Carnegie Mellon University
Electrical & Computer Engineering

THE CIRCUIT

undergraduate education
for the new century

welcome

Dear friends of CMU ECE, welcome to the undergraduate edition of The Circuit!

The amazing, smart, passionate undergrads we teach and interact with every day form the core of our educational initiatives, and are at the heart of “E” in our Strategic Plan, FIRE: (Foster, Impact, Research, Educate). We aspire to provide high quality, innovative education to future intellectual leaders and technical trailblazers. We have embarked over the past four years on taking a fresh look at every aspect of our undergrad’s lives: from academics and their “home away from home,” to having fun in social situations with us, their professors, De-Stressing with ECE, and supporting student organizations. This issue offers a glimpse of how far we have come!

Jelena

Jelena Kovačević
Hamerschlag University Professor
Department Head of Electrical and Computer Engineering

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Electrical & Computer ENGINEERING

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Education for the new century

Over the past 25 years, the Department of Electrical and Computer Engineering has revamped the curriculum to better prepare students for life after college.

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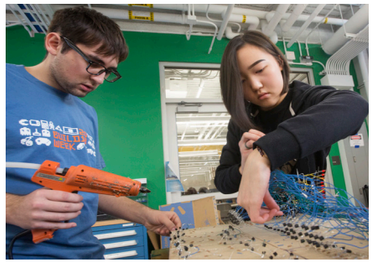

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education transformed

Education for the new century

By Krista Burns

Rigid. Bland. Outdated.

These were the words that students used to describe the ECE curriculum in the 1990s. Surely this is not how a top-tier department wanted to be known. Rob Rutenbar, ECE professor from 1984-2010 and current senior vice chancellor for research at the University of Pittsburgh, together with ECE professors*, knew something had to change. In order to make the ECE curriculum flexible, dynamic, and current, the team spearheaded an effort to wipe the slate clean and rebuild the course structure.

Starting with the undergraduate curriculum, the team revamped the structure so that students had the opportunity to take cross-discipline courses throughout all colleges at the university. By doing so, the department coded interdisciplinary collaboration into its DNA, the academic foundation Carnegie Mellon prides itself on today. This overhaul eventually made its way through the graduate and Ph.D. curricula, establishing a reinvented department for future generations.

Inspired by the Wipe the Slate Clean curriculum revamp in the 1990s, the department continually searches for ways to improve the student experience in the classroom. The maker movement, where DIY meets hacker culture, has filtered through the electrical and computer engineering curriculum. From lab assignments to student-led initiatives, like Build18, the maker culture has a strong and inspiring presence in the department.

A holistic look at the curriculum was engineered at the 2014 Faculty Retreat where about 60 ECE faculty attendees discussed more than 20 topics related to ECE education, organized in themes from undergraduate and graduate education to curriculum revamping and assessment. The education component of the department's Strategic Plan, FIRE: Foster, Impact, Research, Educate, set the tone for maintaining the flexibility that makes the ECE curriculum one to inspire to. With only seven required ECE classes, students have the opportunity to personalize their undergraduate academic experience.

"We learn best by doing," says Jelena Kovačević, department head of electrical and computer engineering. "The essence of electrical and computer engineering is that it is hands-on. We strive to acclimate students when they are here to the tactile culture of the field. I think that is one of the many reasons why our students are so valuable to employers."

The department and the college have been investing in infrastructure and resources that will support the newly formed Maker Ecosystem. The seamless transition between the new nanofabrication facility in Scott Hall, renovations on the C-level of Hamerschlag Hall, and the future ANSYS building will encourage undergraduate research and making. This entrepreneurship corridor will enable students to put into practice what they learn in the classroom.

The final piece of the curriculum puzzle is making sure that students learn how to work with others and dynamically communicate in an impactful way, a learned skill that many engineering students often struggle with. Kovačević and Diana Marculescu, ECE associate head for academic affairs, were determined for their department to produce triple-threat engineers—students who knew how to learn, make, and successfully work and lead teams. This is the backbone of the ECE curriculum.


