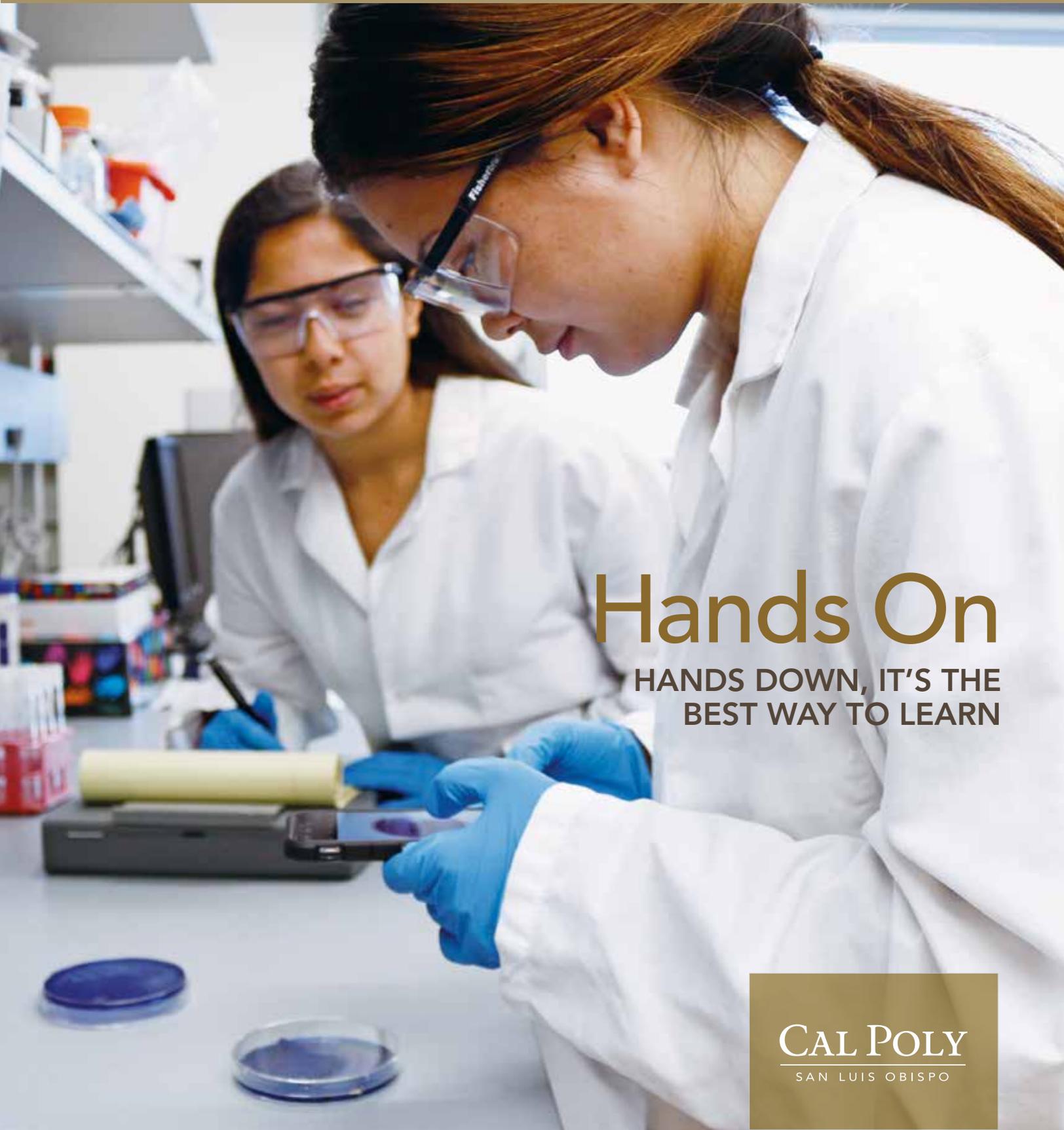


HELLO WORLD

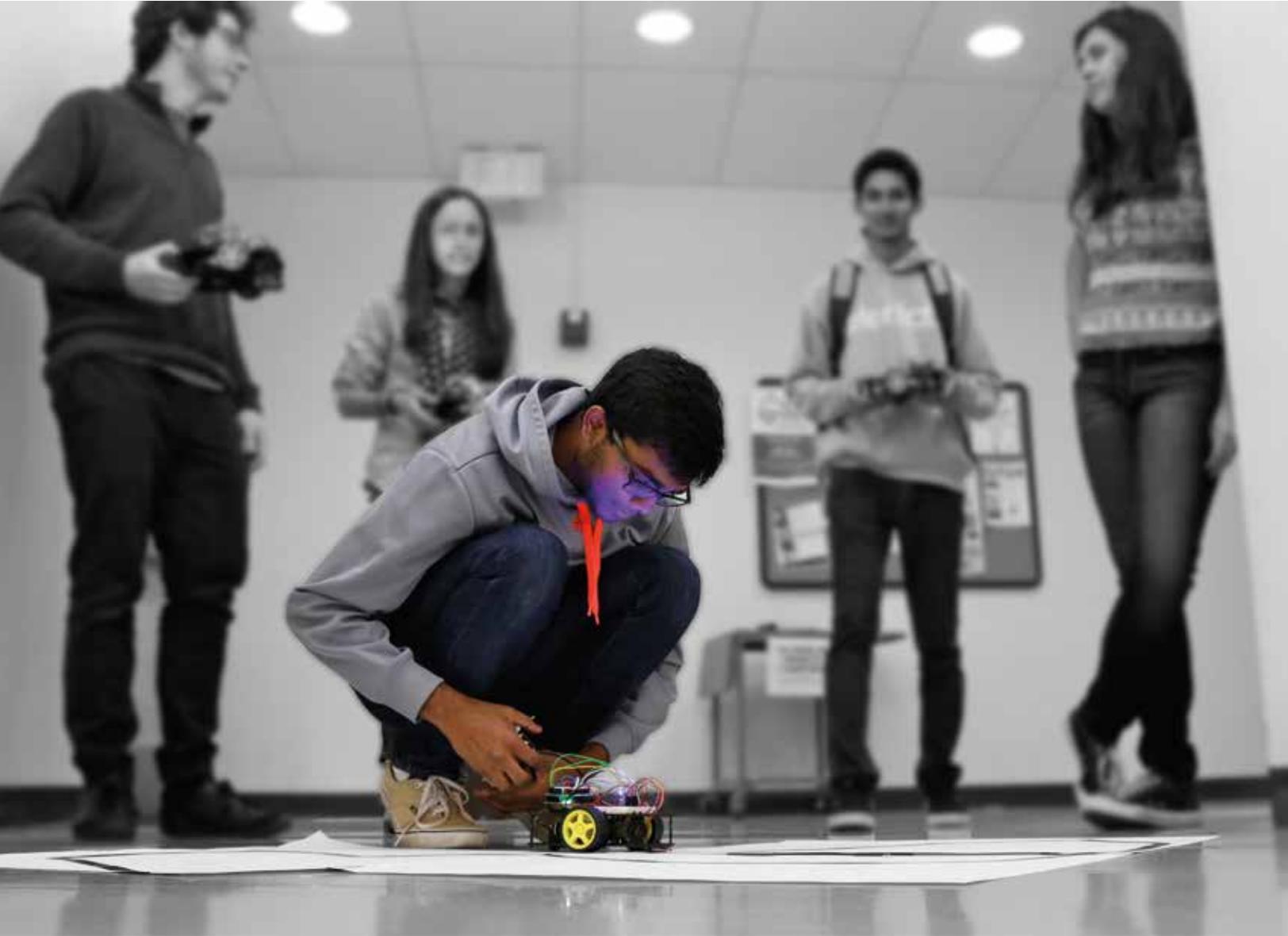
COMPUTER ENGINEERING | CAL POLY | FALL 2016



Hands On

HANDS DOWN, IT'S THE
BEST WAY TO LEARN

CAL POLY
SAN LUIS OBISPO



Inside

PROFILES

Alumna Rada Charles' hardware and software interests lead to developing and delivering employee training. | **Page 3**

Alumnus Eric Firestone takes a risk on a new career path that leads him to a job at a San Francisco startup. | **Page 4**

Professor Maria Pantoja joins Cal Poly's computer engineering and computer science faculty this fall. | **Page 5**

LEARN BY DOING

Robocrop proves to be a perfect culminating project for seniors Adam Calabrigo, Brian Holland and Jeremy Kerfs. | **Page 6**

Senior Drew Balthazor and his team have developed Robostock, a product that streamlines inventory tracking. | **Page 8**

As part of a multidisciplinary team, senior Matthew Walker is working on a Lawrence Livermore Laboratories project. | **Page 9**

THE SPIRIT OF GIVING

Professor Emeritus Joe Grimes and his wife, Mary, introduce an endowment to aid Roborodentia participants. | **Page 10**

"Paying it forward," computer engineering students in the Class of 2015 buy Nexys boards for the program's incoming freshmen. | **Page 11**

ABOVE Freshmen students build and program two-wheeled robots using Arduino boards and sensors that allow them to detect and follow a black-line autonomously. | PHOTO BY BETH HOTCHKISS

COVER Working on their capstone project, Kimberly Aguero observes as Gilenn Collado photographs a Petri dish using their team's iOS cell counter app. | PHOTO BY BETH HOTCHKISS

