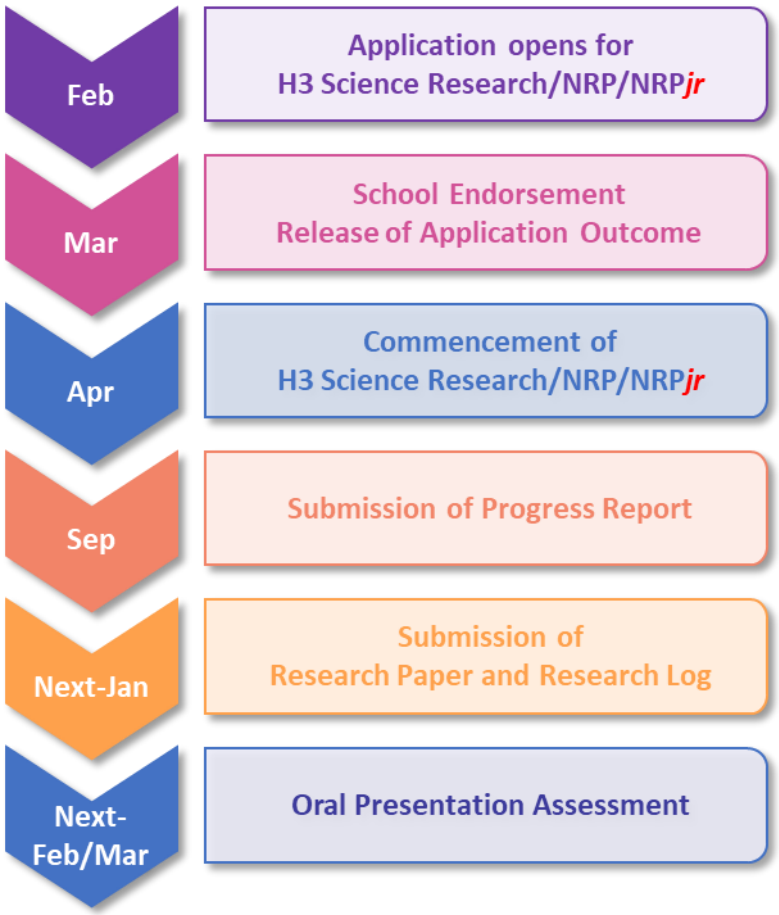
NANYANG research programme junior

NRP*jr* 2025
Project Synopses

Nanyang Research Programme Junior Researcher (NRP*jr*) is a sister programme to the Nanyang Research Programme (NRP). It is an enrichment programme targeted at Secondary 3 students and Year 3 and 4 students in Integrated Programme (IP) Schools.

NRP*jr* seeks to offer students with a keen interest in and aptitude for research the opportunity to engage in the process of intellectual inquiry by undertaking projects in a real research environment under the supervision of NTU faculty and researchers.

Students from the same school will work in pairs and undertake eight months of research activities from April to December, culminating in the submission of a Research Paper in January of the following year and an Oral Presentation Assessment in late February/early March.



Category	Project Code	Project Title
Engineering	CCDS*jr*01	Deep learning based mental health/status interpretation
	CCEB*jr*01	Natural Deep Eutectic Solvents (NADES) as Green Solvents in Pharmaceutical and Food Industries: Are They Truly Green?
	CCEB*jr*02	Lifecycle Assessment of Plants-Based Alternatives to Dairy Proteins: Are they really more environmentally friendly?
	CCEB*jr*03	Process Simulation
	EEE*jr*01	Research and development of spectrum-adaptive light
	EEE*jr*02	Application of deep learning algorithm for orthogonal frequency-division multiplexing systems
	EEE*jr*03	Deep learning based algorithm for frequency estimation from noisy signals
	EEE*jr*04	Performance study of DVB-T2 system using common simulation platform (CSP)
	EEE*jr*05	Performance study of rotated quadrature amplitude modulation (QAM) signals over fading channels
	NIE*jr*04	Exploring Local Micro-Climates With Open-Source Sensors