Diana Marculescu

"Companies are looking for well-rounded electrical and computer engineers," says Marculescu. "They want employees who are not only solidly trained in fundamentals, but can also use their technical expertise to solve socially impactful problems. The ECE curriculum prepares students to be successful in both areas and we are fortunate to have a solid way to assess and adapt our education and curriculum so it fits the ever changing society demands."

Acknowledging that requirements often change, the ECE curriculum is a living, breathing being. Course outlines are constantly being updated and assignments are frequently tweaked.

"We are known to produce top-notch electrical and computer engineers," says Kovačević. "The only way to continue on this path is to step back, look at our curriculum with fresh eyes, and revamp the curriculum to produce highly sought-after engineers for the 21st century."

**The team of ECE professors included: Rob Rutenbar (Editor), Richard Carley, Stephen Director, James Hoburg, Pradeep Khosla, Vijaya Kumar, Ronald Rohrer, Ed Schlesinger, Daniel Stancil, Jay Strosnider, and Donald Thomas.*

18-100 is the first course ECE students enroll in.

18-100: Introduction to Electrical and Computer Engineering

Goals

- Introduce basic concepts in electrical and computer engineering in an integrated manner.
- Motivate basic concepts in the context of real applications.
- Illustrate a logical way of thinking about problems and their solutions.

Perspective

"18-100 is focused on developing literacy and familiarity with the entire spectrum of subjects in ECE. This course is intended to level the playing field and instill in each student a sense that they can find something worth digging into deeply."

Jim Bain, Professor

18-213: Introduction to Computer Systems

Goals

- Provide a programmer's view of how computer systems execute programs, store information, and communicate.
- Enable students to become more effective programmers.
- Serve as a foundation for courses on compilers, networks, operating systems, and computer architecture.

Perspective

"The aim is to explain the enduring concepts underlying all computer systems, and to show students the concrete ways that these ideas affect the correctness, performance, and utility of their application programs."

David O'Hallaron, Professor

18-220: Electronic Devices and Analog Circuits

Goals

- Introduce fundamental topics that are common to a wide variety of electrical engineering devices and systems.
- Allow students to use modern electronic instrumentation and to build and operate circuits that address specific concepts covered lectures.

Perspective

"We wanted to make circuits and electronics exciting and fun, with hands-on labs that relate to real-world systems. The underlying theory and math in the lectures that are now synchronized with the labs becomes relatable to actual products that are of interest to students of all backgrounds in ECE."

Larry Pileggi, Tanoto Professor of Electrical and Computer Engineering

Taken during sophomore year, the four topic courses cover main areas of electrical and computer engineering.

18-500: ECE Design Experience

Goals

- This capstone design course serves to introduce students to broad-based, practical engineering design and applications through an open-ended design problem.
- Student teams work on a project of their choosing, culminating with a final project presentation, report, and public demonstration.

Perspective

"This newly redesigned course takes a crosscutting view on students' undergrad education with the intent of giving students a broader engineering design experience and enable them to understand the big picture implications of their work."

Radu Marculescu, Professor

All ECE students take 18-500 in their senior year.

18-290: Signals and Systems

Goals

- Develop the mathematical foundation and computational tools for processing continuous-time and discrete-time signals in both time and frequency domain.
- Provide background to a wide range of applications.

Perspective

"18-290 is all about the mathematical scaffolding that supports many diverse aspects of ECE. My hope is that students discover the tight inter-connections between all things ECE and appreciate the central role played by 18-290 in bringing it all together."

Aswin Sankaranarayanan, Assistant Professor

18-240: Structure and Design of Digital Systems

Goals

- Introduce basic issues in design and verification of modern digital systems.
- Emphasis is on the fundamentals.