A Perfect Mix

HARDWARE AND SOFTWARE WORK SUITS RADA CHARLES

As a computer engineering major, Rada Charles (B.S., Computer Engineering, 2001) had a choice of going into the hardware field or the software field.

At the time, hardware seemed to be a finite and straightforward route. Software, on the other hand, seemed less defined and more difficult. But it was the melding of the two areas that really piqued her interest.

“That was what I loved most about computer engineering — getting to see

ALUMNI: SHARE YOUR NEWS!

Please submit your career notes at cpe.calpoly.edu/alumni/alumni-update/.

how hardware and software worked together,” she said.

After graduation, Charles was able to secure a job effortlessly. “I interviewed with a company in Paso Robles and was offered a job right on the spot,” she said. Her new employer, a small computer services

firm, developed warehouse manufacturing systems, and one of its clients was mega-tech giant Hewlett-Packard (HP).

Charles was immediately tasked with writing software that could collect weight data as printers were being packaged for shipping. Before she knew it, she was heading off to Germany to install the program in HP’s overseas warehouse. “I’d never been out of California, let alone the country,” said Charles.

When the company downsized the following year, Charles once again found a job opportunity locally. She connected with alumni working for PG&E, and in less than a month was working in the company’s IT systems application division. She credits a database course she took at Cal Poly in helping her excel at her job.

