OLD DOMINION UNIVERSITY

Department of Electrical and Computer Engineering

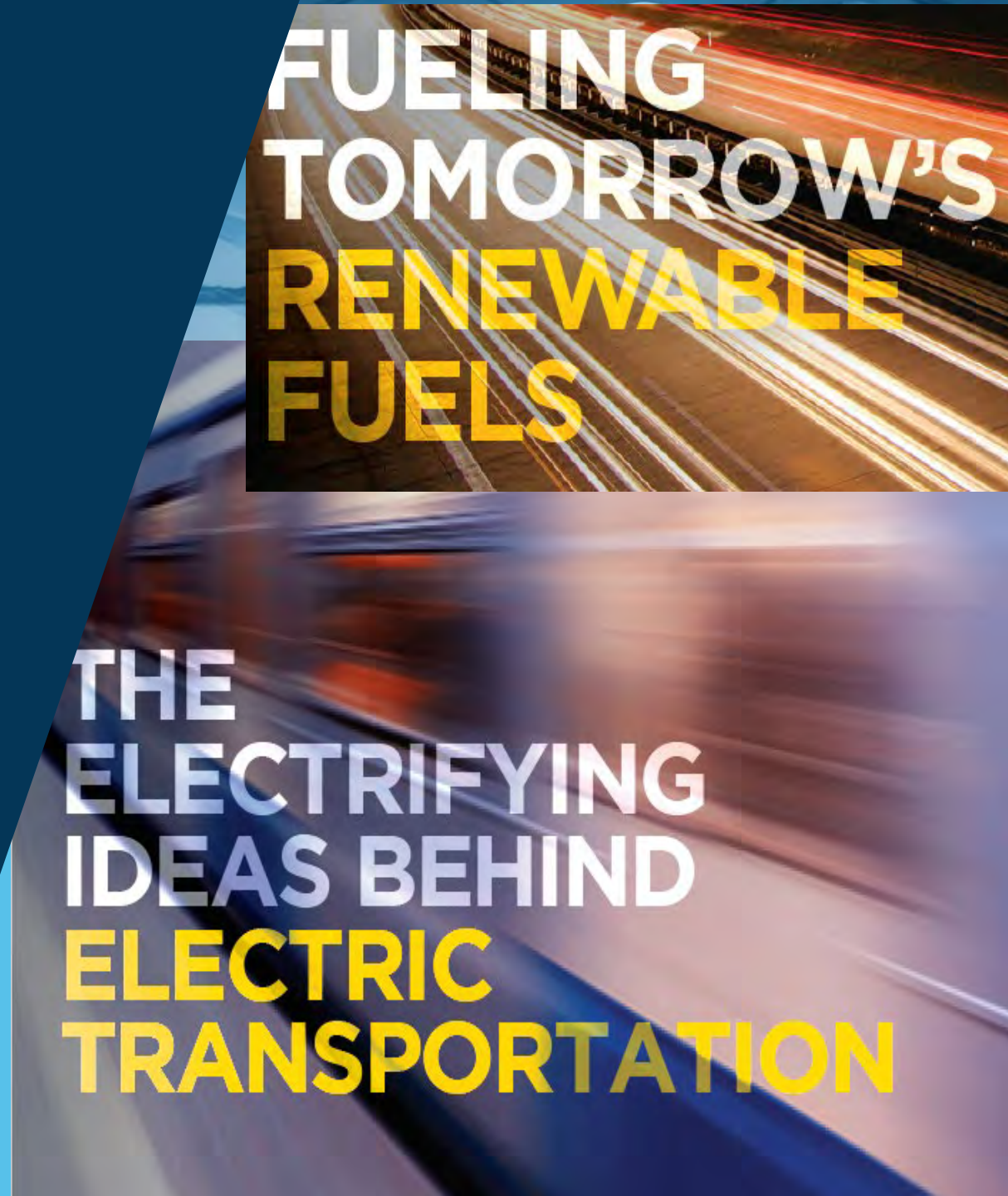
What are Electrical Engineering and Computer Engineering?

ODU REYES Program

- Oscar R. González

Professor and Chair

July 23, 2020



What are the goals of this ODU REYES presentation?

- Promote interest in engineering
- Provide suggestions to succeed in engineering studies
- Introduce the disciplines of electrical and computer engineering
- Answer your questions

ODU REYES = Old Dominion University Remote Experience for Young Engineers and Scientists

Why study engineering?

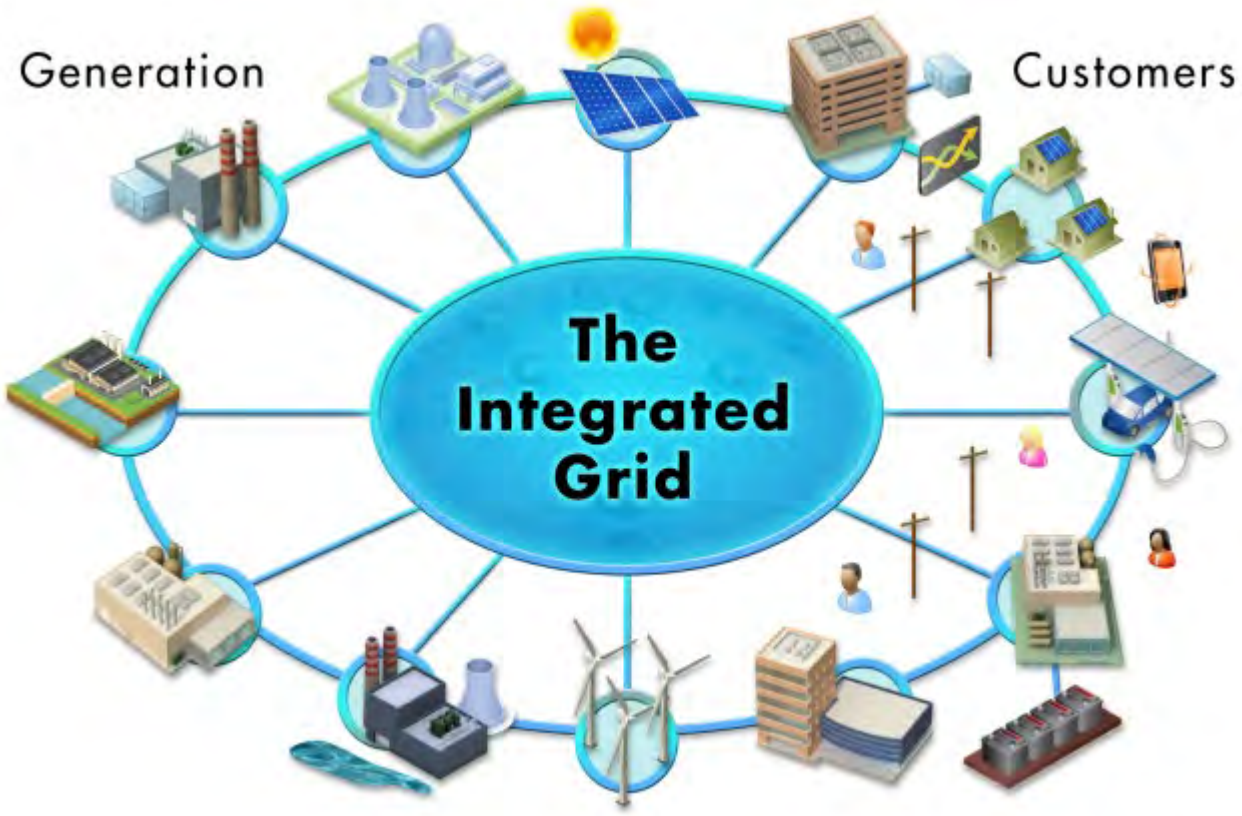
- Engineers solve problems and create products that benefit society
- In February 2000, the National Academy of Engineers announced the ***top 20 engineering achievements*** of the 20th century
- Neil Armstrong:
  - "Almost every part of our lives underwent profound changes during the past 100 years thanks to the effort of engineers, changes impossible to imagine a century ago. People living in the early 1900s would be amazed at the advancements wrought by engineers."
  - "As someone who has experienced firsthand one of engineering's most incredible advancements-space exploration-I have no doubt that the next 100 years will be even more amazing."

