



Portland
State
UNIVERSITY

Intelligent Robotics Laboratory

Department of Electrical and Computer Engineering

Research Experience for Teenagers



Professor Marek Perkowski

Director of Intelligent Robotics Laboratory

About Marek Perkowski

Marek Perkowski obtained his M.S. degree in Electronics and Ph.D. Degree in automatic control from Institute of Automatic Control, Department of Electronics, Technical University of Warsaw, Warsaw, Poland. He studied also pure mathematics at University of Warsaw. In years 1981-1983 he was a Visiting Assistant Professor at University of Minnesota in Minneapolis.

Since 1983 Dr. Perkowski works for Department of Electrical and Computer Engineering at Portland State University where he is a full professor and director of Intelligent Robotics Laboratory.

He worked for Cypress Semiconductor (co-author of WARP, the first FPGA compiler of VHDL), Intel Supercomputer, Sharp Microelectronics, GTE and other companies in areas of computer architecture, CAD tools for logic synthesis and image processing.

Dr. Perkowski invented Kronecker Decision Diagrams and lattices and contributed to logic synthesis software that is used in US industry. In 1994 he worked for Machine Learning group in Wright Laboratories of U.S. Air Force applying logic decomposition as a machine learning approach to pattern recognition and continued this work on several grants.

He is an author of more than 300 papers in CAD, logic synthesis, multiple-valued logic, machine learning, robotics and quantum computing and his research is highly cited. He had visiting professor and visiting scientist positions in the Netherlands, France, Japan and Korea. In years 2002-2004 he was professor in KAIST – Korean Advanced Institute of Science and Technology where he participated in research on humanoid robotics and quantum computing.



He chaired the IEEE Technical Committee on Multiple-Valued Logic in years 2003-2005 and was a chair of IEEE Computational Intelligence Society Task Force on Quantum Computing 2006 - 2007. His main current interests are in quantum circuits and algorithms, humanoid bipeds, emotional quantum robots, robotics for teenagers and Grover algorithm. He collaborates with many groups worldwide.

His main research area is quantum computing – how to build a new generations of computers based on principles of quantum mechanics. These computers will be significantly more powerful than all contemporary standard computers.

For many years Dr. Perkowski worked with very talented middle-school and high-school students on technical fairs and scout competitions. Since 2001, every year he has a group of students meeting regularly and participating in competitions.

They work on projects related to quantum computing, intelligent robotics, Machine Learning and image processing. Since 2001, the students that he supervised obtained more than 40 awards in US national and international science fairs and competitions.

If you are interested that your kid will join this program, please contact Dr. Perkowski. The meetings are at least twice a week and everything is free.

Email: mperkows@ee.pdx.edu

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Student Projects

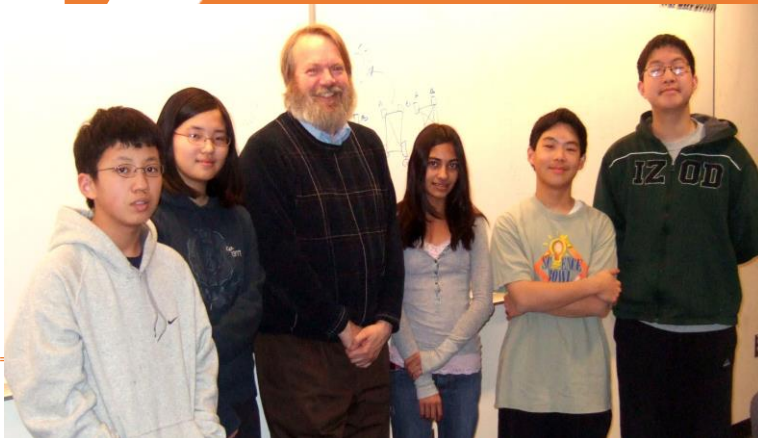
Areas of Projects

The Project provides research experience for talented middle and high school students in the areas of:

- Digital Design and Computer Architecture
- FPGA system prototyping
- Logic Synthesis and Electronic Design Automation
- Quantum Circuits and Quantum Computing
- Image Processing
- Robotics
- Artificial Intelligence and Machine Learning (especially for medical and environmental applications).
- Robots in Arts, particularly the “Quantum Consciousness” robot musical that we are in the process of preparation.
- Quantum Robotics.

- Design a robot toy with sensors and motors.
- Design a robotic musical instrument.
- Image processing for cancer detection (breast, melanoma, etc).
- Synthesis of quantum circuits with certain types of gates.
- Quantum algorithms.
- Fuzzy and Quantum logic for robot control.
- Kalman filter for localization and mapping.
- Design an arm for a humanoid robot.

Typical Projects



The group of students in “Sunday School on Quantum Robotics”, around 2006, included Yale Fan, Arushi Raghuvanshi, Yuchi Wang and Frank Zhao.

Awards and Grants

Recent awards for Dr. Perkowski and his students

- 2007. Marek Perkowski, Columbia-Willamette Chapter of Sigma Xi Outstanding Researcher Award.
- 2008. Marek Perkowski, Civic Engagement Award from PSU for Excellence in Community-based Research.
- 2012. Marek Perkowski, IEEE Computer Society, Multiple-Valued Logic Technical Committee. Long Term Contribution Award, in recognition of his outstanding contributions and service to the Multiple-Valued-Logic community.
- 2012. Intel's Cornell Cup Design Competition, First Place for IVS team from Portland State University: Hung Nguyen, Hoa Nguyen, Anh Ngo and Thang Vo. "Computer-Aided Prescription Drug Identification Device". Mark Faust and Marek Perkowski advisors.
- 2014. Intel's Cornell Cup Design Competition, Second Place for SAFE team from Portland State University: Nikolas Davis, Matthew Stehr, Tuan Hoang, Cuc Duong "Situational Awareness Fault-Finder Extension". An intelligent device to help bicyclists and motorcyclists avoid hazards on the road by detecting oncoming threats such as distracted or erratic drivers. Mark Faust and Marek Perkowski advisors.

Some grants related to this program

- 1988. National Institute of Health. "Image Processing for Cervical Mucus Ferning Patterns".
- 1992. PSU. Wheelchair robot for Handicapped with computer vision.
- 1994. National Science Foundation. "Use of FPGA Hardware Emulator and VHDL to Teach Digital Design".
- 1999. Intel Faculty Fellow. "Machine Learning for Robotics".
- 2002. Portland School District. "Curriculum for High School Robotics".
- 2003. Hillsboro School District. Robotics for autistic children.
- 2005. PSU Faculty Research Award. "Robot Theatre".
- 2009. Mentor Graphics Corp. "Robotics for teenagers".
- 2010. PSU Development Grant for quantum algebras.
- 2012. National Natural Science Foundation of China, Classification on Quantum Logic Circuits and Synthesis on Multi-valued Quantum Logic Circuits.
- 2012. PSU MCECS Dean's Award to design a mobile robot guide for MCECS.
- 2015. Private donation to build Portland Cyber Theatre with humanoid robots

Articles about this Project

Dr. Perkowski's young students sweep a multitude of awards, dominate science fairs

By Zhivko Penev

March 21, 2011

Four of Dr. Marek Perkowski's high school students, part of his research group and Sunday seminars, won recently multiple awards in science fairs, created new quantum circuit synthesis algorithms to surpass the best previously existing ones, built an intelligent robot controlled by a simulated quantum circuit, and some went as far as meeting with President Obama and being mentioned by name in his Oregon Intel's speech.

Two of Oregon's five high school semifinalists in the 2011 Intel Science Talent Search, a program of Society for Science & the Public, come from this team. The students are among 1,744 entrants from 30 states and the District of Columbia who will receive \$1,000 and move closer to the finals. Yushi Wang, [Sunset High School](#) in Beaverton, was selected for his computer research into "The Applications of Quantum Ternary Algorithms and Oracles." Arushi Raghuvanshi, [Jesuit High School](#) in Beaverton, was chosen for her robot project titled, "Modeling Fuzzy Logic with Quantum Circuits for Humanoid Robots." Yushi and Edison shared the first place award in the Computer Science category at 2011 Beaverton-Hillsboro Science Expo, while Sidharth took the second place in the Physics and Astronomy one. Yushi advanced also to finals of Intel Science Talent Search. Edison won the Intel's Excellence in Computer Science and Best Freshman Project awards, while Sidharth swept three: the Mu Alpha Theta Award, the award for Outstanding Project by an 11th Grade Student from the Yale University Science and Engineering Association and the Army Award For Scientific And Engineering Excellence.

Arushi Raghuvanshi, Yushi Wang, Sidharth Dhawan and Edison Tsai are outstanding students in the words of Dr. Perkowski, who even describes Tsai as "a genius" and "the most independent and creatively thinking student I have ever met in my whole academic career of 43 years". They are young and their research and discoveries are promising.

