



NUS
National University
of Singapore

Institute of
Data Science



EDUCATION RESOURCE CENTRE



A focal point for data science
research leveraging expertise from
multiple disciplines to tackle real-world
problems from multifaceted perspectives.



(Please Observe Your Surroundings
Keep Clean)

Founded on 27 May 2016, Institute of Data Science (IDS) is a multi-million university-funded research centre to develop integrated data science solutions and to nurture data scientists for Singapore's Smart Nation initiative.

Building on the broad spectrum of research leaderships in the data sciences across the various faculties and schools in NUS, Institute of Data Science (IDS) is the focal point for data science research, leveraging expertise from multiple Schools and Faculties to tackle problems from multifaceted perspectives.



Our Mission

To leverage and strengthen data science expertise for transdisciplinary and translational research into important real-life problems and education of the next generation of data scientists.

Our Vision

A globally admired institute for groundbreaking research into the efficient discovery of reliable and meaningful knowledge from data for informed decision-making by individuals, businesses, governments, and society.

4 Pillars of Institute of Data Science

IDS Faculty Affiliates

Interdisciplinary faculty members from NUS Business School, Faculty of Arts and Social Sciences, Faculty of Engineering, Faculty of Science, School of Computing, School of Medicine, and School of Public Health.

IDS PhD Program in Data Science

Jointly hosted with the NUS Graduate School for Integrative Sciences and Engineering (NGS) – a unique PhD program that prepares students with a distinctive set of interdisciplinary skills for careers in academia or industry.

IDS Interdisciplinary Seed Grants

Seeds transdisciplinary research for data science across departments and disciplines.

IDS External Research Collaborations

Collaborates with industry partners and public agencies for research on real-life problems and data that can be translated for real use to create impact and lasting values.

Transdisciplinary Data Science

Statistics

Behavioral Economics

Machine Learning & AI

Decision Sciences

Mathematical Modelling

Health Sciences

Databases

Text & Multimedia Analysis

Distributed Systems

Public Policy



Creating Real World Impacts

Industry Partners



Public Agencies



National Research Consortia



IDS PhD in Data Science Program



Institute of Data Science



Jointly hosted by Institute of Data Science (IDS) and NUS Graduate School for Integrative Sciences and Engineering (NGS) - It prepares students with a distinctive set of interdisciplinary skills for careers in academia or industry. With this PhD program, IDS aims to educate the next generation of “brain-heavy” data scientists.



Interdisciplinary Coursework

Taking data science and research courses across multiple schools and faculties - NGS, FoS, FoE, SOC, and BIZ.

Teaching & Projects@IDS

Becoming a data science evangelist - “PhD-teach-PhD Data Science Mini-Tutorials”, “IDS Data Science Summer School”.
Participating in interesting data science projects in IDS.

PhD Thesis

Working on a topic that advances data science research under the supervision of multidisciplinary IDS faculty affiliates.

IDS Research Lab

Interacting with other IDS PhD students and researchers.
Access to IDS’ computational resource.

Why PhD in Data Science?

Prepares for Data Science careers in academia and industry with a distinctive set of interdisciplinary skills.

Conducts deep research to address fundamental challenges in Data Science.

Develops innovative solutions for real-world problems using Data Science.

IDS PhD Program Overview

- Monthly stipend, up to 4 years of PhD studies, OR up to date of graduation, whichever is earlier
- Full tuition fee subsidies for 4 years
- Conference travel support
- Under NGS Scholarship scheme
- Open worldwide to: Bachelor degree holders (or above), with at least a very good 2nd Upper Honours (or equivalent qualifications), and outstanding research potential and strong research interests in Data Science.

Our Students

Xu Xiuqin is making deep learning more interpretable with statistical models. She feels that the program provides highly supportive environment and student-oriented guidance.

Wang Kaixin is teaching machines to understand what they see and make decisions accordingly. He thinks that the IDS PhD program most perfectly aligned with his research interests than the other programs.

Jiang Jun is combining econometrics and reinforcement learning on supply and demand. He feels that the IDS program provides a great network that connects eminent professors and students in Data Science in NUS.

Steven Lee is teaching computers to detect image repurposing for spreading fake news. He thinks IDS provides students with the machinery to explore the working principles and applications of cutting-edge ML techniques.

Research @ IDS

Through transdisciplinary and translational research, we aim to address real-life grand challenge problems that call for collaborative effort from multiple disciplines.