“I began to understand the power of data and the importance of being able to retrieve and analyze the information to make it meaningful,” said Charles. She began supplying reports she’d developed to the company’s directors and vice presidents, helping to inform their decision-making.

Today, Charles develops and provides online training to PG&E employees, who, at almost every level, are required to complete on-the-job training for certification.

“Tracking an employee’s progress through the training process and validating their certification is key,” she said. “You begin to see how important these computer systems are in keeping a company’s workforce functional and up-to-date.”

Looking back, Charles said she couldn’t be happier with the direction her life has taken, thanks to her solid Cal Poly education.

“With this degree, you can work in any field and any industry,” she said. “As a grad, your possibilities are unlimited.”

Rada Charles enjoys developing and providing online training at PG&E.
COURTESY PHOTO



Eric Firestone (B.S., Computer Engineering/ M.S., Computer Science, 2008) has fond memories of his days at Cal Poly, but he admits that back then, he didn't have a clear vision of the career path he wanted to pursue.

"I know I was intrigued with building tools that people would find useful, and I was also interested in the visual aspects of design," recalled Firestone. "Other than that, I didn't have a set game plan; I was a typical student trying to get through the flowchart."

Firestone satisfied his interests by taking several computer graphics courses. He credits Professor Zoë Wood's patient instruction for helping to turn his fascination into a solid foundation for future success.

"Seeing something I created graphically represented a tremendous sense of gratification," he said.

Window of Opportunity

ERIC FIRESTONE FINDS SAN FRANCISCO STARTUP JOB TOO ENTICING TO MISS

Later in his academic career, Firestone secured an internship with Apple, which evolved into a full-time position after graduation. "It's funny that I ended up at Apple," he said, "because outside of my high school yearbook class, I mainly worked with PCs."

Five years later, Firestone was still content in his Apple job when a colleague

invited him to visit a new San Francisco startup. Square was a small company hoping to break into the financial market with technology that facilitated mobile phone payments. Firestone wasn't looking to change jobs, but his visit to Square that day made an impression.

"People were in a mad rush, putting materials together for an ad campaign deadline," he said. "I could feel their enthusiasm for the company, and I was immediately drawn to it."

So when an opportunity came along at Square "to be part of a smart, talented team that was passionate about its work," he said, "I knew it was a huge risk, but I couldn't pass it up."

Firestone can't believe that six years have passed since he joined the company. A senior software engineer, he worked during one of the company's "hack weeks" on a Bluetooth-enabled vending machine for which he was awarded a patent.

"Without any knowledge of hardware, there's no way I would understand how to put that idea together," said Firestone. "I'm grateful to my Cal Poly computer engineering degree for that."

Firestone's advice to students just starting out is to "always be curious, take risks and try something new." As evidenced by his own career path, if you follow your interests, you never know where they might lead.

Eric Firestone works as a senior software engineer at Square. | COURTESY PHOTO





Meet Maria Pantoja

PROFESSOR IS ALGORITHM, PARALLEL PROGRAMMING EXPERT

The Computer Science Department and Computer Engineering Program welcomes Maria Pantoja to campus this fall.

Pantoja holds a Bachelor of Science Degree in engineering from Universidad Politecnica de Valencia, Spain, and a doctorate from Santa Clara University, Santa Clara, Calif. Her primary interests are in algorithm development and implementation of parallel programming, from data science to neural networks.

“In the past, engineers and computer scientists could make their algorithms run faster just by updating the hardware every

other year,” said Pantoja. She points out that these advances in computer architectures mainly involve adding multiple cores, which make the graphical processing computers wider — not faster. Pantoja understands that to fully exploit the hardware, computer scientists in industry and academia are challenged to change their algorithms and make them parallel.

“Parallel implementation is revolutionizing scientific fields including data science, computer graphics, computer vision, robotics, medical imaging, security systems and scientific computation,” she said.

With this parallel computing evolution underway, Pantoja is excited by the

Professor Maria Pantoja is eager to share her interests in algorithm development and parallel programming with Cal Poly’s computer science and computer engineering undergraduates. | COURTESY PHOTO

