Justin Yirka

B.S. in Computer Science and B.S. in Mathematics
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Research Interests

Quantum computing: algorithms, complexity theory, and connections with applications

Education

Virginia Commonwealth University (VCU) **Richmond, VA**
B.S. in Computer Science *May 2018*
B.S. in Mathematical Sciences, GPA: 3.98 out of 4.0 *Dual degrees*
Specialization in Data Science
Concentration in Pure Math
Minor in Physics
University Honors

Research

Experience

University of Paderborn, Germany
Visiting Researcher *(3 weeks) November 2018*
Collaboration with Sevag Gharibian, Ph.D.
Topic: Complexity theory and algorithms. Worked to show QMA_1-hardness of the quantum satisfcation problem (k-QSAT) for input of lower dimensions (i.e. improving on current necessary dimensions).

Graph Theory Computational Discovery Lab, VCU
Research Assistant *Summer 2018*
Supervisor: Craig Larson, Ph.D.
Topic: Automated conjecturing and graph Hamiltonicity. *Sage*, *Python*, and *GitHub*. Implemented algorithms for graph properties, improved open-source project structure, and tested graph conjectures.

Joint Center for Quantum Information and Computer Science (QuICS), University of Maryland (UMD)
NSF REU Undergraduate Researcher *Summer 2017*
Supervisor: Andrew Childs, Ph.D.
Support: NSF Research Experience for Undergraduates (REU). P.I.: William Gasarch, Ph.D.
Topic: Quantum tomography. Investigated minimum number of Pauli observables to identify a pure state. Used numerical results, group theory, and hypergraph theory.

Quantum Computing Lab, VCU
Undergraduate Research Assistant *2015–2016*

Supervisor: Sevag Gharibian, Ph.D.
Topic: Quantum computational complexity. Studied quantum oracle classes (e.g. $\mathrm{P}^{\mathrm{QMA[log]}}$) characterized by local physical problems and partially developed "quantum Toda's Theorem" ($\mathrm{QCPH} \subseteq \mathrm{P}^{\mathrm{PP}^{\mathrm{PP}}}$).

Preprints

Sevag Gharibian, Stephen Piddock, and **Justin Yirka**. "Oracle complexity classes and local measurements on physical Hamiltonians". Preprint available soon.

Sevag Gharibian, Miklos Santha, Aarthi Sundaram, and **Justin Yirka**. "Quantum generalizations of the polynomial hierarchy with applications to QMA(2)". Available at https://arxiv.org/abs/1805.11139. Apr. 2018.

Journal Publications

Sevag Gharibian and **Justin Yirka**. "The complexity of simulating local measurements on quantum systems". In: *Quantum* (2016). Available at https://arxiv.org/abs/1606.05626.

Conference Presentations

Sevag Gharibian, Stephen Piddock, and **Justin Yirka**. *Oracle complexity classes and local measurements on physical Hamiltonians*. **Contributed talk by J. Yirka** at 18th Asian Quantum Information Science Conference (AQIS). Nagoya, Japan, Sept. 2018.

Sevag Gharibian, Miklos Santha, Aarthi Sundaram, and **Justin Yirka**. *Quantum generalizations of the polynomial hierarchy with applications to* QMA(2). Contributed **"long"/plenary talk** by A. Sundaram at 18th Asian Quantum Information Science Conference (AQIS). Nagoya, Japan, Sept. 2018.

Sevag Gharibian, Miklos Santha, Aarthi Sundaram, and **Justin Yirka**. *Quantum generalizations of the polynomial hierarchy with applications to* QMA(2). Contributed talk by A. Sundaram at 43rd International Symposium on Mathematical Foundations of Computer Science (MFCS). Liverpool, UK, Aug. 2018.

Sevag Gharibian and **Justin Yirka**. *The complexity of simulating local measurements on quantum systems*. Contributed talk by S. Gharibian at 12th Conference on the Theory of Quantum Computation, Communication, and Cryptography (TQC). Paris, France, 2017.

Sevag Gharibian and **Justin Yirka**. *The complexity of estimating local physical quantities*. **Poster by J. Yirka** at 20th Conference on Quantum Information Processing (QIP). Seattle, USA, 2017.

Justin Yirka. *Evaluation of TCP header fields for data overhead efficiency*. **Poster by J. Yirka** at 30th National Conference on Undergraduate Research (NCUR). Asheville, USA, 2016.

Justin Yirka. *Evaluation of TCP header fields for data overhead efficiency*. **Poster by J. Yirka** at VCU Symposium for Undergraduate Research and Creativity. Richmond, USA, 2015. — **Awarded "Launch Award for Outstanding Research Poster"**.

