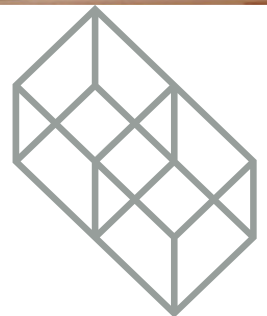


# SUSTAINING A LEGACY OF INNOVATION



ALBERT NERKEN SCHOOL OF ENGINEERING | 2025 STRATEGIC PLAN  
THE COOPER UNION FOR THE ADVANCEMENT OF SCIENCE AND ART





## FROM THE DEAN



The Albert Nerken School of Engineering at The Cooper Union for the Advancement of Science and Art is one of the most prestigious and selective engineering schools in the United States, consistently ranked within the top ten undergraduate engineering programs among non-doctorate-awarding schools nationwide. Defining characteristics of our engineering curriculum include rigorous preparation in mathematics and natural sciences, emphasis on project-based learning, strong integration of undergraduate research, and rich opportunities for graduate-level coursework while an undergraduate. We admit exceptionally talented students, nurture and develop their talents, encourage them to work and learn at their highest levels, and instill in them the desire and the ability to use their engineering background

to fulfill their potential as knowledgeable, creative, and responsible leaders in society. Our faculty and staff are committed to Peter Cooper's founding vision of providing an education equal to the best without regard to class, gender, or race in the promotion of an enlightened citizenship.

Educational innovation and our graduates' successes and accomplishments have been foundational to the rich heritage and legacy that sustains our exceptional reputation in higher education. Among our graduates are a Nobel laureate, civic leaders, and innovators whose achievements range from developing the first Global Positioning System, to pioneering applications of artificial intelligence, to designing the infrastructures that support and shape everyday life here in New York City. In our commitment to preserve this rich heritage and reputation while simultaneously positioning our school for the future, the Albert Nerken School of Engineering is now at an inflection point. The faculty and staff are envisioning a vibrant future in which we prepare our graduates to succeed in a dynamic and increasingly complex world. This includes a commitment to educational innovation and leading-edge pedagogies, integration of ethical design and leadership, and experimentation in the curriculum. We will actively pursue interdisciplinary approaches at the intersection of art, architecture, engineering, and the humanities and social sciences and collaborate across disciplinary boundaries to create innovative solutions to societal challenges. We seek to promote Peter Cooper's proposition that civic virtue and harmony follow from education. We are committed to instilling a sense of social justice that translates into action by inspiring our community to apply their expertise and leadership for the benefit of society and humanity.

What follows is the strategic plan for the Albert Nerken School of Engineering. It was informed by an assessment of the external environment including topics such as population growth; changing demographics; the global economy; emerging social, political, and cultural influences; the grand challenges facing society; and trends in higher education. It aligns with The Cooper Union's institutional goals and strategic priorities but with an engineering focus. Faculty and student input and feedback were key to the high quality of the final product and the unanimous adoption by the faculty. This document reflects the foundational principles and goals that will guide our organization through the year 2025.

“LEADERSHIP IS ABOUT SETTING THE CONDITIONS SO THAT OTHERS CAN SUCCEED.”  
—BARRY L. SHOOP

**Barry L. Shoop, Ph.D., P.E.** | Dean, Albert Nerken School of Engineering

# ENVIRONMENTAL TRENDS

To position the Albert Nerken School of Engineering and our graduates for continued success it is useful to broadly consider changes in our world that will impact our organization, our disciplines, and our graduates. The following are offered as relevant environmental data<sup>1</sup> to inform the development and execution of our strategy for 2025.

The long-term global economic outlook predicts a shift of economic power to the developing world. China, India, and Brazil, as well as countries like Colombia, Indonesia, Malaysia, Mexico, Nigeria, South Africa, Turkey, and Vietnam will become more important in the global economy. India, China, Africa, and Southeast Asia markets together hold the potential for significant continued economic expansion. Analysts expect more than half of the global growth over the next ten years to come from these geographic areas.