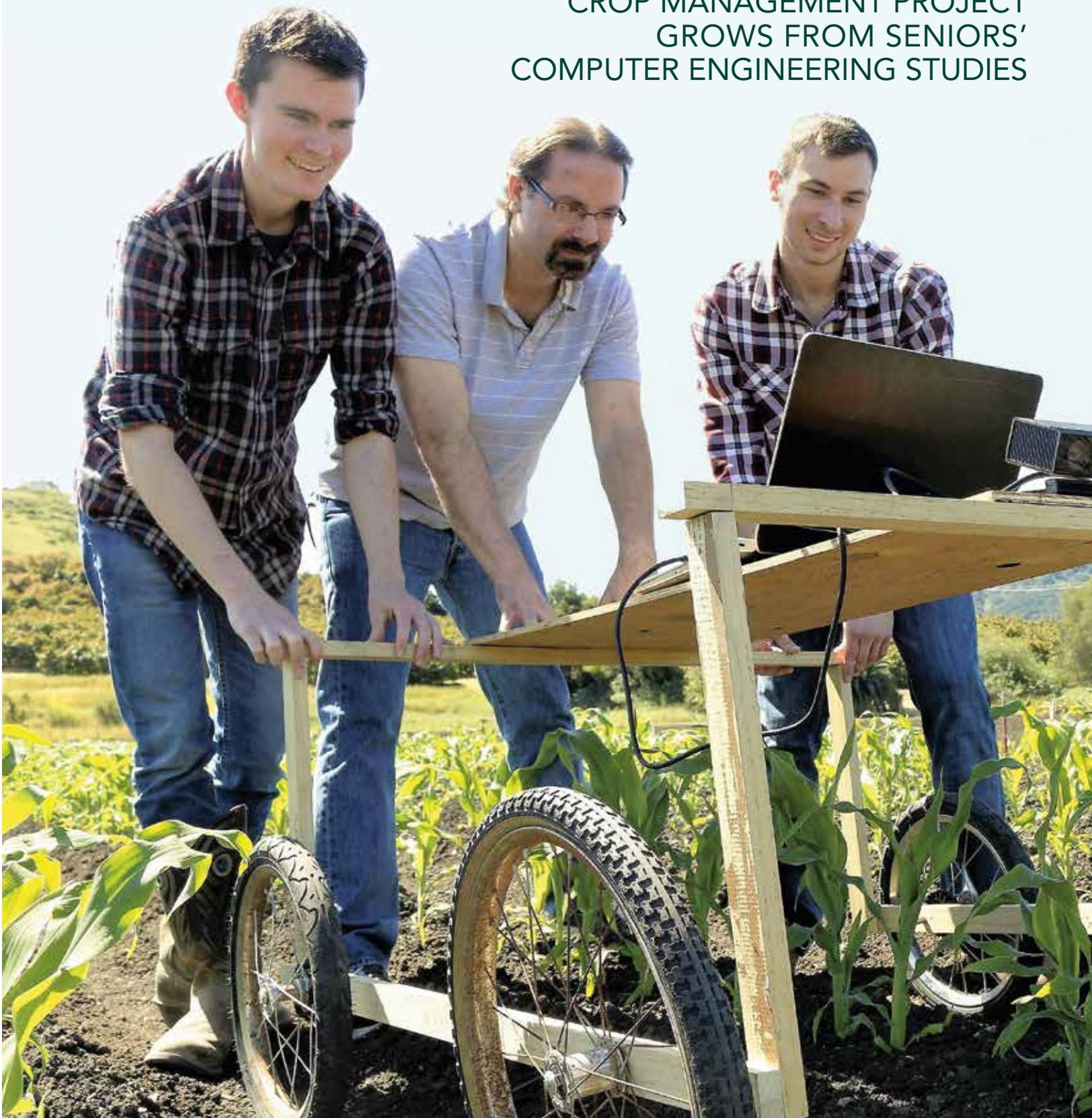
prospect of educating the next generation of engineering students.

“I’m impressed with Cal Poly’s reputation as a top undergraduate school,” she said. “My hope is to bring my knowledge and expertise to undergraduates. There is an emerging, urgent need to train competent parallel programmers so they can face the vast changes ahead.”

LEARN BY DOING

ROBOCROP

CROP MANAGEMENT PROJECT
GROWS FROM SENIORS'
COMPUTER ENGINEERING STUDIES



Computer engineering seniors Adam Calabrigo, Brian Holland and Jeremy Kerfs were looking for a culminating project that incorporated what they learned throughout their studies. They found that Robocrop, a robotic crop monitoring project, fit the bill perfectly.

Representing the quintessential combination of hardware and software, the project required them to apply their knowledge of embedded systems, electronics and programming. Focusing on agricultural engineering, they felt they could make an impact because the use of automated robotics in farming is still developing.

"We were excited by the prospect of making a significant contribution," said Kerfs. "After all, agriculture is one of the industries driving California's economy."

Team Robocrop (from left): Jeremy Kerfs, Brian Holland and Adam Calabrigo.

PHOTO BY BETH HOTCHKISS

The team was asked to create an autonomous system that could collect field crop data — in this instance, from strawberries. From that information, farmers could calculate yield and better determine when to harvest.

"The robot basically navigates the crop field on its own to count strawberries," said Kerfs. To provide the farming background needed on the project, they collaborated with Professor Bo Liu and a team of students from the Bioresource and Agricultural Engineering Department.

Each team member worked on a different component of the project, bringing their three-fold talents to fruition. Holland worked on the computer that ran the Robot Operating System (ROS) and all the software that controlled the robot. To aid in navigation and positioning, Calabrigo developed a Graphical User Interface (GUI) program using C# and .NET framework. The application also allowed farmers to select GPS waypoints that the robot could navigate between and configure when sensors were activated.

"That way the farmer has complete control when the robot takes crop readings," explained Kerfs.

Kerfs applied machine learning concepts to enable the robot to operate autonomously. First, he built a test rig from wood scraps and bike tires to create a sturdy camera mount. More than 40,000 crop field images were collected to "train" the machine to safely move down crop rows and count accurately. He admitted that designing a navigation system for a robot that didn't exist was a major challenge.

"We weren't sure of the dimensions or maneuverability of the proposed robot, so we had to create a system that was general enough to work on a variety of platforms," he said. "Our final approach used artificial neural networks to compute velocity vectors based on the camera data."

Overall, the skills each student developed during the project paid off almost immediately. Calabrigo applied his newly acquired knowledge of C# and .NET at his summer internship. Holland now works on secure embedded systems for InfoGuard in San Luis Obispo. And Kerfs will continue to work on the project with Professor Liu and his team.

"This project truly underscores the idea that no matter how much expertise a team member has in a particular area, you will always produce superior results when you work together," said Kerfs.



