

Department of Computing - 2025/2026 Capstone Project Proposal

Last Update: 11 April 2025

Project Category (for Round 1):

BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

BSc Information Security: Category C

BSc FTAI: Category A or D

Project Category	Project Code	Supervisor Name	Proposed co-supervisor, if any	Project Title	Quota: Number of Students	Area Code	Description of the Project	Expected Outcome	Knowledge/ Skill/ Tools Required	Industrial Elements in the Capstone Project	Group/ Individual Project
C	AA1	AU Allen		Applications of Blockchain	1	13, 20, 103	Explore real-world use cases of blockchain technology beyond cryptocurrencies. Potential focus areas include: supply chain traceability; digital identity management; secure voting systems; IP protection. Students may also propose their own applications.	Identify an application of blockchain, design and implement the application	Blockchain, Smart Contract	No	Individual
C	AA2	AU Allen		Virtual Currency/Central Bank Digital Currency (CBDC)/Real World Assets (RWA)	1	13, 20, 103	Investigate the design and implementation of digital currencies and asset tokenization, e.g., Technical and policy challenges in CBDC systems, Privacy-preserving payments, Tokenization of RWAs like real estate, bonds, or carbon credits, Comparison of stablecoin vs CBDC mechanisms. Projects could involve simulations, prototyping wallets or token systems, or evaluating security/privacy risks.	Investigate regulatory requirements related to RWA/ Virtual Currency. Develop regtech for the identified requirements	Cryptocurrency	No	Individual
C	AA3	AU Allen		Anonymous Credentials	1	13, 20, 103	Focus on privacy-enhancing authentication methods leveraging cryptography. Design and implementation of anonymous credential systems (e.g., Idemix, zk-SNARKs-based systems). Use cases: privacy-preserving KYC, age verification, selective disclosure. Tradeoffs between anonymity, usability, and compliance. Projects can prototype credential issuance/verification or evaluate anonymity under different attack models.	Implement an anonymous credential system	ECC or Pairing-Based Cryptography or Zero-Knowledge Proofs	Yes	Individual
C	AA4	AU Allen		Decentralised Finance	1	13, 20, 103	Study and build DeFi protocols or analyze risks and governance models. Lending, staking, DEXs, synthetic assets, smart contract vulnerabilities and formal verification, DAO governance and tokenomics, DeFi and regulatory compliance. Project could include building a DeFi protocol prototype, simulating attack vectors, or analyzing protocol performance. Students may also propose their own DeFi applications.	Design and implementation of oracle service to blockchain, or decentralised exchange	Blockchain, Smart Contract	Yes	Individual
A	CYX1	CAO Yixin		Dual-pivot quicksort	2	9, 27	Since 2007, Java has been using dual-pivot quicksort for non-stable sorting (https://web.archive.org/web/20151002230717/http://iaroslavski.nard.ru/quicksort/DualPivotQuicksort.pdf), which has been shown to outperform the previous algorithm primarily due to better cache utilization (https://arxiv.org/abs/1511.01138). Despite its success, no other major languages have adopted this approach yet. Consider adapting dual-pivot quicksort to other languages and compare its performance with the existing sorting libraries in those languages.	Programs	data structures and algorithms	No	Individual/ Group
A	CYX2	CAO Yixin		Powersort	2	9, 27	Python has been using Powersort (https://youtu.be/XjOnY-OLAPc) since the release of version 3.11 in October 2022. Powersort is an improved version of Timsort, revolutionizing the merging strategy. Consider adapting Powersort to other programming languages, such as C, C++, or Java. Since Java already has an excellent implementation of Timsort, adapting Powersort to Java might be easier than other languages.	Programs	data structures and algorithms	No	Individual/ Group

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A	CYX3	CAO Yixin		Feedback vertex set on cubic graphs	2	9	<p>Sometimes, cycles in a graph mean troubles; e.g., "in an operating system, a deadlock occurs when a process or thread enters a waiting state because a requested system resource is held by another waiting process, which in turn is waiting for another resource held by another waiting process."</p> <p>We may remove edges to break cycles, which is nothing but finding a maximum spanning tree and very easy to solve. If we instead want to remove vertices, then the problem becomes very difficult (https://en.wikipedia.org/wiki/Feedback_vertex_set). A special case is when every vertex has at most three neighbors.</p> <p>There are polynomial-time algorithms for this problem, feedback vertex set on cubic graphs, but they are too complicated. This project is to find a simple and implementable algorithm for this purpose.</p> <p>This project is intended for students with a strong knowledge of algorithms and logical thinking.</p>	algorithms, potentially research paper(s)	algorithm design and analysis.	No	Group
A	HCA1	CHAN Henry		AI-based Computing System/Application	5	1, 7, 8, 11, 19	<p>Students will conduct an Artificial Intelligence (AI)-based computing project (i.e., one of the following projects) based on your interest such as:</p> <ul style="list-style-type: none"> - AI-based Avatar / Chatbot System: The aim of this project is to develop an interactive and intelligent avatar / chatbot system (e.g., using a Large Language Model such as DeepSeek and generative AI methods). For example, companies can use it to recommend products to customers and provide customer/technical support. - AI-based Investment System: The aim of this project is to design and implement an intelligent investment system. For example, stock data will be analysed by using a machine learning algorithm (e.g., predicting future stock prices, selecting potential stocks and/or formulating trading strategies). Furthermore, investment portfolios can be recommended based on different return and risk requirements. - Mobile AI Application: This project seeks to develop an AI-based mobile application such as a virtual reality or metaverse-based application using Apple Vision Pro. Students are encouraged to explore interesting and creative use cases. - Mobile AI-based IoT Application: This project seeks to develop a mobile AI-based Internet of Things (IoT) application such as recognizing things (e.g., using image/video recognition technologies and/or tracking locations (e.g., using UWB). - Other Innovative AI Applications: Students are also welcome to propose other innovative AI applications with various computing technologies (e.g., using DeepSeek). 	A prototype	Programming (e.g., Python, Java)	No	Individual

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A	CHENCW-01	CHEN Changwen		Long-form Video Temporal Understanding	1		<p>Video has gradually become a major type of information transmission media, thanks to the fast development and innovation in communication and media creation technologies. A video is formed from a sequence of continuous image frames possibly accompanied by audio and subtitle. Compared to image and text, video conveys richer semantic knowledge, as well as more diverse and complex activities. Despite strengths of video, searching for contents from video is challenging. Thus, there is a high demand of techniques that could quickly retrieve video segments of user interest, specified in natural language.</p> <p>In this project, we focus on temporal understanding on long-form (minutes to hours long) videos. Our goal is to develop a complete system that can realize efficient query-guided temporal grounding in long videos using the most advanced deep learning techniques.</p>	<ul style="list-style-type: none"> a. A complete system with re-implementation of an existing video temporal understanding method via open-source code. (Basic); b. Implementation of an effective long-form video understanding algorithm. (Advanced); c. Significant improvement on existing methods and a complete scientific paper submitted to a journal/conference. (Optional) 	<ul style="list-style-type: none"> a. Strong interest in the topic of deep learning & video understanding; b. Background in computer vision & video processing; c. Python & PyTorch programming; d. Academic reading and writing 	No	Individual
A	CHENCW-02	CHEN Changwen		Multi-modal Tokenization for Video Large Language Models	1		<p>With the burgeoning growth of online video platforms and the escalating volume of video content, the demand for proficient video understanding tools has intensified markedly. Given the remarkable capabilities of Large Language Models (LLMs) in language and multimodal tasks, these models are leveraged to process and analyze video content recently. The emergent capabilities of Vid-LLMs are surprisingly advanced, particularly their ability for open-ended spatial-temporal reasoning combined with commonsense knowledge, suggesting a promising path for future video understanding.</p> <p>In this project, we focus on the tokenization procedure of video LLMs. In particular, our goal is to develop a joint video-audio-speech tokenization method tailored for LLM based video understanding. This project requires strong background in deep learning, LLMs, and Python programming.</p>	<ul style="list-style-type: none"> a. A complete system with re-implementation of an existing video LLM via open-source code. (Basic); b. Implementation of an effective multi-modal tokenization algorithm. (Advanced); c. Significant improvement on existing methods and a complete scientific paper submitted to a journal/conference. (Optional) 	<ul style="list-style-type: none"> a. Strong interest in the topic of deep learning & video understanding & large language models; b. Background in multi-modal large language model; c. Python & PyTorch programming; d. Academic reading and writing 	No	Individual
A	CHENCW-03	CHEN Changwen		Real-to-Virtual World Reconstruction for Enhanced Editing and Visualization	1		<p>By leveraging cutting-edge technologies like Neural Radiance Fields (NeRF) and 3D Gaussian Splatting, this research seeks to accurately reconstruct real-world objects and scenes within virtual spaces. This not only allows for photorealistic rendering but also enables users to edit and manipulate these virtual environments in unprecedented ways. Through this innovative approach, the project promises to unlock new possibilities in computer graphics (CG) and virtual reality, bridging the gap between the physical and the virtual worlds.</p>	<ul style="list-style-type: none"> a. Write a survey of this area with your own analysis of the limitations. b. Make a demo of your scene reconstruction using different methodologies across various datasets. c. (Advanced) Write an academic paper on your proposed methodology in addressing one of the limitations. 	<ul style="list-style-type: none"> a. Strong passion for this topic; b. The ability to read and write Python and PyTorch code 	No	Individual

