, 2017, 109-116.
5. Ruz, G.A. Improving the performance of inductive learning classifiers through the presentation order of the training patterns. *Expert Systems with Applications*, Vol. 58, 2016, 1-9.
6. Mascareño, A., Goles, E., Ruz, G.A. Crisis in Complex Social Systems: A Social Theory View Illustrated with the Chilean Case. *Complexity*, Vol. 21, No. S2, 2016, 13-23.
7. Valle, M.A., Ruz, G.A. Turnover prediction in a call center: behavioral evidence of loss aversion using random forest and naive Bayes algorithms. *Applied Artificial Intelligence*, Vol. 29, 2015, 923-942.
8. Valle, M.A., Ruz, G.A., Varas, S. Explaining job satisfaction and intentions to quit from a value-risk perspective. *Academia Revista Latinoamericana de Administración*, Vol. 28, 2015, 523-540.
9. Valle, M.A., Ruz, G.A., Varas, S. A Survival Model Based on Met Expectations: Application to Employee Turnover in a Call Center. *Academia Revista Latinoamericana de Administración*, Vol. 28, 2015, 177-191.
10. Goles, E., Ruz, G.A. Dynamics of neural networks over undirected graphs. *Neural Networks*, Vol. 63, 2015, 156-169.
11. Ruz, G.A., Timmermann, T., Barrera, J., Goles, E. Neutral space analysis for a Boolean network model of the fission yeast cell cycle network. *Biological Research*, Vol. 47, 2014, 64.

12. Ruz, G.A., Goles, E., Montalva, M., Fogel, G.B. Dynamical and Topological Robustness of the Mammalian Cell Cycle Network: A Reverse Engineering Approach. *Biosystems*, Vol. 115, 2014, 23-32.
13. Araya-Díaz, P., Ruz, G.A., Palomino, H.M. Discovering Craniofacial Patterns Using Multivariate Cephalometric Data for Treatment Decision Making in Orthodontics. *International Journal of Morphology*, Vol. 31, 2013, 1109-1115.
14. Ruz, G.A., Varas, S., Villena, M. Policy making for broadband adoption and usage in Chile through machine learning. *Expert Systems with Applications*, Vol. 40, 2013, 6728-6734.
15. Goles, E., Montalva, M., Ruz, G.A. Deconstruction and dynamical robustness of regulatory networks: application to the yeast cell cycle networks. *Bulletin of Mathematical Biology*, Vol. 75, 2013, 939-966.
16. Ruz, G. A. and Goles, E. Learning gene regulatory networks using the bees algorithm. *Neural Computing & Applications*, Vol. 22, 2013, 63-70.
17. Valle, M.A., Varas S., Ruz, G.A. Job performance prediction in a call center using a naive Bayes classifier. *Expert Systems with Applications*, Vol. 39, 2012, 9939-9945.
18. Ruz, G. A. and Pham, D. T. NBSOM: The naive Bayes self-organizing map. *Neural Computing & Applications*, Vol. 21, 2012, 1319-1330.
19. Pham, D. T. and Ruz, G. A. Unsupervised training of Bayesian networks for data clustering. *Proceedings of the Royal Society A*, Vol. 465, 2009, 2927-2948.
20. Ruz, G.A. and Pham, D.T. Building Bayesian network classifiers through a Bayesian complexity monitoring system. *Proc. IMechE, Part C: J. Mechanical Engineering Science*, Vol. 223(C3), 2009, 743-755.
21. Ruz, G.A., Estévez, P.A. and Ramirez, P.A. Automated visual inspection system for wood defect classification using computational intelligence techniques, *International Journal of Systems Science*, Vol. 40, No. 2, February 2009,163-172.
22. Ruz, G.A., Estévez, P.A., Perez, C.A. A neurofuzzy color image segmentation method for wood surface defect detection. *Forest Products Journal*, Vol. 55, N 4, April 2005, 52-58.