Arushi Raghuvanshi

How did you meet Arushi? – I ask Dr. Perkowski – "I first met Arushi in 2006 when she was in 7th grade. She was working on a science project in which she had built different robotic drives from Lego Robotics kit and was comparing the performance of different designs. She looked for a mentor and I have been Arushi's mentor throughout her research effort" - Dr. Perkowski said. Dr. Perkowski teaches an informal class for teenage students on Sundays at PSU, the "Sunday School on Quantum Robotics". Arushi regularly attended it and learnt about advanced Robotics, Quantum theory and Image Processing concepts. Arushi was also a regular student in some of Dr. Perkowski's graduate classes and seminars. She built upon these concepts in her research. For instance, when she learnt about Braitenberg Vehicles she wondered if she could combine some of Braitenberg's ideas into her robot vehicles. Arushi put some serious thinking, research and ideas into it and created the second family of her robots – the Boolean logic programmable Braitenberg vehicles. At the same time, she got interested in learning about Quantum Computing, which is Dr. Perkowski's main field of expertise. From the weekend meeting sessions and other background material provided, Arushi was able to pick up a lot of concepts and incorporate them into a project creating innovative Quantum Braitenberg Vehicles for her 8th

Articles about this Project – Cont'd

grade project. These robots simulated a quantum computer as a controller of their behaviors. Over the past 4 years she has been evolving her research, and has come up with new ideas getting inspired by new things and concepts she learns. Dr. Perkowski has taught her the concepts of quantum computing, quantum gates, boolean, fuzzy, reversible and complex logic and modeling using matrices. Arushi took the discussed concepts and applied to her various projects. For example, she built the Schrodinger Cat mobile animal-like robot for robot theatre, and she was having problems with programming the lip motions of the cat. She first programmed each motion manually, then decided that she will look for a better alternative and applied genetic algorithm to synchronize sound with lip motion and evolved the behavior of the cat. She then applied quantum logic to further enhance the robot behavior. Arushi lists a long lists of achievements and here are just few recent: she presented the paper "Image Processing and Machine Learning for the Diagnosis of Melanoma Cancer" at BIODEVICES 2011 - the International Conference on Biomedical Electronics and Devices, this was her fourth presentation at international conference. She was Oregon's Delegate for American Jr. Academy of Science and Jr. Science and Humanities Symposia, she got Davidson Fellows Honorable Mention in Technology, National Center for Women in Information Technology (NCWIT) Award for Aspirations in Computing, National Honor Society & French National Honor Society, Award for Exemplary Civic Engagement from Portland State University and was nominated as a Presidential Scholar.

Yushi Wang

Yushi Wang has been working with Dr. Perkowski for the last four years. "Because of his interest in pure mathematics and theoretical problems of quantum computing, I decided that researching quantum logic circuits was a good choice for him, and I asked him to research quantum algorithms realized with multi-valued quantum circuits,"

Dr. Perkowski said.

After further discussions and meetings with his advisor, Yushi selected to create and simulate a multi-valued oracle, which could be applied to some of the group's previous projects on Grover's Algorithm; a general method of quadratically speeding-up combinatorial algorithms on quantum computers.

"Yushi's projects, including this one, are all original, but of course they come from the general interest and research areas of my lab," Perkowski said. "In last ten years at PSU, several PhD and Masters students worked on binary and multi-valued quantum circuits and quantum algorithms."

Yale Fan, another student of Perkowski (now in Harvard University, recipient of numerous highly prestigious national and international awards), had previously done a project which generalized Grover's Algorithm to multiple radices, "but he did not concern himself with detailed logic circuit design of the oracle section."

"In Yushi's project, the work deals with the oracle inside Grover's Algorithm, which he generalized to ternary. However, Yushi's work also uses a different type of generalization in which he produces binary results from non-binary systems, instead of multi-valued results, as Yale has done," Dr. Perkowski added.

Yushi's topic took also some inspiration from the work of Anu Rajendran, another high school student in Dr. Perkowski's Sunday seminar. (Anu was awarded last year for her work on quantum circuits in ISEF semifinals, and also by Air Force and second award in Physics.) While Anu used gates invented by a team of researchers from Australia, Yushi's work invented new binary "multi-input Toffoli" gates and is also of a much broader scope, as he evaluates ternary circuits for Grover's oracle. Furthermore, Yushi's own discovery of the generalized Toffoli gate in his project has never been talked about before and it is new, creative, and probably important for the field.

Articles about this Project – Cont'd

According to Dr. Perkowski, there are several research directions that Yushi's project could take, including realization of quantum primitives from EM pulses in various quantum technologies, counting costs in various technologies, considering oracles for some special types of graph coloring problems, designing various oracle types, and so on.

Yushi's work is also somewhat related to Sidharth's work on comparing encoding for quantum oracles, but there are no direct links or shared ideas.

Sidharth Dhawan

Sidharth's work "represents an extraordinary achievement by a high school student," said his advisor and mentor, Dr. Perkowski. He added, "It's advanced, original and of very high quality. His research results are verifiable and his research is very relevant to the advancement of the field of quantum circuit design and quantum computing."

All of Sidharth's research work, which focuses on comparison of data encoding techniques for Grover algorithm, inventing of a new ternary quantum circuit synthesis algorithm, programming the algorithm, analyzing the results of this algorithm and benchmarking with existing algorithms, was done independently by Sidharth. With Dr. Perkowski's encouragement and help choosing the research topic, Sidharth worked on the practical design of Grover oracles and compared the two leading data encoding method for the oracle design. He also calculated and compared the cost of resulting quantum circuits designed to solve various real world constraint satisfaction problems.

Perkowski has worked with Sidharth, a Westview High School student, since 2007, as his advisor for three research projects for various science fairs. For the past three years, Sidharth has also been a regular student in Perkowski's "Quantum Robotics for Teenagers" Sunday school's class and

and weekly seminar series on Quantum computing for graduate and undergraduate PSU students.

"I have been very impressed by Sidharth during the last three years, due to his demonstrated ability to quickly and deeply understand advanced concepts of college level mathematics, quantum computers and digital circuit design. He shows great dedication and enthusiasm in learning advanced scientific concepts, applying them to his research projects which have won several awards in various national, regional and state science fair competitions," Perkowski said.

It was Dr. Perkowski and Sidharth's joint idea to develop a two year long science research to learn Grover algorithm and data encoding method for Quantum Oracle and Ternary circuit design on a deeper level. "There has been a lot of work in last ten years on binary quantum circuit design but not much research has been done on the ternary quantum circuit designs," Sidharth's advisor said.

"So I challenged [Sidharth] to learn more in this field and after several months of research on the existing material, [he] decided that he was interested in understanding the efficiency of existing algorithms for quantum circuit designs and then work on inventing new more efficient algorithm."

Sidharth completed the first part of his research last year, which resulted in him and his advisor co-authoring a research paper, "Comparison of influence of two data-encoding methods for Grover Algorithm on quantum costs". This research paper was accepted for publication in IEEE International Symposium on Multiple-Valued Logic (ISMVL 2011).

"Sidharth's projects have steadily increased in complexity during last three years, which shows his aptitude and deep interest in scientific research. I have found the quality of his research and projects to be very much on par with several graduate level students at

Articles about this Project – Cont'd

Portland State University, even if the span of his projects has been shorter," Dr. Perkowski said.

"Encouraged by successes of our students in competitions, many high school teenagers have come to me over the several years, but very few stay with the subject of quantum computing because it requires hard work to understand these advanced concepts. Sidharth has been one of my top students, and has stayed with this topic for the last three plus years and has continued to independently gain depth in his knowledge of quantum computing technology."

According to Dr. Perkowski, the strongest aspect of Sidharth's research is his originality, relevance and the amount of work he has done to complete his projects. "I have not seen any research paper published in this area which does a good comparison of data encoding methods."

In the second phase of his research, Sidharth has invented a new algorithm to synthesize quantum ternary circuits. Sidharth's algorithm is different than the previously existing one, because his algorithm is not restricted to using disjoint groups in a ternary map. The algorithm uses also advanced Artificial Intelligence methods for efficient search of solution space. This makes Sidharth's algorithm much more efficient for the design of quantum ternary circuits. Sidharth also proved this by developing a CAD tool for his algorithm and benchmarking it with existing results.

"Sidharth's work is very relevant in the emerging field of quantum computing, as it deals with the development of quantum logic synthesis and more efficient quantum ternary circuits," said Dr. Perkowski.

Quantum computers are unique, among other aspects, in their ability to switch between binary and ternary logic in the same (hybrid) circuit. Quantum computers are already projected to perform certain computing tasks exponentially faster than the traditional

computers.

"This ability to create hybrid circuits (mixed binary and ternary) makes them even more efficient," Dr. Perkowski explained.

He added, "Much work still needs to be done in pursuit of the construction of quantum computers, and it is the work of many young budding scientists like Sidharth that will make quantum computer a reality and thus fundamentally change the way we build computers and process information."

"Quantum computers will enable us to perform certain information processing tasks which are impossible with our current super computers. We will be able to perform much more detailed simulations of biological molecules to help advance the health sciences, research into novel materials, and other advance research to further mankind's progress in chemistry, physics, and engineering. We will be able to find exact minimum solutions to combinatorial problems that are out of reach of current computing."

Edison Tsai

Edison, a student of Portland's School of Science and Technology and one of the most recent additions to Dr. Perkowski research group, has been attending the "Sunday School on Quantum Robotics" and other meetings related to quantum circuits, computer architecture and robotics since May 2010.

Edison also took the Dr. Perkowski's ECE 171, a class that teaches basic logic design, with excellent results. "[He] was able to solve all quizzes and special difficult problems that I assigned to students... He proved to be better than all my previous students," Dr. Perkowski praised Tsai. "I was so impressed with his thinking ability and hard work that I decided to treat him on exactly the same terms as my graduate students."

For the last 12 years, Dr. Perkowski's research team worked on creating synthesis algorithms for quantum circuits. Their results were much

Articles about this Project – Cont'd

published in computer science and physics journals and much referenced.

