



**Australian Government**  
**Defence**

**DSTG Summer Vacation Placement Program**

**2024 - 2025**

**Proposed Projects**

List of Abbreviations

<b>Division</b>	<b>Abbreviation</b>
Human and Decision Sciences	HADS
Information Sciences Division	ISD
Platforms Division	PLAT
Research Technology Operations	RTO

<b>Research Stream</b>	<b>Abbreviation</b>
Aerospace / Aeronautical Engineering, Naval Architecture Stream	AAENA
Chemical, Radiological, Biological, Food Sciences Stream	CRBFS
Computer Sciences, IT, Software Engineering, Telecommunications Stream	CSITSET
Electronic / Electrical Engineering Stream	EEE
Materials Science Stream	MS
Mathematics and Physics Stream	MP
Mechanical and Mechatronic Engineering (including Robotics) Stream	MMER
Psychology and Social Sciences Stream	PSS

Project ID	Location	Project Title	Project description	Desirable Skills	AAENA	CRBFS	CSITSET	EEE	MS	MP	MMER	PSS
SVP HADS 01	Edinburgh, South Australia	Coach, we just got hustled	<p>Slamming your hat on the ground, you curse and rant under your breath. Losing the grand final, despite comfortably winning at half time. So frustrating. As you calm down, questions begin appearing in your mind. How did this happen? Is one of our players to blame, or were we just not on the same page? Did we have the wrong strategies and tactics? Did their star players step up? ... ooohrr...a tingle of insight rushes through your body... maybe... we got hustled! They tricked us! During the round games, their tactics seemed to be inferior to ours. But what just happened was a masterclass. They changed their goals to perfectly counteract ours. So sneaky.</p> <p>Lucky students who pick this project will research and develop hustling (or perhaps anti-hustling) concept demonstrators. You might consider how multi-agent team coordination depends on commander goals, focusing on power imbalance dynamics when the other team might deceptively counteract your goals. Ultimately, we want students to learn and make an impact (and have fun!), so we are happy to take students from many different disciplines such as Artificial Intelligence, Machine Learning, Psychology, Biology, Mathematics and Physics. Experience with software development is preferred, but if not, all good, we can help you.</p>	<ul style="list-style-type: none"> <li>• Experience with software development is desirable, but not essential</li> <li>• Interest in Applied AI and Machine Learning</li> <li>• Ability to work independently and in small teams.</li> </ul>			X	X		X	X	X
SVP HADS 02	Edinburgh, South Australia	Augmented Reality Visualisation Development	<p>The exploration and study of new technologies and concepts for visualisation of complex tactical battlefield information is a focus area within the Human and Autonomous Decision Sciences Division, DSTG.</p> <p>With particular application to Joint, Maritime and Air defence domains, the Engagement Decision Modelling &amp; Simulation (EDMS) group has an ongoing program investigating the use of Augmented/Virtual Reality concepts for providing commanders and operators on-demand information and data visualisation systems that provide a seamless extension to traditional information systems used aboard platforms.</p> <p>This project will focus on adapting an augmented reality framework using the Microsoft HoloLens 2 system. In order to quickly deploy and assess functional layouts and computer interactivity for Defence personnel, an AR system can be adapted to project functional displays where implementing the same display physically -- before testing its efficacy -- would be time-consuming and costly.</p> <p>This project aims to allow operators to explore and interact with additional displays around their current physical workstations, with the intent of determining the potential for increased performance before physical equivalents are implemented.</p> <p>Future work may look to adapt the software to other Virtual Reality or Mixed Reality headsets.</p>	<ul style="list-style-type: none"> <li>• Software Development Skills (ideally in C#)</li> <li>• Knowledge of Unity or similar 3D-gaming frameworks</li> <li>• Familiarity with version control systems (ideally git)</li> <li>• Ability to work in teams</li> <li>• Good verbal and writing skills.</li> </ul>			X				X	
SVP HADS 03	Edinburgh, South Australia	Adapting to Change: Evolutionary Approaches for Dynamic Goal Seeking	<p>In this ever-changing world, both goals and environment are in constant evolution. Your actions need to evolve if you want to achieve your goals. By implementing an evolutionary system, we can create a robust evolving actions that can effectively handle evolving objectives and changing environment.</p> <p>Imagine we are using UAVs to combat forest fires in a dynamic and unpredictable environment. The primary goal is to minimise the spread of the fire while ensuring the safety of the UAVs and maximise their effectiveness in supporting putting out the fire. The adaptive evolutionary algorithm will optimise the UAVs flight paths, water dropping locations and coordinate strategies. As the fire dynamics evolves, with the fire spreading, intensifying or decreasing, the algorithm will continuously update each UAV's strategy to achieve the changing goals scenario and environmental conditions.</p> <p>Students will learn more about evolutionary goal seeking approaches and will research and develop evolutionary algorithm techniques for goal-based actions. Ultimately, we want students to learn and make an impact (and have fun!), so we are happy to take students from different disciplines such as Artificial Intelligence, Machine Learning, Software Engineering, Computer Science, Biology, Mathematics and Physics. Experience with software development is preferred, but if not, all good, we can help you.</p>	<ul style="list-style-type: none"> <li>• Experience with software development is desirable, but not essential</li> <li>• Interest in Applied AI and Machine Learning</li> <li>• Ability to work independently and in small teams.</li> </ul>			X	X		X	X	X

