Faculty of Information Networking for Innovation and Design (INIAD), Toyo University

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INIAD GUIDE BOOK 2018-2019
The power of “humanities, arts, and sciences”

The Internet has significantly changed society. New technology is changing society, and that change is accelerating the speed of research and development. And the newly created technology further accelerates the change of society - thus, the speed of change is rapidly increasing. For utilization of new technologies, and for research and development, wisdom based on science is necessary, of course. Successful development of a new technology alone, however, does not warrant its introduction to society. Wisdom in the field of the humanities is needed to figure out how to incorporate new technologies into the sustainable business models, and how to do so in sync with existing laws and regulations. In addition, whether a service is deployed widely depends on whether a service is fun and easy to use and/or if it matches people’s tastes. Such differences are created by design, and the wisdom of the arts.

The power to connect

The Internet has the power to change society significantly because it connects people openly and broadly. Communication via e-mail and website within individual companies only never had such power. You can connect “anytime, anywhere, and to anybody” if you know the e-mail address or the URL. That accessibility is the power of the Internet. The next wave of technological/social innovation is said to be the “IoT: Internet of Things.” An era is coming where “objects” around us are connected to the network, and “objects and people” and “objects and objects” are openly connected. The objects in the network realm will reach real world beyond the Internet. The laws and systems concerned will become more complicated, and the importance of design, which shapes the tangible objects that we touch, will increase.

Toward the study of information networking for innovation and design

The speed of change is accelerated today. IoT services and objects that are based on the wisdom of “humanities, arts, and sciences” merged at a high level from the start can achieve rapid success. There is no single person, however, talented enough in all areas of “humanities, arts, and sciences.” Human resources in need today are people who have understanding not only in their area of expertise, but also in areas they are not specialized in so that they can communicate in a common language in order to collaborate with others and lead to successful goal of projects in which they are engaged. This is why we have created the discipline of “Information Networking for Innovation and Design” for studying how knowledge and learning of “humanities, arts, and sciences” should be for collaboration, and INIAD is the place where practical education is provided based on the discipline.

Ken Sakamura
Dean of Faculty of Information Networking for Innovation and Design (INIAD)
Faculty of Information Networking for Innovation and Design (INIAD), Toyo University

Geared towards a new university education in an era of rapid change

(Transcription of a guidance speech given at INIAD hall.)

Ken Sakamura, Dean of INIAD, Toyo University
I would like to talk about what Faculty of Information Networking for Innovation and Design (INIAD), Toyo University, is trying to do. The goal of INIAD is to provide the best university education possible, while always being connected to society.

**Human resources with networking ability**

The technologies of artificial intelligence (AI) and the Internet of Things (IoT) will considerably change the future. The Internet which appeared in the 1990s has changed the world. Especially, the last 10 years of technology in the Internet, cloud computing, and Mashup. Mashup is a little difficult to translate into Japanese. It is something similar to “the power of networking.” It has affected the business world, and significantly changed its shape. IoT and AI technologies will accelerate such changes.

**A place of education in the era of AI + the IoT**

INIAD is a place of education for the era of AI and IoT. An essential element here is “collaboration.” We provide INIAD Basic Education shortly after enrollment in order to create the foundation for a team that networks while maintaining a high degree of specialization. INIAD advocates the “Fusion of humanities, arts, and sciences.” All students learn the same curriculum in the first year, and go on to one of four courses from the second year. They practice solving problems in collaboration with people from various courses.

Gathering people who share the same values is not enough. In order to create a new value, diversity in values of the people gathered is essential. The Serendipity that occurs there becomes a key for bringing about innovation. “Serendipity” is also a difficult word to translate. It means “to utilize accidentally-encountered luck.” Therefore, we consider the ideal proportions of students should be 1:1 between Japanese and foreigners, male and female, and new graduates and working adults, respectively. So far, the proportion of foreign students is a little under 20 percent, and that of female students is around 30 percent. We are trying to make it closer to 50 percent.

INIAD considers furthering education of working adults important. It is impossible to keep up with the rapidly accelerating advances of AI and IoT technologies with only conventional education. So, I would like corporations to consider INIAD as an institution for further education, and send their employees as students to us. Enryo Inoue, the founder of Toyo University, also put much effort into life-long education during his later years. Similar to the turbulent time of modernization in the Meiji era, when Dr. Inoue established Tetsugakukan, currently Toyo University, we have entered a rapidly changing era of cloud + AI + IoT technologies. It is for this reason INIAD has been opened at Toyo University now.
Curricula of INIAD

I would like to introduce the curricula of INIAD (Figure). Students learn programming and communication in the first year. Normally, students begin their university education with general education courses. General education courses are very important in a university education. At INIAD, we believe it is essential for students to study the areas which seem irrelevant to their specialties at a university, for personal enrichment. However, there may be other ways than providing all of general education courses in the first year and proceeding to each special field after that. We want students to start their studies from areas different than what they learned in high school. We believe that during their four years of general education students should take the subjects they have interest in at the time they become interested in them.

Therefore, the first thing students do after entering the university is to thoroughly learn the basic subjects for networking, which INIAD considers important — mainly programming and communication. Japanese students study English, and foreigners who cannot speak English study Japanese, so that they can communicate with each other. Communication ability is fostered not only through language skills, but also through various forms of training.

Curricula of INIAD

- **Fusion of humanities, arts, and sciences**
- **Four courses**
- **Global skills**
  - Team practice
  - Basic education of networking in the 1st year
- **Diversity**
  - Systems to facilitate diverse participation

INIAD HUB-1

The school building of INIAD is called the “INIAD HUB-1.” It is a building with 19,000-square-meters of floor space. There are 5,000 IoT devices installed. Kengo Kuma, Professor of the Graduate School, the University of Tokyo, designed the exterior of the building. Thanks to him, it has become a very expressive and impressive building. I was in charge of its interior including the facilities and interior design. For example, I prioritized the comfort of chairs when sitting on them rather than the appearance. There is enough space for students to cross their legs, so they will not become tired when sitting for a long time.

The Media Center is a facility equivalent to a conventional library. The Media Center is not only a quiet space, but also a learning space conducive to communication between students. It is a library without paper books, which I have always wanted to realize. I expect that paper books will disappear in the future, and INIAD is experimenting with it proactively. There are no blackboards or whiteboards in the classrooms. The lessons are conducted using projectors. Since all the teaching materials projected are on the cloud, students can share them. And there is no paper bulletin board within the campus. All information is acquired through PC
or smartphones. In addition, there are digital signages at various places in the building. Appropriate information for the present date and time are displayed selectively.

At INIAD, education is provided by a flipped teaching of MOOCs, Massive Open Online Courses. Students study the video of lectures delivered in advance, take short quizzes and then attend the lectures. Classes are conducted in small classrooms, and students receive a follow-up on the understanding of advance study. After that, discussions are mainly conducted during the class.

**Makers' Hub**

There is a facility called Makers' Hub in INIAD. The facility is fully equipped with various types of mechanical equipment and materials: for digital creation, 3D printers, 3D scanners, laser cutters, and others for digital fabrication, and measuring instruments for electronic works such as logic analyzers and oscilloscopes. Students can rapidly realize their ideas in this environment.

The school building of INIAD HUB-1 itself is a teaching material of the IoT. We use it for a programming exercise of setting lights on and off in the classroom. By calling the lighting control API with a program, students can turn on and off the lights of the classroom they are using. This is what I mean when I say the whole building is teaching material for the IoT.

In another exercise, lighting is controlled by voice by combining a lighting control API and an open voice recognition API, in other words, by mashup. It is possible to turn off the classroom lights by saying “Turn off the light.” The skill of creating a system by mashup using various types of globally published API will become very important from now on. Such exercises have been provided since INIAD was established in April 2017, and some students have started to incorporate voice recognition into the system they created.

In addition, a smartphone application for controlling the building for visually challenged people is also being developed. It tells the current conditions of lights and door locks by voice when you swipe the screen. And it turns on/off the lights, or opens the door by double-tapping.

Thus the whole environment is teaching material at INIAD HUB-1. “It is possible to expand the living environment of one’s own by programming” - this is the attitude we most want freshmen to learn at INIAD.