We seek to collect data for sharing and to abstract out challenging research questions from real-life problems that can be investigated to gain a deeper understanding of data science. This allows researchers to collaborate for a larger cause, and at the same time, retain their freedom to address challenging and meaningful abstracted problems.

Transdisciplinary Research

Data science is an interdisciplinary field. Many of the existing and future data science problems are complex, and the complexity will require a transdisciplinary approach to address.

Instead of individual disciplines coming up with their own solutions independently, multiple disciplines must come together to recognize the problem first, and then devise solutions that are only possible when multiple disciplines work together to design that one solution. For example, the many problems of an ageing population can benefit from taking a transdisciplinary approach, one that includes colleagues from Engineering, Computing, Medicine, Public Health, Arts and Social Science pushing ahead in data science research in concert and with a clear purpose.

As the focal point for university-wide data science research, the value of the solutions that the Institute can provide is through bringing together experts from multiple Schools and Faculties to investigate a problem from multifaceted perspectives. The Institute will coordinate data science research and funding for developing integrated capabilities, leverage on and mobilize existing strengths in NUS to collectively address real-life data science problems.

Translational Research

Practically every sector of our society today has accumulated or generated a large quantity of data that needs to be mined to extract useful information for businesses, biomedical, healthcare, the internet of things, public policy, law, government, media and emerging areas such as smart nations.

The Institute will develop enabling technologies that encompass horizontal domains related to mathematics, statistics and computing. These enabling technologies will be used to support a wide variety of vertical sectors.

Effective solutions for the vertical sectors require discipline-specific expertise in tandem with core computing and mathematical/statistical expertise. NUS is able to draw on core competency in many of these domains from various departments including Saw Swee Hock School of Public Health, School of Medicine, Faculty of Arts and Social Sciences, Risk Management Institute, Global Asia Institute, and Business School.

When we work on real-life problems that meet the needs of the various sectors, there is great potential for technology transfer and translation of research output for real world deployment.

Data Hub

The research at the Institute naturally operates on a variety and large collection of real-world datasets. Some of these are publicly available data while others may have restrictions imposed on their use by the data owners. In addition, the Institute's research may further create, generate and collect data. Our position in Asia will allow us to collect unique datasets to tackle problems that are not present or less common in those Western world institutes.

The Institute will serve as a trusted broker and custodian of these datasets for research. Whenever possible, the Institute will share the datasets with NUS researchers and external partners affiliated with the Institute. The Institute will also develop best practices across NUS and the research community to improve data accessibility. The rich datasets accumulated by the Institute will continue to provide for developing transdisciplinary research in data science, and the building up of talents for a data-driven economy.

We envision the research activities within the Institute to not only push the boundary of current knowledge on data science through upstream research, but also lead to solutions that can be translated for uses that are impactful and of lasting value (e.g., improve productivity, promote healthy living, improve quality of life, etc).





Projects @ IDS

We seek to change the traditional mindset of researchers – to collaborate across disciplines for impactful research rather than working in silos on “small” problems, and to work with industries and public agencies on challenging real-life problems rather than problems that are only of academic interests.

The Institute facilitates joint collaborations across the departments, and provides a single focal point for industries and public agencies to tap into the broad spectrum of scientific and technological expertise in the University. We focus on solving real-life data science problems that meet the needs of various sectors, and leads to the potential for technology transfer and translation of research outputs for real world deployments.



Grab-NUS AI Lab

Multi-million joint lab to support cities with solving some of the region's most pressing challenges, such as congestion and the liveability of cities

Grab's first major AI laboratory and NUS' first AI laboratory with a commercial partner.

AI Lab

A collaboration between:



Objectives



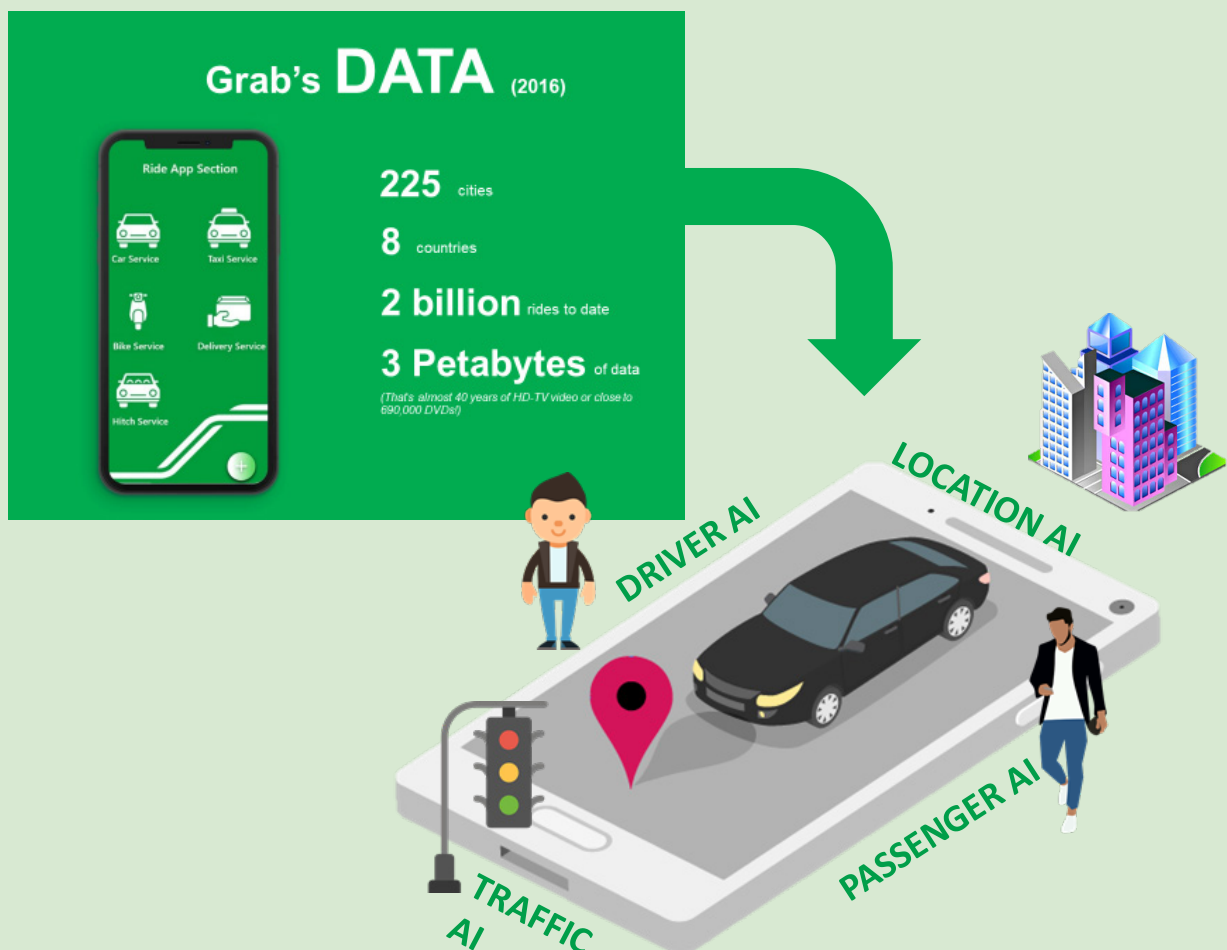
Improve the efficiency and reliability of transportation on the Grab platform using AI.



Solve key challenges facing cities in Southeast Asia, such as congestion and livability using AI.

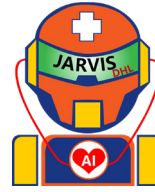


Boost AI research and talent development in Singapore, and see its impact across the region.



AI in Health Grand Challenge

“How can Artificial Intelligence (AI) help primary care teams stop or slow disease progression and complication development in 3H – Hyperglycaemia (diabetes), Hypertension (high blood pressure) and Hyperlipidaemia (high cholesterol) patients by 20% in 5 years?”

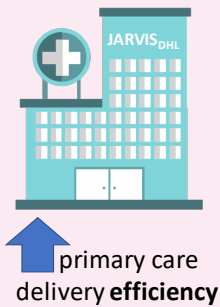


JARVIS_{DHL}: Transforming Chronic Care for Diabetes, Hypertension and Hyperlipidaemia (DHL) with AI

3 Key Transformations (“3 P’s”) for Primary Care

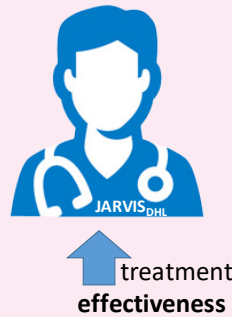
1.

