A*STAR Research Attachment Programme (ARAP)
I²R's Projects

CATEGORIES	RESEARCH AREAS
Biomedical Sciences (BMS)	• Genetics/ Genomics
Computing and Information Sciences (CIS)	• AI and Data Science • AI and Data Science, Communications, Computational Engineering, Computational Social Sciences, Digital Health, Digital Humanities • AI and Data Science, Communications, Cybersecurity • AI and Data Science, Computational Engineering • AI and Data Science, Computational Engineering, Digital Health • AI and Data Science, Cybersecurity • Bioinformatics • Communications • Communications, Cybersecurity
Engineering and Technology (E&T)	• Automation & Robotics • Automation & Robotics, Cognitive Engineering, Food Technology, Green Urban Technologies, Product Design & Engineering • Automation & Robotics, Cognitive Engineering/ AI and Data Science, Computational Social Sciences • Green Urban Technologies • MedTech & HealthTech • MedTech & HealthTech, Microelectronics & Semiconductors • Microelectronics & Semiconductors, Sustainable Materials, Process & Manufacturing

Biomedical Sciences (BMS)
Focus Area: Genetics/ Genomics

❑ **I²R Supervisor: Foo Chuan Sheng, Assistant Department Head (Research), Senior Scientist I**
I have a background in regulatory genomics, particularly transcriptional regulation, and am happy to explore collaborations applying deep learning (especially data-efficient deep learning techniques that my group works on) to genomics data.

Computing and Information Sciences (CIS)
Focus Area: AI and Data Science

❑ **I²R Supervisor: Ang Kai Keng, Group Leader (Signal Processing), Senior Scientist III**
The research in my lab focuses on neural signal processing, specifically on EEG, NIRS and neural spike data. We also focus on developing AI algorithms and applying them to the data. We have a lot of data and methods, and we like to collaborate with groups that are interested in the same area of research.

❑ **I²R Supervisor: Cai Lile, Scientist II**
I would like to collaborate with groups who have expertise in label-efficient learning, including active learning, semi-supervised learning, self-supervised learning, and transfer learning.

❑ **I²R Supervisor: Chen Zhenghua, Scientist III**
The research in my laboratory focuses on transfer learning, self-supervised learning, and related applications. I would like to collaborate with groups which are interested in the research areas of our lab.

❑ **I²R Supervisor: Efe Camci, Scientist II**
- Reinforcement Learning
- Multi-Robot Systems
- Drones

❑ **I²R Supervisor: Kim Jung-Jae, Group Leader (Explainable & Automatic AI), Senior Scientist II**
I would like to collaborate with groups which are interested in multi-modal data analytics, including visual Q&A, information extraction from image, multi-modal dialogue systems, CAD document translation, multi-modal question generation (Math, Science), self-supervised learning of multi-modal documents, multi-modal fake/abusive online content detection, voice commands for controlling robot arms, report generation for medical images, etc.

- ❏ **I²R Supervisor: Liu Fayao, Scientist III**
  The research in my laboratory focuses on computer vision problems, especially 3D vison problems.

- ❏ **I²R Supervisor: Michael Chuah, Scientist II**
  Dynamic Obstacle Avoidance with Tactile-aware Local Path Planning using Reinforcement Learning

  Many research in the area of dynamic obstacle avoidance using classical control techniques is prone to have a robot stuck in a local minima or fail in terms of localization when navigating through a sea of crowd. Latest avant-garde solution in dynamic obstacle avoidance have mostly implemented reinforcement learning for the purpose of inducing socially compliant behaviour, such as in Collision Avoidance in Pedestrian-Rich Environments with Deep Reinforcement Learning (2021), which often leverage on laser sensor data, and top-down information of the environment including the precise positions of the dynamic obstacles moving within vicinity which will be used as inputs to a neural network model.

