ESD NEWSLETTER
ENGINEERING SYSTEMS AND DESIGN

WELCOME GREETINGS
Message by Peter Jackson, Professor and Head of Pillar

It is natural to reflect on what the COVID-19 pandemic has cost us and tempting to dwell on what we have lost. But history will record this period as a singularity during which there were massive realignments in social conventions and a super acceleration in the adoption of digital technologies. At a recent panel discussion with industry leaders, we asked them what had changed in the nature of work and what they were now looking for in new graduates. They came back with words such as "resilient",

"agile", and "adaptable", and emphasized the need to use virtual and digital tools for collaboration. Our recent alumni responded that our project-focused curriculum had already forced them into this new mode of working. They had developed expertise in a variety of tools for design collaboration, project management, and communication. They commented that project management had improved with online tracking of tasks: all team members were now accountable for their progress. You, our current cohorts, have an even greater justification to describe yourselves as resilient, agile, and adaptable. I encourage you to see these as strengths employers will value in this world of work.

This has also been a period of refreshing. In the past year, we have created a new program to partner with industry: the "C3P" (Connecting Students – Connecting Systems – Connecting Companies). Nine companies are partnering with us to form talent pipelines into their organizations through advertising their internships and job openings directly to the ESD bulletin board. They have also committed to providing projects to our signature Data and Business Analytics course and other courses. We have also been refreshing our curriculum. Engineering Systems Architecture was revamped to include a major component of data wrangling. In the current year (2022), we will be refreshing Energy Systems and Management, Advanced Topics in Optimization, Manufacturing and Service Operations, and Statistical and Machine Learning. We also introduced two new courses into our graduate curriculum: Convex Optimization and Metaheuristic Methods of Optimization.
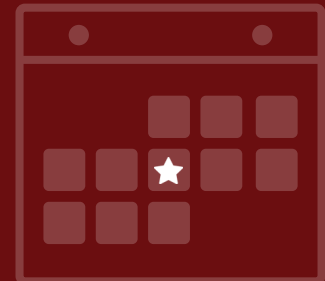
When we emerge from this pandemic, we will all be stronger. Keep up the good work!

Mark this date!

WELCOME EVENT

26 January 2022
1.30pm - 3.00pm
Lecture Theatre 1

ESD sophomores,
do check your emails
for more details closer
to the event date.

NEW FACULTY MEMBERS

Warmest welcome to our new faculty members joining the ESD family!

Yue Mu
Lecturer

Francisco Benita
Lecturer

FACULTY ACHIEVEMENTS

Georgios Piliouras
Associate Professor

- **Spotlight Award at NeurIPS**
- **Best Paper at 35th AAAI Conferences on Artificial Intelligence 2021**

  Title: Exploration Exploitation in Multi-Agent Co-authored with Dr Stefanos Leonardos and Dr Kelly Spendlove

Karthik Natarajan
Professor

- **Published a Graduate Level Research Book**

  Title: Optimization with Marginals and Moments

Lingjie Duan
Associate Professor

- **Listed in the world's top 2% scientists by Stanford University**

Lynette Cheah
Associate Professor

- **Featured on the Institution of Engineers (IES) social media**

UNDERGRADUATE RESEARCH OPPORTUNITIES PROGRAMME (UROP)

An Airport Capacity Study - Application to the ASEAN Airports
Nuno Ribeiro
Assistant Professor

Student Participants (2 Teams)
Vanessa Chia, Feng Zhengqing Mark, Jyotit Kaushal, Lim Ze Li, Ong Tao Jie, Pan Tnag Kai Ryan, Shyam Sridha

Understanding how flight delays evolve, and how different operating conditions affect airport capacity is critical in airport planning and management. From a planning standpoint, this information helps airports to decide the best airport expansion interventions to take in the medium and long term. From a management standpoint, this information helps air traffic controllers to perform better decisions during the day of operations (air traffic flow management). During the Summer and Fall 2020, a team of 7 UROP students worked under my guidance in the development and calibration of analytical, data-driven and simulation tools for airport capacity estimation. The project was built on the top of research conducted under the newly created Aviation Studies Institutes (ASI-SUTD), and in collaboration with the Civil Aviation Authority of Singapore (CAAS).

