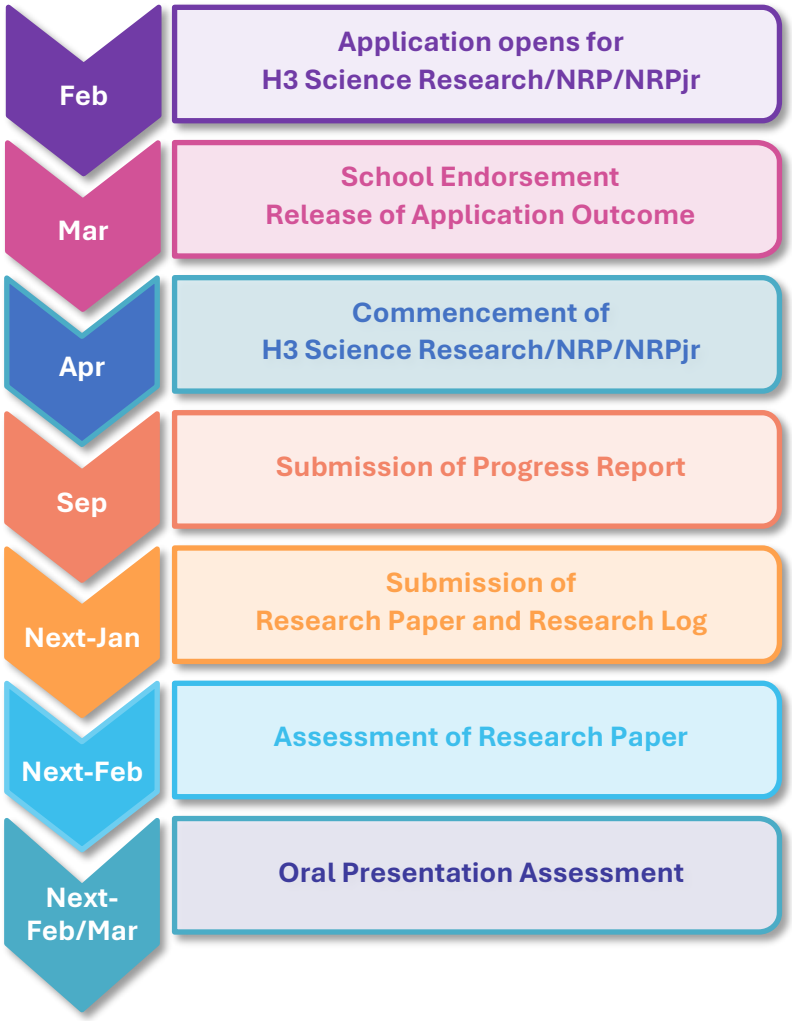
NANYANG research programme Junior

NRPjr 2026
Project Synopses

Nanyang Research Programme Junior Researcher (NRPjr) 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.

NRPjr 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 & TECHNOLOGY	CCDSjr01	Deep learning based mental health/status interpretation
	CCEBjr01	Evaluating Single-Use Technologies in Upstream Processes of Biopharmaceutical Manufacturing
	CCEBjr02	Evaluating Single-Use Technologies for Downstream Processes of Biopharmaceutical Manufacturing
	CEEjr01	Wind propulsion sail for shipping decarbonisation
	EEEjr01	Research and development of spectrum-adaptive light
	EEEjr02	Application of deep learning algorithm for orthogonal frequency-division multiplexing systems
	EEEjr03	Deep learning based algorithm for frequency estimation from noisy signals
	EEEjr04	Performance study of DVB-T2 system using common simulation platform (CSP)
	EEEjr05	Performance study of rotated quadrature amplitude modulation (QAM) signals over fading channels
	NIEjr04	Exploring Local Micro-Climates With Open-Source Sensors

Category	Project Code	Project Title
SCIENCES	NIEjr02	Effect of energy gel on physiological measures during high-intensity anaerobic sprint test
	NIEjr05	Formulating insect-based food suitable for 3D Food Printing
	SBSjr01	De novo design/engineering of an (template-less) RNA polymerase

Category	Project Code	Project Title
BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES	CRADLEjr01	Organisational Success Through Workplace Learning: Unveiling Its Value and Dynamics in SMEs
	NIEjr01	Topics in Singapore English
	NIEjr03	Exploring Digital Tools and Methods for Investigations within the field of Humanities
	SoHjr01	Code-mixing as a Communication Strategy: Students' Perspectives and Practices.
	SSSjr01	Assessing Social Attributes of Faces

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

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

Project Code	CCDSjr01
Project Title	Deep learning based mental health/status interpretation
Description	To recognise 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, such as 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 predict/interpret the mental health issues that an individual might reach or develop.
Group Size	Pair
Specific Knowledge	Basic knowledge of Python programming or interested in learning Python.