From reactive care to Predictive care



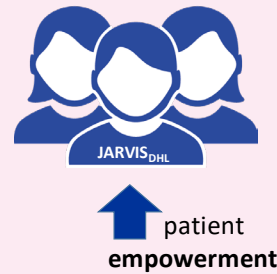
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From “one-size-fit-all” to Personalized care

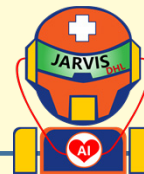
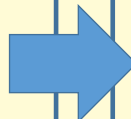


3.

From paternistic to Participatory care



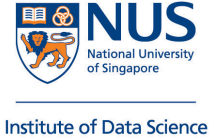
- **Continuously learn from local primary care data** to provide individualized evidence-based decision support to physicians to facilitate shared-decision making (SDM) with patients
- **Harvest next-generation healthcare and lifestyle tracking data** to include behavior and lifestyle data for 360-degree 24/7 view of the patient



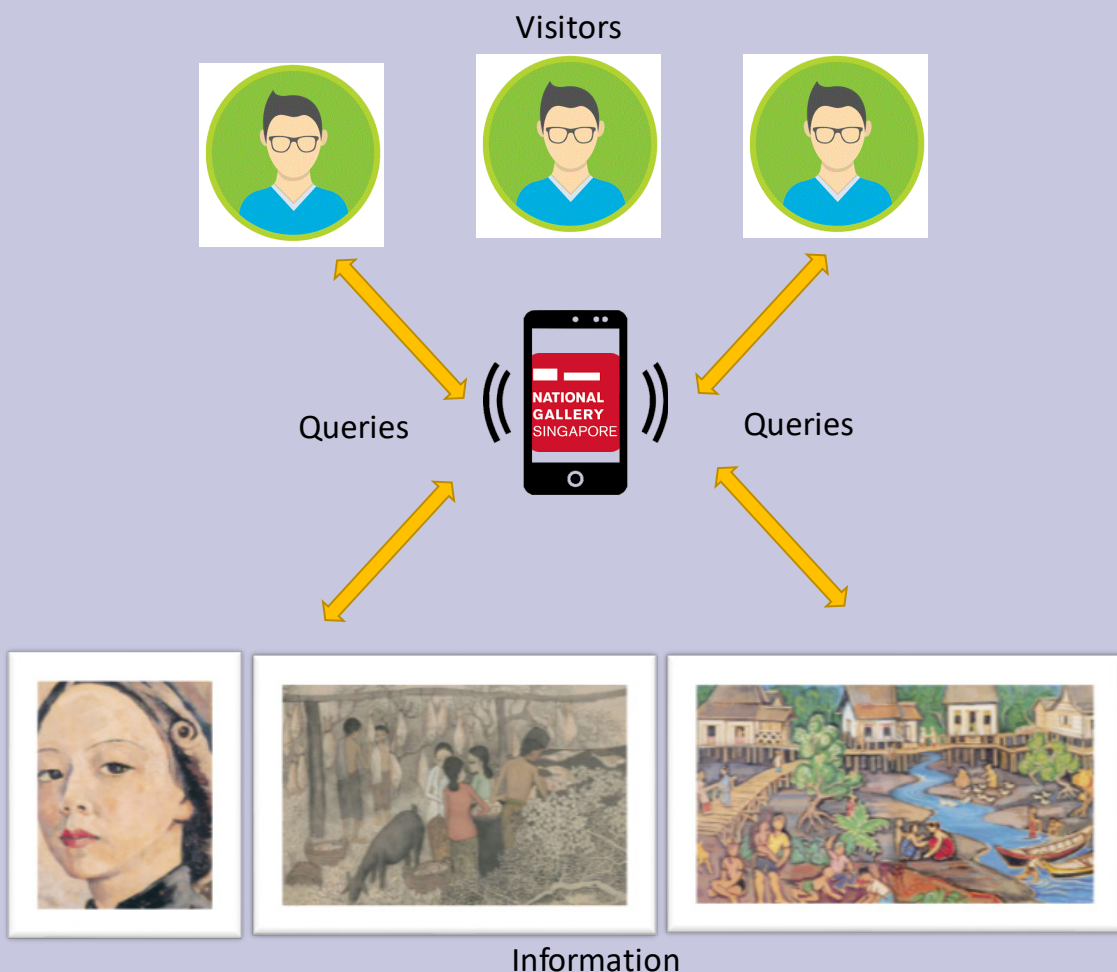
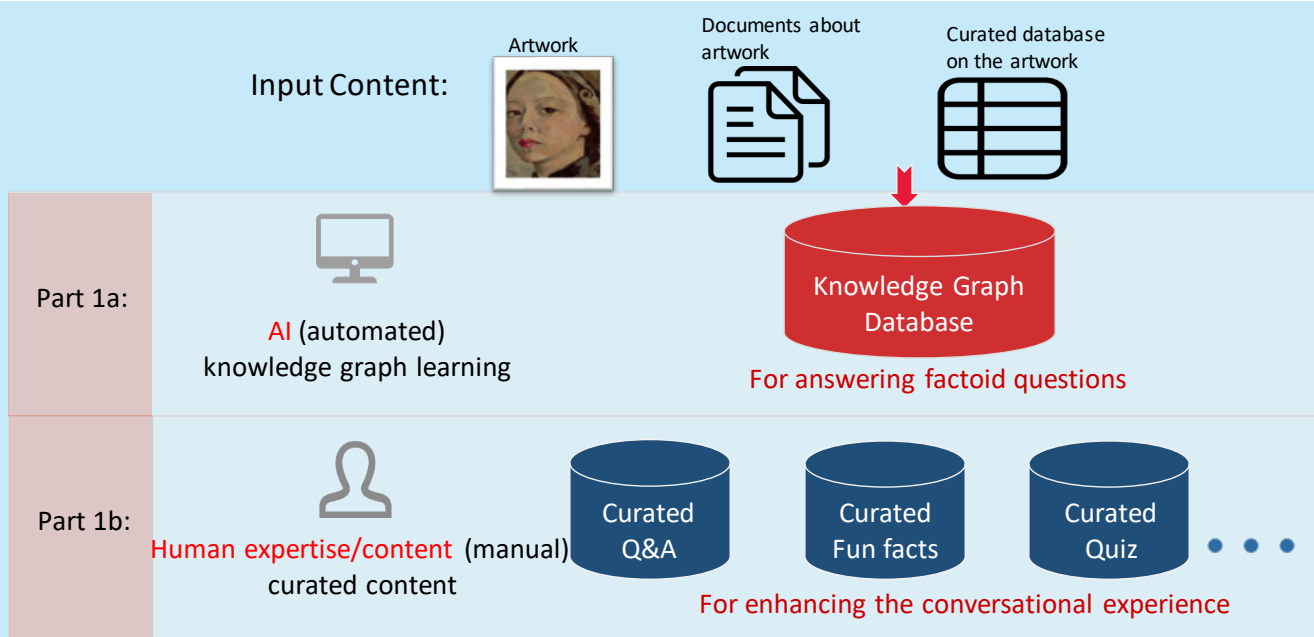
AI algorithms that are efficient, robust, and explainable to