The world's population will add more than one billion people over the next decade reaching 8.5 billion by 2030. Projections estimate that this will grow to 9.7 billion by 2050 and exceed 11 billion by 2100. Most of the growth in the world's working-age population will occur in India and the developing economies of Africa and South Asia, placing pressure on education and employment systems

in these nations that are least capable of supporting this growth economically, politically, and environmentally. We're witnessing increased urbanization as people move to cities—a trend that, for many nations, will continue throughout the next several decades. People will be more mobile in the future, changing migration patterns<sup>2</sup> worldwide as they more freely move about the globe. Economic migrants will be the fastest growing group of migrants as the demand for both skilled and unskilled labor increases. Ethnic and cultural diversity of national populations will increase, reshaping demographics as well as national values and attitudes in the decades ahead. We will see increasing participation of women in the world's economy, and entry into the workforce by an entire generation of young people who grew up with computers, the Internet, mobile phones, texting, and social networking.

In 1990, there were ten “megacities” in the world, with 10 million inhabitants or more, which were home to 153 million people or 7% of the global urban population. In 2016, there were 31 megacities worldwide, home to 453 million people or about 12% of the world's urban dwellers. Today there are 33 megacities, with that number projected to grow to 41 by 2030. Growing urbanization and

megacities in both emerging and developed markets—reflecting shifting economic and demographic trends—will create enormous need for new infrastructure. Aging populations in Western Europe and Japan, for instance, will require additional healthcare facilities, while countries in Sub-Saharan Africa, the Middle East, and many parts of Asia-Pacific will need more schools. Worldwide investments in telecommunications, road, rail, water, electricity generation, and other energy-related infrastructure will need to increase.

The nearly nine billion people sharing our planet in 2030 will increase demands for food, water, energy, other natural resources, and infrastructure. Several of the underlying factors impacting the environment include population growth, polluting technologies, and unsustainable consumption-and-production patterns. Other environmental challenges include climate change, degradation of air and land, water scarcity, deforestation, marine pollution, and a decline in biodiversity. In October 2018, the United Nations' Intergovernmental Panel on Climate Change reported that if greenhouse gas emissions are sustained at the current rate, atmospheric warming will exceed 1.5°C over pre-industrial levels as

early as 2030, resulting in far more dire consequences for human and natural systems than had previously been projected. The report urged “rapid, far-reaching and unprecedented changes in all aspects of society” and cited “acceleration of technological innovation” as an important measure for mitigating the environmental impacts of climate change.<sup>3</sup>

The U.N. has also identified 17 Sustainable Development Goals (SDGs) including climate change, gender equality, affordable and clean energy, industry, innovation and infrastructure, sustainable consumption, and sustainable cities and communities, among other priorities. Being good stewards of our world and resources for future generations can be considered a megatrend that can be viewed through societal, economic, and governmental lenses. The need for societal and economic sustainability as well as global responsibility is critical.

The U.S. National Academy of Engineering (NAE), the Royal Academy of Engineering (RAE), and the Chinese Academy of Engineering (CAE) held a Global Grand Challenges Summit (GGCS) in 2017 to address some of the most pressing issues and promising innovations at the time. The challenges included virtual reality, AI, health care, climate change, and education of future engineers. The 2017 Summit was



the third in a series that focused on the four themes of the NAE Grand Challenges for Engineering: sustainability, health, security, and joy of living, as well as education and public engagement related to the Grand Challenges.

In 2012, the American Society of Engineering Education (ASEE) supported in part by a grant from the National Science Foundation (NSF), published the report *Innovation with Impact*<sup>4</sup> which outlined changes to engineering professional practice and suggested corresponding changes required for engineering education. The report found that engineering careers had become increasingly collaborative, multidisciplinary, entrepreneurial, and global, and as the pace of change of

technological innovation accelerated, the expectation for engineering education had expanded. To the foundations of mathematics, science, engineering fundamentals, disciplinary depth, and professional and ethical standards have been added interdisciplinary breadth; communications; teamwork; global economic, environmental, and societal contexts; ethical design; critical thinking; innovation; creativity; leadership; and the list continues to grow. Additionally, as faculties and student bodies become more diverse, there is a need to make engineering programs more engaging, relevant, and more welcoming, especially to groups traditionally underrepresented in engineering.