Department Seminars

Pure state tomography with Pauli observables. QuICS, University of Maryland. 2017.

Quantum complexity of estimating local physical quantities. Department of Computer Science, VCU. 2016. — **Only undergraduate invited in previous 5 years**.

Independent Studies

Convex Optimization (CMSC 601)
VCU *Fall 2017*
Studied material for graduate optimization course as an undergraduate. Supervised by S. Gharibian.

Scholarships (all dollar amounts in USD)

VCU Presidential Scholarship
$110,000, Virginia Commonwealth University *2014–May 2018*
Top scholarship offered. Full cost of 4-year tuition, room, and board.
Awarded to 0.6% of students

WPI Presidential Scholarship [unable to accept]
$80,000, Worcester Polytechnic Institute *2014*

Rensselaer Medal Merit Scholarship [unable to accept]
$100,000, Rensselaer Polytechnic Institute *2014*

Funding

Travel grant for attendance at QIP 2019
$400, QIP student support / NSF *January 2019*

Event grants for seminar series by VCU RamDev software development club
$1,900, VCU Student Government Association *2016–May 2018*

Travel grant for presentation at QIP 2017
$500, VCU Honors College *2017*

Travel grant for presentation at NCUR 2016
$550, VCU Honors College *2016*

Awards and Honors

Pure Mathematics Award
VCU College of Humanities and Sciences *May 2018*
Awarded to student in pure mathematics concentration with highest graduating GPA.

Mark A. Sternheimer Capstone Design Award
VCU School of Engineering *2017*
For "innovation and entrepreneurship" of senior project developing mobile app.
Included grant of $660.

University Student Scholar Award
Virginia Commonwealth University *2015*

Launch Award for Outstanding Research Poster
VCU Symposium for Undergraduate Research and Creativity *2015*
For poster *Evaluation of TCP header fields for data overhead efficiency*.

Volunteer of the Year
Grade-school robotics program, Prince William County Schools, VA *2014*

Teaching Experience

VCU

Teaching Assistant
Algebra with Applications (MATH 141) *(2 semesters) 2016–2017*
Assisted with in-class work, offered tutorials, graded assignments.
Average student evaluation scores — Fall 2016: 4.78 / 5.0; Spring 2017: 4.36 / 5.0.

Mentor for 1st year student
Honors College freshman mentorship program *Fall 2016*

Teaching Assistant
Honors Rhetoric (HONR 200) — first-year honors writing and research course *Fall 2015*

Other

Instructor
CPR and first-aid courses for lifeguards *2016–March 2018*
Department of Parks and Recreation, Prince William County, VA

Service

University Service

Student Advisory Board member
VCU Department of Computer Science *2016–May 2018*
- Participated in hiring interviews for new faculty, 2017 (one of two students to participate).
- Invited to School of Engineering strategic planning retreat, 2017 (only C.S. undergraduate).

Senior Reader for Honors graduation dossiers
VCU Honors College *(2 academic years) 2016–2017*
Assessed papers submitted in fulfillment of University Honors. Coordinated other readers.

Panelist — Career workshop for freshman mentorship program
VCU Department of Computer Science *2017*

Panelist — Undergraduate conference preparation workshops
VCU Honors College *2017*

Judge — Launch Award for Outstanding Research Poster
VCU Symposium for Undergraduate Research and Creativity *2016*

Organizer — Local Hack Day of Richmond, VA
Major League Hacking (MLH) and VCU Department of Computer Science *2016*
Hosted event for 30 students, including 12 high school students.

Extracurricular Service

Founder and President
RamDev: Software Development at VCU *2016–May 2018*

- Coordinated 46 weekly seminars including 9 corporate speakers.
- Secured and managed $2400 in funding and resources.
- Increased weekly attendance to 20 students, becoming largest C.S. organization at VCU.

Community Service and Outreach

Asked to meet with U.S. Army Operations Group
Answered questions about my observations from AQIS 2018. *November 2018*

Talk — Computer Science theory *is* fun
VCU RamDev software development club *April 2018*

Talk — Quantum programming (e.g. IBM Q, LIQ$Ui|\rangle$
VCU RamDev software development club *2017*

Volunteer for grade school robotics competitions (FIRST, Vex robotics)
Prince William County Schools, VA *2011–2015*
Awarded "Volunteer of the Year", 2014.

Mentor to middle school robotics team (FIRST robotics)
Wilder Middle School, Richmond, VA *2014*