Perspective

"18-240 is about an almost magical concept, where we design hardware that can execute software. This is an important set of ideas, central to most of the technological systems that ECE designs and builds. I love teaching the course and hope that I can open my student's eyes to the incredible possibilities of digital hardware."

Bill Nace, Associate Teaching Professor

After taking all four courses, students typically decide to focus on one subject area for the remainder of their undergraduate career.

new committee

Committed to diversity, inclusion, and outreach

By Daniel Carroll

For over 20 years, Dr. Shawn Blanton has worked with others towards creating a more diverse and inclusive environment within the Department of Electrical and Computer Engineering (ECE). Starting this past fall, he now has a more formal way in pursuing that endeavor. As part of ECE's Strategic Plan for 2020, the department has created the Committee for Diversity, Inclusion and Outreach.

The committee, headed by Blanton, is composed of 13 staff and faculty members from a variety of backgrounds. Their mission is to support the faculty and staff of the ECE department in ensuring an environment where every student, regardless of ethnicity, orientation, or circumstance, feels welcomed and given every opportunity to succeed and thrive.

To achieve this vision, the committee is working towards a vertical approach that appeals to students and partners at every level: K-12 outreach, prospective students, admissions, current students, and prospective and current faculty. Beginning in the fall of 2017, the committee has met monthly and has already begun promoting existing ECE programs, while also working on a number of new initiatives, such as the formalization of the department's travel support program, the establishment of open "Ask Me Anything" office hours for students, and updates to the department's diversity handbook.

In addition, the College of Engineering's Strategic Plan for Diversity, Inclusion and Equity calls for each department within the college to create its own plan to help promote the larger college-wide objectives. This is the largest task on the horizon for the committee, which will be intimately involved in formulating the ECE department's contribution to the overall college effort.

The department has already made great headway towards promoting a more diverse environment. Within the last three years the number of undergraduate women within ECE has increased by 10%, and in just the last two years alone the department has hired five female junior faculty members. These are outstanding results, however there is still plenty for the committee to improve upon.

In the end, for Blanton, the key to measuring the committee's future success all comes back to the numbers. Statistics like these will truly demonstrate the department's commitment to diversity, inclusion, and outreach.

"In this era of big data, we plan to track committee progress not only qualitatively, but quantitatively," he says. "I truly believe that after a decade of work, we will all be able to look back and observe tangible improvements in the diverse and inclusive environment of the department."

Teaching the teaching assistants

Teaching Assistants are crucial in any college-level course. They conduct recitations, grade papers, and are often the first point-of-contact for students enrolled in a course. To ensure that all electrical and computer engineering Teaching Assistants (TAs) are prepared and qualified for the position, the department has created a mandatory training program for all students interested in becoming a TA.

"The goal of the Teaching Assistant Education Program (TAEP) is to provide a solid foundation for ECE students to be successful teaching assistants," says Leona Kass, director of student and academic affairs. "Not only for the TAs' own professional development, but also for their students to have an enriching learning experience."

Interested students are required to complete foundational preparation work prior to coming to campus or during the semester prior to becoming a TA. Throughout the first few weeks of classes, TAEP offers workshops and trainings.

"The required workshops and trainings prepare TAs for both academic and social issues," says Kass. "We equip them to identify concerns ranging from academic integrity issues to how to offer initial help in a mental health crisis. I'm proud that we are able to offer TAEP to our TAs. It makes them better teachers and mentors."

Training sessions include:

- **Improv** • Improv workshops are interactive and participatory where students practice using verbal, vocal, and visual channels in a supportive and fun environment.
- **Fundamentals of teaching** • Students learn the essential skills needed to be a successful educator, including creating lesson plans, motivating students to acquire, retain, and apply what they are learning, and effective communication skills.
- **Teaching a solid recitation** • Students obtain tips for leading a recitation and learn strategies for encouraging student discussion and participation.
- **Classroom presentation skills** • Students learn how to create organized PowerPoint presentations and gain effective public speaking skills.
- **Teamwork in the classroom** • Students learn skills for encouraging and fostering cohesive teamwork in the classroom and how to deal with underperforming team members.
- **Developing and teaching metacognitive skills** • TAs learn strategies to help students think metacognitively about course content, the importance of learning as opposed to just getting the correct answer, and approaches for helping students prepare for assignments, mid-terms, and homework.
- **Diversity and inclusion** • Students learn skills for creating safe and inclusive classrooms, while considering racial, ethnic, cultural, gender, sexual orientation, and disabilities.
- **AlcoholEdu** • This online program discusses drinking in college, when it can become dangerous, and strategies for staying safe.
- **Haven** • This online program focuses on important issues impacting college students; relationship violence, sexual assault, stalking, and sexual harassment.
- **Mental health first aid** • Introduces TAs to risk factors and warning signs of mental illnesses, demonstrates how to offer initial help in a mental health crisis, and how to connect students to the appropriate professional, social, and self-help care.
- **Stress management** • Identifies what stress is and techniques for properly managing it.
- **Working as a TA** • This training takes place at the beginning of every semester and covers payroll, department expectations, cheating cases, expectations of the instructor, academic integrity, and student privacy.
- **Introduction to ECE labs** • This training covers lab safety, gives an overview of equipment in the lab, how to report issues, and ordering parts for projects.

> "I'm proud that we are able to offer TAEP to our TAs. It makes them better teachers and mentors."

Leona Kass, Director of Student and Academic Affairs

Get to know ECE

Between registering for courses and joining student clubs, the undergraduate experience can be intimidating at times. Throughout the academic year, the department hosts multiple fairs and open houses aimed at helping undergraduate students, specifically freshmen and sophomores, navigate college life.

First year open house

Designed for first-year engineering students interested in majoring in electrical and computer engineering, this open house showcases a typical curriculum and the opportunity to meet the undergraduate advisors.

Sophomore welcome

Held at the beginning of every academic year, this is an opportunity for newly declared sophomore students to meet the department head, their assigned advisor, representatives from student clubs and employer relations, and student support services.

Registration fair

Held in the spring after first-year engineering students declare electrical and computer engineering as their major, this fair guides students through the course selection process. Geared towards rising sophomores, but open to all undergraduates, students are introduced to the core ECE courses, faculty, and advisors.

"I've been so pleased to see programs like the registration fair take hold and help our incoming sophomores navigate scheduling and create connections as early as they can!"

Vickie Woodhead, Undergraduate Academic Advisor

De-stress with ECE

By Krista Burns

The weeks leading up to finals can be stressful for students. Between balancing final projects and studying for exams, the end of the semester often leads to anxiety and concern. Recognizing this pattern, the department created De-stress with ECE to address ongoing stress management, especially during particularly challenging times of the semester.

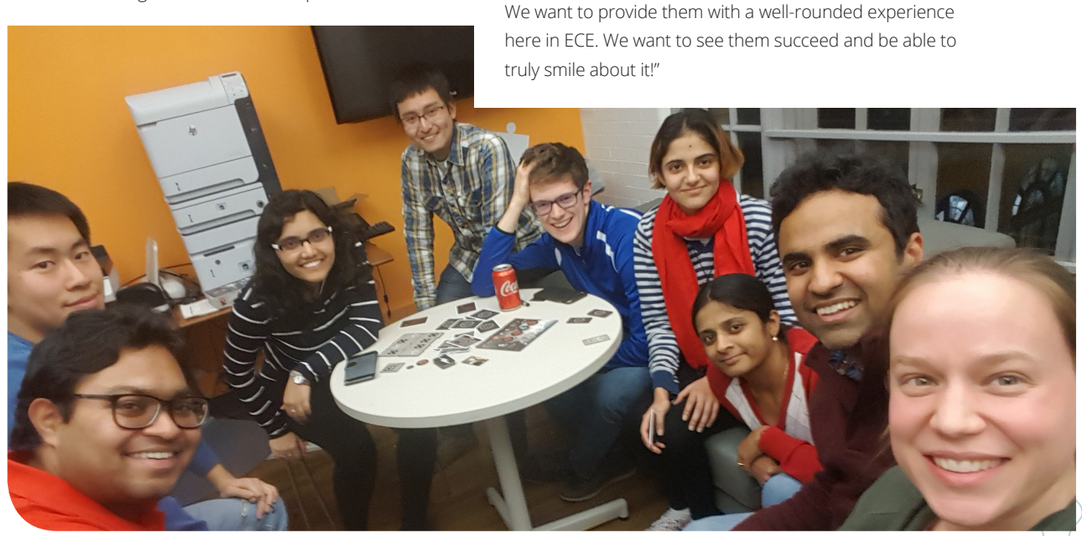
"I noticed students' stress levels rising during particular times throughout the semester," says Bari Morchower, student organizations and activities advisor. "And wanted to live up to the old adage of work hard, play hard by complementing our academic rigor with activities that are as interesting and fun. By creating De-stress with ECE, we hope to offer opportunities for students to relax and think of something else besides homework, projects, and tests for a little while."