  To improve the performance of dynamic obstacle avoidance in a crowded environment, we aim to equip our robot with a layer of tactile intelligence (on top of a laser sensor) which will provide more information about the surroundings of a robot while we aim to induce smart behaviors in circumventing dynamic obstacles yet being socially compliant at the same time. This additional input will be added to a reinforcement learning pipeline to train a neural network policy that is able to conduct online path planning around dynamic obstacles effectively to navigate through crowd based on local sensor information. A few test scenarios include squeezing through two nearby moving dynamic obstacles, crossing through a busy doorway with passing dynamic obstacles, replanning, and reacting robustly upon contact or impact with dynamic obstacles.

- ❏ **I²R Supervisor: Michael Chuah, Scientist II**
  This project involves the simulation and control of a legged robotic platform, and the implementation of algorithms for parameter optimization, localization, and navigation.

  Student will learn about advanced robot kinematics and dynamics and their relevant applications. Student will explore the latest in legged locomotion and have the opportunity to apply their findings on a quadrupedal robotic system.

  Student will be responsible for understanding the current control framework of the legged robot using ROS, and the design and testing of various algorithms.

  Students can explore the use of bimodal hemispherical sensors on legged robots as well as in wearables or prosthesis. The idea is that by having these force sensors at the end of the robot's feet, they would be better equipped to understand their surroundings and perform agile motions. Similarly, having these force sensors in wearable smart shoes could aid in sports/rehabilitation analytics or in the future development of feet prosthesis for improved locomotion and gait. The latest in machine learning techniques for time series analysis such as GRUs and transformers would be employed to improve the sensor performance, especially with time-dependent properties such as stress relaxation. Alternative sensor geometries would be explored for different applications such as robotic grippers.

❑ **I²R Supervisor: Michael Chuah, Scientist II**
The research in my laboratory focuses on the development of agile locomotion systems based on quadruped robots. It involves the simulation and control of a legged robotic platform, and the implementation of algorithms for parameter optimization, localization, and navigation. We are interested in using a combination of reinforcement learning and imitation learning to develop robust legged locomotion algorithms.

Student will explore the latest in legged locomotion and have the opportunity to apply their findings on a quadrupedal robotic system. Student will be responsible for understanding the current control framework of the legged robot using ROS, and the design and testing of various algorithms.

Students can explore the use of bimodal hemispherical sensors on legged robots as well as in wearables or prosthesis. The idea is that by having these force sensors at the end of the robot's feet, they would be better equipped to understand their surroundings and perform agile motions. Similarly, having these force sensors in wearable smart shoes could aid in sports/rehabilitation analytics or in the future development of feet prosthesis for improved locomotion and gait. The latest in machine learning techniques for time series analysis such as GRUs and transformers would be employed to improve the sensor performance, especially with time-dependent properties such as stress relaxation. Alternative sensor geometries would be explored for different applications such as robotic grippers.

❑ **I²R Supervisor: Nancy F. Chen, Group Leader (Language Generation), Principal Scientist I**
Dialogue comprehension, summarization, and generation.

Dialogue modelling is still one of the most open research topics in natural language processing and artificial intelligence. The unstructured and interactive nature of verbal information exchanges from multiple parties make dialogue processing a complex yet interesting endeavour. In this project, we focus on addressing dialogue comprehension challenges via computational approaches. Applications of the work include conversation/meeting summarization and dialogue response generation.

❑ **I²R Supervisor: Nancy F. Chen, Group Leader (Language Generation), Principal Scientist I**
The research in my laboratory focuses on spoken and natural language processing (using machine learning and deep learning). I would like to collaborate with groups which have expertise in computational linguistics.

❑ **I²R Supervisor: Nancy F. Chen, Group Leader (Language Generation), Principal Scientist I**

The research in my laboratory focuses on spoken and natural language processing (applied machine learning). I would like to collaborate with groups which have expertise in machine learning theory.

- [ ] **I²R Supervisor: Ng Lai Xing, Scientist II**
  Robust Human-in-the-loop Machine Learning

  Several models for collaborations between human and machine learning have been proposed. In the context of reinforcement learning, human feedback is used as a reward value or as policy labels to train an agent. Human inputs have also been used to block actions that are considered wrong by human observers. In the context of active learning, the machine chooses data samples for humans to label, which is then fed into the training process either in an online fashion or in batches. In human-machine co-learning, humans and machines iterate through the labelling process to improve the quality of labels.

