

# William S. Moses

Curriculum Vitae

MIT Computer Science and AI Lab  
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U.S. Citizen

## Education

**Massachusetts Institute of Technology**, Cambridge, MA Aug 2017 – present  
*PhD, Computer Science & Engineering*

**Massachusetts Institute of Technology**, Cambridge, MA 2014 – June 2017 (expected)  
*M.Eng., Electrical Engineering & Computer Science* Major GPA: 5.0/5.0  
Graduate Algorithms (6.854), Graduate Performance Engineering for Multicore Systems (6.886/6.172), Graduate Machine Learning (6.867), Graduate Operating Systems (6.828), Graduate Algorithmic Lower Bounds (6.890)

*B.S., Electrical Engineering & Computer Science* Major GPA: 5.0/5.0  
Advanced Algorithms (6.046), Advanced Performance Engineering for Multicore Systems (6.172), Compilers and Programming Languages (6.035), Circuits and Electronics (6.002), Microelectronics Project Lab (6.115)

*B.S., Physics* Major GPA: 5.0/5.0  
Graduate Quantum Computation (8.370), Graduate General Relativity (8.962), Quantum Mechanics I/II/III (8.04/8.05/8.06), Statistical Mechanics (8.044)

**Thomas Jefferson High School for Science and Technology**, Alexandria, VA 2010 – 2014  
*Concentration in Optics & Modern Physics* GPA: 4.5/4.0  
Artificial Intelligence, Parallel Computing, Quantum Physics/Electrodynamics, Computational Physics

## Selected Publications

**Tapir: Embedding Fork-Join Parallelism in LLVM's Intermediate Representation**  
*PPoPP 2017, Best Paper Award* [papers.wsmoses.com/tapir.pdf](http://papers.wsmoses.com/tapir.pdf)  
Tao B. Schardl, **William S. Moses**, Charles E. Leiserson

**Extreme Multi-Resolution Visualization: A Challenge On Many Levels**  
*SuperComputing 2015 Visualization Showcase* [papers.wsmoses.com/spacex15.pdf](http://papers.wsmoses.com/spacex15.pdf)  
Joanna Balme, Eric Brown-Dymkoski, Victor Guerrero, Stephen Jones, Andre Kessler, Adam Lichtl, Kevin Lung, **William Moses**, Ken Museth, Tom Fogel

**Computational Complexity of Arranging Music**  
*Revised Papers from MOVES 2015, Princeton University Press.* [papers.wsmoses.com/moves15.pdf](http://papers.wsmoses.com/moves15.pdf)  
**William S. Moses**, Erik D. Demaine

**Online Adaptive Frequency Hopping**  
*Thomas Jefferson High School for Science and Technology* [papers.wsmoses.com/oafh.pdf](http://papers.wsmoses.com/oafh.pdf)  
**William Moses**, Andrew Robertson, John Dell

# Professional Experience

**MIT Computer Science and Artificial Intelligence Lab.**, Cambridge, MA Sep 2014 – present

*Researcher, Supercomputing Technologies Group*

- Designed extension to LLVM IR to efficiently represent and optimize parallel code.
- Developed of high-performance, high-accuracy algorithms to determine the connectome of a cubic millimeter of brain.
- Created new serial and parallel-specific optimizations for parallel code.
- Designed syntactic extensions to C language for Cilk reducer framework.

Supervisor: Dr. Charles Leiserson

**Facebook AI Research Laboratory (FAIR)**, New York, NY; Paris, France Jun 2017 – Aug 2017

*Research Intern*

- Performance engineering of deep neural networks using recent advances in compiler technology to allow frameworks such as Pytorch, Caffe2, Tensorflow to generate optimal kernels for their specific task and data set.
- Use of deep neural networks for image/video recognition.

Supervisor: Dr. Nicolas Vasilache

**Space Exploration Technologies (SpaceX)**, Hawthorne, CA Jun 2015 – May 2016

*Software / Propulsion Engineering Intern*

- Developed advanced multiphysics simulation using Wavelet Compression and GPU's/CUDA.
- Redesign of core algorithms (e.g. distributed wavelet transform) for scalability and run on Titan supercomputer

Supervisors: Dr. Adam Lichtl, Stephen Jones

**U.S. Naval Research Laboratory**, Washington, DC Jun 2013 – Aug 2014

*Electrical Engineering Intern*

- Conducted research into data transfer efficiency in the wireless spectrum.
- Created machine-learning algorithm to identify gaps in wireless spectrum and increase bandwidth and resilience of signals
- Designed cognitive radio protocols including improved signal jammers and resilient communication networks.
- Granted secret-level security clearance from U.S. Government

Supervisor: Dr. Andrew Robertson

**Hume Center for National Security and Technology**, Arlington, VA Jun 2012 – Feb 2013

*Web Developer / Security Researcher*

- Created and operated the Hume Center web portal
- Set-up and evaluated various internal systems (LDAP, MySQL, Apache)
- Aided in research to close security holes in the Android operating system.

