

NTU SUMMER PROGRAMME 2020

The Fourth Industrial Revolution – Are You Ready?

8 – 17 July 2020, Singapore



NTU Summer Programme 2020

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Nanyang Technological University, Singapore

In this age of technological disruption, are you ready for the Fourth Industrial Revolution that is affecting the world?

The Fourth Industrial Revolution identifies trends and changes in the way we live and work due to the adoption of new technologies such as artificial intelligence, robotics, and the Internet of Things. As the driving force of our societies, knowing how to effectively use as well as tackle issues with these new technologies will enable us to be efficient and make change where necessary. Learn about the various digital technologies of Industry 4.0 and how you can adopt them in your current/future workplace and living environment.

A two-week summer programme organised by NTU Centre for Professional and Continuing Education from 8 to 17 July 2020, we aim to equip you with the basic knowledge and skills you need to step into the world of Industry 4.0.

University students are welcome to join in the programme to experience a fulfilling learning journey in the beautiful campus of NTU decorated with lush greenery. Immerse yourself and enjoy life in this vibrant and cosmopolitan city!



IMPORTANT DATES

Early Bird Registration Payment Deadline

18 April 2020

Standard Registration Payment Deadline

23 May 2020

Confirmation of Registration

29 May 2020



Programme Outline

✓ Classes are conducted in English by NTU faculty members and adjunct trainers.

Topics include:

- The Fourth Industrial Revolution – An Overview
- Industrial Internet of Things and the Forth Industrial Revolution
- Cybersecurity in the Fourth Industrial Revolution
- The Impact of AI and Big Data to the future world
- Augmented and Virtual Reality for the Fourth Industrial Revolution
- Blockchain Revolution: How it is changing the world
- Business 4.0 & Industry 4.0 – A New Paradigm
- The 4th Industrial Revolution: Digital Manufacturing and 3D Printing
- Implement Robotic and Intelligent Solutions for Smart Manufacturing
- Cloud Computing and the Fourth Industrial Revolution

✓ Lab Visits:

- Fraunhofer IDM@NTU
- Delta-NTU Corporate Lab

✓ Excursions

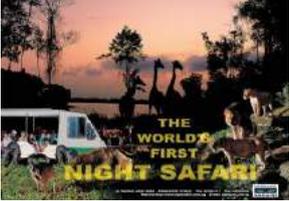
- Chinatown
- Esplanade
- Gardens by the Bay
- Little India
- Marina Bay Sands SkyPark
- Marina Bay Waterfront Promenade
- Merlion Park
- Night Safari
- Singapore River

✓ Activities with NTU students



Programme Schedule

DATE	AM	PM
Tuesday 7 July 2020		<p>Check-in to NTU Student Hostel (9am - 7pm)</p> 
Wednesday 8 July 2020	<p>9.00am – 10.15am Welcome Session & Programme Briefing</p> <p>10.30am – 12.30pm Class: The Fourth Industrial Revolution – An Overview <i>(Trainer: Adjunct Professor Wolfgang Mueller-Wittig)</i></p>	<p>12.45pm – 1.45pm Welcome Lunch</p> <p>2.00pm – 6.00pm Ice-breaking activities, campus & Neighbourhood tour conducted by NTU students</p> 
Thursday 9 July 2020	<p>9.00am – 11.30 am Class: Industrial Internet of Things and the Fourth Industrial Revolution <i>(Trainer: Mr Philip Teng)</i></p>	<p>2.00pm – 6.00pm Guided City Tour: Little India, Singapore River, Merlion Park & Esplanade</p> 
Friday 10 July 2020	<p>9.00am – 11.30am Class: Cybersecurity in the Fourth Industrial Revolution <i>(Trainer: Professor Sabrina Luk)</i></p>	<p>2.00pm – 6.00pm Visit: Marina Bay Waterfront Promenade</p>  <p>Marina Bay Sands SkyPark</p> 

DATE	AM	PM
Saturday 11 July 2020	One way transfer provided to VivoCity at 8.30am. (for access into Sentosa Island)	
		
Sunday 12 July 2020	Free & Easy	
Monday 13 July 2020	9.00am – 11.30am Class: The Impact of AI and Big Data to the future world <i>(Trainer: Professor Mohammed Yakoob Siyal)</i>	1.00pm – 3.30pm Class: Augmented and Virtual Reality for the Fourth Industrial Revolution <i>(Trainer: Dr Marius Erdt)</i> 6.00pm – 10pm Visit: Night Safari 
Tuesday 14 July 2020	10.00am – 12.30am Class: Blockchain Revolution: How it is changing the world <i>(Trainer: Professor Mohammed Yakoob Siyal)</i>	2.00pm – 3.00pm Visit: Fraunhofer IDM@NTU 
Wednesday 15 July 2020	9.00am – 11.30am Class: Business 4.0 & Industry 4.0 – A New Paradigm <i>(Trainer: Mr Francis Tay)</i>	1.30pm – 3.45pm Visit: Gardens by the Bay  4.00pm – 6.00pm Chinatown 

DATE	AM	PM
Thursday 16 July 2020	10.00am – 12.30pm Class: The 4 th Industrial Revolution: Digital Manufacturing and 3D Printing (Trainer: Professor Tan Ming Jen)	2.00pm – 4.00pm Class: Implement Robotic and Intelligent Solutions for Smart Manufacturing (Trainer: Mr Cheng Chia Loon) 4.00pm – 4.30pm Visit: Delta-NTU Corporate Lab 
Friday 17 July 2020	9.00am – 11.30 am Class: Cloud Computing and the Fourth Industrial Revolution (Trainer: Mr Philip Teng) 11.40pm – 12.30pm Certificate Presentation Ceremony Group Photo-taking	12.30pm – 1.30pm Farewell Lunch
Saturday 18 July 2020	11am Check-out	

* Programme schedule may subject to change.