  Unlike learning from a large number of pre-labelled data samples, human inputs in human-in-the-loop learning have a larger impact or even overriding effects on machine decisions. Such human-AI collaboration models made it possible for malicious humans to impact the outcome of machine learning models. These issues extend to semi-supervised techniques and few-shot learning techniques, where only a small number of labelled data are used for training, and thus, maliciously labelled data can have consequences on the output.

  The aim of this project is to improve the robustness of human-in-the-loop machine learning methods against malicious user inputs through the development of machine learning systems, models, and algorithms. The following aspects will be investigated:

  - Development of robust collaborative human-machine learning models that can learn quickly yet are robust against malicious labels
  - Modelling of the impact of mislabelled data on various machine learning paradigms
  - Development of techniques to recover from malicious human inputs

- [ ] **I²R Supervisor: Ramanpreet Singh Pahwa, Scientist III**
  I would like to collaborate with groups which are interested in 2D-3D Semi Supervised Object detection, Semantic Segmentation, and Robotic vision.

- [ ] **I²R Supervisor: Ramanpreet Singh Pahwa, Scientist III**
  Computer Vision, Robotic vision, AI in Semiconductor manufacturing, 3D Vision and applications

- [ ] **I²R Supervisor: Ramon Sagarna Almandoz, Scientist II**
  I would be keen in collaborating with groups/researchers interested in hyperparameter optimization of transfer learning models, and/or in the use of meta learning for the selection of optimization methods.

- [ ] **I²R Supervisor: Senthilnath Jayavelu, Scientist III**
  AI: Deep Generative Models, Reinforcement learning, Online/ Continual Learning, and optimization

  Application: Multi-agent Systems

- ❑ **I²R Supervisor: Shen, Li, Scientist II**
  I would like to collaborate with groups which are interested in self-supervised and active learning from long-tailed data, deepfake detection, and low-level vision with deep learning.

- ❑ **I²R Supervisor: Shen, Li, Scientist II**
  I would like to collaborate with groups which are interested in Self-Supervised and Active Learning from Long-Tailed Data, Source Free Domain Adaptation and Continuous Learning.

- ❑ **I²R Supervisor: Shen, Li, Scientist II**
  I would like to collaborate with groups which are interested in Deepfake Detection, and Low-level Vision with Deep Learning.

- ❑ **I²R Supervisor: Yang Xulei, Senior Scientist I**
  My current research interests include generative adversarial networks (GAN), weakly / self-supervised learning, image restoration, low-level vision, deep learning for medical image analysis

- ❑ **I²R Supervisor: Zhang Wenyu, Scientist II**
  My current research focus is on the transferability and generalizability of neural network models in terms of domain adaptation, generalization, and robustness. I would like to collaborate with groups interested in these areas.

- ❑ **I²R Supervisor: Zou Bowei, Scientist II**
  I would like to collaborate with groups which are interested in natural language processing.

Computing and Information Sciences (CIS)
Focus Area: AI and Data Science, Communications, Computational Engineering, Computational Social Sciences, Digital Health, Digital Humanities

- ❑ **I²R Supervisor: Duan Richeng, Scientist II**
  The research in my group focuses on the spoken dialog system (SDS) which includes speech recognition, dialog management, and speech synthesis. We have successfully developed an SDS for supporting multilingual language learning and assessment and we are now expanding into other disciplines such as STEM. We are also targeting SDS in other application areas such as healthcare services. Therefore, we would like to seek cooperation with groups interested in SDS.

Computing and Information Sciences (CIS)
Focus Area: AI and Data Science, Communications, Cybersecurity

❑ **I²R Supervisor: Teo Sin Gee, Senior Scientist I**
The research in my laboratory focuses on malware and network anomaly detection using A.I. techniques. I want to collaborate with groups that are interested in similar research topics. The groups have expertise in using various A.I. techniques (deep learning/machine learning methods) applied in cybersecurity, malware analysis tools (e.g., Cuckoo Sandbox, Ghidra, IDA, MITRE ATT&CK framework, etc.), and so on.