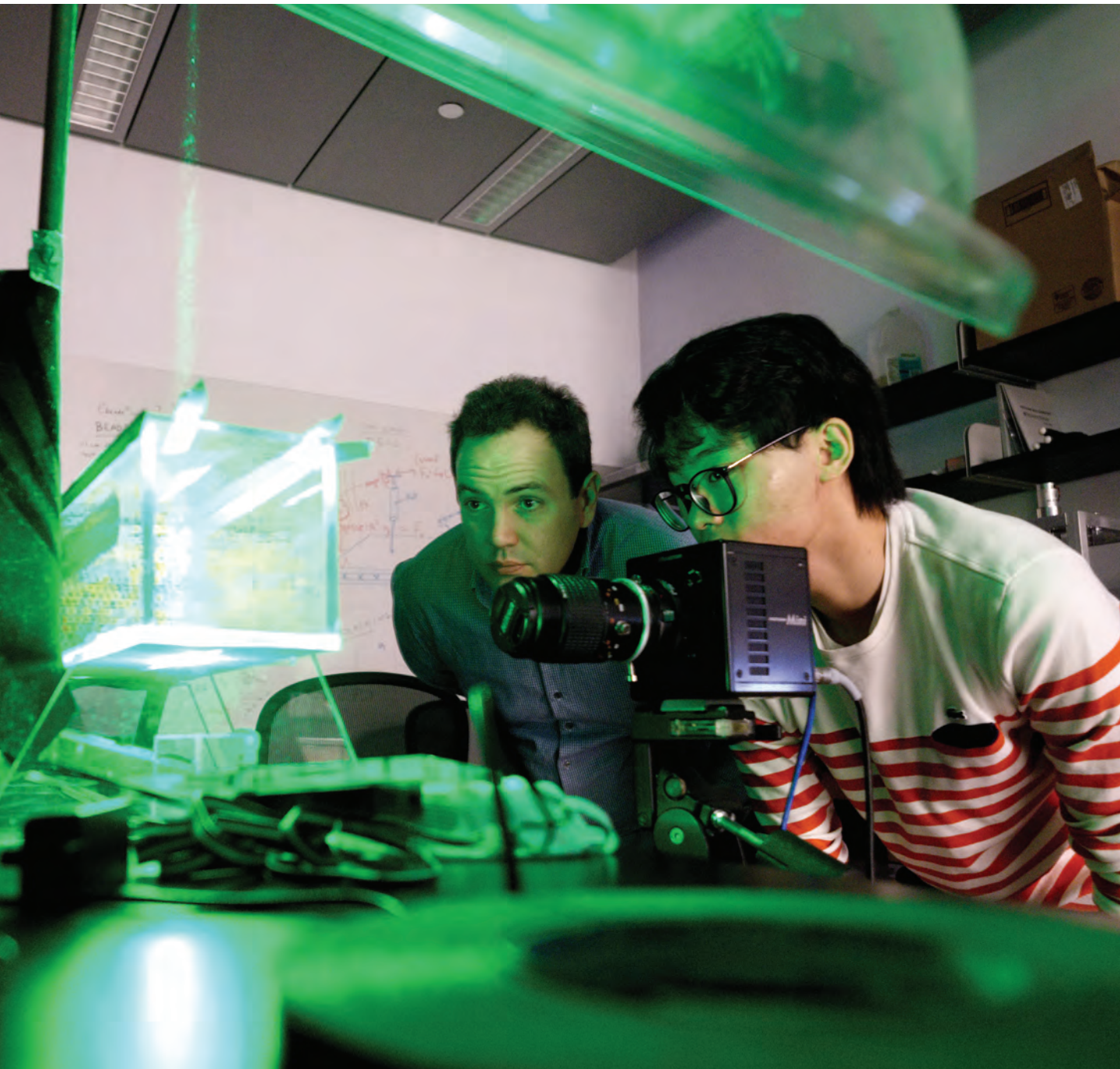
“SCIENTISTS STUDY THE WORLD AS IT IS; ENGINEERS CREATE THE WORLD THAT HAS NEVER BEEN.”  
—THEODORE VON KARMAN

<sup>1</sup> Excerpts from “Change Drivers for IEEE,” John Keaton, 2017

<sup>2</sup> United Nations Research Institute for Social Development, *Global Trends, Challenges and Opportunities in the Implementation of the Sustainable Development Goals*, 2017

