RESUME

Ryan Martinez

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EDUCATION:

Harvey Mudd College, 2018-2022, GPA: 3.973
Bachelor's of Science in Mathematics. Graduated with High Distinction, Departmental Honors: Humanities/Social Sciences/Arts and Mathematics.

University of California Berkeley, 2022- Current
PhD in Mathematics, planned graduation 2027, advanced to candidacy March 2024

PUBLICATIONS:

"On Good Infinite Families of Toric Codes or the Lack Thereof," with Mallory Dolorfino, Cordelia Horch, and Kelly Jabbusch (U. Michigan Dearborn) to appear in INVOLVE. arXiv:2201.08464 (refereed)

"Algebraic Invariants of Knot Diagrams on Surfaces," HMC Senior Thesis 2022, https://scholarship.claremont.edu/hmc_theses/260

CURRENT RESEARCH:

Currently I am working with Daniel Tataru in the general field of Nonlinear Dispersive PDEs. Briefly, this field studies PDEs which exhibit wavelike (where time and space frequencies are strongly tied) behavior and takes advantage of Fourier analysis to get stronger control over the behavior of solutions than would be possible otherwise, but the techniques can apply even when dispersion is weak or even absent. Given my proficiency in computation, I have an interest in using numerics to build intuition for problems as well as using theoretical understanding to get better guarantees on simulations. This attitude towards computation seems to be less prevalent in the PDE community, so I'm excited to see what I can learn in this space!

I am in the process of writing up a result which follows the work of Tataru and Ifrim to get a "modified lifespan" for a quasilinear wave equation at lower regularity. What this means is that I can make better theoretical guarantees about how long solutions will stay small than previously known; and this existence time depends only on the "low frequency part" of the initial data - which means that the results are more stable than previously known under rougher data.

The idea makes use of “dispersion” of the linearized equation, which is to say that time and space frequencies are tied together, which allows for better control of nonlinear interactions.

My next projects will be to numerically check if the smallness time for the above problem is the best possible and to apply a related but more involved technique to get global in time “dispersive” estimates (which is an estimate for how much things decay) for the cubic 1D Nonlinear Schrodinger Equation (where the gain from dispersion is weakest) for the roughest possible solutions given by Harrop-Griffiths, Killip, and Visan.

AWARDS/SCHOLARSHIPS:

Harvey S. Mudd Merit Award (2018)
The Robert James Prize (Harvey Mudd First Year Mathematics Award): Fall 2019
Chancellor’s Scholarship (UC Berkeley, 2022)
Outstanding Graduate Student Instructor (UC Berkeley, 2023)

PROFICIENT LANGUAGES/PROJECTS:

C++: Data structures class (Harvey Mudd CS 70; A)

Projects: https://github.com/ryanmart00/Hellscape is a work in progress video-game with a working 3D game engine built on Bullet and OpenGL; https://github.com/ryanmart00/BlackHole is a simulation of what geodesics look like in the Schwartzschild metric.

Python: Intro programming class (Harvey Mudd CS 42; Pass)

Projects: https://github.com/ryanmart00/ToricVarietyCodes is some code to do some abstract algebra over finite fields for some computations for work related to my work with Dolorfino, Horch, and Jabbusch.

Julia: Graduate Numerical Partial Differential Equations (UC Berkeley Math 228B; A-)

Worked problems: https://github.com/ryanmart00/PDENumerics

C: Computer systems class (Harvey Mudd CS 105: A)

Prolog: Computability and logic class (Harvey Mudd CS 81: A)

Java: Old experience from high school

Haskell: Less experience, completed the first 30 or so of the 99 Lisp problems for Haskell

GRADUATE STUDENT INSTRUCTOR POSITIONS:

Multivariable Calculus (Math 53, Berkeley), Prof. James Sethian Fall 2022

Course covers standard multivariable calculus.

Honors Multivariable Calculus (Math H53, Berkeley), Prof. Edward Frenkel Spring 2023

Same as above for self-selected "honors" students.

Multivariable Calculus (Math 53, Berkeley), Prof. Maciej Zworski Fall 2023

Course covers standard multivariable calculus.

Multivariable Calculus (Math 53, Berkeley), Prof. Sunica Canic Spring 2024

Course covers standard multivariable calculus.

TEACHING PHILOSOPHY:

At Berkeley, I've had the privilege to run discussion/recitation sections of 4 semesters of Multivariable Calculus, even receiving the Outstanding Graduate Student Instructor award from the Math department. My fundamental assumption is that supporting active and empowered engagement in my classes will lead to the best outcomes. I believe my effectiveness at achieving this is exemplified through my use of group quizzes. First, the way classes work at Berkeley ends up meaning that regardless of how much engagement you get out of your students, especially in lower division courses and at unfavorable times of day, by the middle of the semester most students will not come to discussion. (I think this is in fact not a bad thing: students have lives and priorities and I'm happy that they are spending their time doing things that they feel is good for them!) What this means is that I have to pack the maximal amount of learning into those classes which I can guarantee my students will come to, which are quiz days.