NAE GRAND CHALLENGES FOR ENGINEERING

NATIONAL ACADEMY OF ENGINEERING

National Academy of Engineering Top 10 Achievements

1. Electrification
2. Automobile
3. Airplane
4. Water Supply and Distributi
5. Electronics
6. Radio and Television
7. Agricultural Mechanization
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration



https://www.epri.com/

http://www.greatachievements.org/

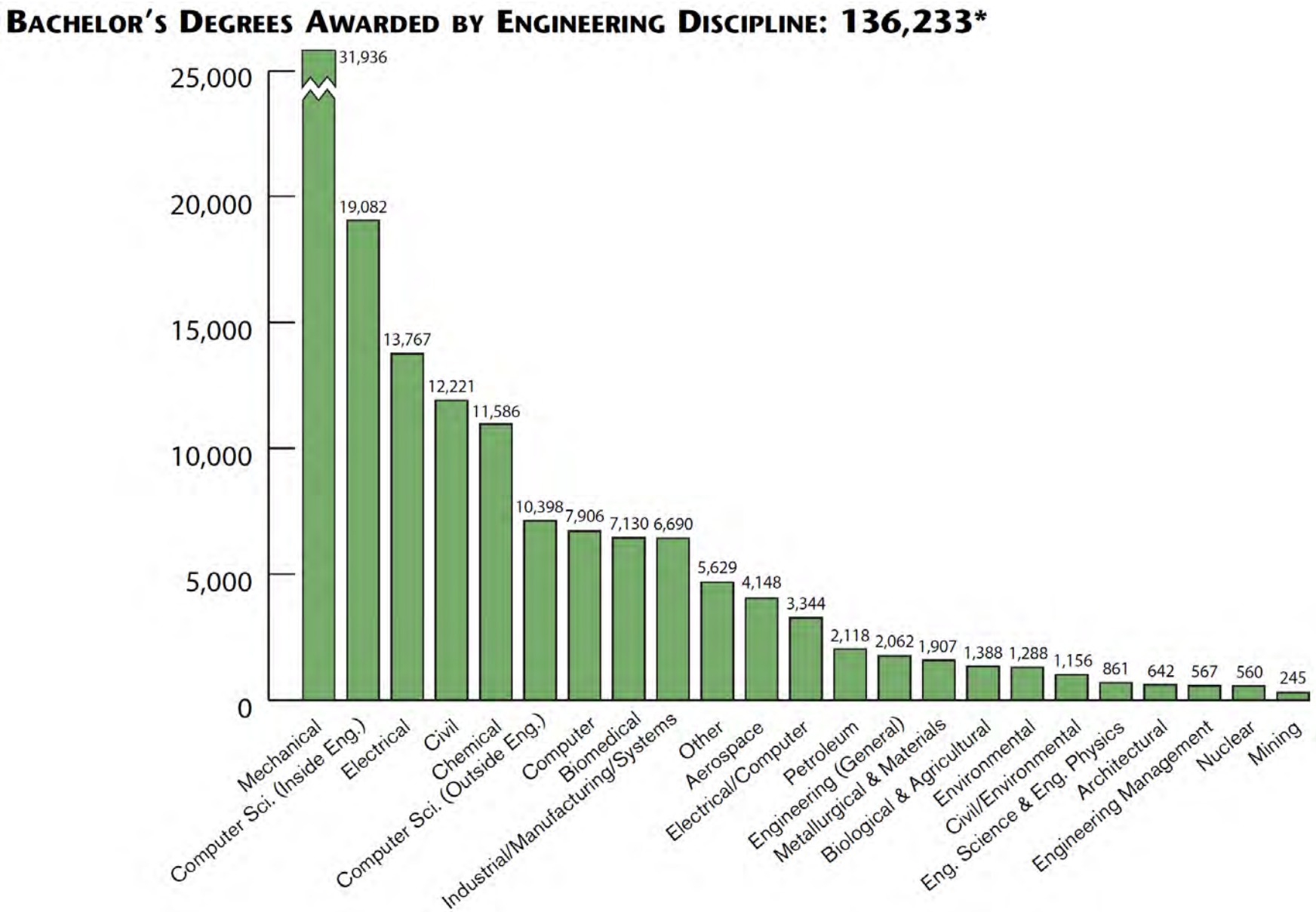
What makes an engineer, an engineer?

- Engineers work in a team that solves problems using systematic techniques that include, for example,
  - Developing mathematical models of the problem
  - Performing engineering analysis of the mathematical model
  - Designing solutions to meet specifications while following ethical norms, dealing with economic & engineering constraints, and abiding by engineering standards
  - Testing the solution in simulation
  - Testing the solution in hardware under load conditions
  - Iterating the design process until the solution meets the design goals

What can you do to get an engineering job?

- Graduate from an ABET accredited program such as Electrical Engineering and Computer Engineering at Old Dominion University
- Gain experience working as an engineer in
  - Internships
  - Co-ops (cooperative education)
  - Undergraduate research projects
- Have a well-written resume
- Use your *network*
  - Friends
  - ODU alumni and faculty
  - Engineering networks (for example, IEEE)

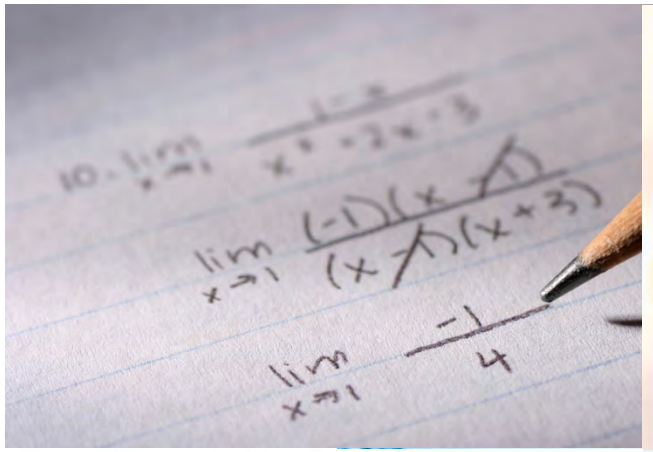
USA Bachelor's Degrees Awarded(ASEE 2017-2018)

