

# Ruslan Shaydulin

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## Profile

PhD candidate in computer science, expecting to graduate in May 2020. My research focusses around the intersection between (hyper)graph problems, optimization, machine learning, quantum and high-performance computing. I have extensive experience designing and implementing hybrid quantum-classical algorithms, with particular interest in variational and decomposition-based approaches (including multilevel).

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## Peer-reviewed Publications

Sami Khairy, **Ruslan Shaydulin**, Lukasz Cincio, Yuri Alexeev, Prasanna Balaprakash. Learning to Optimize Variational Quantum Circuits to Solve Combinatorial Problems. In *Proceedings of Thirty-Fourth AAAI Conference on Artificial Intelligence (AAAI-20) (to appear)*, 2020. **Acceptance rate: 20.6%**

Sami Khairy, **Ruslan Shaydulin**, Lukasz Cincio, Yuri Alexeev, Prasanna Balaprakash. Reinforcement-Learning-Based Variational Quantum Circuits Optimization for Combinatorial Problems. In *Proceedings of the Machine Learning and the Physical Sciences workshop at Conference on Neural Information Processing Systems (NeurIPS 2019) (to appear)*, 2019

**Ruslan Shaydulin**, Yuri Alexeev. Evaluating Quantum Approximate Optimization Algorithm: A Case Study. In *Proceedings of the 2nd International Workshop on Quantum Computing for Sustainable Computing (QCSC 2019) (in conjunction with 10th International Green and Sustainable Computing Conference (IGSC 2019))*, 2019  
Preprint: [arXiv:1910.04881](https://arxiv.org/abs/1910.04881)

Sami Khairy, **Ruslan Shaydulin**, Lukasz Cincio, Yuri Alexeev, Prasanna Balaprakash. Reinforcement Learning for Quantum Approximate Optimization. *Research Poster, accepted at Supercomputing '19*, 2019

**Ruslan Shaydulin**, Ilya Safro, and Jeffrey Larson. Multistart Methods for Quantum Approximate Optimization. In *Proceedings of 2019 IEEE High Performance Extreme Computing Conference (HPEC)*, 2019  
**Best Student Paper** (of ~50 student papers). Preprint: [arXiv:1905.08768](https://arxiv.org/abs/1905.08768)

**Ruslan Shaydulin**, Hayato Ushijima-Mwesigwa, Christian F.A. Negre, Ilya Safro, Susan M Mniszewski, and Yuri Alexeev. A Hybrid Approach for Solving Optimization Problems on Small Quantum Computers. *Computer*, 52(6):18-26, 2019.  
**Cover Feature**. DOI: [10.1109/MC.2019.2908942](https://doi.org/10.1109/MC.2019.2908942)

**Ruslan Shaydulin**, Hayato Ushijima-Mwesigwa, Ilya Safro, Susan Mniszewski, and Yuri Alexeev. Network Community Detection on Small Quantum Computers. *Advanced Quantum Technologies*, 2(9):1900029, 2019.  
DOI: [10.1002/qute.201900029](https://doi.org/10.1002/qute.201900029)

**Ruslan Shaydulin**, Hayato Ushijima-Mwesigwa, Ilya Safro, Susan Mniszewski, and Yuri Alexeev. Community Detection Across Emerging Quantum Architectures. In *Proceedings of the 3rd International Workshop on Post Moore's Era Supercomputing (in conjunction with Supercomputing '18)*, 12-14, 2018. Preprint [arXiv:1810.07765](https://arxiv.org/abs/1810.07765)

**Ruslan Shaydulin** and Ilya Safro. Aggregative Coarsening for Multilevel Hypergraph Partitioning. In *Proceedings of 17th International Symposium on Experimental Algorithms (SEA 2018)*, 103:2:1-2:15, 2018.  
DOI: [10.4230/LIPIcs.SEA.2018.2](https://doi.org/10.4230/LIPIcs.SEA.2018.2)

Ruslan Shaydulin, Jie Chen, and Ilya Safro. Relaxation-Based Coarsening for Multilevel Hypergraph Partitioning. *Multiscale Modeling & Simulation*, 17(1):482–506, 2019. DOI: [10.1137/17M1152735](https://doi.org/10.1137/17M1152735)

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## Online Preprints and In-Submission Works

Hayato Ushijima-Mwesigwa, **Ruslan Shaydulin**, Christian F. A. Negre, Susan Mniszewski, Yuri Alexeev, Ilya Safro. Multilevel Combinatorial Optimization Across Quantum Architectures. *In submission*. Preprint: [arXiv:1910.09985](https://arxiv.org/abs/1910.09985)

Zirou Qiu, **Ruslan Shaydulin**, Xiaoyuan Liu, Yuri Alexeev, Christopher S. Henry, Ilya Safro. Network Alignment by Propagating Reliable Similarities. *In submission*.

