

Pioneering the future together

—— Engineering to pave the way for the future ——

Junichiro Shiomi
Assistant Dean / Professor
School of Engineering / Faculty of Engineering
The University of Tokyo

Outline of SEUT



By the Numbers

Founded in **1877**

10 Undergraduate Faculties

15 Graduate Schools

 = UTokyo

 = School of Engineering

18
Depart
ments

5,962
Faculty

787
Faculty

5,563
Staff

355
Staff

28,218
Students

5,825
Students

4,257
International
Students

1,447
International
Students



Overall

29
*2024

**Reputation
Ranking**

10
*2024

5	University of Cambridge United Kingdom	77.6	78.5	75.0
6	University of California, Berkeley United States	62.2	66.6	49.4
7	Princeton University United States	37.3	38.9	32.7
8	Tsinghua University China	32.5	33.2	30.4
9	Yale University United States	31.9	32.1	31.3
10	The University of Tokyo Japan	30.2	31.7	25.7



Overall

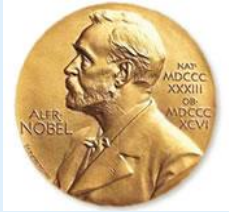
23
*2024

**Academic
Reputation**

7
*2024

**Engineering &
Technology**

18
*2024



Eiichi Negishi
Nobel Prize laureate
1958 alumnus of the
Department of
Applied Chemistry
(1935.7.14-2021.6.6)



Hiroaki Nakanishi
Former Chairman of
Keidanren
(Japan Business Federation)
1970 alumnus of the
Department of
Electronic Engineering
(1946.3.14-2021.6.27)



Naoko Yamazaki
Astronaut
1993 alumna of the
Department of Aeronautics



Distinguished Professors of UTokyo (Nobel Prize Candidates)

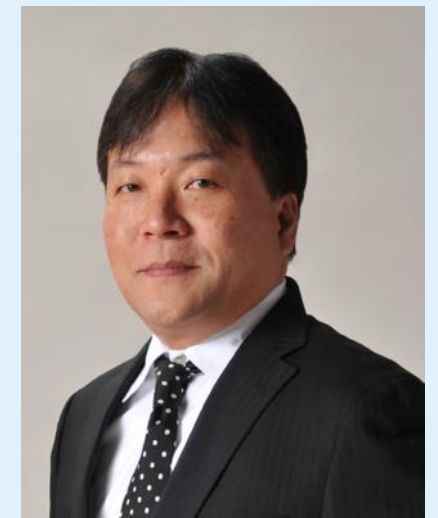


Yoshinori Tokura
Former Professor at the
Department of Applied Physics
School of Engineering
The University of Tokyo

Makoto Fujita
Professor
Department of Chemistry
& Biotechnology
School of Engineering
The University of Tokyo



Takuzo Aida
Former Professor at the
Department of Chemistry
& Biotechnology
School of Engineering
The University of Tokyo



Graduate School 18 Departments Total

Department of Civil Engineering

Department of Architecture

Department of Urban Engineering

Department of Mechanical Engineering

Department of Precision Engineering

Department of Systems Innovation

Department of Aeronautics and Astronautics

Department of Electrical Engineering and
Information Systems

Department of Applied Physics

Department of Materials Engineering

Department of Applied Chemistry

Department of Chemical System Engineering

Department of Chemistry and Biotechnology

Department of Advanced Interdisciplinary
Studies

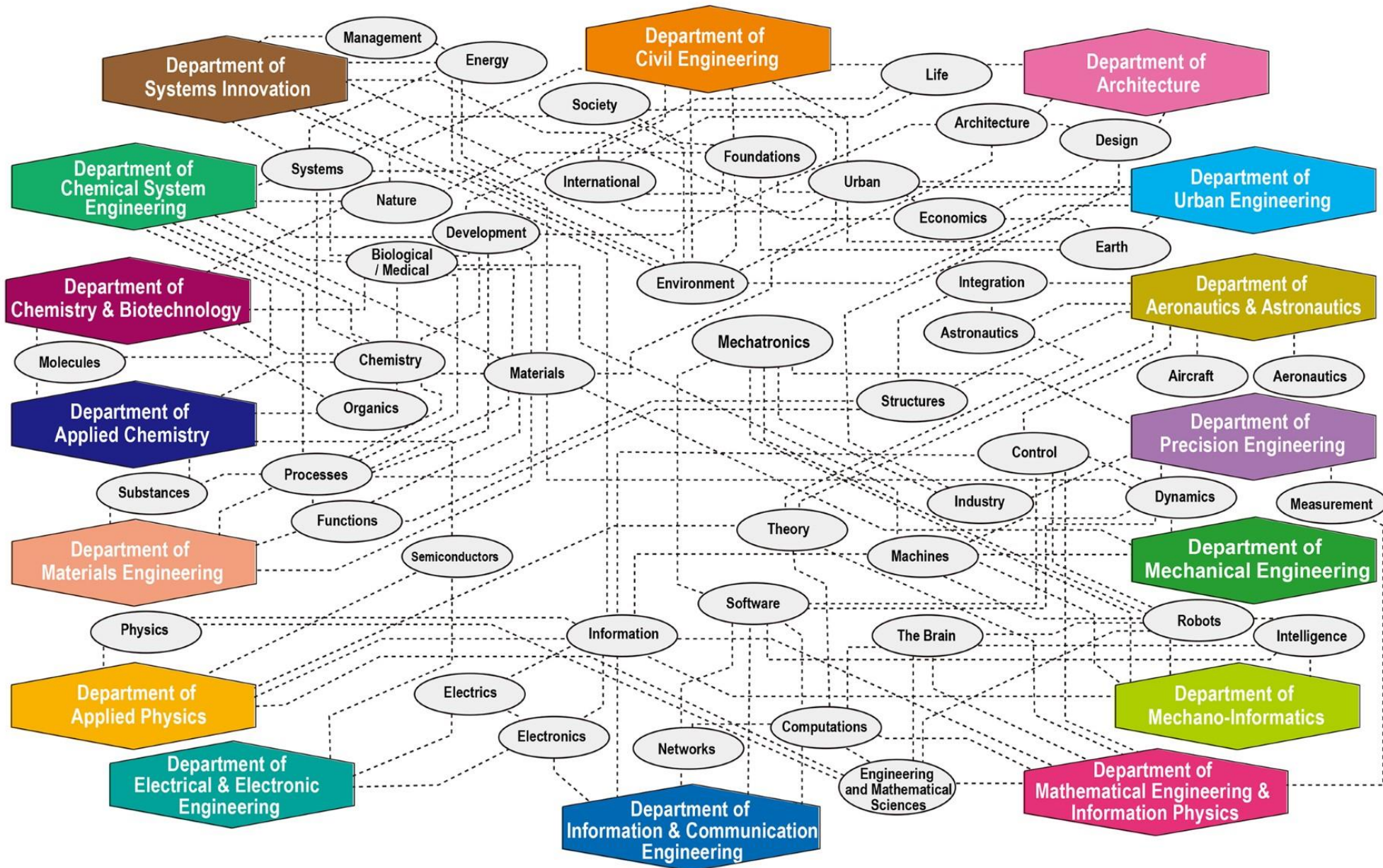
Department of Nuclear Engineering and
Management