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SVP HADS 04	Edinburgh, South Australia	Torn, I feel pulled in multiple directions	<p>On the one hand, he had to rescue search for survivors – some of them teammates – and on the other, he needed to cover and protect innocent bystanders from imminent harm. Not to mention avoiding being captured. Recalling his ethical class from university, his Professors voice echoed in his mind – “preserving life is of upmost importance”. But which life? The knowingly frail life or the potential for loss in the future? The harsh reality is that humans simply do our best in such complex situations. When operating in teams that are competing for the same resources and goals, we usually defer to a central decision maker. But what of autonomous agents who try and predict the outcomes of decisions? Such is life in the games we play. Team sports, organisational coordination, emergency services and military teams know this all too well. They must reconcile multiple conflicting goals and priorities, some from official command, others from rules of “the game”. All this, whilst maintaining composure and smooth team coordination.</p> <p>You will research and develop techniques for multi-agent systems that must make decisions and actions in the face of multiple conflicting goals. These could be priorities to maintain, as well as states to avoid. Goals may change, and may have interdependencies. We had originally considered this project as using Reinforcement Learning, but now we feel conflicted. Maybe you’d like to discover your own ideas? Ultimately, we want students to learn and make an impact (and have fun!), so we are happy to take students from many different disciplines such as Artificial Intelligence, Machine Learning, Psychology, Biology, Mathematics and Physics. Experience with software development is preferred, but if not, all good, we can help you.</p>	<ul style="list-style-type: none"> <li>• Experience with software development is desirable, but not essential</li> <li>• Interest in Applied AI and Machine Learning</li> <li>• Ability to work independently and in small teams.</li> </ul>			X	X		X	X	X
SVP HADS 05	Edinburgh, South Australia	I’m sorry Coach, disobedience killed us	<p>We have all been in teams with that disobedient player. I remember one team player who lost us the grand final because they unexpectedly changed roles – failing to appreciate our game plan. Another time, it was less about disobedience and more about lack of self-awareness – they always said one thing but did another! Suffice to say, when there is confusion and miscommunication about team goals, the team suffers. It’s true in team sports and even more so in organisations, especially when we try and scale. Let alone the complexity of the goals and changing tactical landscape – uncertainty is a killer!</p> <p>You will research and develop techniques for goal-misalignment and monitoring. This could be anything from misbehaviour, miscommunication, ignorance or otherwise! You might consider how multi-agent coordination is stifled by individual decisions and actions towards (or counteracting!) team goals. Ultimately, we want students to learn and make an impact (and have fun!), so we are happy to take students from many different disciplines such as Artificial Intelligence, Machine Learning, Psychology, Biology, Mathematics and Physics. Experience with software development is preferred, but if not, all good, we can help you.</p>	<ul style="list-style-type: none"> <li>• Experience with software development is desirable, but not essential</li> <li>• Interest in Applied AI and Machine Learning</li> <li>• Ability to work independently and in small teams.</li> </ul>			X	X		X	X	X
SVP HADS 06	Edinburgh, South Australia	Organisational Assessment and Psychometric Development	<p>This project entails the development and refinement of survey measures to support Joint Operations Command's annual work survey, which collects data across a broad range of sociotechnical variables.</p> <p>This project will principally entail the development of measures (i.e. Likert scales) and collecting a small pilot sample to validate the measures. This project may involve the collection of qualitative data to inform the development of scales.</p>	<ul style="list-style-type: none"> <li>• Factor Analysis</li> <li>• Psychology theory, preferably organisational psychology</li> <li>• Good communications skills</li> </ul>								X
SVP HADS 07	Adelaide, SA	Analysis of Weapon Concepts	<p>Novel and Emerging Weapon Systems (NEWS) is a team focused on exploring how new technologies could be applied for the Australian Defence Force (ADF). This assessment is generally called "Military Utility", a measure of how well the weapon system fits for what the ADF want to do. Our science requires engaging with subject matter experts to collect qualitative data, as well as numerical simulation to assess weapon performance. Generally, it is easier to rule concepts out than rule concepts in, and the team is interested in finding assumptions and limitations for proposed concepts and assessing whether that's a 'deal breaker' for overall utility.</p> <p>This project would explore analysis techniques for qualitative and quantitative data sets. The successful applicant would investigate trends to identify cases where numerical simulation might disagree with</p>	<ul style="list-style-type: none"> <li>• Good communication skills</li> <li>• Ability to contribute as part of a team</li> <li>• Interest in Defence technologies</li> <li>• Basic competency in one or more programming languages</li> <li>• Familiarity with data analysis tools (Jupyter Notebook, Microsoft Excel, etc.)</li> </ul>	X		X		X	X	X	

