

# RAFAEL S. GONZÁLEZ D'LEÓN

Universidad Sergio Arboleda · Calle 74 # 14-14 · Bogotá, Colombia

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## RESEARCH INTERESTS

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I am passionate about the interactions between algebra, combinatorics, topology, and its applications. In particular, I am working on or have done work related to:

- Associative algebras and operads using techniques from poset topology.
- Volumes and lattice point enumeration of flow polytopes.
- Catalan combinatorics and its generalizations.
- Combinatorial and algebraic problems in graph theory and matroid theory.
- Representation theory of the symmetric group. Symmetric and Quasisymmetric functions.
- Combinatorial Hopf algebras.
- The combinatorial structure of RNA folding.

## EDUCATION

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### Ph.D. in Mathematics

*August 2014*

*University of Miami, Coral Gables, FL, USA.*

*Thesis: On the combinatorics of the free Lie algebra with multiple brackets.*

*Advisor: Michelle Wachs.*

### M.Sc. in Mathematics

*May 2011*

*University of Miami, Coral Gables, FL, USA.*

### M.Sc. in Mathematics

*June 2009.*

*KTH - Royal Institute of Technology, Stockholm, Sweden.*

*Thesis: Representing matroids by polynomials with the half-plane property.*

*Advisor: Petter Brändén.*

### Electrical Engineering

*March 2006*

*UPB University, Medellín, Antioquia, Colombia.*

*Thesis: Enhancement of the fiber optics network and design of the SDH information transport system of Metro de Medellín.*

## ACADEMIC EMPLOYMENT

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### Docente Investigador (Assistant professor)

*July 2017 – Present*

Universidad Sergio Arboleda, Bogotá, Colombia.

### Director of masters program in applied mathematics

*July 2018 – Present*

Universidad Sergio Arboleda, Bogotá, Colombia.

### Postdoctoral Visitor

*August 2017 – December 2017*

York University. Toronto, ON, Canada.

### Postdoctoral Scholar

*August 2014 – June 2017*

University of Kentucky. Lexington, KY, USA.

**Research Assistant (NSF funded)**  
University of Miami. Coral Gables, FL, USA.

*June 2012 – July 2014*

**Adjunct Instructor**  
UPB University. Medellín, Antioquia, Colombia.

*January 2006 – June 2007*

## PREPRINTS AND PUBLICATIONS

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*The Whitney duals of a graded poset* (with J. Hallam)  
J. Combin. Theory Ser. A. Volume 177, January 2021.

*A combinatorial model for computing volumes of flow polytopes* (with C. Benedetti, C. R. H. Hanusa, P. E. Harris, A. Khare, A. H. Morales, M. Yip).  
Trans. Amer. Math. Soc. Volume 372, Number 5, Pages 3369-3404, 2019.

*Signature Catalan Combinatorics* (with C. Ceballos)  
J. Comb. Volume 10, Number 4, 725-773, 2019.

*A family of symmetric functions associated with Stirling permutations.*  
J. Comb. Volume 10, Number 4, 675-709, 2019.

*The colored symmetric and exterior algebras.*  
J. Algebra 496, 187-215, 2018.

*On the free Lie algebra with multiple brackets.*  
Adv. Appl. Math. 79, 37-97, 2016.

*On the (co)homology of the poset of weighted partitions* (with M. L. Wachs).  
Trans. Amer. Math. Soc. 368, 6779-6818, 2016.

*A note on the  $\gamma$ -coefficients of the tree Eulerian polynomial.*  
Electron. J. Combin. Volume 23, Issue 1, #P1.20, 2016

*On the half-plane property and the Tutte-group of a matroid* (with P. Brändén).  
J. Combin. Theory Ser. B. 100, 2010.

## REFEREED CONFERENCE PROCEEDINGS

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*Whitney labelings and 0-Hecke algebra actions on graded posets* (with J. Hallam).  
Sém. Lothar. Combin. 80B, Art. 88, 12 pp, 2018. (Proceedings FPSAC 2018).

*The volume of the caracol polytope* (with C. Benedetti, C. R. H. Hanusa, P. E. Harris, A. Khare, A. H. Morales, M. Yip).  
Sém. Lothar. Combin. 80B, Art. 87, 12 pp, 2018. (Proceedings FPSAC 2018).