Course Synopsis

The Fourth Industrial Revolution – An Overview

Trainer: Adjunct Professor Wolfgang Mueller-Wittig

The term “Industrie 4.0” (“Industry 4.0”, or in short “I4.0”) was used in public for the first time at the Hannover Messe 2011 in Germany. “Industrie 4.0” represents the so-called Fourth Industrial Revolution and the digital transformation of manufacturing. Similar terms used internationally include Internet of Things, Industrial Internet, Advanced Manufacturing and Smart Factory.

These terms encounter us in manifold ways on a daily basis. But what does this actually mean?

According to the German “Industrie 4.0” Working Group, it comprises “networks of manufacturing resources (manufacturing machinery, robots, conveyor and warehousing systems and production facilities) that are autonomous, capable of controlling themselves in response to different situations, self-configuring, knowledge-based, sensor-equipped and spatially dispersed and that also incorporate the relevant planning and management systems”.

This session gives an introduction to “Industry 4.0”, components and technologies, numerous challenges due to increasingly complex systems as well as opportunities addressing also SMEs to improve processes and quality. Initiatives and current trends are highlighted. Finally, scenarios are presented how in particular immersive media and advanced interfaces can support the human in the era of “Industry 4.0”.

Industrial Internet of Things and the Fourth Industrial Revolution

Trainer: Mr Philip Teng

The 4th Industrial Revolution promises to bring a complete makeover of the industrial manufacturing, bringing in advanced manufacturing capabilities that enables faster response to the end customer demands, more efficient methods of carrying out the design, manufacturing and delivery of the products, moving from mass production to customized solutions, gaining deeper insights into market needs through the products that are delivered and deployed, creating products and products that are sustainable environmentally and socially.

The use of Industrial Internet of Things in the 4th industrial revolution meant a complete transformation to the way products are being manufactured, the way factory floors are managed, the way supply chain are optimized, the way maintenance are carried out. Operational Technology is now more important if not as important as Information Technology which drives the 3rd Industrial Revolution.

In this short overview, we will examine the impact of Industrial Internet of Things on Advance Manufacturing, and how it forms one of the major pillars of the manufacturing process, enabling other supporting technologies like Artificial Intelligence, Data Analytics, 3D Printing, Real time Supply Chain etc. We will also take a look at the IOT landscape in the application of IOT into manufacturing and the key vertical technology building blocks involved.

Cybersecurity in the Fourth Industrial Revolution

Trainer: Professor Sabrina Luk

The Fourth Industrial Revolution brings benefits to individuals, governments, society and the economy. The increased application of smart technologies like artificial intelligence (AI), the Internet of Things (IoT) and robotics has improved productivity and efficiency in business. Besides, it has improved the quality of life for individuals by making people's homes more energy-efficient, delivering more personalized healthcare services, and providing safer transport.

The government's use of big data, sensors and facial recognition technologies has improved public safety, traffic management, air and water quality. Smart technologies have also increased connectivity among individuals and across businesses. While the Fourth Industrial Revolution has positive impacts on society and the economy, it also brings with it new cyber risks. Countries' growing dependence on smart technologies to develop the economy and society has increased their vulnerability to cybercrime and cyber attacks.

Over the past decade, cyber attacks have inflicted wide-ranging damages on countries, institutions and individuals and have far-reaching effects on the economy and society. Cyber-attacks often result in identity theft arising from the loss of personal data, financial loss arising from the theft of financial information, and reputational damages arising from the loss of customer records. They can also cripple critical information infrastructure, health information systems and economy. In order to tackle the ever-increasing cyber attacks, many governments have put cybersecurity at the top of the agenda and are racing against time to build a safe, secure and trusted cyber environment. The chase for a perfect cybersecurity system or strategy is both impossible and unnecessary. However, it is important and necessary for the governments to become more vigilant and adopt a proactive, holistic, and cooperative approach to strengthen their cybersecurity. Governments have to formulate a cybersecurity strategy that can enhance the competencies of public sector, private sector and the general public against cyber threats and ensure a secure and reliable infocomm environment that is vital to the functioning of the economy and society. They also have to regularly review the cybersecurity strategy to ensure its relevance and applicability so that their nations can keep pace with the constantly changing cyber threat landscape and address evolving cybersecurity challenges. Meanwhile, cybersecurity is a shared responsibility. The government alone is insufficient to tackle an unprecedented increase in volume, sophistication and severity of cyber attacks. The business sector and individuals also play an important role in cybersecurity. Nations can only become stronger, safer and more secure when there is broad participation of stakeholders to address cybersecurity challenges.

This session will examine what cybersecurity is, the importance of cybersecurity in relation to the Fourth Industrial Revolution, the cyber threat landscape and cybersecurity measures in different countries.

The Impact of AI and Big Data to the future world

Trainer: Professor Mohammed Yakoob Siyal

With the enormous growth of "Big data" and the technological advancement in Artificial intelligence (AI), a disruptive revolution is taking place and it is clear that it will have a huge impact to the future world. The convergence of big data with AI has emerged as the single most important development that is shaping the future of how firms drive business value from their data and analytics. Thus, the purpose of this talk is to explain the basic concepts of big data and AI, the areas of the economy that are expected to be most affected, the types of companies potentially stand to benefit from the emergence of AI & Big Data and the potential impact of this radical innovation to the future world.