De-stress with ECE activities take place every semester. In the past, events have included mental wellness workshops on a range of topics including stress management and finding happiness. During particularly stressful times of the semester, such as midterms and finals weeks, the department provides snacks and catered meals. Students are also encouraged to visit wellness spaces in ECE department lounges. These spaces are available day and night, and equipped with coloring books, games, snacks, and blank stationary so students can write encouraging notes to each other and their families.

Along with wellness spaces, students have the opportunity to attend numerous events and activities, like movie nights, guided relaxation sessions, and yoga classes provided by the university. Faculty and staff members often lead workshops throughout the initiative. Last year, Diana Marculescu, associate department head for academic affairs, led a workshop on continental knitting, while Vickie Woodhead, undergraduate academic advisor, spearheaded an origami session.

Students are also encouraged to attend a Let's Listen to Each Other panel, a new series that underscores and highlights the importance of inclusion in the department. Attendees can share personal experiences, offer advice, or just listen in a safe and welcoming environment.

"By offering De-stress with ECE, my hope is that students recognize how important it is to incorporate non-academic related activities into their lives," says Morchower. "And that the department cares for their well-being. Our students work hard and we hope they learn how to play hard, too. We want to provide them with a well-rounded experience here in ECE. We want to see them succeed and be able to truly smile about it!"



Assistant Professor Pulkit Grover hosts a game night as part of the De-stress with ECE series.

The new undergraduate wing

Home to the Department of Electrical and Computer Engineering, Hamerschlag Hall is a Pittsburgh historic landmark. Built in the early 1900s, the structure has become an icon on campus. To maintain usable workspaces, the department frequently conducts renovations. Undergraduate students recently asked if the department could update the undergraduate wing—and the department answered! Below is an overview of the newly renovated undergraduate wing.

Welcome area

Featuring a couch and magazine rack, the welcome area is the entrance to the undergraduate wing. Since the welcome area is a common meeting spot for prospective students and families, don't be surprised if you find this area filled with families waiting for a tour of the department.

Café

Waist-high counters have been installed in the first alcove along with whiteboard paint. This set-up provides extra seating for dining and studying.

Digital displays

Digital displays have been installed in two of the study alcoves. Students are able to connect to these displays via provided wires. Screen sharing allows for student collaboration on projects and assignments.

Whiteboard paint

Whiteboard paint has been added to many of the walls in the undergraduate wing, along with dry-erase markers and cleaner.

Student lounge

The focal point of the new undergraduate wing is the student lounge. A new couch, beanbag chairs, whiteboard paint, and a digital display provides students with an inspiring yet relaxing atmosphere.

> "The lounge has been a good place to host small events, hang out with friends, or just simply relax."
>
> **Paola Aguilar, ECE masters student**

let's talk

Preparing for life after ECE

By Nathan Healy

Let's talk.