*Whitney duals of geometric lattices* (with J. Hallam) (FPSAC 2017).  
Sém. Lothar. Combin. 78B, Art. 82, 12 pp, 2017. (Proceedings FPSAC 2017).

*The colored symmetric and exterior algebras (extended abstract).*  
DMTCS Proceedings BC, 575586, 2016. (Proceedings FPSAC 2016).

*On the poset of weighted partitions* (with M. L. Wachs).  
DMTCS Proceedings 01, 1029-1040, 2013. (Proceedings FPSAC 2013).

## THESIS AND DISSERTATIONS

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*On the Combinatorics of the Free Lie Algebra With Multiple Brackets* (Ph.D. thesis).

UM 2014. [http://scholarlyrepository.miami.edu/oa\\_dissertations/1246](http://scholarlyrepository.miami.edu/oa_dissertations/1246)

*Representing matroids by polynomials with the half-plane property* (master thesis).

KTH 2009.

## STUDENTS

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### Masters

- Yeison Quiceno - U. Nacional de Colombia sede Medellín. **Thesis** On Whitney duals of operadic posets. June 18 of 2020

### Undergraduate

- Francisco Alfonso Mayorga Cetina - U. Sergio Arboleda. **Thesis** Characterizing dual graphs associated to triangulations of the Caracol flow polytope. March 10 of 2020.
- Cesar Orozco - U. Sergio Arboleda. **Thesis** On Hopf algebras related to Segre powers of a partially ordered set on weak compositions and a family of generalizations of the Riemann zeta function. June 4 of 2020.

## CURRENT STUDENTS

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### Masters

- Daniel Clavijo - U. Sergio Arboleda. Topic:  $q$ -analogs in signature Catalan combinatorics.
- Camilo Hurtado - U. Sergio Arboleda. Topic: Combinatorial approaches to RNA folding.
- Edward Salamanca - U. Sergio Arboleda. Topic: Operadic posets.

### Undergraduate

- Carlos Mayorga - U. Sergio Arboleda. Topic: Combinatorics of positroids.
- Nicolás Rodríguez - U. Sergio Arboleda. Topic: Reverse plane partitions and the Lindström-Gessel-Viennot lemma.

## TEACHING EXPERIENCE

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### At Universidad Sergio Arboleda

- *Enumerative combinatorics and partially ordered sets*. Spring 2020. U. Sergio Arboleda, Bogotá, Colombia
- *Topology*. Spring 2018-Spring 2019-Fall 2019. U. Sergio Arboleda, Bogotá, Colombia
- *Partially ordered sets*. Fall 2018. U. Sergio Arboleda, Bogotá, Colombia.
- *Analysis*. Fall 2018. U. Sergio Arboleda, Bogotá, Colombia.
- *Combinatorics and Graph Theory*. Spring 2018. U. Sergio Arboleda, Bogotá, Colombia.
- *Abstract algebra*. Spring 2018. U. Sergio Arboleda, Bogotá, Colombia.

### At University of Kentucky

- *Poset cohomology and combinatorial species (MA 714)*. Spring 2017. U. of Kentucky, Lexington, KY.

- *Calculus 2 (MA 114)*. Fall 2016. U. of Kentucky, Lexington, KY.
- *Calculus 1 (MA 113)*. Spring 2016. U. of Kentucky, Lexington, KY.
- *Combinatorics and Graph Theory (MA/CS 415G)*. Fall 2015 - Fall 2016. U. of Kentucky, Lexington, KY.
- *Calculus 4 (MA 214)*. Spring 2015. U. of Kentucky, Lexington, KY.
- *Matrix Algebra and Its Applications (MA 322)*. Fall 2014 -Spring 2015-Spring 2016. U. of Kentucky, Lexington, KY.

#### **At University of Miami**

- *Calculus 2 (MTH 162)*. Spring 2012. U. of Miami, Coral Gables, FL.
- *Calculus 1 (MTH 161)*. Fall 2010 - Fall 2011. U. of Miami, Coral Gables, FL.
- *Precalculus 1 (MTH 107)*. Spring 2011. U. of Miami, Coral Gables, FL.