This talk intends to provide participants with concepts of AI and big data, the overview of technology behind AI (clustering, classification, Machine learning, Deep learning) and applications of AI in Industrial automation, Autonomous vehicles, Health care. Consumer retail and E-commerce, Smart Assistants etc.

Topics covered will include:

Introduction to Big Data, AI, and Machine Learning, Regression, classification and clustering technologies, how Big Data Enhances Artificial Intelligence, Advancements in big data technology, the application of AI in Healthcare (Are We Going to be Superhumans), Finance (The More Data, The Better) and Customer Experience (Rise of the Virtual Assistants Workforce- Are Robots Taking our Jobs), the Impact and future of AI.

Augmented and Virtual Reality for the Fourth Industrial Revolution

Trainer: Dr Marius Erdt

Objectives

Participants will learn the fundamentals of Augmented and Virtual Reality (AR and VR) and will get an overview about applications in smart manufacturing / Industry 4.0. They will get an overview about how Augmented and Virtual Reality work and will learn about the demands to hardware and software in order to create applications that are usable in Industry 4.0 scenarios. Furthermore, they will get an in-depth overview of challenges and opportunities of AR/VR solutions already applied in Industry 4.0 and will get an outlook of current research and development in the field.

Outline

This course is about an introduction to Augmented and Virtual Reality for Industry 4.0. The course will start with an introduction about the history of AR and VR and early industry applications and will then provide an overview about the hardware and computing needed to create AR/VR industry applications for cyber-physical systems and smart manufacturing. Afterwards, the basic AR/VR tracking algorithms including optical marker based, image based and model based tracking are introduced and discussed towards their applicability in different Industry 4.0 scenarios.

Blockchain Revolution: How it is changing the world

Trainer: Professor Mohammed Yakoob Siyal

Even though Industry 4.0 has been at the forefront of driving innovation, its highly interconnected nature makes it vulnerable for cyber-attacks and the Blockchain technology has the capability of driving Industry 4.0 to its real potential. The first-generation digital revolution brought us Internet, while the second-generation revolution called Blockchain is changing the world. Although Blockchain technology is still in early stages of development, it is clear that it will have a huge impact on the growth of Industry 4.0. Blockchain allows transactions of any kind to be simultaneously anonymous and secure by maintaining a tamperproof public ledger. Thus, the purpose of this course is to explain the basic concepts of Blockchain, its development, the potential applications and how it can transform the world during Industry 4.0 revolution.

This course intends to provide participants with concepts of Industry 4.0, Blockchain, the overview of technology behind Blockchain (cryptography, digital signature, hashing, and P2P network) and possible applications of Blockchain technology in several industries.

Course Outlines

- Introduction to Industry 4.0 and Blockchain technology.
- Basics of Cryptography and other associated technology used in Blockchain
- Types of Blockchain technology.
- Key concepts and features of Blockchain technology and Distributed Ledger Technologies.
- Blockchain Technology Applications
- How Blockchain can disturb the current status quo and brings new benefits to the whole society during Industry 4.0 period.

Business 4.0 & Industry 4.0 – A New Paradigm

Trainer: Mr Francis Tay

Technological advances and globalization are ushering in a new of age of what and how business is done. The “what” and “how” manufacturing and the provision of services is carried out is chiefly characterized by automation, the use of sensors and embedded technologies (for human-to-human, human-to-machine and machine-to-machine communications), the use of machines to perform human tasks and even those that require cognitive capabilities, and the transformative change at the operational level.

A typical description of the 4.0 scenario is one where automation meets data exchange. It involves cyber-physical systems (CPS), Manufacturing Execution Systems (MES), Enterprise Resource Planning (ERP), the Internet of Things (IoT), and cloud and cognitive computing. This translates to a vision of a marketplace that is influenced by three factors; technology trends (e.g. Big Data, Cloud Computing, Cyber Security, etc.), integrated systems (e.g. CPS, Smart Factories, etc.) and global connectivity (e.g. IoT and Internet of Services).

The advances in robotics, artificial intelligence and machine learning is part of that technology wave that will have a significant impact on businesses, organizations and people. It is beyond doubt that the fourth revolution of Industry and Business will happen. However, the pace and adoption of 4.0 technologies in businesses will depend on a number of factors, e.g. technical feasibility, cost of developing and deploying solutions, labour market dynamics, economic benefits, and regulatory and social acceptance.

Industry 4.0 is happening and a new business paradigm will emerge. In this workshop, we will focus on the new paradigm and some of the possible options available and what can be done about it. The 36th president of the United States, Lyndon B. Johnson probably said it best when he established a national commission to examine the impact of technology on the economy and employment, declaring that automation did not have to destroy jobs but “...can be the ally of our prosperity if we will just look ahead”.

This workshop will unpack the concept of Business 4.0, with specific focus on the manufacturing and services industries, employees and customers. It will also look at the options that are available or becoming available, and to discuss possible approaches for businesses and individuals. In business 4.0, there are sufficient evidence to show that by having the right cultural mindset today can lead to a successful long-term winning strategy; one where fast is better than big, possibility over profitability, and being passionately outward-directed to customers and employees, pays higher dividends. A key challenge

for future businesses is how to create value at the intersection of social, environmental and economic considerations.

Some of the topics covered in this workshop includes:

- What is Business 4.0 and what are the factors that are driving this phenomenon.
- The impact on business and business models, consumers and business leaders.
- Future global trends and its potential impact.
- The skills and competencies required by the “4.0” business leaders.