Category	Project Code	Project Title
Sciences	NIE*jr*02	Physiological Changes During Aerobic Exercise With Cloth Mask
	SBS*jr*01	De novo design/engineering of an (template-less) RNA polymerase

Category	Project Code	Project Title
Business, Humanities, Arts & Social Sciences	CEE*jr*01	Ship risk prediction in port state control inspection
	NIE*jr*01	Topics in Singapore English
	NIE*jr*03	Exploring Digital Tools and Methods for Investigations within the field of Humanities
	NIE*jr*05	Singapore's linguistic landscape
	SSS*jr*01	Assessing Social Attributes of Faces

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ENGINEERING | **College of Computing and Data Science**

Project Code	CCDS*jr*01
Project Title	Deep learning based mental health/status interpretation
Description	To recognize the mental health problems and provide good quality care, early recognition of mental health problems is a crucial stage before an individual suffers some serious consequences (depression or suicidal nature/tendency). At present, mental health assessment is performed by healthcare personnel or clinicians and diagnosed based on a person's answers to specific questionnaires formulated for the recognition of specific patterns of feelings or social interactions. There is a need for an automated and effective algorithm which can assess the social media interactions/messages to identify or interpret a person's mental health status. The aim is to develop an efficient algorithm which can assess the possible mental status of the person and to predict/interpret the mental health issues that the individual might reach or develop.
Group Size	Pair
Specific Knowledge	Basic knowledge about Python programming or interested in learning Python.

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ENGINEERING	School of Chemistry, Chemical Engineering and Biotechnology

Project Code	CCEB*jr*01
Project Title	Natural Deep Eutectic Solvents (NADES) as Green Solvents in Pharmaceutical and Food Industries: Are They Truly Green?
Description	NADES has been touted in recent years as the future of solvents in the synthesis and extraction of pharmaceuticals and food ingredients attributed to its environmentally friendly characteristics (e.g., non-toxic, non-flammable, non volatile). These characteristics minimise the emission of NADES to the environment and its hazards to the ecosystem and human health. In this project, we raise the research question of whether considering these characteristics alone is sufficient to call NADES as green solvents. NADES is prepared from ingredients that are not necessarily green. To this end, we will perform Lifecycle Assessment (LCA) from cradle-to-grave (i.e., beginning with resource extraction to the disposal of NADES) to truly quantify the environmental footprints of NADES. In this project, you will learn the basics of NADES synthesis, the basics of LCA, and the use of open-source LCA software. This project does NOT involve any wet lab experiments. This project is suitable for students with strong interests in chemistry and sustainability.
Group Size	Pair
Specific Knowledge	Strong foundation in chemistry and mathematics

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ENGINEERING	School of Chemistry, Chemical Engineering and Biotechnology

Project Code	CCEB*jr*02
Project Title	Lifecycle Assessment of Plants-Based Alternatives to Dairy Proteins: Are they really more environmentally friendly?
Description	In recent years, plants-based alternatives for dairy proteins (e.g., milk, meat) have been marketed to the public as a more environmentally sustainable option for the consumers to address the devastating environmental impacts of animal farms which emit a large amount of green gases. However, exact quantifications of the environmental footprints of these plants-based alternative proteins have rarely been carried out. In this project, we will conduct lifecycle assessment (LCA) of plants-based alternative protein starting from the resource extraction (e.g., soy) to the final product (e.g., plants-based cheese). We will compare the LCA results with that of dairy products (e.g., cow cheese). This project is suitable for students with strong interest in chemistry and food science. This project does not involve any wet lab experiments.
Group Size	Pair
Specific Knowledge	Strong foundation in chemistry and mathematics

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ENGINEERING	School of Chemistry, Chemical Engineering and Biotechnology

Project Code	CCEB*jr*03
Project Title	Process Simulation
Description	Chemical engineering is not just about experiments, but also about playing with simulation software. In this project, we shall look into various parts of the chemical plant. We shall employ a modelling platform - a user-friendly and exciting tool - to simulate and understand the different operations of chemical plants. The aim of this project is to give students a light appreciation of some core chemical engineering fundamentals with the aid of typically used simulation tools.
Group Size	Pair
Specific Knowledge	Students will be doing modelling