#### **At Universidad Pontificia Bolivariana**

- *Computer Networks*. Spring/Fall 2006 - Spring 2007. UPB university, Medellín, Antioquia, Colombia.
- *Data Networks Lab*. Spring 2007. UPB university, Medellín, Antioquia, Colombia.

### **INDUSTRIAL EXPERIENCE**

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*Projects Engineer*

*August 2005–August 2007*

*Fluidsignal Group*

*Medellín, Antioquia, Colombia*

Network design and implementation with open source software tools, information security advisory, project leading in the deployment of a colombian ISP and many other network infrastructure projects, project leading in network security and intrusion testing projects, responsible for risk identification, assessment and mitigation within the organization under the scheme of ISO/IEC 27001, OCTAVE and AS/NZS 4360 standards.

*Engineering Intern*

*July 2004–January 2005*

*Metro de Medellín*

*Bello, Antioquia, Colombia*

Design of a metropolitan transport network backbone with SDH standard for the interconnection of all the metro stations and headquarters. Design of new links of optical fiber to enhance the scope over the physical network.

### **AWARDS AND HONORS**

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*Colciencias postdoctoral fellowship* 2019-2020. Administrative Department of Science, Technology and Innovation (Colciencias), Bogotá, Colombia.

*Outstanding graduate student in Mathematics* May 2014. University of Miami, Coral Gables, FL, USA.

*Colciencias doctorate fellowship* 2012-2014. Administrative Department of Science, Technology and Innovation (Colciencias), Bogotá, Colombia.

*College of Arts and Sciences Dean's summer research fellowship* Summer 2011. University of Miami, Coral Gables, FL, USA.

## TALKS AND POSTERS

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In conferences and meetings:

- August 12-15, 2019 (Minicourse) XXXVI del Coloquio de la Sociedad Matemática Peruana “CÉSAR CARRANZA SARAIVIA”. Universidad Nacional Pedro Ruiz Gallo. Lambayeque, Perú.
- August 8, 2019 Sesión temática en posets y matroides. Coloquio latinoamericano de álgebra. Colegio Nacional, Ciudad de México, México.
- Junio 14, 2019 XXII Congreso Colombiano de Matemáticas 2019. Universidad del Cauca, Popayán, Cauca, Colombia.
- January 24, 2019 Décimo encuentro regional de matemáticas. Universidad de Antioquia, Medellín, Colombia.
- July 27, 2018 ICM Satellite Conference: A Pan-Hemispheric Celebration of Mathematics in Miami. University of Miami, Coral Gables, FL, US.
- July 16, (Poster) 2018 Formal Power Series and Algebraic Combinatorics FPSAC 2018. Dartmouth College, Hanover NH, USA.
- July 17-28, 2017, (Minicourse) Días de Combinatoria DIAS 2017. Universidad Pontificia Bolivariana. Medellin, Colombia.
- April 2, 2017 Special Session on Algebraic and Enumerative Combinatorics with Applications. AMS Sectional Meeting. Indiana University, Bloomington, IN.
- September 24, 2016. Special Session on Plethysm and Kronecker Products in Representation Theory. AMS Sectional Meeting. Bowdoin College, Brunswick, ME.
- July 14, 2016. V Congreso Latinoamericano de Matematicos. Universidad del Norte. Barranquilla, Colombia.
- July 5, 2016. (Poster) FPSAC'16 The 28th International Conference on Formal Power Series and Algebraic Combinatorics. Vancouver, BC, Canada.
- October 17, 2015. Special Session on Topological Combinatorics. AMS Sectional Meeting. University of Memphis. Memphis, TN.
- October 3, 2015. Special Session on Enumerative Algebraic and geometric combinatorics. AMS Sectional Meeting. Loyola University. Chicago, IL.
- August 28, 2015. Algebraic Combinatorics and Applications, The first annual Kliakhandler Conference. Michigan Technological University, Houghton, MI, USA
- April 18, 2015. Special Session on Algebro-Geometric Methods in Graph Theory. AMS Sectional Meeting. U. of Nevada. Las Vegas, NV.
- March 27, 2015. Colloquium-Graduate Students Combinatorics Conference. U. of Kentucky, Lexington, KY.
- March 14, 2015. Special Session on Algebraic Combinatorics. AMS Sectional Meeting. Michigan State University, East Lansing, MI.
- January 5, 2015. Conference in honor of Michelle Wachs. U. of Miami. Miami, FL.
- October 26, 2014. Special Session on Topological Combinatorics and Combinatorial Commutative Algebra. AMS Sectional Meeting. SFSU, San Francisco, CA.