- **quantify** benefits of treatment and risk of complications
- **adapt** customized treatment regimen according to lifestyle
- **alleviate** patient anxiety over perceived side effects
- **support** robust clinical decision-making
- **recommend** evidence-based treatment options

National Gallery Singapore Intelligent Gallery-Bot using NLP



National Gallery and Institute of Data Science (IDS) jointly develop an intelligent GalleryBot that is able to assimilate the rich unstructured content about the artworks to interact with the visitors by automatically generating content-rich conversations to interact with the visitors to discover their interests, recommend relevant artworks for their visit.

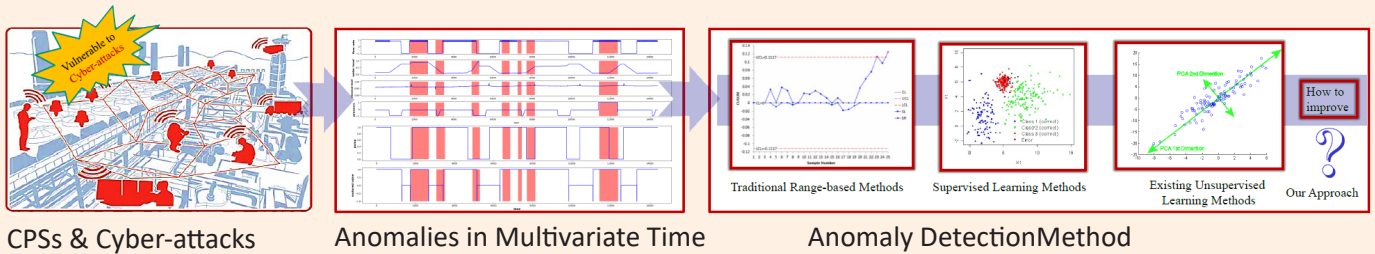


Motivation and Challenges for Anomaly Detection in Cyber-Physical Systems

“How can Artificial Intelligence (AI) be used on IoT sensor data to model complex multivariate time series data for normal scenarios, so as to detect anomalies from the predicted normal and the actual data?”