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			expert judgement, or where a concept's performance might be limited by key factors. We expect that the applicant would have the opportunity to be involved in investigations to explore these discrepancies with simulation or subject matter interviews. We expect there would be opportunity to focus the work based on the applicants' interest and aptitude across simulation, data collection, mathematical modelling and analysis.										
SVP HADS 08	Edinburgh, South Australia	International Engagement and Influence – comparative case study analysis of international policy and practice	The Influence and Conflict Analysis Group at DSTG examines how nations can and might seek to engage with and influence other actors cooperatively, in competition and in conflict. This project will undertake a review of existing, open-source materials that outline the doctrine, policies, approaches to, and evaluations of, information campaigns, strategic communications, military diplomacy and similar related activities. The outcomes will include a report and presentation outlining a critical analysis of current and recent practices, informed by relevant theoretical and scholarly approaches and applied to the situations outlined in the Defence Strategic Review (2023) and the Defence Strategic Update (2020).	<ul style="list-style-type: none"> <li>• Demonstrated ability to undertake open-source document and archival research</li> <li>• General knowledge of strategic communications and international relations</li> <li>• Ability to work in teams</li> <li>• Excellent verbal and writing skills</li> </ul>								X	
SVP HADS 09	Fairbairn, ACT	Strategic Wargame	This project will assist the evaluation of conceptual models for international relations and develop a strategic wargame prototype.	<ul style="list-style-type: none"> <li>• Background in social or political science (or similar)</li> <li>• Understanding of qualitative analysis and problem structuring methods</li> <li>• Good communications skills</li> </ul>									X
SVP ISD 01	Edinburgh, South Australia	Real-time signal processing for Software Defined Radio	<p>Robust wireless communications underpins many Defence capabilities. DSTG undertakes research into novel communication systems that must operate in the most challenging environments. Software Defined Radio (SDR) is a recent technology that enables highly flexible waveforms to be rapidly developed and deployed to meet Defence's operational requirements.</p> <p>A key component in many commercial SDR offerings is the Analog Devices AD9361 high performance and flexible RF transceiver integrated circuit. The receiver chain within the transceiver contains multiple parameters which can be tweaked to control the overall gain of the receiver. Automatic gain control is a feedback state machine based algorithm which modifies these parameters in real time. This project will focus on optimizing the automatic gain control within the AD9361 to improve the performance of bespoke communications waveforms within volatile environments where gain control is essential for optimal performance.</p>	<ul style="list-style-type: none"> <li>• An interest in wireless communication systems</li> <li>• Experience with Matlab/Simulink</li> <li>• Experience with SDR, embedded system design (Linux based) and firmware development is highly desirable.</li> </ul>			X	X			X		
SVP ISD 02	Edinburgh, South Australia	Graph-based Machine Learning for Network Situational Awareness	<p>Situational awareness within a computer network is fundamental for network administrators and security analysts alike. The knowledge of what devices are on a network—and the purpose of their use—facilitates improved quality of service and allows for the identification of devices that may pose a security risk. The complexity of providing this situational awareness, however, has been greatly exacerbated by the scale and heterogeneity of modern computer networks.</p> <p>The aim of your project is to investigate the use of graph-based machine learning to provide a common representation of the devices on a computer network. This representation shall encode the behavioural similarity of the devices thus enabling security analysts to quickly gain insight into the devices that exist on their networks. Your work shall contribute to a wider research effort to develop tools and techniques to help address Australia's growing cyber needs.</p>	<ul style="list-style-type: none"> <li>• Computer Science (e.g., Python programming)</li> <li>• Data Science (machine learning)</li> <li>• Optional: Mathematics (e.g., graph theory).</li> </ul>			X	X		X			
SVP ISD 03	Edinburgh, South Australia or Lot 14 Adelaide, South Australia or University of	Vulnerability testing of Large Language Models	Counter AI, also known as adversarial machine learning (AML), disrupts the effective use of machine learning, including those used for translation and audio transcripts. This project will allow the student to gain knowledge of AML and cyber security by experimenting with large language models like GPT, looking for vulnerabilities when translating from one language to another. Attack scenarios, their plausibility and	<ul style="list-style-type: none"> <li>• Coding experience in Python</li> <li>• Familiarity with machine learning</li> <li>• Interest in cyber security</li> <li>• Fluency in an Asian language</li> </ul>			X						

