

# Justin Yirka

*Curriculum Vitae*

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: algorithms, complexity theory, and connections with applications

## Education

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**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

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## Experience

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**Graph Theory Computational Discovery Lab, VCU**

*Research Assistant*

*Summer 2018*

**Supervisor:** Craig Larson, Ph.D.

**Topic:** Automated conjecturing and graph Hamiltonicity. Implemented algorithms for graph properties, improved open-source project structure for future use, and evaluated graph Hamiltonicity 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 pure-state tomography. Investigated Pauli observables using group theory (e.g. Clifford group) and bounds from study of hypergraphs.

**Quantum Computing Lab, VCU**

*Undergraduate Research Assistant*

*2015–2016*

**Supervisor:** Sevag Gharibian, Ph.D.

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

## Preprints.....

Sevag Gharibian, Stephen Piddock, and **Justin Yirka**. “Local measurements on physical Hamiltonians and oracle complexity classes”. 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.

Sevag Gharibian and **Justin Yirka**. “The complexity of simulating local measurements on quantum systems”. Available at <https://arxiv.org/abs/1606.05626>. May 2016.

## Conference Presentations.....

Sevag Gharibian, Stephen Piddock, and **Justin Yirka**. *Oracle complexity classes and local measurements on physical Hamiltonians*. **Contributed talk by J. Yirka** at 18<sup>th</sup> 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 18<sup>th</sup> 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 43<sup>rd</sup> 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 12<sup>th</sup> 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 20<sup>th</sup> 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 30<sup>th</sup> 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**.

## Public-Audience Talks.....

*Computer Science theory is fun*. VCU RamDev software development club. Apr. 2018.

*Quantum programming (e.g. IBM Q, LIQUi|)*. VCU RamDev software development club. 2017.

## Independent Studies.....

### Convex Optimization (CMSC 601)

VCU

Fall 2017

Independently studied material for graduate optimization course as an undergraduate.

Only undergraduate granted independent study approval in computer science in Fall 2017.

## Scholarships (all dollar amounts in USD)

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### 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

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### 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

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### 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

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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 1<sup>st</sup> year student

*Honors College freshman mentorship program*

Fall 2016

### Teaching Assistant

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

Fall 2015

Assisted with in-class work and critiqued student papers.

Other.....

### Instructor

*CPR and first-aid courses for lifeguards*

2016–March 2018

Department of Parks and Recreation, Prince William County, VA

## Service

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University Service (VCU).....

### Student Advisory Board member

*Department of Computer Science*

2016–May 2018

- o Invited to School of Engineering strategic planning retreat, 2017 (only C.S. undergraduate).
- o Participated in hiring interviews for new faculty, 2017 (one of two students to participate).

### Senior Reader for Honors graduation dossiers

*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

*Department of Computer Science*

2017

### Panelist — Undergraduate conference preparation workshops

*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.....

### Volunteer for grade school FIRST & Vex robotics competitions

*Prince William County Schools, VA* 2011–2015

Awarded “Volunteer of the Year”, 2014.

### Mentor to middle school FIRST robotics team

*Wilder Middle School, Richmond, VA* 2014

## Programming Experience

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**Languages:** Java, C, Python, Sage, Perl, Wolfram Language, Lua

**Software:** LaTeX, git and GitHub, Unix, Android, Mathematica, Weka, AutoCAD

**Software Engineering coursework:** Software Engineering (Agile, Android), Algorithm Analysis, Programming Languages (C, Python, Racket), Introduction to Operating Systems, Object Oriented Programming (Java)

**Applications coursework:** Introduction to Natural Language Processing (assignments in Perl), Introduction to Data Science (Weka), Artificial Intelligence (neural networks), Graphs and Algorithms, Visualization of Physics with Mathematica

## Projects.....

### Graph Brains Project — Graph Theory Computational Discovery Lab, VCU

*Python* Summer 2018

Implement functions for calculating graph properties. Manage known examples and properties in Python and SQL. Improve project structure, documentation, and usability.

### Campus Bluetooth tag network — Senior project

*Java, Swift, Python, Android, iOS, Raspberry Pi / Unix, Google Firebase* (2 semesters) 2017–May 2018

Team project developing campus item-tracking system implementing Android, iOS, and Raspberry Pi programs to locate users’ items tagged with BLE beacons.

### GeoViewer Android app — Software Engineering course project

*Java, Android, Amazon AWS* Fall 2016

Team project with focus on Agile development. Implemented Android app enabling users to share and discover geocached photos.

### Run Planner Mathematica program — RamHacks hackathon

*Wolfram Language, Mathematica* 2016

Developed program utilizing opensource GPS data to take as input a starting location and a distance goal and output a jogging route of that distance along the city road network.

## ***GroupMe Stats Android app — VTHacks hackathon***

*Java, Android*

2016

Team project developing app to use GroupMe API to retrieve information about user's GroupMe conversations and provide interesting statistics to the user.