Supervisor: Dr. Charles Clancy

## Teaching Experience

**Instructor, Introduction to C/C++**, Cambridge, MA

Jan-Feb 2015, Jan-Feb 2016

*MIT Dept. Electrical Engineering and Computer Science*

Devised curriculum and taught Introduction to C/C++ (6.179). Duties included preparing and delivering lectures, developing and grading homework and lab assignments, mentoring students, and evaluating final projects. Along with one other person, each year I taught roughly two hundred undergraduate and graduate students from MIT, Harvard, and Wellesley.

**Curriculum Developer**, Cambridge, MA

Oct 2015 – Dec 2016

*MIT Dept. Electrical Engineering and Computer Science*

Helped develop curriculum and create final capstone lab for MIT's new class in introductory programming, Fundamentals of Programming (6.S04/6.009). The lab required students to implement a primitive physics engine and eventually write code to play Pong and Breakout in a web browser.

## Invited Technical Talks

**Leveraging LLVM to Optimize Parallel Programs**

October 2017

*LLVM Dev Meeting 2017*

**Tapir: Embedding Fork-Join Parallelism into LLVM IR**

December 2016

*MIT EECSCon 2017, 2nd place talk*

**Tapir: Embedding Fork-Join Parallelism into LLVM IR**

December 2016

*IBM PL Day 2016*

<https://goo.gl/sdfjIT>

**Embedding Fork-Join Parallelism into LLVM IR**

July 2016

*Compilers for Parallel Computing 2016*

<https://goo.gl/N9Yw0x>

**Computational Complexity of Arranging Music**

August 2015

*Mathematics of Various Entertaining Subjects (MOVES) 2015*

<https://goo.gl/zckpuM>

**Syntactic Simplifications for Reducer Hyperobjects**

January 2015

*Intel Corporation*

## Honor Societies

**Sigma Pi Sigma**

Jun 2017

Member of the national physics honor society on behalf of my academic accomplishments in physics.

**Eta Kappa Nu Electrical Engineering and Computer Science Society**

Sep 2016

Offered membership into MIT's premier electrical engineering and computer science honor society, offered to top 1/4 of junior class in the department.

## Awards

### **Robert M. Fano UROP Award for SuperUROP Project** June 2017

Award for outstanding capstone undergraduate research project.

### **Larry G. Benedict Leadership Award** May 2017

MIT institute-wide award for my undergraduate leadership efforts, both on behalf of my personal work, as well as for inspiring others to develop as leaders.

### **MakeMIT 2017, Top 10, iRobot Prize** Jan 2017

One of the top 10 teams in a hardware hackathon for DormBot – a robot that you communicate with via Facebook Messenger and it will deliver you a soda of choice. Awarded the iRobot Prize for best robotics project.

### **MIT Idea2 Global Competition, Finalist** Jul 2016

One of 15 finalists in a worldwide biotech idea competition sponsored by MIT linQ, AstraZeneca, Fipse, and PDS.

### **Keel Foundation Undergraduate Research and Innovation Scholar** Jun 2016

Awarded funding from Keel foundation for research on Tapir under MIT's SuperUROP program.

### **Intel Science and Talent Search, Semifinalist** Jan 2014

Research award for top 300 science projects in the country for Online Adaptive Frequency Hopping.

### **Innovative Defensive Technologies Programming Contest, 1st place** Winter 2014

Month-long competition to develop software capable of identifying errors in mission-critical systems.

### **USA Computing Olympiad, Gold Division** Dec 2012 – June 2014

Premier high school programming competition; Gold was the highest division while a competitor.

## Leadership

### ***The Engine Working Group*** Dec 2016 – present

Worked with MIT's Technology Licencing Office, Professors, start ups, and venture capitalists to come up with recommendations for MIT's new startup accelerator.