I have disclosed all technical information for free for 38 years in the world of embedded computers in a project called TRON Project. The world is now evolving by people’s making public the results of their research and development using other people’s open results, and this process being repeated. Therefore, I want INIAD’s students to fully utilize the school building of INIAD HUB-1, and disseminate their achievements to the world. I sincerely hope that innovation will be brought about from INIAD, which will lead to a higher recognition of INIAD, and in turn more and more people will want to study here.
Dr. Enryo Inoue was born in 1858 and founded the Philosophy Academy (Tetsugakukan), the predecessor of Toyo University, in 1887 at the age of 29. The school's philosophy was “The basis of all learning lies in philosophy.” He was also known as the founder of “Spectrology,” the study of ghosts and goblins. The Meiji era was a turbulent time for Japan due to the influence of rapid modernization and Westernization (Bunmei-kaika). Mysterious phenomena such as monsters, ghosts, balls of fire were extremely popular probably as a reflection of people’s desire to rely on something in a time of unsettledness. The divination called Kokkuri-san, a form of table turning, in which a spirit called Kokkuri-san was believed to give oracles was also in fashion. Many tragic incidents were caused by those who believed in it. Dr. Inoue strongly criticized the tendency of people to make decisions based on such dubious ideas. He tried to quell social unrest by scientifically exposing the principle behind the phenomenon of Kokkuri-san and publicizing the results. Kokkuri-san of those days played out as follows: first, the participants put their fingers on an unstable table-like stand made of a kind of lid and bamboo legs. When one of the participants asked a question to Kokkuri-san, it answered yes or no by tilting the stand. Dr. Inoue discovered a strong correlation between the phenomenon and the personalities of the participants by gathering a lot of data. He found the phenomenon of Kokkuri-san occurred when some of the participants believed easily and were unsuspicious. He also constructed a hypothesis that unfamiliar behavior such as putting one’s finger on a table together with other people was apt to cause unconscious muscle movements. He compared the questions to which all the participants knew the answers and the ones to which they did not. The result was that Kokkuri-san answered the questions of the former group more accurately. From the survey Dr. Inoue concluded that the phenomenon of Kokkuri-san was a mere result of unconscious muscle movements caused by the subconscious mind of the participants.

Philosophy in those days was science. As a philosopher, he constructed a hypothesis by conducting a comprehensive survey, collecting a lot of data, analyzing them scientifically and confirmed it through experiments. Philosophy was a study to seek the fundamental idea of life and the world. Evidence was necessary to clarify and fully understand why and how events happen. Dr. Inoue was totally committed in his attitude towards modern philosophy. He emphasized the importance of thinking for oneself instead of swallowing transcendental truth without questioning it. He advocated that what was needed in Japan in the Meiji era was modernization of the mind, which meant implanting in each person’s mind the disposition of thinking for themselves. He continued to promote that throughout his life. However, the so-called “Tetsugakugan Incident” happened when he was 44. He approved the answer of one of his students to an ethics question in the graduation examination saying “It is not necessarily wrong to kill one’s lord or parents if the motive is right.” The government at that time judged that it was dangerous education and regarded it as a problem. Confronted with the backlash, Dr. Inoue tried to protect more than anything else the principle that thinking for oneself was the most important concept for students. As a result, he was confronted by the government and eventually chose to resign from the school in order to protect it. It is a great pity that due to that incident the school had nothing to do with him later on when Tetsugakukan became Toyo University. As an educator he changed his focus to lifetime education that was just beginning in the UK. He established the Testugakudo (Philosophy Hall) in Nakano City, Tokyo as a place for lifetime education. He also gave lectures as many as 5,400 times in 14 years to disseminate his ideas. He passed away during one of his lectures in Manchuria in 1919 at the age of 61.
We would like to look back the history of the land on which the Akabanedai campus stretches. The campus is located on the north side of the Akabanedai housing complex in Kita City, Tokyo. The land owned by the US Army was sold to the Japan Housing Corporation (present-day Urban Renaissance Agency) in 1959. The Akabanedai housing complex, the first housing complex in the 23 wards of Tokyo with more than 1,000 families, was constructed there and people began taking up residence there in 1963. It was designed by a famous architect named Mr. Shuichi Tsubata, who was working for Japan Housing Corporation at that time. Various advanced innovations were made including complete separation of the pedestrian lane and the traffic lane, burying of electric cables underground and placing of a supermarket on the first floor of the buildings. It was an important architectural venture and it helped shape the designing of subsequent housing complexes throughout Japan. Because of deterioration, however, Urban Renaissance Agency has been rebuilding the buildings one by one since 2000 into a high-rise housing complex with the new name of the Nouvelle Akabanedai. With the conversion to high-rises, surplus land was left in the area, and Toyo University acquired the land around the new campus. The land on which INIAD buildings are now standing was once used for Akabanedai Junior High School of Kita City. Toyo University acquired the land and used it for the temporary school buildings of the junior high school and the high school originally established by Enryo Inoue until the new school buildings were built in Hakusan. In 2015, when the new school buildings were complete, these schools were moved there as Keihoku Junior High and High School. The Akabanedai campus was built on the site of the old schools. Thus, the Akabanedai housing complex has a long history of about 60 years.
An interview with Dean Ken Sakamura: What does Dean Ken Sakamura think of the development of this new faculty?

With regards to Toyo University, the Hakusan Campus in Bunkyo City, Tokyo, is famous, why not there?

“Faculty of Information Networking for Innovation and Design” is a totally new faculty, and it is not located at the Hakusan Campus. At Akabanedai, Kita City, Tokyo, where there used to be an apartment complex of Urban Renaissance Agency, we built a new building which can accommodate 400 undergraduate students per grade, 20 graduate students per grade, and teachers and other staff, for a total of slightly less than 2000 occupants. This facility was opened on April 1, 2017. I worked as the overseer of the construction. We hired Prof. Kengo Kuma, known for designing the New National Stadium, to work on the exterior design of this project.

What is INIAD?

INIAD, pronounced “ee-nee-ad,” is the abbreviation of Information Networking for Innovation and Design. INIAD is a faculty established for fostering people who can start innovations compatible with the network era.

What is fusion among humanities, arts, and sciences?

Currently, a new era of information usage has arrived, and there are many intermediate areas of study, which do not fall into conventional categories such as non-science and science. Such areas are the main agents of innovation.

For example, FinTech\(^1\) is gaining the spotlight recently in the business world. It is a newly coined word which combines “finance” and “technology.” It stands for a new concept of finance that utilizes computer networks and

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\(^1\) FinTech, Financial Technology
A coined word of Finance and Technology. It indicates new services including banking, payment, and finance utilizing technologies such as the Internet, security, big data, and artificial intelligence (AI).

\(^2\) Uber
A car dispatch service in the U.S. It deploys its service in more than 450 cities around the world. A user calls a car with an application, and pays by the credit card they registered. The driver and the user evaluate each other on a five point scale scoring system. Ordinary people may transport users in their own cars. However, this may infringe on laws and regulations in some countries, and in some cases the service is opposed by the local taxi industry.
the Internet. Of course, electronic money and virtual currencies such as bit coin are part of it. By the emergence of such new technologies, areas of study such as economics are expected to create a new model, which is totally different from the conventional models.

In the business world, sharing economy is gathering attention worldwide, too. For example, in the transportation industry, Uber is changing the service of taxi to a completely different business. I can say that the world is in a very large vortex of change.

Since established areas of study had been formed before the birth of the Net society, they cannot adequately cover new topics. We started INIAD because we considered it necessary to set up a new academic classification. Naturally, computer science and engineering are the core of it, but we wanted to include areas which are deeply related to innovation such as business, design, and civil engineering, and create a new faculty by reconstructing them.

What is “design” of a new era?

I think design is very important. With regard to industrial design, the appearance of the 3D printer has totally changed the method of making things, and as a result product development in the era of network is becoming easier and easier. The quality of design might determine the product’s success or failure. Since we can produce anything that we can image, the concept of design needs to be rethought.

In addition, various user interfaces are brought together in devices such as smartphones now. People are more concerned about creating better user experiences (UX: User Experience) with various technologies such as voice recognition, location recognition and motion detection in addition to screen operation. The concept of user interface has changed greatly from the way it was in the past. For a new era, we have to create new designs.

*3) 3D printer
A device to form solid objects by processing resin or other material using three-dimensional data. It is used for making a mock-up, a prototype, or a mold for mass production, and artificial legs and artificial bones in the medical area. The price has dropped, and it has become possible to form solid objects at a low cost in a short period.

*4) UX, User Experience
A general term for experience that users feel when using products and services. It is a wide concept including not only usability and ease of use, but also the impression of use and the degree of satisfaction.
A new discipline called data science⁵ has appeared. In the present era of the IoT, huge amounts of real and trustworthy data are gathered. Unlike the existing businesses that were conducted based on human experience and intuition, data is collected using IoT and open data technologies, and analyzed by computers with technologies like artificial intelligence (AI) and machine learning. Such technologies and disciplines are collectively called data science, which has emerged and now allows us to start innovations.

Civil Engineering also Evolves

Civil engineering may be translated as urban engineering in Japanese. Conventionally, the basis of urban engineering was the construction of infrastructures. Certainly, planning of roads, water supply and sewerage is still important when developing a city or a town. However, after such infrastructures have become the norm in developed countries, quality of life (QOL) becomes important⁶. How should we form a community, how should we address the problem of low birth rate and an aging society? Also, how can we solve the disparity between urban cities and rural areas, which is recently a frequently discussed problem in Japan. Up until now they had been treated just as topics on paper, but we push them to the front as real-world problems that need to be solved for real.

A new era of computer science

Computer science, my specialty, has definitely changed. It is common knowledge that computing has changed from the era of batch processing on mainframe computers to the era of time sharing systems⁷, personal computers, the Net and then cloud computers. In the era of the Net, research

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⁵) Data science
A general discipline dealing with data analysis as a conventional field of research. As the development of technologies for collecting, processing, and analyzing a large amount of data (big data, artificial intelligence) has progressed in recent years, its utilization is highly anticipated in a wide range of areas including business and government.