- July 12, 2014. Cuarto Encuentro Colombiano de Combinatoria ECCO2014. Universidad de los Andes, Bogotá, Colombia.
- October 19, 2013. Special Session on Topological Combinatorics. AMS Sectional Meeting. Washington University, St. Louis, MO.
- June 17, 2013. The 11th Nordic Combinatorial Conference (NORCOM). KTH, Stockholm, Sweden.
- June 24, 2013. (Poster) FPSAC'13 The 25th International Conference on Formal Power Series and Algebraic Combinatorics. Paris, France.
- October 14, 2012. Special Session on Algebraic and Topological Combinatorics. AMS Sectional Meeting. Tulane University, New Orleans, LA.

In seminars:

- March 23, 2020 Discrete Math Seminar. UMass Amherst, MA, USA.
- March 5, 2020 Seminario Sabanero de Combinatoria. Fundación Universitaria Konrad Lorenz, Bogotá, Colombia.
- September 19, 2019 Seminario Sabanero de Combinatoria. Pontificia Universidad Javeriana, Bogotá, Colombia.
- April 22, 2019 Representation theory seminar. UMass Amherst, MA, USA.
- April 8, 2019 Combinatorics seminar. University of Miami, FL, USA.
- March 15, 2019. Seminario Sabanero de Combinatoria. Universidad Sergio Arboleda. Bogotá, Colombia.
- September 17, 2018. Seminario Sabanero de Combinatoria. Universidad de los Andes. Bogotá, Colombia.
- August 22, 2018. Coloquio Universidad Sergio Arboleda. Bogotá, Colombia.
- March 5, 2018. Seminario Sabanero de Combinatoria. Universidad Nacional de Colombia. Bogotá, Colombia.
- November 27, 2017. Applied Algebra Seminar. York University. Toronto, Canada.
- October 30, 2017. Discrete CATS seminar. U. of Kentucky, Lexington, KY.
- September 25, 2017. Applied Algebra Seminar. York University. Toronto, Canada.
- June 21, 2017. Combinatorics Seminar. University of Miami, Coral Gables, FL.
- April 21, 2017. Combinatorics Seminar. Wake Forest University, Winston-Salem, NC.
- April 3, 2017. Discrete CATS seminar. U. of Kentucky, Lexington, KY.
- November 16, 2016. Algebra-Geometry-Combinatorics seminar at SFSU, San Francisco, CA.
- November 14, 2016. Algebra and Discrete Mathematics seminar at UC Davis, Davis, CA.
- October 24, 2016. Discrete CATS seminar. U. of Kentucky, Lexington, KY.
- April 4, 2016. Discrete CATS seminar. U. of Kentucky, Lexington, KY.
- September 14, 2015. Discrete CATS seminar. U. of Kentucky, Lexington, KY.
- May 13, 2015. Combinatorics seminar. U. of Washington. Seattle, WA.
- November 24, 2014. Applied Algebra Seminar. York University. Toronto, Canada.

- October 31, 2014. Discrete CATS seminar. U. of Kentucky, Lexington, KY.
- October 2, 2010. Combinatorics Seminar. U. of Miami, Coral Gables, FL.
- March 2, 2010. Combinatorics Seminar. U. of Miami, Coral Gables, FL.
- May 27, 2009. Combinatorics Seminar. KTH-The Royal Institute of Technology, Stockholm, Sweden.

## ORGANIZED CONFERENCES AND SESSIONS

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Nov 30 - Dec 4, 2020 III Encuentro de mujeres matemáticas en latinoamérica. Pontificia Universidad Javeriana, Bogotá, Colombia.

July 20-24, 2020 Sesión temática en Combinatoria algebraica de funciones simétricas, cuasisimétricas y aplicaciones <https://www.clam2020.cmat.edu.uy/>. VI Congreso latinoamericano de Matemáticos. Universidad de la República, Montevideo, Uruguay.