Mapping the Public Transport System in Singapore
Xingyin Wang
Assistant Professor

Student Participants
Loh Jian An Lionell, Ng Sin Jinn Ryan

Public buses in Singapore operate on fixed routes and schedules. A bus has to follow its assigned route exactly and, therefore, visits every stop even if there is no passenger waiting or getting off at the stop. In addition, buses depart from their terminals at predetermined schedules. The schedule depends on peak or non-peak hours and weekday or weekend, but not directly on the number of passengers waiting or to be waiting at the bus stops in real time.

In a proposed flexible bus scheduling system, a bus does not have to follow a fixed route or fixed schedule, but a tailored route and departure time according to passenger arrivals or planned arrivals (this is achieved if passengers book the bus service in advance). We hope that with this model, either we can lower the cost of operating the bus services without sacrificing service level or we can achieve higher service level without increasing the cost, especially during off-peak hours.

## ESD FACILITIES

Systems Design Studio (1.610)

The Systems Design Studio is an idea-friendly home for teams and design classes to meet and explore concepts that could change the world. There is ample white-space for sketching your ideas as well as display areas for showing off ideas in progress. We can cover large surfaces with sticky notes and engage in "Voice-of-the-Customer" affinity exercises. The space is re-configurable, so there is room for "body-storming" exercises to complement brain-storming activities. This is intended to be a low-technology room but we do intend to experiment with multi-touch display walls to spur and capture your creativity. This is the place to conceive your next big idea.
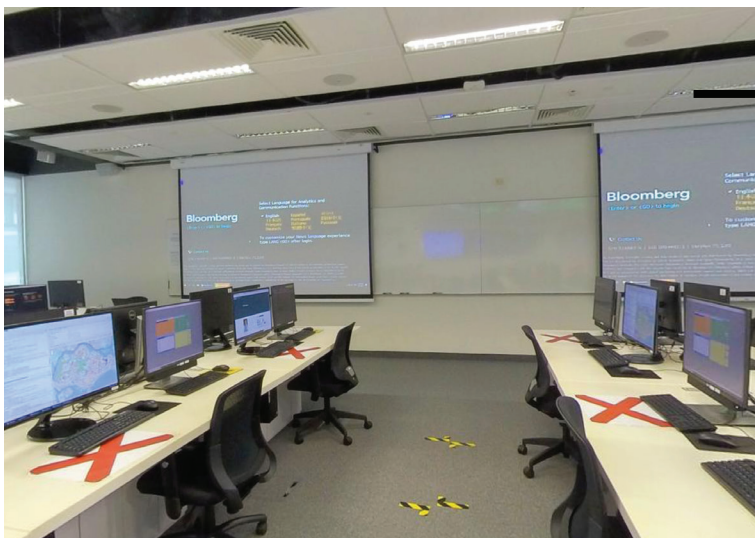
Data Analytics Lab (1.615)

The Data Analytics Lab is where computational power meets systems thinking. This is the ESD home for simulation, optimisation, and analysis. It began life as a Trading Lab, simulating the research and trading activities of a financial professional. It is equipped with Bloomberg terminals giving you access to a wealth of up-to-date financial information on publicly traded firms. It also features a display board with running updates of current stock prices. But the lab has grown to embrace statistical analysis of large datasets, simulation of complex facilities, and optimisation of large scale multi-objective planning and design problems. It provides the latest tools that cover all three aspects of data analytics – descriptive, predictive and prescriptive analytics. We also host interactive, computer-based games where teams of students tackle realistic, fast-paced operational challenges such as bringing a large development project to completion on time and under budget in spite of disruptive events. This is the place to hone your computational and decision-making skills.

Capstone Project: Solving Ninja Van's Petty Cash Issue

Andrea Chong, Seah Ee Song Jensen, Soh Jun Hern, Tan Hui Ming Grace

Four ESD students in a team of seven worked with Ninja Van to solve an issue with petty cash management. Here is their experience!