### ***LLVM Parallelization Working Group*** Apr 2017 – present

Part of committee helping design the future of the LLVM compiler with respect to parallelization.

### ***President, MIT Maseeh Hall*** Dec 2015 – Jan 2017

Lead initiatives for the creation of a maker space, improved sustainability, and better sanitation. Responsible for over \$100K annual budget. Organized events for roughly 500 people including formals and study breaks.

### ***Representative, MIT Undergraduate Association*** Feb 2016 – Jan 2017

One of twenty voting members of MIT's institute-wide student government. Working on issues such as the creation of a new dormitory, institute-wide sustainability programs, student withdrawal policy, among others.

### ***Executive Board, Society of Physics Students*** May 2016 – present

Member of the executive board for the MIT chapter of SPS, the premier physics club for college students. Help run faculty dinners and organizes events such as the MIT undergraduate physics conference.

### ***Executive Board, MIT IEEE/ACM*** May 2015 – May 2016

Member of the executive board for the MIT chapter of IEEE/ACM, the premier electrical engineering and computer science club for college students. Helped lead the first ever IEEE-sponsored conference for undergraduate students.

## Research Projects

- Tapir/LLVM**, Parallel Compiler IR Jan 2015 – present  
Modification to LLVM IR in order to represent task-based parallelism. Compiler is able to perform both serial and parallel-specific optimizations on parallel tasks, resulting in significant performance boosts. Compiler is in use by over a hundred students at MIT taking Performance Engineering (6.172). Code is available at [github.com/wsmoses/Parallel-IR](https://github.com/wsmoses/Parallel-IR).
- Harvard & MIT Computational Connectomics Group**, Research Project May 2016 – present  
Project designed to use machine learning algorithms to determine the connectome or connections between neurons of a cubic millimeter of brain and use this information to design better artificial neural networks. Performance-engineering of neural network to identify neurons and develop the effectiveness of the skeletonization code as well as efficient alignment.
- Efficient Linguistics for Cilk Reducers**, Language Extension Sept 2014 – Jan 2015  
Concise linguistics for Cilk reducer mechanism. Drastically reduced linguistic overhead for such constructs and allowed the compiler to perform optimizations on reducers.
- Computational Complexity of Arranging Music**, Complexity Analysis Sep 2014 – Dec 2014  
Evaluation of the computational complexity of various problems in musical arrangement. Results presented at MOVES 2015 and to appear in follow-up book *Papers from MOVES 2015*.
- Online Adaptive Frequency Hopping**, Wireless Protocol / Algorithm June 2013 – August 2014  
Algorithm to improve network stability and throughput through opportunistic access and environmental modeling. Capable of working with existing hardware while providing 47% increase of data rate and able to withstand high volatility scenarios such as after earthquakes or natural disasters when congestion stops existing protocol. Provisional patent accepted June 2014.

## Applied Projects

- AudioStyle**, Musical Style Transfer Fall 2016  
A system that is able to take audio written in one style (i.e. classical, pop) and building off of deep neural networks trained to detect genres of music, generate a new version of the original song in the style that the user chooses. Built as my final project for 6.867: Graduate Machine Learning, inspired by A Neural Algorithm of Artistic Style.
- Pacifist: A non-intrusive, intelligent baby monitor**, Smart Device June 2016 – present  
Baby monitor that uses machine learning of sensor data gathered from a pacifier to predict macro states of infants such as hunger and fatigue. Project is a finalist for the international MIT linQ Idea2 competition. <http://goo.gl/FUy61H>
- Flamingo**, Multi-resolution physics simulator Jun 2015 – May 2016  
A multi-resolution physics simulator based on wavelets capable of accurately predicting the behavior of combustible fluids. In use by SpaceX for development of rocket engines.
- Cohesion**, Android Application Feb 2015 – Jun 2015  
Social network for MIT students to find nearby partners for working on problem sets.
- Optricks Programming Language**, Programming Language / Compiler Feb 2013 – Jun 2014  
High-level programming language which runs as fast as C while adding high-level features such as garbage collection, function generators, classes, functional programming, lazy evaluation, among others. Compiler written in C++ with LLVM as a target for portability to a variety of clients such as the Google Chrome browser.
- EmotivAid**, Smart Device Jan 2014 – Feb 2014  
Created smart watch geared for autistic users to help them identify emotion. Device listens to surrounding conversation and classifies current speaker's emotion by onscreen picture. <https://goo.gl/89LF77>