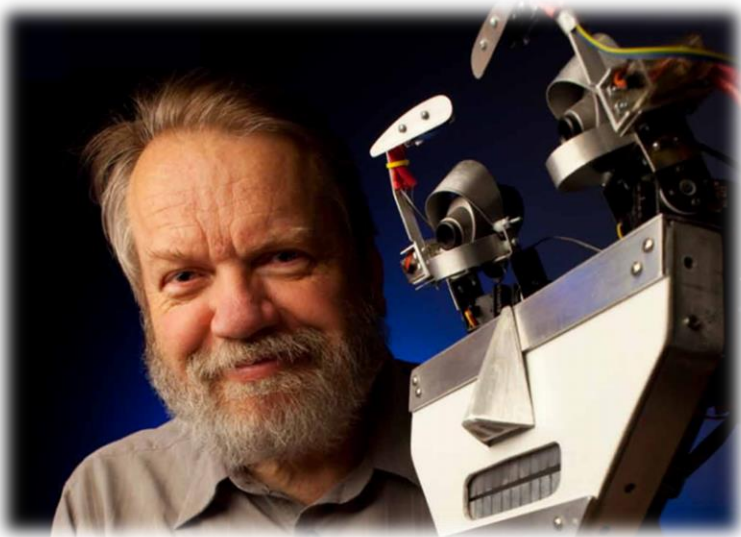
In fact, in 2010, Perkowski's team created the best algorithm in the world for quantum circuit synthesis, and their software beat all previous software tools for this task from several authors world-wide.

"Edison was participating in several lectures in which he learned about all kinds of quantum gates and their properties. I suggested a new topic to him for which I had generated initial results by myself but I had no time to continue working on it. This topic was a direct extension of our previous algorithm 'MP' that was able to synthesize the largest circuits in the world already," Perkowski said.

He continued, "Edison took the project over and has found new properties and algorithms that were not known to me. This is definitely the top level world achievement, all his work is new, and he learned it just by talking to me and observing my lectures and reading some notes and papers. He did most of the work by himself and he programmed everything very quickly, which is unusual even for graduate students."

According to Perkowski, such achievement is comparable to those of the top of his PhD students. "Edison created a theory and a CAD software tool that is now the best in the world, as he beats our tool 'MP'," he added.

"[Edison]'s work will be soon published in one of top physics journals," Perkowski said confidently of his 12-years old student.



Some Press Coverage

Two Catlin Gabel students bring home top Intel international science awards



By [Wendy Owen, The Oregonian](#)

May 17, 2010

Two Catlin Gabel students were awarded \$50,000 each for their computer science projects today at the Intel International Science and Engineering Fair in San Jose.

Yale Fan, 18, of Beaverton and Kevin Ellis, 18, of Vancouver, were the second-place finishers out of 1,611 competitors from 59 countries, regions and territories.



[View full size](#) provided by Intel. Yale Fan, left, and Kevin Ellis celebrate their Intel International science fair win this afternoon.

It is the first time in the Intel International competition's 14-year history that two of the top three winners have attended the same school, said Bill MacKenzie Intel Communications Manager.

Caught by cell phone an hour after the competition, both teenagers still sounded a bit shocked.

"It was loud and we were surrounded by

the press and we were mobbed on stage and it was kind of hectic," Fan said as he rode a train to his hotel.

Both boys had already won ribbons in other categories for their projects — physics and astronomy for Fan, computer science for Ellis — and were waiting in the audience at the San Jose Convention Center for the names of the top three overall winners.

Some Press Coverage – Cont'd

Amy Chyao of Richardson, Texas, came first. She received a \$75,000 prize in honor of Gordon E. Moore, Intel co-founder and retired chairman and CEO. Fan and Ellis were next.

"It didn't quite seem fathomable," Fan said. "The thing is it still is kind of like winning the lottery."

Confetti rained down as the boys held plaques and smiled for all the news cameras.

Both teenagers plan to use the money for college. Ellis will attend the Massachusetts Institute of Technology and Fan will head to Harvard.

Ellis ran off a list of majors, "Computer science, but I'm also interested in math and physics and robotics," he said. "I want to try all different things."

Fan plans to major in physics and math but also continue studying computers. Both teens created projects around computers. Ellis developed a method to automatically speed up computer programs by analyzing the programs while they are running so that work could be divided across multiple microprocessors.

Fan's project demonstrated the advantages of quantum computing in performing difficult computations. The Oregonian featured Fan and Ellis in a story in January after they were named national finalists.

Back in Oregon, Catlin Gabel, a private school in Beaverton, was abuzz with the news.

"We are so proud," said Karen Katz, communications director. "They're amazing boys and they're very humble and really well liked by their peers. They have described their research at assemblies and they get standing ovations."

Katz said she expects to see them one day win Nobel Prizes.

Both students are returning home tonight.

The Intel Foundation also awarded \$8,000 each to 19 Best of Category winners and provided \$1,000 grants to the winners' schools and the affiliated fairs they represent.

In addition to Fan and Ellis, Oregon had three category winners:

Avilash Cramer, 17, West Linn High School, won the environmental management category with his project "Design, Fabrication, and Evaluation of a Deployable In Situ Nitrate Sensor for Real-Time Analysis of Sediments."

Akash Krishnan, 15, and Matthew Fernandez, 16, both of Oregon Episcopal School, won the physical sciences category with their project, "The Classification and Recognition of Emotions in Pre-recorded German Speech: Using MATLAB 7.8 Student Edition." The Portland teenagers also won top team project for the European Union Contest for Young Scientists.

The Intel International Science and Engineering Fair finalists were selected from 539 affiliated fairs around the world, according to Intel. Their projects were then evaluated on site by more than 1,000 judges from nearly every scientific discipline, each with a Ph.D. or the equivalent of six years of related professional experience in one of the scientific disciplines.

--Wendy Owen

Some Press Coverage – Cont'd

Anika Raghuvanshi at ICCAD 2014

The screenshot shows the DAC 2015 website with a navigation bar at the top. The main content area features an article titled "Week 23: ICCAD, the Kaufman Award and the DAC exhibitor meeting" by Anne Cirkel. The article text discusses the author's experience at the International Conference on Computer-Aided Design (ICCAD) and mentions Anika Raghuvanshi, a high school student in Portland, Oregon, who presented her work on "Logic Synthesis and a Generalized Notation for Memristor-Realized Material Implication Gates". To the right of the article is a LinkedIn profile for Anika Raghuvanshi, showing her as a student at Jesuit High School in West Linn, Oregon, with a background in Intel Corporation and Summer Interns Intel Research Labs.

Elisabeth Zhao at Google 2014



Zhao, 17, a Jesuit High School student who lives in West Linn, will present her work on [A Novel Implementation of Image Processing and Machine Learning for Early Diagnosis of Melanoma](#).



100 shares

Her research was inspired by the death a friend's mother from melanoma cancer several years ago. "The most common cancer is skin cancer, and the most deadly skin cancer is melanoma," she wrote in her Google profile. "I wanted to do something to help the countless people affected by this disease, and that is what drove me to do my project."



Elisabeth Zhao, Jesuit High School

Courtesy of Google

Zhao wrote that her education at Jesuit has taught her, "to do whatever I can to make our world safer, stronger, and healthier. Science, I believe, is real-world magic. The innovations and technology that have come out of this field continue to amaze me and inspire me each and every day."

The 15 finalists were selected from 90 regional finalists by a panel of international judges. Thousands of 13-18 year olds from more than 120 countries submitted their projects to the third annual Google Science Fair this year.

-- Wendy Owen

Some Press Coverage – Cont'd

School News

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Two JHS Students Win Top Category Awards at ISEF

Posted 05/29/2014 03:07PM

The Intel International Science and Engineering Fair (Intel ISEF), the world's largest international pre-college science competition, provides an annual forum for approximately 1,700 high school students from more than 70 countries, regions, and territories to showcase their independent research as they compete for more than \$5 million annually. The Intel ISEF is the premier global science competition for students in grades 9–12. This year the week-long event was held in Los Angeles, California. On May 16, 2014, Society for Science & the Public, in partnership with the Intel Foundation, announced Grand Awards of the Intel ISEF 2014.

Jesuit High School students Elizabeth Zao and Anika Raghuvanshi, who had qualified for Team Oregon through IWSE, won top category awards at ISEF.

Engineering: Electrical and Mechanical: Second Place Award

EE074 Generalized Decision Functions for Synthesis of Multi-level Logic Circuits Realized by Memristor Imply Gates

Anika Raghuvanshi, 17, Jesuit High School, Portland, Oregon

Computer Science: Third Place Award

CS017 A Novel Implementation of Image Processing and Machine Learning for the Early Diagnosis of Melanoma

Elizabeth Zhao, 18, Jesuit High School, Portland, Oregon

[Click here](#) to view the complete list of award winners.



Two of our students awarded in Intel's ISEF Finals in 2014



Leo Deng, in second row from bottom was a national finalist and met with President Obama in 2015.

Some Previous Alumni and their Achievements

In 2001 Uland Wang was the first student in this program.

- Uland created a complete design of a large humanoid robot hand and animatronic head with integrated computer vision to greet the visitors and communicate with them.
- Several awards in science fairs.
- Published papers M. Perkowski.
- He graduated in April 2012 with a PhD in Robotics from CMU. His dissertation explored fusion of optical sensors (cameras, LIDAR, structured light, etc) for planetary 3D perception.
- Senior Scientist at SGT Inc. and the NASA Ames Intelligent Robotics Group in Mountain View.

In 2001 Miranda Fix built our first two talking heads.

- Awards in science fairs.