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D	CR1	CHENG Ran		Interactive Intelligent Optimization Platform Based on EvoX	6	1, 23	<p>As optimization problems grow in complexity, evolutionary algorithms have become indispensable for solving real-world challenges. However, a gap remains between these algorithms and human intuition, limiting user engagement and guidance in the optimization process. This project aims to bridge that gap by developing an interactive optimization platform that empowers users to actively participate in optimization progress, fine-tune hyperparameters, and guide the optimization through human-in-the-loop integration. A real-time visualization system enhances user interaction, providing valuable insights and feedback throughout the process.</p> <p>The platform is built around three core components:</p> <ul style="list-style-type: none"> Optimization Engine – Integrates with EvoX, incorporating evolutionary algorithms such as Differential Evolution (DE), NSGA-III, and Competitive Swarm Optimization (CSO) to address diverse optimization tasks. Interactive Optimization – Enables users to dynamically adjust algorithm parameters, intervene in decision-making, and monitor optimization progress, facilitating adaptive control and experimentation. Visualization & Analysis – Offers real-time graphical insights into optimization dynamics, including Pareto fronts, convergence trends, and population evolution, helping users make decisions effectively. <p>By integrating human intuition with algorithmic power, this project bridges research and application, offering an intuitive, interactive, and efficient solution for optimization tasks.</p>	<ol style="list-style-type: none"> 1. A fully functional interactive optimization platform – A web-based system integrating EvoX, enabling users to interactively run evolutionary algorithms, fine-tune hyperparameters, and guide the optimization process through human-in-the-loop interaction. 2. An advanced visualization framework for tensorized algorithms, interactively demonstrating their computation graphs and providing deeper insights into algorithmic structures. 3. A scalable and efficient backend – A robust backend that efficiently integrates into EvoX, handles optimization requests, and processes computations across the network. 	<p>Knowledge: Evolutionary computation, hyperparameter tuning, optimization, web development, and data visualization.</p> <p>Skills: Python (NumPy, Pandas, PyTorch), web development (e.g. React.js/Vue.js, Flask/FastAPI), RESTful API design, data visualization (e.g. ECharts/Plotly.js).</p> <p>Tools & Technologies: EvoX, React.js/Vue.js, ECharts/Plotly.js, Flask/FastAPI, Git/GitHub.</p>	No	Group
A	CFL1	CHUNG Korris		Finetuning of LLM for HKDSE Question and Answer Generation	2	1,8	<p>Training of LLM had been largely based on open knowledge. It is believed that LLM should be finetuned with specialized knowledge for more in-depth content generation. In this project, we focus on the application of Hong Kong Diploma of Secondary Education Examination questions generation. Specialized question bank, e.g., those from prestige schools, will be solicited and used to finetune a pretrained LLM. Extensive evaluations of finetuned LLM will be carried out with respect to different HKDSE subjects.</p>	A finetuned LLM for HKDSE question and answer generation	AI and Machine Learning	No	Individual/ Group
D	CFL2	CHUNG Korris		Stock Investment AI Agent	2	1,8	An artificial intelligence (AI) agent refers to a system or program that is capable of autonomously performing tasks on behalf of a user or another system. At the core of AI agents are large language models. The agents can encompass a wide range of functionalities beyond natural language processing including decision-making, problem-solving, interacting with external environments and executing actions. In this project, an AI agent is targeted to be developed for stock analysis and investment application scenario.	An AI agent for stock applications	AI and Machine Learning	Yes	Individual/ Group
D	CFL3	CHUNG Korris		Help Me to Finish My Drawing	2	1,8	<p>Image inpainting, which is known as an important task of computer vision, aims at filling missing regions within an image. Essentially, the inpainted parts are supposed to harmonize with the rest of the original image and be semantically reasonable. In that case, image inpainting models require strong generative capabilities. This project aims to make use of the generative capability of LLM in the image inpainting tasks. Different application scenarios will be formulated to take advantages of the targeted LLM empowered image inpainting framework.</p>	A LLM empowered image inpainting system	AI and Machine Learning	Yes	Individual

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A	FWQ1	FAN Wenqi		Recommendations in the Era of Large Language Models (LLMs)	4	1,8,18	Recommender systems are crucial to alleviate the information overload problem in the online world by providing users personalized lists of items that are likely to be clicked on or purchased. In addition to modeling user-item interactions behaviors, social media (e.g., Facebook and Weibo) can also provide useful information to understand users' preferences as suggested by the social theories such as homophily and influence. In this project, students will develop an understanding of the research issues, technical basis, and practical applications of personalized recommender systems in social networks, as well as design advanced recommendation algorithms that may achieve better prediction and recommendation performance. Meanwhile, in the era of large language models (LLMs), the project plan to take advantage of some advanced LLMs techniques, like pre-training, fine-tuning, in-context learning, RAG, etc.	Deliverables include algorithm design, code and demonstration.	programming skills (required, any language is accepted, preferably python); basic statistics and machine learning/data mining (recommended); Tensorflow/PyTorch or equivalent AI libraries.	No	Individual
A	FW01	FUNG Walter		Digital Transformation with AI integration for industry	3	1,8,13,20,103,104	The industry still demands digital transformation to drive their business in the turbulent environment. AI is an emerging topic that industries find it almost impossible to exclude it from existing and new business processes. Student will pick up one industry (Logistics / Supply Chain, Government, Education, Tourism, Banking, Finance, etc) to deliver an AI driven digital transformation project. Examples are, but not limited to : <ul style="list-style-type: none">- Managerial simulations for anti-money-laundering (AML)- Low Altitude Airspace Economy Applications- Digital Twins for Educations /Tourisms / Health Care / Robots- ESG applications- Any combinations of above	Working prototype which may become a startup project	Basic programming, Fintech and AML knowledge, Willing to consider publication; additional tools like Flexsim, Unity, SAS, Nvidia omniverse, for example, will be useful.	Yes	Individual
B	FW02	FUNG Walter		Digital Transformation with AI integration for industry	9	1,8,13,20,103,104	The industry still demands digital transformation to drive their business in the turbulent environment. AI is an emerging topic that industries find it almost impossible to exclude it from existing and new business processes. Student will pick up one industry (Logistics / Supply Chain, Government, Education, Tourism, Banking, Finance, etc) to deliver an AI driven digital transformation project. Examples are, but not limited to : <ul style="list-style-type: none">- Managerial simulations for anti-money-laundering (AML)- Low Altitude Airspace Economy Applications- Digital Twins for Educations /Tourisms / Health Care / Robots- ESG applications- Any combinations of above	Working prototype which may become a startup project	Basic programming, Fintech and AML knowledge, Willing to consider publication; additional tools like Flexsim, Unity, SAS, Nvidia omniverse, for example, will be useful.	Yes	Individual
C	GS1	GAO Jason		Lattice-based Schnorr Protocol for Login System	2	20	Lattice-based cryptography is emerging as a promising solution for the post-quantum era. Historically, lattice-based proofs have faced challenges, being either inefficient or suffering from soundness slack. Recently, Boneh and Chen introduced an innovative approach called LatticeFold, which employs a sum-check protocol to eliminate slack while maintaining efficiency. This project aims to harness this technique to develop a lattice-based Schnorr protocol for identity authentication. The expected outcome is a login system built upon lattice-based cryptography, ideally implemented in Rust.	1. A lattice-based login system	lattice-based cryptography, schnorr protocol, sumcheck protocol, rust programming	No	Group