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	Queensland, Brisbane		defensive measures will be investigated. We are particularly interested in how this applies to translation between fundamentally different languages, e.g. those from Asia and Europe.	<ul style="list-style-type: none"> <li>Ability to work independently and in a small team.</li> </ul>								
SVP ISD 04	Brisbane	Utilising Abstract Interpretation for Summary Synthesis	Building on existing work in the area of static program analysis, this project will investigate how to instrument an abstract interpretation framework to support the generation of function summaries. The project will be part of an overarching effort to build an analysis framework for information flow security that operates on binary code. Function summaries, where they are available, help to conduct the analysis in a modular fashion and thus increase the scalability of the overall approach. Results on function summary synthesis are available in the literature and will be consulted. In our context they will have to be adapted to the particular problem space of binary analysis.	<ul style="list-style-type: none"> <li>Discrete math</li> <li>Static program analysis and/or compiler techniques</li> <li>Programming in Scala/Java</li> <li>Ability to work independently and in small teams</li> <li>Good communications skills.</li> </ul>			X			X		
SVP ISD 05	Edinburgh, South Australia	Equivariant Convolutional Neural Networks	<p>The abundance of overhead imagery from satellites enables a plethora of real-world civil and military applications. The key component in those applications is the ability to detect and classify objects present in the image. One aspect of this component is the concept of rotation equivariance. That is, when the overhead camera is rotated in space the captured object would appear to be rotated in the image, yet detection and classification performance should not be affected.</p> <p>The aim of this project is to design a convolutional neural networks (CNN) model for object detection and classification that could handle this rotational aspect. To this aim, the student will learn how to use the xView-1 data to train a CNN model incorporating the Pytorch-based library for equivariant deep learning known as "escnn", and then apply the trained model on test data. The effectiveness of the model performance is then evaluated in the context of applications for natural disaster relief missions.</p>	<ul style="list-style-type: none"> <li>Software Development Skills in Python</li> <li>General IT systems knowledge</li> <li>Ability to work in teams</li> <li>Good verbal and writing skills.</li> </ul>			X			X		
SVP PLAT 01	Fishermans Bend, Victoria	Performance of additively manufactured nickel aluminium bronze (NAB)	<p>Nickel aluminium bronze (NAB) is an important copper alloy used in marine applications such as valves, pumps and propellers. It is selected due to its superior combination of properties including high resistance to seawater corrosion, wear, cavitation, biofouling and environmentally assisted cracking.</p> <p>Traditionally NAB is produced in cast or wrought form, however recently it has been fabricated via additive manufacturing (AM). Producing components via AM not only allows for fast turnaround and complex part design, but improves the manufacturing supply chain in times of crisis, providing sovereign capability. Due to the rapid localised material cooling associated with AM however, for NAB results in radically different microstructures compared to its cast and wrought alloy equivalent. Often a post build heat treatment is required.</p> <p>This project involves an investigation into the AM NAB microstructures formed (as built and heat treated), while also conducting targeted mechanical and corrosion materials tests to determine how these different microstructures affect material performance. You will learn how to use some advanced materials characterisation techniques, while working in a small multidisciplinary team – including materials, welding engineers, and computational physicist.</p> <p>By understanding the performance of AM NAB compared to cast and wrought NAB, paves the way toward using AM as a viable fabrication method for NAB in real marine applications.</p>	<ul style="list-style-type: none"> <li>Laboratory work</li> <li>Ability to work independently and in a small team</li> <li>Ability to carry out careful materials testing experiments to standard procedures.</li> </ul>					X			
SVP PLAT 02	Edinburgh, South Australia	Journey costing estimation and prediction for unmanned autonomous vehicles	The tasking of movements for unmanned vehicles such as UAVs and UGVs requires considerable planning often with little time for analysis. In our example, we operate a fleet of unmanned vehicles but wish to investigate good estimation techniques for the cost in time and energy required to take such journeys. We expect different types of unmanned vehicles in different environment conditions with different path options will behave differently in terms of the costing of journeys. The ability to provide reasonable estimates of journey costings given terrain, weather and path information may help in determining feasible strategic planning for system with multi vehicle problems. In this specific case, we apply it to a sensor placement problem whereby the unmanned vehicles are positioned/moved to assist in protecting an asset or area and act to detect any incursions. The problem should involve investigating a variety of	<ul style="list-style-type: none"> <li>Python</li> <li>Mathematics</li> <li>Computer Science</li> <li>Algorithm &amp; AI/ML skills.</li> </ul>	X		X	X		X	X	