2001-2002 Karl Kuchs built a humanoid robot arm and a robot colony simulating a form of artificial life.

- Awards in science fairs.

Since 2005 the project was extended from robot-building to logic synthesis and quantum computing.

In 2006 Yale Fan from Catlin Gabel School developed a multiple-valued variant of the Deutsch-Jozsa quantum algorithm. He created also a quantum algorithm to solve many-body problem extended Grover algorithm to multiple-valued logic.

- Worked in our team since 2005
- Portland Semifinalist Siemens competition 2009-2010
- **ISEF Finalist.** 2010.
- Recipient of highly valued Davidson Scholarship and more than 20 major awards. Top in USA.
- Many other awards, too many to even list.
- Yale graduated from Harvard University
- Now works at PhD in Physics Department at Princeton University.

Some Previous Alumni and their Achievements

Mikhail Pivtoraiko contributed very much to the projects and the Intelligent Robotics Lab. 2001-2003.

- Started as High School student.
 - *Reversible circuit design*
 - Implemented a genetic algorithm for automatic design of reversible logic circuits. Co-developed new representations for efficient circuit encoding.
 - Conducted extensive experimentation and assessed the performance of the approach.
 - *Computer vision on an ultra-low power computer*
 - Ported, optimized and evaluated components of computer vision libraries (OpenCV, VxL, CMVision) on a single-board computer, “Stayton”, based on a mobile XScale CPU.
 - Constructed an autonomous mobile robot featuring vision-based navigation.
 - *Hexapod robot soccer Led a group of seven to develop a small league soccer system.*
 - Designed a set of six-legged walking robots.
 - Setup the overhead camera vision system: adapted Player/Stage Mezzanine software, optimized the Linux device driver for fast picture acquisition.
 - *Multi-arm coordination*
 - Modified the existing hardware (6 robotic arms) to include sensors for joint angles for simultaneous control.
 - Designed a complete hardware data acquisition/processing digital system with power output (motor drives) and bi-directional interface with computer (parallel port, EPP mode); authored the schematic and VHDL code for interface controller (PAL chip).
 - Created software to interface with the hardware design: a 3-D graphical front-end utilizing C and Win32 API.
 - He is now a Post Doctoral researcher at the University of Pennsylvania.



Mikhail Pivtoraiko on right

Some Previous Alumni and their Achievements

Arushi Raghuvanshi, Jesuit High School.

- Worked in our team since 2006.
- ISEF Alternate, national.
- The Intel Science Talent Search 2010 semifinalist.
- Created a model of Fuzzy Logic with Quantum Circuits for Humanoid Robots. Built several small robots with simulated quantum control.
- Worked on several robotics and quantum robotics projects,
- Presented our work at several international conferences
- Stanford University, since 2011.



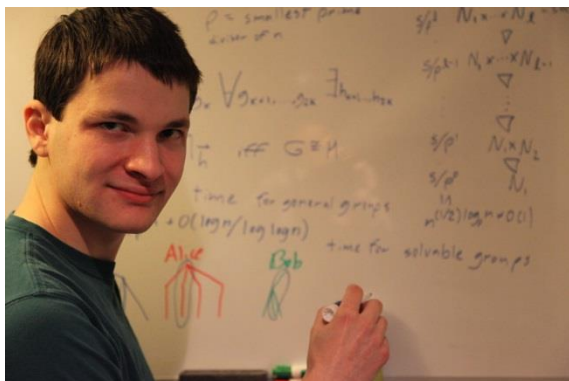
Sidharth Dhawan with an early version of Einstein robot

Sidharth Dhawan, Westview High School.

- Invented a new encoding method for Grover Oracles in Quantum Computing.
- Worked in our team since 2006.
- ISEF Finalist. 2nd award in Physics and Astronomy, 2011.
- Outstanding Project by an 11th Grade Student sponsored by Yale University Science and Engineering Association, 2011.
- Army Awards for Scientific and Engineering Excellence sponsored by Army Research Office, U.S. Army, 2011.
- He is now a PhD student at Princeton.
- Sridharth Dhawan built version one of our Albert Einstein robot.
- Author of several publications in area of quantum algorithms

David Rosenbaum started in 2001 as a teenager interested in chess-playing robot and ended as an author of important works in quantum computing.

- Invented a new algorithm to initialize quantum states for Machine Learning algorithms.
- He wrote several papers on Quantum Circuits with M. Perkowski and got award for his work from MVL Committee of IEEE.
- Two Bachelor Degrees from PSU.
- He worked as a Visiting Scientist at MIT.
- Now he works as a Postdoc in Japan.



David Rosenbaum

Some Previous Alumni and their Achievements

Yushi Wang, Sunset High School,

- Worked in our team since 2006,
- Invented a new way of building quantum gates and talked about this with President Barack Obama when the last one was visiting Intel.
- This gate is now known in the literature on quantum circuits.
- ISEF Finalist
- 1st award in Computer Science, ISEF, 2011.
- Advanced to finals of Intel Science Talent Search.
- Semifinalist for 2010. Applications of Quantum Ternary Algorithms and Oracles
- In MIT since 2011.

Frank Zhao, Westview High School

- Worked in our team since 2006,
- Worked on many projects, most significant achievement was quantum algorithm for creating error correcting code.
- 2010 ISEF Alternate,
- 2009-10 Siemens Competition , Math: Science : Technology, regional finalist.
- Created software related to Melanoma cancer in eyes.
- Studies at MIT.

William Han, Westview High School

- Worked with me since 2009.
- Created software related to Melanoma cancer in eyes.
- 2010 ISEF Alternate
- 2009-10 Siemens Competition , Math: Science : Technology, regional finalist,
- Studies at MIT.



Some Previous Alumni and their Achievements

Edison Tsai

- Works in our team since 2010.
- 1st award in Computer Science, 2011.
- Intel Excellence in Computer Science sponsored by Intel Corporation, 2011
- Best Freshman Project, 2011.
- PSU undergraduate degree with program study in mathematics, physics and electrical engineering
- At age 14 Edison Tsai started to work on his PhD in Quantum Computing at ECE of PSU.
- The youngest PSU Phd Student with program in mathematics, physics and electrical engineering.
- Author of several papers.
- His forthcoming PhD dissertation will cover a complete methodology to design quantum circuits and algorithms at pulse, logic, and system level, including top algorithm to symmetric functions and realize Quantum Machine Learning and search using Grover Algorithm.

Alan Cheng,

- Worked on our team 2010 – 2015.
- Advanced to NSWE,
- ISEF finalist 2015
- Built a robot with evolutionary control and vision, on the level of graduate work.
- Author of several conference papers.
- Invented new hardware architecture to solve permutation and subset combinational problems
- Created a hardware/software system for image capture that won top award at ISEF.
- Admitted to MIT, 2015

Terrance Sun and Lawrence Sun, working with a lawyer and me, created a system in nuSMV language that verified the Oregon Laws about using force by police and found some contradictions in them.

Lawrence Sun created an algorithm to generate quantum error correcting codes using evolutionary computation.

Tahsin Saffat created a method to optimize binary quantum multiplexers and next extended it to multiple-valued quantum multiplexers.

Ankit Gupta and Kevin Wang found the method to encode quantum automata from flowcharts, and next extended it to a class of “n out of m” codes, proving that adding only few ancilla qubits decreases much the quantum cost of the automaton.

Lizzy Zhao created an algorithm to find melanoma from photographs of moles.

Anika Raghuvanshi created efficient algorithm to minimize combinational networks built with stateful iMPLY memristors and compared it with other methods.

Seminars, lectures, presentations and individual meetings

- Middle school and High School students present their work in our team seminars.
- Sometimes these are special meetings only for the teenagers, but in other cases they present their work to PSU graduate students and are evaluated by them.
- Some of their work high school students presented at international conferences.



- Vikul published his results in a journal.
- He created efficient algorithm to minimize stateful memristor circuits with IMLY gates.
- John helped some high school students in areas of his expertise, Artificial Intelligence and programming, logic design.

Vikul Gupta and John Parker at the seminar.

Nashita Rahman, 12 years old, presents her work on Machine Learning to graduate students.



High School Student Publications

- **Alan Cheng, Edison Tsai, Robert Fiszer, Anu Rajendar, Yushi Wang, Marek Perkowski**, Comparison of Various Quantum Costs for Several Multi-qubit Toffoli Gates with Ancilla Qubits and Ancilla Values. *In final preparation for new submission.*
- **Ankit Gupta, Kevin Wang, Maher Hawash and Marek Perkowski**, An improved method to encode quantum automata, *in preparation.*
- **Robin Tan and Marek Perkowski**, Wavelet-Coupled Machine Learning Methods for Drought Forecast Utilizing Hybrid Meteorological and Remotely-Sensed Data, *International Conference on Data Mining, DMIN'15.*
- **Leo Deng, Clemen Deng, Marek Perkowski, John Saltenberger**, A Novel Forest Fire Prediction Tool Utilizing Historical Weather Data and Machine Learning Methods, 2015, *submitted.*
- **Vikul Gupta**, A Minimization Approach for Two Level Logic Synthesis Using Constrained Depth-First Search, *International Journal of Computer Engineering and Technology (IJ CET)*. Vol. 5, Issue 11, November 2014, pp. 23-31.
- **Clemen Deng and Marek Perkowski**, “A Novel Weighted Hierarchical Adaptive Voting Ensemble Machine Learning Method for Breast Cancer Detection”, *Proc. ISMVL '2015.*
- **Clemen Deng and Marek Perkowski**, “A General Data Mining Methodology based on a Novel Weighted Hierarchical Adaptive Voting Ensemble Machine Learning Method”, on January 14, 2016.
- **Anika Raghuvanshi and Marek Perkowski**, Synthesis of Incompletely Specified Logic Functions with Memristor-Realized Material Implication gates and a New Notation to Describe Circuits from such Gates, Poster, *44th IEEE International Symposium on Multiple-Valued Logic*, Bremen, Germany; May 19 - 21, 2014. Poster.
- **Anika Raghuvanshi, and Marek A. Perkowski**, Logic synthesis and a generalized notation for memristor-realized material implication gates, *Proceedings of the 2014 IEEE/ACM International Conference on Computer-Aided Design, ICCAD*, 2014: pp. 470-477.