Department of Bioengineering

Department of Technology Management for
Innovation

Nuclear Professional School

Department Map



Digital

AI · Big Data

Can hundreds of millions of parameters be optimized instantly?

$$\text{Min.} \quad - \sum_k y_k \log(f(x_k))$$

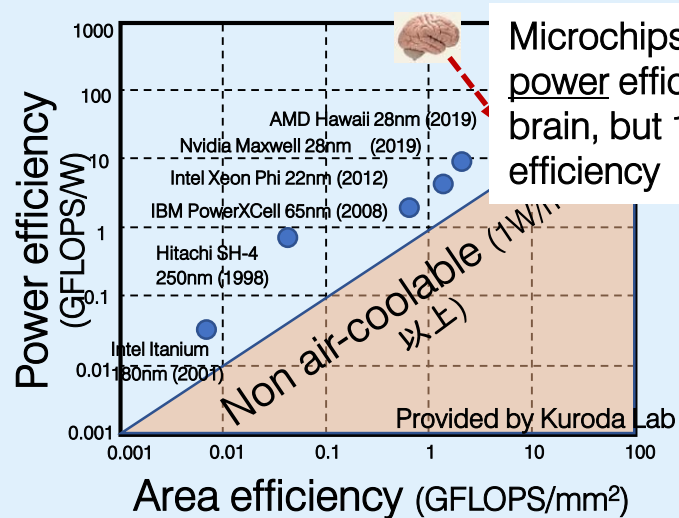
y_k : labels
 $f(x_k)$: outputs for input x_k

Minimize cross-entropy error (for classification problems)

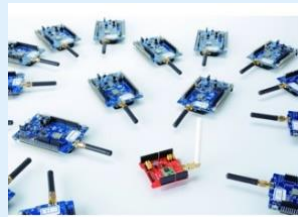
⇒ how to calculate quickly and find good solutions

5G · IoT · Security

Will a microchip's power efficiency exceed that of the human brain?



IoT Devices



Provided by Morikawa Lab

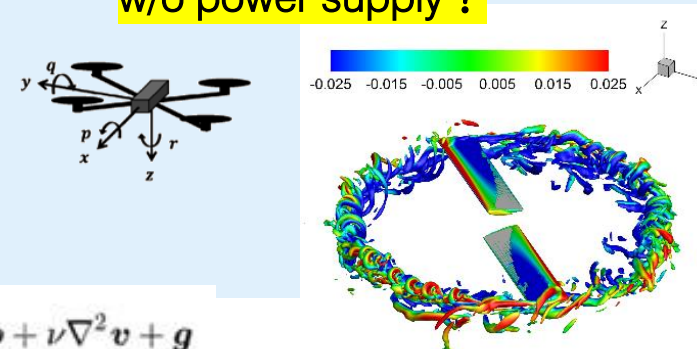
Mobility · Logistics



「Phenox 2」 drones developed by UTokyo

$$\frac{\partial \mathbf{v}}{\partial t} + (\mathbf{v} \cdot \nabla) \mathbf{v} = -\frac{1}{\rho} \nabla p + \nu \nabla^2 \mathbf{v} + \mathbf{g}$$

Can drones fly long distances w/o power supply ?



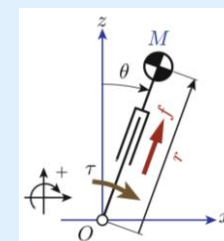
Provided by Rinoie, Imamura Lab

Robots · Digital Manufacturing

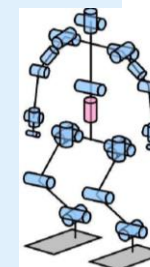
Can we make robots to be as flexible as living organisms?