<sup>3</sup> IPCC, *Special Report on Global Warming of 1.5°C (SR15)*, 2018

<sup>4</sup> “Innovation with Impact, Creating a Culture for Scholarly and Systematic Innovation in Engineering Education,” American Society for Engineering Education, 2012



“YOU MISS 100% OF THE SHOTS YOU DON’T TAKE.” —WAYNE GRETZKY

As one of the schools of The Cooper Union for the Advancement of Science and Art, the Albert Nerken School of Engineering Strategy is necessarily nested within and supports the institution’s strategic goals. In December of 2018, the Cooper Union Board of Trustees approved a set of institutional goals and strategic priorities that the Cabinet and the community worked to develop over the course of a year. For completeness, the organizational goals and strategic priorities are included here.

## INSTITUTIONAL GOALS

- Create an institution of excellence that:
  - engages students in an academic program that is rigorous, supportive, and dynamic
  - fosters a culture of curiosity, agency, compassion, and engagement
  - is tuition-free and financially resilient
- Prepare students to question and lead in a complex world
- Develop leading-edge models for higher education that consider the ethical, cultural, and environmental contexts and consequences of technical and creative disciplines
- Lead by example to promote civil discourse and engagement on important civic issues
- Advance the fields of architecture, art, and engineering and foster intersections of study and practice among them

## STRATEGIC PRIORITIES

- Fortify our rigorous professional schools
- Return The Cooper Union to full-tuition scholarships
- Create opportunities for experimentation at the intersections of disciplines
- Increase compositional diversity and diversity of thought, background, and experiences
- Balance budget, build reserves, instill financial discipline
- Develop programs, activities, and physical space to increase student engagement and improve student, staff, and faculty life
- Set a leading-edge standard for the integration of professional, practice-based education with a humanities and socio-political education
- Integrate debate, public discourse, and public service orientation into academics, and actively contribute to betterment of New York
- Position the Great Hall as a premier forum to advance critical issues of our time



“AT ITS HEART ENGINEERING IS ABOUT USING SCIENCE TO FIND CREATIVE PRACTICAL SOLUTIONS. IT’S A NOBLE PROFESSION.” —QUEEN ELIZABETH II

The role and influence of technological innovation on the human experience has fundamentally changed in the recent past. Historically, technology played a secondary and supportive role while social, economic, political, and cultural dimensions played a primary role. Today, technological innovation is actually leading these dimensions in the influence on humanity. Consider, for example, recent influences of technologies like personal communication, robotics, distributed computing, cyber, and others on the human dimension. Smart phones have advanced to a point where they not only allow 24/7 connectivity but they provide geolocation information to aid in personal navigation, provide geotagged high-resolution photographs and videos, monitor personal health and fitness, and provide real-time language translation. Robotics applications are diverse and include industrial automation, video collaboration, co-robots acting in direct support of and in a symbiotic relationship with human partners, autonomous vehicles and even robotically-assisted minimally-invasive surgery. The cloud is now where data is accessed, processed, and stored. There have been numerous headlines in *The New York Times*, *The Wall Street Journal*, *Bloomberg News*, and others reporting cyber-attacks that subsequently resulted in geopolitical consequences.

With the knowledge of this changed role of technological innovation, the primary question to ask is what attributes will future professionals require to succeed and lead in this new environment? A recent survey of CEOs by PricewaterhouseCoopers (PwC) provides some insights. According to the survey, industry leaders are looking for employees to do more than perform well as skilled professionals. They also want them to anticipate external issues—such as public policies and regulation, and the convergence of technologies—that affect their disciplines and fields of interest. The CEOs also place high value on the ability to work collaboratively—with fellow professionals, stakeholders, and others—to create comprehensive, balanced, and effective



“THE MOST DANGEROUS PHRASE IN THE LANGUAGE IS,  
‘WE’VE ALWAYS DONE IT THIS WAY.’”  
—GRACE HOPPER

initiatives and solutions. The ability to build diverse and well-aligned partnerships will be a hallmark of successful leaders in our fields. Similarly, tomorrow’s technology leaders must work as synthesists—individuals who can draw expertise from an array of disciplines and bring that knowledge to bear on multidisciplinary and interdisciplinary problems. A successful leader in

such an environment will have to draw not only on deep disciplinary knowledge but also on modern professional skills: written and oral communications, teamwork, critical thinking, innovation, and entrepreneurship. Some have called this the rise of the “T-shaped” individual, a reference to a deep knowledge of a single field of interest coupled with other broad abilities—the so-called

soft skills and a firm grounding in collaboration.<sup>3</sup> We are committed to further expand beyond disciplinary knowledge and modern professional skills and include ethical design, social responsibility, civic virtue, and the courage to act.