⁶) Quality of life
Quality of life is not only based on material abundance, but also the total human living style and conditions including spirituality.

⁷) Time Sharing System, TSS
A timesharing system allows multiple users to simultaneously use the same computer. This operating method is not usually used now.
on how to divide the workload between the cloud and the edge is needed. New research is emerging related to network protocols, too, such as research for changing the protocols used in the era of TCP/IP for the next generation; specifically how to switch protocols between those for small amount of data such as connecting a sensor and those for large amount of streaming data such as video.

In the upcoming IoT era, the conventional information processing technology and embedded technology will be merged. Few universities provide information processing education that is in step with the IoT era. Thus, in the era when even the academic frameworks need to go through extensive changes, INIAD is determined not to keep the existing educational system as is, but to go through new challenges of creating a new academic framework in the midst of change.

Curricula of INIAD

At Japanese universities, students usually start general education in the first year, then proceed to each specialized area. General education is important, but I think the current order of studying general education at the first year and specialized areas after that is inappropriate. At INIAD, students can take their general education course at any time during the four years. On the other hand, all students receive education on computer science mainly on programming in their first year, regardless of their specialized areas.

This is a big difference. I want to show that there is a clear difference between the students that graduated from this university and the students from other universities after several years since INIAD was founded. In order to help students adopt a new way of thinking as soon as possible, we use computers in everything, and make the maximum use of them to master all areas of study.

The new building of INIAD - INIAD HUB-1

The model of it is the Daiwa Ubiquitous Computing Research Building, which was donated from Daiwa House to me and built in The University of Tokyo. All components of the building are connected to the network, and it is possible to control the authorized items via Application Program Interface (API). The mechanism of its access is controlled by a strong architecture. It is the Aggregate
Computing model, which mainly uses the IoT-Aggregator that I am designing now. The INIAD HUB-1 is a next-generation intelligent building based on this idea.

It is truly a transforming building, whose space becomes more and more comfortable for the students as they program it. The functions of the building change according to the purpose. I hope that our students acquire a new way of thinking toward business from these new experiences.

**What is important besides programming education?**

Besides programming education, another important aspect is no doubt communication. In this faculty, students are divided into the following courses of special areas: Computer Science & Engineering, Digital Design, Business Innovation, and Social Infrastructure. However, as the name “Faculty of Information Networking for Innovation and Design” shows, there is hands-on training in the third year, where students across the four specialized areas virtually work as if they were working in the real world, and collaborate to create objects and services. Collaborative work by networking.

Communication skills are necessary to move things forward in collaboration with people from different specialized areas.

I hope to make the proportion of female students equal to that of male students at INIAD. If half of the students are Japanese, the other half should be foreigners, and if half of them are high school graduates then the other half should be working adults. I believe that such a mixture coupled with good communication and cooperation would lead to something new. In order to accomplish that, various skills to communicate with people different from oneself are necessary. In addition to Japanese, English is also important. It is also necessary to polish presentation skills and the ability to make one’s thought understood by other people. For the above stated purpose, many types of hands-on training are provided at INIAD.

**What We Expect from Graduates of INIAD**

We encourage graduates of INIAD to start a business, and we are preparing an organization and a system for supporting them. Of course, we are not against working at
existing corporations and government offices. We hope graduates have the guts to carve out a new future they learned at INIAD in existing organizations.

**Networking with the Outside**

We are planning to network with universities from all over the world as well as in Japan. For example, we have begun collaborating with the University of Tokyo, Nagoya University, Yokohama National University, and Meijo University to start the enPit-Pro Project of MEXT (Ministry of Education, Culture, Sports, Science and Technology), where new information and communications technology (ICT) such as the IoT are taught to working adults. Joint research projects with corporations from all over the world have started, too, and we are in the middle of making a new organization to deal with the IoT era. It is something you can look forward to.

Since we are interested in the furthering education of working adults, we welcome working adults including active engineers who want to study further to gain new power of this new era. We have various methods of entrance exams. Please see the website for details: https://www.iniad.org/.
INIAD HUB-1

The INIAD HUB-1 is a state-of-the-art IoT building of Faculty of Information Networking for Innovation and Design (INIAD), Toyo University.

Digital signage

There are no blackboards or whiteboards. There is no notice board to put up paper notices at INIAD, in accord with our policy to eliminate paper. Therefore, digital signages are placed at many places in INIAD HUB-1 (Figure 1). Of course, you can acquire information from smartphones and PCs, but in order to make information known to people, digital signage is effective. Fifty-five-inch touch panel displays are used for the majority of digital signages. The notices change rapidly, but it is possible to freeze them by touching the screen. Students can find necessary information and read it on the site, or import it to their smartphones and other devices. In addition, wall projectors have been installed to easily provide information within INIAD.
Intelligent Lockers

There is no name plate on the intelligent lockers. They are designed with simple panels (Figure 2). These panels, i.e., the doors of the lockers, are controlled by the IoT. The locker opens when the user’s registered IC card is placed over the card reader. Since the lockers are controlled by the IoT, users can open them directly from their smartphones. The IC cards we use are the same as those used for public transportation. Their train passes become the keys of their lockers.

We also use the intelligent lockers as a teaching device. Students can use their lockers only after they associate their smartphones and electronic cards with the lockers by programming them. As they learn more, they can design how to use it in many different ways, such as giving an electronic key to an authorized friend via e-mail to allowing the friend to open the locker only once.

Media Center — A library without paper books

Media Center is a facility equivalent of a library at INIAD (Figure 3). However, the difference from a normal library is that there are no paper books. It is because INIAD intends to realize a paperless environment. Then, how do the students use the library? INIAD subscribes to e-books and e-journals of various study areas. Students, teachers and other staff who are authorized by the INIAD access control system can view e-books on their own laptop PC, or the tablets installed at the Media Center, etc.

Some of the students make serious use of a computer for the first time at INIAD, so there is a help desk to consult about computers at the Media Center. There students can ask how to connect to the Internet, and so forth anytime during the opening hours. Many self-study spaces with electric outlets are provided within the Media Center, so students can prepare for and review their lessons using their own computers.

In addition, there is a curved screen for presentations and exhibitions (Figure 4). It is possible to seamlessly combine images from three projectors and project them as one image on this curved screen using a technology called Stitching.

Figure 4 shows an example of how to use this curved screen. It is an image of a picture scroll of ghosts and goblins from the collection of Dr. Enryo Inoue, who is the founder of Toyo University and a researcher of ghosts and goblins. Since the real picture scroll is very valuable, it is rarely allowed to actually unroll it and take a close look. However, in this exhibition, it is possible to view it by digitizing it and projecting it on the curved screen.
Desks and chairs

INIAD's students attend a class with their laptop PC. Recent laptops suitable for carrying are thin and keyboards do not tilt too much. And when the PC is placed on a desk, the screen is placed close to the surface of the desk, so students tend to lean over and look down at the screen as shown in Figure 7. The weight of a human head is about 10 percent of the total weight of a body, so it is about six kilograms if the person's weight is 60 kilograms. It equals the weight of three two-liter pet bottles. Since such a heavy weight is being supported by the neck, the burden to the neck and backbone becomes large with the bent over posture.

The desks and chairs in Figure 9 may look like normal types for classrooms, but they are designed for the IoT era by Ken Sakamura, the Dean of INIAD, to solve the problem above. There is a wooden pad at an end of the desk attached with magnets. By placing the pad on the desk, and placing the laptop PC on it, the PC is naturally tilted (Figure 10). The keyboard is tilted by about 10 degrees, and the screen faces up. Arms are placed in a natural angle of about 110 degrees, which makes the head's position higher and the posture becomes upright, as shown in Figure 8. It largely reduces the burden on the body.

There is a lumbar support (relatively hard cushion for supporting lumbar vertebrae), which alleviates the burden on the lower back by leaning against the back of the chair. The seat of the chair is tilted toward the front side by two degrees, which lessens the burden on the backside of knees.

At INIAD HUB-1, various equipment such as sensors, lighting, air conditioners, lockers, and elevators are directly connected to the cloud, and controlled via API. INIAD proactively utilizes API in the lectures, making a good use of our small class size.

For example, a task to “write a program to repeat Full/ Dim/Off with the lighting” may be assigned. Students write a program using INIAD’s API. Then, each student’s screen is projected on the classroom screen, and the API is executed to present the result.

Furthermore, students are taught how to mashup INIAD’s API and API of outside services to develop an advanced application. For example, a program to control lighting in the room by voice such as “Turn on the light” and “Turn off the light” is realized by the mashup of the API of a voice recognition service provided by Google or other companies and INIAD’s API.

As described above, the students of INIAD will acquire the knowledge necessary in the era of the IoT in accordance with the concept of open API.
Navigation using AR technology

INIAD HUB-1 itself is a test bed of the IoT, and it is possible to create various application systems utilizing its facilities in real world. One of the applications is the navigation system that uses Augmented Reality (AR) technology. AR is a general term for technologies which show extended images of the real space by adding or emphasizing information to the real space sensed by humans. A famous example is “Pokémon GO.”