June 16-27, 2020 7th Encuentro Colombiano de Combinatoria ECCO 2020. Universidad Sergio Arboleda y Universidad de los Andes. Bogotá, Colombia. June, 2020. <http://ecco2020.combinatoria.co>

June 12-14, 2020 Applied and Computational Mathematics in the Americas ACMA/IMSA. Institute of the Mathematical Sciences of the Americas. University of Miami, Coral Gables, FL, USA.

Días de Combinatoria DIAS 2019. Universidad del Cauca, Popayán, Colombia. July 15-26, 2019. <http://dias2019.combinatoria.co>

Seminario Sabanero de Combinatoria SeSaCo. Bogotá, Colombia. Spring-Fall 2018, Spring-Fall 2019.

CIMPA research school: 6th Encuentro Colombiano de Combinatoria ECCO 2018. Universidad del Norte. Barranquilla, Colombia. June 5-16, 2018. <http://ecco2018.combinatoria.co>

Días de Combinatoria DIAS 2017. Universidad Pontificia Bolivariana, Medellín, Colombia. July 17-28, 2017. <http://dias2017.combinatoria.co>

AMS special session on applications of Partially Ordered Sets in Algebraic, Topological, and Enumerative Combinatorics at the 2017 Joint Mathematics Meetings. Atlanta, GA. January 4-7, 2017.

Special session on algebraic combinatorics, Hopf algebras and tensor categories at the V Congreso Latinoamericano de Matemáticos. Universidad del Norte. Barranquilla, Colombia. July 11-15, 2016.

CIMPA research school: 5th Encuentro Colombiano de Combinatoria ECCO 2016. Universidad de Antioquia. Medellín, Colombia. June 13-24, 2016. <http://ecco2016.combinatoria.co>

## ATTENDED CONFERENCES

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- August 12-16, 2019 XXXVI del Coloquio de la Sociedad Matemática Peruana “CÉSAR CARRANZA SARAIVA”. Universidad Nacional Pedro Ruiz Gallo. Lambayeque, Perú.
- August 5-9, 2019 Sesión temática en posets y matroides. Coloquio latinoamericano de álgebra. Colegio Nacional, Ciudad de México, México.
- July 15-26, 2019 Días de Combinatoria DIAS 2019. Universidad del Cauca, Popayán, Cauca, Colombia.
- June 10-14, 2019 XXII Congreso Colombiano de Matemáticas 2019. Universidad del Cauca, Popayán, Cauca, Colombia.

- January 22-24, 2019 Décimo encuentro regional de matemáticas. Universidad de Antioquia, Medellín, Colombia.
- December 2-7, Matemáticas en el cono sur. Universidad de la República, Montevideo, Uruguay.
- November 12-16, AIM SQuaRE: Computing volumes and lattice points of flow polytopes. American Institute of Mathematics, San Jose, CA, US.
- July 26-29, 2018 ICM Satellite Conference: A Pan-Hemispheric Celebration of Mathematics in Miami. University of Miami, Coral Gables, FL, US.
- July 16-20, 2018 Formal Power Series and Algebraic Combinatorics FPSAC 2018. Dartmouth College, Hanover NH, USA.
- 6th Encuentro Colombiano de Combinatoria ECCO 2018. Universidad del Norte. Barranquilla, Colombia. June 5-16, 2018.
- April 29- May 6, 2018 BIRS Focussed Research Group on Algebraic Structure of Cyclic Combinatorial Objects The Banff Centre, Banff, Alberta, Canada.
- Días de Combinatoria DIAS 2017. Universidad Pontificia Bolivariana. Medellin, Colombia. July 17-28, 2017.
- Special Session on Algebraic and Enumerative Combinatorics with Applications. AMS Sectional Meeting. Indiana University, Bloomington, IN, April 1-2, 2017 .
- AMS Special Session on Applications of Partially Ordered Sets in Algebraic, Topological, and Enumerative Combinatorics. 2017 Joint Mathematics Meetings, Atlanta, GA, USA. January 4-7, 2017.
- Workshop "Polyhedral geometry and partition theory". American Institute of Mathematics, San Jose, CA. November 7-11, 2016.
- Special Session on Plethysm and Kronecker Products in Representation Theory. AMS Sectional Meeting. Bowdoin College, Brunswick, ME. September 24-25, 2016.
- V Congreso Latinoamericano de Matematicos. Universidad del Norte. Barranquilla, Colombia. July 11-15, 2016.
- FPSAC 2016. Vancouver, British Columbia, Canada. July 4-8, 2016.
- 5th Encuentro Colombiano de Combinatoria ECCO 2016. Universidad de Antioquia. Medellin, Colombia. June 13-24, 2016.
- Special Session on Topological Combinatorics. AMS Sectional Meeting. University of Memphis. Memphis, TN, USA. October 17-18, 2015.
- Special Session on Enumerative Algebraic and geometric combinatorics. AMS Sectional Meeting. Loyola University. Chicago, IL, USA. October 3-4, 2015.
- Algebraic Combinatorics and Applications, The first annual Kliakhandler Conference. Michigan Technological University, Houghton, MI, USA. August 26-30, 2015.
- Special Session on Algebro-Geometric Methods in Graph Theory. AMS Sectional Meeting. University of Nevada. Las Vegas, NV, USA. April 18-19, 2015.
- Special Session on Algebraic Combinatorics. AMS Sectional Meeting. Michigan State University in East Lansing, MI, USA. March 14-15, 2015.
- Conference in honor of Michelle Wachs. University of Miami. Miami, FL, USA. January 6-9, 2015.