This workshop has been designed to be highly interactive. Besides a lecture, participants will be working in small groups to look at the impact of Industry 4.0 on business operations.

The Fourth Industrial Revolution: Digital Manufacturing and 3D Printing

Trainer: Professor Prof Tan Ming Jen

Industry 4.0 has tremendous potential to improve productivity, efficiency, and overall sustainability for manufacturing industries. It will disrupt manufacturing processes, compress cycle times, and revamp current supply chain models. Especially, with the recent advances in materials and processes, 3D printing or additive manufacturing (AM) technologies are evolving from prototyping to functional part fabrication for a broad range of applications. The AM-enabled design flexibility provides AM processes with great potential in product family development, where both design customization and diversity can easily satisfy various customer requirements. Designs can easily be adapted to changing environments, such as customers’ preferences, available technologies, economic situations, company’s strategies, regulations, and competitive moves.

In this seminar, the Industry 4.0 concepts with the relevant technologies to support digital manufacturing and the smart city will be introduced. Participants will also learn the future research directions in the technologies, limitations encountered in existing designs, and strategies for a more sustainable world.

Cloud Computing and the Fourth Industrial Revolution

Trainer: Mr Philip Teng

Cloud computing is now a key cornerstone in driving the 4th industrial revolution, replacing the traditional servers and mainframes. The convergence of Operational Technology and Information Technology, was made possible with Internet of Things and Cloud Computing. With pervasive Cloud computing platforms, Infrastructure-as-a-Service, Platform-as-a-Service, Software-as-a-Service enable future manufacturing to leverage on data analytics and artificial intelligence to create a highly responsive and adaptable manufacturing floor.

In this seminar on Cloud Computing for the 4th Industrial Revolution, we will look at the journey in Cloud Computing, how it has evolved. Participants will also be introduced to various cloud providers and solutions, and the latest technology offerings, and architecture of a cloud based system from public cloud to private cloud to hybrid cloud. Discussion topics on security, availability, usability for the application of cloud-based systems into the manufacturing systems will be presented.

Implement Robotic and Intelligent Solutions for Smart Manufacturing

Trainer: Mr Cheng Chia Loon

- Introduction of automation and robotic solution under the umbrella of Industry 4.0
- Industrial Robot
 - What is Industrial Robot? - *Understand the fundamental of robotics theory applied to industrial robots*
 - How to implement Industrial Robot in factory?
 - Understanding of industrial robot programming – *major phase and various industrial robot teaching methods*
 - Application: *Implement Industrial Robot in Assembly Tasks*
- Autonomous Guided Vehicles (AGV)
 - How to implement AGV in factory? - *Understand the application scenarios of AGV for manufacturing and fundamental knowledge on AGV*
 - Key components of AGV - *Sensor & Hardware*
 - Understanding of Navigation and Path Planning
 - Understanding of Mapping and Localization (SLAM)
 - Application: *AGV simulation using ROS for warehouse tasks*
- Lab Tour
 - Demo 1: Implement Industrial Robot in Assembly Tasks
 - Demo 2: AGV solution for warehouse tasks

Trainers



Adjunct Professor Dr.-Ing. Wolfgang Müller-Wittig

Wolfgang Müller-Wittig currently heads Fraunhofer Singapore, the 08th subsidiary of the Fraunhofer-Gesellschaft and its very first in Asia. He is the Executive Director of Fraunhofer Centre for Interactive Digital Media and is an Adjunct Professor at the NTU School of Computer Science and Engineering.

Prior to moving to Singapore in 2001, he worked as head of the “Visualisation Group” at Fraunhofer Institute for Computer Graphics Research in Darmstadt, Germany (Fraunhofer IGD).

His successful career in the field of Computer Graphics is demonstrated by more than 100 research papers published in international journals and conferences. He brings with him over 25 years of experience in industry-related applications using new visualisation, Virtual Reality and Augmented Reality technologies. “Virtual Factory” was one of his first projects in cooperation with Apple and SIMTech (Gintic) when he came over to Singapore in 2001.

He was also involved in the SMART-CENSAM (Centre for Environmental Sensing and Modeling) project and responsible for the development of a visualisation platform for interactive exploration of dynamic environmental models. Recent achievements include the delivery of novel augmented learning environments for medical students and the development of tailored visual cockpits and dashboards for complex data spaces such as energy consumption and waste management. Current activities focus on the use of Visual Computing for Industrie 4.0, maritime and construction industry such as visual interfaces and mobile digital services for the workers in the field of industrial training and MRO.

Wolfgang Müller-Wittig has served as member of several Advisory Committees for government and academia such as an expert committee member of *City for All Ages* (CFAA) Project (MoH) and *Safe Cities* (MHA, Interpol). He received a commendation award in the Next Generation Container Port Challenge. He is currently serving as chair of the workgroup *Immersive Media & Advanced Interfaces* for the *Services and Digital Economy Technology Roadmap (IMDA)*.



Mr Philip Teng

Mr Philip Teng is currently an Adjunct Trainer in NTU Centre for Professional and Continuing Education, conducting various short courses like Advance C Programming, Embedded Linux, Real Time Embedded Software. Over the past ten years, he has trained many professionals in topics on embedded software and operating systems, and applying them into real life practical applications. Philip is also the Chief Technology Officer of PPIC Technologies, a business and technology consultancy firm specializing in operationalization of emerging technology into emerging business, which includes Internet of Things, Financial Technology, software and system integration, system and software safety.