Names of students are marked in red.

High School Student Publications

- **Anika Raghuvanshi and Marek Perkowski**, Synthesis of incompletely specified logic functions with memristor-realized material implication gates, *Proc. Reed-Muller Workshop*, pp. 91-99.
- **Sidharth Dhawan, and Marek Perkowski**, ESOP-Inspired Synthesis Method for Ternary Permutative Quantum Circuits, *Proc. ISMVL*, 2012, pp. 57-62.
- **Terrance Sun, Lawrence Sun, and Marek Perkowski**, Using Formal Verification and Robotic Evolution Techniques to Find Contradictions in Laws Concerning Police Rules of Engagement, *Proc. ISMVL*, 2012. pp. 45-49.
- **Edison Tsai and Marek Perkowski**, Synthesis of Permutative Quantum Circuits with Toffoli and TISC Gates, *Proc. ISMVL*, 2012, pp. 50-56.
- **Sidharth Dhawan, Marek Perkowski**, Comparison of Influence of Two Data-Encoding Methods for Grover Algorithm on Quantum Costs, *Proc. ISMVL*, 2011, pp. 176-181
- **Yushi Wang and Marek Perkowski**, Improved Complexity of Quantum Oracles for Ternary Grover Algorithm for Graph Coloring, *Proc. ISMVL*, 2011, pp. 294 – 301.
- **David Rosenbaum, and Marek Perkowski**, Mapping Binary Functions to a Practical Adiabatic Quantum Computer, *Proc. 40th IEEE ISMVL*, pp. 270 - 275. 2011.
- **Arushi Raghuvanshi and Marek Perkowski**, Fuzzy Quantum Circuits to Model Emotional Behaviors of Humanoid Robots, *Proc. Evolutionary Computation (CEC), IEEE Congress*, 2010, pp. 1 - 8.
- **Marek Perkowski, Sazzad Hossain, and Franklin Zhao**, Minimal Graph Coloring using the Quantum Algorithm of Grover and the Importance of the Quantum Composition/Layout Problem in the Complete Design of Quantum Oracles, *Proc. 9th International Workshop on Boolean Problems*, Sept. 16-17, Freiberg, pp. 65-74.
- **David J. Rosenbaum, Marek A. Perkowski**, Superposed Quantum State Initialization Using Disjoint Prime Implicants (SQUID), *ISMVL 2008*. Pp. 144-149.
- **Arushi Raghuvanshi, Yale Fan, Michal Woyke, Marek Perkowski**, Quantum Robots for Teenagers, *Proceedings of ISMVL 2007*. May 14-15, 2007, Oslo, Norway.

High School Student Publications

- **Michele Folgheraiter, Giuseppina Gini, Marek Perkowski, and Mikhail Pivtoraiko**, Blackfingers: a Sophisticated Hand Prosthesis, *Proceedings of ICORR 2003 (the 8th International Conference on Rehabilitation Robotics)*, April 22-25, 2003, KAIST, Korea, pp. 238 -- 241.
- **Marek Perkowski, Tsutomu Sasao, Atsumu Iseño, Uland Wong, Mikhail Pivtoraiko, Michele Folgheraiter, Martin Lukac, David Ng, Miranda Fix and Karl Kuchs**, Use of Machine Learning based on Constructive Induction in Dialogs with Robotic Heads, *Proceedings of ICORR 2003 (the 8th International Conference on Rehabilitation Robotics)*, April 22-25, 2003, KAIST, Korea. pp. 326 – 329
- **Michele Folgheraiter, Giuseppina Gini, Marek Perkowski, and Mikhail Pivtoraiko**, Adaptive Reflex Control for an Artificial Hand, *Proceedings of 7th IFAC Symposium on Robot Control, SYROCO 2003*, Holliday Inn, Wroclaw, Poland, 1-3 September, 2003.
- **Martin Lukac, Mikhail Pivtoraiko, Alan Mishchenko and Marek Perkowski**, Automated Synthesis of Generalized Reversible Cascades using Genetic Algorithms, *Proc. 5th International Workshop on Boolean Problems*, Freiberg University of Mining and Technology, Freiberg, Germany, September 19-20, 2002, pp. 33-45.
- **Uland Wong and Marek Perkowski**, A New Approach to Robot's Imitation of Behaviors by Decomposition of Mutiple-Valued Relations, *Proc. 5th International Workshop on Boolean Problems*, Freiberg University of Mining and Technology, Freiberg, Germany, September 19-20, 2002, pp. 265-279.
- **Tahsin Saffat and Marek Perkowski**, Optimizing q-valued Quantum Multiplexers, *Proc. 22nd International Workshop on Post-Binary ULSI Systems*, May 21, Toyama International Conference Center, Toyama, Japan, 2013, pp. 19 - 26.
- **Alan Cheng, Edison Tsai and Marek Perkowski**, Methodology to Create Hardware Oracles for Solving Constraint Satisfaction Problems, *Proc. 22nd International Workshop on Post-Binary ULSI Systems*, May 21, Toyama International Conference Center, Toyama, Japan, 2013, pp. 36 – 43.

High School Student Publications

- **Tahsin Saffat, and Marek Perkowski**, A Method for Optimizing Quantum Multiplexers, *Proc. ULSI*, 2012.
- **Ankit Gupta, Kevin Wang, Prathyusha Ganti and Marek Perkowski**, Direct Synthesis of Quantum Automata from Flow Charts, *Proc. ULSI*, 2012.
- **Alan Cheng, Edison Tsai, Yushi Wang, Anu Rajendar, and Marek Perkowski**, Comparison of Maslov's Quantum Costs and LNNM Quantum Costs for Five types of Multi-qubit Toffoli Gates, *Proc. ULSI*, 2012.
- **Arushi Raghuvanshi, and Marek A. Perkowski**, Image Processing and Machine Learning for the Diagnosis of Melanoma Cancer, *BIODEVICES 2011*: pp. 405-41
- **Sidharth Dhawan, Arushi Raghuvanshi, Yale Fan, Frank Zhao, Yushi Wang and Marek Perkowski**, What's that? Schrödinger Cat! *Proc. the Third International Conference on Science and Technology, Policy, Culture and Communication*, Korea, December 4-5, 2008.
- **Arushi Raghuvanshi, and Marek Perkowski**, Using Fuzzy Quantum Logic to learn facial gestures of a Schrödinger Cat puppet for robot theatre, *Proc. ULSI 2008*, Dallas, May 2008.



This robot was supposed to be sir Isaac Newton for our Portland Cyber Theatre, but he looked so stupid that we decided to use this head for Frankenstein Monster.

High School Student Publications

- **Bryan Lee**, and **Marek A. Perkowski**, Quantum Machine Learning Based on Minimizing Kronecker-Reed-Muller Forms and Grover Search Algorithm with Hybrid Oracles. Proc. [DSD 2016](#): pp. 413-422.
- **Xiaoxiao Wang**, **Robin Tan**, **Marek A. Perkowski**, Synthesis of memristive circuits based on stateful IMPLY gates using an evolutionary algorithm with a correction function. Proc. [NANOARCH 2016](#): pp. 97-102.
- **Robin Tan** and **Marek Perkowski**, ECG Biometric Identification Using Wavelet Analysis Coupled with Probabilistic Random Forest, Proc. 15th IEEE International Conference on Machine Learning and Applications, Anaheim, California December 18-20, 2016, p.251.
- **Leo Deng**, **Marek Perkowski**, **John Saltenberger**, A Novel Forest Fire Prediction Tool Utilizing Fire Weather and Machine Learning Methods, Proceedings for the 5th International Fire Behavior and Fuels Conference April 11-15, 2016, Portland, Oregon, USA, Published by the International Association of Wildland Fire, Missoula, Montana, USA.



Recent robot theatre. High school students worked on animation, programming and stage design

Awards of Students Participating in this Program

Northwest Science Expo System Awards in 2006

1. **Yale Fan**, Meadow Park Middle School – Summa, An Implementation of the Deutsch Algorithm for Base-n Quantum Logic, First Award in Computer Science - MS Madden Industrial Craftsmen.
2. **Yale Fan**, Best of Fair.
3. **Yale Fan**, Discovery Channel Young Scientists Challenge Nomination.
4. **Yale Fan**, IEEE Special Awards IEEE Oregon.

Northwest Science Expo System Awards in 2007

1. **Yale Fan**, Catlin Gabel School, First Place, Computer Science Sponsored by Intel, Exhibit number: HS-CO-021 Student: Yale Fan of Catlin Gabel School. Project title: Applications of Multi-Valued Quantum Algorithms.
2. **Yale Fan**, IEEE Special Awards sponsored by IEEE Oregon, Prize includes: Certificate and plaque.
3. **Yale Fan**, Intel Excellence in Computer Science sponsored by Intel Corporation, Prize includes: \$200, certificate.
4. **Yale Fan**, Best of Fair sponsored by Madden Industrial Craftsmen, Prize includes: Plaque and \$100.
5. **Arushi Raghuvanshi**, Computer Science.