- IMA Annual Program Year Workshop Geometric and Enumerative Combinatorics. IMA University of Minnesota. Minneapolis, MN, USA. November 10-14, 2014.
- Special Session on Topological Combinatorics and Combinatorial Commutative Algebra. AMS Sectional Meeting. SFSU, San Francisco, CA, USA. October 25-26, 2014.
- Cuarto Encuentro Colombiano de Combinatoria ECCO2014. Universidad de los Andes, Bogotá, Colombia. June 2-13, 2014.
- Bijective and Algebraic Combinatorics: In honor of Bruce Sagan's 60th birthday. University of Florida, Gainesville, Florida. March 24-25, 2014.
- Special Session on Topological Combinatorics. AMS Sectional Meeting. Washington University, St. Louis, MO, USA. October 18-20, 2013.
- FPSAC'13 The 25th International Conference on Formal Power Series and Algebraic Combinatorics. Paris, France. June 24-28, 2013.
- The 11th Nordic Combinatorial Conference (NORCOM). KTH, Stockholm, Sweden. June 17-19, 2013.
- Triangle Lectures in Combinatorics (TLC), Seventh meeting. Wake Forest University, Winston-Salem, NC, USA. February 9, 2013.
- Special Session on Algebraic and Topological Combinatorics. AMS Sectional Meeting. Tulane University, New Orleans, LA, USA. October 13-14, 2012.
- MSRI Summer Graduate Workshop - Cluster Algebras and Cluster Combinatorics. Mathematical Sciences Research Institute, Berkeley, CA, USA. August 1-12, 2011.
- Ninth Annual Graduate Student Topology and Geometry Conference. Michigan State University, East Lansing, MI, USA. April 2-3, 2011.
- Eighth Annual Graduate Student Topology and Geometry Conference. University of Michigan, Ann Arbor, MI, USA. April 10-11, 2010.
- AMS Fall Southeastern Meeting. Florida Atlantic University, Boca Raton, FL, USA. October 30-31, 2009.

## OTHER ACTIVITIES

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Member of the gender and equality commission of the Colombian Mathematical Society. 2019-current.

Coorganizer of the Math Circles program of the Colombian Mathematical Society. Universidad Sergio Arboleda. Spring-Fall 2019.

Cocreator and coleader of the research group **Comunidad Colombiana de Combinatoria** with Colciencias code COL0180477 since January of 2016.

Faculty co-advisor for the Math Club. University of Kentucky, Fall 2016-Spring 2017.

Cofounder and coorganizer of the UM Math Graduate Students Seminar. Fall 2010 to Spring 2012.

Students delegate on the faculty counsel of Electrical Engineering and on the Engineering School 2003-2004. UPB University, Medellín, Colombia.

## SKILLS

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*Languages:* Spanish (native), English (fluent).  
*Operating Systems:* GNU/Linux and WINDOWS.  
*Computer Languages:* Python, MATLAB, Sage Math.

## REFERENCES

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*Available on request*