Philip graduated with a BEng (EE) degree from National University of Singapore and received his Masters in Electrical and Computer Engineering from Carnegie Mellon University, USA. Having worked on embedded system software in mission critical and safety critical applications for the past twenty years, Philip has extensive know-how in developing complex software, as well as key technologies in real time embedded software, embedded operating systems, internet of things. His experience includes large scale commercial and defence applications, such as the unmanned ground vehicle application for commercial port operations and flight software for space systems.



Professor Sabrina Luk

Dr. Sabrina Ching Yuen LUK is Assistant Professor in Public Policy and Global Affairs, School of Social Science, Nanyang Technological University, Singapore. Prior to this, she was Adjunct Associate Professor at the Open University of Hong Kong (January -June 2017), Visiting Lecturer at the Hong Kong Polytechnic University SPEED (January -June 2017), and Associate Professor at Kunming University of Science and Technology, China (2013-2016). She holds both Bachelor of Social Science (First Class Honours) and M.Phil from the Chinese University of Hong Kong and Ph.D. from the University of Birmingham, the United Kingdom.

Dr. Luk's research interests lie broadly in aging and health care reforms, e-government and governance in Asia, digital health and cyber security, the Fourth Industrial Revolution, public administration, public policy analysis, cultural diplomacy and soft power, and China studies. She was a recipient of the 2012 Michael O'Rourke PhD Publication Award at the University of Birmingham for her research contributions and publication record. She was also the Highly Commended Award Winner of the 2013 Emerald/EFMD Outstanding Doctoral Research Awards in the Healthcare Management Category.



Professor Mohammed Yakoob Siyal

Dr Siyal holds MSc and PhD degrees in Computer Engineering from University of Manchester, UK and an MBA (specializing in IT) degree from European Management School, Surrey University, England. Dr Siyal has been working in Universities in Europe and Asia and has been involved in teaching, research and supervising/advising students in Information Security areas at the school of EEE, NTU, Singapore. With his inter-disciplinary background, he has been teaching and conducting research in Information Security, Medical Image Processing, Computer Vision, E-business/IT Management, Innovation and technology management areas.

Dr Siyal has published over 200 refereed journal and conference papers and has authored 8 books. At NTU, he has won numerous teaching awards including “Best Dressed Teacher”, “Teaching Excellence Award” and “Nanyang Teaching Excellence Award”.



Dr Marius Erdt

Dr. Marius Erdt is Deputy Director of Fraunhofer Singapore / Fraunhofer IDM@NTU where he is also Head of Visual and Medical Computing. He is also an Adjunct Assistant Professor at the School of Computer Science and Engineering at Nanyang Technological University in Singapore. From 2012-2013, he was Head of Medical Computing at Fraunhofer IDM@NTU. From 2007-2012, he worked at the Fraunhofer Institute for Computer Graphics Research (IGD) in Germany in the cognitive computing and medical imaging department as a post-doc and research associate, respectively. In 2007, he was affiliated with Siemens Medical Solutions as part of his studies. He received a PhD in Computer Science from the Technische Universität Darmstadt with summa cum laude and graduated with distinction from University of Koblenz-Landau with the German degree of Diplom-Informatiker (eq. MSc Computer Science).

His research interests include Visual and Medical Computing, in particular, statistical shape modeling and machine learning based approaches, as well as Virtual and Augmented Reality. Dr. Erdt is co-founder of the Clinical Image-based Procedures (CLIP) workshop established in 2012 and is active in various program committees of international conferences and journals. He has led various research projects in the field of Visual and Medical computing and has strong experience in managing R&D projects together with the industry to apply latest research results in real-world applications.



Mr Francis Tay

Francis is currently a lecturer at Nanyang Technological University (NTU) Wee Kim Wee School for Communications and Information (WKWSCI), teaching Business Intelligence and Information Entrepreneurship in the Master of Knowledge Management course. His courses are also taken up by students reading for their Master of Information Systems, Master of Information Studies and Master of Mass Communications. He has also taught Organizational Leadership and Information Sources and Services in the Master of Information Studies course. He has been teaching at NTU at the post-graduate level for more than 10 years.

Francis has authored three books “Latent Factors”, “Turning Good Ideas into Great Businesses” and “Picking Winners”, published by Marshall Cavendish. The first two books focus on business advantages and financial models and the third book is on market intelligence and building up market and sector models for benchmarking analysis. His market intelligence and benchmarking portal – www.profitstrail.com - was developed as a real-time update for “Picking Winners”.

He is concurrently a Director at Singapura Management Pte Ltd, a corporate services company providing bookkeeping, tax and other services to local and foreign companies. He founded NextGen Ventures Pte Ltd, his second equity investment company, focusing on Internet-related businesses and new technologies like Bluetooth BLE. He has also held senior positions in government and government-linked organizations.

Francis obtained his Honours degree from NUS, majoring in Economics and Computer Science & Applications, and his Master of Science in Management (Sloan Fellowship) from the London Business School in the UK. Francis served 5 years on the National Youth Council’s Singapore Youth Awards (SYA) Entrepreneurship committee and has provided mentorship to companies and others under various business programmes at universities and start-up accelerators.



Professor Tan Ming Jen

Dr Ming Jen TAN, received both his B.Sc (Eng.) and Ph.D. from The Royal School of Mines, Imperial College, London. He was Japan Society for the Promotion of Science (JSPS) Fellow at Kyoto University in 1991, Science & Technology Agency (STA) Fellow at the Mechanical Engineering Laboratory (A.I.S.T., M.I.T.I.), Tsukuba, Japan 1992-93, Visiting Scientist at Columbia University (2003) and Fulbright Research Scholar (2004) at both UCLA and Northwestern University in the U.S.