Provided by Asama Lab



Kajita et al., 2004



$$\ddot{\mathbf{q}} = \mathbf{M}^{-1}(\mathbf{q}) \{ \boldsymbol{\tau} - \mathbf{C}(\mathbf{q}, \dot{\mathbf{q}}) \dot{\mathbf{q}} - \mathbf{g}(\mathbf{q}) \}$$

$$\boldsymbol{\tau} \rightarrow (\mathbf{q}, \dot{\mathbf{q}}, \ddot{\mathbf{q}})$$

Provided by Kuniyoshi, Niiyama Lab



Life

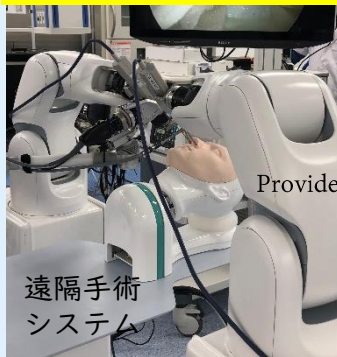
Resilience

Health, Medical, and Nursing Care

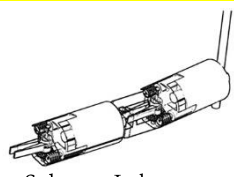
Can the sensations encountered while performing surgery be reproduced remotely?



Provided by Mitsubishi Lab



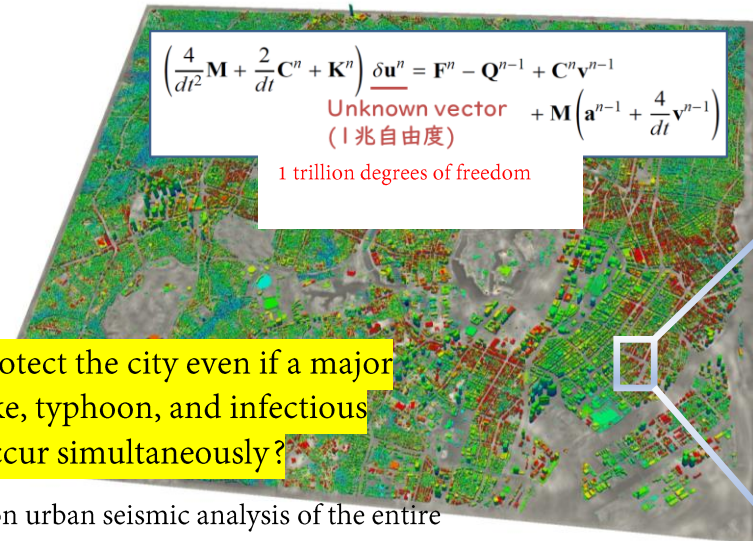
遠隔手術システム



Provided by Sakuma Lab

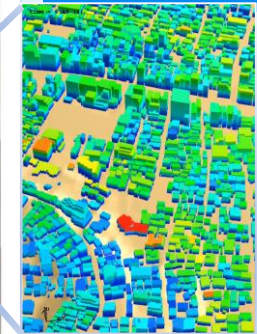
Can we protect the city even if a major earthquake, typhoon, and infectious disease occur simultaneously?

Ultra-high resolution urban seismic analysis of the entire Yamanote Line



Provided by Ichimura Lab

City Disaster Prevention



Housing & Culture

What public spaces carry on local culture?

↓
Design collaboration between architects and residents.



Kumamoto Earthquake Reconstruction "Minna no Ie" (House for Everyone)