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C	GS2	GAO Jason		Evaluating the Cost of G_T Operations in Circum	2	20	Circum and gnark are powerful tools for converting user-defined relations into circuits, serving as the front-end of many zkSNARK systems. While elliptic curve operations are integral to modern cryptography, they can be quite costly when implemented as relations in circum/gnark, particularly when pairing groups are involved. This project aims to develop a library for pairing group (G_T) operations in circum/gnark, including addition and scalar multiplication operations. Additionally, we will assess the performance of generating and proving G_T relations.	1. Performance report of G_T operations. 2. Circum library for G_T operations.	Elliptic curve, pairing, circum, gnark	No	Group
A	GJC1	GUO Jingcai		Exploring Discriminative and Efficient Data Representation for Zero-shot Learning	3	1, 26	Zero-shot learning is an extreme case of transfer learning that aims to recognize data samples (e.g., images) of novel unseen classes using a train-set consisting of only seen classes and a set of auxiliary knowledge (e.g., semantic descriptors) between both classes. Due to the lack of unseen class data during model training, it is observed that existing zero-shot learning frameworks are readily biased towards seen classes. This project will investigate more discriminative and efficient data representation in order to reduce bias and build more accurate zero-shot recognition models.	1) Understanding of zero-shot learning and the modeling process of most machine learning models; 2) Understanding of data representation and explore more discriminative and efficient way to jointly present seen and unseen data; 3) Construct and implement more accurate zero-shot recognition models.	Pytorch Framework, Python Programming	No	Individual
A	HCH1	HE Chenhang		Blind image restoration using deep neural network	3	1, 17	The capstone project aims to develop a deep neural network-based solution for blind image restoration, a process of recovering the original image from a degraded version without prior knowledge of the degradation process. This project will involve the design and implementation of a convolutional neural network (CNN) or other advanced deep learning architectures to address common image degradations such as blur, noise, and compression artifacts. Students will begin by understanding the fundamentals of image processing and deep learning, followed by the exploration of existing state-of-the-art image restoration techniques. The project will require the creation of a dataset for training and testing, consisting of pairs of degraded and high-quality images. Students will then design, train and evaluate their deep learning models, optimizing for restoration accuracy and computational efficiency.	The final outcome will be a robust image restoration system that can generalize well to various types of degradation, potentially applicable in real-world scenarios such as enhancing low-quality images in surveillance, improving medical imaging, or restoring old photographs.	Python (pytorch, numpy, scipy, opencv, etc.)	No	Individual
C	HN1Y	HE Ningyu		Automatic Vulnerability Detection in Smart Contracts	3	20,29,103	Smart contract is the killer application for blockchain technology. However, security issues or even vulnerabilities widely exist in smart contracts, leading to huge financial losses for developers, users, and even the whole ecosystem. In this project, you are going to adopt basic program analysis methods (like control flow analysis and data flow analysis) and even the advanced ones (like taint analysis, symbolic execution, fuzzing, and ML-based) to automatically identify vulnerabilities in smart contracts. Your findings will be beneficial to all entities involved and the healthy development of the whole blockchain ecosystem.	1. Proficient in mainstream program analysis methods 2. Proficient in mainstream vulnerabilities in smart contracts 3. Develop an automatic vulnerability detector on smart contracts	Python or Rust	No	Individual

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D	HW1	HUA Wen		Financial Fraud Detection	3	1, 8	Fraud detection is crucial in protecting consumers and financial institutions from significant financial losses and maintaining trust in digital financial services. In this project, students will explore the intersection of Fintech and AI by developing robust models for financial fraud detection. It aims to empower students to design and implement AI-driven solutions that can effectively identify and prevent fraudulent activities within financial transactions. Students will engage with machine learning algorithms and data analytics to create models that can detect anomalies and suspicious patterns in transaction data. By working with extensive datasets, students will train their models to accurately differentiate between legitimate and fraudulent activities, thereby enhancing the security of financial systems.	1. Understand the limitations of existing financial fraud detection solutions. 2. Design and implement an improved fraud detection model. 3. Conduct performance evaluation on some publicly-available benchmarks.	1. Python programming 2. Deep learning 3. Graph neural networks	No	Individual
D	HW2	HUA Wen		Financial Time Series Forecasting	2	1, 8	Financial time series forecasting is crucial for enabling investors and financial institutions to make informed decisions, manage risks, and optimize investment strategies. In this project, students will delve into the dynamic world of financial time series forecasting, leveraging the power of Fintech and AI. It aims to equip students with the skills to analyze and predict financial market trends using advanced AI techniques. Students will explore various machine learning models and statistical methods to forecast future values of financial time series data, such as stock prices, interest rates, or currency exchange rates. By working with historical financial data, students will develop models that can identify patterns and trends, providing valuable insights for decision-making in financial markets. The project will also emphasize the importance of model evaluation and validation to ensure accurate and reliable forecasts.	1. Understand the limitations of existing financial time series forecasting solutions. 2. Design and implement an improved time series forecasting model. 3. Conduct performance evaluation on some publicly-available benchmarks.	1. Python programming 2. Deep learning 3. Graph neural networks	No	Individual
A	HX1	HUANG Xiao		Evaluating LLMs with Challenging Questions in Computer Science	2	1,8,10	The background of this project is to align the large language models (LLMs) for college education. We need to build a dataset to evaluate the performance of LLMs in answering questions in Computer Science. We need to systematically collect challenging questions. We need to make sure that the questions are meaningful, and answers are correct and easy to evaluate. By saying "challenging", it means the questions cannot be correctly answered by LLMs. Then, you can analyze the reason for this and draw conclusions about LLM's abilities. You may grasp a deeper understanding of our QA dataset after you read how typically we evaluate an aligned LLM, please refer to https://arxiv.org/pdf/2307.12966.pdf P.10 Section 4 about benchmarks and evaluation methods and metrics, e.g., human-based and LLM based. You can refer to how crowdsourcing works for QA datasets, given the knowledge/topics/domains. Please refer to https://arxiv.org/abs/2410.17558 for question/answer candidates collection.	A set of challenging questions in CS, associated with answers and rationales.	Python, including Pytorch	No	Group
A	HX2	HUANG Xiao		Computer Science Course Exercise Generation based on Retrieval-Augmented Generation	1	1,8,10	Large language models (LLMs) hold significant potential for enhancing educational experiences. Students often need course exercises to prepare for the final exams. We aim to develop an exercise generation tool based on retrieval-augmented generation. Users can input keywords or exemplar questions, and the tool will generate diverse exercises to reinforce learning. How can we carefully design the prompts so that LLMs will generate high-quality exercises? Page 7 of 40	An LLM-based tool that can generate diverse exercises when users input keywords or exemplar questions.	Python, including Pytorch	No	Individual

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A	HX3	HUANG Xiao		Converting PDF Textbooks into Structure Data for effective Retrieval-Augmented Generation	1	1,8,10	Large language models (LLMs) hold significant potential for enhancing educational experiences. However, their efficacy in specialized contexts is often constrained by insufficient domain-specific knowledge. Retrieval-augmented generation is a transformative approach that utilizes domain-specific corpora to enhance the accuracy and relevance of LLM responses. However, it is challenging to accurately convert PDF Textbooks into Structure JSON files.	A set of JSON files that contain the accurate content of computer science textbooks.	Python, including Pytorch	No	Individual
A	HX4	HUANG Xiao		Effective Retrieval-Augmented Generation for LLM Reasoning in Computer Science Exercise Answering	2	1,8,10	Large language models (LLMs) hold significant potential for enhancing educational experiences. However, their efficacy in specialized contexts is often constrained by insufficient domain-specific knowledge. Retrieval-augmented generation (RAG) is a transformative approach that utilizes domain-specific corpora to enhance the accuracy and relevance of LLM responses. Given a set of CS questions, https://arxiv.org/abs/2410.17558 , how can we carefully design RAG models and prompts to improve the accuracy of LLM output?	An effective retrieval-augmented generation model that can improve the accuracy of LLMs in answering CS exercises.	Python, including Pytorch	No	Group
D	JFM1	JIN Fengmei		Knowledge Graph-Based Fraud Detection in Financial Data	3	1,10,103	This project focuses on developing a fraud detection system using knowledge graphs to model relationships between financial entities (e.g., accounts, transactions, merchants). The system will leverage graph-based machine learning to identify suspicious patterns and anomalies in transaction data. The group will collaboratively build a knowledge graph, design detection algorithms, and enhance model explainability. Two key challenges will be addressed: 1) Scalable Knowledge Graph Construction: Financial datasets often involve large-scale, heterogeneous data. Students must develop efficient techniques for integrating data, resolving entities, and constructing a graph that supports fast queries and real-time updates. 2) Graph-Based Anomaly Detection: Fraud patterns are often subtle and sparse. Students will implement advanced graph neural networks and anomaly detection techniques to handle imbalanced data, while incorporating explainable AI methods to justify system outputs.	1) A fully constructed and scalable knowledge graph representing financial transaction data. 2) A graph-based fraud detection system with a trained model capable of identifying fraudulent activities with high precision. 3) A report detailing the methodologies, challenges, and trade-offs in scalability, accuracy, and explainability.	1) Proficiency in Python programming. 2) Familiarity with graph databases (e.g., Neo4j) and graph processing frameworks. 3) Understanding of machine learning algorithms, particularly graph neural networks.	No	Group
B	LKH1	LAI Kim Hung	Kathy Fu (Laboratory Manager, HKPMAC) Matthew Tsui (Managing Director, App2One Limited)	Development of Laboratory Information System (LIMS) for operation performance enhancement	3	10, 11	Hong Kong Precious Metals Testing Centre Limited (HKPMAC), owned by the Hong Kong Gold Exchange (HKGX), is an independent laboratory offering testing services, including gold purity assessments, based on international standards. To enhance operational efficiency, HKPMAC plans to develop a Laboratory Information Management System (LIMS). This system will streamline processes such as sample entry, invoicing, and reporting. The LIMS will feature a login system, an invoicing system, and a reporting system.	Prototype of LIMS include functions below: 1. Login system 2. Invoice system 3. Reporting system	Odoo (an open-source ERP framework built with Python) and a PostgreSQL database	Yes	Group