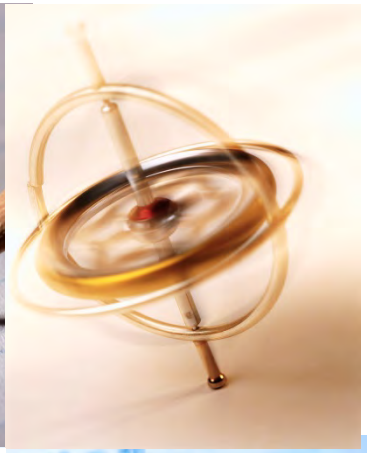


https://www.asee.org/

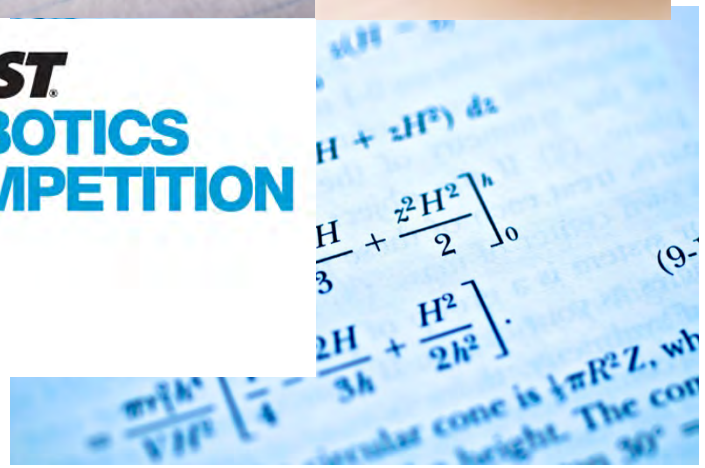
How do you prepare to major in engineering?

- Challenge yourself with *math and science* courses
  - Algebra, Geometry, Trigonometry, Pre Calculus, etc
  - Physics and Chemistry
  - AP courses, if possible
- Have fun by becoming active in STEM and other clubs
- Prepare and do well on standardized tests!
  - You qualify for scholarships with good test scores!