Robostock

PROJECT STREAMLINES INVENTORY TRACKING

Drew Balthazor (below) led his team in the development of Robostock, a project that uses robotics to improve inventory tracking for businesses.

PHOTO BY DONNA AIKEN

Tracking inventory is a crucial but time-consuming practice which is often fraught with errors and headaches. Businesses can easily lose track of their bottom line without a well-established monitoring process in place.

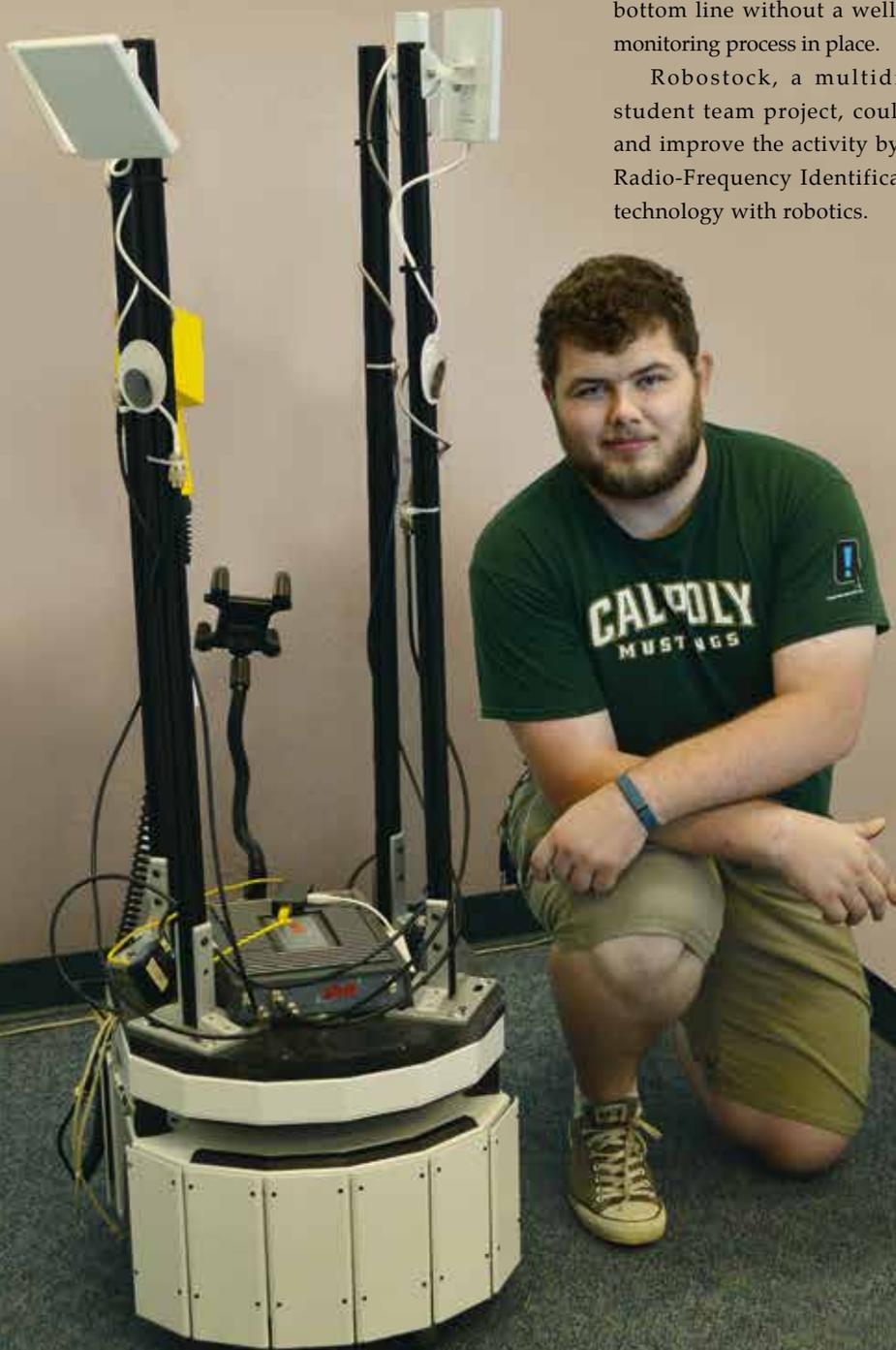
Robostock, a multidisciplinary student team project, could automate and improve the activity by integrating Radio-Frequency Identification (RFID) technology with robotics.

The manual process of dealing with inventory generally involves a person identifying stock, manually writing that information on paper, and later entering that data into a database. With Robostock, a robot moves around the warehouse and scans inventory data via RFID technology so the information goes directly into a database system, eliminating the need to track stock on paper.

“Our biggest challenge was the fact that we inherited this device from a previous team,” said project team leader Drew Balthazor, a computer engineering senior. “Since we had very little documentation, it took some time to get the robot to even work again.”

Despite the setbacks, Balthazor and his three teammates — students from materials engineering, computer engineering and engineering — moved ahead, rebuilding the robot, developing the code and balancing the scope of work against cost feasibility. Industrial/manufacturing engineering Professor Tali Freed provided guidance on RFID capabilities, while the students applied their knowledge of coding and robotics.

“I was excited to have an opportunity to work with classmates that have different engineering backgrounds,” said Balthazor. “I feel even better prepared for what I will face at my first job.”



