

Justin Yirka

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

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

Education

Virginia Commonwealth University (VCU)

B.S. in Computer Science

May 2018

B.S. in Mathematical Sciences, GPA: 3.98 out of 4.0

Dual/Simultaneous degrees

Specialization in Data Science

Concentration in Pure Math

Minor in Physics

University Honors

Research

Experience

Visiting Researcher

(3 weeks) November 2018

University of Paderborn, Germany

Collaboration with Sevag Gharibian, Ph.D.

Topic: Complexity theory and algorithms. Worked to show QMA_1 -hardness of the quantum satisfaction problem (k -QSAT) given qudits of lower dimensions (i.e. improving on current necessary dimensions).

Research Assistant

Summer 2018

Graph Theory Computational Discovery Lab, VCU

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.

NSF Research Experience for Undergraduates (REU) / Undergraduate Researcher

Summer 2017

Joint Center for Quantum Information and Computer Science (QuICS), University of Maryland

Supervisor: Andrew Childs, Ph.D.

Topic: Quantum tomography. Investigated minimum number of Pauli observables necessary to identify a pure state. Attempted to apply numerical results, group theory (i.e. Clifford group), and hypergraph theory.

Undergraduate Research Assistant

2015–2016

Quantum Computing Lab, VCU

Supervisor: Sevag Gharibian, Ph.D.

Topic: Quantum computational complexity. Studied quantum oracle classes (e.g. $\text{P}^{\text{QMA}[\log]}$) characterized by local physical problems and helped develop “quantum PH” and “quantum Toda’s Theorem” ($\text{QCPH} \subseteq \text{P}^{\text{PPPP}}$).

Preprints.....

- S. Gharibian, S. Piddock, and J. Yirka Oracle complexity classes and local measurements on physical Hamiltonians. Preprint available on arXiv soon.
- S. Gharibian, M. Santha, A. Sundaram, and J. Yirka. Quantum generalizations of the polynomial hierarchy with applications to QMA(2). Available at <https://arxiv.org/abs/1805.11139>. April 2018.

Journal Publications.....

- S. Gharibian and J. Yirka. The complexity of simulating local measurements on quantum systems. Accepted to *Quantum* pending revisions to presentation. Available at <https://arxiv.org/abs/1606.05626>. 2016.

Conference Presentations (grouped by paper)

- S. Gharibian, S. Piddock, and J. Yirka. Oracle complexity classes and local measurements on physical Hamiltonians.
- o **Poster by J. Yirka** at 22nd Conference on Quantum Information Processing (QIP). Boulder, CO, USA, Jan. 2019.
 - o **Contributed talk by J. Yirka** at 18th Asian Quantum Information Science Conference (AQIS). Nagoya, Japan, Sept. 2018.
- S. Gharibian, M. Santha, A. Sundaram, and J. Yirka. Quantum generalizations of the polynomial hierarchy with applications to QMA(2).
- o Poster by A. Sundaram at 22nd Conference on Quantum Information Processing (QIP). Boulder, CO, USA, Jan. 2019.
 - o Contributed talk by A. Sundaram at 18th Asian Quantum Information Science Conference (AQIS). Nagoya, Japan, Sept. 2018. — **“Long”/plenary talk: top 7% of submissions.**
 - o Contributed talk by A. Sundaram at 43rd International Symposium on Mathematical Foundations of Computer Science (MFCS). Liverpool, UK, Aug. 2018.
- S. Gharibian and J. Yirka. The complexity of simulating local measurements on quantum systems.
- o Contributed talk by S. Gharibian at 12th Conference on the Theory of Quantum Computation, Communication, and Cryptography (TQC). Paris, France, 2017.
 - o **Poster by J. Yirka** at 20th Conference on Quantum Information Processing (QIP). Seattle, USA, 2017. Presented under a different title.
- J. Yirka. Evaluation of TCP header fields for data overhead efficiency.
- o **Poster by J. Yirka** at 30th National Conference on Undergraduate Research (NCUR). Asheville, NC, USA, 2016.
 - o **Poster by J. Yirka** at VCU Symposium for Undergraduate Research and Creativity. Richmond, VA, USA, 2015. — **Awarded “Launch Award for Outstanding Research Poster”.**

Departmental 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 Fall 2017
VCU (CMSC 492/CMSC 601)
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 Top scholarship offered. Full cost of 4-year tuition, room, and board. Awarded to 0.6% of students	2014–May 2018
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 to attend QIP 2019 in Boulder, CO, USA \$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 to present at QIP 2017 in Seattle, USA \$500, VCU Honors College	2017
Travel grant to present at NCUR 2016 in Asheville, NC, USA \$550, VCU Honors College	2016

Awards and Honors

Pure Mathematics Award VCU College of Humanities and Sciences Awarded to student in pure mathematics concentration with highest graduating GPA.	May 2018
Mark A. Sternheimer Capstone Design Award VCU School of Engineering For “innovation and entrepreneurship” of senior project developing mobile app. Included grant of \$660.	2017
University Student Scholar Award Virginia Commonwealth University	2015
Launch Award for Outstanding Research Poster VCU Symposium for Undergraduate Research and Creativity For poster <i>Evaluation of TCP header fields for data overhead efficiency</i> .	2015
Volunteer of the Year Grade-school robotics program, Prince William County Schools, VA	2014

Teaching Experience

VCU.....

Teaching Assistant (2 semesters) 2016–2017

Algebra with Applications (MATH 141)

Assisted with in-class exercises, 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 Fall 2016

Honors College freshman mentorship program

Teaching Assistant Fall 2015

Honors Rhetoric (HONR 200) — first-year honors writing and research course

Other.....

Instructor 2016–March 2018

CPR and first-aid courses for lifeguards

Department of Parks and Recreation, Prince William County, VA

Service

University Service.....

Student Advisory Board member 2016–May 2018

VCU Department of Computer Science

- o Participated in hiring interviews for new faculty, 2017 (one of two students to participate).

- o Invited to School of Engineering strategic planning retreat, 2017 (only C.S. undergraduate).

Senior Reader for Honors graduation dossiers (2 academic years) 2016–2017

VCU Honors College

Assessed essays submitted in fulfillment of University Honors. Coordinated other readers.

Panelist — Career workshop for freshman mentorship program 2017

VCU Department of Computer Science

Panelist — Undergraduate conference preparation workshops 2017

VCU Honors College

Judge — Launch Award for Outstanding Research Poster 2016

VCU Symposium for Undergraduate Research and Creativity

Organizer — Local Hack Day of Richmond, VA 2016

Major League Hacking (MLH) and VCU Department of Computer Science

Hosted event for 30 students, including 12 high school students.

Extracurricular Service.....

Founder and President 2016–May 2018

RamDev: Software Development at VCU

- o Coordinated 46 weekly seminars including 9 corporate speakers.

- o Secured and managed \$2400 in funding and resources.

- o 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 <i>is</i> fun VCU RamDev software development club	April 2018
Talk — Quantum programming (e.g. IBM Q, LIQU <i>i</i>)) VCU RamDev software development club	2017
Volunteer for grade school robotics competitions (FIRST, Vex robotics) Prince William County Schools, VA Awarded “Volunteer of the Year”, 2014.	2011–2015
Mentor to middle school robotics team (FIRST robotics) Wilder Middle School, Richmond, VA	2014