FIRST ROBOTICS COMPETITION

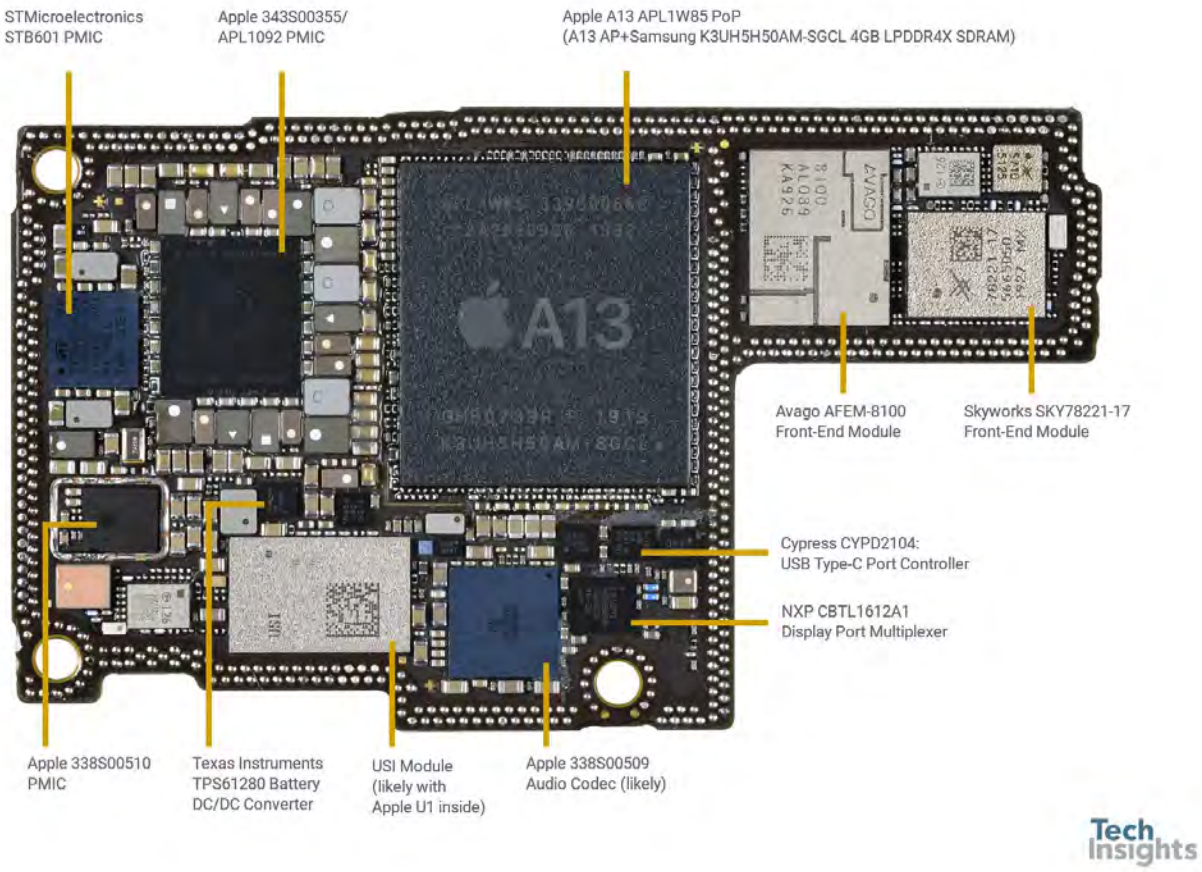


A product designed by electrical and computer engineers

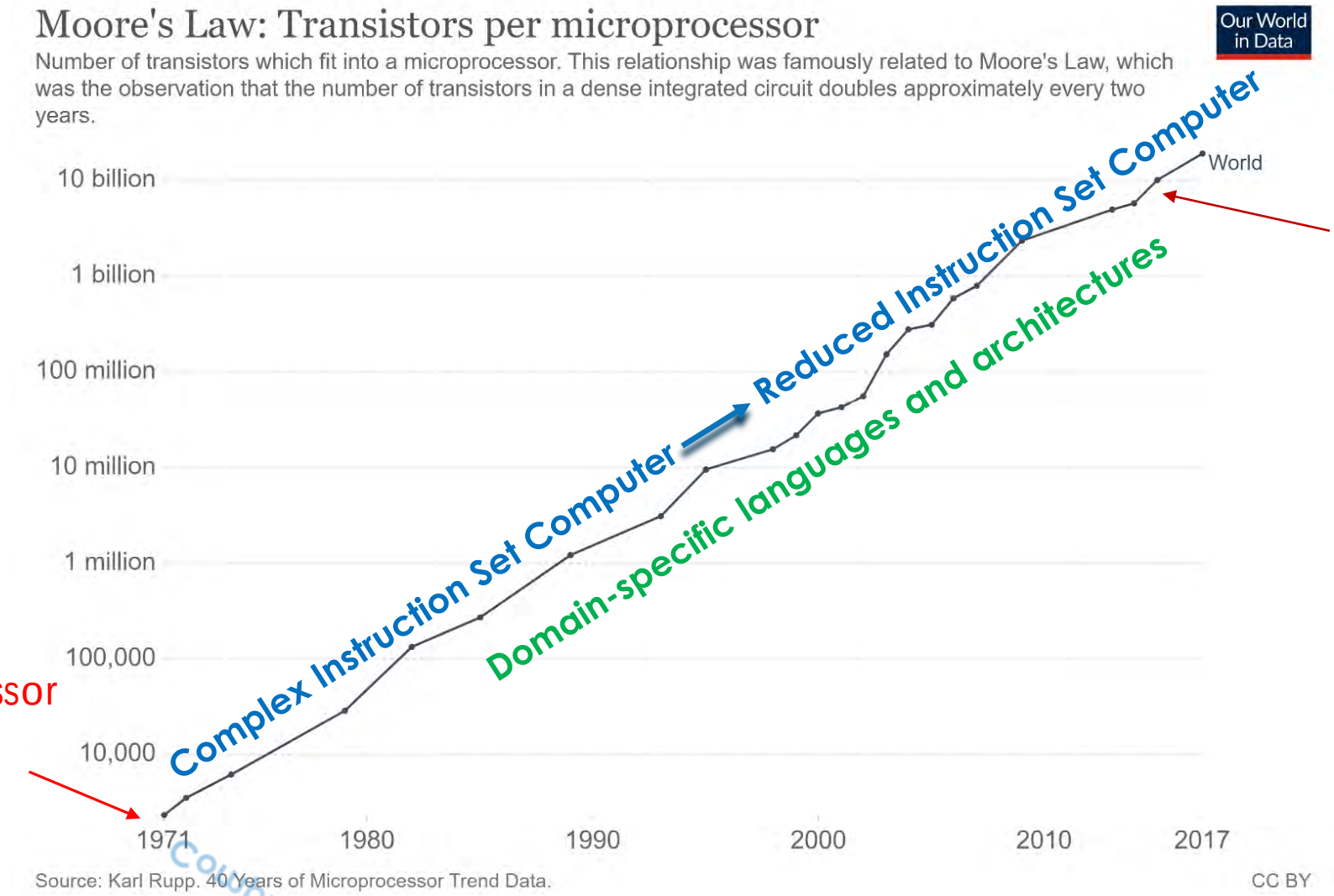
- A smartphone

- Basic componen
  electrical and co
  - Battery
  - Processor
  - Antennas
  - Screen

iPhone components



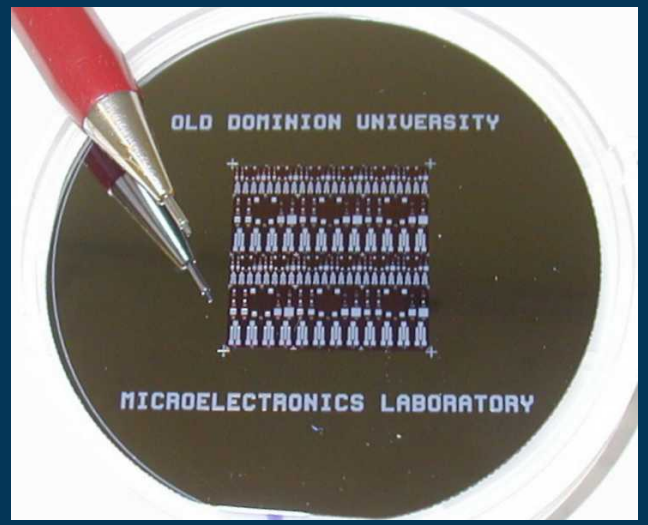
A brief history of integrated circuits



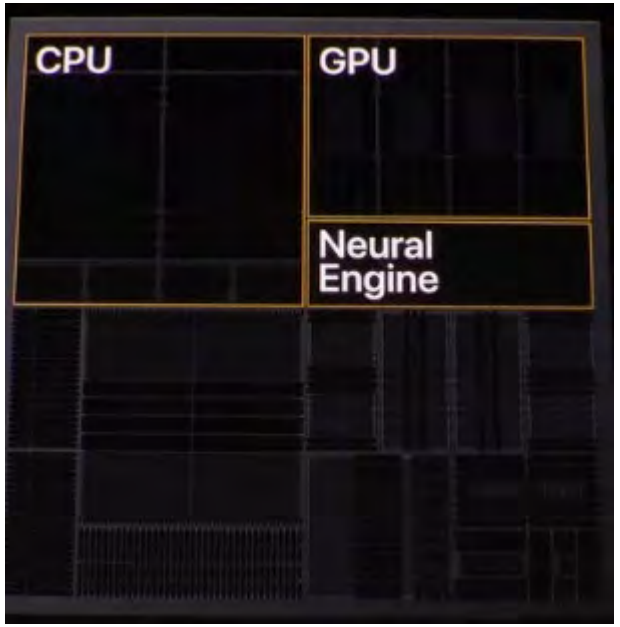
Apple A13 Bionic
ARM-based system on a chip (SoC)
64 bit
6 cores
8.5B transistors
7nm
≤ 2.66 GHz