Manufacturing processes can be lengthy and time-consuming, particularly when the mechanisms used are highly customized. While many companies have found three-dimensional (3-D) printing equipment to be the solution, Lawrence Livermore National Laboratories was seeking a more materials-efficient, thus cost-effective, technology.

Enter a multidisciplinary team of Cal Poly students and faculty, who came together to see if they could help. Their goal: to improve the current method in which a chamber in the equipment fills with metal powder, and a laser bonds the material layer by layer.

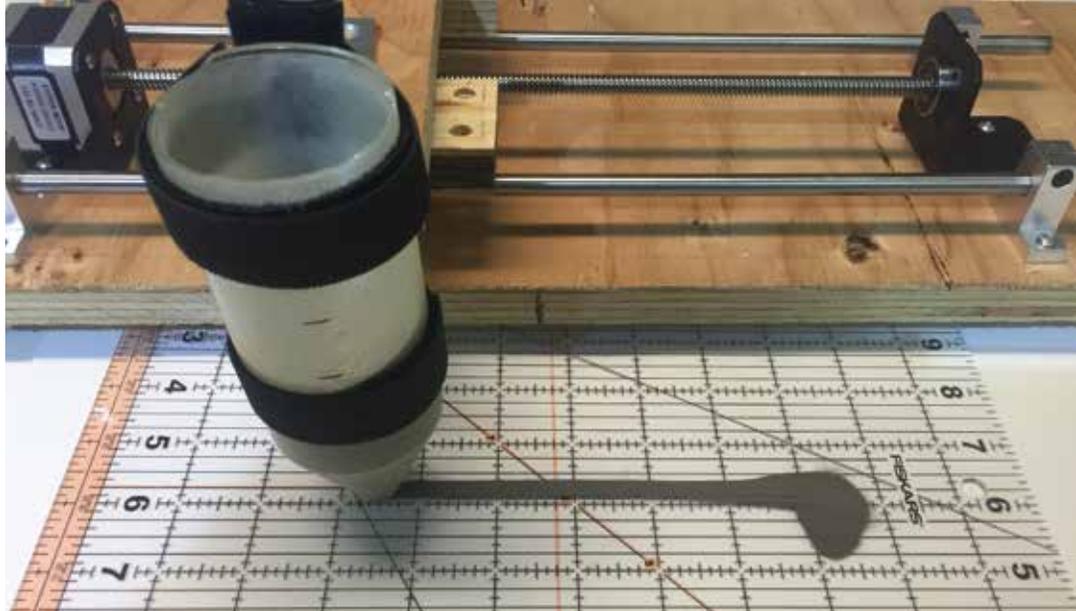
“We wanted a method that would allow a nozzle to lay or pour the metallic powder right where you need it,” explained computer engineering senior Matthew Walker. He and his mechanical engineering teammates Winnie Townsend and Luca Fuller worked with mechanical engineering Professor Andrew Davol to understand the scope of work.

“The powder we’re working with is high-quality stainless steel with a nominal diameter of 40 microns,” said Walker. “For reference, a grain of sand is between 2,000 and 64,000 microns.”

Because the material is expensive, cutting waste was a top priority for the team. The students used a simple nozzle available for other applications and developed a process that directed the flow of powder from a reservoir to a specified location.

Walker was responsible for electrical aspects, programming the positioning mechanism for the nozzle, the start and stop mechanism, and the overall system controls. His teammates designed the 3-D models of the prototypes and conducted analysis.

During the project’s final stages, Townsend and Fuller will work with Professor Jose Macedo, chair of the Industrial Manufacturing Department, to test and validate their manufacturing solution.