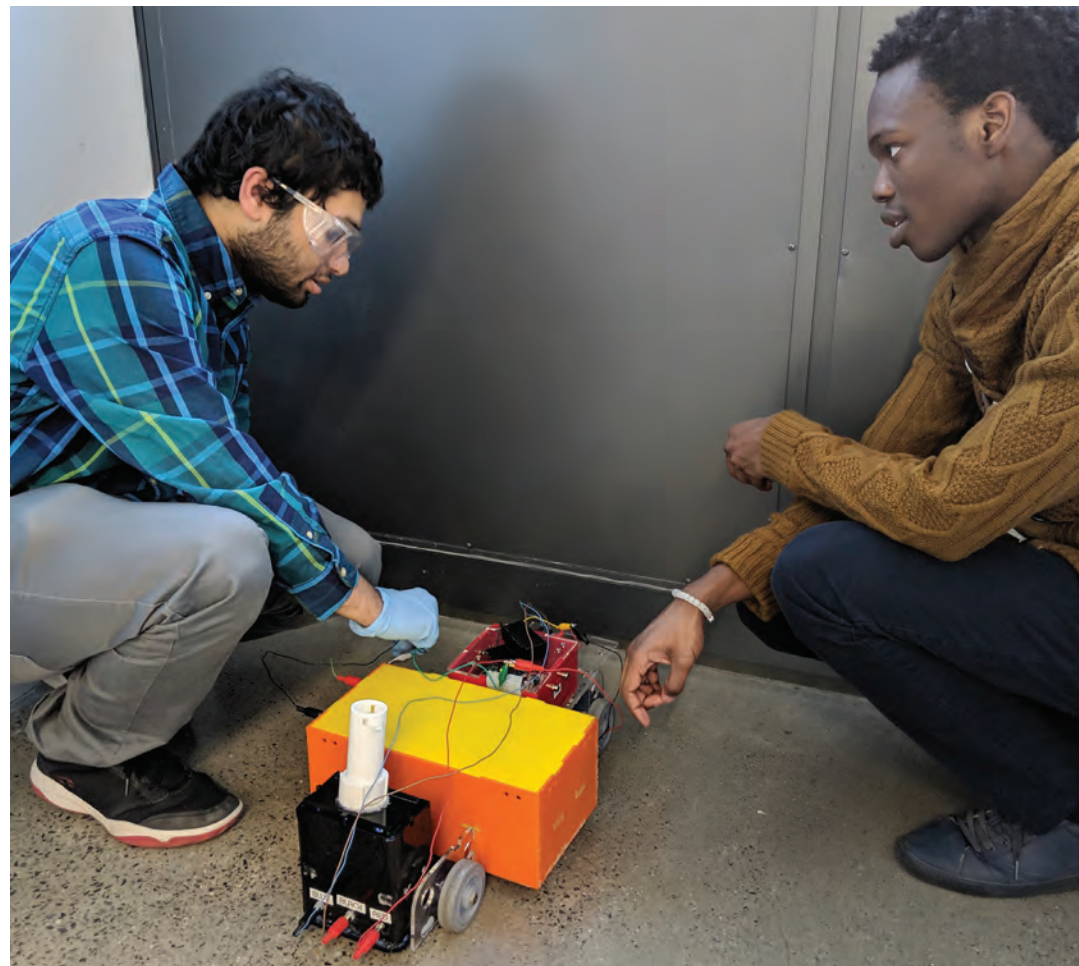
<sup>3</sup> Adapted from the original article “The Face of Leadership,” B.L. Shoop, The Institute, IEEE, March 2016

# MISSION

The Albert Nerken School of Engineering is a learning community committed to educational excellence that fosters creativity, critical thinking, innovation, and civic engagement through experiential, project-based and interdisciplinary learning. We bring together talented and diverse students and engage them in a modern math, science, and engineering curriculum that is rigorous, dynamic, and supportive. We inspire our students to achieve their full potential and apply their expertise and leadership for the benefit of society and humanity.