Intel 4004
1st microprocessor
4 bit
2300 transistors
10µm
740 KHz

Electrical Engineers

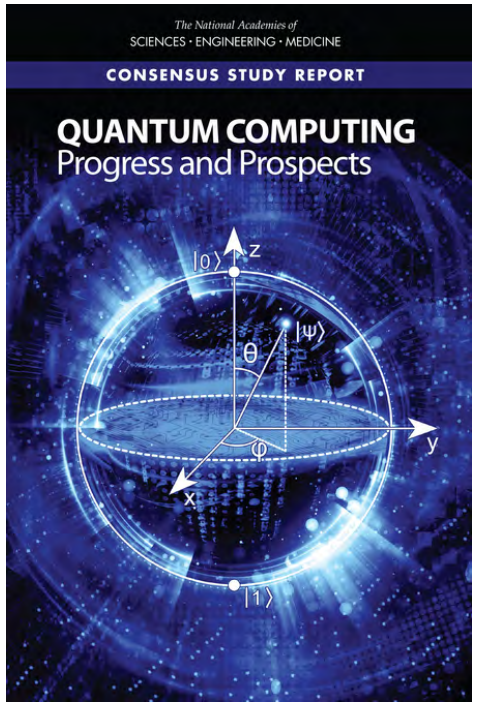


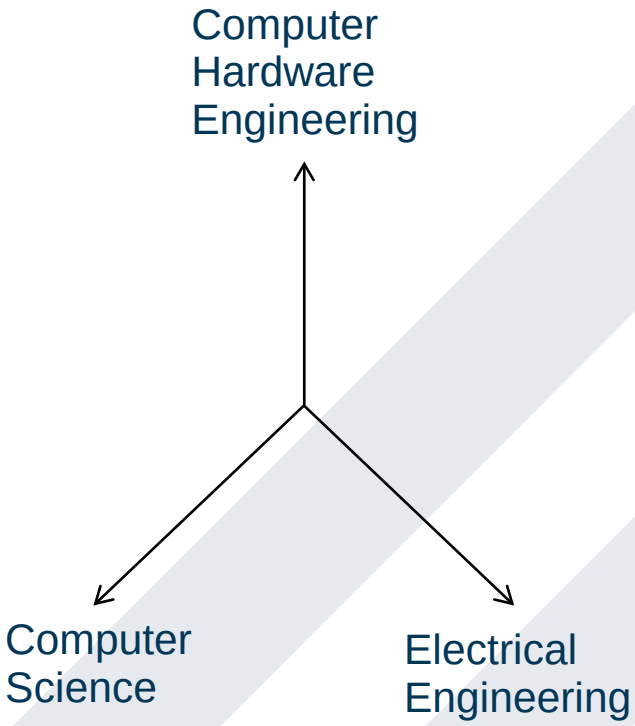
Computer Engineers



Computer Engineering Overview

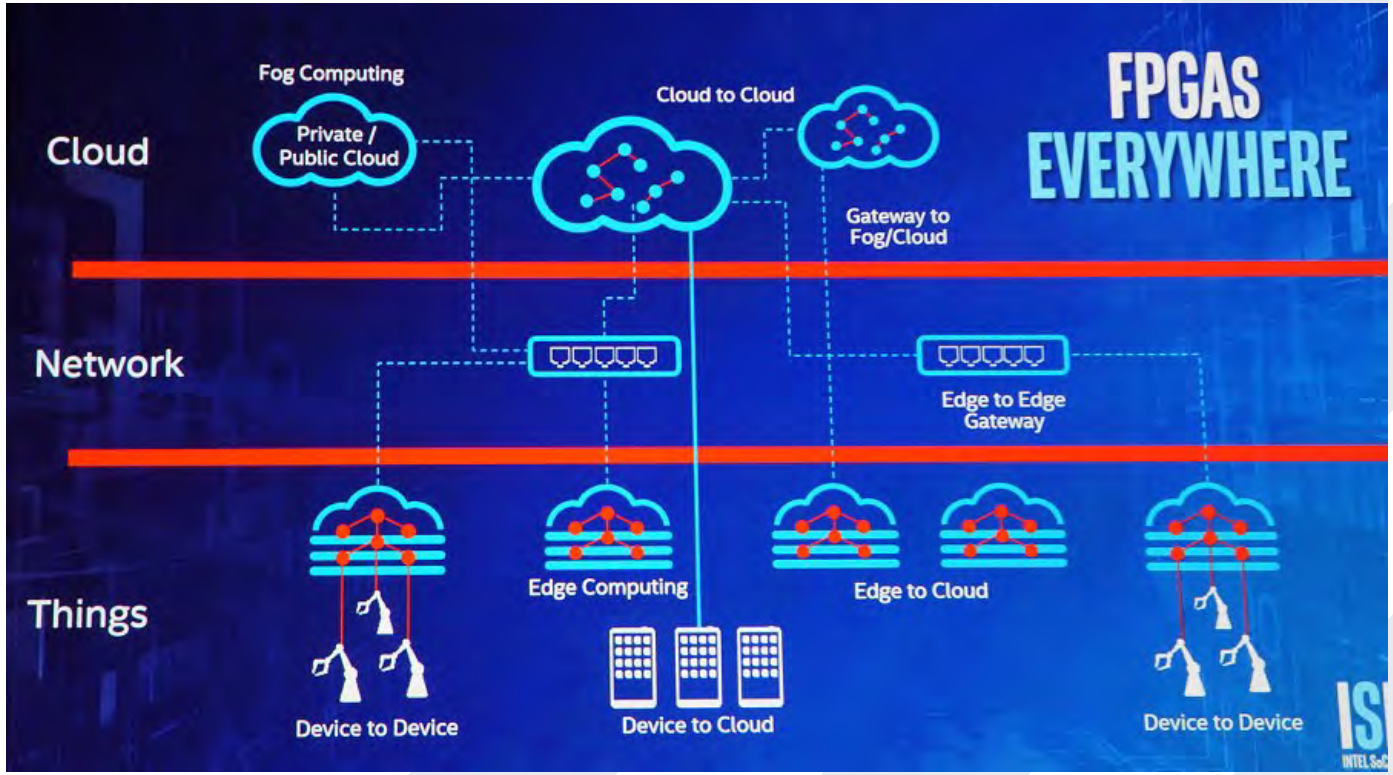
- Holistic approach for solving data processing problems in a way that simultaneously optimizes both hardware and software considerations.





Computer Engineering Overview

- Use digital computing devices, and data processing software to solve problems
- Computer Engineers problems include
  - Computer networks
  - Computer system design/integration
  - Cybersecurity
  - Domain specific architectures/custom data processing systems
  - Embedded systems
  - Software engineering



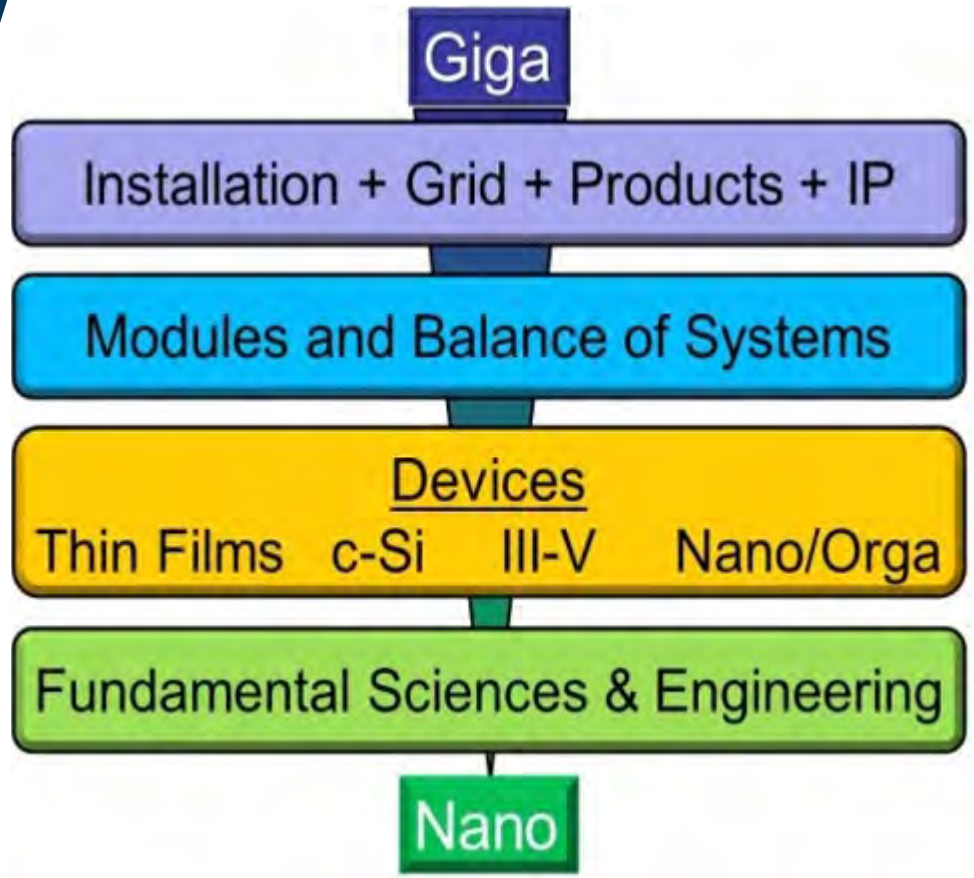
Computer Engineering Overview

- Foundational Coursework in
  - Math: Calculus and Differential Equations
  - Science: Calculus-based Chemistry and Physics
  - English: Composition, Technical Writing, & Public Speaking
  - Computer Engineering: Digital Logic
  - Electrical Engineering: Circuit & System Analysis
- Further Coursework in
  - Computer Hardware: Microcontrollers
  - Computer Systems: Digital System Design & Computer Architecture
  - Computer Science: Computer Programming & Operating Systems

