

Elizabeth J. Hartung

Massachusetts College of Liberal Arts ◊ Department of Mathematics
105A Bowman Hall, North Adams, MA 01247
413-346-4093 ◊ E.Hartung@mcla.edu

EDUCATION

PhD Mathematics, Syracuse University, August 2012

- **Thesis:** *The Clar Structure of Fullerenes*, Syracuse University.
- **Advisor:** Jack E. Graver

Certificate of University Teaching, Syracuse University, May 2011

MS Mathematics, Syracuse University, May 2008

BS Mathematics, Indiana University of Pennsylvania, May 2006

RESEARCH INTERESTS

Graph theory and combinatorics with special interests in chemical graph theory, benzenoids, graphene patches and fullerenes, and planar graphs. Computational geometry and combinatorial generation.

AWARDS

Faculty Incentive Award for Research, MCLA 2021

Course release awarded to support collaborative research in chemical graph theory.

Chemical Graphs on Steroids, Bilateral Research Grant, ARRS 2019

Grant Awarded by ARRS (Agency of Research of the Republic of Slovenia) to support research collaboration with Nino Basic at the University of Primorska, Slovenia.

Faculty Incentive Award for Sabbatical Research, MCLA 2018

Funding awarded to support collaborative sabbatical research in chemical graph theory.

40 Under Forty, Berkshire County 2017

Recognized as one of 40 individuals under 40 years old in the Berkshires for professional accomplishments and work in the community

The Fullerene Project, Syracuse University, Pilot Grant 2016

Grant Awarded by Syracuse University to support collaborative research with Syracuse and MCLA students led by myself and Jack Graver at Syracuse.

Faculty Incentive Award for Research, MCLA 2015

Course release awarded for research in chemical graph theory.

Of the Month Award, MCLA National Residence Hall Honorary Chapter 2014

Awarded as a faculty member for work with students.

Outstanding Teaching Assistant Award, Syracuse University 2011

The Outstanding TA Award is given to approximately the top 4 percent of all graduate student instructors campus wide.

TEACHING EXPERIENCE

Full Professor, Massachusetts College of Liberal Arts 2021-Present
Associate Professor, Massachusetts College of Liberal Arts 2016-2021
Assistant Professor, Massachusetts College of Liberal Arts 2011-2016

Courses Taught: Linear Algebra, Calculus I, II, and IV, Real Analysis, Calculus for High School Teachers, Graph Theory for Math Educators, Graph Theory I and II, Topology, Set Theory and Logic, Proof II, Intro to Statistics, Math for Elementary Educators II and III, First Year Experience, Discrete Math, Abstract Algebra, Probability Theory, MTEL Prep Course, Fullerenes and Carbon Molecules, Topics in Chemical Graph Theory I and II, STEM Academy.

RELATED EXPERIENCE

Research visit TU Berlin Worked with Torsten Mutze and Aaron Williams at TU Berlin on Combinatorial Generation. Summer, 2018

MCLA Summer Research Institute

Supervisor of two undergraduate student in chemical graph theory 2018

Geometry of Redistricting Workshop

Participant in Tuft's workshop on the mathematics of redistricting and voting rights and a specialized Educator Track 2017

The Fullerene Project: Pilot Grant

MCLA leader in collaborative research project with Syracuse University. Mentored MCLA and Syracuse undergraduates and graduate students in chemical graph theory, particularly computing the Clar and Fries numbers for infinite classes of fullerenes. This work was supported by a pilot grant from Syracuse University. A paper with these results is in preparation. Spring 2016

MCLA Summer Research Institute

Supervisor of two undergraduate students researching chemical graph theory 2014

MCLA Alternative Spring Break

Group-leader for student service learning trip to Belize March 2014

New York State Department of Education Title IIB MSP Grant

Graduate Administrative Assistant, Syracuse University 2008

- Developed and presented workshops for Syracuse City School District teachers focusing on mathematics content in the current curriculum
- Learning Mathematics: Visualizing and Reasoning Summer 2010
Developed and taught workshops in a summer course for Syracuse City School District 1-8 grade teachers.
- Mathematics in Science Summer 2009
Developed and taught workshops focusing on science for Syracuse City School District 1-12 grade teachers.