Northwest Science Expo System Awards in 2008

1. **Sidharth Dhawan** Summa Academy North, Using Sociable Robots to Help Cure Autism, MS Engineering, First Award, Using Sociable Robots to Help Cure Autism *MS-EG-0017*.
2. **Sidharth Dhawan**, Middle School Herbert Hoover Young Engineer Award Sponsored by Herbert Hoover Presidential Library Association, Medallion, certificate.
3. **Franklin Zhao**, Westview High School, Quantum Encoding Algorithm for Error Correction, HS Computer Science, *HS-CO-0018*. ?? Award.
4. **Franklin Zhao**, High School Intel Excellence in Computer Science Sponsored by Intel Corporation, \$200, certificate.
5. **Arushi Raghuvanshi**, Jesuit High School, Genetic Algorithms and Robotics for Speech and Lip Synchronization, High School IEEE Special Awards. Sponsored by IEEE Oregon.

Beaverton-Hillsboro Science Expo System Awards in 2008

1. **Franklin Zhao**, Westview High School, Intel Excellence in Computer Science Sponsored by: Intel Corporation
2. **Franklin Zhao**, U.S. Air Force Outstanding Project Sponsored by: U.S. Air Force
3. **Franklin Zhao**, First Category Award Computer Science.

Awards of Students Participating in this Program

Portland Community College Science Expo System Awards in 2008

1. **Arushi Raghuvanshi**, Jesuit High School. Computer Science, Second Award.
2. **Anugraha Rajendran**, Tualatin High School, Physics and Astronomy.

Northwest Science Expo System Awards in 2009

1. **Yale Fan**, Catlin Gabel School, First Award in Physics and Astronomy. *HS-PH-0026*.
2. **Yale Fan**, Outstanding Project by an 11th Grade Student sponsored by the Yale University Science and Engineering Association.
3. **Arushi Raghuvanshi** in 10th grade at Jesuit High School, Physical Science Intel ISEF Alternate, for project titled: Group Theory: From Rubik's Cube to Quantum Reversible Logic.
4. **Arushi Raghuvanshi**, PSU Maseeh College of Engineering and Computer Science Computer Sciences, Scholarship sponsored by the PSU College of Engineering and Computer Science.
5. **Arushi Raghuvanshi**, *HS-MA-0013. Second Award.*
6. **Arushi Raghuvanshi**, IEEE Special Awards sponsored by the IEEE Oregon.
7. **Frank Zhao and William Han**, Westview High School, *HS-EE-0033, First Award.*
8. **Frank Zhao and William Han**, 11th grade at Westview High School, Physical Science Intel ISEF Alternate, Team, for project titled: A Novel Automated Eye Tracking System for Treatment of Uveal Melanoma.
9. **Frank Zhao and William Han**, IEEE Special Awards sponsored by the IEEE Oregon.
10. **Frank Zhao and William Han**, University of Oregon Scholarships sponsored by the University of Oregon.
11. **James Siderius** from West Linn High School, Highway Transport Prizes sponsored by the Highway Transport Research.
12. **James Siderius**, Honorable Mention. *HS-EE-0016*.
13. **Terrance Sun**, Summa Academy South. IEEE Special Awards sponsored by the IEEE Oregon.
14. **Terrance Sun**, Mu Alpha Theta Award sponsored by the Mu Alpha Theta,
15. **Terrance Sun**, MS Mathematics and Computer Science, Second Award, *MS-MC-0002*
16. **Lawrence Sun**, Highland Park Middle School, MS Mathematics and Computer Science, Honorable Mention, Honorable Mention.
17. **Anugraha Rajendran**, Tualatin High School *HS-PH-0031*.
18. **Alan Cheng**, Summa Academy South, IEEE Special Awards sponsored by the IEEE Oregon.
19. **Alan Cheng**, IEEE Special Awards sponsored by the IEEE Oregon.

Awards of Students Participating in this Program

Northwest Science Expo System Awards in 2010

1. **Yale Fan**, 12 grade Catlin Gable, ISEF Finalist.
2. **William Han and Frank Zhao**, Westview High School, 2009-10 Siemens-Westinghouse Competition , Math: Science : Technology, regional finalists.

Beaverton-Hillsboro Science Expo System Awards in 2011

1. **Edison Tsai**, School of Science and Technology, First Award in Computer Science
2. **Edison Tsai**, Intel Excellence in Computer Science sponsored by Intel Corporation.
3. **Edison Tsai**, Best Freshman Project.
4. **Yushi Wang**, Sunset High School, First Award in Computer Science.
5. **Sidharth Dhawan**, Westview High School, Second Award in Physics and Astronomy.
6. **Sidharth Dhawan**, Mu Alpha Theta Award sponsored by Mu Alpha Theta.
7. **Sidharth Dhawan**, Outstanding Project by an 11th Grade Student sponsored by Yale University Science and Engineering Association.
8. **Sidharth Dhawan**, Army Awards for Scientific and Engineering Excellence sponsored by Army Research Office, U.S. Army.

Northwest Science Expo System Awards in 2011

1. **Yushi Wang**, Sunset High School, *ISEF FINALIST FROM OREGON.*
2. **Yushi Wang** , HS-CO-0019, IEEE Oregon, IEEE Special Awards, Prize includes: certificate and thumb drive
3. **Anika Raghuvanshi**, Valley Catholic Middle School , Color Image Edge Detection Using Clifford Algebra, Honorable Mention in Mathematics and Computer Science.
4. **Anika Raghuvanshi**, Color Image Edge Detection Using Clifford Algebra, Mathematics and Computer Science, Honorable Mention
5. **Terrance Sun, Lawrence Sun**, Catlin Gabel School, Using Formal Verification Techniques to Find Contradictions in Laws Concerning Police Use of Force, Third Place in Computer Science.
6. **Edison Tsai**, Merlo Station High School HS-CO-0023, IEEE Oregon IEEE Special Awards Prize includes: certificate and thumb drive
7. **Alan Cheng**, Summa Academy South, Third Place in Mathematics and Computer Science
8. **Alan Cheng**, Mu Alpha Theta Award, Prize includes: certificate, MS-MC-0017
9. **Alan Cheng**, IEEE Oregon, IEEE Special Awards, Prize includes: MS-MC-0017

Awards of Students Participating in this Program

Northwest Science Expo System Awards in 2010

1. **Yale Fan**, 12 grade Catlin Gable, ISEF Finalist.
2. **William Han and Frank Zhao**, Westview High School, 2009-10 Siemens-Westinghouse Competition , Math: Science : Technology, regional finalists.

Beaverton-Hillsboro Science Expo System Awards in 2011

1. **Edison Tsai**, School of Science and Technology, First Award in Computer Science
2. **Edison Tsai**, Intel Excellence in Computer Science sponsored by Intel Corporation.
3. **Edison Tsai**, Best Freshman Project.
4. **Yushi Wang**, Sunset High School, First Award in Computer Science.
5. **Sidharth Dhawan**, Westview High School, Second Award in Physics and Astronomy.
6. **Sidharth Dhawan**, Mu Alpha Theta Award sponsored by Mu Alpha Theta.
7. **Sidharth Dhawan**, Outstanding Project by an 11th Grade Student sponsored by Yale University Science and Engineering Association.
8. **Sidharth Dhawan**, Army Awards for Scientific and Engineering Excellence sponsored by Army Research Office, U.S. Army.

Northwest Science Expo System Awards in 2011

1. **Yushi Wang**, Sunset High School, ISEF FINALIST FROM OREGON.
2. **Yushi Wang** , HS-CO-0019, IEEE Oregon, IEEE Special Awards, Prize includes: certificate and thumb drive
3. **Anika Raghuvanshi**, Valley Catholic Middle School , Color Image Edge Detection Using Clifford Algebra, Honorable Mention in Mathematics and Computer Science.
4. **Anika Raghuvanshi**, Color Image Edge Detection Using Clifford Algebra, Mathematics and Computer Science, Honorable Mention
5. **Terrance Sun, Lawrence Sun**, Catlin Gabel School, Using Formal Verification Techniques to Find Contradictions in Laws Concerning Police Use of Force, Third Place in Computer Science.
6. **Edison Tsai**, Merlo Station High School HS-CO-0023, IEEE Oregon IEEE Special Awards Prize includes: certificate and thumb drive
7. **Alan Cheng**, Summa Academy South, Third Place in Mathematics and Computer Science
8. **Alan Cheng**, Mu Alpha Theta Award, Prize includes: certificate, MS-MC-0017
9. **Alan Cheng**, IEEE Oregon, IEEE Special Awards, Prize includes: MS-MC-0017

Awards of Students Participating in this Program

The Semifinalist of the Intel Science Talent Search (Intel STS) in 2011

1. **Arushi Raghuvanshi**, 17, Jesuit High School, Beaverton, Modeling Fuzzy Logic with Quantum Circuits for Humanoid Robots
2. **Yushi Wang**, 17, Sunset High School, Applications of Quantum Ternary Algorithms and Oracles.