- Built-in minor in Computer Science
- Elective areas of concentration:
  - Computer Hardware Systems
  - Computer Networks
  - Cybersecurity
  - Data Analytics Engineering

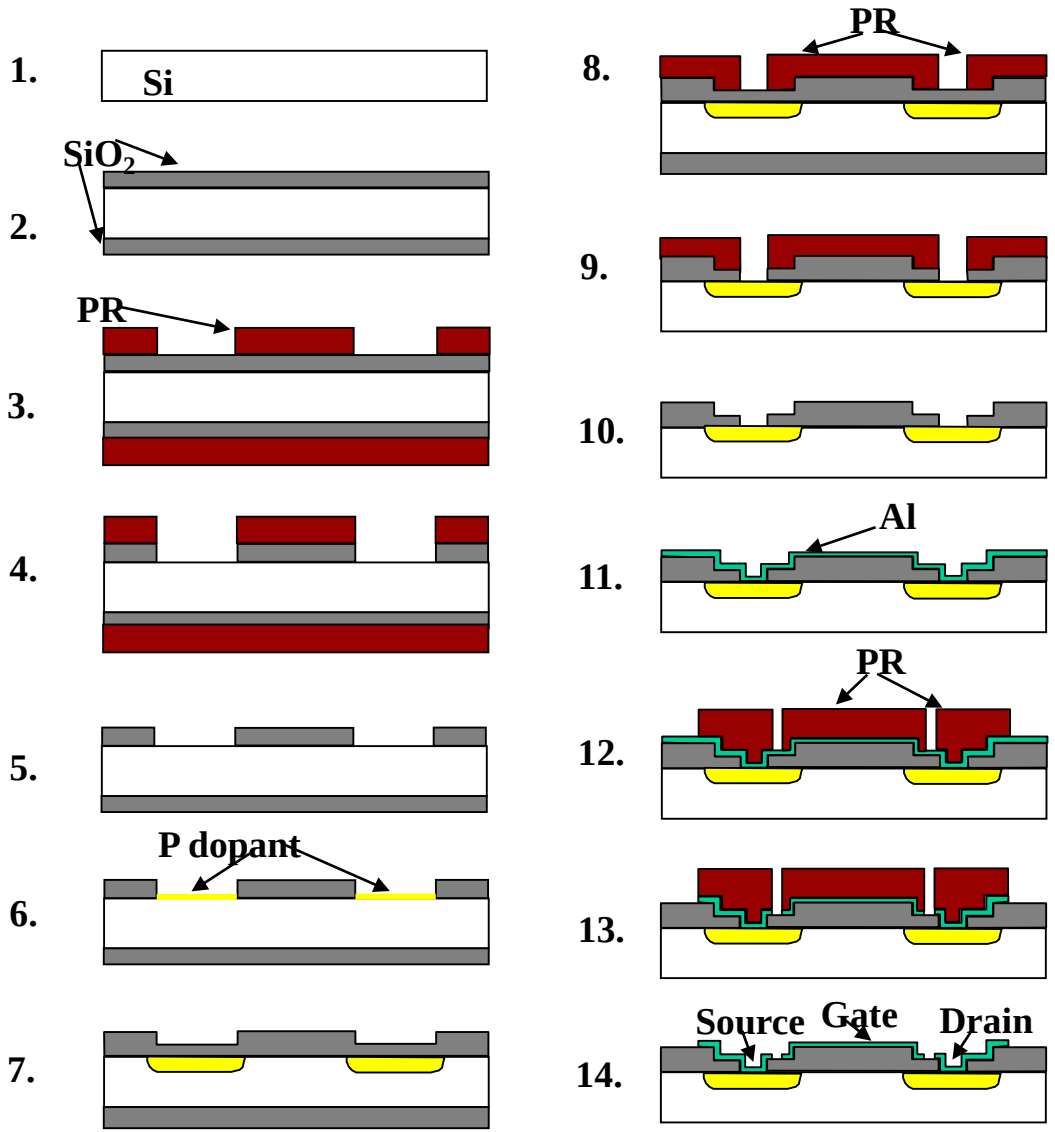
Electrical Engineering Overview

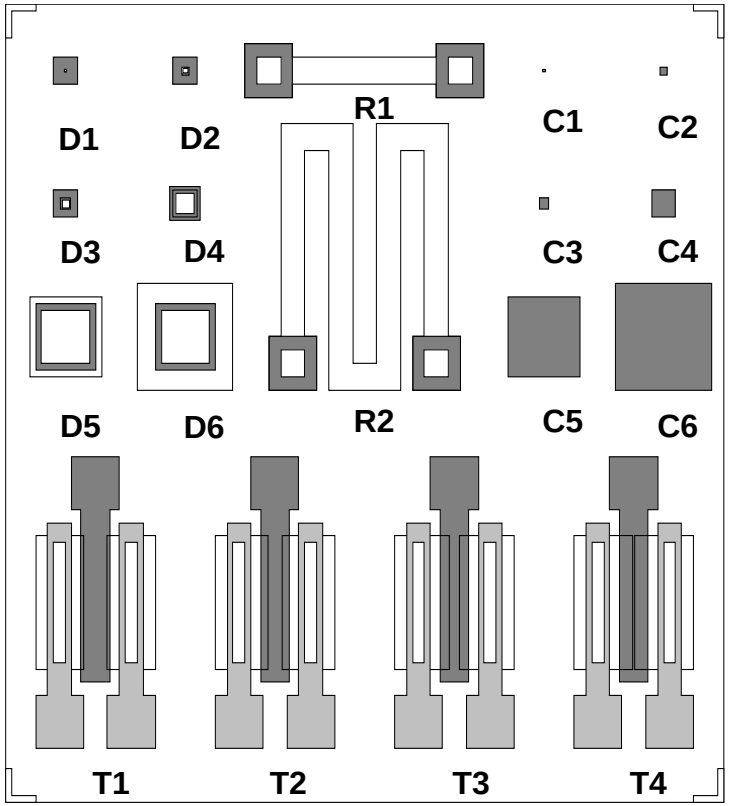
- Design and build engineering solutions from the physics to the systems level
- Learn device fabrication processes and fabricate circuits in a hands-on laboratory in the clean room
- Solve power, system automation, machine learning problems, etc.
- Transform information



