Justin Yirka

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

YirkaJk@vcu.edu
(703) 229-7956
www.JustinYirka.com

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 — Concurrent/Dual 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 satisfcation 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. $\mathrm{P}^{\mathrm{QMA[log]}}$) characterized by local physical problems and helped develop "quantum PH" and "quantum Toda's Theorem" ($\mathrm{QCPH} \subseteq \mathrm{P}^{\mathrm{PP}^{\mathrm{PP}}}$).

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, 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. 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.

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

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

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

Funding

Travel grant to attend QIP 2019 in Boulder, CO, USA January 2019
$400, QIP student support / NSF

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

Travel grant to present at QIP 2017 in Seattle, USA 2017
$500, VCU Honors College

Travel grant to present at NCUR 2016 in Asheville, NC, USA 2016
$550, VCU Honors College

Awards and Honors

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

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

University Student Scholar Award 2015
Virginia Commonwealth University

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

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

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
- 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 (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
- 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 — November 2018
Answered questions about my observations from AQIS 2018.

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

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

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

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