The room number plates on each room in INIAD HUB-1 are designed for easy recognition and tracking, which are suitable for AR applications. By reading the number plates with the camera of a smartphone and making a computer recognize them, it is possible to check where the person is and which direction the person is facing.

With this technology, it becomes possible to navigate the person to a room. For example, a visitor receives an invitation and comes to INIAD, and reads the AR marker “5F” on the 5th floor (Figure 11). Then, a guide map to the room to which the person is invited, and an arrow showing the way are displayed overlaid on the image from a camera which is displaying a live feed of the actual space.

It is made possible because the number plates of each room and the signs on the map are provided in the AR marker format.

Furthermore, by tapping on the map of the overlaid display and starting the navigation, an arrow appears on the walls and floors in the actual space (Figure 12). A pin is shown at the destination like in a map application (Figure 13). The arrow and pin above are not displayed in the smartphones, but are shown on the interior of the real building from projectors. AR augments the space within a screen generally, but it is possible to augment the actual space by using them. People who are not able to arrive at the destination by using the current navigation applications on the screen will not get lost, if they walk along the arrow displayed on the floor.
INIAD Makers' Hub

INIAD Makers' Hub is a space for INIAD's students and teachers to manufacture items using computers. Manufacturing with computers is generally called digital fabrication, and manufacturing using 3D printers and laser processors is becoming a new global trend. INIAD introduces multiple machines for digital fabrication including 3D printers, laser processors, and 3D scanners (Figure 14 - 16). In addition, measuring instruments such as highly accurate testers, oscilloscopes and network analyzers, and tools for manufacturing such as electric drills and soldering irons are provided. Figure 17 shows an example made with the machines and instruments of INIAD Makers' Hub: a replica of a skull-shaped porcelain pen vase used by Dr. Enryo Inoue, the founder of Toyo University. The actual pen vase is a valuable item, but by using digital fabrication, it becomes possible for visually challenged people to touch and feel the shape of the pen vase, for instance. Thus, it is possible to contribute to making a museum barrier free.

*1) 3D printer: A device to form a three-dimensional shape by accumulating thin layers of resin or other material based on a 3D model data created in a computer with 3D CAD, etc. It is mainly used during a product design. It used to require making a mold for the same purpose, but it became possible to output from a 3D printer, and realized rapid prototyping in manufacturing.

*2) Laser processor: A device to cut, drill, and engrave with high-power laser beams. Using laser instead of cutters for machining, it is possible to directly process from the two-dimensional CAD data created on a PC. It is possible to process complicated shapes and patterns in a short time.

*3) 3D scanner: An input device which captures the shape of a solid object in a three-dimensional form and stores it as data. Its applications are the measurement for comparing a manufactured article and CAD data, reverse engineering by capturing data of the actual object for analysis, digitization of highly-valued cultural assets, and others.
Architectural Model of the Area around the Akabanedai Campus

The site of INIAD HUB-1 was used for Akabanedai Junior High School of Kita City for 42 years from 1964 to 2006. Toyo University acquired the land and used the old school for the temporary school buildings of Keihoku Junior High School, Keihoku High School and Hakusan High School, the annexed schools of the University, for four years from April 2011. In April 2017, two years after April 2015 when the construction began, the Akabanedai campus of Faculty of Information Networking for Innovation and Design, Toyo University was opened on the ground connecting the school sites above and a part of the sites of Akabanedai housing complex. The architectural model (Figure 18, 19) was made by the Urban Renaissance Agency for easy grasp of the progress of the reconstruction project of the Akabanedai housing complex. The big project, which began in 2000, is almost complete now. The model is composed of 17 replaceable blocks and can be easily reconstructed according to the progress of the construction work. The process of the development of the Akabanedai housing complex can be clearly perceived there.

With the opening of INIAD in April 2017, we made the construction model of INIAD HUB-1 and replaced it with that of the former school buildings. Specifically, we 3D-scanned the part of the former school buildings to obtain the 3D data of the outline of the land, combined it with the CAD data of INIAD HUB-1 and converted it into 3D data, then 3D-printed it and inserted the finished model to the original architectural model (Figure 20). We used the AGILISTA-3200 of Keyence Corporation for 3D printing with which highly precise molding with lamination pitch of 15 µm was possible.
Future to be created by the cloud and AI

Acquiring the ability of logical thinking, and making it an advantage.

Ken Sakamura, Dean of Faculty of Information Networking for Innovation and Design (INIAD), Toyo University

Source: “An introduction to cloud and artificial intelligence (AI) for junior high school and high school students” hosted by INIAD cHUB at the Akabanedai Campus of Toyo University on March 30, 2017

What is the cloud?

Have you heard the term “the cloud” before? Let me start with the topic of what the cloud is. The Internet is used all over the world now. And the Internet is connected to a large number of computers.

INIAD’s building is the world’s most advanced IoT (Internet of Things) building. Almost everything including electric lights, air conditioners, and elevators are connected to the network. They are connected, but you don’t know where and how they are connected, do you? We don’t know how they are connected, but we can use them. When the Internet of computers is drawn in a picture, it is drawn wavy like this (Figure 1). This wavy thing is the cloud. Its shape is like a cloud in the sky. The cloud is named after a cloud in the sky. The power of computers connected via the Net is huge. It is capable of, for example, finding a necessary thing from vast information, storing any amount of photo data – e.g. Google photo. You can also upload as many photos as you like. Normally, the data would be too much and it would overload your PC if you tried to store all of it. It can also; send messages to others, inform you of tomorrow’s weather, reserve a restaurant, purchase a movie ticket, deliver something you want and enable you to watch a movie or listen to music. There are many more uses of the cloud, and people are actually using it for many more purposes.

Thus, we do not know where the cloud is, but it provides various convenient functions. For example, when you search on your smartphone, you use the power of computers connected to the Net. We do not know where they are, but there are many large computer systems behind the cloud, and they combine various things and do many things to bring us the answer we request. No one knows all the specific details. However, we can use it. What kind of a computer in which place answered your
question? It might be a computer in the U.S., or it might be a computer in Japan. Maybe 100 computers collaborated to give the answer, or maybe only one computer answered. The unknown part as above is a good feature of the cloud (Figure 2).

Even I, a specialist of computers, don’t know where the information is coming from. Cloud computing uses the optimal computer power from the cloud as needed. The people who designed computer systems used to know all operations, but now, it is unknown what operates where in the current network environment.

It was very difficult to use a computer a long time ago. I have been the Dean of a new faculty, INIAD, of Toyo University since April 2017. Before that, I worked at the University of Tokyo for 38 years. Just to operate a computer was difficult 38 years ago. It was very expensive — you use your own personal computer now. Even a large computer, which occupied a large room called a computer room, had less ability than your personal computer, and costed about 1 billion yen. Since a large computer generated a large amount of heat, it required a powerful air conditioner for cooling it, and electricity bills were very expensive. In addition, it broke at least once a day, so an engineer had to take care of it all the time, (laughs).

However, we have the cloud now. We can use computer power whenever and as much as we need, and it is charged only for what we use. There are a lot of free services, too. Adding to that, the cloud becomes more interesting than just using it if you can program. Have you tried programming? You haven’t? But you came here because you would like to (laughs).

When to start programming

There are three areas in computer education. “Information” has already become a required subject for the current high school students. In this subject, the following three areas are taught: IT (information technology), which is mainly about how to use computers — how to effectively search on the Web, how to operate software, etc.; DL (digital literacy), which is about literacy such as how to use computers safely, privacy, proper social manners, security, etc.; and CS (computer science), which includes principles of computers, algorithm and programming. However, this is not studied often at high schools. Actually, programming will become a subject at elementary schools from 2020. People who have already graduated from elementary schools can study programming properly if they come to INIAD. What elementary school students learn in the six years can be learned by high school graduates in a month. But even if you can learn fast, you
still have to start from the beginning. Even if you understand part of the content of the first grade of elementary school, you cannot skip the other part, but have to learn step by step. In this way you can catch up for sure.

Japanese computer education has provided only IT and DL so far. However, more and more emphasis is placed on teaching programming around the world. It is starting in Japan now, but it is more advanced in the rest of the world. Israel was the first country that started teaching compulsory computer programming. In Israel, programming has been a required subject in high school since 2000. It is taught regardless of whether or not students are studying in the field of science. In the U.K., it became compulsory at elementary schools in 2014. Programming is becoming compulsory education also in other countries.

Some people say “Mathematics is enough,” or “It is enough to start from high school. Students should acquire the language skill first,” but what they are saying is totally wrong. First of all, mathematics and computer science are different. I am not saying that language skill is unimportant. If you do not learn language, you cannot read a book on programming. Since there are many studies that are necessary for humans, we cannot argue which is better or worse. It is meaningless to compare language and programming.

People who can meet the challenges of the future world are those who can utilize programming in the own specialized areas.

They are not necessarily the "Professional of Programming."

Fostering people who can face a challenge

As described above, programming is learned at elementary schools and junior high schools in many countries. It may surprise you, but programming education is provided not for making programming specialists. We are moving towards our goal of fostering people who can meet the challenges of the future world. The reason is people who can challenge the world in the future are people who can utilize programming in their own specialized areas. They are not programming specialists (Figure 3 and 4).