Microelectronics Fabrication Laboratory

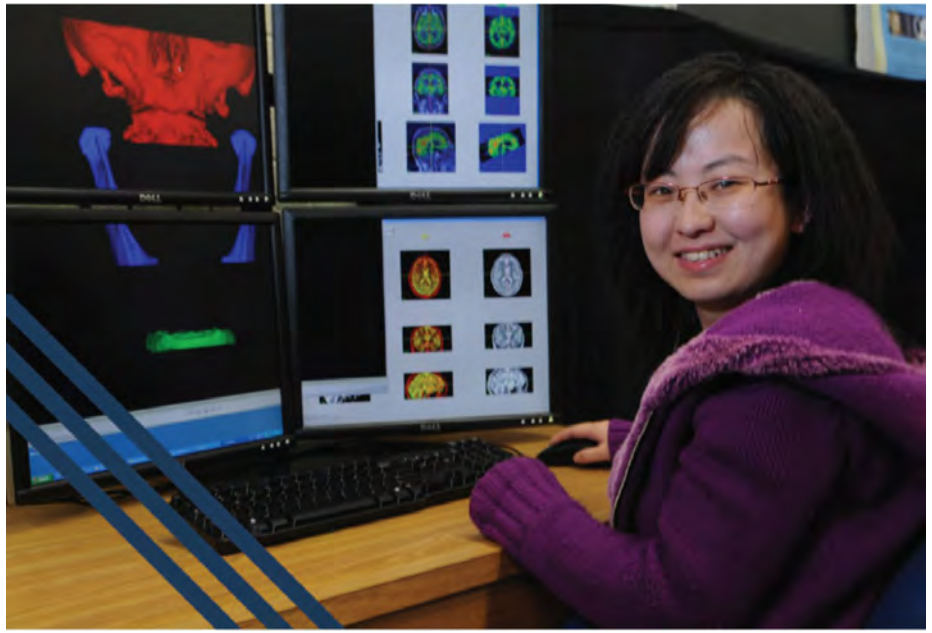
Process Steps





Machine Learning Applications

- Medical imaging analysis



20 Jul 2020 | 19:00 GMT

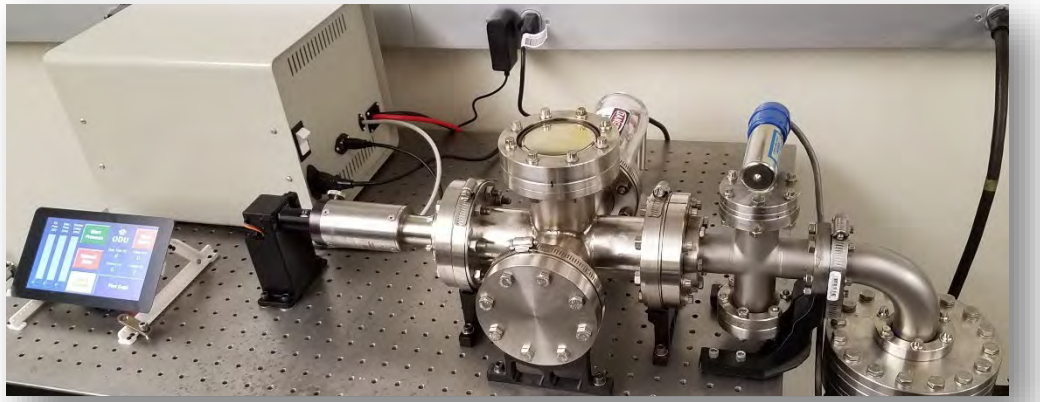
New AI Estimates the Size of Remote Refugee Camps Using Satellite Data

Compared to previous models, the new machine learning algorithm proves to be more accurate and precise, which could help better support humanitarian efforts

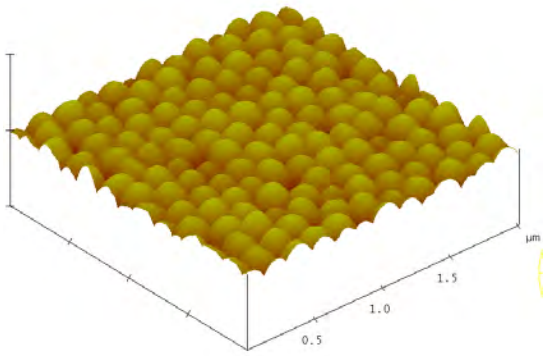
By **Michelle Hampson**

IEEE SPECTRUM

Undergraduate Research: Ultrafast Laser-Driven Phase Transitions in Nanoparticles near their Melting