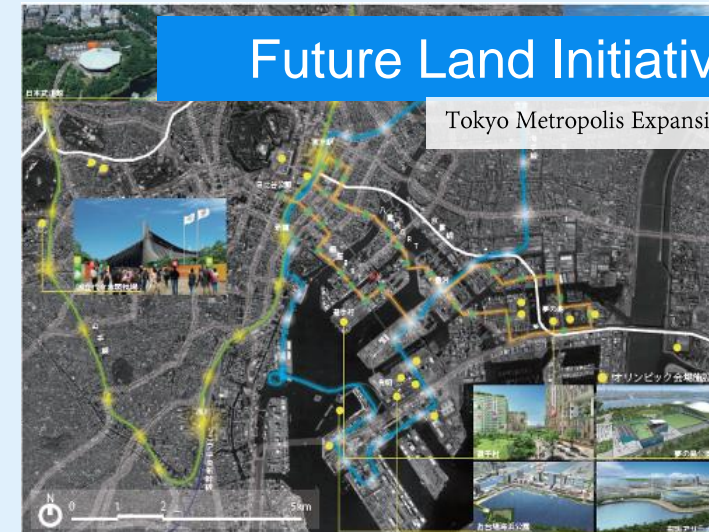
Photo by Vincent Hecht

What is the land of the future? ↓

Policy Making and Social Implementation

Future Land Initiative

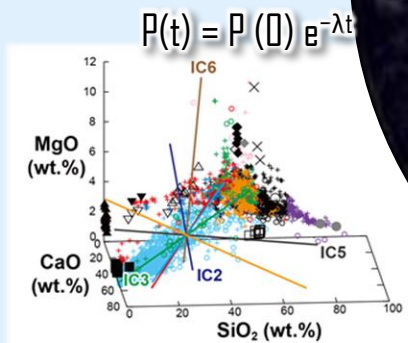
Tokyo Metropolis Expansion Plan 2050



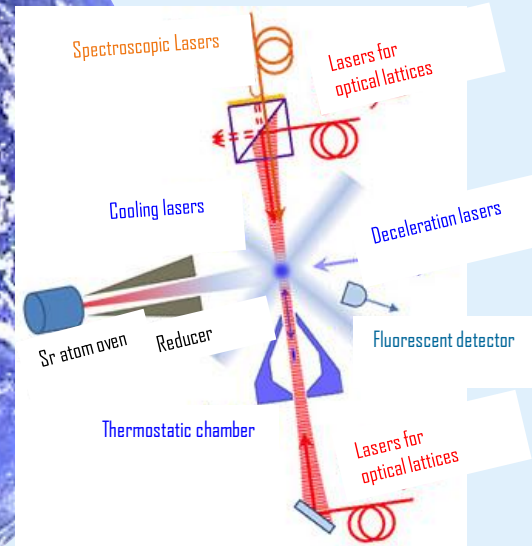
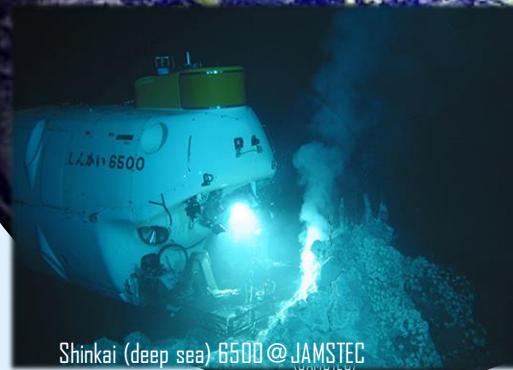
3. Earth & Science

Sustainability

What is the quantity and distribution of Earth's resources?



Provided by Kato, Yasuhiro Lab



Provided by Katori Lab

Science Link

Quantum & Matter

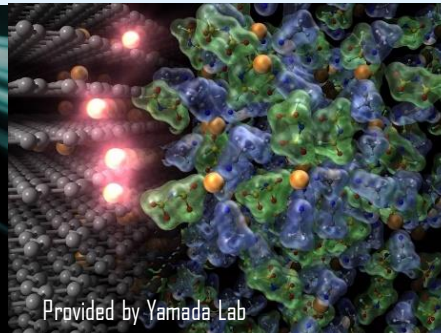
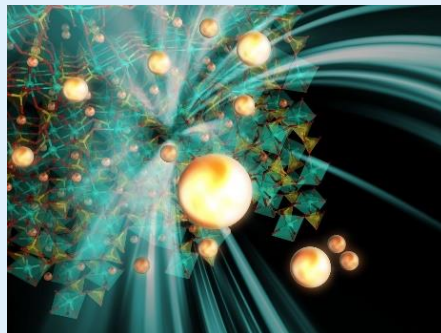
What is the most accurate clock in the world?

Laser cooling of Sr atoms
"Optical Lattice Clock"

A clock that is not off by a second in 13.8 billion years of cosmic age

Environment & Energy

Can batteries be made without resource constraints?



Provided by Yamada Lab

Space & Nature

What complex systems
can accomplish missions in
unknown space environments?

