Ruslan Shaydulin

E-mail: rshaydu@g.clemson.edu GitHub: https://github.com/rsln-s
Web: shaydul.in Google Scholar: https://scholar.google.com/citations?user=PxOuGGcAAAAJ

Profile

PhD candidate in computer science, expecting to graduate in August 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).

Peer-reviewed Publications

Zain Saleem, Kaiwen Gui, **Ruslan Shaydulin**, Martin Suchara. Comparing Constrained and Unconstrained Quantum Approximate Optimization Algorithms. In *Proceedings of the 2nd International Workshop on Quantum Resource Estimation (QRE 2020) (co-located with International Symposium on Computer Architecture (ISCA) 2020) (to appear).*

Ruslan Shaydulin, Caleb Thomas, Paige Rodeghero. Making Quantum Computing Open: Lessons from Open-Source Projects. In *Proceedings of First International Workshop on Quantum Software Engineering (Q-SE 2020) (co-located with ICSE 2020) (to appear).* Preprint: arXiv:1902.00991

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),* 2020. **Acceptance rate: 20.6%**
DOI: 10.1609/aaai.v34i03.5616

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),* 2019. (link)
Preprint: arXiv:1911.04574

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
DOI: 10.1109/IGSC48788.2019.8957201

Sami Khairy, **Ruslan Shaydulin**, Lukasz Cincio, Yuri Alexeev, Prasanna Balaprakash. Reinforcement Learning for Quantum Approximate Optimization. *Research Poster, Supercomputing '19,* 2019 (available in Proceedings)

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). DOI: 10.1109/HPEC.2019.8916288

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

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

Ruslan Shaydulin

shaydul.in

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

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

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

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

Zirou Qiu, **Ruslan Shaydulin**, Xiaoyuan Liu, Yuri Alexeev, Christopher S. Henry, Ilya Safro. ELRUNA: Elimination Rule-based Network Alignment. *In submission*. Preprint: arXiv:1911.05486

Justin Sybrandt, **Ruslan Shaydulin**, Ilya Safro. Hypergraph Partitioning With Embeddings. *In submission*. Preprint: arXiv:1909.04016

Ruslan Shaydulin, Justin Sybrandt. To Agile, or not to Agile: A Comparison of Software Development Methodologies. Preprint: arXiv:1704.07469

Education

Clemson University, SC **Summer 2020 (expected)**
PhD candidate in Computer Science, advisor: Ilya Safro
Master of Science in Computer Science en route to PhD **Fall 2019**
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

Work Experience

Research Intern, IBM Research – Quantum **Summer 2020**
- Working on Clifford circuit optimization under the supervision of Dmitri Maslov

Intern, Quantum Artificial Intelligence Lab (QuAIL) **Spring 2020**
NASA Ames Research Center (KBR)
- Developed novel analysis connecting the symmetries in problem instance structure to the performance of Quantum Approximate Optimization Algorithm under the supervision of Salvatore Mandra

- Performed extensive numerical simulations using HPC resources

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

Quantum Computing Tutorial *Argonne National Laboratory* **Jun 15, 2020**
Led a tutorial on Quantum Approximate Optimization Algorithm.

SIAM Conference on Parallel Processing for Scientific Computing (PP20) *Seattle, WA* **Feb 13, 2020**
Gave talk "Multilevel Hybrid Quantum-Classical Algorithms on Graphs"

Information Science and Technology Institute Seminar *Los Alamos National Laboratory* **Nov 26, 2019**
Gave talk "Practical Optimization on Near-term Quantum Computers"

Supercomputing '19 *Denver, CO* **Nov 17-22, 2019**
Gave talk "Hybrid Quantum-Classical Algorithms for Graph Problems: Forging a Path to Near-Term Applications" at the Clemson booth and at the SC Theater

Mathematics and Computer Science Seminar *Argonne National Laboratory* **Nov 15, 2019**
Gave talk "Practical Optimization on Near-term Quantum Computers"

Quantum Computing Seminar *Oak Ridge National Laboratory* **Nov 4, 2019**
Gave talk "Practical Optimization on Near-term Quantum Computers"

International Green and Sustainable Computing Conference (IGSC 2019) *Alexandria, VA* **Oct 22, 2019**
Presented poster "Reinforcement Learning for Quantum Approximate Optimization"

Chicago Quantum Exchange Meeting *University of Chicago* **June 12, 2019**
Presented poster "Practical Quantum Approximate Optimization"

SIAM Conference on Computational Science and Engineering (CSE19) *Spokane, WA* **Feb 25-28, 2019**
Presented poster "Quantum Local Search for Graph Community Detection"

Quantum Computing Tutorial *Argonne National Laboratory* **Dec 10-11, 2018**
Gave talk "QAOA Algorithm Introduction"

Ruslan Shaydulin

shaydul.in

Supercomputing '18 *Dallas, TX* **Nov 11-16, 2018**
Gave talk "Community Detection Across Emerging Quantum Architectures" at Clemson booth

Quantum Computing Workshop *Argonne National Laboratory* **Jul 25-27, 2018**
Presented preliminary results on "Machine Learning on Near-Term Quantum Computers"

32nd Clemson Mini-Conference on Discrete Mathematics and Algorithms *Clemson University* **Nov 4, 2017**
Presented poster "Relaxation-Based Coarsening for Multilevel Hypergraph Partitioning"

58th Scientific Conference *Moscow Institute of Physics and Technology* **Nov 23–28, 2015**
Gave talk "IPC (Inter-Process Communication) in OS X"

Leadership and Service

Requested Reviewer (peer review)

- Quantum journal
- IEEE Transactions on Computers

Supercomputing '19 *Denver, CO* **Nov 17-22, 2019**
Student volunteer, run tutorials, technical program session and Birds-of-Feather

SIAM Conference on Parallel Processing for Scientific Computing (PP20) *Seattle, WA* **Feb 12-15, 2020**
Led and co-organized a minitutorial "Combinatorial Optimization on Quantum Computers"

SIAM Conference on Parallel Processing for Scientific Computing (PP20) *Seattle, WA* **Feb 12-15, 2020**
Co-organized a minisymposium "Recent Advances and Trends in Hybrid Quantum-Classical Algorithms"

Quantum Computing Tutorial *Argonne National Laboratory* **May 14, 2019**
Led and co-organized a hands-on tutorial for Qiskit, a framework for quantum computing

Mathematics Teacher, Summer School *Kostroma, Russia* **Summer 2014**
School administrator, organized extracurricular activities.

Teaching

Network Science CPSC 8480 *Clemson University* **Fall 2018, 2019**
Teaching Assistant responsible for grading and answering students' questions during office hours

Design and Analysis of Algorithms CPSC 8400 *Clemson University* **Spring 2019**
Teaching Assistant responsible for grading and answering students' questions during office hours

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.

Ruslan Shaydulin shaydul.in

Languages and Technologies

C , Python

Prior experience: C++, MATLAB, Objective-C, Swift, Bash, IBM QISKit
Limited prior experience: R, SQL, yacc, bison, AWS, Google Cloud Engine, Rigetti PyQuil
Technologies and tools: Git, Xcode for iOS/OSX UI/Backend, TCP/IP, UNIX/Linux, MPI, OpenMP

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*
- IBM Teach-the-Qiskit-Teacher training program, *selected to represent Argonne National Laboratory*
- 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*