He is currently Professor at Nanyang Technological University (NTU), Singapore; and up to recently, the Programme Director (Building & Construction) at the Singapore Centre of 3D Printing (SC3DP). He has just been appointed the Director of the newly established HP-NTU Digital Manufacturing Corporate Lab, a US\$62 million endeavor, funded jointly by HP Inc., National Research Foundation (Singapore) and NTU Singapore. He is also a member of the 2019/20 World Economic Forum's Global Futures Council on Advanced Manufacturing & Production.

Mr Cheng Chia Loon

Cheng Chia Loon is a Robotics & Automation Engineer by profession, he received his BEng(Hons) in Mechatronics Engineering in 2011 from UTAR and MSc (Management of Technology) at the National University of Singapore (NUS) in 2019. He is a Senior Research Engineer (Automation) at Delta Research Centre (DRC) Singapore, with more than 8 years experience in Robotics & Automation as well as Product Commercialisation.

Lab Visits

Fraunhofer IDM@NTU

Fraunhofer Singapore is 8th subsidiary of the Fraunhofer-Gesellschaft outside Germany and 3rd outside Europe respectively.

Fraunhofer Singapore looks at real world problems and uses technologies in the field of interactive digital media to transfer visual solutions and skilled minds to the market. In essence, the Centre looks at user-centered, immersive, real-time visual environments that allow users to interact with information.

As the very first Fraunhofer subsidiary in Asia, Fraunhofer Singapore delivers Visual Computing solutions to support the transformation of enterprises through digitization with impact on industry and society. In particular, it seeks to achieve breakthroughs in applying Visualisation, Virtual and Augmented Reality for Industrie 4.0 and higher-skilled workforce training for the Employee 4.0. This will also include additive manufacturing and industrial cybersecurity.

An essential cornerstone is the close collaboration with the various schools and colleges of Fraunhofer's long-term partner, the Nanyang Technological University Singapore (NTU), providing a multi-disciplinary research environment to tackle great challenges in science, engineering and society.

<https://www.fraunhofer.sg>

Delta-NTU Corporate Lab

The Delta-NTU Corporate Laboratory for Cyber-Physical Systems was officially launched on 16 Jun 2016 by Deputy Prime Minister and Coordinating Minister for Economic and Social Policies, Mr Tharman Shanmugaratnam. Cyber-physical systems are important in our everyday lives. They include electronic devices such as mobile phones, temperature and humidity sensors connected through networks for monitoring and control of physical systems like air-conditioning and lighting. Nanyang Technological University (NTU Singapore) and Delta Electronics have established the corporate laboratory to develop smart technologies that will enhance everyday lives, enable better learning and advance manufacturing processes.

The new corporate lab is supported by the National Research Foundation (NRF) Singapore under its Corporate Laboratory@University Scheme, which funds key corporate laboratories set up through public-private partnerships. The S\$45 million corporate lab works on developing cyber-physical systems, ranging from large infrastructure systems such as water and power distribution to emerging consumer systems such as the Internet-of-Things (IoT), an ever-growing network of physical objects and systems connected to the Internet.

At its full capacity, the lab will have more than 80 researchers and staff, including NTU PhD students. Together with scientists from both Delta Research Center and NTU, the new lab will develop innovations in four key research areas in cyber-physical systems: Smart Manufacturing, Smart Learning, Smart Living, and Smart Commercialisation.

<http://www.eee.ntu.edu.sg/research/delta-ntu-cpsl/Pages/Home.aspx>

Registration Fee

Early Bird Registration (NTU to receive payment by 18 April 2020)	SGD 2,300 + 7% GST = SGD 2,461
Standard Registration (NTU to receive payment by 23 May 2020)	SGD 2,500 + 7% GST = SGD 2,675
Group Registration (Minimum 3 pax) (NTU to receive payment by 23 May 2020)	SGD 2,300 + 7% GST = SGD 2,461

*GST: Goods and Service Tax

The registration fee covers 11-night twin-sharing student hostel accommodation (air-conditioned), tuition fee, excursions, programme materials, welcome lunch and closing lunch. Each participant will be issued an official receipt from NTU.

The fee does not include airfare, insurance, meals, visa application, personal expenses or other expenses not stated.

Registration

All international university students are eligible to apply for the programme but must possess a good command of English language, as the programme will be conducted in English.

Please click [here](#) to register online. You are required to submit online, a soft copy of the letter from your university verifying your student status.

To enjoy the early bird registration fee, your payment must reach us by **18 April 2020**. The standard registration payment deadline is **23 May 2020**. If you wish to register after the deadline, please send an email to pace@ntu.edu.sg to check if vacancy is still available.

The programme may be cancelled if there are insufficient participants and full refund will be made.

You will be notified on the final confirmation of your registration and the status of the programme by **29 May 2020**.

Modes of Payment

You may pay by one of the following payment modes:

a) Bank Draft

Bank draft in Singapore dollars is to be made payable to “Nanyang Technological University”. A copy of the registration form must be attached with the bank draft which has to be sent by registered mail or by courier to the following address

Nanyang Technological University
Centre for Professional and Continuing Education
60 Nanyang Drive, SBS-01s-50
Singapore 637551
Attention: NTU Summer Programme 2020

b) Telegraphic Transfer

Payment to be transferred to NTU bank account as stated below:

Beneficiary's Name	Nanyang Technological University
Beneficiary's Banker Name	Overseas-Chinese Banking Corporation Limited
Beneficiary's Banker Address	65 Chulia Street, OCBC Centre Singapore 049513
Beneficiary's Account Number	537-010027-001
SWIFT Code	OCBCSGSG

*Please note that you have to bear all the bank charges incurred in your home country and Singapore (approximately SGD 20 x 2 transactions). You are also required to state in the telegraphic transfer slip that the payment is for “NTU Summer Programme 2020”.