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B	LKH2	LAI Kim Hung	Mr. Felix Chan (Managing Director, Material Tech Co. Ltd.) & Mr. Herman Tang (Assistant General Manager, Material Tech Co. Ltd.)	Robot Arm Control System for Concrete Cube Handling	4	15, 29	This project aims to develop a software system that controls a robot arm to automate the handling of concrete cubes. The robot arm will pick up individual cubes from a storage pile, transport them to a weighing balance, and then to a measuring jig for dimension assessment. Upon obtaining measurement data, the system will upload the information to a computer server. Finally, the robot arm will move the cube to another storage pile for manual crushing. This project integrates robotics, software development, and automation to streamline a repetitive and labor-intensive process.	1.A fully functional software system capable of controlling the robot arm with high precision. 2.Automated handling of concrete cubes, reducing manual labor and increasing efficiency. 3.Accurate data collection and uploading to a server for further analysis. 4.A user-friendly interface for monitoring and controlling the robot arm operations. 5.A detailed project report and presentation showcasing the system's capabilities and potential for future enhancements.	•Knowledge: Robotics fundamentals, automation principles, programming (Python, C++), computer vision basics, mechanical engineering concepts. •Skills: Software development, robot arm programming, data handling and communication protocols, troubleshooting and debugging. •Tools: Robot arm hardware (e.g., UR5), computer with necessary software (ROS, Visual Studio Code), sensors (load cells, cameras), microcontroller (Arduino), computer server for data storage, CAD software for mechanical design (optional).	Yes	Group
A	LKH3	LAI Kim Hung	Dr. Xueping Chen (co-founder and CTO of Vitargent Biotechnology Co., Ltd.)	AI-powered system to automate the detection of developmental defects in zebrafish embryos	1	1, 2, 17, 26	This project aims to build an AI-powered system to automate the detection of developmental defects in zebrafish embryos, which are used to test if chemicals or drugs could harm humans. Zebrafish embryos are ideal for this because they're transparent, develop quickly (24–72 hours), and share genetic similarities with humans. Traditionally, scientists manually check these embryos for issues like heart defects, spine deformities, or delayed growth, but this is time-consuming and prone to human error. The goal is to replace manual checks with a machine learning (ML) system that analyzes microscope images of embryos. Using expert-validated datasets, the AI will be trained to spot defects faster and more consistently than humans. Key steps include: 1.Data Processing: Organizing and labeling embryo images (normal vs. abnormal). 2.Model Training: Using tools like Python, TensorFlow, or PyTorch to create a convolutional neural network (CNN) that classifies defects. 3.System Development: Building a scalable pipeline to process hundreds of images quickly.	1.Development of a Validated AI/ML Model for Defect Detection 2.Enhanced Detection of Subtle Morphological Defect 3.Scalable Framework for High-throughput Toxicity Screening	•Knowledge: Machine Learning Fundamentals & Image Processing. •Skills: Programming and Python for ML development. •Tools: Python, PyTorch, TensorFlow and Visualization tools.	Yes	Individual
A	LKH4	LAI Kim Hung	Mr. Peter Suen (Pharmacist & Owner, ACP ActiveCareGroup)	AI-powered system to automate drug inspection and packaging process for elderly residents	2	1,17, 26	ActiveCareGroup's drug service that pills are manually loaded and adjusted for half-doses if needed, then automatically sorted into a 7-day medication board, verified by a pharmacist for accuracy, and sealed for delivery to ensure safe, precise medication dispensing for elderly residents. This project aims to design an AI-powered system to automate ActiveCareGroup's drug inspection and packaging process for elderly residents, reducing human error and improving efficiency.	1. Enhanced Accuracy: Achieve zero defect (100% precision) in AI-driven pill detection, classification, and dosage verification, minimizing prescription errors 2. Improved Compliance & Safety: Generate automated audit reports and real-time alerts for pharmacists, ensuring 100% adherence to prescription guidelines and regulatory standards	•Knowledge: Machine Learning Fundamentals & Image Processing. •Skills: Programming and Python for ML development. •Tools: Python, PyTorch, TensorFlow and Visualization tools.	Yes	Group

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Project Category (for Round 1):

BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

BSc Information Security: Category C

BSc FTAI: Category A or D

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B	LKH5	LAI Kim Hung	Matthew Tsui (Managing Director, App2One Limited)	Website based online gamification of Externics named "METS Game"	2	104	Since 1983, Prof. Cai Wen has developed "Externics," a foundational AI theory from China. The Extension Innovation Method, derived from Externics, is designed to apply this theory across various practical fields, particularly in proposing new products and services, and fostering creativity in projects and strategies. To transform the Extension Innovation Method (METS) into an engaging educational tool, the project aims to create an online game called "METS Game". This website-based game will facilitate the generation of new products by integrating Generative AI (GenAI) and will utilize 3D printing to visualize prototypes.	Website based online METS Game includes: 1. Overall framework got the preliminary final product. 2. Function of Extension using GenAI (e.g. OpenAI / DeepSeek) 3. The final product generate the prompt for 3D printing model	•Knowledge: Principles of gamification, user engagement, and educational game design as well as, 3D Printing modeling •Skills:HTML/CSS/JavaScript for UI/UX design, 3D Printer operation •Tools: Python, OpenAI, DeepSeek, Fusion 360	No	Group
A	LHV1	LEONG Hong-va		Learning Data Structures and Concepts via Game Playing	3	6, 9, 10, 104	Data structures are generally difficult topics to many beginner programmers. Besides the rather straightforward stacks and queues useful data structures like the trees and their variants could be hard to understand. In this project, we are to develop good learning tools to help students in learning the concepts of different types of trees, e.g. binary tree, binary search tree, AVL tree, 2-3 tree, or heap presented in the form of a binary tree. Furthermore, gaming elements are to be introduced to help students in understanding the relevant operations besides strengthening their momentum in learning and remembering the knowledge that they gain. Adoption of virtual reality and multiplayer features could also be explored, in addition to game scoring.	One or more games that can help users in understanding the operations on one or more variants of the trees as the important data structures are developed. Gaming elements will be incorporated to enhance users in accepting and trying the operations out on the different types of trees, so as to indirectly learn and master the key concepts behind these types of data structures.	Game programming, data structures and databases, HTML5	No	Individual/ Group
A	LHV2	LEONG Hong-va		Learning Indexed Data Access via Game Playing	2	6, 9, 10, 104	A fundamental support in retrieving the correct data items from a large data volume, commonly from a database, is the provision of a good indexing structure. The most common data structure adopted in large database systems to support both random and sequential access is the B+ tree. It is capable to support the useful Indexed Sequential Access Method to data items. It also forms the basis for more advanced indexing structures to support accessing more complex data, e.g. R+ tree for spatial data. Unfortunately, there are different variations in the implementation of B+ trees regarding tie-breaking rules, making it much more difficult for students to understand. This project aims at developing some games that can help students in better understanding the different operations of the B+ tree, rather than simply relying on the animation of the insert/delete/search operations on an item within the tree. Adoption of virtual reality and multiplayer features could also be explored, in addition to game scoring.	A game that can help users in understanding the operations on the B+ tree as the key indexing structure to a large collection of data items is developed. Gaming elements will be incorporated to enhance users in accepting and trying it out, so as to encourage them to learn and master the key concepts behind this indexing structure.	Game programming, data structures and databases, HTML5	No	Individual/ Group
A/B	LHV3	LEONG Hong-va		Learning Database Design and Normalization	3	6, 9, 10, 15	A fundamental design issue for good database systems is to normalize the relations in First Normal Form resultant from the ER diagram design stage. The most preferred way is to produce relations in Boyce Codd Normal Form (BCNF), and yet preserving functional dependencies (FD) across the decomposition. If FD cannot be preserved in the BCNF design, one would resort to a dependency-preserving Third Normal Form (3NF) design. It is not an easy task to derive proper BCNF or 3NF designs based on the identified FD based on well-defined principles behind. In this project, we are to develop suitable tools to help users with understanding the procedure of normalization, and to assist them in producing good relation design under the proper normal forms. Good visualization feature and user-interface design are also preferable properties of the tools.	A system or set of tools to help users in understanding the procedure of normalization in database design, the concepts of common useful normal forms is developed. Good interaction elements are preferably incorporated to enhance users in learning the concepts and trying out their own design.	data structures and databases, Java/C++/Python with graphics elements	No	Individual/ Group