#### *Conference Proceedings and Book of Abstracts*

23. Ruz, G.A, Ashlock, D., Ledger, T., Goles, E. Inferring bistable lac operon Boolean regulatory networks using evolutionary computation. The 2017 IEEE Conference on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB 2017), Manchester, U.K., 23-25 August, 2017, Accepted.
24. Ashlock, D., Ruz, G.A. A novel representation for Boolean networks designed to enhance heritability and scalability. The 2017 IEEE Conference on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB 2017), Manchester, U.K., 23-25 August, 2017, Accepted.
25. Goles, E., Ruz, G.A. A Boolean model of gene regulatory networks with memory: application to the elementary cellular automata, Conference on Complex Systems (CCS'16), Amsterdam, Netherlands, September 19-22, 2016.

26. Mascareño, A., Goles, E., Ruz, G.A. Crisis in Complex Social Systems: A Social Theory View Illustrated with the Chilean Case, Conference on Complex Systems (CCS'16), Amsterdam, Netherlands, September 19-22, 2016.
27. Osoreo, S., Optiz, T., Ruz, G.A., Lardies, M. Physiological responses of intertidal crabs to environmental gradients on the coast of Chile using an integrated approach with machine learning, Conference on Complex Systems (CCS'16), Amsterdam, Netherlands, September 19-22, 2016.
28. Ruz, G.A., Timmermann, T., Goles, E. Neutral space analysis of gene regulatory network models of salt stress response in Arabidopsis using evolutionary computation, The 2016 IEEE Congress on Evolutionary Computation (IEEE CEC 2016), Vancouver, Canada, July 24-29, 2016, pp. 4281-4288.
29. Valle, M.A., Ruz, G.A., Masias, V. Using Self-Organizing Maps to model turnover of Sales Agents in a Call Center as probabilities of state changes, Conference on Business Analytics in Finance and Industry (BAFI 2015), Santiago, Chile, December 14-16, 2015, pp. 42-43.
30. Timmermann, T., Ruz, G.A., Goles, E. , Reconstruction of a GRN Model of Salt Stress Response in Arabidopsis using Boolean Networks, Conference on Complex Systems (CCS'15), Tempe, Arizona, USA, September 28-October 2, 2015.
31. Goles, E., Ruz, G.A. Threshold Networks: Universality and Applications, Conference on Complex Systems (CCS'15), Tempe, Arizona, USA, September 28-October 2, 2015.
32. Ruz, G.A., Timmermann, T., Goles, E. Reconstruction of a GRN model of salt stress response in Arabidopsis using genetic algorithms. The 2015 IEEE Conference on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB 2015), Niagara Falls, Canada, August 12-15, 2015, pp. 1-8.
33. Zúñiga, A., Ruz, G., González, B. A synthetic bacterial consortium design to optimize and control plant-bacteria interaction, II Latin American Workshop on PGPR, La Falda, Argentina, September 21-26, 2014, pp. 69.
34. Goles, E., Montalva, M., Ruz, G.A. From the qualitative analysis in a lac operon model that predicts bistability, European Conference on Complex Systems (ECCS'14), Lucca, Italy, September 22-26, 2014.
35. Timmermann, T., Ruz, G.A., Armijo, G., Holuigue, L., Goles, E., Gonzalez, B. Reconstruction of a gene regulatory network controlling the induced systemic resistance triggered by a plant growth promoting bacterium in Arabidopsis thaliana infected with a phytopathogen, 15th International Conference on Systems Biology (ICSB 2014), Melbourne, Australia, September 14-18, 2014, pp. 198.
36. Montalva, M., Ruz, G.A., Goles, E. Attraction basins in a lac operon model under different update schedules, ALIFE14: The Fourteenth International Conference on the Synthesis and Simulation of Living Systems, New York, USA, July 30-August 2, 2014, pp. 689-690.
37. Zuniga, A., Ruz, G., Gonzalez, B. A synthetic bacterial consortium design by compartmentalized logic gates, Synthetic Systems Biology Summer School (SSBSS 2014), Taormina, Italy, June 15-19, 2014, pp. 15.