Humanity's frontier requires extreme
performance



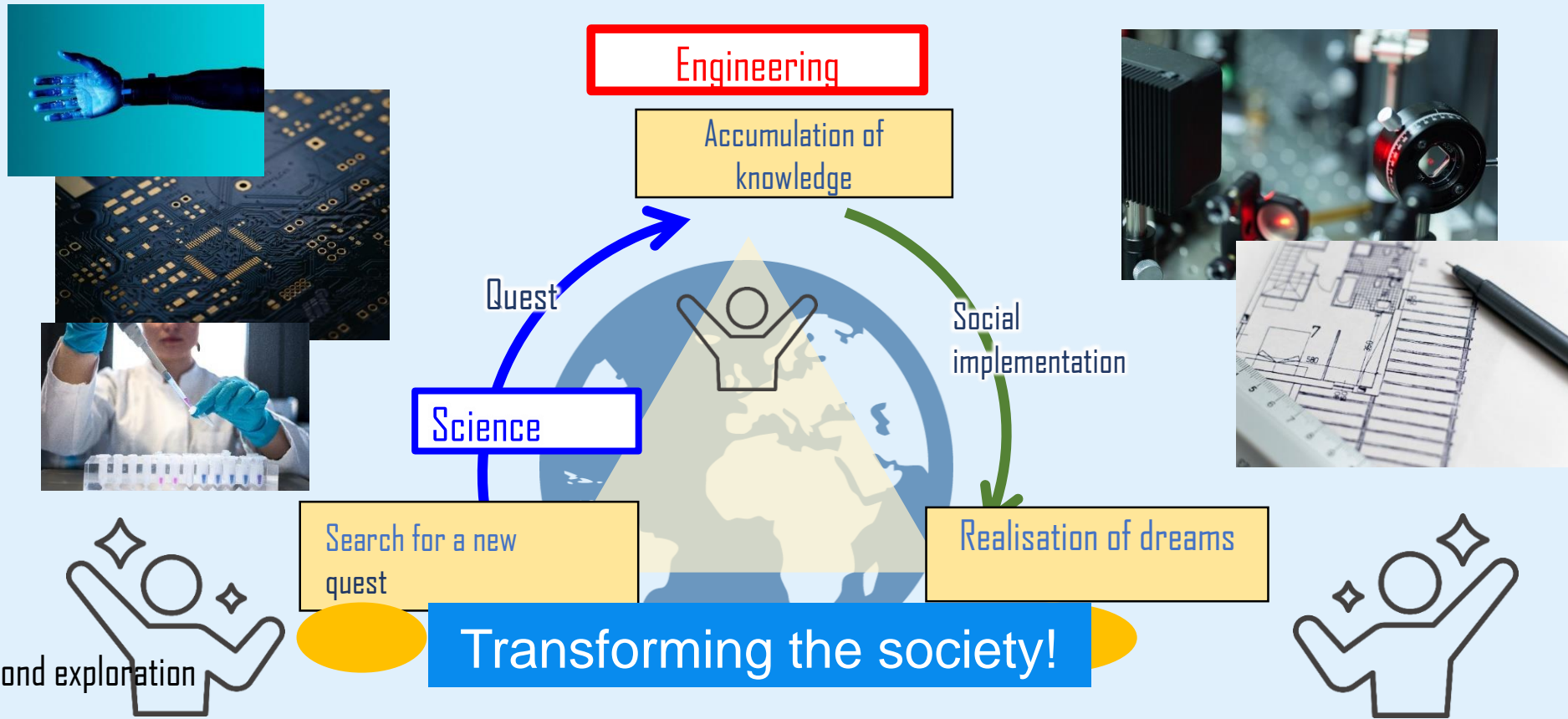
Provided by Nakasuka Lab

What is engineering?

Science = The study of exploring truth in nature



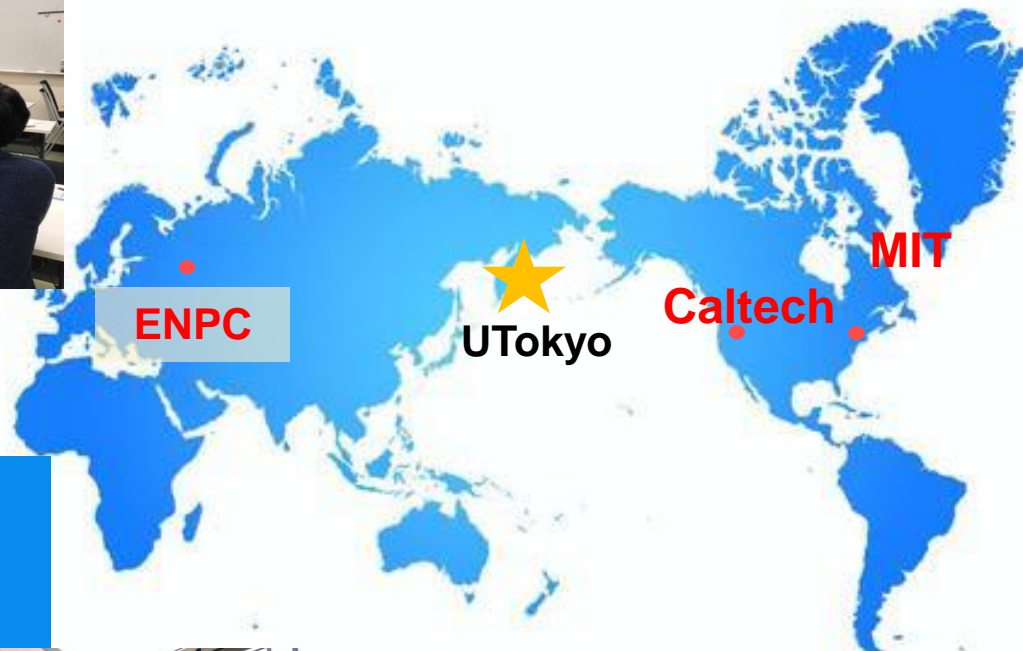
Engineering = The study that contributes to the development of human society on the basis of basic science



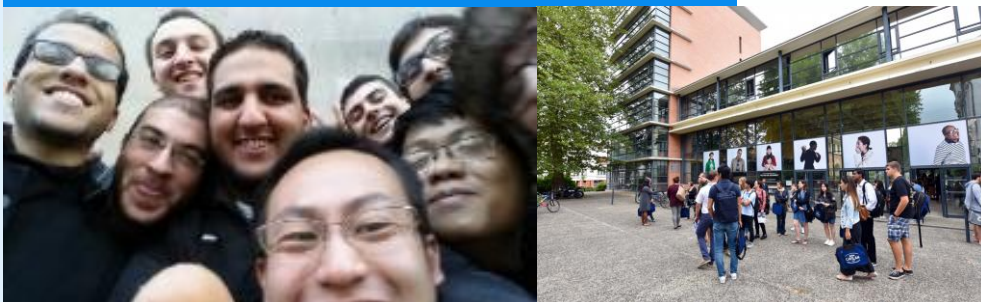
Exchange programs with world leading universities (weeks to a year):
~100 students/ year



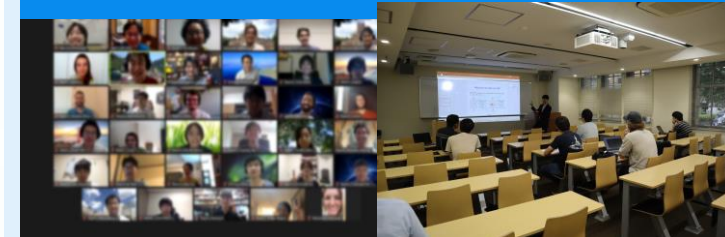
“X-Lecture (Cross-lecture) program”: online lecture by an invited overseas speaker