NSF Research Experience for Undergraduates

Researcher, California University of San Bernardino Summer 2004

PUBLICATIONS

- Graver, J.E., Hartung, E.J., Williams, A. Resonance structures and aromaticity for capped carbon nanotubes, *Carbon*, **173** (2021), 1082-1092.
- Ian Angell, Paul Steven Davila, Jennifer Edmond, Joshua Fenton, William Fines-Kested, Jack Graver, Elizabeth Hartung, Brandon Lane, Satchel Lefebvre, Zhenyun Shi. Computing the Clar Number for Families of Fullerenes, in preparation.
- E.J. Hartung, H. Huang, T. Mutze, A. Williams, Combinatorial generation via permutation languages. I. Fundamentals. To appear in *Transactions of the American Mathematical Society*, (2021).
- Hartung, E.J., Huang, Mutze, T, Williams, Combinatorial Generation via Permutation Languages. *SODA (Symposium on Discrete Algorithms)*, (2020).
- Graver, J.E., Hartung, E.J., The Combinatorial Structure of Graphene. In: *Handbook of Graphene: Volume 2*, Tobias Stauber. Scrivener Publishing, pp. 73-94 (2019).
- J. Chapman, J. Foos, Hartung, E.J., A. Nelson, A. Williams. Pairwise Disagreements of Kekule, Clar, and Fries Numbers for Benzenoids: A Mathematical and Computational Investigation, *MATCH Commun. Math. Comput. Chem.* **80** (2018).
- Graver, J.E., Hartung, E.J., The Clar and Fries Structures of a Fullerene I, *Discrete Applied Mathematics* **216** (2016).
- Graver, J.E., Hartung, E.J., Internal Kekulé structures for Graphene and General Patches, *MATCH Commun. Math. Comput. Chem.*, **76** 3 (2016) pp. 693-705.
- Hartung, E.J., Clar Chains and a Countexample, *Journal of Mathematical Chemistry*, (2014) **52**, pp. 990-1006.
- Graver, J.E., Hartung, E.J., Kekuléan Benzenoids, *Journal of Mathematical Chemistry* (2014) **52**, pp. 977-989.
- Graver, J.E., Hartung, E.J., Self-dual Spherical Grids, *Electronic Journal of Combinatorics* (2014) **21**.
- Hartung, E.J., Fullerenes with complete Clar Structure, *Discrete Applied Mathematics* (2013) **161**, pp. .
- Graver, J.E., Hartung, E.J., Souid, A.Y., Clar and Fries Numbers for Benzenoids, *Journal of Mathematical Chemistry* (2013), **51**, pp. 1981-1989.
- Hartung, E.J. *The Clar Structure of Fullerenes*, Doctoral Thesis, Syracuse University, Syracuse, NY (2012).

CONFERENCE TALKS

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| Canadian Discrete and Algorithmic Mathematics Conference,
Virtual Conference
<i>Resonance Structures and Aromaticity in Capped Carbon Nanotubes</i> | May 2021 |
| Coast Combinatorics Conference,
University of Hawaii, Manoa
<i>Aromaticity and Stability for Carbon Nanotubes</i> | February 2019 |
| SIAM Conference on Discrete Mathematics,
University of Colorado, Denver
<i>The Fullerene Project</i> | June 2018 |
| AMS Sectional Meeting, | April, 2018 |