38. Ruz, G.A., Goles, E. Neutral graph of regulatory Boolean networks using evolutionary computation. The 2014 IEEE Conference on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB 2014), Honolulu, Hawaii, USA, May 21-24, 2014, pp.1-8.
39. Valle, M.A., Ruz, G.A. Predicting Turnover of Sales Agents in a Call Center with Random Forest and Naive Bayes: Evidence of Loss Aversion in Turnover Intentions, Conference on Business Analytics in Finance and Industry (BAFI 2014), Santiago, Chile, January 6-9, 2014, pp. 14-15.
40. Osoreo, S.J.A., Optiz, T., Prado, L., Ruz, G.A., Lardies, M.A. Máquina de aprendizaje para una clasificación biogeográfica latitudinal del cangrejo *Cyclograpsus cinereus* de acuerdo a sus atributos fisiológicos, V Reunión Binacional de Ecología, XX Reunión de la Sociedad de Ecología de Chile, Puerto Varas, Chile, November 3-6, 2013, pp. 128.
41. Montalva, M., Ruz, G.A., Goles, E. Mathematical tools for the dynamical analysis of Boolean regulatory networks, LXXXII Encuentro Anual Sociedad de Matemáticas de Chile, Olmue, Chile, November 7-9, 2013, pp. 85.
42. Montalva, M., Goles, E., Ruz, G.A. Dynamical robustness of the Mammalian cell cycle network: a mathematical approach, European Conference on Complex Systems (ECCS'13), Barcelona, Spain, September 16-20, 2013, pp. 71.
43. Ruz, G.A., Montalva, M., Goles, E. On the preservation of limit cycles in Boolean networks under different updating schemes, Advances in Artificial Life, ECAL 2013, 12th European Conference on Artificial Life, Taormina, Italy, September 2-6, pp.1085-1090, 2013.
44. Valle, M. A., Ruz, G.A. Predicción de la rotación de empleados en un call center mediante entrenamiento y aprendizaje de árbol de clasificación, VISIII2013, VI Simposio Internacional de Ingeniería Industrial: Actualidad y Nuevas Tendencias 2013, Colombia-Bogotá, July 24-26, 2013, pp. 66.
45. Ruz, G.A., Timmermann, T., Goles, E. Building synthetic networks of the budding yeast cell-cycle using swarm intelligence. IEEE the Eleventh International Conference on Machine Learning and Applications (ICMLA 2012), Boca Raton, Florida, USA, December 12-15, pp. 120-125, 2012.
46. Ruz, G.A., Goles, E. Reconstruction and update robustness of the mammalian cell cycle network. The 2012 IEEE Symposium on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB 2012), San Diego, California, USA, May 9-12, pp. 397-403, 2012.
47. Valle, M. A., Ruz, G. A., Varas, S. El rol de la aversión al riesgo en los ingresos y las expectativas de agentes de venta sobre la satisfacción en el trabajo y las intenciones de renuncia. CLADEA 2012, XLVII Annual Assembly, Lima - Peru, October 22-24, 2012.
48. Valle, M. A., Ruz, G.A. Predicción de la rotación de empleados en un call center mediante análisis discriminante. ENEFA 2012, XXVIII Encuentro Nacional de Facultades de Administración y Economía, Talca, Chile, November 21-23, Vol. 5 pp. 1622-1642, 2012.
49. Goles, E. and Ruz, G.A. Robustness of limit cycle attractors in Boolean networks under update schedule perturbations. European Conference on Complex Systems (ECCS'11), Vienna, Austria, Sept. 12-16, 2011, pp 80-81.