Let me share an example. Agriculture in the Netherlands failed as soon as they joined the EU. Why did it fail?

The Netherlands is located in the northern part of Europe, where it is hard to produce crops. Warm countries such as Italy and Spain have many advantages in growing crops. Inexpensive vegetables from such countries were distributed and crops from the Netherlands met stiff competition.

Then, what they did was to consolidate farm lands in order to expand tracts of land. Their greenhouses are surprisingly large. Furthermore, farmers learned programming and created smart farms. Temperature, humidity, the amount of water, and others are measured, and opening/closing of windows, watering, etc. are controlled by computers there.

As a result, they became the second largest agricultural
country in the world, let alone Europe. It is worth noting, the people who made the computer systems were not from computer companies, but they were farmers. They are trying to export this system to the rest of the world. They changed agriculture so much. What I want to say is that the farmers realized what they wanted to do with computers. Programming is the same as “writing, reading, and arithmetic” in an information society. It is a skill required in all areas. An era has come when programming is taught as a basic academic skill, not only for training expert programmers.

The power of programming

We had to start from scratch when we wanted to write a program before. We needed to make hardware first, and then write programs by ourselves. However, it is not necessary to do the same now.

For example, what would you do if you are asked to research the number of art museums in Japan? You would search the Internet first, right? Then, you will find a site named “Public cloud system,” which is provided for collecting tourism information (https://www.chiikinogennki.soumu.go.jp/k-cloud-api/search/download/). Now, the Japanese government is collecting open source information so that people can freely search and process, which is called “open data,” so you can easily find such a site.

You can find data on all the tourism facilities, a total of 21,069. When you download the data, the total number of rows in the CSV (Comma Separated Value: a table of values separated by comma) file is 554,120. Since one facility’s data is written on multiple rows, the number becomes as shown above. What should we do if we would like to only count art museums? If you count by hand, it would take you about 17 and a half hours, even if you were able to process one facility in only three seconds. If you factor in the need to double check for miscalculations, you do not know how long it will take.

```python
import csv
import codecs
import pprint
import time

print("Totalize the number of art museums in Japan
")
start_time = time.time()
facility_data = {}
with codecs.open('kanko_all.csv', 'r', 'utf-8') as f:
    reader = csv.reader(f)
    for row in reader:
        if row[1] == 'genres[0]' and row[2] == 'S':
            if not row[9] in facility_data:
                facility_data[row[9]] = 0
            facility_data[row[9]] += 1

print('{{"count":{0}}}
'.format(facility_data['Art museum']))
elapsed_time = time.time() - start_time
print("processing time: {0} [seconds]
")
```

So, what can we do if we can program? With a program of about 10 lines for processing the CSV file, you can get the answer in 10 seconds — how does that sound? Are you convinced enough to learn programming now? (laughs)

This programming language is called Python, and it is learned by all students in the first year at INIAD (Figure 5).

Even programs are not necessary if you use the cloud

However, you do not need a program now. Even if you do not download data on your PC, there is a powerful database in the cloud, and you can acquire the result only by writing a line of URL-type command. The mechanism where you ask a task to the cloud in URL format and receive an answer from it is called “RESTful API.” Adults who know computers may not have learned about recent computers. You should ask if they know the word “RESTful.” If they do not know, you should think that it is waste of time asking them (laughs).

To use the features of other systems in one’s own program is called “Mashup.” Recently, people use good programs made by others in their system. Therefore, you do not have to write all the programs by yourself. At INIAD, the method for writing a whole program is taught first. If you cannot write a whole program, you can’t say that you have learned programming. After that, the method for Mashup using RESTful API is taught.
**Why is AI receiving so much attention?**

I would like to talk about another theme, artificial intelligence. AI is a technology to infer and learn the same way humans do using computers.

This is a robot made by an American company, Boston Dynamics (Figure 6). Many healing-type robots are made in Japan, but different types of robots are made in the U.S. They are studying how to make robots that can walk on bad roads with two legs, carry things, and so forth, and trying to put to practical use. The latest results of research on AI are used there.

Artificial intelligence (AI) is a research area that is rapidly becoming a focus of attention recently. I think you have seen it on TV or in newspapers. Research on AI started around 60 years ago. Computers were first made around 1946, the end of the Second World War. The first computer was for military use. Therefore, it was a state secret, and mostly used for making a large amount of mathematical tables for calculating the trajectories of artillery guns. After the war, in the 1950s, American universities all started to put effort into research of computers, because they found computers could be used for other purposes than as a tool of war. For example, MIT (Massachusetts Institute of Technology) considered AI would become a reality in the future. They started research from the 1950s, and established MIT Artificial Intelligence Laboratory (Al Lab). Soon after a computer was created, research for making a machine that can think like a human started.

However, the limitation of such expectations soon became apparent. The technology of AI at that time used statistics and symbol manipulation. Tōrobokun, which was an AI engineered to take the entrance exam of the University of Tokyo and pass it, also used that type of technology. But it was announced that the research would be abandoned in November 2016. I am proud of those researchers. It is difficult to admit failure when research is conducted using government funds. By its very nature, some research fails and some succeeds. One important result of research is to know what doesn’t work.

There had been a long period during which AI research did not bear the expected results. However, ultimately there was a breakthrough. In science, there is a moment when various things suddenly become possible by one method which breaks a wall after various methods failed. It is called a breakthrough. In the area of AI, the “multilayer neural network” was the breakthrough.

The neural network is a method by which computers imitate the nerve net of human brains. The concept is totally different from symbol manipulation, but it is based on - in a sense - a simple idea. Actually, this research also started in the 1950s, but did not gain any remarkable results for a long time. The reasons why it is actively used these days are the advancement of hardware which enabled processing of multilayer neural network and the emergence of the technology which enabled automatic fine adjustment of neural network.

**Deep learning - a machine learning by itself**

This technology is called “deep learning” now. (“Shinsogakusyu” in Japanese.) It is named after the way it creates a deep network with multiple layers imitating the nerve net of human brains. Therefore, it could have been called a deep neural network, but it is called “learning” because this technology makes it possible for the
computer to “learn.” “Learning” in the field of AI means a computer learns without detailed instructions on how to process the task by humans.

Deep learning started from the application to image recognition. It recognizes what is in a picture. For example, when you search with a key word “dog” in Google photo, it searches pictures of dogs from your pictures. It is a result of learning a lot of images (problems) and answers (what they are) by computers. It is called “supervised learning.”

The learning methods and the applications spread widely in no time. There is an experiment in which a robot learned how to open a door (Figure 7). What is interesting is that how to open the door was not taught to the robot, but it was learned by trial and error. It is called “reinforcement learning.”

Parallel learning, which a human cannot do, is possible with robots. For example, 14 robots learn how to grab objects with different shapes and materials by trial and error, not by direct instructions. Then, when a robot becomes able to grab an object, it teaches other robots. They learn how to grab the objects in a very short time by working in collaboration (Figure 8).

Deep learning started to receive attention just five to 10 years ago. However, it has yielded many interesting results in a short period. Don’t you think artificial intelligence (AI) is interesting? INIAD provides a curriculum that enables you to fully learn from basics to applications of AI.

**How to interact with AI**

I have talked about the cloud and AI so far. If you would like to become a researcher of deep learning, you can study in the engineering course of INIAD. If

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*1) [https://www.youtube.com/watch?v=5D6OkyiClb8](https://www.youtube.com/watch?v=5D6OkyiClb8)  
[https://www.youtube.com/watch?v=frKiad0mm6o](https://www.youtube.com/watch?v=frKiad0mm6o)  

*2) [https://www.youtube.com/watch?v=iiD3Klvm96s](https://www.youtube.com/watch?v=iiD3Klvm96s)  
[https://www.youtube.com/watch?v=R2kEi_KK5sA](https://www.youtube.com/watch?v=R2kEi_KK5sA)

*3) [https://www.youtube.com/watch?v=iaF43Ze1oeI](https://www.youtube.com/watch?v=iaF43Ze1oeI)

*4) [https://youtu.be/4HCE1P-m11B](https://youtu.be/4HCE1P-m11B)
you don’t, you can use the latest AI in the cloud. This is an example of a Japanese farmer who used a function of AI in the Google cloud to develop a system for selecting cucumbers (Figure 9). I talked about farmers in the Netherlands, and there are similar stories of people in Japan. The farmers could program and use the cloud.

How we use AI will become more important in the coming era. As you may understand from what I talked about today, there is no doubt that AI is more excellent than humans in some areas. When you become adults, there will likely come a time job competition is not with foreign countries, but with machines. For example, if a robot which transfers cargoes in the video I showed you is sold at a low price in the future, you would think twice about selecting that as your occupation, wouldn’t you? (laughs) It is still a job now, but it may disappear by the time you become adults. That is the competition with machines. The AI researchers at the University of Oxford made a list of occupations that may be replaced with AI in the future, and it is becoming increasingly realistic (Figure 10).

Therefore, my opinion and the concept of INIAD is that if machines learn human sensibilities, then conversely humans have to strengthen logic. If machines gradually resemble humans, humans have to acquire the logic that machines have. Humans sometimes act based only on emotions. However, acting only because of emotions may cause arguments and wars. It is important to keep a cool head and think logically throughout our lives. For fostering logical thinking, programming becomes a good training tool, and it is important (Figure 11).