Justin Sybrandt, **Ruslan Shaydulin**, Ilya Safro. Hypergraph Partitioning With Embeddings. *In submission*. Preprint: [arXiv:1909.04016](https://arxiv.org/abs/1909.04016)

**Ruslan Shaydulin**, Caleb Thomas, Paige Rodeghero. Making Quantum Computing Open: Lessons from Open-Source Projects. Preprint: [arXiv:1902.00991](https://arxiv.org/abs/1902.00991)

**Ruslan Shaydulin**, Justin Sybrandt. To Agile, or not to Agile: A Comparison of Software Development Methodologies. Preprint: [arXiv:1704.07469](https://arxiv.org/abs/1704.07469)

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## Education

### **Clemson University, SC**

**Spring 2020 (expected)**

PhD candidate in Computer Science, advisor: Ilya Safro

Research in algorithms, high performance computing, big data analysis and quantum computing

Relevant coursework: Design & Analysis of Algorithms, Data Mining, Distributed & Cluster Computing, Parallel Architecture, Network Science

### **Moscow Institute of Physics and Technology**

**Summer 2016**

Department of Control and Applied Math,

Bachelor of Science in Applied Mathematics and Physics

Minor: Computer Science and Data Analysis

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## Work Experience

### **Research Aide, Argonne National Laboratory**

**Summer 2018, 2019**

- Developed quantum-accelerated frameworks for network community detection and graph partitioning under the supervision of Yuri Alexeev
- Co-authored 6 papers on quantum optimization and machine learning (5 first author)
- Contributed to multiple proposals

### **Research Intern, Parallels LABs**

**Winter 2014 - Summer 2016**

- Improved stability and security of SmartMail macOS email client by isolating potentially unstable parts as separate services
- Added features to UI of iQuickMark iOS app

## Contributed Talks and Posters

<b>Quantum Computing Seminar</b> <i>Oak Ridge National Laboratory</i> Gave talk "Practical Optimization on Near-term Quantum Computers"	<b>Nov 4, 2019</b>
<b>International Green and Sustainable Computing Conference (IGSC 2019)</b> <i>Alexandria, VA</i> Presented poster "Reinforcement Learning for Quantum Approximate Optimization"	<b>Oct 22, 2019</b>
<b>Chicago Quantum Exchange Meeting</b> <i>University of Chicago</i> Presented poster "Practical Quantum Approximate Optimization"	<b>June 12, 2019</b>
<b>SIAM Conference on Computational Science and Engineering (CSE19)</b> <i>Spokane, WA</i> Presented poster " <a href="#">Quantum Local Search for Graph Community Detection</a> "	<b>Feb 25-28, 2019</b>
<b>Quantum Computing Tutorial</b> <i>Argonne National Laboratory</i> Gave talk " <a href="#">QAOA Algorithm Introduction</a> "	<b>Dec 10-11, 2018</b>
<b>Supercomputing '18</b> <i>Dallas, TX</i> Gave talk "Community Detection Across Emerging Quantum Architectures" at Clemson booth	<b>Jul 25-27, 2018</b>
<b>Quantum Computing Workshop</b> <i>Argonne National Laboratory</i> Presented preliminary results on " <a href="#">Machine Learning on Near-Term Quantum Computers</a> "	<b>Jul 25-27, 2018</b>
<b>32nd Clemson Mini-Conference on Discrete Mathematics and Algorithms</b> <i>Clemson University</i> Presented poster "Relaxation-Based Coarsening for Multilevel Hypergraph Partitioning"	<b>Nov 4, 2017</b>
<b>58th Scientific Conference</b> <i>Moscow Institute of Physics and Technology</i> Gave talk "IPC (Inter-Process Communication) in OS X"	<b>Nov 23-28, 2015</b>

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## Leadership and Service

<b>SIAM Conference on Parallel Processing for Scientific Computing (PP20)</b> <i>Seattle, WA</i> Led and co-organized a minitutorial " <a href="#">Combinatorial Optimization on Quantum Computers</a> "	<b>Feb 12-15, 2020</b>
<b>SIAM Conference on Parallel Processing for Scientific Computing (PP20)</b> <i>Seattle, WA</i> Co-organized a minisymposium "Recent Advances and Trends in Hybrid Quantum-Classical Algorithms"	<b>Feb 12-15, 2020</b>
<b>Quantum Computing Tutorial</b> <i>Argonne National Laboratory</i> Led and co-organized a <a href="#">hands-on tutorial for Qiskit, a framework for quantum computing</a>	<b>May 14, 2019</b>
<b>Mathematics Teacher, Summer School</b> <i>Kostroma, Russia</i> School administrator, organized extracurricular activities.	<b>Summer 2014</b>

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## Teaching

<b>Network Science CPSC 8480</b> <i>Clemson University</i> Teaching Assistant responsible for grading and answering students' questions during office hours	<b>Fall 2018, 2019</b>
<b>Design and Analysis of Algorithms CPSC 8400</b> <i>Clemson University</i> Teaching Assistant responsible for grading and answering students' questions during office hours	<b>Spring 2019</b>

## **Algorithms and Data Structures CPSC 2120** *Clemson University*

**Spring 2019**

Teaching Assistant responsible for running the lab section, grading and answering students' questions during office hours

## **Mathematics Teacher, Summer School** *Kostroma, Russia*

**Summer 2014**

Created and taught a course on basics of graph theory, combinatorics and number theory to middle and high school students.

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## Languages and Technologies

C , Python

Prior experience: C++, MATLAB, Objective-C, Swift, Bash, IBM QISKit, Rigetti PyQuil

Limited prior experience: R, SQL, yacc, bison, AWS, Google Cloud Engine

Technologies and tools: Git, Xcode for iOS/OSX UI/Backend, TCP/IP, UNIX/Linux, MPI

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## Honors and Awards

- International Green and Sustainable Computing Conference (IGSC 2019) student travel award, *recipient*
- Best Student Paper at IEEE HPEC 2019 (of ~50 student papers), *recipient*
- Upsilon Pi Epsilon CS Honor Society, *member*
- Supercomputing '19 Student Volunteer Travel award, *recipient*
- SIAM CSE '19 Broader Engagement Travel award, *recipient*
- Clemson CCIT Supercomputing '17, '18 and '19 travel award, *recipient*
- Clemson Graduate Travel Grant, Spring '19, *recipient*
- Moscow Institute of Physics and technology Abramov scholarship – Top 300 students in the university, based on high academic achievement, *recipient*