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ENGINEERING | **School of Electrical and Electronic Engineering**

Project Code	EEE*jr*01
Project Title	Research and development of spectrum-adaptive light
Description	Table lamps currently in the market could have warm or cold white light. Users will choose the one which is suitable for them. However, users typically do not know the scientific reasons for their choice. In fact, our eyes have evolved to adapt to sunlight, which changes from dawn to dusk with various light spectrums from warm to cool white light. The project will do research on the sunlight spectrum throughout the day and build the table lamp with a tunable spectrum that can change the spectrum according to the user's need or following the sunlight so that users have a feeling of outdoor light. Students will not only learn about the sunlight spectrum but also control the light with a simple microcontroller (Arduino) and coding.
Group Size	Pair
Specific Knowledge	NIL

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ENGINEERING	School of Electrical and Electronic Engineering

Project Code	EEE*jr*02
Project Title	Application of deep learning algorithm for orthogonal frequency-division multiplexing systems
Description	Recently, orthogonal frequency-division multiplexing (OFDM) techniques have been widely used for wireless communication systems, including the fifth-generation (5G) cellular system. To further improve the performance and robustness of the OFDM systems, deep learning based algorithms have been introduced. In this project, the student will study and design a deep learning based receiver for OFDM system in an end-to-end approach. We will explore the advantage of the deep learning model to recover the distorted signal. Moreover, the channel state information will not be required as compared with the traditional method. Matlab and Python simulations will be conducted to study the performance of the proposed system.
Group Size	Pair
Specific Knowledge	Preferably to have basic programming skills in Matlab and Python, though it is not compulsory, as the student should be able to pick up the skill during the execution of the project.

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ENGINEERING	School of Electrical and Electronic Engineering

Project Code	EEE*jr*03
Project Title	Deep learning based algorithm for frequency estimation from noisy signals
Description	Estimation of the frequency of a noisy modulated signal has been one of the main challenges in the field of signal processing and communications. The objective of this project is to investigate the existing techniques for frequency estimation. Following that, a deep learning algorithm will be proposed to estimate the frequency of the modulated signal that is corrupted by Gaussian noise with the advantages of having higher accuracy and faster estimation time. Comparisons between existing frequency estimation methods and the proposed deep learning-based method will be carried out. Matlab or Python programming will be used to study the performance of the proposed scheme.
Group Size	Pair
Specific Knowledge	Preferably to have basic programming skills in Matlab and Python, though it is not compulsory, as the student should be able to pick up the skill during the execution of the project.

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ENGINEERING | **School of Electrical and Electronic Engineering**

Project Code	EEE*jr*04
Project Title	Performance study of DVB-T2 system using common simulation platform (CSP)
Description	Recently, the Terrestrial Digital Video Broadcast (DVB-T2) system has widely been deployed worldwide. It has been officially adopted as well in Singapore. The DVB-T2 system can provide much better signal quality. The main focus of this project is on the decoding of the DVB-T2 signals under various channel conditions such as additive white Gaussian noise (AWGN) and fading channels. The performance of the algorithms will be studied and verified through the readily available common simulation platform (CSP). Matlab simulation will be conducted to study its performance under different scenarios of channel conditions.
Group Size	Pair
Specific Knowledge	Preferably to have basic programming skills in Matlab, though it is not compulsory, as the student should be able to pick up the skill during the execution of the project.

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ENGINEERING	School of Electrical and Electronic Engineering

Project Code	EEE*jr*05
Project Title	Performance study of rotated quadrature amplitude modulation (QAM) signals over fading channels
Description	Recently, rotated quadrature amplitude modulation (QAM) has been widely used in practical wireless systems. One of the important applications is the digital video broadcasting system in Singapore. In this project, the objective is to study rotated QAM signals and simulate their bit-error rate (BER) performance over various fading channels. The performance of the algorithms will be analyzed and verified through the commonly available simulation programs from the common simulation platform (CSP). Matlab programming will be used for BER simulation.
Group Size	Pair
Specific Knowledge	Preferably to have basic programming skills in Matlab, though it is not compulsory, as the student should be able to pick up the skill during the execution of the project.