50. Valle, M.A., Varas S., Ruz, G.A. Explaining turnover: A survival model based on expectations. ENEFA 2011, XXVII Encuentro Nacional de Facultades de Administración y Economía, Pucón, Chile, November 23-25, Vol. 4 pp. 1486-1511, 2011.
51. Ruz, G.A., Goles, E. Learning gene regulatory networks with predefined attractors for sequential updating schemes using simulated annealing. IEEE the Ninth International Conference on Machine Learning and Applications (ICMLA 2010), Washington DC, USA, December 12-14, pp. 889-894, 2010.
52. Araya-Díaz, P., Ruz, G.A., Palomino, H.M. Discovering facial biotype pattern using multivariate cephalometric data for treatment decision making. Intelligent Production Machines and Systems-6th I\*PROMS Virtual Conference, November 2010.
53. Ruz, G.A., Goles, E. Cycle attractors for different deterministic updating schemes in Boolean regulation networks. The IASTED International Conference on Computational Bioscience (Comp-Bio 2010), Cambridge, Massachusetts, USA, 1-3 Nov, pp. 620-625, 2010.
54. Araya, P., Ruz, G.A., Palomino, H. Growth patterns identification for prediction based on multivariate statistics. IADR Annual Meeting Chilean Division, Talca, Chile, October 16-17, 2008.
55. Ortega, P.A., Figueroa, C.J., and Ruz, G.A. A medical claim fraud/abuse detection system based on data mining: A case study in Chile. DMIN'06, The 2006 International Conference on Data Mining, Las Vegas, Nevada, USA, June 26-29, pp. 224-231, 2006.
56. Ruz, G.A., Estévez, P.A. Image segmentation using fuzzy min-max neural networks for wood defect detection. Intelligent Production Machines and Systems-First I\*PROMS Virtual Conference, D.T Pham, E.E. Eldukhri and A.J. Soroka (eds.), pp. 183-188, 4-15 July 2005.
57. Estévez, P.A., Ruz, G.A., and Perez, C.A. Fuzzy Min-Max Neural Network for Image Segmentation. CVPRIP'2003, International Conference on Computer Vision, Pattern Recognition and Image Processing, Cary, North Carolina, Sept. 2003, pp.655- 659.

## Research Projects

2016-2017 “Methodological Approaches Investigated as Accurately as possible for applications to biology”. (Project STIC-AmSud) *Project coordinator UAI*

2015-2017 “Millennium Nucleus Models of Crises: the Chilean Case”. (Project NS130017) *Associate Researcher*

2014-2019 “Centro de Ecología Aplicada y Sustentabilidad”. (Project FONDAP FB-0002) *Researcher*

2014-2016 “Consortios bacterianos sintéticos: Una estrategia de biología sintética para optimizar la asociación planta-bacteria mediante una adecuada selección y regulación de la expresión de genes”. (Project Postdoc Fondecyt 3140031, Ana Zúñiga) *Sponsoring Researcher*

2011-2014 “Attractors in Boolean networks under different types of update perturbations: A reverse engineering approach”. (Project Iniciación Fondecyt 11110088) *Head Researcher*

2012 “Mathematical Modeling for Industrial and Management Science Applications: An Interdisciplinary Approach” (Project Conicyt Anillo ACT-88) *Young Researcher*

2010-2012 “Mathematical Modeling for Industrial and Management Science Applications: An Interdisciplinary Approach” (Project Conicyt Anillo ACT-88) *Postdoc student*

2010-2011 “Constructing genetic regulatory networks from data using evolutionary computation” . (Project Postdoctoral Fondecyt 3100044) *Head Researcher*

2002-2003 “Max Min Neural Networks: Capacity of Representation and Learning by Means of Linear Programming and Genetic Algorithms”. (Project Fondecyt 1030924) *Assistant Researcher*

2001-2002 “Complex Systems: Industrial Applications” (Project Fondef 1050) *Assistant Researcher*