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ENGINEERING & TECHNOLOGY

School of Chemistry, Chemical Engineering and Biotechnology

Project Code	CCEBjr01
Project Title	Evaluating Single-Use Technologies in Upstream Processes of Biopharmaceutical Manufacturing
Description	Biopharmaceuticals or biologics represent a niche class of pharmaceuticals that can treat complex diseases that are not effectively treated by traditional small-molecule pharmaceuticals. Biologics are large molecular weight biomolecules produced by living cells (e.g., insulin, human growth hormone, enzymes), in contrast to small molecule pharmaceuticals produced by chemical synthesis (e.g., aspirin). Due to their biological origin, manufacturing of biologics is highly complex, requiring a large number of equipment that need to be in perfectly sterile conditions for each production run. This results in a very costly operation and a long production time. To expedite the manufacturing process, the researchers have explored the use of disposable plastic-made equipment in place of the traditional stainless steel equipment. This type of equipment is referred to in industry jargon as single-use technologies (SUT). The use of SUT has been explored in all aspects of biologics manufacturing from synthesis (e.g., plastic fermenter, plastic bioreactor) to purification (e.g., plastic filter, plastic chromatography flow path). Different types of polymer materials can be used to manufacture SUT. The suitability of each material depends on the intended application of SUT. For example, plastics suitable for a fermenter may not be suitable for centrifugation. In this project, you will evaluate the suitability of different types of plastics as SUT ingredient, its production process, and also its environmental impacts from its production stage to its disposal. The project focused on plastics suitable for upstream processes in biologics manufacturing (i.e., bioreactor, centrifugation). You will learn lifecycle assessment (LCA) software to evaluate the environmental impacts.
Group Size	Pair
Specific Knowledge	Keen interest in chemistry and chemical engineering.

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ENGINEERING & TECHNOLOGY

School of Chemistry, Chemical Engineering and Biotechnology

Project Code	CCEBjr02
Project Title	Evaluating Single-Use Technologies for Downstream Processes of Biopharmaceutical Manufacturing
Description	Biopharmaceuticals or biologics represent a niche class of pharmaceuticals that can treat complex diseases that are not effectively treated by traditional small-molecule pharmaceuticals. Biologics are large molecular weight biomolecules produced by living cells (e.g., insulin, human growth hormone, enzymes), in contrast to small molecule pharmaceuticals produced by chemical synthesis (e.g., aspirin). Due to their biological origin, manufacturing of biologics is highly complex, requiring a large number of equipment that need to be in perfectly sterile conditions for each production run. This results in a very costly operation and a long production time. To expedite the manufacturing process, the researchers have explored the use of disposable plastic-made equipment in place of the traditional stainless steel equipment. This type of equipment is referred to in industry jargon as single-use technologies (SUT). The use of SUT has been explored in all aspects of biologics manufacturing from synthesis (e.g., plastic fermenter, plastic bioreactor) to purification (e.g., plastic filter, plastic chromatography flow path). Different types of polymer materials can be used to manufacture SUT. The suitability of each material depends on the intended application of SUT. For example, plastics suitable for a fermenter may not be suitable for centrifugation. In this project, you will evaluate the suitability of different types of plastics as SUT ingredient, its production process, and also its environmental impacts from its production stage to its disposal. The project focused on plastics suitable for downstream processes in biologics manufacturing (i.e., purification, filtration, chromatography). You will learn lifecycle assessment (LCA) software to evaluate the environmental impacts of different types of SUT.
Group Size	Pair
Specific Knowledge	Keen interest in chemistry and chemical engineering.

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ENGINEERING & TECHNOLOGY | **School of Civil and Environmental Engineering**

Project Code	CEEjr01
Project Title	Wind propulsion sail for shipping decarbonisation
Description	The shipping industry is under immense pressure to decarbonise, and Wind-Assisted Propulsion Systems (WAPS), such as Flettner Rotors, are emerging as a key solution. However, their efficiency varies significantly depending on complex variables like vessel type, shipping routes, seasonal weather patterns, and economic factors. In this project, students will utilise the Flettner Rotor Savings Estimator (Lloyd's Register) to conduct a comprehensive study on the feasibility of wind propulsion. Students will begin by familiarising themselves with the tool to understand how Flettner Rotors function and their potential for energy savings. They will then design and simulate various shipping scenarios, such as Singapore-Rotterdam or Trans-Pacific routes, to construct a comprehensive dataset. Using this collected data, students will perform correlation analyses to identify key variables and visualise how efficiency fluctuates across different months and seasons. A significant portion of the research will focus on determining which major trade routes originating from Singapore are most suitable for Flettner Rotor deployment. As the simulation tool provides data on fuel savings in tonnage, students will expand their study into a techno-economic evaluation by researching current fuel prices and installation costs to calculate the payback period for shipowners.
Group Size	Pair
Specific Knowledge	• Strong interest in Maritime Studies, Sustainability, and Decarbonisation. • Good at using Microsoft Excel (for data collection, visualisation, and economic analysis) is required. • Basic programming skills using Python are advantageous.