Only the people who can change will survive

Society will face significant changes in the next decade or so. However, even specialists of computers and specialists of information and communications do not know how it will change from now. It is difficult to predict the future. However, Information and Communication Technology (ICT), i.e., computers and networks, is changing society for sure. There is a saying of Darwin, “Only the people who can change will survive.” It is important how able we are to change in an ever changing society. We ourselves have to change. The programming and communication skills become an advantage for that. I expect many people will acquire the two skills at INIAD and prosper in their endeavors (Figure 12).
INIAD
Faculty of Information Networking for Innovation and Design
Graduate School of Information Networking for Innovation and Design
The main concept is "networking."

Present-day society thrives thanks to advances in science and technology including computers and the Internet. We are entering an age when a single person cannot understand everything and make everything work. What is sought today is cooperation and networking among as many people as possible.

Diverse functional blocks can be obtained from the Internet easily, and the development environment for smartphone has improved. Through the combination of only a few programs, it will be possible to develop sophisticated applications and offer new services.

Today’s Internet society makes it even easier to take on new challenges in the world arena.

The foundation of such networking is computer science.

The Internet has eliminated geographical barriers, making it easy for like-minded people to know each other and work together. It is possible to collaborate with people who are far away (cloud sourcing), or to send a design drawing of an object and request for its manufacture and delivery by courier service. Attractive prototypes created in this manner can raise funds from all over the world via the Internet (crowdfunding). There are an increasing number of "startups" worldwide that have succeeded in bringing innovative products to the world in this manner.

Empower students to network with people with different talents

People who can participate in a team, use computers efficiently, and cooperate with team members based on available information to swiftly transform ideas into something tangible are widely sought today.
A key to the future success is the skill of networking.

The four offered courses will equip students with the skill to quickly give shape to ideas by making full use of development environments, such as the Internet and 3D printers, through programming and working with other individuals and organizations.

Team-based practical training across the four courses

The Faculty offers practical training classes spanning multiple years where students across the four courses form a team in order to tackle shared tasks.

CS education in all the four courses

Computer Science (CS) allows students to acquire programming skill and more.

The Faculty, placing emphasis on CS education as the foundation of networking, offers introductory classes in CS and programming education in all the four courses.

Emphasis on communication skill

Students develop practical communication skills, such as presentation and debate in English, in order to solve shared issues with a team of students having different nationalities, cultural backgrounds and fields of expertise.

Programming — the power to help students regardless of the career they lead
The IoT (Internet of Things)

Building state-of-the-art information systems that support society

The Information Networking Computer Science & Engineering Course

Students acquire the skill to support networking technically and implement new information services.

Nurturing human resources for designing state-of-the-art information systems that underpin society

Today, we can access all kinds of information from all over the world anywhere at any time through PCs and smartphones. This was inconceivable until about 10 years ago. The age of the IoT (Internet of Things) is soon to come. Then everything in the world will be networked.

Supporting such highly computerized society is computer science.

In the Information Networking Computer Science & Engineering Course, students acquire advanced knowledge in computer science, which enables them to develop state-of-the-art information systems that underpin the future society.

Based on a world-standard curriculum

All classes in the Information Networking Computer Science & Engineering Course are based on a world-standard curriculum developed by two international engineering and academic societies, IEEE and ACM.

This curriculum allows students to acquire advanced knowledge of computers that is useful anywhere in the world, with emphasis on two research areas: "advanced computer architecture," and "computer network," which represents communications technology in the new age.

The Information Networking Computer Science & Engineering Course aims to nurture highly skilled engineers who are one step ahead of those only with standard programming skill, and who can create next-generation information systems on their own.

Career paths

[Network system developers, system engineers, programmers and researchers]
Developing human resources that can give shape to future information services and products

Attractive designs bolster the appeal of websites and various industrial products. In the Information Networking Digital Design Course, students acquire a wealth of design knowledge and learn practical skills for creating unique designs. They also acquire the skill to give shape to future information services and industrial products.

Design by making full use of computers

Today, manufacturing is inseparable from computers. Rapid prototyping, i.e., creating a design using 3D CAD and other tools and transforming it into a tangible object quickly by 3D printers and laser-based manufacturing machines, is attracting much attention. In the Information Networking Digital Design Course, students focus on two areas: “digital design,” which covers manufacturing by making full use of computers, and “user experience design,” which deals with interactions between humans and computers. The course aims to nurture highly talented people who make full use of computers to give shape to new ideas in the shortest time possible.

Career paths
[Web designers and industrial designers]
Data-enhanced management

Information businesses today continue to collect large amount of information from all over the world via the Internet. The ability to analyze large amount of data based on statistical analysis and to use the result of analysis for marketing and other business operations is indispensable to future businesses, particularly in the realm of information business driven by the Internet. In the Information Networking Business Innovation Course, students study not only “business incubation,” which addresses methodologies for creating new businesses, but also “data science,” which helps to create strategies based on data analysis. This course aims to nurture management experts who have a solid foundation in data analysis.

Career paths

[Project managers, consultants, marketing personnel and startuppers]
Information Networking Social Infrastructure Course

Acquiring the skill to build application of ICT to create enriched society and well-being with networking.

**Creation of enriched society and well-being**

- **Complex and advanced urban activities**
  - Urban well-being

**Application of ICT to society**

- **Infrastructure services**
  - Design and management of infrastructure
  - Smart city
  - Traffic information management

- **Quality of living**
  - Healthcare management
  - Internet services
  - Community development

**Application to infrastructure**

**Application to living**

Human resource development for application of ICT to urban infrastructure and well-being

The city is supported by infrastructures such as buildings, roads, water and wastewater services and electricity supply. The application of ICT to design and utilization of such infrastructures is essential to support complex and advanced urban activities. ICT applications to environmental management, healthcare, comfortable and convenient living, culture and community are widely developed for creation of enriched well-being. The Information Networking Social Infrastructure course builds capacities on basic approaches of ICT applications to urban infrastructure and well-being.

Focused curriculum to develop the skill to put one’s knowledge to application

Buildings and various facilities have been designed and maintained individually according to the purposes. This course provides holistic concepts, planning, design, management and ICT applications. Rapidly growing application of ICT to well-being is taught. Basic course concept is to nurture capacity of flexible thinking and application of technology to catch up with future change rather than mere understanding and memorizing the current knowledge because the development of ICT is very rapid.

Career in the following sectors

[Public sector, construction, commerce, services and others]
In the first year, all students are required to study programming and Japanese-English communication intensively in order to build a solid foundation in information networking.

Starting from the second year, students are divided into four courses, and in each course, they acquire technical knowledge in two research areas. They also learn information networking skills through practical exercises.

Team-based practical training provides an opportunity to put information networking into practice. By making the most of the specialized knowledge and skills they acquire in each course, students in a team spanning the four courses receive simulated startup training. Students learn how to work in society through collaborations with other students from different courses and possibly of different nationalities.

In the fourth undergraduate year and the Graduate School, students can join a research laboratory to pursue further study in their fields of expertise.
Business Innovation Course

2nd year
- Management Theory I
- Accounting Theory I
- Statistics and Data Analysis I
- INIAD Business Exercise I - II

3rd year
- Management Theory II
- Accounting Theory II
- Statistics and Data Analysis II
- Data Mining Theory
- Artificial Intelligence
- INIAD Business Exercise III - IV

4th year
- Management Theory III
- Intellectual Property Rights Theory
- Big Data Analysis
- Deep Learning
- Business Incubation Theory I - IV (elective)
- Data Science Theory I - IV (elective)

Social Infrastructure Course

2nd year
- Architectural Design
- Infrastructure Management
- Environmental Science and Policy
- INIAD Civil Systems Exercise I - II
- Industrial Ecology
- Energy and Environment Infrastructure
- Geographical Information Systems

3rd year
- Urban and Regional Management
- Social Capital Management
- Ubiquitous Networks and Life
- INIAD Civil Systems Exercise III - IV
- Transportation and Information Management
- Lifeline Management
- Sustainable Society and Information Management

4th year
- Infrastructure Services Theory I - IV (elective)
- Quality of Living Theory I - IV (elective)
Programming education in the IoT era

Basic programming education which creates the power of "networking"

Objects which previously operated independently are becoming networked due to the IoT (Internet of Things), and society is significantly changing due to the "networking" of every service and device around us through the computer.

With the whole society now becoming globally connected, we also need to become "networked" with people around the world and develop the basic skills to solve various issues.

Students in the Faculty of Information Networking for Innovation and Design use the "Python" programming language widely adopted around the world and the Internet-standard "HTML5" and "JavaScript" languages in all of their courses to develop an appropriate foundation for the basic skills of the IoT era.

Specialized education to cultivate the human resources that can lead the "networking" process

In order to cultivate the human resources that can lead the "networking" process, a custom-designed, specialized curriculum has been prepared for each course which uses the common networking knowledge learned in the basic programming education as a foundation.