"Attempting to introduce process improvements to the operations of 5 vastly different country teams in Ninja Van definitely felt like a tremendous challenge for the team from the very start.

However, the ESD curriculum had trained us to adopt bigger-picture systems thinking, and use frameworks to break down complex systems into smaller elements and processes. Together with our previous experiences in handling client-facing industry projects, the team was thus able to design a comprehensive solution fulfilling the requirements of each country team.

Past ESD courses also helped in this regard, as they gave us exposure to various optimization techniques which could be adapted in the design of intelligent systems.

Ultimately, the capstone project called upon us to distill complex issues into the root problem to be solved, and draw creatively on our previous experiences to ideate, iterate and implement a well-considered solution. It was a trying but infinitely rewarding experience."

Catch their full story on #WEARESUTD
https://tinyurl.com/wearesutd-ninjavan

2D Project 2021: Manufacturing and Service Operations (MSO) with Statistics

The 2D Project engages students to integrate technical content of two or more courses. Students identifies with an industrial or commercial client to face a real-world operational problem.

Students take on these problems with the analytical tools covered in the Manufacturing and Service Operations courses. They collect the client's data and transform the data into forecasts or insights to find meaningful solutions.

Scan to learn more about their projects!
https://tinyurl.com/esdshowcase-2dproject

Data And Business Analytics (DBA) :
Revenue Prediction Based on Historical Data and Economic Indicators


Goh Ray Fong, Ignatius Goh, Lim Kok Tong, Nicholas Tan, Ong Tao Jie

"Our group was given the opportunity to work with Infineon to predict their future revenue through historical data and additional economic indicators. This was an invaluable experience as we were able to gain first-hand experience in applying concepts learned in class to generate insights for an actual business.

Besides exploring multiple machine learning forecasting techniques that were covered in class, we took additional steps to learn more novel techniques such as the ARIMA and LSTM RNN models. Eventually, our group adopted an ensemble model that used both historical data and economic indicators to provide Infineon with an accurate forecast of their revenue.

Other than being exposed to multiple machine learning techniques, we capitalized on the opportunity to hone our soft-skills as we experienced client-facing interactions throughout the project. This was an experience that was truly beneficial to our holistic education."
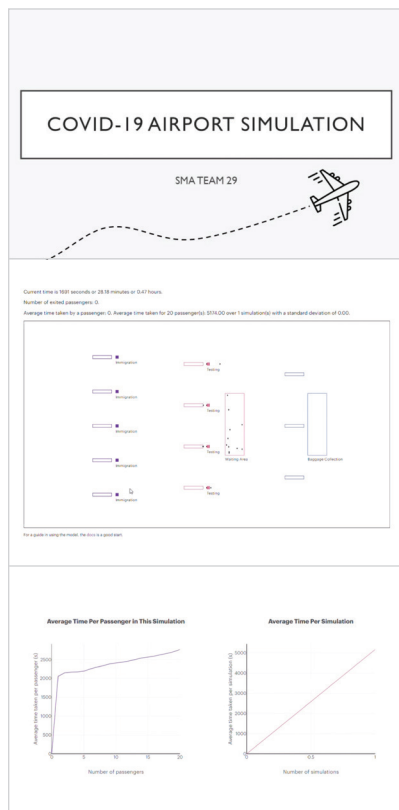
Simulation Modelling and Analysis (SMA)
Modelling a Post-Pandemic Airport Passenger Flow

Vincent Leonardo, Sarah Ramjoo, Sarah Wong

"Our SMA project "Modelling Airport Arrivals in a Post-Pandemic World" was inspired by the difficulties faced by airports around the world in handling their arrivals as they adapted to the effects of the Covid-19 pandemic and the restrictions that come because of that.

Working on this project was an eye-opening and valuable experience. Using web development tools, mainly JavaScript, we built our model of an airport's arrival halls, where the usual immigration process has become more complicated as arriving passengers are now required to take a PCR and/or ART depending on where they arrived from. For future users of the model, our goal was to be able to provide better visualisation and justification of the number of immigration counters, test stations, and order of the stations for their airports, such that manpower and wait times are minimised.