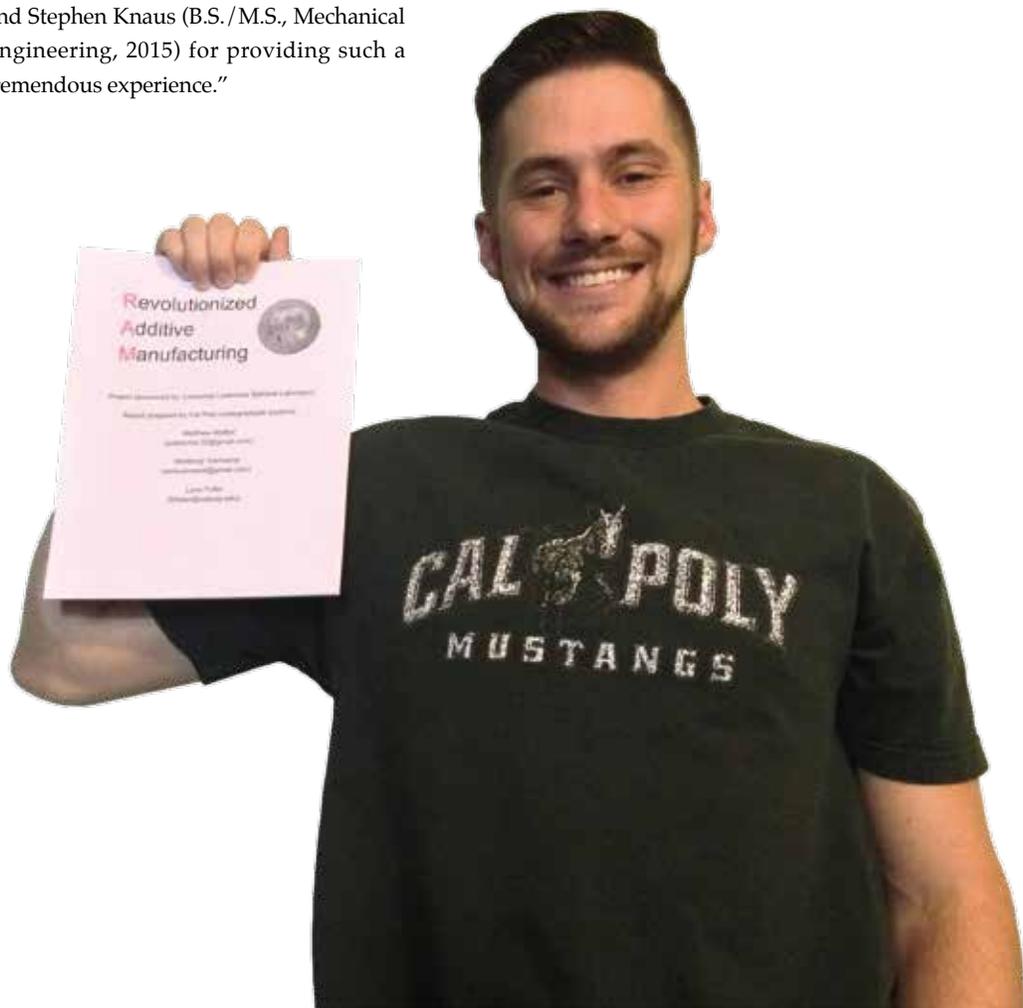
Making A Mark

WITH REAL-WORLD PROBLEM-SOLVING

“Working across disciplines is a vital skill, not for just computer engineers, but all engineers,” said Walker. “I’m so grateful to Lawrence Livermore alumni contacts Tommy Pluschkell (B.S., General Engineering, 2015) and Stephen Knaus (B.S./M.S., Mechanical Engineering, 2015) for providing such a tremendous experience.”

Matthew Walker (below) is on a team that is developing a prototype (above) of a more cost-efficient 3-D printing method for use by Lawrence Livermore Laboratories.

COURTESY PHOTOS



Roborodentia Endowment

JOE AND MARY GRIMES LEND A HAND TO CONTEST PARTICIPANTS

Robotics has been a part of Cal Poly Computer Engineering (CPE) since the program's early days, demonstrating how a complex blend of hardware and software studies produces invaluable lessons and amazing results.

CPE's annual Roborodentia competition — established in 1995 with the first competition in 1996 — has provided an arena in which the students can fine-tune their robotics skills and showcase their knowledge of computer engineering.

The event is near and dear to Joe Grimes' heart — and for good reason.

"Roborodentia has been a well-structured activity for the past 21 years, exemplifying the essence of CPE and Cal Poly's Learn by Doing tradition," said Grimes, a professor emeritus who served

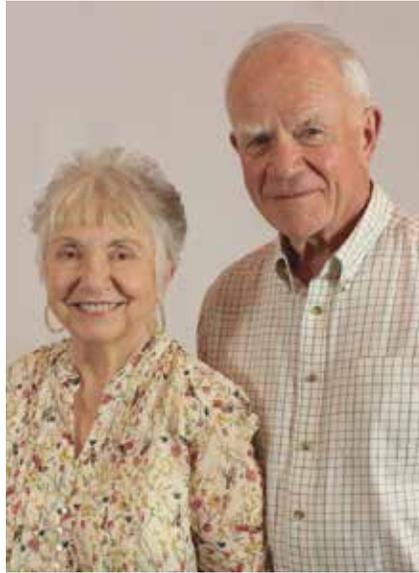
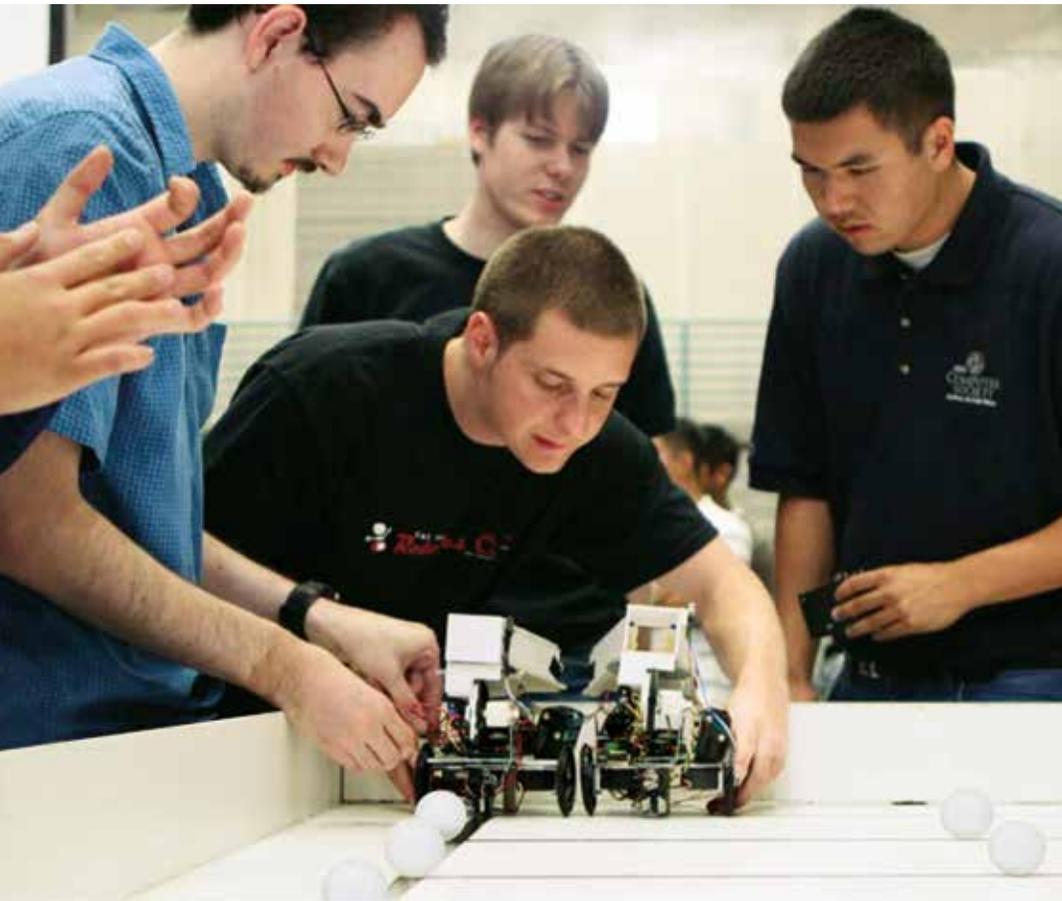