- Vanderbilt University, Nashville
The Fullerene Project
- Ontario Combinatorics Workshop**, Invited Speaker June 2017
University of Guelph, Guelph, Canada
Fullerenes and Graphene Patches
- Canadian Discrete and Algorithmic Mathematics Conference**, June 2017
Ryerson University, Toronto, Canada
Pairwise Incompatibility of Predictors of Stability for Graphene Patches
- Meeting of the International Academy of Mathematical Chemistry & International Conference on Mathematical Chemistry**, Invited Speaker July 2016
Nankai University, Tianjin, China
Internal Kekulé structures for Graphene and General Patches (speaker)
Pairwise Incompatibility of the Kekule, Fries, and Clar Numbers for Benzenoids (co-author)
Session Chair
- Computers in Scientific Discovery**, Invited Keynote Speaker July 2015
Virginia Commonwealth University, Richmond, VA
The Clar and Fries Numbers of Fullerenes and Benzenoids
- 8th Slovenian Conference on Graph Theory** June 2015
Kranjska Gora, Slovenia
The Clar and Fries Structures of a Fullerene
Session Chair
- International Academy of Mathematical Chemistry** June 2015
Kranjska Gora, Slovenia
The Clar and Fries Structures of a Fullerene
- Canadian Discrete and Algorithmic Mathematics Conference** June 2015
University of Saskatchewan, Saskatoon, Saskatchewan, CA
The Kekulé Count and Clar Number of Benzenoids
- Society for Industrial and Applied Mathematics** June 2014
Minneapolis, MN
Kekuléan Benzenoids
- Canadian Discrete and Algorithmic Mathematics Conference** June 2013
University of Newfoundland, Newfoundland, CA
The Clar Structure of a Fullerene
- Society for Industrial and Applied Mathematics** June 2012
Dalhousie University, Halifax, Nova Scotia, CA
Self-Dual Plane Graphs with Maximum Degree 4
- Canadian Discrete and Algorithmic Mathematics Conference** May 2011
University of Victoria, British Columbia, CA
Fullerene Parameters: A Colorful Approach
- Hudson Mohawk Valley Area Mathematics Conference** March 2011
Schenectady, NY

Inexpensive, Homemade Devices for Mathematical Demonstrations

- Computers in Scientific Discovery 5** July 2010
 University of Sheffield, Sheffield, UK
Face Independence Numbers of Fullerenes
- Discrete Math Day**, Invited Speaker May 2010
 Worcester Polytechnic Institute, Worcester, MA
Fullerenes and Carbon Molecules
- Association of Mathematics Teachers of New York State** November 2009
 Buffalo, NY
Enrichment Projects for Middle and High School Students
- Canadian Discrete and Algorithmic Mathematics Conference** May 2009
 University of Montreal, Montreal, CA
A Catalog of Self-Dual Plane Graphs with Maximum Degree 4
- AMS Sectional Meeting** April 2009
 Worcester Polytechnic Institute, Worcester, MA
A Catalog of Self-Dual Plane Graphs with Maximum Degree 4

OTHER PRESENTATIONS

- Diversity, Equity, and Inclusion Conference**, MCLA June 2019
Diversity and Civic Engagement: Integrating Two Critical Components of Higher Education
- Math Colloquium**, Middle Tennessee State University November 2018
Aromaticity and Stability for Carbon Nanotubes
- Math Colloquium**, TU Berlin August 2018
Fullerenes and Carbon Molecules
- Math Colloquium**, MCLA March 2018
Fullerenes, Graphene, and Carbon Molecules
- Faculty Brown Bag Presentation**, MCLA March 2017
Carbon Molecules and Graph Theory
- Unpacking Presidential Politics**, MCLA October 2017
Logical Fallacies
- Berkshire County goes to College**, MCLA April 2016
High Impact Experiences at MCLA
- COPLAC Summer Institute**, UNC Asheville June 2014
Service Learning at MCLA
- Strategic Planning Retreat**, MCLA May 2014
Excellence in Teaching Inside and Outside the Classroom
- Mathematics Colloquium**, Smith College February 2014
Fullerenes and Carbon Molecules
- Mathematics Colloquium**, MCLA

<i>Graph Theory and Carbon Molecules</i>	<i>Elizabeth Hartung</i> 6 February 2013
Math Students Colloquium , MCLA <i>Research Experiences for Undergraduates</i>	March 2012
Math Students Colloquium , MCLA <i>Thinking About Graduate School in Mathematics?</i>	December 2011
Graduate Student Colloquium , Syracuse University <i>Fullerenes and Carbon Molecules</i>	November 2010
Department Orientation , Syracuse University <i>Practical Advice for Graduate Students</i>	August 2010
Combinatorics Seminar , Syracuse University <i>Latin Squares and Projective Planes</i> <i>Random Graphs</i>	Spring 2010 Fall 2009
Women In Science and Engineering , Syracuse University <i>An Introduction to Graph Theory</i>	October 2009
Syracuse City School District <i>Various Workshops for teachers in the Syracuse City School District</i>	2008-2009