You may email a scanned copy of the telegraphic transfer slip to pace@ntu.edu.sg .

c) Credit Card

You may make payment by Visa or MasterCard via the online registration form.

Certificate

NTU will award a Certification of Completion to participants who achieved at least 75% attendance.

Academic credits will not be awarded by NTU but home universities may consider awarding credit to their own students.

Insurance

You are required to purchase travel insurance to cover your stay in Singapore. Proof of purchase of travel insurance must be submitted to NTU two weeks prior to your arrival. You will not be able to participate in the programme if you do not comply with this requirement.

Accommodation

Twin-sharing student hostel accommodation (air-conditioned) will be provided at NTU main campus during the programme period.

Check-in Date : 7 July 2020 (Tuesday), 9am – 7pm

Check-out Date : 18 July 2020 (Saturday), 11am

Remarks

* No extension of stay in the hostel is allowed and you have to adhere strictly to the check-in/check-out timing. A late check-in fee of SGD 100 will be charged if students arrive after 7pm on 7 July 2020.

* Please arrange your own accommodation outside campus if you wish to arrive earlier or extend your stay in Singapore.

* A CASH deposit of SGD 100 or authorisation to charge to a credit card is required upon checking in. The deposit will be fully refunded upon checking-out if there are no damages to the hostel room.



**Actual student hostels allocated may not be the same as shown in the photos.*

Comments from Past Summer Programme Participants

I could get to know different cultures from all over the world especially Asia. I also got the chance to know Singapore and had a better understanding of this country.

– Paulina Ewa Lakomiec, Austria

The lectures were not too long but in the short amount of time given, I was able to get important information. Also the visits for this programme were the best.

– Nkamogeleng Chepape Caroline Thubakgale, South Africa

I like that the lecturers were very informative and they are the expert in their field, so that I was motivated to listen in the class. And also I liked that we had city tour and outdoor activities that were held outside the campus.

– Dian Setyawati, Indonesia

The programme was very innovative and educational. The contents were delivered efficiently by experts in the field. It was a very good approach to immerse and prepare students for the rapid technological changes and advancement in the world.

– Kayode Oyindamola, Nigeria

What I like about this programme: The variety of subjects covered and the trainers of varied background.

– Maja Roso, Croatia

It was a perfect programme. It would be awesome if this programme could last for 1 month.

– Shen Han, China

It's good that I can make international friends and touring with them will be unforgettable memories in life.

– Jo Seo Yun, South Korea

It was a wonderful experience and it did help me in improving myself. I loved the entirety of this programme.

– Ishita Bhattacharya, India

I get to make friends to go travelling with. It's just a lovely, friendly environment. I like that we get to explore Singapore in the programme.

– Eleny Hooijer, Australia

About Singapore

Singapore is made up of not just one island but a main island with 63 surrounding islets. The main island has a total land area of approximately 719.1 square km.

However, its compact size belies its economic growth. In just 150 years, Singapore has grown into a thriving centre of commerce and industry. Its former role as an entrepot has diminished, as the nation has increased its manufacturing base.

Singapore is the busiest port in the world with over 600 shipping lines sending super tankers, container ships and passenger liners to share the busy waters with coastal fishing vessels and wooden lighters. One of the world's major oil refining and distribution centres, Singapore is a major supplier of electronic components and a leader in shipbuilding and repairing. It has also become one of the most important financial centres of Asia, with more than 130 banks. Business dealings are facilitated by Singapore's superb communications network which links the nation to the rest of the world via satellite, 24-hour telegraph and telephone systems.

Singapore's strategic location, excellent facilities, fascinating cultural contrasts and tourist attractions contribute to its success as a leading destination for both business and pleasure.



About NTU - World's Top Young University



A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 33,000 undergraduate and postgraduate students in the colleges of Engineering, Business, Science, and Humanities, Arts and Social Sciences, and its Graduate College. NTU's Lee Kong Chian School of Medicine was established jointly with Imperial College London.



NTU's campus is frequently listed among the Top 15 most beautiful university campuses in the world and has 57 Green Mark-certified (equivalent to LEED-certified) buildings, of which 54 are certified Green Mark Platinum.



Besides its 200-ha (500-acre) lush green, residential campus in the western part of Singapore, NTU also has a second campus in the heart of Novena, Singapore's medical district.

Meteoric rise in international academic reputation

In 2019, NTU was placed 11th globally in the Quacquarelli Symonds (QS) World University Rankings. It was also ranked the world's best young university (under 50 years old) by QS for the fifth consecutive year. In addition, NTU was named the world's fastest rising young university by Times Higher Education in 2015.

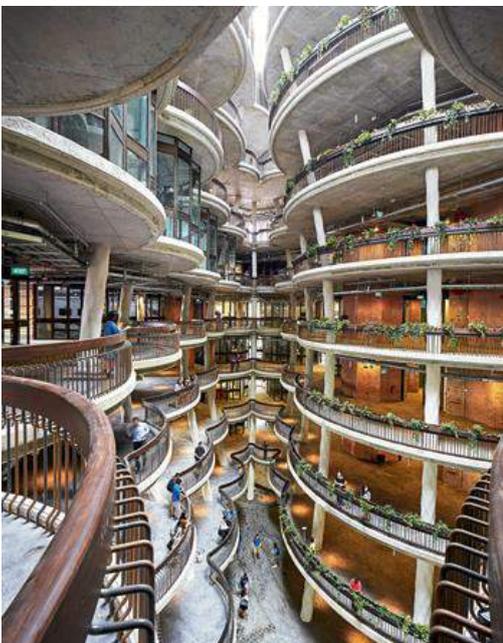
In engineering and technology, NTU is ranked 5th worldwide in the QS World University Rankings by Subject 2018. With six schools, NTU's College of Engineering is among the top nine globally for research output and the 5th most cited in the world (Essential Science Indicators 2017).