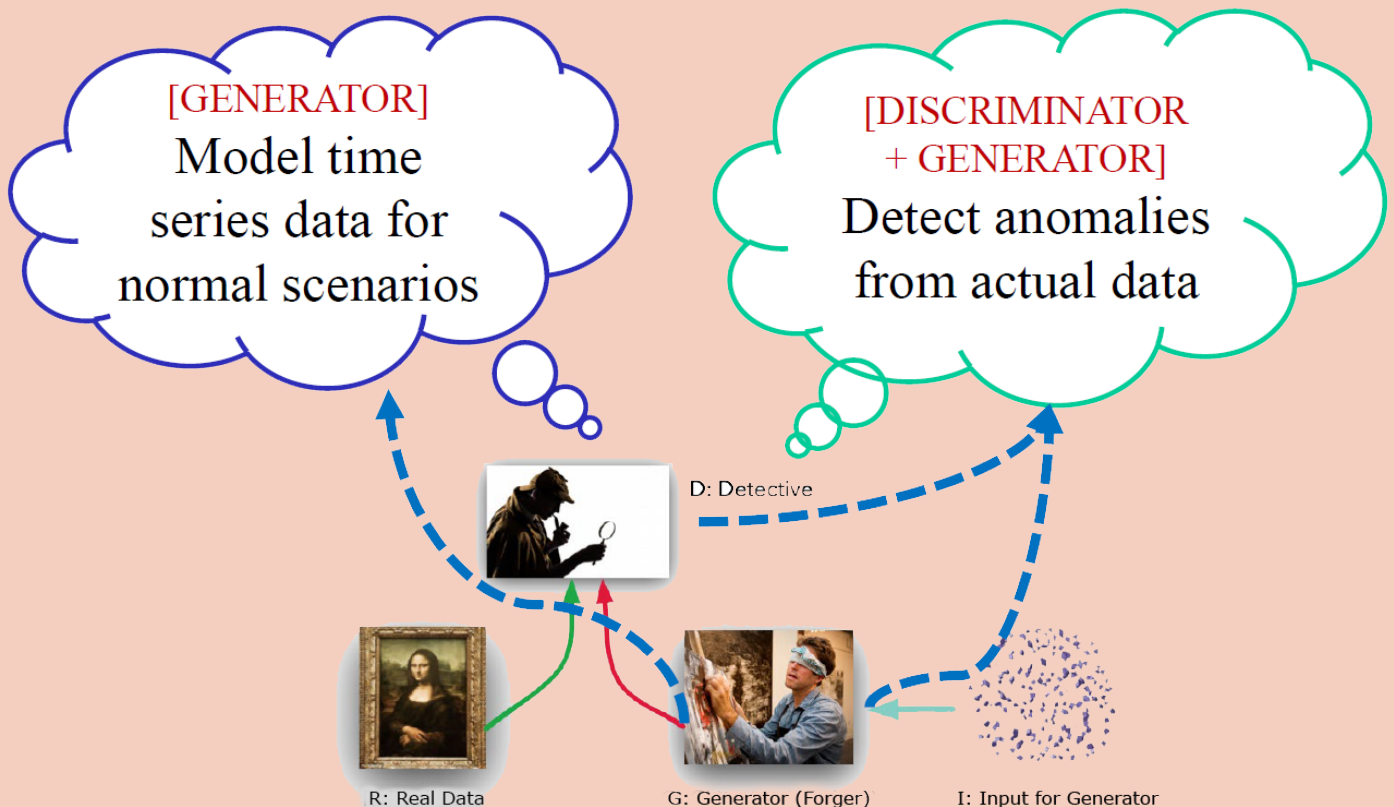
MAD-GAN: Learning to Detect Anomalies in Cyber-Physical Systems with Generative Adversarial Networks on Networked Sensor Time Series Data.

