

# Justin Yirka

B.S. in Computer Science and B.S. in Mathematics  
Virginia Commonwealth University, Richmond, VA, USA

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## Research Interests

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

## Education

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### 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

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### Experience

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Visiting Researcher

(3 weeks) November 2018

University of Paderborn, Germany

Collaboration with Sevag Gharibian, Ph.D.

Topic: Complexity theory and algorithms. Worked to show  $\text{QMA}_1$ -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.  $\text{PQMA}^{\text{log}}$ ) characterized by local physical problems and helped develop “quantum PH” and “quantum Toda’s Theorem” ( $\text{QCPH} \subseteq \text{P}^{\text{P}^{\text{PP}}}$ ).

## 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.
- 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)

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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

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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

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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

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<b>VCU</b> .....	
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 1 <sup>st</sup> year student	Fall 2016
Honors College freshman mentorship program	
Teaching Assistant	Fall 2015
Honors Rhetoric (HONR 200) — first-year honors writing and research course	
<b>Other</b> .....	
Instructor	2016–March 2018
CPR and first-aid courses for lifeguards	
Department of Parks and Recreation, Prince William County, VA	

## Service

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<b>University Service</b> .....	
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.	
<b>Extracurricular Service</b> .....	
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.	

<b>Community Service and Outreach</b> .....	
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