“Double Degree Program”: get a master's in both countries



Accelerating online exchanges with top universities



**MIT, Caltech, KTH (Sweden),
Tsinghua University (China)
Seoul National University**

**9 countries and 10 universities
overcoming the time difference
for an online summer camp**

**Over 150 participants in an
online exchange event**

Academic English skills training

**Over 120 attendees for a large-
scale Academic Writing &
Presentation lecture**



Education and research collaboration with the world's top universities

Deans' Forum in Engineering

MEMBER INSTITUTIONS:

IBM Watson Research Center, Imperial College London, University of Oxford, UC Berkeley, University of Cambridge, ETH Zurich, KTH, Grandes Écoles de France, MIT, UTokyo



Deans' Forum 2013 UC Berkeley



Deans' Forum 2016, Cambridge

Asian Deans' Forum (ADF)

MEMBER INSTITUTIONS:

Seoul National University, Tsinghua University, Hong Kong University of Technology, National Taiwan University, National University of Singapore, University of New South Wales, UTokyo



8th ADF@UTokyo

1st: DF2011@UTokyo
2nd: DF2013@UC Berkeley
3rd: DF2014@KTH
4th: DF2015@IBM Watson
5th: DF2016@Cambridge
6th: DF2017@Paris
7th: DF2019@ETH Zurich
8th: DF2021@KTH online
9th: DF2022@UTokyo online
10th: DF2025@UTokyo (planned)

1st: ADF2016 UTokyo (MOU signed among 6 universities)
2nd: ADF2017 National Taiwan University
3rd: ADF2018 National University of Singapore
4th: ADF2018 Hong Kong University of Technology
5th: ADF2019 Seoul National University
6th: ADF2021 Tsinghua University (online)
7th: ADF2022 University of New South Wales
8th: ADF2023 UTokyo
9th: ADF2024 National University of Singapore (planned)



Joint efforts for gender equality, etc.



International workshop on career development for women researchers



Planned in 2024 at National University of Singapore

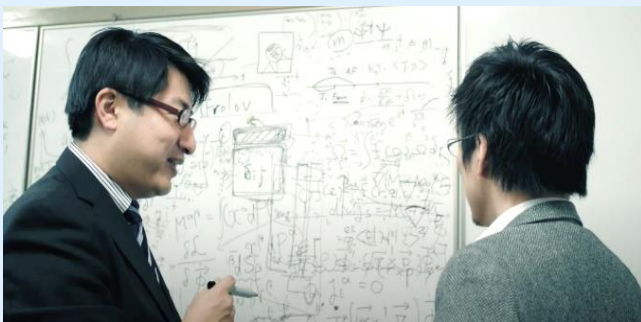


Comfortable learning environment, thoughtful and friendly guidance

Learning environment



Thoughtful guidance by world-class faculties



Providing a comfortable campus life

You can use the lounge space as needed



Bento (boxed-lunch) Shop



Subway Sandwiches



Food Trucks



Starbucks Coffee



On-Campus Convenience Stores



Basic subjects and exercises

partial differential equations

complex functions

computer science

electrodynamics

statistical physics

quantum mechanics

$$\Psi_2(x) = \frac{1}{\sqrt{k_2}} (B_+ e^{ik_2 x} + B_- e^{-ik_2 x}) \quad x > 0$$

$$i\hbar \frac{\partial}{\partial t} \Psi(r,t) = \hat{H} \Psi(r,t)$$

$$|\Psi\rangle A B = \sum_{ij} c_{ij} |i\rangle A \otimes |j\rangle B$$

$$P[a \leq X \leq b] = \int_a^b \int_{-\infty}^{\infty} W(x,p) dp dx$$

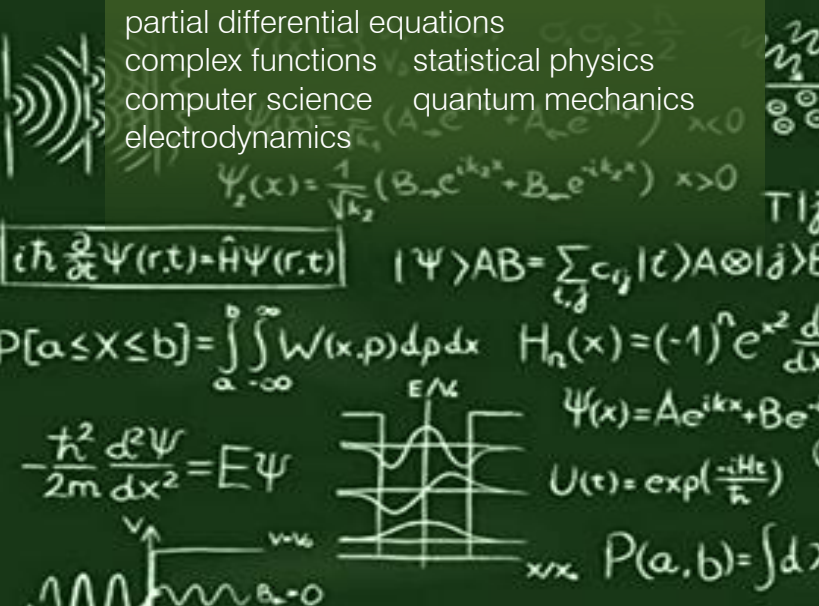
$$H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n} e^{-x^2}$$