- In the era of Big Data and Internet of Things (IoT), all the sensors and actuators in Cyber-Physical Systems (CPSs) are connected to network for controlling and monitoring purposes.
- As many of the CPSs are engineered for mission-critical tasks, they are prime targets for cyber-attacks.
- Traditional range-based detection methods fall short difficult to handle the multivariate data streams generated by the increasingly dynamic and complex nature of modern CPSs.
- Due to the inherent lack of labelled data, anomaly detection is typically treated as an unsupervised machine learning task; need to handle non-linearity in the hidden inherent correlations of the multivariate time series.



Our Framework

MAD-GAN: Multivariate Anomaly Detection with GAN



EZ-Transaction Analytics for a Cashless Future

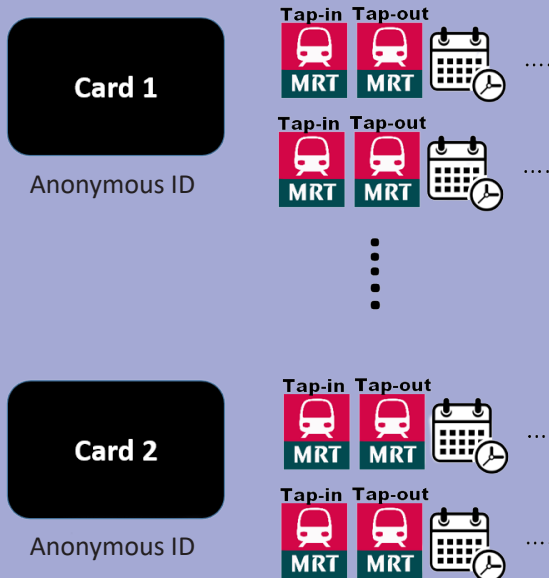


“Almost every Singaporean carries at least one ez-link card in his or her wallet not just for transit purposes but for all kinds of lifestyle payment needs such as ERP charges, shopping at retail outlets, dining, government services and so much more.”

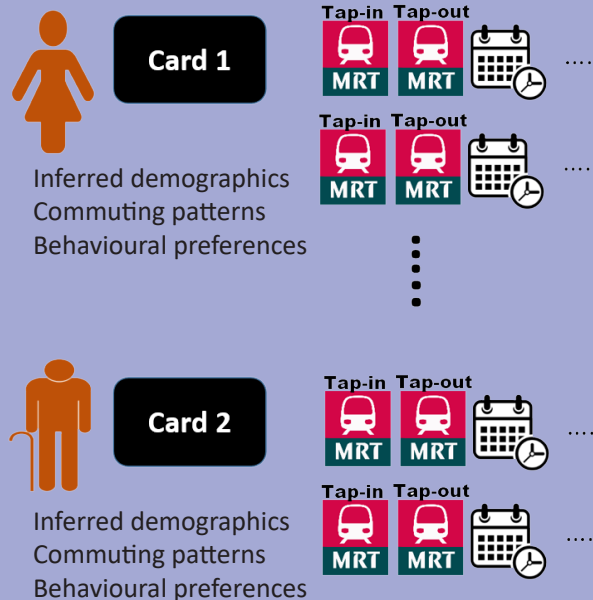


- The objective of project is to develop data-driven approaches to study EZ-Link customers’ behaviors and develop insights about their card top-up behaviors.
- In line with the vision of transforming Singapore into a Smart Nation, EZ-Link would like to encourage its customers to embrace the cashless and digital lifestyle.
- EZ-Link is keen to understand what it would take for commuters to shift from making cash to cashless top-up payments in transit, as well as to encourage the use the smart cards for non-transit cashless payments.
- Customer segmentation is important for understanding the underlying structures of the customer population for implementing targeted marketing and customized services.