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BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

BSc Information Security: Category C

BSc FTAI: Category A or D

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A/B	LHV4	LEONG Hong-va		An Intelligent Financial Advisor	4	1, 32, 103	Financial planners are very useful to people to manage their wealth. In this aging society, people are living longer and longer. There is a need to ensure wealth growth to catch up with the inflation and to prepare for the retirement in this aging society. Most financial planners are human but AI is quickly taking over for the planning task. In this project, we are to design an intelligent financial advisor. It is a platform that is able to provide advice to people on managing their investment portfolio, for example, based on portfolio theory. A common feature is to estimate the value of the portfolio in any specific time in the future, under different assumptions about trends on interest rate, inflation, economic growth etc. By varying the current portfolio, a user can get a picture of its future value under different what-if scenarios. The system should help to reduce the user effort in specifying those what-if scenarios, since they are not experts. The system should also be able to provide financial and economic information to help users making more well-informed decisions, by collecting requirements from the industry.	An intelligent financial advisor system is built that can help users to evaluate their portfolio and to project the future value under different scenarios, so that they can make judicial decision to invest.	Python/Java/JavaScript/HTML5/React/nodejs	No	Individual/ Group
A	JL1	LI Amelia		Interactive Storytelling for Elderly-Friendly RPG Games	2	1,15	Objective: Develop an AI-powered storytelling system for elderly-friendly RPG games, generating age-appropriate narratives in script format with interactive multiple-choice questions (MCQs) to let players guide the story. Description: This project aims to develop a dynamic storytelling system that generates engaging and personalized narratives tailored to elderly players in script format. The story will be structured like a play or screenplay, featuring dialogue and stage directions to make it easy to read and follow. Players will be able to customize their experience by selecting themes (e.g., nostalgic, adventure) and tone (e.g., light-hearted, dramatic). At key points, players will interact with the story by selecting from simple MCQs, influencing how the narrative unfolds. The system will follow a modular structure with defined sections (introduction, conflict, resolution) and branching story paths. AI will ensure the generated scripts are concise, relatable, and accessible for elderly users. The interface will include large fonts, high-contrast visuals, and easy navigation for improved usability. Testing will involve elderly participants to evaluate accessibility, engagement, and overall user experience, with feedback being used to refine the system.	<ul style="list-style-type: none"> • AI-generated storytelling system producing narratives in script format. • MCQs integrated into the story for player-driven decisions. • A demo showcasing an interactive, script-based RPG. • Comprehensive documentation of the story framework, AI implementation, and testing with elderly participants. 	Python Programming; Large Models; UI/UX Design	No	Individual

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A	JL2	LI Amelia		Adaptive Music Matching in Elderly-Friendly RPG Games	2	1,15	<p>Objective: Develop a music matching system that dynamically selects and plays background music to enhance the emotional experience of an interactive storytelling game for elderly players.</p> <p>Description: This project focuses on creating a music system that adapts to the emotional tone and context of AI-generated narratives. The system will analyze story elements, such as mood (e.g., peaceful, tense, joyful), and dynamically select background music to match the scene. This system enhances immersion while ensuring the music is age-appropriate, soothing, and accessible for elderly players.</p> <p>A curated library of music tracks will be categorized by tone and context (e.g., exploration, resolution, conflict) to ensure seamless integration with the story. The system will feature smooth transitions between tracks to maintain immersion. Additionally, players can personalize their experience by selecting preferred music genres or adjusting volume levels through a simple, user-friendly interface. Testing will involve elderly participants to assess how well the music aligns with the story, its impact on engagement, and its accessibility. Feedback will be used to improve the system.</p>	<ul style="list-style-type: none"> A functional music matching system integrated with the storytelling platform. A categorized library of music tracks for dynamic selection. A demo showcasing adaptive music transitions during storytelling. Documentation detailing the music matching algorithm, testing with elderly participants, and results. 	Python Programming; Large Models; UI/UX Design	No	Individual
A	JL3	LI Amelia		Adaptive Visual Matching for Backgrounds and Characters in Elderly-Friendly RPG Games	2	1,15	<p>Objective: Develop a visual matching system that dynamically selects and displays appropriate background images and character visuals to align with the tone and events of stories for elderly players.</p> <p>Description: This project focuses on creating a system that enhances storytelling by dynamically matching visuals (backgrounds and character images) to the context of the story. A curated library of background images and character illustrations will be categorized by settings (e.g., forest, village, castle) and emotional tone (e.g., peaceful, tense, joyful). As the story progresses, the system will dynamically update visuals, ensuring smooth scene transitions. Character illustrations will align with the story's context and player preferences, with potential customization options (e.g., outfit or colour adjustments). The visuals will prioritize clarity, simplicity, and aesthetic appeal, incorporating accessibility features such as high-contrast colours and large, clear designs to support elderly players. Testing will involve elderly participants to evaluate the relevance of visuals, their accessibility, and their impact on storytelling immersion. Feedback from these sessions will be used to refine the system.</p>	<ul style="list-style-type: none"> A functional visual matching system integrated with the storytelling platform. A library of categorized background images and character illustrations. A demo showcasing background and character changes in response to the story. Documentation of the visual matching algorithm, testing with elderly participants, and results. 	Python Programming; Large Models; UI/UX Design	No	Individual
A	LB1	LI Bo		Fair Cost Sharing Problem	2	1,9,13	<p>Fair division is an important problem facing society today as increasing economical, environmental, and other pressures require us to try to do more with limited resources. Much previous work in fair division assumes the problem is offline and fixed. That is, we suppose that the agents being allocated resources, and the resources being allocated to these agents are all known and fixed. But practical reality is often quite different. Fair division problems are often online, with either the agents, or the resources to be allocated, or both not being fixed and potentially changing over time. This presents a number of technical challenges and opportunities. In this project, we aim at designing fair and efficient algorithm to allocate resources in the online setting.</p>	A useful model and novel algorithms.	algorithm theory, programming	No	Individual

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BSc Computing/ Computer Science/ IT: Category A