Computing and Information Sciences (CIS)
Focus Area: AI and Data Science, Computational Engineering

❑ **I²R Supervisor: Tran Huy Dat, Deputy Department Head, Group Leader (Audio Analytics & Speech Recognition), Senior Scientist III**

Acoustic & speech AI technologies

❑ **I²R Supervisor: Xu Yichao, Scientist I**
I would like to collaborate with groups which are interested in computational imaging, computational holography, and computer vision applications.

❑ **I²R Supervisor: Yang Xulei, Senior Scientist**
3D Deep Learning, Deep Learning for Computer Vision, Deep Learning for Medical Imaging, Video Analysis

Computing and Information Sciences (CIS)
Focus Area: AI and Data Science, Computational Engineering, Digital Health

❑ **I²R Supervisor: Yang Xulei, Senior Scientist**
My recent research interests include generative adversarial networks, weakly/ self-supervised learning, deep learning for medical image analysis, transfer learning.

Computing and Information Sciences (CIS)
Focus Area: AI and Data Science, Cybersecurity

❑ **I²R Supervisor: Teo Sin Gee, Senior Scientist I**
The research in my laboratory focuses on A.I. for cybersecurity (malware research and network anomaly detection).

I want to collaborate with interested groups with good research experience (e.g., good paper publications) in the mentioned area.

❑ **I²R Supervisor: Teo Sin Gee, Senior Scientist I**
The research in my laboratory focuses on data privacy and trustworthy machine learning. I want to collaborate with interested groups with good research experience (e.g., good paper publications) in the mentioned area.

❑ **I²R Supervisor: Teo Sin Gee, Senior Scientist I**
The research in my laboratory focuses on data privacy and trustworthiness A.I. model. I want to collaborate with groups that are interested in similar research topics. The groups are expertise in the following research fields:

1) Privacy-preserving machine learning
2) Emerging privacy-preserving technologies (e.g., Homomorphic Encryption, Secure Multiparty Computation, differential privacy, etc.)
3) Explainable A.I. techniques

Computing and Information Sciences (CIS)
Focus Area: Bioinformatics

❑ **I²R Supervisor: Wu Min, Group Leader (Distributed & Adaptive Learning), Senior Scientist II**
I would like to collaborate with groups working on bioinformatics and biomedical informatics.

Computing and Information Sciences (CIS)
Focus Area: Communications

❑ **I²R Supervisor: Sun Sumei, Distinguished Institute Fellow**
I would like to collaboration with groups in areas of:

1) 6G Communications
2) Deep Learning in wireless communication systems with focus on but not limited to impairment mitigation, channel state information intelligence
3) Wireless networked control: age of information
4) Integrated sensing and communications

❑ **I²R Supervisor: Zeng Yonghong, Senior Scientist III**
The research in my laboratory focuses on wireless communication and network. I would like to collaborate with professors/scientists and their group in the broad area of communication technologies, including 5G and 6G, AI for communications, joint sensing and communications, advanced signal processing, future communication waveform, etc.

Computing and Information Sciences (CIS)
Focus Area: Communications, Cybersecurity

❑ **I²R Supervisor: Sun Sumei, Distinguished Institute Fellow**

I would like to collaborate with groups working on beyond 5G/6G, industrial internet of things, secure communications, wireless sensing and intelligence, artificial intelligence and machine learning for wireless systems and networks. We have facilities such as research testbeds, analytical and modelling/emulation platforms, to support the research activities.

Engineering and Technology (E&T)
Focus Area: Automation & Robotics

❑ **I²R Supervisor: Efe Camci, Scientist II**
- Multi-Robot Systems
- Drones
- Reinforcement Learning

❑ **I²R Supervisor: Liang Wenyu, Scientist II**

I would like to collaborate with groups that are interested in robotics, intelligent system, force/tactile control, and motion control.