Beaverton-Hillsboro Science Expo System Awards in 2012

1. **Tahsin Saffat**, Westview High School, First Award in Computer Science.
2. **Tahsin Saffat**, Intel Excellence in Computer Science - sponsored by Intel Corporation
3. **Tahsin Saffat**, Naval Excellence in Science and Engineering Award - sponsored by Office of Naval Research, US Navy and Marine Corps.
4. **Alan Cheng**, Southridge High School, Second Award for Engineering: Electrical and Mechanical
5. **Edison Tsai**, Merlo Station High School, First Award for Mathematical Sciences.
6. **Edison Tsai**, Army Awards for Scientific and Engineering Excellence - sponsored by Army Research Office, U.S. Army.
7. **Sidharth Dhawan**, Westview High School, Second Award for Mathematical Sciences.
8. **Sidharth Dhawan**, Mu Alpha Theta Award - sponsored by Mu Alpha Theta
9. **Ankit Gupta and Kevin Wang**, Westview High School, Outstanding Project by an 11th Grade Student - sponsored by Yale University Science and Engineering Association.
10. **Ankit Gupta and Kevin Wang**, Naval Excellence in Science and Engineering Award - sponsored by Office of Naval Research, US Navy and Marine Corps.

Northwest Science Expo System Awards in 2012

1. **Sidharth Dhawan**, Westview High School, Complexity of Interlocking Polyominoes, Northwest Science Expo System, ISEF Finalist.
2. **Sidharth Dhawan**, Second Place, Mathematical Sciences.
3. **Elizabeth Zhao**, Jesuit High School, Computer Aided Diagnosis of Melanoma Cancers, Second Place in Computer Science.
4. **Elizabeth Zhao**, University of Oregon Scholarships, from University of Oregon.
5. **Elizabeth Zhao**, TiE Oregon Entrepreneurship Honorable Mention from TiE Oregon.

Awards of Students Participating in this Program

Northwest Science Expo System Awards in 2012

1. **Tahsin Saffat**, Westview High School, Optimization of Quantum Multiplexers using Spectral Transformations, University of Oregon Scholarships from University of Oregon
2. **Anika Raghuvanshi**, Jesuit High School, Discovering Clueless Puzzles, Third Place in Computer Science.
3. **Alan Cheng**, Southridge High School, Fast Prototyping of Constraint Satisfaction Problem Architecture Using FPGAs, First Place in Engineering: Electrical and Mechanical.

Northwest Science Expo System Awards in 2013

1. **Ankit Gupta and Kevin Wang**, Westview High School, The Introduction of Higher-Order Encoding For Synthesizing Quantum Automata and an Analysis of Novel Encoding Mechanisms, ISEF finalists.
2. **Ankit Gupta, Kevin Wang**, Computer Science First Place.
3. **Ankit Gupta, Kevin Wang**, Intel Excellence in Computer Science from Intel Corporation.
4. **Anika Raghuvanshi**, Jesuit High School, Synthesis of Incompletely Specified Logic Functions With Memristor-Realized Material Implication, Third Place in Electrical and Mechanical Engineering.
5. **Anika Raghuvanshi**, Naval Excellence in Science and Engineering Award, Office of Naval Research, US Navy and Marine Corps.
6. **Alan Cheng**, Southridge High School, Improving Precision of Robot Control Using Kalman Filters, Second Place in Engineering: Electrical and Mechanical.
7. **Alan Cheng**, IEEE Special Awards from IEEE Oregon.
8. **Dina Zaslavsky, Clemen Deng, Shadman Abedin**, A Vision based guiding system for the blind, – advancement to NWSE
9. **Maria Chang, Jessica Xiao**. SCHOOL TITLE advancement to NWSE.

Beaverton-Hillsboro Science Expo System Awards in 2013

1. **Ankit Gupta and Kevin Wang**, Westview High School, Intel Excellence in Computer Science, sponsored by Intel Corporation.
2. **Ankit Gupta and Kevin Wang**, Mu Alpha Theta Award, sponsored by Mu Alpha Theta.
3. **Ankit Gupta and Kevin Wang**, First Award in Computer Science.
4. **Ankit Gupta, Kevin Wang**, Naval Excellence in Science and Engineering Award, *sponsored by Office of Naval Research, US Navy and Marine Corps.*

Awards of Students Participating in this Program

Beaverton-Hillsboro Science Expo System Awards in 2013

1. **Tahsin Saffat**, Westview High School, Naval Excellence in Science and Engineering Award, sponsored by Office of Naval Research, US Navy and Marine Corps.
2. **Tahsin Saffat**, Westview High School Third Award in Mathematical Sciences.
3. **Tahsin Saffat**, Westview High School Mu Alpha Teta Award
4. **Alan Cheng**, Southridge High School, second award in Engineering: Electrical and Mechanical.

Students Selected as Recipients of Regional Award for Aspirations in Computing

Posted 02/16/2013 12:54PM

JHS sophomores **Uma Doshi** and **Anika Raghuvanshi** have been selected as recipients of the NCWIT (National Center for Women & Information Technology) 2012-13 Regional Award for Aspirations in Computing.

A panel of 23 regional judges from the computer industry and NW colleges examined the material that Uma and Anika submitted along with their applications and concluded based on their academic history, technical skills, aptitudes, experiences, leadership abilities, outreach to others, and future college plans, that they are among the top candidates in Oregon and SW Washington this year.

In honor of Uma's and Anika's achievements, they will be recognized at a special ceremony to be held at the Portland Double Tree Hotel on April 6. They will have the opportunity to meet the judges, NCWIT officials, the awards committee, representatives of Oregon colleges, and members of the media.

You can learn more about NCWIT at www.ncwit.org.

Awards of Students Participating in this Program

Northwest Science Expo System Awards in 2014

1. **Anika Raghuvanshi**, Jesuit High School,
 - ISEF Finalist, Northwest Science Expo System,
 - Generalized Decision Functions for Synthesis of multi-level Logic Circuits Realized by Memristor Imply Gates.
 - IEEE Special Awards from IEEE Oregon.
 - Outstanding Project by an 11th Grade Student from Yale University Science and Engineering Association .
 - First place in the Engineering: Electrical and Mechanical Category.
2. **Alan Cheng**, Southridge High School, A Novel Human Machine Interface Using 3D Vision and Kalman Filter Optimization.
 - PSU Maseeh College of Engineering and Computer Science Computer Sciences Scholarship.
 - First place in Computer Science category.
3. **Vikul Gupta**, Oregon Episcopal School, Novel Algorithms for Digital System Synthesis using Innovative Low-Power Memristor Technology,
 - Intel Excellence in Computer Science from Intel Corporation.
4. **Elizabeth Zhao**, Jesuit High School, **A Novel Implementation of Image Processing and Machine Learning for the Early Diagnosis of Melanoma**
 - Qualified for ISEF Finals.
 - 1st Place in Computer Science Category

Google Global Science Fair (Worldwide) 2014

1. **Alan Cheng**, Regional Finalist, June 2014.

Awards of Students Participating in this Program

2014 Intel Northwest Science Expo Middle School Awards

- **Leo Deng**, ACCESS School, Development of Forest Fire Prediction Tool for the State of Oregon
 - First Place, Environmental Science
 - Outstanding Natural Resources Science Project, Pacific NW Research Station, USDA Forest Service
 - Outstanding Project in an Atmospheric Science Exhibit, American Meteorological Society
 - Tom Owen Award for Excellence in Statistics, Oregon Chapter of the American Statistical Association

Northwest Science Expo System Awards in 2014

- **Clemen Deng, 16**, Lincoln High School, Development of A General Data Mining Methodology based on a Novel Weighted Hierarchical Adaptive Voting Ensemble Method and Its Applications
 - OSU College of Engineering Scholarship
 - Intel Excellence in Computer Science
 - Tom Owen Award for Excellence in Statistics
 - First Place Computer Science and Robotics

Google Science Fair Global Finalist, 2014

Elizabeth Zhao, Jesuit High School, West Linn, CS017

A Novel Implementation of Image Processing and Machine Learning for the Early Diagnosis of Melanoma

Third Award, \$ 1,000.

Robertson Scholars 2014

Thirty high school graduates, one of them **Elizabeth Zhao**, have accepted invitations to become Robertson Scholars, receiving undergraduate merit scholarships to attend either Duke University or the University of North Carolina at Chapel Hill.

Intel International Science and Engineering Fair (ISEF) Global and Regional Awards 2014:

- **Clemen Deng**, 16, Lincoln High School, Portland, Oregon Award for project “Development and Comparative Analysis of Machine Learning Algorithms for Breast Cancer Detection”.
- May 2014 International Finalist.
- 2014 ISEF Special Award from American Statistical Association
- 1st Place Award in Mathematical Science Category at 2014 Portland Public Schools Science Expo
- Intel Excellence in Computer Science Award
- Oregon State University General Scholarship Award



High School and Middle School students helped to organize and clean the lab

Awards of Students Participating in this Program

Middle School Competition of ISEF 2015

Leo Deng, Jesuit High School, A Novel Forest Fire Prediction Tool Utilizing Historical Weather Data and Machine Learning Methods

- ASU Walton Sustainability Solutions Initiatives , Arizona State University
- Third Place Environmental and Earth Sciences

Broadcom Masters Competition 2015

- **Leo Deng** was among three Beaverton students among 30 national finalists in Broadcom Masters Competition.
 - The numbers were whittled down from 2,054 applications and 300 semifinalists.
 - All of the students met top executives at the White House and shook hands with President Barack Obama (Photo on my Facebook).
 - A planet was named after him. (see more on Facebook Page of Marek Perkowski).