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A	LB2	LI Bo		Fair Resource Allocation Problem	2	1,9,13	Fair cost sharing is an important problem faced by the society today due to its industrial and social importance. Much previous work in fair cost sharing assumes the problem is offline and fixed. That is, we suppose that the agents in the system, and the induced cost being shared among these agents are all known and fixed. But practical reality is often quite different. Fair cost sharing problems are often online, with either the agents, or the cost, or both not being fixed and potentially changing over time. This presents a number of technical challenges and opportunities. In this project, we aim at designing fair and efficient algorithm for the online cost sharing problem.	A useful model and novel algorithms.	algorithm theory, programming	No	Individual
A	LB3	LI Bo		Mechanism Design for Facility Location Games	2	1,9,13	The study of approximate mechanism design for facility location problems has been in the center of research at the intersection of artificial intelligence and economics for the last decades, largely due to its practical importance in various domains, such as social planning and clustering. At a high level, the goal is to design mechanisms to select a set of locations on which to build a set of facilities, aiming to optimize some social objective and ensure desirable properties based on the preferences of strategic agents, who might have incentives to misreport their private information such as their locations. This project is going to identify new variants for facility location games and propose novel mechanisms.	A useful model and novel mechanisms.	algorithm theory, programming	No	Individual
A	HYL1	Li Haoyang		Retrieval-Augmented Generation for Large Language Model	1	1,15	Large Language Models (LLMs) have demonstrated remarkable capabilities in natural language understanding and generation. However, their reliance on fixed pre-trained knowledge introduces challenges in handling domain-specific, time-sensitive, or vast datasets. Retrieval-Augmented Generation (RAG) emerges as a promising paradigm to mitigate these limitations by combining LLMs with external retrieval systems. This paper explores the architecture, benefits, and challenges of RAG, with a particular focus on its applications, including dynamic knowledge updates, efficient memory utilization, and domain-specific query handling.	Code, Report	Python, LLM, Knowledge Base, Text mining	No	Individual
A	HYL2	Li Haoyang		Text2SQL with LLMs	1	1,15	This proposal outlines the development and implementation of a Text2SQL system powered by Large Language Models (LLMs) to enable users to interact with relational databases using natural language. The project aims to simplify database querying for non-technical users, improve accessibility to data, and streamline analytics and decision-making processes. By leveraging the capabilities of advanced LLMs like GPT, this system will transform natural language input into accurate and meaningful SQL queries, bridging the gap between technical complexity and user-friendly data interaction. The solution will be adaptable to various database schemas and industries, making it a versatile tool for organizations seeking to democratize access to their data.	Code, Report	Python, LLM, Knowledge Base, Text mining	No	Individual

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A	HYL3	LI Haoyang		Robust Graph Learning	1	1,15	<p>This proposal focuses on Robust Graph Learning, a cutting-edge approach to building machine learning models that operate on graph-structured data while maintaining resilience to noise, adversarial attacks, and incomplete or corrupted data. Graph learning has become a cornerstone in fields like social network analysis, recommendation systems, biological modeling, and transportation networks. However, real-world graph data is often imperfect, making it critical to design models that can learn effectively even under adverse conditions.</p> <p>The goal of this proposal is to develop a robust graph learning framework capable of handling noisy edges, missing nodes, adversarial perturbations, and inconsistencies while maintaining high predictive performance. This framework will ensure the reliability and scalability of graph-based machine learning systems across diverse applications.</p>	Code, Report	Python, GNNs	No	Individual
A	LWJ1	LI Maggie		Social Robots with Embedded Large Language Models Releasing Stress	4	1,15	<p>In recent years, the Hong Kong community has faced significant mental health challenges. Research shows that approximately 12.8% of the population suffers from post-traumatic stress disorder (PTSD), while 61% experience symptoms of stress, anxiety, and depression. These issues have placed immense pressure on the mental health care system and led to billions of dollars in economic losses annually, underscoring the urgent need for innovative mental health solutions. Although various social chatbots have been developed, there remains a strong demand for a localized and personalized chatbot tailored to the unique context of Hong Kong.</p> <p>This project aims to develop social chatbots that can provide emotional support to users by addressing both local circumstances and individual needs. To achieve this, the first step is to conduct surveys to better understand the specific conditions and preferences of potential users in Hong Kong. The insights gathered will then inform the adaptation of large language models (LLMs), enabling them to respond more effectively based on localized information and user-specific knowledge. Additionally, to ensure responsiveness and efficiency, the model will be optimized with a reduced number of parameters without compromising performance. Advanced techniques such as Retrieval Augmented Generation (RAG), model distillation, and Reinforcement Learning for Human Feedback (RLHF) can be used.</p>	<p>Basic: A language model capable of providing users with emotional support. The model will integrate either personalized preferences or a localized communication style to enhance user experience.</p> <p>Advanced: Building on the basic version, the underlying language model will be further improved to learn and adapt to both individual preferences and local cultural context. In addition, a web-based interface will be developed to enable real-time interaction with users.</p>	LLMs, Dialogue Systems	No	Individual

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BSc Computing/ Computer Science/ IT: Category A

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A	LP1	LI Ping		Reference-Based Anime Image Colorization	2	1, 6, 17	<p>It is a time-consuming and tedious task for manually colorizing anime line drawing images, which is an essential stage in cartoon/manga animation production. Reference-based colorization methods convert color information from the reference images to the target anime line drawing colorization, which is a challenging task that relies on the precise cross-domain dependency modelling between the line drawing and reference image. Existing methods mainly utilize generative/diffusion models as key modules in anime image colorization. However, the existing methods could not preserve well for the key features in the anime portraits. We plan to propose a feature-aware anime sketch colorization using reference-based deep learning method, which could provide suitable colors for anime portraits while preserving well for the fine features of the input portrait sketches. In the training stage, training pairs of anime sketches and ground truth color anime images will be utilized as inputs. In the test stage, new anime sketches with color image references will be used as inputs, the outputs should be aesthetically colorized anime images.</p>	<p>A detailed project report, and a program that can produce reference-based anime image colorization.</p>	Programming Skills and Deep Learning	No	Individual
A	LP2	LI Ping		Semantic-Aware Natural Image Re-Colorization	2	1, 6, 17	<p>Natural image re-colorization plays a vital role in many types of design tasks such as flat media, advertisements, and wallpapers. They are not only for decoration purposes but also channels to attract viewers and users. When performing design tasks, professional artists often need to deliberately edit the colors of objects in images according to the design goals. The target colors can be the theme color of the design goal, or with specially desired purposes. Existing methods utilize deep learning approaches (e.g., diffusion models) as components for natural image re-colorization. However, the existing methods did not consider semantic information in images, which is essential for performing high-quality re-colorization. We plan to propose a semantic-aware natural image re-colorization via deep neural networks, which could provide compatible colors for objects in images while meeting image re-colorization needs for design tasks. In the training stage, training pairs of color images and their variations will be used as inputs. In the test stage, new color images will be used as inputs, the outputs should be aesthetically re-colored natural images with semantic awareness.</p>	<p>A detailed project report, and a program that can produce semantic-aware natural image re-colorization.</p>	Programming Skills and Deep Learning	No	Individual
A	Li-Qing1	Li Qing		A Recipe Database System Supporting Personalized Search and Recommendation Services	2	10	<p>Recipes are interesting types of data which can be in the forms of text, diagrams, and even photos. In this project, a multimedia recipe database is to be built which can support personalized search and recipe recommendation services based on user interests and preferences.</p>	<p>a method of recipe- and user-profiling, and a personalized searching approach and recommendation based on item and user profiles.</p>	JDBC, ODBC, database technology	No	Individual/ Group
A	Li-Qing2	Li Qing		Towards multimodal knowledge graph construction and utilization for smart education	1	8, 18	<p>Knowledge graphs (KGs) are getting increasingly popular for many applications. Conventional KGs are text-based only. In this project, an approach to construct multimodal KG (eg, nodes can be either textual or images) are to be built and completed, with an application to be developed in the domain of smart education.</p>	<p>an approach of multimodal KG construction and completion; a smart education application based on the multimodal KG.</p>	C, C++, or Java, plus graph neural network (GNN) techniques	No	Individual/ Group

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BSc Computing/ Computer Science/ IT: Category A

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A	LCR5	LI Richard		Social-emotional Learning (SEL) through Immersive Experience	3	6, 15, 104	The project aims to enhance social-emotional learning (SEL) among the youth in Hong Kong by leveraging virtual reality (VR) technologies. It intends to create an engaging and interactive environment where students can explore and develop their five core competencies: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. The expected deliverables include a literature review, the design of the learning content, and a VR prototype in the first semester, followed by an immersive learning experience that covers at least two of the five core competencies in the second semester.	Immersive experience for social-emotional learning	Game engine, VR programming	No	Group
A	LYQ1	LI Yongqi		Large Language Model based AI Search Engines	3	1,18	Large Language Models (LLMs) are pretrained on extensive web content in a generative manner. The advanced abilities of LLMs drive to explore generative AI-powered search engines, known as AI search. On the one hand, the powerful capabilities of LLMs can be directly applied to enhance search engines. For example, LLMs could be utilized to transform traditional search engines, like Bing into conversational search engines, New Bing. On the other hand, it is also worth considering how the successful paradigms of LLMs can be adapted and integrated to revolutionize the traditional information retrieval paradigm.	Dataset, Retrieval model, and Search UI	Python Programming	No	Group
C	LZC1	LI Zecheng		Identifying Malicious Smart Contracts via Graph Neural Network	3	20, 29	Malicious smart contracts represent a form of malware within blockchain systems, posing significant threats to security and trust. These contracts are often deployed to execute attacks or to function as deceptive schemes. In this project, we aim to delve into the potential of Graph Neural Network (GNN)-based methods to effectively identify and analyze these harmful contracts. By leveraging the advanced capabilities of GNNs, we hope to enhance the detection and prevention of malicious activities in blockchain environments, thereby contributing to a safer and more reliable digital ecosystem.	open source tools and research papers	familiar with smart contract and GNN	Yes	Individual