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ENGINEERING | **National Institute of Education**

Project Code	NIE*jr*04
Project Title	Exploring Local Micro-Climates With Open-Source Sensors
Description	You will be using open-source environmental sensors (based on Arduinos) to build a dataset of the microclimate around your home, over a period of time spanning the duration of the project. You and your team-mate will use the datasets to compare the microclimate from your two respective sites and make reasoned inferences and analyses regarding the variation in the patterns of the data observed. The sensors can be configured to measure variables such as light, temperature, and humidity. They can be self-powered and can be configured to run off regular handphone battery-pack chargers. For extension activities, you and your team-mate could explore modifying and customising the sensors, and/or modifying the source code, and/or thinking about different ways of housing the sensors and weatherproofing them, possibly using fabricated parts that you design. You will come away with a more informed understanding of how and why microclimate varies over time, using empirical data gathered from your respective local (home) environments. Your study can contribute to wider datasets that the research team is already building in Singapore as well as in other countries in ASEAN.
Group Size	Pair
Specific Knowledge	NIL

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SCIENCES | **National Institute of Education**

Project Code	NIE*jr*02
Project Title	Physiological Changes During Aerobic Exercise With Cloth Mask
Description	As Coronavirus Disease 2019 evolves to become an epidemic and the future of mask-wearing activities is unknown, understanding the physiological effect and exercise performance with reusable cloth masks (RCM) is essential. It is hypothesized that RCM impedes airflow transmission between the environment and user, hence a negative impact on the ventilatory breakpoint (Vpt) and physiological variables (i.e. blood lactate, heart rate and oxygen consumption). However, the understanding is not concrete and many other studies conducted on surgical masks show conflicting results. There are three objectives to the study: 1) To investigate the physiological effects of reusable cloth mask (RCM) worn during exercise, 2) To investigate the perceived exertion level and perceptual discomfort of RCM during aerobic exercise, and 3) to determine the appropriate exercise intensity level while wearing a RCM during exercise for healthy adults. The study will look into the physiological makers, perceptual mask discomfort, and rate of perceived exertion during aerobic exercise. The study adopts a randomized crossover counterbalanced experimental design. All participants will be randomly assigned into the experimental (with RCM) or control group (without RCM) and the changeover will take place in the following week. A submaximal graded exercise treadmill protocol will be used to conduct the experiment where the ventilatory breakpoint will be identified. The protocol requires participants to run and rest for four minutes each, on an alternate basis until volitional exhaustion is achieved.
Group Size	Pair
Specific Knowledge	1) Communication skills 2) Attention to details 3) Adhere to protocols and guidelines for safe procedures in the laboratory 4) Positive learning attitude and open mind 5) Basic understanding of human anatomy, circulatory and respiratory systems, effect of exercise and training

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SCIENCES	School of Biological Sciences

Project Code	SBS*jr*01
Project Title	De novo design/engineering of an (template-less) RNA polymerase
Description	Currently, long RNA molecules are produced in the laboratory using reverse transcriptase, which requires a DNA template. While short, single-stranded RNAs can be synthesized chemically, this approach is significantly more expensive. One of the most sought-after breakthroughs in biotechnology is a purely enzymatic method for generating RNA strands of varying lengths and sequences without relying on DNA templates. Our research group is actively developing and testing novel approaches to achieve this goal. We invite interested high school students to join us — whether by contributing ideas during brainstorming sessions or by participating directly in experiments aimed at optimizing our strategies.
Group Size	Pair
Specific Knowledge	- Basic knowledge of Biology and Chemistry. - Good in Mathematics. - Optional programming experience.