In the Computer Science & Engineering course, students use the "T-CAR" model car with embedded computers, which can be networked to various Internet cloud systems, to practice building an entire IoT application system. This is clearly different from "embedded systems practice" to learn how to create a single machine, and helps students understand comprehensive systems which integrate with the cloud and is designed to nurture the human resources who can lead the IoT era.
Features of the New Campus

INIA educational systems

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Traditional lecture hall classrooms

- Traditional Japanese universities, particularly private and liberal arts universities, primarily used a "lecture" format where the teacher would unilaterally impart knowledge to the students.
- For such lecture style, lecture halls were an efficient way to accommodate larger numbers of students.
- However, with the teacher merely imparting knowledge in a one-sided manner and the students only receiving it, there was no "networking" between them.

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Education for a new era which combines network and campus-based learning

- INIA specifically stresses the importance of "gathering in the same place" exactly because of the network era.
- The knowledge is received through "MOOCs," an online educational system. Students can watch the lectures through a browser at any time, from anywhere, and as many times as they wish until they understand the material, and they can check their level of comprehension through exercises.
- In contrast, activities which cannot be performed over the network are conducted on campus.
  In concrete terms, the students engage in discussion-based classes focusing on debates with the teachers and other students as well as hands-on practice to promote the assimilation and mastery of the knowledge acquired through the online educational system.

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Use of many small classrooms

- Discussion-based classes do not work with large numbers of students. So the INIA classrooms consist of many small classrooms.
- There are also many small team rooms, which can be used for various purposes such as a hub for team projects which start from Junior (third) year or as offices for companies founded on campus.
Even as the Net becomes mainstream, face-to-face communication is still important.

The Media Center located in a public area on the first floor of INIAD is a space which focuses on facilitating face-to-face communication by providing media functions that cannot be implemented over the Net.

For example, there is a meeting space where a small number of students can gather to communicate while viewing the same large screen.

- The meeting spaces have various types of interiors, which changes the mood of the students and stimulates creative thinking.
- A good balance of distance from other team members produces serendipity (pleasant surprises) and multiplies ideas.

There is also a small-scale theater space to hold small seminars and discussions.

Conversely, there are many personal spaces with a moderate sense of isolation which allow students to be alone while simultaneously sensing the presence of other people around them.

When students get tired of the creative process, there is a cafe nearby. Students can refresh themselves with delicious drinks and desserts.

The space adjacent to the Media Center is a public area designed for students and other people to gather and meet.

The space is equipped with exhibition furniture such as stands and large screen projectors to support panels, full-scale real demonstrations, and projector exhibitions.

It can be used for exhibitions for on-campus lectures, student projects, product announcements for campus startups as well as various events such as university festivals.

Architectural equipment, interior, overall architecture produce: Ken Sakamura

The advocate and leader of "TRON" Project to build and disseminate the computer architecture for creating the IoT society.

Architectural design: Kengo Kuma

Supervised by Kengo Kuma and Associates. Professor of the Graduate School, the University of Tokyo. Prof. Kuma also designed the new National Sports Stadium which will serve as the main venue for the 2020 Olympic and Paralympic Games and features a striking design that uses wood and other materials to express the concept of "harmony."
Campus of the Future with the IoT integration

Located on the Akabanedai campus, INIAD connects various equipment and devices to the net using cutting edge IoT technologies to operate them in a coordinated manner according to campus conditions, provide people with the optimal environment, and optimize the energy usage. The concept of optimizing the control of equipment and devices according to how spaces are being used is a goal of TRON Project led by Dean Ken Sakamura, and the Akabanedai campus has applied the results of the project to create the campus of the future.

Learning in environment enriched by cutting-edge technologies

There are no lighting or air conditioner switches in the research labs. On-campus sensors are used to automatically recognize and control the environment conditions. Users can issue instructions from smartphones and PCs over the network. Classrooms and research labs are unlocked and accessed with IC cards and smartphones. Lecture details and messages are available on digital signages installed on campus and via smartphones.

Programming practice with the INIAD Campus API

The various equipment and devices installed on the Akabanedai campus come with an API (Application Programming Interface, an interface which defines the conventions for retrieving information from, and controlling other programs and devices by a computer program). All the students will study the API and be able to control this IoT-enabled smart campus within the limitation of access permissions given to them by programming via API to operate these facilities and devices.

Examples of using the INIAD Campus API

- The blinds lower and the lights turn on automatically when the sun is shining into the room during a presentation.
- When a person uses an IC card to enter a room, the lighting and air conditioning operate according to that person's preferred settings.
- The elevator is automatically controlled just by standing in front of it by entering the destination or regularly used floor in your smartphone in advance. This is useful for reaching the desired floor when your hands are full.
Network environment suitable for computer education

The campus is equipped with Wi-Fi, and a sufficient bandwidth of Internet connectivity has been allocated to support information technology education. This enables students to bring their PCs and smartphones to use for classes and research.

The INIAD Educational Cloud is also provided as the cloud computing environment. This numerous courses which utilize the INIAD Educational Cloud are being prepared. The INIAD Educational Cloud is available for all students to use in their study and research, and the environment is supported by the INIAD staff if they have any questions.
INIAD Makers’ Hub

The "maker movement," the trends of individuals engaging in personal manufacturing, is becoming popular around the world. The catalyst for this movement is the wide availability of "digital fabrication" technology resulting from the infusion of ICT into the manufacturing world. This allows items in various shapes to be easily created.

INIAD believes it is important to support "makers" engaged in the personal manufacturing movement. In order to do so, we have created a space called the INIAD Makers’ Hub which is outfitted with various types of equipment and tools and run by full-time staff dedicated to supporting the makers. This fully stocked hub enables students to create items in various shapes based on their ideas.

Supported manufacturing steps

The INIAD Makers’ Hub supports the full range of manufacturing steps from processing the raw materials to applying paint and other forms of shaping.

• Processing wood, metal, and resin using tools
• Digital fabrication
• Creating electronic circuits
• Painting

Examples of manufacturing equipment

The hub provides an environment for executing a series of manufacturing steps including digital fabrication.

• 3D printer
• 3D scanner
• 3D cutting machine
• Laser cutter
• Cutting plotter
• Vacuum forming machine
• PCB milling machine
• Air spray gun

Examples of measuring instruments installed

The hub is also equipped with professional measuring instruments for creating components with electronic circuits.

• Digital multimeter
• Oscilloscope
• Logic analyzer
• Network analyzer
• Spectrum analyzer
Graduates of this department utilize the following skills to play an active role in many parts of society.

**Specialized skills:** expert skills in the area of information technology

**Global skills:** ability to communicate globally

**Human networking skills:** ability to resolve issues as a team

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**Career support**
Students can apply their individual skills to play an active role in society. INIAD supports job hunting with its career support system.

**Intern system**
Participating in joint projects with outside companies allows students to gain practical experience which can become a significant advantage in job hunting and other situations after graduation. The school actively introduces interns to companies and research labs which have collaborative relationship with INIAD to support their activities.

**Business incubation system**
Students can also launch startups together with partners found through team projects and various school activities. INIAD plans to provide a business incubation system to support team-based startups in various ways such as offering shared office space and introducing sponsors.

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**Faculty of Information Networking for Innovation and Design**

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**Graduate school**
Students go on to graduate school to develop their specialized skills through research.

**Startups**
Students use their specialized and global skills to gain employment and contribute to society.

**Startups**
Students apply the results of their team projects to launch new businesses.

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**Engineers**

**Designers**

**Managers**

**Coordinators**

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**Public sector**

**Global companies**

**Japanese companies**

**ICT-related companies**

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**Crowd funding**

**Proceeding as a team**
Graduate School of Information Networking for Innovation and Design

Graduate School of Information Networking for Innovation and Design, Toyo University conducts education and research in collaboration with the undergraduate courses. Students can engage in in-depth research and master the nine areas of specialization which support "networking" based on computer science. The Graduate School of Information Networking for Innovation and Design supports recurrent education. The program can be completed in one year by focusing on required courses. Ph.D. degree program is also provided.

### Nine research areas

<table>
<thead>
<tr>
<th>Area</th>
<th>Focus Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information infrastructure technology</td>
<td>Focuses on the infrastructure technologies which support &quot;networking,&quot; including programming languages and information security.</td>
</tr>
<tr>
<td>Computer architecture</td>
<td>Focuses on computer systems of the new era such as today's Internet of Things (IoT). Topics include element technologies such as real-time operating systems to applications.</td>
</tr>
<tr>
<td>Computer network</td>
<td>Focuses on network technologies which support the Internet of Things era such as low-power wireless communications technology and cloud computing.</td>
</tr>
<tr>
<td>Business incubation</td>
<td>Focuses on the relationship between business and information and communications technologies (ICT) including computers and development of new business which utilizes those technologies.</td>
</tr>
<tr>
<td>User experience design</td>
<td>Focuses on the relationship between people, information, and computers such as new user interface designs, and the relationship between people and spatial information.</td>
</tr>
<tr>
<td>Digital design</td>
<td>Focuses on digital fabrication technologies including 3D printers and manufacturing that utilizes computers.</td>
</tr>
<tr>
<td>Data science</td>
<td>Focuses on application of machine learning technologies including deep learning and data analysis techniques to big data in various sectors of society.</td>
</tr>
<tr>
<td>Infrastructure services</td>
<td>Focuses on ICT which are useful for the design of various forms of social infrastructure or urban and traffic management.</td>
</tr>
<tr>
<td>Quality of living</td>
<td>Focuses on ICT which can be applied to healthcare and community development such as community formation to improve the standard of living.</td>
</tr>
</tbody>
</table>
Open IoT Education Program

What is an “Open IoT education” program?