PRESENTATIONS BY MENTORED STUDENTS

MCLA Undergraduate Research Conference , MCLA Paul Steven Davila and William Fines-Kested, "What Makes a Fullerene: The Quest for Clar Numbers"	Spring 2019
MCLA Undergraduate Research Conference , MCLA Selected students from Graph Theory II presented their research projects. <ul style="list-style-type: none"> • Ian Angell and Satchel Lefebvre, "Finding the Clar and Fries Numbers for Infinite Classes of Graphs" • Josh Colon, "Applied Electrical Circuit Analysis with Graph Theory" • Allison Gaylock, "Vertex Coloring Game" • Rebecca Godbout and Kayla Lavoie, "Using Graph Theory to Analyze Social Networks" 	Spring 2016
National Conference for Undergraduate Research , Washington State James Chapman and Andrew Nelson, "A Search for the Kekuleanness and Upper Bounds on the Clar and Fries Numbers of a Benzenoid." Research supervised in independent studies Topics in Chemical Graph Theory I and II.	Spring 2015
Statewide Undergraduate Research Conference , UMass Amherst James Chapman and Andrew Nelson, "A Search for the Kekuleanness and Upper Bounds on the Clar and Fries Numbers of a Benzenoid." Research supervised in independent studies Topics in Chemical Graph Theory I and II.	Spring 2015
Pokemon and Probability , MCLA Math Colloquium Heather Chiros presented research supervised in the courses "Discrete Mathematics" and "Graph Theory II"	Spring 2015

MCLA Undergraduate Research Conference, MCLA Spring 2015
James Chapman and Andrew Nelson, “Combinations of Graphs, Infinite Classes, and the Disproof of a Clar-Kekule Conjecture”

Statewide Undergraduate Research Conference, UMass Amherst Spring 2014
James Chapman, “The Quest for Upper Bounds on Clar and Fries Numbers for Benzenoids”

MCLA Undergraduate Research Conference, MCLA Spring 2014
Selected students from Graph Theory II presented their research projects.

- Ross Betti, “Constellations through Graph Theory”
- James Chapman, “The Quest for Upper Bounds on Clar and Fries Numbers for Benzenoids”
- Amory Galili, “Graph Maker”
- Patrick Munier, “The Human Brain and Mental Illness Examined through Graph Theory”

MCLA Undergraduate Research Conference, MCLA Spring 2014
Students from the MCLA Alternative Spring Break trip presented “Service and Cultural Learning in Belize”

High School Math Competition, MCLA Spring 2014
Ross Betti “Constellations: Simple by Coincidence” during break for students

SERVICE

Committee on Tenure 2020-Present
Served as one of two faculty on the Committee on Tenure. Evaluated tenure applications, met with departments and candidates, wrote recommendations to the Vice President of Academic Affairs.

Minisymposium Organizer May 2021
Co-organized a 15-speaker minisymposium in chemical graph theory for the virtual CanaDAM (Canadian Discrete and Algorithmic Mathematics) 2021 conference.

Peer Evaluation Committees Fall 2020
Served on two peer evaluation committees for faculty.

- Chair for Dr. Shen’s reappointment PEC
- PEC member for Dr. Kleintop’s reappointment PEC

Workshop Facilitator: Civic Learning and DEI Fall 2020
Co-facilitated a workshop on the topics of Civic Learning and Diversity, Equity, and Inclusion for faculty developing capstone courses. Reviewed draft syllabi and provided feedback.

Peer Evaluation Committees Fall 2019
Served on four peer evaluation committees for faculty.

- Chair for Dr. Ward’s reappointment and promotion PEC
- PEC member for Dr. Kiley’s reappointment PEC
- PEC member for Dr. Kleintop’s reappointment PEC
- PEC member for Dr. Socolof’s reappointment and promotion PEC

Supporting Faculty Member for Math Drop-in Center, Fall 2018- Present
Assisted with running tutor meetings and trainings, advertising the Drop in Center, assessment of the Math Drop in Center, and writing Title III proposals.

Interim Department Chair,

Spring 2019

Served as Interim Chair for the Math department while Dr. Thomas was on sabbatical.

Lead Faculty Member for New Math Drop-in Center, Spring 2017-Spring 2018

Wrote Title III grant proposal to fund a new Math Drop-in Help Center which opened in Fall 2017. Hired students, provided training, advertised center, run monthly meetings with peer tutors and meet weekly with head tutor, meet with students and faculty as needed, collect data.

Peer Evaluation Committees

Fall 2017

Served on three peer evaluation committees for faculty.