Intel Science Talent Search (STS) 2015 US Semifinalists

1. **Cheng, Alan De-Hao**, 17, Southridge High School, Beaverton, OR
2. **Raghuvanshi, Anika**, 17, Jesuit High School, Portland, OR. She met President Obama.

Awards of Students Participating in this Program

Northwest Science Expo System Awards in 2015

- **Alan Cheng**, Southridge High School A Novel Human Machine Interface: Hardware Implementation of the Kalman Filter with Faddeev's Algorithm for Advanced Co-Processing
 - First Place , Engineering: Electrical and Mechanical
 - TiE Oregon Student Membership , TiE Oregon
 - U.S. Air Force Outstanding Project, U.S. Air Force
- **Robin Tan**, Jesuit High School , Wavelet-Coupled Machine Learning Methods for Drought Forecast Utilizing Hybrid Meteorological and Remotely-Sensed Data
 - Tom Owen Award for Excellence in Statistics, Oregon Chapter of the American Statistical Association
 - TiE Oregon Student Membership , TiE Oregon
- **Nashita F. Rahman**, Summa Cedar, Predicting Distribution of Invasive Species in Oregon Using Machine Learning Techniques
 - Environmental Science First Place
 - Naval Excellence in Science and Engineering Award
 - Tom Owen Award for Excellence in Statistics



Leo Deng, first from left. Robin Tan, second from right

Vikul Gupta

- **Intel International Science and Engineering Fair (ISEF)**
Pittsburg, PA, March, 2015
- *Best Project in Computer Engineering: K. Soumyanath Memorial Award.* \$3000 and \$1000 for school.
(<https://student.societyforscience.org/k-soumyanath-memorial-award>)
- Fourth place in Embedded Systems Category. Won \$500 Award.
- Various nominations for the IEEE Presidents' Scholarship Award, United Technologies Special Award, and Naval Science Awards Program
- Project title: "Parallel Implementation of the Convolution Operation in Quotient Polynomial Rings for the NTRU Cryptosystem."

Intel Science Talent Search Finalist

- **Selected as one of 40 Finalists.**
- **Only student selected from Oregon**
- **Awarded \$ 9500 in Cash**
- **He will compete at the National competition in Washington, D.C., March 2016.**
-

Awards of Students Participating in this Program 2015 - 2016

Clemen Deng

- Edison Innovation Induction Award, National Museum of Education and Edison Innovation Foundation, September 2015
- 2015 Inductee to the National Gallery for America's Young Inventors by the National Museum of Education and Edison Innovation Foundation for research invention of "WHAWE: A Novel Machine Learning Method for More Accurate Breast Cancer Detection"
- Clemen Deng, Leo Deng, Marek Perkowski, John Saltenberge, A Novel Forest Fire Prediction Tool Utilizing Historical NFDRS Indices and Weather Data and Advanced Machine Learning. Submitted to International Journal of Wildland Fire, 2015

Leo Deng.

- *National Director of the Student Board, National Museum of Education April 2015 – Present*
- "The National Student Board of Directors is comprised of six students (grades 9-12) from across the United States [selected on the basis of academic and scientific success and performance, leadership, self-motivation, responsibility and dependability, respect by peers and teachers, positive attitude, integrity, and written and spoken clarity and articulacy]."
- Minor Planet 30166 is named Leodeng <http://ssd.jpl.nasa.gov/sbdb.cgi?sstr=30166>
- 2016 Science Fair Awards for Project "A Novel Machine Learning Approach to Proteomics Analysis of HIV-1 Protease Interactome for Effective Combative Drugs Development" Second Place Award in Medical & Health Sciences
- 2015 Science Fair Awards for Project "A Novel Forest Fire Prediction Tool Utilizing Historical Weather Data and Machine Learning Methods" Third Place Award in Environmental and Earth Science Category at NWSE State Competition Second Place Award in Environmental.
- 2014 Science Fair Awards for Project "Development of Forest Fire Prediction Tool for the State of Oregon"
- First Place Award in Environmental Science Category Advanced to National Middle School Science Competition Broadcom MASTERS.
- 2016 Science Fair Awards for Project "A Novel Machine Learning Approach to Proteomics Analysis of HIV-1 Protease Interactome for Effective Combative Drugs Development" Gresham-Barlow Science Expo (GBSE) March 2016. Second Place Award in Medical & Health Sciences.

Robin Tan

- First Place in Computer Science and Robotics, for project "A Novel Algorithm Combining Random Forest and Wavelet Distance Measurement for Biometric Identification Using Electrocardiograms," NWSE State Competition 2016.
- Intel Excellence in Computer Science, NWSE State Competition 2016.

Bryan Lee

- Third Place in Computer Science and Robotics, An Innovative Quantum Machine Learning Accelerator to Find the Minimum Kronecker Reed-Muller Form Based on Grover's Search Algorithm. NWSE State Competition 2016.

2017 Achievements and Awards of Students Participating in this Program

Arjun Jain.

- Tom Owen Award for Excellence in Statistics from Oregon Chapter of the American Statistical Association for project “EPICS (Ensemble-learning for Prediction of Cancer Survival): A new high-accuracy predictor of cancer survival using microarray gene expression and clinical data”, NWSE.
- First place in Medicine category, regional fair for NWSE.
- Nominated to ISEF.

Leo Deng.

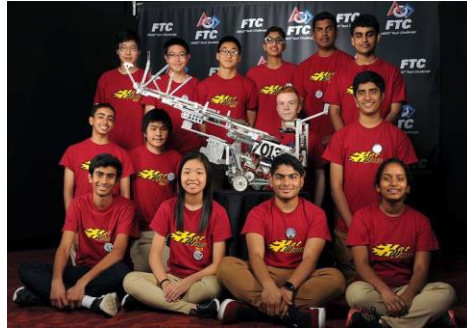
- Tom Owen Honorable Mention in Statistics from Oregon Chapter of the American Statistical Association for project A Novel Approach to Machine Learning Combining Classical Occam’s Razor Learning with Vapnik’s Modern Statistical Theory, NWSE.
- 1st Place Award in Computer Science and Robotics Category at the regional science fair competition.
- Yale University Science and Engineering Association's Outstanding Project by an 11th Grade Student Award;
- Intel Excellence in Computer Science Award
- U.S. Air Force Outstanding Project Award
- Second place at NSWE in the area of Computer Science and Robotics for project “A Novel Approach to Machine Learning Combining Classical Occam’s Razor Learning with Vapnik’s Modern Statistical Theory.”
- Fourth place in Oregon Junior Science & Humanities Symposium (JSHS), January 20th-21st. Evergreen Aviation Museum Oregon Junior Science & Humanities Symposium (JSHS) is sponsored by the US Army, Navy, and Air Force. Advanced to finals
- Invited to write a journal paper “A Novel Forest Fire Prediction Tool Utilizing Fire Weather and Machine Learning Methods” presented at the 5th International Fire Behaviour and Fuels Conference 2016 in your "*Modern Environmental Science and Engineering* (ISSN 2333-2581), a journal published by Academic Star Publishing Company. Submitted.

2017 Achievements and Awards of Students Participating in this Program

Robin Tan

- First Place in Computer Science and Robotics, for project “A Novel Algorithm Combining Random Forest and Wavelet Distance Measurement for Biometric Identification Using Electrocardiograms,” NWSE State Competition 2016.
- Intel Excellence in Computer Science, NWSE State Competition 2016
- A regional finalist in the Google Science Fair out of 100 finalists in the world..

Robin Tan First from left in back row



Bryan Lee

- Selected as one of 300 Regeneron STS 2017 Scholars. The Regeneron Science Talent Search (Regeneron STS) is the nation's most prestigious pre-college science competition. Alumni of STS have made extraordinary contributions to science and hold more than 100 of the world's most coveted science and math honors, including the Nobel Prize and National Medal of Science. Annually, students entering the Regeneron STS compete for more than \$3.1 million in awards.
- Bryan Lee, an 18-year-old Westview High School senior, received acceptance letters from seven Ivy League schools on March 30. He selected Computer Science and Mathematics at Harvard University.
- Paper and conference presentation: Bryan Lee, Marek Perkowski, Quantum Machine Learning Based on Minimizing Kronecker-Reed-Muller Forms and Grover Search Algorithm with Hybrid Oracles, Proc. 19th EUROMICRO Conference on Digital Systems Design, August 2016.



Schools

Beaverton Student Accepted to Seven Ivy League Schools

Bryan Lee, an 18-year-old Westview High School senior, received acceptance letters from seven Ivy League schools on March 30.

By Travis Loose (Patch Staff) · Updated April 12, 2017 7:03 pm ET



Some Universities to which alumni of our program have been admitted

1. Anika Raghuvanshi, Stanford
2. Arushi Raghuvanshi, Stanford
3. Yale Fan, Harvard BS, now PhD. at Princeton
4. Alan Cheng, MIT.
5. Ankit Gupta, MIT.
6. Frank Zhao, MIT.
7. Yuchi Wang, MIT.
8. Elizabeth Zhao, University of North Carolina at Chapel Hill.
9. David Rosenbaum, University of Washington and MIT. Postdoc in Japan in Theoretical Physics.
10. Tahsin Saffat, MIT.
11. Kevin Wang, Duke
12. Dina Zaslavsky, Rensselaer
13. Sridharth Dhawan, Princeton
14. Mikhail Pivtoraiko, Carnegie Mellon
15. Bryan Lee, Harvard
16. Clemen Deng, University of Pennsylvania
17. Edison Tsai, the youngest PhD student at PSU