PHOTO BY BETH HOTCHKISS

Joe and Mary Grimes (above) have created an endowment to aid future Roborodentia participants (below).

FILE PHOTO



as an adviser to Roborodentia participants. "This wonderful learning experience helps students achieve CPE's educational objectives and learning outcomes."

Roborodentia involves students in every aspect of the event, from managing it and developing competition rules to raising funds for the awards. And then there is the building of competitive robots.

"Not everyone will successfully complete a robot for competition, and some will really struggle," he noted. "But it's the students encountering those difficulties who learn the most. That's something you can't duplicate in a classroom."

For that reason, Grimes wants to ensure that Roborodentia is open to every student who wants to compete. Aware that expensive materials and electronic components have kept some from participating, he and his wife, Mary, have created the Professor Joe and Mary Grimes Family Endowment to help future participants with the costs.

"Our goal is to reduce some of the financial burden that might prevent dedicated students from participating in Roborodentia," said Grimes.

As the endowment evolves, he hopes it will have a positive impact on an activity that has been invaluable to so many.

"I want to ensure that Roborodentia is and will continue to be an enriching experience for students as well as visitors to the campus, showing prospective students that the CPE program is truly about Learn by Doing."

If you'd like to contribute, please send a check to the Computer Engineering Program office made out to Cal Poly Foundation and designated to the Grimes Family Endowment. For more information, please contact John Seng at jseng@calpoly.edu.



Paying It Forward

2015 GRADS EASE FINANCIAL BURDEN FOR INCOMING FRESHMEN

When Computer Engineering (CPE) Program Director John Oliver asked graduating seniors in spring 2015 for a class gift, his goal was to help ease the financial burden for incoming freshmen.

"I wanted our freshmen to have access to Nexys boards at no cost," said Oliver, noting that while they're invaluable tools, they are pricey.

"In CPE 133 students learn the fundamentals of digital design and hardware description language using the boards," Oliver explained, "and in CPE 233 they apply that knowledge to build computer processors on the Nexys boards. Then they write software that runs on these

processors, and they interface the processors to common input/output devices like LCD screens and keyboards."

Oliver's request for support resonated with several seniors, who enthusiastically supported the cause.

"Participating in this campaign gave me a tremendous sense of gratitude for Cal Poly," said Max Parelius (B.S., Computer Engineering, 2015). "I paid my own way through college, so I know how challenging managing expenses can be."

Binh Robles (B.S., Computer Engineering, 2015) echoed Parelius' message. "My classmates and I were often on a tight budget," he recalled. "Buying an extra textbook or materials for a course could mean living on ramen for awhile. If I can help remove an obstacle from a

Computer engineering student Lilly Paul (above) uses the invaluable Nexys board. PHOTO BY DONNA AIKEN

student's educational progress, it's money well spent."

Both alumni said their degrees have led to a multitude of job opportunities, exemplifying how Cal Poly prepares graduates for the real world.

"The reality is that getting through a top-ranking engineering school is tough," said Parelius. "I admire Dr. Oliver for reaching out to us. I know he wouldn't ask us for help if there wasn't a real need."

To participate in the Pay It Forward Campaign, visit cpe.calpoly.edu/pay-it-forward/.

CAL POLY

SAN LUIS OBISPO

Computer Engineering Program

California Polytechnic State University
1 Grand Avenue
San Luis Obispo, CA 93407-0361

Nonprofit
US Postage Paid
Santa Barbara, CA
Permit #TBD

Stress Testers

When Drew Balthazor and Ryan Moelter learned that a portable stress measurement device was not readily available to consumers, they made it their goal to develop one. Their capstone team designed a wearable stress-test prototype that collects raw data, such as heart and perspiration rates, and created a program that can analyze that information to determine the level of stress.

"The device measures body stress similar to a polygraph," explained Moelter, the project leader, "except with our device, you're alerted to your own stress so you can take actions to calm down and relax."

The team is partnering with students in the Kinesiology Department to get feedback about the practicality of their device.

Ryan Moelter (foreground) monitors input on his computer as Drew Balthazor tests the sensors for their project.

PHOTO BY JOANNE MENDOZA