- Chair for Dr. Kiley’s reappointment PEC
- PEC member for Dr. Billetz seeking promotion to Full Professor
- PEC member for Dr. Maher’s chair evaluation

Computer Science Department Search Committee, Member

Fall 2017

Serving on search for a tenure track Computer Science faculty member

Quantitative Understanding Across the Curriculum, Member Fall 2015-Present

Discussed and implemented strategies for improving quantitative understanding across disciplines, including starting the Math Drop-in Help Center

Undergraduate Research Council, Member

Fall 2015-Present

Helped plan and organize the Undergraduate Research Conference, reviewed undergraduate proposals for funding, reviewed abstracts for URC.

Math Society, Advisor

Fall 2013-Spring 2018

Advise this student group; take students on field trips and to conferences; help organize student events.

STEM Pathways Program, Co-PI

Fall 2014-Spring 2019

Co-Principal Investigator on a NSF-funded STEM Pathways program for MCLA students. This grant established a cohort model and awarded scholarships for high-achieving Pell-eligible students in STEM majors. Helped to apply for grant, choose awardees yearly, run programming for students.

Peer Reviewer

Fall 2013-Present

Reviewed mathematical journal articles and grants for:

- *The Journal of Applied Mathematics*
- *Discrete Applied Mathematics*
- *MATCH (Communications in Mathematical and Computer Chemistry)*
- *Journal of Information Processing*
- *Ars Mathematica Contemporaria*
- *Discussiones Mathematicae Graph Theory*
- An NSF grant in chemical graph theory

Community-Based Learning Group, Faculty Co-coordinator Spring 2013-Spring 2020

Encourage community-based learning in MCLA courses, meet with faculty members to discuss ideas for courses and logistics, serve as a liaison between faculty and community partners.

Math Alignment Group, MCLA Representative

Spring 2012-Present

Connect with local teachers, principals, and math coaches in area to discuss common interests.

- Regular math alignment meetings with Berkshire county teachers and professors.
- Co-facilitated *Diving Deeper*, a workshop for principals, math teachers, and math coaches in implementing new common core standards.
- Participated in Train-the-Trainer Workshop

Computer Science Department Search Committee, Member

Fall 2016-Spring 2017

Served on search for a tenure track Computer Science faculty member

Peer Evaluation Committees

Fall 2016

Served on four peer evaluation committees for faculty.

- Two junior faculty seeking reappointment
- One faculty member seeking tenure and promotion to Associate Professor
- One faculty member seeking promotion to Full Professor

Math Department Search Committee, Chair

Fall 2015-Spring 2016

Our committee secured a new tenure track math faculty member.

Monument Mountain Regional High School Self-Study, Community Partner

Spring 2016
Met with faculty, administrators, and students at Monument Mountain Regional to assess and report back to the administration and mathematics department. This self study was used as an alternative assessment to NEASC.

Pathways to College, Advisor

Fall 2016

Faculty Advisor for undergraduate student starting a Pathways to College Program with MCLA undergraduates helping North Adams high school students navigate college and career plans.

MSCA Union, Treasurer and Executive Member

Fall 2015-Spring 2017

Maintain the budget for the MCLA Faculty Union, collect dues, coordinate with state union office, meet with faculty and administration to advance faculty needs and concerns.

PARCC Fellow

Fall 2014-Spring 2016

Math representative for MCLA for statewide discussion and analysis of PARCC, a new test to determine competency at the K-12 level that may replace MCAS. Attended workshops, co-organized panel at MCLA.

Developmental Math Advisory Board, MCLA Representative

Spring 2014-Fall 2016

Work with the department of higher education and CSSE to determine policies for developmental math courses and placement.

MCLA Alternative Spring Break

Group-leader for student service learning trip to Belize.

March 2014

Brought 18 students to Belize, where we engaged in cultural exchange, brought school supplies, built sidewalks and did maintenance at an elementary school

Service Learning Assessment Group, Member

Spring 2013-Spring 2014

Our group is developed a program to assess Service Learning programs and courses on campus.