# VISION

A model learning community that engages talented and diverse students in an intellectually challenging, supportive, and exceptional academic program. Our graduates are inventive, creative, and influential individuals who make impactful contributions to society and humanity.



# CORE VALUES

Our core values are the principles that guide our internal conduct and our relationship with the external world. Living these core values creates a culture within the Albert Nerken School of Engineering that supports students, faculty, and staff in all we do.

## RESPECT

We treat others as they would have us treat them. We support the vigorous and open debate of ideas within a community marked by mutual respect.

## INTEGRITY

We value ethical behavior, integrity, and transparency in all aspects of life. We respect others; conduct ourselves ethically, honestly, and openly; honor our commitments; and fairly resolve ethical issues.

## DIVERSITY & INCLUSION

We are committed to Peter Cooper's radical commitment to diversity and value, living and working in a diverse community. We value, encourage, and promote all aspects of human differences, fostering a culture that embraces a broad variety of personal circumstances, experiences, perspectives, and opinions.

## INTERDISCIPLINARITY

We value interdisciplinary approaches and the intersection of art, architecture, humanities, and engineering. We collaborate across disciplinary boundaries to create innovative solutions to societal challenges.

## TEAMWORK

We embrace a developmental culture, one in which cooperation and collaboration are cornerstones. Our faculty, staff, and students are collaborative, supportive, and serve as role models and mentors for professional and personal growth.

## FREE

We are committed to Peter Cooper's vision of a free center of learning.

## SOCIAL IMPACT

Through our engagement we instill a sense of social justice that translates into action. We inspire members of our community to apply their expertise and leadership for the benefit of society and humanity.

## PARTNERSHIP

We are an engaged partner with industry, academia, government, and the communities in which we live. We are an indispensable partner with New York City.

# STRATEGIC GOALS

## STUDENT SUCCESS

We recruit and admit exceptionally talented and diverse students, provide an environment that fosters student success and inspire them to achieve their full-potential and apply their expertise and leadership skills for the benefit of society and humanity.

## EDUCATIONAL EXCELLENCE

The Albert Nerken School of Engineering is a recognized leader in undergraduate math, science, and engineering education and innovation. Our majors are nationally accredited and highly regarded within the community of higher education. The School of Engineering is a model learning community that fosters creativity, critical thinking, innovation, and civic engagement through experiential, project-based, and interdisciplinary learning.

## EXCEPTIONAL TEAM

Our faculty and staff are an exceptional team of professionals who are collaborative, supportive, and serve as role models and mentors for professional and personal growth. Each member makes their personal best contributions to our mission while simultaneously valuing the contributions of others.

## POSITIVE ORGANIZATIONAL CULTURE

Our culture prizes initiative, innovation, and accomplishment for the team, underpinned by enthusiasm for learning in all our disciplines. Our organization is kind and fair to people, assigning work equitably, honoring preference, recognizing, and rewarding excellence and enabling continued professional success.

## DIVERSITY AND INCLUSION

The Albert Nerken School of Engineering values, encourages, promotes, and celebrates all aspects of human differences, fostering a culture that embraces a broad variety of personal circumstances, experiences, perspectives, and opinions.

## ENHANCE RESOURCES AND ORGANIZATIONAL EFFECTIVENESS

We will work relentlessly to become tuition-free and financially resilient. We will constantly pursue the effective and efficient use of human, financial, and facility resources. We will be a model of shared governance and operate in a transparent and inclusive way.

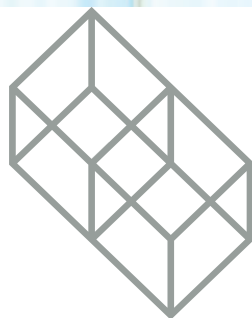
## IMPACTFUL ENGAGEMENT

Our faculty, staff, and students are leaders who engage in civil discourse and engagement on important civic issues. We positively influence and impact our professions and our community.



“I HAVE BEEN IMPRESSED WITH THE URGENCY OF DOING. KNOWING IS NOT ENOUGH; WE MUST APPLY. BEING WILLING IS NOT ENOUGH; WE MUST DO.” —LEONARDO DA VINCI





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