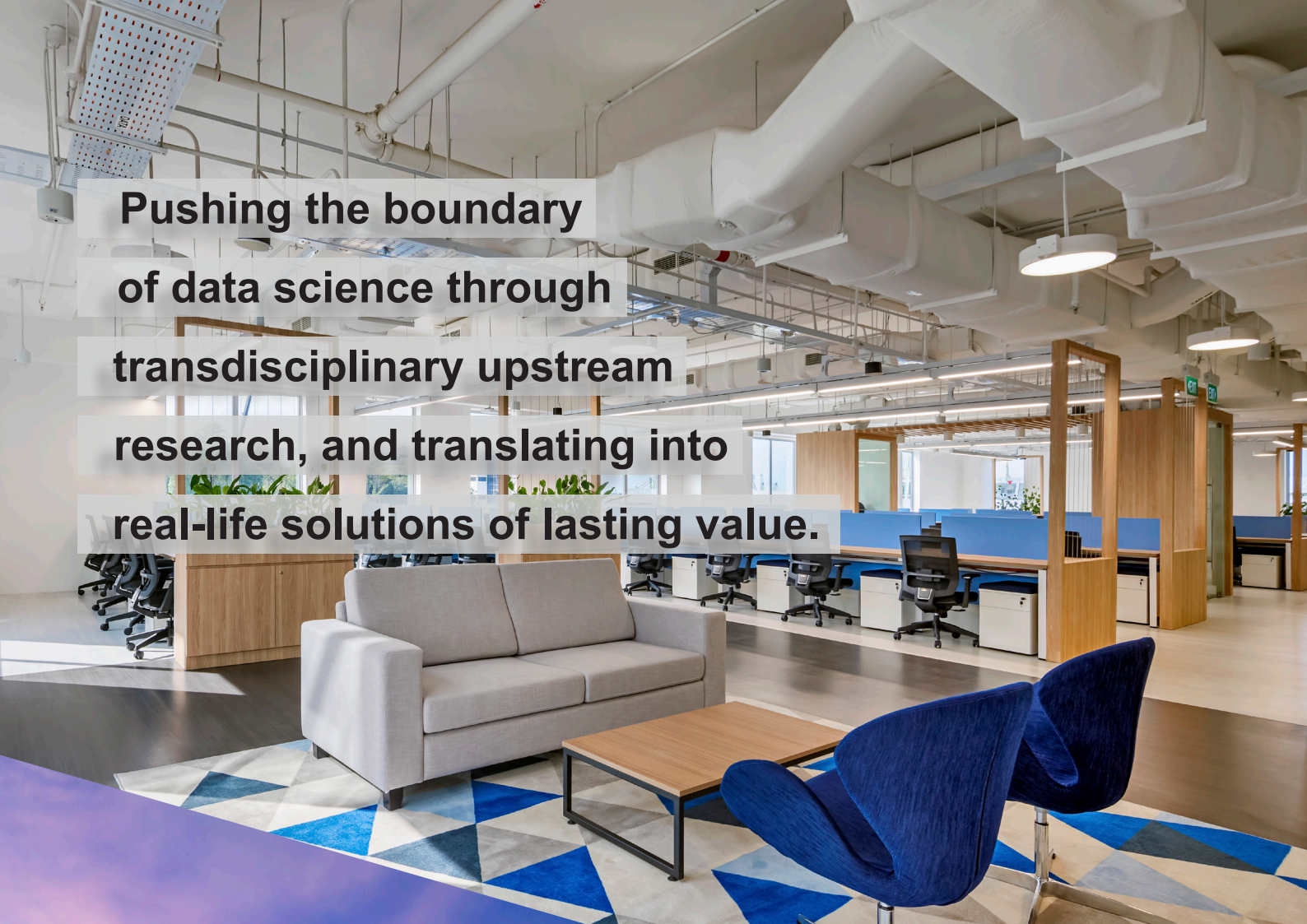
Raw Data




Segmentation of Commuters



- IDS developed data science and AI algorithms* for EZ-Link’s smart card data to segment public transit travellers into meaningful customer segments, and to understand their commuting patterns as well as behavioral preferences.
- We also combined big data approach (AI algorithms on Smart Card data) with small data approach (social science ground surveys) to understand the commuters’ smart card top-up behaviours and preferences.
- The data-driven insights can inform the design of targeted and individualized strategies for EZ-Link to provide customized services and promote desirable adoption effectively.

A modern, open-plan office space with a lounge area in the foreground. The lounge features a light grey sofa, a wooden coffee table, and two blue armchairs on a blue and white geometric patterned rug. In the background, there are workstations with blue cubicles, desks, and office chairs. The ceiling is high with exposed pipes and modern lighting fixtures.

**Pushing the boundary
of data science through
transdisciplinary upstream
research, and translating into
real-life solutions of lasting value.**

A photograph of the Institute of Data Science building at dusk. The building is a multi-story structure with a prominent glass facade on the lower levels and a curved section. The interior lights are on, and the sky is a deep blue. A large tree is visible on the left side of the frame.

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