

# Justin Yirka

Ph.D. Student in Computer Science  
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## Research Interests

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Quantum computing & Theoretical computer science:

Complexity theory, algorithms, and connections to applications

## Education

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### University of Texas at Austin (UT)

Ph.D. in Computer Science

2019 – present

Advisor: Scott Aaronson, Ph.D.

### Virginia Commonwealth University (VCU)

B.S. in Computer Science

2018

B.S. in Mathematical Sciences

Concurrent/Dual degrees

Minor in Physics

## Research

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### Experience

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Summer school / Research Assistant

June 2019–August 2019

Los Alamos National Laboratory Quantum Computing Summer School

Supervisor: Yiğit Subaşı, Ph.D.

Topic: Near-term (NISQ) quantum algorithms. Studied use of qubit resets to construct for entanglement spectroscopy which were noise-resilient *and* low-width.

Visiting Researcher

(3 weeks) November 2018

University of Paderborn, Germany

Collaboration with Sevag Gharibian, Ph.D.

Topic: Complexity theory and algorithms. Studied QMA<sub>1</sub>-hardness of the quantum satisfaction problem ( $k$ -QSAT) given qudits of lower dimensions.

Research Assistant

Summer 2018

Graph Theory Computational Discovery Lab, VCU

Supervisor: Craig Larson, Ph.D.

Topic: Automated conjecturing and graph theory. Studied conditions for graph Hamiltonicity. Assisted with programming and open-source project management.

NSF Research Experience for Undergraduates (REU)/Undergraduate Researcher Summer 2017  
Joint Center for Quantum Inform. 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 quantum pure state.

Undergraduate Research Assistant

2015–2016

Quantum Computing Lab, VCU

Supervisor: Sevag Gharibian, Ph.D.

Topic: Complexity theory. Studied quantum oracle classes (e.g.  $P^{QMA[\log]}$ ) and complexity of simulating local measurements. Helped develop a “quantum PH” and “quantum Toda’s Theorem” ( $QCPH \subseteq P^{PP^{PP}}$ ).

## Preprints.....

J. Yirka and Y. Subasi. Qubit-efficient entanglement spectroscopy using qubit resets. Available at <https://arxiv.org/abs/2010.03080>. October 2020.

S. Gharibian, S. Piddock, and J. Yirka. Oracle complexity classes and local measurements on physical Hamiltonians. Available at <https://arxiv.org/abs/1909.05981>. September 2019.

(Graph theory) N. Bushaw, V. Gupta, C. Larson, S. Loeb, M. Norge, J. Parrish, J. Yirka, and G. Yu. Automated conjecturing and the Hamiltonian problem. In submission. August 2019.

S. Gharibian, M. Santha, J. Sikora, 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. *Quantum*, 3:189, September 2019. DOI: 10.22331/q-2019-09-30-189.

## Conference Presentations ..... (grouped by paper) .....

J. Yirka and Y. Subasi. Qubit-efficient entanglement spectroscopy using qubit resets.

- Contributed talk by Y. Subasi at APS March Meeting 2021. Virtual.
- **Contributed talk by J. Yirka** at 20th Asian Quantum Information Science Conference (AQIS). Virtual, Dec. 2020.

S. Gharibian, S. Piddock, and J. Yirka. Oracle complexity classes and local measurements on physical Hamiltonians.

- Contributed talk by S. Piddock at 37th Symposium on Theoretical Aspects of Computer Science (STACS). Montpellier, France, March 2020.
- **Contributed talk by J. Yirka** at 23rd Conference on Quantum Information Processing (QIP). Shenzhen, China, Jan. 2020.
- Poster by S. Piddock at 14th Conference on the Theory of Quantum Computation, Communication, and Cryptography (TQC). College Park, MD, USA, June 2019.
- Poster by S. Piddock at Workshop on Quantum Computing Theory in Practice (QCTIP). Bristol, UK, April 2019.
- **Poster by J. Yirka** at 22nd Conference on Quantum Information Processing (QIP). Boulder, CO, USA, Jan. 2019.

- **Contributed talk by J. Yirka** at 18th Asian Quantum Information Science Conference (AQIS). Nagoya, Japan, Sept. 2018.

S. Gharibian, M. Santha, J. Sikora, A. Sundaram, and J. Yirka. Quantum generalizations of the polynomial hierarchy with applications to QMA(2).