2000 “Optimization of Neural Networks for Classification Tasks and Prediction Using Genetic Algorithms”. (Project Fondecyt 1980909) *Assistant Researcher*

## Professional Activities

Reviewer for the following ISI journals: *Neurocomputing*; *IEEE Trans. Systems, Man, Cybernetics, Part C.*; *IEEE Trans. Systems, Man, Cybernetics, Part B.*; *Soft Computing*; *Pattern Analysis & Applications*; *Image and Vision Computing*; *Proceedings of the Royal Society A*; *Proceedings of the Institution of Mechanical Engineers, Part C*, *Journal of Mechanical Engineering Science*; *BMC Bioinformatics*.

Program committee member for the following international conferences: CIBB 2013; PRIB 2013; IEEE SCII 2013, LA-CCI 2014.

Associate Editor for Track 1: Pattern Recognition and Machine Learning for ICPR 2016

Departmental service: PhD in Complex Systems Engineering Committee (2012-Present), Undergraduate Studies Committee (2014-Present).

Computer Science committee for Becas Chile.

International Association for Pattern Recognition IAPR TC-20 (Technical Committee on Pattern Recognition for Bioinformatics), 2013-Present.

Member, Institute of Electrical and Electronics Engineers (IEEE), 2000-Present.

Member, International Society for Artificial Life (ISAL), 2013-Present.

## Teaching

I=first semester, II=second semester

### *Universidad Adolfo Ibáñez*

Programming (II 2009)

Information Systems (II 2009, II 2010)

Fundamentals of Electrical Engineering (I 2010, I 2011)

Probabilities (I and II 2011, I 2012, II 2013, I and II 2014, I and II 2015, II 2016, I 2017)

Business Intelligence (II 2011, II 2012, II 2013, II 2014, II 2015, II 2016)

Data Management and Analysis (PhD course) (II 2012, I 2013, I 2014, I 2015, I 2016, I 2017)  
Statistics I (I 2016, I 2017)

## Advising

### Current Students:

Ph.D.: Pablo Henríquez, Juan Manuel Rozas, Gustavo Rodríguez (second advisor), Tania Timmermann (second advisor), Alex Di Genova (second advisor), Sebastián Osoro (second advisor)

M.Sc.: Daniel Rubio

Undergraduate Students:

### Past Students:

Ph.D.: Mauricio Valle (2012).

Master Students: Cristóbal Figueroa (2015).

Undergraduate Students: Martín Gallegos, Francisco Lyng, Diego Navia, and Franziska Sherman (2016), Axel Leddihn and Javier Gallardo (2016), Rodrigo Anuch and Christian Albina (2016), Luciano Caramori and Diego Araya (2016), Martin Roberts (2016), Juan Carlos Maguire and Germán Rudolph (2015), Álvaro González and Nicolás Cuadra (2015), Anne Luisa Moenne-Loccoz and Carol Lockling (2015), Francisco Astudillo Rodriguez and Michael Breytmann Schulze (2013), Samuel De La Sotta and Ricardo Hoffmann (2013), Felipe Cárdenas Ovalle and Jean Paul Derout Dattoli (2012), Pablo Ramirez Marin (2011), Cristián Bohn Rodriguez and Matías Reyes Ganzur (2011).

## Honors, Awards & Fellowships

2013: Outstanding contribution in research. Faculty of Engineering and Sciences, Universidad Adolfo Ibáñez.

2005: IPROMS 2005 young authors prize, for the best paper by a young author at the Intelligent Production Machines and Systems-First I\*PROMS Virtual Conference.

2004: Overseas Research Students Awards Scheme (ORSAS) for PhD studies in the UK.

2003: ALFA (América Latina - Formación Académica) award, 6 month visit at the Manufacturing Engineering Centre-Cardiff University.

1999: Honor roll student (top 5%), School of Physical and Mathematical Sciences, University of Chile.