Apart from the opportunity to gain better technical knowledge, this project has helped us gain a better understanding of how simulations work and how to create one that is not only interactive and attractive, but also easy-to-use for analysis purposes."

STUDENT COMPETITIONS

Synthesis Sustainability IRL Data Science Challenge

Adharsha Sam

The challenge involved finding answers to real-world sustainability problems through data. With the use of the data analysis tool R, Adharsha solved problem statements given in the challenge and was awarded one of the four awards, the Outstanding Entry award as a solo contestant among 135 entries.
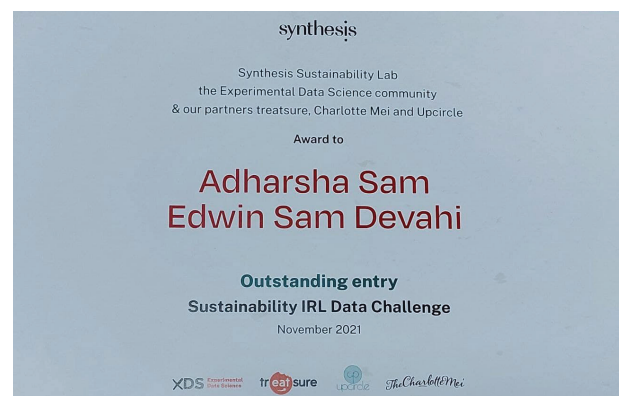
Global Challenge Lab (GCL) Hackathon

Bing Xuan Ho

Bing Xuan Ho took on the Global Challenge Lab (GCL) with a team of five others from various universities. The competition involves a 3-minute pitch and 4-minute Q&A with senior management of different sponsoring Multinational Corporations (MNCs) as judges. He and his team emerged 1st place in the "Access to Healthcare" focus track and overall 3rd place among 932 participants and 53 teams from participating universities such as Tsinghua, London School of Economics, and Imperial College London.

Citi HackOverflow Hackathon

Bing Xuan Ho, Feng Zhengqing Mark, Mak Wei Zheng, Sherwin Seah, Jervis Sim

As a team of five ESD students, Bing Xuan Ho, Feng Zhengqing Mark, Mak Wei Zheng, Sherwin Seah, and Jervis Sim, puts their skills to the test in the Citi HackOverflow Hackathon. With a 8-minute pitch and 2-minute Q&A to Citibank's senior management as judges, they won an overall 2nd place amongst 102 participants and 22 teams comprising of Computer Science majors with their MVP mobile application created using Flutter and Firebase.

Congratulations team 15 for winning the 2nd prize at the recently conducted CITI Hackathon - From the Citi HackOverflow 2021 team!

"The skills we picked up from ESD courses helped us to differentiate ourselves in the design, development, and presentation of our ideas. It was a certainly fun and fruitful experience for us! I would recommend my fellow ESD friends to actively participate in hackathons and leave their mark."

- Bing Xuan Ho

ESD Welfare Packs

Giving their warm support to the students working hard for their exams, the ESD Committee distributed welfare packs containing snacks to all ESD juniors and seniors as a form of encouragement ahead of the upcoming midterms.

"The winter term was a hectic one for all our students. Our juniors saw a busy term filled with industrial and 2D projects, while our seniors saw the start of their capstone projects with several reviews and deliverables. To keep everyone motivated, the ESD Exco distributed welfare packs to motivate everyone and keep their gears grinding. The packs contained a few snacks to power study sessions, and a pun filled message to tickle their humour!

We are all in this together, push on!"