$$-\frac{\hbar^2}{2m} \frac{d^2 \Psi}{dx^2} = E \Psi$$

$$\Psi(x) = A e^{ikx} + B e^{-ikx}$$

$$U(t) = \exp(-\frac{iHt}{\hbar})$$

$$P(a,b) = \int d\lambda$$



Basic skills that can be applied in all situations

Thoughts on Interpretation



Integration with application

Discovery of new principles

Derivation of universality

AI · information

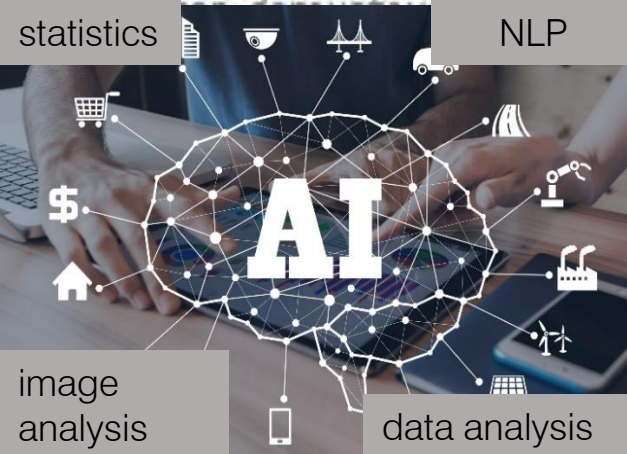
```
export class Node {
  id: string;
  /** List of input links. */
  inputLinks: Link[] = [];
  bias = 0.1;
  /** List of output links. */
  outputs: Link[] = [];
  totalInput: number;
  output: number;
}
```