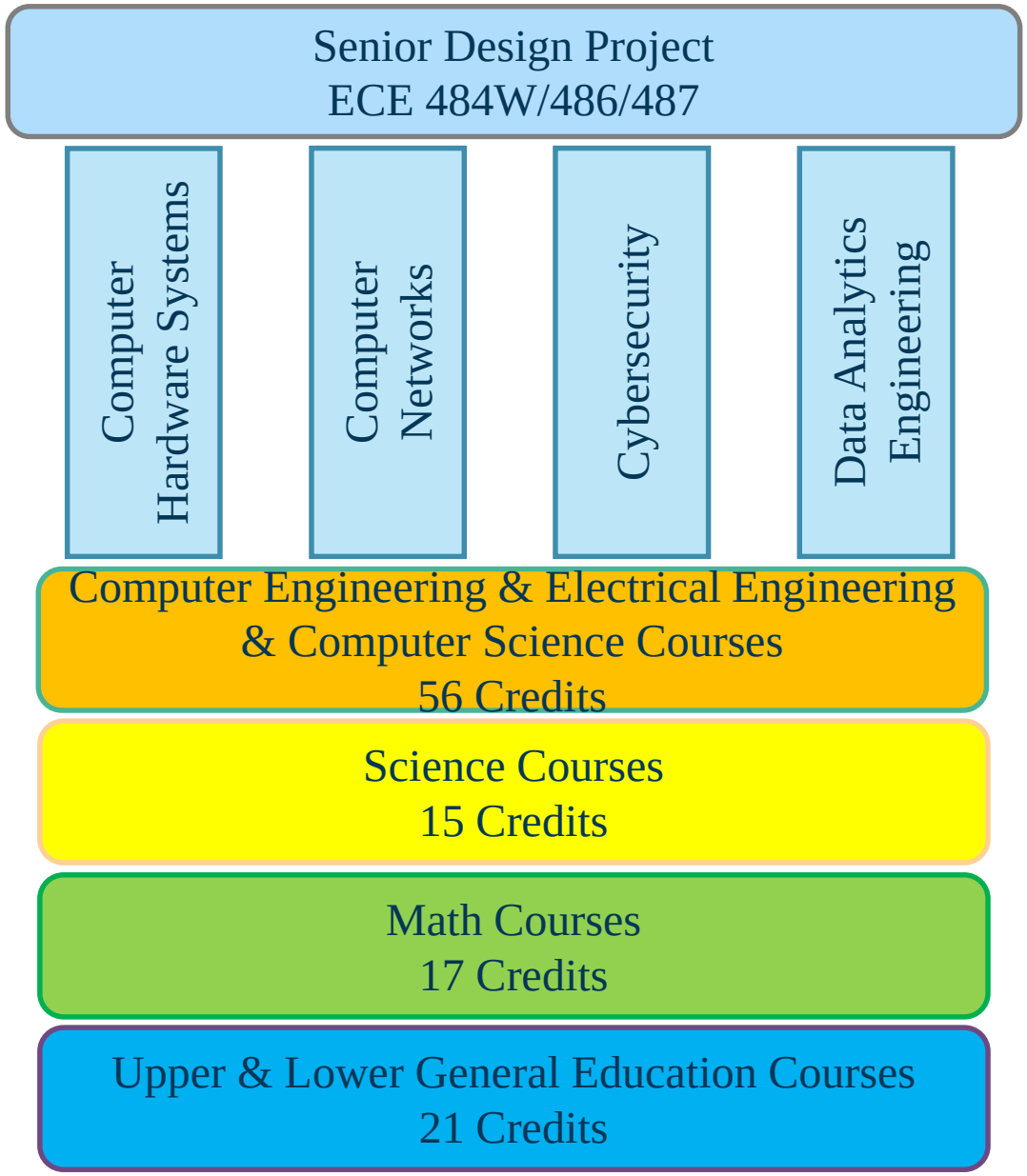


Senior design project conducted by electrical and computer engineering students designed, constructed, and tested a microprocessor-controlled thermal evaporator for fabrication of nanoparticles and thin films.

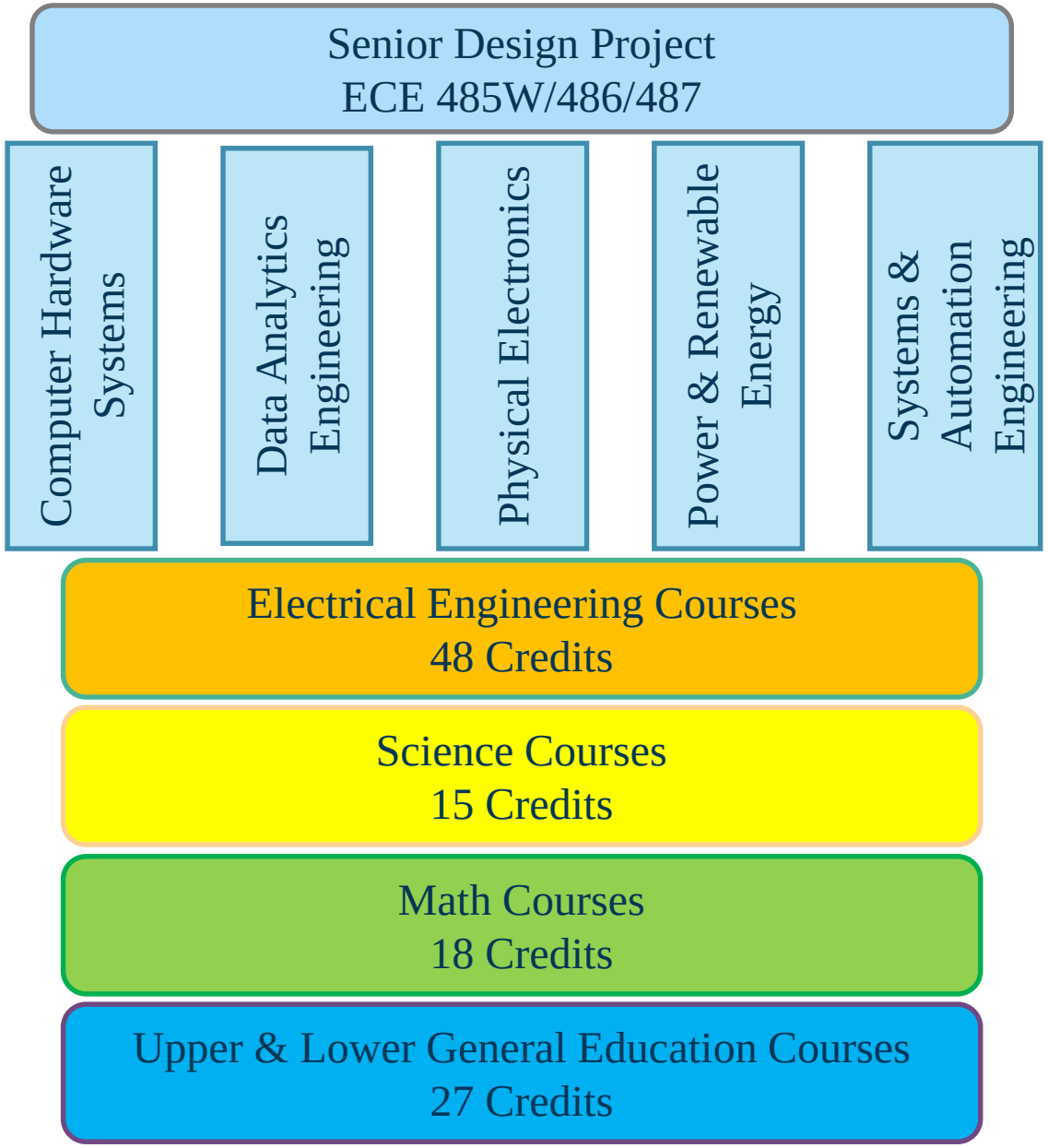


Undergraduate student studied the optical properties of photonic crystals assembled from silicon dioxide nanoparticles. The atomic force microscope image of the assembled nanoparticles is shown.

Computer Engineering Curriculum – 128 Credits



Electrical Engineering Curriculum – 127 Credits



Average Entry-level Salaries

- Electrical Engineering
  - 64,936
- Computer Engineering
  - 68,436 – 71,007

- At ODU the two highest earning undergraduate majors are:
  1. Computer Engineering
  2. Electrical Engineering

Data from payscale.com, October 2019

Can electrical engineers be awarded a Nobel Prize?

- 1956 - Physics - John Bardeen with William Shockley and Walter H. Brattain
  - "for their researches on semiconductors and their discovery of the transistor effect“
- 1972 – Physics - John Bardeen, Leon Neil Cooper and John Robert Schrieffer
  - "for their jointly developed theory of superconductivity, usually called the BCS-theory“
- 2000 – Physics - Jack St. Clair Kilby
  - "for his part in the invention of the integrated circuit“
- 2014 – Physics - Isamu Akasaki, Hiroshi Amano, and Shuji Nakamura
  - "for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources"
- 2018 – Physics - Arthur Ashkin, Gérard Mourou, and Donna Strickland
  - "for groundbreaking inventions in the field of laser physics", in particular "for their method of generating high-intensity, ultra-short optical pulses"

Electrical and Computer Engineering Links

ECE Undergraduate Programs

- Information on the BS Computer Engineering and BS Electrical Engineering degrees
- Program and Course highlights
- Application steps
- & more

ODU Online: Computer Engineering Online

- Information on online programs and the online learning environment
- Contact form for specialized assistance
- & more

Transfer Students Webpage

- Information for all transfer students including International students and military/veterans
- Course by course equivalencies
- Application checklist
- & more

Take the Next Step: Admissions

- Visit campus – LIVE online tours
- Cost estimator
- Applications
- & more

ECE & BME Graduate Programs

- Information on the MS and Ph.D. degrees
- Program and Course highlights
- Application steps
- & more

Connect with ECE:

www.odu.edu/ece

THANK YOU!

Acknowledgements

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