– 2021 ESD EXco
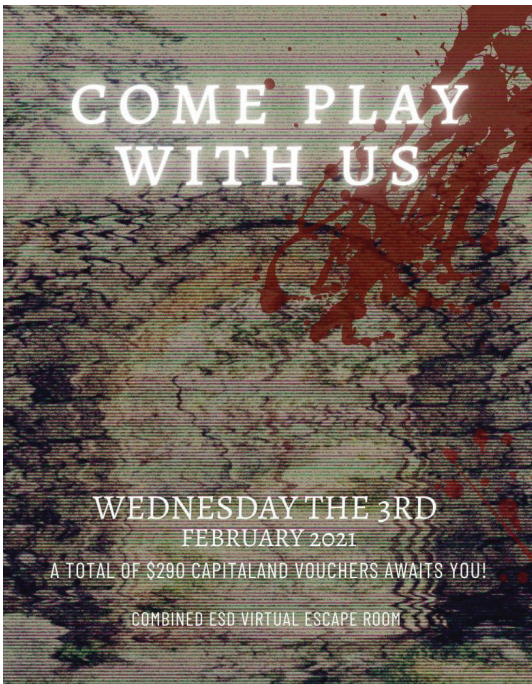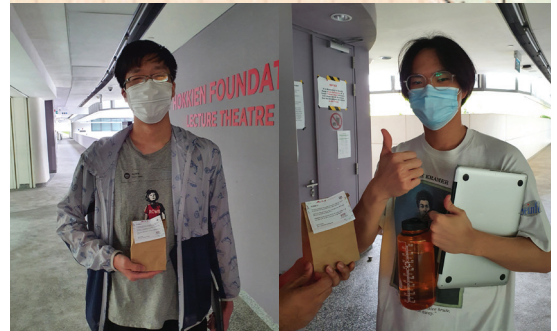
The Virtual Escape Room

To begin the winter term on a fun note, the ESD executive committee organised a virtual escape room. The game featured several tasks which tested both the puzzle solving and teamwork ability of participants. All students who participated had a challenging time, but enjoyed the bonding opportunities, especially for seniors and juniors meeting each other for the first time!

"The puzzles were very difficult, but I enjoyed solving them with my group. The escape room was a good getaway from the hectic winter term and will definitely participate again next time!"

– Tan Peck Kee

"Trying to solve those puzzles was a good experience and it was nice to let off some steam before the capstone term! Thanks to everyone who organised the escape room!"

– Eugene See

Dialogue Sessions with ESD Head of Pillar

As part of our continual engagement with ESDians, closed-door dialogue sessions with ESD Head of Pillar are organized in every pillar term.

Do look out for email notifications for more details and don't miss the opportunity to meet with the ESD Head of Pillar personally for an open discussion!

ALUMNI' SHARINGS

Chloe Tan
ESD Alumna
Class of 2021

Chloe Tan graduated in 2021 with Bachelor of Engineering Systems and Design as a top student in the Aviation and Urban Infrastructure Systems Tracks. Here she reflects on her learning experience in SUTD.

"The intense curriculum definitely pushed me to my limit, having to juggle project works, assignments and exams all at once during crunch time. Couldn't have been able to make it through without the support and company of my friends. From staying up till dawn in hostel to being library residents. From dancing to choreographing and playing tchoukball. Not to forget the killer PT and gym sessions. I am glad to have been able to have experienced and gone through my university life the way I have with this amazing group of friends. And also all the kind professors and seniors who never failed to offer their guidance. Not to forget my family who has been with me every step of the way. Really hope to be able to retain all relationships while also forging new ones."

Ng Jia Yi is an ESD pioneer who her received her Ph.D. in 2020 and Bachelor in Engineering Systems and Design as a top student in the Energy and Environment focus track in 2015. Her work experience involves working as a research officer at SUTD-MIT International Design Centre (IDC), a research scientist at Veolia City Modelling Center, a visiting scholar at Oden Institute for Computational Engineering & Science (ICES) at University of Texas, Austin, and a research fellow at SUTD. Currently, she has started to teach as an adjunct lecturer in ESD on the subject Modelling Uncertainty.

Ng Jia Yi
ESD Alumna
Class of 2020 (Ph.D.)
and 2015 (Bachelor)

"At the time SUTD had just started, I was in the first batch for the undergraduate programme. I am interested in math in general from quite a young age. Eventually, I went to ESD and things went on from there - opportunities popped up here and there. The course I am teaching now, Modelling Uncertainty, is also related to my interest - math in general. I have always thought that math is interesting and I hope for students to enjoy the learning process. When I got quite positive feedbacks from the students, I felt quite happy that it seems - at least for those who left comments - that they enjoyed the lessons."

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