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			options in algorithms involving optimisation and constraint based formulations, potentially involving artificial intelligence and machine learning techniques.									
SVP PLAT 03	Eveleigh, New South Wales	Modelling the magnetic field of a power cable in seawater	<p>Power cables are used by power companies, such as offshore wind farm operators, to transmit electrical power underwater. Detecting and tracking power cables ensures the integrity of the cables and helps to prevent catastrophic damage to valuable infrastructure. Detecting a cable in seawater is more complicated than on land as electromagnetic wave velocity and attenuation is frequency dependent in seawater.</p> <p>In this research project you will model a power cable as an infinitely long current in seawater. You will numerically calculate, using Python, the magnetic field of the cable at different distances, frequencies and currents. Magnetic sensors will be modelled and maximum detection distance will be ascertained. Time permitting, various tracking algorithms, such as inversion modelling and Kalman filters, may also be investigated.</p>	<ul style="list-style-type: none"> <li>An ability to program in at least one language, preferably Python</li> <li>Numerical modelling and data analysis using Python</li> <li>Some understanding or interest in electromagnetic theory</li> <li>An ability to understand mathematics such as Bessel functions</li> <li>Studying a degree in physics, electrical engineering, or similar.</li> </ul>			X	X		X	X	
SVP PLAT 04	Eveleigh, New South Wales	Channel characterization and modelling for undersea acoustic communications	<p>Long-range undersea communication remains a critical capability that is essential for maritime operations. Acoustic waves are considered the most suitable form for achieving this due to their ability to propagate over long distance with significantly less attenuations compared to electromagnetic waves. However, the undersea environment, serving as the propagation medium, is highly complex and varied. A thorough understanding and accurate modelling of the characteristics of underwater acoustic propagation channels are essential for designing acoustic waveforms as well as communication systems.</p> <p>This project involves developing an acoustic data processing tool to analyse channel probing data, which enables the characterization of the probed underwater channel and the extraction of the corresponding time-varying impulse response. The project may also involve acquiring insight into the statistical properties of underwater acoustic channels and testing acoustic waveforms based on the generated channel impulse response.</p> <p>The work may encompass literature reviews on the fundamentals of wireless communications and channel modelling; development and implementation of the acoustic data processing tool using MATLAB, followed by translation into C++ or Python; investigation of stochastic channel models of underwater acoustic channels and numerical simulations of acoustic waveforms.</p>	<ul style="list-style-type: none"> <li>Numerical modelling and data analysis using MatLab</li> <li>Signal processing techniques</li> <li>Programming experience with C++ or Python</li> <li>Knowledge on wireless communication systems</li> <li>Ability to work independently and in small groups.</li> </ul>			X	X		X		
SVP PLAT 05	Fishermans Bend, Victoria	Similar vessel analysis	<p>Naval ships are highly complex systems where small changes can have a large effect on the overall design and performance. Integrated ship performance modelling links together a number of simulation tools to capture a wide range of performance measures. This then allows a holistic assessment of a ship design that can be used to support the development of platform requirements and to assist with design decisions.</p> <p>The Ship Systems Analysis (SSA) team at DSTG are developing an integrated ship performance modelling tool called InteShip, which is being used to support several Defence shipbuilding projects. It consists of a growing repository of models of ship performance metrics, including range endurance, stability, habitability propulsion systems and many more. One method of validating the results produced by InteShip is by comparison with the performance of existing ships.</p> <p>This research will develop a tool and database in Python to support similar vessel analysis, using publicly available data on warships from sources such as Janes Fighting Ships. The output of this research will be a valuable tool to assist the SSA team with assessing the performance of current and future Royal Australian Navy ships.</p>	<ul style="list-style-type: none"> <li>Mathematical modelling of physical systems</li> <li>Coding, especially in python</li> <li>Ability to work independently and in small teams</li> <li>Good communications skills.</li> </ul>	X							