Broadly, I make quizzes whose questions are more open ended, intellectually demanding, and just beyond what they have been taught in lecture; and put students into randomly assigned pairs to complete them. (I've experimented with different sizes, and I've found that 2 is the best because it is the arrangement where the fewest people are ignored by their group). Working in pairs, and especially on vertical white/chalk-boards (as suggested by "Building Thinking Classrooms in Mathematics"), teaches students to have a more active role in learning and builds confidence. And in practice, while the first couple quizzes are kinda silent and awkward, students quickly start experimenting with ideas and giving very intuitive/heuristic arguments for and against ideas. Of course students will often get stuck which is where my job comes in: instead of being a detached bystander like during a normal quiz, I circulate around the class to make sure students are engaging positively. If not, I first try to remind groups of general advice that they might not have remembered: draw a picture, make a guess of what the answer should be (if the answer is numerical) or at least the units, or ask what would they need to have first to have an answer. If students need more specific help, I try to keep my help vague enough that they feel like they are coming to answers on their own intelligence, but just pointed in the right direction.

In terms of grading, there are two factors I have to weigh: that the professors that run these classes (and more generally UC Berkeley) expects me to generate grades that differentiate students; and that grades are the most direct feedback that students get for their work. To balance these factors I have my students turn in individual write-ups for their group's solutions, but grade based generally on how well their exposition demonstrates their individual understanding of their group work. This semester, I have gotten great success out of having a clear rubric which emphasizes clarity of writing and verbose reasonability checks (I give points even if they find that their answers are unreasonable) which I think has taught them good critical thinking habits. The area I want to make a change next semester is to emphasize my rubric by having some sort of self, peer, or prepared solution grading, so that my students can see what "bad" solutions look like in the hopes that this will be another avenue for learning.

Overall, I have had great success with these methods, never statistically falling behind other sections, and even on this most recent midterm, my sections' mean was 2 standard deviations higher than expected if the students were assigned to sections randomly. Of course this could be for many reasons and I wouldn't say that these methods are definitely significantly better for test outcomes. However, I do believe that my students are happier (I have kept in touch with many more of my students than my peers with theirs) and several of my students have had enough comfortability with me to ask for recommendation letters for various things. So even barring strict academic efficacy, I feel confident that I am doing what I can to make my students' lives even just a bit smoother as they navigate their academic journey.

UNDERGRADUATE RESEARCH EXPERIENCE:

Undergraduate Researcher; Harvey Mudd College, Summer 2020

Research in Scheduling for the purpose of Human Robot Interaction: I, two fellow Harvey Mudd undergraduates, and our supervisor, Professor Jim Boerkoel, created an extension of a Simple Temporal Network for multiple agents that cannot cooperate in creating their schedules. We asked standard controllability questions from the context of Simple Temporal Networks with Uncertainty, such as, under what conditions does an agent know enough about other agents' schedules to be able to control for every choice they might make? We created a MILP to decide a strong version of controllability.

Undergraduate Researcher; University of Michigan, Dearborn, Summer 2021.

Research in Error Correcting Codes coming from Toric Varieties: I, two fellow undergraduates from different institutions, and our advisor, Professor Kelly Jabbusch from the University of Michigan, Dearborn, gave compelling evidence that larger toric codes are "worse" than shorter ones (in the limit). More precisely, as the size of toric codes grows, either the relative amount of information stored in the code or how many errors can be corrected in the code goes to zero. While we do not give a complete proof of this conjecture, we do give conditions under which the conjecture does hold and evidence that it holds in all cases. If our conjecture does hold, it guarantees an upper bound on the size of code given a fixed information rate and error correcting ability.

Thesis Student; Harvey Mudd College, 2021-2022.

Working under Professor Sam Nelson at Claremont McKenna College, I am in the process of finding new knot/knotoid invariants from colorings of the knot complement. Most of my work so far has been to gain a deep understanding of the tools in Knot Theory and Algebraic Topology. Learning these ideas has been a journey on its own. I now feel confident in my ability to learn from academic research papers, which is an incredibly important skill to have. Beyond this preliminary research, I have ideas for strengthening invariants, which resist my efforts. As such I have had to find strategies to push forward despite the challenges. These consist in finding simple cases of problems and looking for patterns there as well as using computational methods to assist in this search.

REFERENCES:

Daniel Tataru, University of California Berkeley, Professor of Mathematics
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Relation: Instructor

Kelly Jabbusch, University of Michigan Dearborn, Associate Professor of Mathematics
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Relation: Research Supervisor

Sam Nelson, Claremont McKenna College, Professor of Mathematics
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Relation: Instructor and Undergraduate Thesis Supervisor