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BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES | **School of Civil and Environmental Engineering**

Project Code	CEE*jr*01
Project Title	Ship risk prediction in port state control inspection
Description	Port state control (PSC) is the ship inspection conducted by port states on foreign visiting ships. It is regarded as an effective way to enhance maritime safety and reduce pollution from vessels to the marine environment. Due to the large number of foreign visiting ships, the scarce inspection resources, and the tight ship schedule, not every ship can be, and should be inspected. Therefore, a critical step to improve the efficiency of PSC inspection is to identify ships with higher risk effectively, and then inspect these identified high-risk ships. In this project, students are expected to scan related literature and databases to identify ship risk indicators and filter useful features for ship risk prediction; analyze why and how such features influence ship risk level; develop quantitative models (such as statistical models and/or machine learning models) to predict ship risk level; describe and explain the prediction results; propose ship inspection planning suggestions to the port and management suggestions to ship operators/owners.
Group Size	Pair
Specific Knowledge	- A basic understanding of data analytics - A basic understanding of Python programming - A basic understanding of the maritime industry would be a plus

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BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES | **National Institute of Education**

Project Code	NIE*jr*01
Project Title	Topics in Singapore English
Description	For this project, we will work on natural language data from Colloquial Singapore English (otherwise known as Singlish). Data will either be collected through elicitation/production tasks, designed experiments, or from existing corpora/data sets. Singapore English is a contact variety of English with several unique features. The specific aspect of Singapore English, as well as how the data is analysed will depend on the linguistic subfield of your choice: syntax (structure), semantics/pragmatics (meaning), or phonology/phonetics (sound). I am fine with adopting whatever linguistic framework you prefer to use.
Group Size	Pair
Specific Knowledge	- Native speaker of Singapore English, or have easy access to one. - Good intuition, interest and curiosity in the way language is produced and processed.

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BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES **National Institute of Education**

Project Code	NIE*jr*03
Project Title	Exploring Digital Tools and Methods for Investigations within the field of Humanities
Description	In this project, you will learn how to use digital tools and methodologies to investigate a Humanities-related topic of your choice. The field of Digital Humanities is broad, so potential projects might involve (though not limited to) using text mining tools to analyse historical texts, using Geographical Information Systems (GIS) to analyse maps, or using network analysis to analyse relationships between characters in a work of literature. You will be guided through the design of a project, which will be crafted to align with your own interests as feasibly possible. As such, you will come away with a deeper understanding of how digital tools can be used to analyse and interpret data within your chosen Humanities topic.
Group Size	Pair
Specific Knowledge	NIL

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BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES | **National Institute of Education**

Project Code	NIE*jr*05
Project Title	Singapore's linguistic landscape
Description	The pervasive use of language around us -- on street signs, posters, buildings, shops, government notices, building and shop names --- shows not only the presence of people in that area, but it also reflects the inhabitants' history, culture and identity. A linguistic landscape is understood as a “marker of the geographical territory occupied by a distinctive language community within multilingual states” (Landry & Bourhis, 1997, p. 24). The visibility of certain languages reflects the status and value of those languages in relation to others. Languages in the linguistic landscape not only provide an understanding of the community's ethnic identity, but they also offer some insights into the power dynamics and social hierarchies that exist in multilingual societies.
Group Size	Pair
Specific Knowledge	An interest in language use. A keen eye for details. If the student is looking at minority languages, some proficiency is useful, but not necessary.

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BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES | **School of Social Sciences**

Project Code	SSS*jr*01
Project Title	Assessing Social Attributes of Faces
Description	We tend to make inferences about a person's traits or attributes based on the appearance of the face. For example, we judge trustworthiness, attractiveness, dominance or threats, based on the face images, though the accuracy of such judgment is under debate. It has been shown that our judgment of trustworthiness can be built within the first 100 ms after seeing the face. There have been extensive studies evaluating such social dimensions of faces. However, there are still open questions remaining to be answered. For example, what are the most important factors in assessing facial attributes? Are there associations among these different attributes? How does the previous exposure to faces of similar or different attributes affect our judgment of subsequently presented faces? Such as, does a happy face appear more trustworthy than a neutral or sad face? We will use online surveys and/or psychophysical experiments to address these questions.
Group Size	Pair
Specific Knowledge	Good at math and writing in English.

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