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

Project Code	EEEjr01
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 a table lamp with a tunable spectrum that can change the spectrum according to the user's need or follow 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 & TECHNOLOGY | **School of Electrical and Electronic Engineering**

Project Code	EEEjr02
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 an 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 students should be able to pick up the skill during the execution of the project.

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

Project Code	EEEjr03
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 students should be able to pick up the skill during the execution of the project.

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

Project Code	EEEjr04
Project Title	Performance study of DVB-T2 system using common simulation platform (CSP)
Description	Recently, the Terrestrial Digital Video Broadcast (DVB-T2) system has been widely deployed worldwide. It has been officially adopted in Singapore as well. 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 students should be able to pick up the skill during the execution of the project.

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

Project Code	EEEjr05
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 analysed 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 students should be able to pick up the skill during the execution of the project.

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ENGINEERING & TECHNOLOGY **National Institute of Education**

Project Code	NIEjr04
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 teammate 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 teammate 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 yourselves 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 ASEAN countries.
Group Size	Pair
Specific Knowledge	NIL

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SCIENCES **National Institute of Education**

Project Code	NIEjr02
Project Title	Effect of energy gel on physiological measures during high-intensity anaerobic sprint test
Description	Carbohydrate supplements are known to improve endurance performance, but their benefits in short, high-intensity anaerobic activity remain unclear. This study aims to investigate the effects of energy gel on physiological measures during high-intensity anaerobic sprint tests.
Group Size	Pair
Specific Knowledge	• Communication skills • Attention to details • Adhere to protocols and guidelines for safe procedures in the laboratory • Positive learning attitude and an open mind • Basic understanding of human anatomy, circulatory and respiratory systems, and the effect of exercise and training • Microsoft Word and Excel (not the online version)

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SCIENCES | **National Institute of Education**

Project Code	NIEjr05
Project Title	Formulating insect-based food suitable for 3D Food Printing
Description	This project focuses on developing innovative, nutritious, and sustainable food formulations using insect-derived ingredients that are compatible with 3D food printing technology. As global demand for environmentally friendly protein sources continues to rise, insects offer a highly sustainable alternative due to their low ecological footprint, high protein content, and efficient cultivation.
Group Size	Pair
Specific Knowledge	• 3D printing • Food science

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SCIENCES | **School of Biological Sciences**

Project Code	SBSjr01
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 synthesised 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 optimising our strategies.
Group Size	Pair
Specific Knowledge	• Basic knowledge of Biology and Chemistry. • Additional Mathematics or equivalent. • Optional programming experience.

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BUSINESS, HUMANITIES, ARTS & SOCIAL SCIENCES **CRADLE@NTU**

Project Code	CRADLEjr01
Project Title	Organisational Success Through Workplace Learning: Unveiling Its Value and Dynamics in SMEs
Description	Rapid technological advancements, evolving market dynamics, and geopolitical shifts are converging to create a turbulent work environment, placing immense pressure on individuals and organisations, particularly SMEs, to adapt and upskill. While workplace learning (WPL) offers a promising path forward, effective implementation is often hindered by challenges in securing buy-in from key stakeholders, and the absence of robust WPL strategies can stifle growth and even jeopardise survival. This critical need fuels our research. This study will delve into how WPL can empower individuals and organisations to not just survive but thrive amidst this constant change. The findings will provide significant, evidence-based insights for both policy and practice, informing decision-making and driving the development of effective WPL strategies that unlock the full potential of SMEs.
Group Size	Pair
Specific Knowledge	NIL

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

Project Code	NIEjr01
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	NIEjr03
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 **School of Humanities**

Project Code	SoHjr01
Project Title	Code-mixing as a Communication Strategy: Students' Perspectives and Practices.
Description	This study investigates the trend of code-mixing among students in everyday communication. In multilingual environments, students often switch between languages within a single conversation, sentence, or phrase. While code-mixing is commonly observed, the reasons behind its use and the patterns through which it occurs remain varied and context dependent. This project aims to explore how frequently students code-mix, why they code-mix, and how they integrate multiple languages during interaction.
Group Size	Pair
Specific Knowledge	NIL

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

Project Code	SSSjr01
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 judgments 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? 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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