In this IoT era, information and communication technology (ICT) develops very rapidly. New knowledge and skills are always required of engineers who are involved in the development of new services and new products. For example, the technologies on the edge side, such as mobile computing and development of embedded systems, the technologies on the cloud side, such as rapidly-developing artificial intelligence (AI) including deep learning, and the networking technologies that connect them. With such a background, so-called recurrent education of working adults returning to university for further study, is gathering attention in the ICT area.

Starting from FY2018, Faculty of Information Networking for Innovation and Design (INIAD), Toyo University is providing “Open IoT education” program, a recurrent education program offered in collaboration with the University of Tokyo, Yokohama National University, Nagoya University, and Meijo University. This program provides a course where working adults who would like to learn advanced IoT technology can acquire the knowledge and skills of IoT-related areas systematically in a short time.

The “Open IoT education” provides a practical curriculum of the IoT area based on the needs from the industry in collaboration with TRON Forum (http://www.tron.org) whose member roster includes about 200 companies which support the IoT area.

Curriculum

Half-year courses are held at each of the partner universities of this program.

— Specialized courses of the IoT
Specialized courses of the IoT area with distinctive features of each partner university are taught for a half year. It is possible to take a course provided at different universities or take it remotely by MOOCs.

— IoT exercise courses
Each partner university provides practical exercise courses with distinctive features as series of intensive lectures on weekends and during a long holiday period. It is possible to take a course provided at partner universities.

— Information networking workshops
During a long holiday period, a project-based workshop is provided using the IoT campus of INIAD, Toyo University.

This program is a lecture at graduate school level, but students can access teaching material for undergraduates provided by INIAD, Toyo University on MOOCs. Students can learn programming from the basics using Python and JavaScript.
Fostering lecturers

Dispatching teachers

Universities in collaboration

Collaboration

Research institution

VHP-Ubiquitous Networking Laboratory

Academic society

IEEE Consumer Electronics Society

Faculty of Information Networking for Innovation and Design (INIAD), Toyo University

Yokohama National University

Nagoya University

Meijo University

TRON Forum

Recommended to the people as below

- This program provides education at a graduate school level for acquiring knowledge and skills of IoT-related areas systematically to the engineers who want to learn advanced IoT technology.
- This program provides ICT engineers with less opportunities for further education in rural areas a remote learning environment utilizing MOOCs.
- This program provides basic computer science education to the engineers who did not receive computer science education systematically when they were students.

A message from the Dean

Engineers in the IoT era have to acquire both systematic knowledge of computer science and the skills actually required in the industry in a balanced manner. This program contributes to improvement of the Japanese industry-wide adoption of IoT technology utilizing the know-how we acquired through TRON Project in collaboration with the industry sector.

Adopted as a project for “Creation of the sites for human resource development in the area of information technology which supports other growing fields” of Ministry of Education, Culture, Sports, Science and Technology (MEXT). “enPiT-Pro: ICT Education for creating future society based on ICT with emphasis on both technology and general arts”
The basic concept of INIAD (Faculty of Information Networking for Innovation and Design, Toyo University) is, as the name shows, “networking.” This “networking” has several meanings: Networking within INIAD - networking among the four courses: Computer Science & Engineering, Business Innovation, Digital Design, and Social Infrastructure, and networking among students from various countries and social backgrounds. In addition, networking outside of INIAD is important. Because that is “open networking.”

As the word “Open innovation” implies, open networking beyond the barrier of organizations is said to be the key for accelerating innovation. Therefore, INIAD established INIAD chUB—collaboration Hub for University and Business—as the “hub” for networking with society and the world. “Open innovation”—researching “networking,” providing education on “networking,” and making innovation by “networking”—is the purpose and duty of INIAD. Therefore, we believe that networking with INIAD will create many opportunities for outside companies, groups, and organizations.
What is cHUB?

cHUB is the abbreviation for “collaboration Hub for University and Business.” It is an organization intended to become the hub, or node, for networking between the university and business. The Japanese name is “Organization for collaboration between academy and business.”

Organizations named “Business-academia collaboration center” or the like were created at many universities for similar purposes a generation ago. As the name “Business-academia collaboration center” shows, most of the collaborations between business and academia were utilization of the university’s basic researches in industrial purposes and collaborative development of element technology.

However, the situation has changed largely due to the development of information and communication technology (ICT). Clear boundaries between basic technology and commercialization or the like have disappeared in the ICT area. Many results of research and development are routinely released as actual services rather than academic papers in the world.

In addition, business models, service models, provision of incentives, agreements, and institutional design such as laws and regulations are becoming more important for making information systems function in society.

Collaboration with various entities is difficult to associate with the conventional word “Industry,” such as with service industries, retail business, government administrative offices, municipalities, NPOs and NGOs. Such collaboration will become more important for the utilization of ICT in society in the future.

When making a “connecting node” between INIAD and outside, we named it not a “Business-academia collaboration center,” but “Organization for collaboration between academy and business,” to clearly show our concept, since the name shows what it is.
Collaboration method

Various forms of collaboration are possible depending on the project.

- Contract research to INIAD
- Joint research by sending staff to INIAD
- Creating an endowed course by donation to INIAD
- Short-term cooperative seminars at INIAD
- Short-term intensive seminars / leaders training / business courses at INIAD
- Attending INIAD courses
  (undergraduate / graduate level)
- Accepting INIAD students for internship
- Sending lecturers from INIAD
- Donation to INIAD
There is not any prepared manual or schedule for realizing innovation. Rather, you cannot really call things with those mentioned above innovation. The only certain way to increase the chance of creating innovation is to increase the number of challenges. It is important to prepare the environment to increase the number of challenges.

— Resources within the network

Therefore, INIAD provides various resources in the network, such as super-fast Internet backbone, cloud computing resources that can be used with simple configuration, and middleware in the cloud to help utilize AI for new challenges.

— Resources of physical equipment and facilities

In addition, resources of physical equipment and facilities are also available, such as INIAD Makers’ Hub, which provides 3D printers, laser cutters, and other machines and tools, project offices for task groups, a hall for lecture meetings and symposiums, a presentation hub with various types of equipment for presentation and demonstration, a test hub for testing control programs of the remote-controlled cars and robots, various meeting spaces intended for serendipity (lucky encounter or combination of ideas that occurs coincidentally) and the Media Center.

— The building is also a resource for research

Furthermore, the building of INIAD, INIAD HUB-1 itself is a state-of-the-art IoT building, and an open API-controlled building. Most of its functions can be controlled by API, and it is possible to know the real-time status of the environment. It is a teaching material to learn the basic concept of the IoT, “it is possible to affect reality by programming,” while it also serves as research platform. For example, there is a personal locker for each student to store their personal belongings. Its lock is API-controlled, and writing an application to use it is a training - which means, the locker is an IoT teaching material.
The resource management system itself is a resource of research

INIAD Pay, a payment system dedicated to use within the campus, is available. It is used to manage the use of resources. At the same time, it is a value distribution platform that can be used with API for experiment and training of net business. There might be a student who starts a business by lending the student's locker per hour by combining the system and resources. With the campus currency earned as above and school achievement points, resources within the campus are distributed based on market principle. The daily life within this building is a practice for net business in the IoT era, and a new venture business is created from it. We expect such things.

— Human resources

Of course, the faculty of INIAD are powerful human resources, while 400 students per year, 2,000 students in the whole university, may possibly become human resources for conducting business model demonstration experiments and field research with appropriate incentive design. Programming contests and “ideathons” within the campus are also planned to be held frequently. Please use INIAD, which has been improving the environment for coping with many challenges.

We have already started many joint seminars with governments and corporations around the world in the application fields of the IoT, AI, big data analysis, open data, sharing economy, and other subjects. For example, there is a platform building project for applying the IoT to urban problems being carried out with Japanese and EU partners, CPaaS.io. Please feel free to contact us at INIAD cHUB (e-mail: chub-contact@iniad.org).
TOYO UNIVERSITY
Faculty of Information Networking for Innovation and Design (INIAD),
Graduate School of Information Networking for Innovation and Design
https://www.iniad.org/

Akabanedai Campus: 1-7-11, Akabanedai, Kita-ku, Tokyo
- 10-minute walk from JR Akabane Station
- 12-minute walk from Akabane-iwabuchi Station of the Tokyo Metro Namboku Line
- Akabanedai san-chome (赤羽台三丁目) bus stop of Kokusai Kogyo Bus

*The school buildings are located on a hill, and the stair-free route is very steep. Wheelchair users are recommended to take a route with elevator(s), or a bus or taxi from the west exit of Akabane Station.
* Please refrain from visiting the campus by driving your car.

For inquiries, please contact:
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