Lorraine B. Maloney Award Committee , Member	Spring 2013
Our selection committee reviewed nominations and selected award recipients.	
Mission Statement Advisory Group , Member	Fall 2012-Spring 2013
Our advisory group created a draft for the new MCLA Mission Statement.	
Math Department Search Committee , Member	Fall 2012-Spring 2013
Our committee secured a new tenure track math faculty member.	
First Year Experience Faculty , Instructor	Fall 2012, 2013
Faculty Incentive Awards Committee , Member	Spring 2012
Curriculum Committee , Member	Spring 2012-Spring 2015
Empty Bowls Dinner , Pottery Contributor	2012-Present
Made bowls for the Empty Bowls Dinner to support the Berkshire Food Project each year.	
All College Committee , Substitute Member	Fall 2012
Colloquium Organizer , Mathematics Graduate Organization	2010-2011
Combinatorics Seminar , participant, Syracuse University	2009-2011
Learning to Teach Seminar , participant, Syracuse University	2010
• Developed teaching strategies with a group of teaching assistants and professors	
Future Professoriate Program , participant, Syracuse University	2009-2011
• Attended professional development seminars	
• Discussed teaching strategies with a faculty mentor	
Women in Science and Engineering Program , participant	2009-2011
• Attended numerous professional development seminars	
Mathematics Undergraduate Committee , Graduate Representative	2009-2010
• Discussed issues related to the mathematics undergraduate courses and curriculum	
• Initiated departmental ballots	
• Determined teaching assignments for math department faculty	

CONFERENCES and Workshops

Virtual Workshop on Computational Geometry , Virtual. Organized by Erik Demaine, MIT	May 2021
Virtual Workshop on Computational Geometry , Virtual. Organized by Erik Demaine, MIT	March 2020
Diversity, Equity, and Inclusion Conference , MCLA	June 2019
Coast Combinatorics Conference , University of Hawaii, Manoa	February 2019
SIAM Conference on Discrete Mathematics , University of Colorado, Denver	June 2018
Civic Learning and Engagement Conference , Fitchburg State	May 2018

AMS Sectional Meeting,
Vanderbilt University, Nashville April 2018

Japan Conference on Discrete and Computational Geometry, Graphs, and Games,
August 2017
Tokyo University of Science, Tokyo, Japan

Geometry of Redistricting Workshop, August 2017
Tufts University, Boston

Canadian Discrete and Algorithmic Mathematics Conference, June 2017
Ryerson University, Toronto, Canada

Ontario Combinatorics Workshop, June 2017
University of Guelph, Guelph, Canada

Meeting of the International Academy of Mathematical Chemistry & International Conference on Mathematical Chemistry July 2016
Nankai University, Tianjin, China

SENCER (Science Education for New Civic Engagements and Responsibilities) Faculty Summer Institute August 2015
Worcester Polytechnic Institute, Worcester, MA

Computers in Scientific Discovery July 2015
Virginia Commonwealth University, Richmond, VA

8th Slovenian Conference on Graph Theory June 2015
Kransjka Gora, Slovenia

International Academy of Mathematical Chemistry June 2015
Kransjka Gora, Slovenia

Canadian Discrete and Algorithmic Mathematics Conference June 2015
Saskatchewan, CA

SIAM Discrete and Algorithmic Conference June 2014
Minneapolis, Minnesota

COPLAC Summer Faculty Institute June 2014
Asheville, NC

Canadian Discrete and Algorithmic Mathematics Conference June 2013
Newfoundland, CA

Discrete Math Day, Worcester, MA April 2013

SIAM Discrete and Algorithmic Conference June 2012
Halifax, CA

COPLAC Summer Faculty Institute June 2012
Asheville, NC

Canadian Discrete and Algorithmic Mathematics Conference May 2011
Victoria, CA

Hudson Mohawk Valley Area Mathematics Conference Schenectady, NY	March 2011
Joint Meetings , New Orleans, LA	January 2011
AMS Sectional Meeting , Syracuse, NY	October 2010
Computers in Scientific Discovery 5 , Sheffield, UK	July 2010
Discrete Math Day , Worcester, MA	May 2010
Association of Mathematics Teachers of New York State Buffalo, NY	November 2009
Canadian Discrete and Algorithmic Mathematics Conference Montreal, CA	May 2009
AMS Sectional Meeting , Worcester, MA	April 2009
Association of Mathematics Teachers of New York State Rye, NY	November 2008
NYS Regional Graduate Mathematics Conference Syracuse, NY	April 2007 - 2011

PROGRAMS

Familiar with SAS, Minitab, Python, Latex, Powerpoint, Maple, Geometer's Sketchpad