❑ **I²R Supervisor: Liu Fayao, Scientist III**

The research of our team currently focuses on developing machine learning methods that can learn with less labelled data for various computer vision, NLP, and bioinformatics applications. Our next research focus is 3D deep learning, which can help improve current visual recognition systems by leveraging 3D data. I would like to collaborate with groups which are interested in 3D computer vision.

❑ **I²R Supervisor: Michael Chuah, Scientist II**

The research in my laboratory focuses on the development of agile locomotion systems based on quadruped robots. It involves the simulation and control of a legged robotic platform, and the implementation of algorithms for parameter optimization, localization, and navigation. We are interested in using a combination of reinforcement learning and imitation learning to develop robust legged locomotion algorithms.

❑ **I²R Supervisor: Ramanpreet Singh Pahwa, Scientist III**

Robotic Vision, Semantic Understanding, AI in Semiconductor manufacturing and analysis, Computer Vision & applications

❑ **I²R Supervisor: Saurab Verma, Scientist II**

The research in my laboratory focuses on robotic localization, mapping, traversability and navigation. We predominantly develop software algorithms for ground wheeled robots

(including Autonomous Vehicles) and quadrotors to perform several tasks such as payload carry, automated inspection, surveillance, multi-robot collaboration, etc.

To complement our expertise, I would like to collaborate with groups which have expertise in software development of other types of ground and aerial robots or related technologies thereby, or hardware development of enhanced ground and aerial robots for challenging environment and task-scope.

Engineering and Technology (E&T)
Focus Area: Automation & Robotics, Cognitive Engineering, Food Technology, Green Urban Technologies, Product Design & Engineering

❑ **I²R Supervisor: Nancy F. Chen, Group Leader (Language Generation), Principal Scientist I**
The research in my laboratory focuses on natural language processing and deep learning. I would like to collaborate with groups which have expertise in robotics and human computer interaction.

Engineering and Technology (E&T)
Focus Area: Automation & Robotics, Cognitive Engineering/ AI and Data Science, Computational Social Science

❑ **I²R Supervisor: Wu Yan, Deputy Department Head, Group Leader (Manipulation & Human-Robot Collaboration), Senior Scientist II**
Research in my lab focuses on robot dexterity, including multimodal perception, tactile-guided dexterous manipulation and control, human-robot interaction

Engineering and Technology (E&T)
Focus Area: Green Urban Technologies

❑ **I²R Supervisor: Edwin Khoo, Unit Leader (Sustainable Energy), Scientist II**
One of the major research directions in my team focuses on integrating physics-based modelling with machine learning to build hybrid models that are accurate, physically consistent, data-efficient, generalizable, and explainable. Some applications of interest include modelling of electrochemical systems (e.g. batteries), advanced manufacturing (e.g. battery cell manufacturing and semiconductor manufacturing), materials discovery (e.g. electrocatalysts and polymers), drug discovery, organic electrosynthesis and sustainable food production.

Engineering and Technology (E&T)
Focus Area: MedTech & HealthTech

❑ **I²R Supervisor: Yang Xulei, Senior Scientist I**
I would like to collaborate with groups which are interested in deep learning for medical image analysis, cross-modality medical image analysis, AI enhanced medical device.

Engineering and Technology (E&T)
Focus Area: MedTech & HealthTech, Microelectronics & Semiconductors

❑ **I²R Supervisor: Yang Xulei, Senior Scientist I**
Wish to collaborate with the groups which are interested in deep learning for medical image analysis, deep learning for advanced manufacturing, AI enabled medical devices, cross-modality image analysis.

Engineering and Technology (E&T)
Focus Area: Microelectronics & Semiconductors, Sustainable Materials, Process & Manufacturing

❑ **I²R Supervisor: Senthilnath Jayavelu, Scientist III**
AI: Deep Generative Models, Reinforcement learning, Online/ Continual learning, and optimization

Applications: AI-accelerated materials development and AI-accelerated fault isolation