- Poster by A. Sundaram at 22nd Conference on Quantum Information Processing (QIP). Boulder, CO, USA, Jan. 2019.
- Contributed talk by A. Sundaram at 18th Asian Quantum Information Science Conference (AQIS). Nagoya, Japan, Sept. 2018. — **“Long”/plenary talk: top 7% of submissions.**
- 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.

- Contributed talk by S. Gharibian at 12th Conference on the Theory of Quantum Computation, Communication, and Cryptography (TQC). Paris, France, 2017.
- **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.

- **Poster by J. Yirka** at 30th National Conference on Undergraduate Research (NCUR). Asheville, NC, USA, 2016.
- **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.

## Scholarships and Funding (all dollar amounts in USD)

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VCU Presidential Scholarship \$110,000, Virginia Commonwealth University Awarded to 0.6% of admitted students.	2014–2018
Travel grant to attend QIP 2020 in Shenzhen, China \$1100, QIP student support / NSF	January 2020
Travel grant to attend QIP 2019 in Boulder, CO, USA \$400, QIP student support / NSF	January 2019
Grants for seminar series by VCU RamDev software development club \$1,900, VCU Student Government Association	2016–May 2018
Mark A. Sternheimer Capstone Design Award \$660, VCU School of Engineering Grant for developing and testing senior project mobile app.	2017

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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Honorable Mention ( <i>Awarded twice</i> ) NSF Graduate Research Fellowship Program (NSF GRFP) Awarded to top 30% of over 12,000 applicants.	April 2019, 2020
Pure Mathematics Award VCU College of Humanities and Sciences Student in pure math concentration with highest graduating GPA.	May 2018
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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**VCU**.....

Teaching Assistant Algebra with Applications (MATH 141) Assisted with daily in-class exercises, offered tutorials, graded assignments. Average student evaluation scores — Fall 2016: 4.78 / 5.0; Spring 2017: 4.36 / 5.0.	(2 semesters) 2016–2017
Mentor for first-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 Department of Parks and Recreation, Prince William County, VA	2016–March 2018
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## Service

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**Professional Service**.....

Reviewer for: *Quantum*

PC Member 2021  
6th Conference for Young Quantum Information Scientists (YQIS 2020/21)

Representative and Chair Spring 2020–present  
UT Graduate Representative Association of Computer Science (GRACS)  
o GRACS representative to UTCS Diversity, Equity, and Inclusion (DEI) Council.

Graduate representative Fall 2020  
UT CS Graduate Admissions Committee

Lead Mentor Fall 2020  
Graduate Application Assistance Program (GAAP) for UT CS by GRACS  
Student-led program for mentoring under-represented applicants to Ph.D. program. As part of GRACS, I helped organize the first year of this program, managed volunteer mentors, and mentored prospective students.

Panelist — Grad school discussion for underrepresented undergraduates August 2020  
UT CS student organizations

GradFest committee member Spring 2020  
UT Department of Computer Science  
Helped plan visit weekend for admitted Ph.D. students.

Met with U.S. Army Operations Group November 2018  
I was asked to share my observations from AQIS 2018.

Student Advisory Board member (2 academic years) 2016–2018  
VCU Department of Computer Science  
Met with department faculty. Participated in hiring interviews for new faculty in 2017.

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

### **Extracurricular Service.....**

Founder and President (2.5 academic years) 2016–2018  
RamDev: Software Development at VCU  
o Coordinated 46 weekly seminars including 9 corporate speakers and several hackathon trips.  
o Secured and managed \$2400 in funding and resources.  
o Increased weekly attendance to 20 students, becoming largest C.S. organization at VCU.

### **Outreach and Community Service.....**

Tutor for remedial math students at local high school Spring 2019  
Manchester High School, Midlothian, VA

Up to 4.5 hours per week with several groups of students.

Talk — Computer Science theory <i>is</i> fun VCU RamDev software development club	April 2018
Talk — Quantum programming (e.g. IBM Q, LIQUi >) VCU RamDev software development club	2017
Organizer — Local Hack Day of Richmond, VA Major League Hacking (MLH) and VCU Department of Computer Science Organized event for 30 students including 12 high school students.	2016
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	Fall 2014