statistics

NLP

image analysis

data analysis



Real-world sophistication/problem-solving

Research · practical training · workshop

CAD



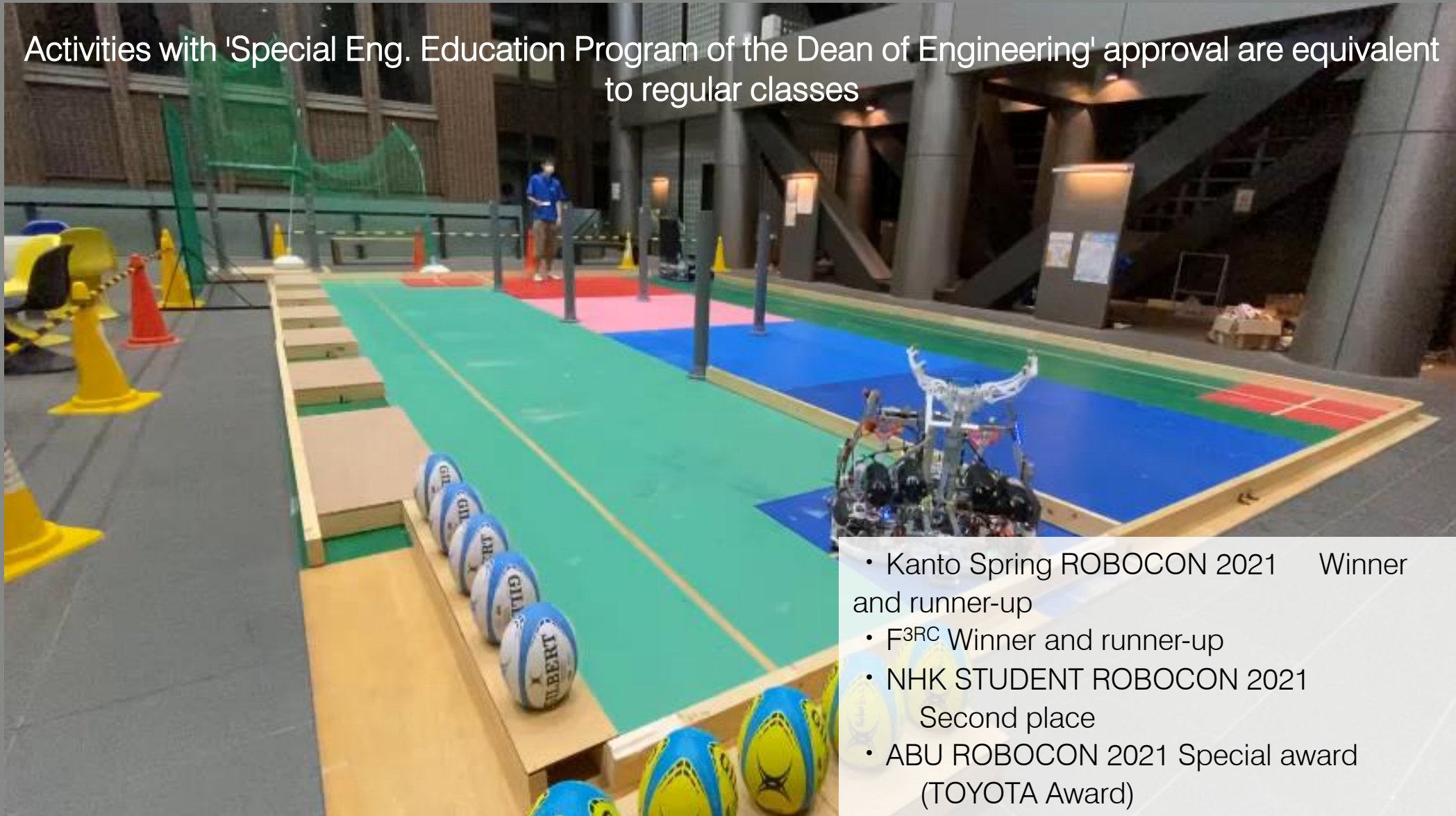
Forest · ground



Digital manufacturing

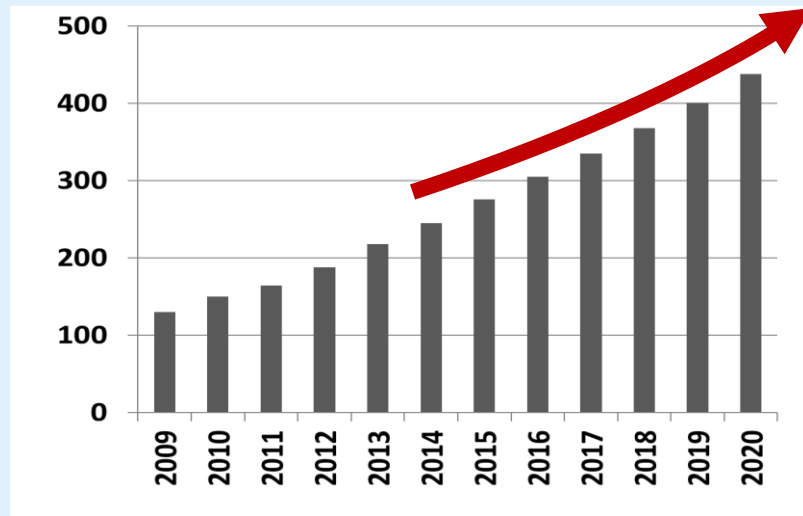


Activities with 'Special Eng. Education Program of the Dean of Engineering' approval are equivalent to regular classes



- Kanto Spring ROBOCON 2021 Winner and runner-up
- F³RC Winner and runner-up
- NHK STUDENT ROBOCON 2021 Second place
- ABU ROBOCON 2021 Special award (TOYOTA Award)

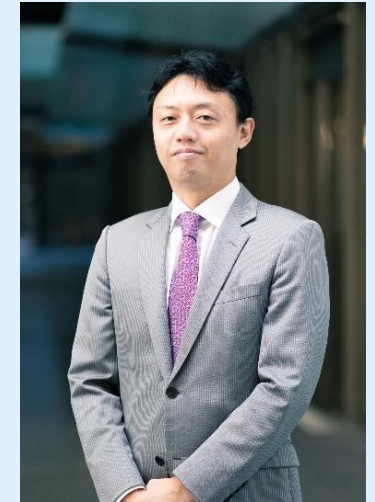
Cumulative number of Todai-related ventures started



Number of University of Tokyo-related ventures Approx. 478
companies (as of Mar. 2022) Around half of these are in Engineering!

Source: Division of University Corporate Relations

*Faculty of Engineering (all departments) leads the
entire University of Tokyo!*



Professor
Yutaka Matsuo

PKSHA Technology



Developing unique solutions with machine
learning algorithms

WASSHA



Delivering electricity to regions in Africa which
have no electricity

ACES



Introducing AI in different industries with AI
"machine eyes"

Introductory program



Summer camp



Preparing an entrepreneurship plan



Taking on the world stage



CIS signal processing
and demonstration development
for mobile applications

Ms. ZI PEILIN

Sony Semiconductor
Solutions Group

2023 M.Eng.
Electrical and
Electronic
Engineering Course

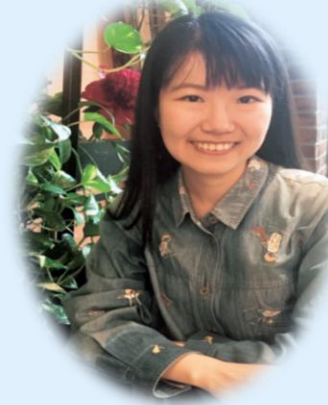


*Engineering can be involved in the
process of bringing ideas to life.*

**Ms.Mami
FURUSAWA**

Chemical company

2019 M.Eng.
Dept. Materials
Engineering



*Piloting is all about preparation
Analysing the environment and anticipating risks*

Ms. Mayu KOYANO

JAPAN AIRLINES
(copilot)

2015 M.Eng.
Dept. Of Aeronautics and
Astronautics



**Mr.Leonardo
Corradini**

Toyo Engineering
Corporation

2023 M.Eng.
Dept. Chemical
System Engineering



Ms.Toshiko MATSUI

Attached to the Main
Taxation Bureau,
Ministry of Finance
(Doctoral student at Imperial
College London)

2013 B.Eng.
Dept.MathematicalEng.
& Information Physics



Ms.Naoko MATSUDA

Bestat Inc
Founder and CEO

2014 Dr.Eng.
Dept.of Technology
Management for
Innovation



Chemical plant design

*Having a foundation in engineering, you'll be
irreplaceable.*

*Developing AI is like developing human
resources.*

You pioneer the future

**The University of Tokyo Faculty
of Engineering is waiting for you**