To kick off the fall 2018 term, the Department of Electrical and Computer Engineering (ECE) and the School of Computer Science (SCS) will hold the sixth installment of their joint career event, Let's Talk.

At Let's Talk, undergraduate students in ECE and SCS programs have the chance to meet potential employers in a casual, low-stakes environment.

According to Catherine Copetas, SCS director of industrial and employer relations, there is a natural symbiosis between ECE and SCS students. Their work—like the work of so many businesses—revolves around the same thing: the critical engineering science behind computers.

Let's Talk is held in the Gates and Hillman Centers, Carnegie Mellon's complex for computer science and future generation technologies. An obvious win-win, visiting companies are afforded the chance to visit students where they work while students are able to ask questions of industry professionals in an arena that, for them, is familiar and comfortable.

Let's Talk made its debut in the fall of 2015. Copetas shared that, from day one, the goal of the initiative has been to create a space where employers and students can talk to each other and be heard; where focused, productive conversations about careers and the realities of professional life can be had; where employers can learn—really learn—about a student, what they are working on, and what they hope to do in the future.

In the past, companies both large and small have taken part in Let's Talk. Andreessen Horowitz, Ansys, and Apple have attended. Bloomberg, Electronic Arts, Facebook, and Google have taken part alongside The Hershey Company, Ford, Lutron, Nvidia, and Uber, said Copetas. On average, roughly 50 companies attend each Let's Talk event.

Copetas said that, in the future, Let's Talk events will expand in size, but only within reason. It's important that they remain casual and comfortable.

So take a seat.

We'll chat for a bit about what's on your horizon.

build18.org

ece.cmu.edu/~ego

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ECE student organizations

The department is committed to developing well rounded students, both in and out of the classroom. ECE students not only participate in engineering specific events, but campus and city-wide activities, too.

The department has many organizations and societies, as well as student run activities. Students also have the opportunity to develop professional skills through the Tech/Career Talks held each semester. Beyond the boundaries of the department, the College of Engineering and the university also support and encourage a wide range of student intellectual, technical, professional, social, and sporting activities. The following is a list of student-run organizations in ECE.

Build18

This annual "freestyle tinkering" festival serves as an intellectual playground for the brightest and most creative Carnegie Mellon students. Taking place at the beginning of the spring semester, Build18 is open to all CMU students who are interested in tinkering for fun.

EGO

The ECE Graduate Organization (EGO) promotes networking and social events for graduate students. EGO sponsors many events throughout the year, including a fall picnic and a winter gala. All ECE graduate students are automatically members of this organization.

ECE Outreach

ECE Outreach aims to provide grade school, middle school, and high school students with opportunities to learn about engineering and figure out whether it is a good career choice for them.

Eta Kappa Nu

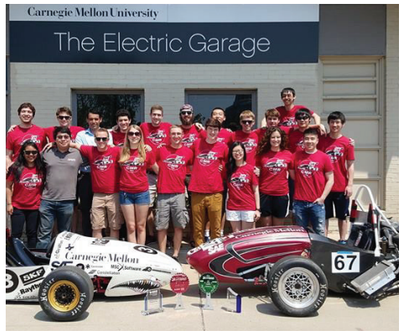
Eta Kappa Nu (HKN) is the CMU student chapter of the national ECE honor society. HKN's goal is to provide Carnegie Mellon ECE students with opportunities to meaningfully interact with faculty members, industry leaders, and their peers.