Mirroring this success is the College of Science, whose young chemistry department is ranked 10th among universities in the Nature Index 2018. Boosted by research at the Lee Kong Chian School of Medicine, NTU is also strengthening its foothold in areas such as biomedicine and life sciences.

The well-established Nanyang Business School is regularly featured among the leading business schools in Asia, with its MBA programme consistently rated top in Singapore since 2004 by The Economist.

Innovative learning

In higher education, NTU is driving new pedagogies so that millennials can learn more effectively in this digital age. Part of NTU's education strategy is the flipped classroom model of learning. The centrepiece of this new way of learning is The Hive, a groundbreaking learning facility that has been described by CNN as having redefined the traditional classroom.



Innovative education initiatives also include signature programmes such as Renaissance Engineering Programme, CN Yang Scholars Programme, NTU-University Scholars Programme. Designed for high-achieving students, these programmes offer a multidisciplinary curriculum, guidance by top faculty, interdisciplinary and intensive research opportunities, overseas exposure, as well as dialogues with world-class scientists and industry leaders.

Set up jointly with Imperial College London, NTU's medical school, is grooming a new generation of doctors to meet the healthcare needs of Singapore.

Research impact

Known for research excellence and technological innovation, NTU leads the top Asian universities in normalised research citation impact (Clarivate Analytics' InCites 2016). In the 2018 Nature Index, NTU is placed 29th among the world's universities and first in Singapore.

NTU's five-year strategic plan, NTU 2020, builds on strong foundations of NTU 2015 and aims to propel NTU to greater heights of research excellence. The plan focuses on five key research thrusts – Sustainable Earth, Global Asia, Secure Community, Healthy Society and Future Learning. The areas leverage NTU's diverse strengths, particularly its longstanding expertise in engineering, business and education, and the interfaces these have with various disciplines such as in healthcare, science and the humanities. NTU's sustainability initiatives have clinched significant competitive research funding and the university is already a global leader in this area.



NTU hosts two national research centres of excellence – the Earth Observatory of Singapore (EOS) and Singapore Centre for Environmental Life Sciences Engineering (SCELSE) – that are tackling important questions in environmental sustainability and public health.

NTU is also home to a number of world-class institutes. The National Institute of Education trains all teachers in Singapore, which is known for having one of the best education systems in the world.

Other key institutes at NTU include the S Rajaratnam School of International Studies, the Nanyang Environment & Water Research Institute and the Energy Research Institute @ NTU.

Collaborations with academia and industry



NTU actively pursues partnerships with top universities and runs joint and dual PhD degree programmes with well-established universities. Some of its key partners in academia and research include Imperial College London, Technical University of Munich, and University of California, Berkeley.



The university also works closely with the biggest industry players in making its research relevant to society. In the past few years alone, NTU has struck a record number of tie-ups with big players such as Alibaba, BMW Group, Rolls-Royce, Delta Electronics, ST Engineering, SMRT, SingTel and Surbana Jurong.

Internationalisation



A cosmopolitan international university, NTU has more than 100 nationalities on its campus. With more than 300 academic partners, international exchange students are a common sight on the sprawling campus.

Believing in the benefits of global exposure and immersion for its students, NTU aims to have at least 8 in 10 undergraduates go overseas at least once during the course of their studies.

This can be through student exchanges, summer programmes, field trips, research attachments, internships and industrial attachments, competitions, conferences and more.

NTU – Centre for Professional and Continuing Education

About PaCE@NTU

Embrace lifelong learning. Grow with PaCE@NTU

NTU established the Centre for Professional and Continuing Education (PaCE@NTU) in Jan 2019 to consolidate continuing education and training capabilities and expertise within the university. This is in line with the government's emphasis on advancing adult education and professional development for Singapore's workforce to better meet future challenges.

PaCE@NTU draws upon NTU's world-renowned faculty and strong industrial connections to develop quality programmes to equip Singapore professionals, managers and executives (PMEs) with updated knowledge and skills to keep pace with the rapid technological changes in today's increasingly competitive economy and industrial landscape.

PaCE@NTU offers a wide range of programmes from various disciplines, durations and learning platforms. We currently administer three Part-Time Bachelor of Engineering (B.Eng) Degree Programmes in Electrical and Electronic Engineering, Mechanical Engineering and Computer Science to cater for Diploma holders to pursue their education qualification aspirations while working full time. Seminars, Short Courses, Semester-long Courses (credit-bearing and stackable) taken from the Undergraduate and MSc programs, E-learning and Mobile learning courses are developed and available to cater to the diverse range of individuals' learning needs. In addition, PaCE@NTU offers Global Executive Programmes to provide industry leaders with networking opportunities and Student Immersion Programmes for students to learn while experiencing the Singapore culture. We also develop In-house Training programmes to meet clients' organisational learning needs.

PaCE@NTU aims to support working adults and its NTU Alumni to update, upskill and reskill in their lifelong learning journey to attain their professional goals and personal educational aspirations.

**Nanyang Technological University, Singapore
Centre for Professional and Continuing Education (PaCE@NTU)**

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