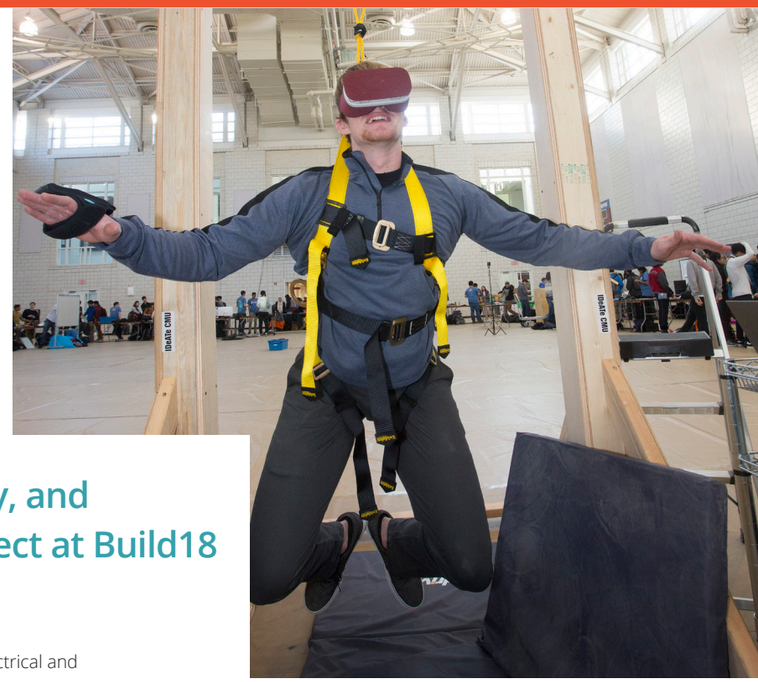
IEEE

The student chapter of the Institute of Electrical and Electronics Engineers (IEEE) provides a social, technical, and professional community to the ECE student body. IEEE hosts weekly Tech/Career Talks, social and sporting events, as well as an ECE Day barbecue.

WinECE

Women in ECE (WinECE) is an organization dedicated to building a sense of community among the women in ECE. It is open to bachelor's, master's, and doctoral students. Mentoring, outreach events, social/professional gatherings, and semester dinners are just a few of the events WinECE plans every year.





build18

Creativity, curiosity, and engineering intersect at Build18

By Krista Burns

Several years ago, members of the Electrical and Computer Engineering Student Advisory Committee were asked what would improve their experience at Carnegie Mellon University. If they lacked anything, it was the ability to work with teams and ideas of their choosing purely for the joy of tinkering, not for a grade.

Build18's mission is to provide students with a risk-free environment to pursue personal engineering challenges, where the only limiting factor to creation is their own ingenuity. Originally named after the electrical and computer engineering (ECE) course prefix, Build18 signifies the start of the spring semester and a chance for students to build for fun.

"Build18 is where creativity, curiosity, and engineering intersect," says Cyrus Tabrizi, a Build18 co-chair. "It's a chance for every innovator at Carnegie Mellon—every student and faculty member with a passion for invention—to make and break things together in pursuit of new ideas. It is exciting to see what everyone comes up with every year!"

Build18 activities and events are funded each year by alumni and corporate sponsors. The festival typically has well-known technology company sponsors, many of whom attend some or all of the Build Week activities. In addition to supporting the festival, a few sponsoring companies host Innovation Tech Talks exclusively for Carnegie Mellon students. These seminars allow builders the opportunity to learn how their projects may be adapted in the real world.

The intense week of building culminates with Demonstration Day, when teams showcase their projects to the public. Visitors have the chance to interact with projects, ask questions, and enjoy the innovative spirit of the festival. This year, some of the projects that were showcased included a motion controlled drone, virtual quidditch, a wireless phone charger, and a smart mirror.

Immediately following the demonstrations, Build18 concludes with a banquet where builders, sponsors, and faculty members celebrate the achievements from the past week. In an effort to maintain the creative spirit of the event, recent Build18 alumni hold panel discussions focusing on the importance of creativity in the workplace.

Build18 is a natural and exciting outgrowth of Carnegie Mellon's strengths: problem-solving, collaboration and teamwork, and a roll-up-your-sleeves work ethic. Simply put, Build18 serves as an engineer's playground for students who love the art of engineering.

For more information, including the 2018 sponsors, please visit build18.org.

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