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BSc Computing/ Computer Science/ IT: Category A

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A	LWY1	LIN Wanyu		3D Molecule Generation Based on Generative Models	3	1	The mission of 3D molecule generation based on generative models is to automate the design of molecules with specific chemical and physical properties. With the help of machine learning algorithms, this innovative approach facilitates an efficient design process that is markedly advanced compared to traditional methods.	The expected outcome of this project includes: 1. Generate unseen molecules: We will use cutting-edge generative models to discover new drugs and materials and efficiently explore the vast space of possible molecules. The generative model will learn the distribution of real molecules; then, we can use this model to generate unseen molecules in the same distribution; 2. Generate molecules for specific targets or functions: In the molecule generation process, we can add different conditional guidance, like specific physical properties for material design or target protein structures for molecule binding; 3. Novel generative models: We will have an opportunity to delve into the latest generative models, such as the diffusion model(Midjourney's base model), flow matching model(a new efficient generative model), and large language model(chatGPT's base model). We will learn and explore ways to use them so they better align with our purpose for molecule generation in an efficient and high-quality way.	Python; Propability; Deep Learning	No	Individual
A	LWY2	LIN Wanyu		Privacy-Preserving Large Language Models	1	1	Privacy-preserving LLM is a critical component of trustworthy AI. As LLM is capable of memorizing the data flowing through the LLM, protecting privacy that may be incorporated by LLM becomes significant due to the surging of user information, especially in sensitive fields such as healthcare, law, and government. This project aims to solve the potential privacy issues in the two most central stages of the LLM pipeline: data input (i.e., prompting) and output (i.e., content generation). Instead of fine-tuning the model that requires computational effort and open-source LLM, we focus on exploring flexible adaptation of differential privacy algorithms to enhance the privacy of the data traveling throughout the LLM. More specifically, we will study the DP-guaranteed data synthesis and private aggregation to ensure the privacy-preserving of prompt data and content generation.	By elaborately designing the DP in LLM, we expect to balance the LLM performance and privacy-preserving strength. The ultimate goal of our research is to maximize the accuracy of various LLM downstream tasks. At the same time, the LLM data flow satisfies the DP principle using a light-weighted DP algorithm.	Python; Propability; Deep Learning	No	Individual

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BSc Information Security: Category C

BSc FTAI: Category A or D

Project Category	Project Code	Supervisor Name	Proposed co-supervisor, if any	Project Title	Quota: Number of Students	Area Code	Description of the Project	Expected Outcome	Knowledge/ Skill/ Tools Required	Industrial Elements in the Capstone Project	Group/ Individual Project
D	LWY3	LIN Wanyu		Multi-LLM Collaborative Inference	2	1	Multi-LLM Collaborative Inference" explores the integration of multiple Large Language Models (LLMs) to enhance decision-making and problem-solving capabilities. This project focuses on designing an architecture where multiple LLMs work together, each contributing its strengths in various specialized areas. The goal is to optimize inference by leveraging the diversity of models, ensuring more accurate, efficient, and context-aware outputs. Through advanced collaborative techniques, the system enables LLMs to exchange information and feedback, dynamically selecting the most appropriate model for specific tasks or queries. This collaboration could improve areas like multilingual processing, complex query handling, and adaptive reasoning in real-time applications. The project aims to investigate methodologies for seamless model coordination, ensuring minimal overhead and consistent performance across various inference tasks.	The expected outcome of the "Multi-LLM Collaborative Inference" project is the development of a robust, scalable system where multiple LLMs collaborate effectively to enhance inference accuracy and efficiency. By dynamically selecting and coordinating models, the system aims to provide more contextually relevant and precise outputs, especially in complex and diverse scenarios.	Python; Propability; Deep Learning	No	Individual
A	LY1	LIU Fiona		Brainwave analysis via machine learning techniques	1	1	Brainwave analysis opens a door to discover the secrete of human mind. This project targets to analyse the brainwave data using machine learning techniques, such as support vector machines.	The runnable system to analyse the brainwave data on one specific task, such as emotion recognition.	AI background and good programming skill in Python	No	Individual
A	LY2	LIU Fiona		Brainwave analysis via deep learning techniques	1	1	Brainwave analysis opens a door to discover the secrete of human mind. This project targets to analyse the brainwave data using deep learning techniques, such as recurrent neural networks	The runnable system to analyse the brainwave data on one specific task, such as emotion recognition.	AI background and good programming skill in Python	No	Individual
A	LY3	LIU Fiona		Machine composition using artificial intelligence techniques	1	1, 22	Machine composition enable the computer to compose the music like human musicians. This project targets to develop a model for machine composition.	A runnable system to compose the music automatically	AI background and good programming skill in Python	No	Individual
A	LY4	LIU Fiona		Music style transfer using artificial intelligence techniques	1	1, 22	Music has different styles. This project aims to develop computational models to transfer the music to a target style.	A runnable system for music style transfer	AI background and good programming skill in Python	No	Individual
A	LY5	LIU Fiona		Incomplete data analysis using machine learning	1	1, 22	Incomplete data analysis is a challenging topic in machine learning. This project targets to work on develop machine learning models for incomplete data analysis.	A runnable system for incomplete data analysis	AI background and good programming skill in Python	No	Individual
A	LY6	LIU Fiona		Literature review via Chat GPT	1	1, 22	This project explore the good strategies and system to gengerate the summarization of the certain area.	Review resarch report	AI background and good programming skill in Python	No	Individual
A	LYU1	LIU Yu		Collaborative Large Language Model Inference at the Network Edge	3	7,12,28	This project develops a distributed edge computing framework for running large language models across multiple low-power devices. Instead of relying on centralized, high-performance servers, EdgeLLM dynamically distributes inference workloads across a network of edge devices. This enables collaborative AI processing in resource-constrained environments, optimizing performance, reducing latency, and enhancing privacy. The framework is designed to support heterogeneous hardware, making AI inference more accessible and efficient at the edge.	A Collaborative Large Language Model Inference Framework and a research paper	Python Programming, Pytorch, and Machine Learning Knowledge	Yes	Group
A	LYU2	LIU Yu		Campus Guardian: Edge AI Safety Response System	3	7,19	This project implements a campus safety system using edge computing devices. The system employs machine learning methods to detect potential safety concerns while preserving public privacy. The system processes video locally without cloud transmission, maintaining a short-term memory buffer that's continuously overwritten. When the system detects patterns indicative of safety concerns (such as fights or potential altercations), it sends an alert to the Campus Security Office, saving only the relevant footage with contextual frames before and after the event.	An Edge AI Safety Response System and a research paper	Python Programming and Machine Learning Knowledge	Yes	Group

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Project Category (for Round 1):

BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

BSc Information Security: Category C

BSc FTAI: Category A or D

Project Category	Project Code	Supervisor Name	Proposed co-supervisor, if any	Project Title	Quota: Number of Students	Area Code	Description of the Project	Expected Outcome	Knowledge/ Skill/ Tools Required	Industrial Elements in the Capstone Project	Group/ Individual Project
A	LW1	LOU Wei		A drone-based structure inspection system	2	1,17, 20, 22, 26	This project aims to design and implement an AI-based structure inspection system that can automatically analyze the real-time video captured by a drone camera. The system aims to apply deep learning mechanisms to inspect the structure defects, such as spalling, cracks, deponding, plants, etc.	Application / Demonstration	Python programming / AI / Image processing / LAN	Yes	individual
A	LW2	LOU Wei		A Privacy-preserving transformer-based language model architecture for encrypted data inference	1	1,8, 20,21	Language models play a pivotal role in many domains. However, during their operation, user inputs may inadvertently expose sensitive personal data or corporate confidential information. Protecting such information has emerged as one of the fundamental security challenges in our evolving digital society. To address this critical issue, this project aims to design a novel homomorphic encryption-based language model architecture. To achieve fully homomorphic encryption (FHE) compatibility for language models, the project proposes to structurally modify the Transformer architecture to support homomorphic operations, enabling inference on encrypted data. This enhanced model maintains rigorous privacy protection for user data while permitting untrusted third parties to process information without requiring decryption capabilities.	Technical report	Python programming / AI / Language processing	No	Individual
A	LW3	LOU Wei		Fine-tune the LLMs to defend against multi-model jailbreak attacks	1	1,8, 20,21	One challenge of the safety of large language models (LLMs) is to safeguard LLMs from the generation of harmful content. However, the inherent vulnerability of safety alignment mechanisms embedded in current LLMs may lead to a potential jailbreak attack due to multi-model harmful inputs. In this project, we aim to investigate this potential jailbreak attack by exploiting LLMs' safety vulnerabilities of multi-modal inputs and devise fine-tuning mechanisms to defend against this jailbreak attack.	Technical report	Python programming / AI / Language processing	No	Individual
A	LW4	LOU Wei		Collaborative block-building robot	1	1,17, 27	In this project, the student will use NAO robots to assemble a jigsaw puzzle. The NAO robots will collaborate with each other to assemble a picture using small pieces of wooden blocks. The project expects to achieve the following tasks: 1. two robots collaborate to complete the task; 2. robots find the pieces of blocks; 3. robots go and pick up the blocks; 4. robots place the blocks at proper positions to assemble the desired picture.	Demonstration	Python, UI script programming, AI	No	Individual
A	LW5	LOU Wei		A classroom analysis system	1	1, 17, 22, 26	This project aims to develop an application that can (1) automatically collect students' facial information and (2) analyze the students' gestures and facial expressions through real-time classroom cameras using deep learning approaches. The application can provide the teacher with students' feedback about a teacher's teaching content.	Application	Python programming / AI / Image processing	No	Individual
C	LXY1	LU Xingye		Post-Quantum cryptography tools and its Application in Privacy-Enhanced Messaging Platform	3	20	This project aims to utilize post-quantum signature schemes and encryption scheme to build a privacy-enhanced messaging platform. The signature scheme will be used to gaurantee the authenticity and the encryption scheme will be used to gaurantee the confidentiality.	A messaging platform with basic chatting Functionality and post-quantum security	Basic understanding of internet security, cryptography. Programming skills: C++, Rust, Java	No	Group

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BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

BSc Information Security: Category C

BSc FTAI: Category A or D

Project Category	Project Code	Supervisor Name	Proposed co-supervisor, if any	Project Title	Quota: Number of Students	Area Code	Description of the Project	Expected Outcome	Knowledge/ Skill/ Tools Required	Industrial Elements in the Capstone Project	Group/ Individual Project
A	WCL1	LUI Richard		Reimagining Education with GenAI	4	1,4,13,32	<p>This project aims to explore the innovative use of GenAI in education. You can work on one of the following topics, or you can propose your own topic (please contact me to discuss your ideas).</p> <p>1. No-code learning app development for educators: The advancement of large language models (LLMs) allows people with little coding experience to develop their own apps or games. We hope to develop a platform that empowers educators with little coding experience to create customized web-based interactive learning activities and games (e.g., simulation-based games) by using LLMs with agentic workflow. For instance, teachers may provide the topic and game ideas, and the platform may generate the game design, complete the coding task, and streamline the process of playtesting and balancing of the game, etc.</p> <p>2. Intelligent tutoring platforms: GPTutor is a GenAI-powered platform we have developed (https://gptutor.comp.polyu.edu.hk) where students can ask questions based on the lecture contents and engage in simulation. Students can work on tasks or research to improve the platform. Depending on students' interests or skills, students can participate in the research and development of a powered learning platform. Examples: 1) Gamify the platform and develop interactive/collaborative learning to increase the engagement of the learning process) Develop a personalized learning AI agent which can interact with the students in different modes in an engaging way, generating and suggesting learning resources (e.g. learning resources from YouTube)</p> <p>3. Develop an AI-powered learning application or game with the use or integration with GenAI.</p>	System Development	Web-based development framework (e.g. HTML, NextJS, JavaScript/TypeScript or other web frameworks)/Mobile Apps Development	No	Individual/ Group
A	WCL2	LUI Richard		A GenAI app to address misunderstanding and false beliefs about autism in families	1	1,4,13,32	<p>This project aims to develop generative AI-based mobile application aimed at dispelling myths and reducing stigma surrounding autism spectrum disorder (ASD) among families in Hong Kong. By providing culturally sensitive and accurate educational content, the application seeks to overcome the barriers imposed by false beliefs (e.g. ASD can be treated by drugs and caused by poor parenting) and the unique challenges of Chinese cultural values.</p> <p>The project may involve the prompting, the use of RAG and agentic workflow, and potentially fine-tuning LLMs for both ASD-related content and relevant cultural contexts. The app should integrate text, audio, and image-based features to deliver tailored, persuasive communications to users. It is designed to recognize user demographics and language preferences (e.g. Cantonese, Putonghua, and English) to provide personalized interactions through different virtual characters (e.g., a wiser, older person to discuss issues of cultural values and a doctor to discuss treatment)</p>	System Development	Web-based and Mobile Apps Development	No	Individual/ Group
A	WCL3	LUI Richard		Interactive learning activities and Simulation Game Development	2	1,4,13,32	Students can design a new app/game or work on the enhancement of the simulation games we developed in earlier years (e.g. Scrum Game (https://scrumgame.vl.comp.polyu.edu.hk), Simpsyber game (https://cindymak-sy.github.io/SimPsyber)). Students can also develop new games and interactive learning activities. AI avatars can be incorporated into the game to enhance interactivity. Students can use GenAI to assist in their app or game development process	System Development	Web-based development framework (e.g. HTML, NextJS, JavaScript/TypeScript or other web frameworks)	No	Individual/ Group

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Project Category	Project Code	Supervisor Name	Proposed co-supervisor, if any	Project Title	Quota: Number of Students	Area Code	Description of the Project	Expected Outcome	Knowledge/ Skill/ Tools Required	Industrial Elements in the Capstone Project	Group/ Individual Project
A	WCL4	LUI Richard		Metaverse for Science Education	1	1,4,13,32	This is a collaborative project with instructors from the Faculty of Science at HK PolyU to develop a metaverse environment for science education using digital storytelling, interactive simulations, and AI-powered NPCs. Students can choose the theme they wish to work on based on their interests. Examples: 1.From Waste to Wealth: Building a Sustainable City: Learners will transform a waste-filled digital city into a sustainable utopia by repurposing food waste and plastic into valuable products and sustainable packaging. 2.Food Processing and Production: Learners will explore modern food production processes, manage production lines, repurpose waste, and ensure food quality. 3.Meat and Egg Production: Learners will tackle ethical and environmental issues in traditional meat and egg production.	System Development	Unity	No	Individual/ Group
A	WCL5	LUI Richard		AI-powered Optometry Clinical Training	2	1,4,13,32	This is a collaborative project with the School of Optometry, which aims to enhance an AI-powered tutoring system that improves clinical skills training through the use of AI and computer vision such as object detection. The AI-enabled application assists optometry students in conducting simulated eye tests by monitoring key aspects of the clinical process. For instance, object detection can be used to accurately track instruments and equipment during the students' training sessions. Students are expected to train AI models, develop and upgrade app functionalities, and perform data analysis to improve the accuracy and usability of the system.	System Development	Web-based development framework (e.g. HTML, NextJS, JavaScript/TypeScript or other web frameworks), Machine learning model training	No	Individual/ Group
A	WCL6	LUI Richard		Data visualization and AI Model Development for Hong Kong Observatory's meteorology data and flight data for aviators	2	1,8, 32, 100	This is a collaborative project with Hong Kong Observatory (HKO) and Hong Kong Youth Aviation Academy (HKYAA) which aims to develop a digital platform to analyze and present a wide range of meteorology and weather data which supports analysis by aviation workers and the general public. The goal is to help aviators such as pilots and air traffic controllers to improve flying conditions. To investigate the HKO's meteorology data, HKYAA will provide basic aviation knowledge, training, and guidance and you may have the opportunity to gain aviation exposure and direct education from aviation professionals including pilots, air traffic controllers, cabin crews, and engineers. This is a group project who will work on different areas based on students' interest and skills: 1) Develop a platform to consolidate meteorology data and visualize the information to aviation co-workers such as pilots and air traffic controllers; 2) Data analysis and AI model development using flight data and meteorology data from HKO and flight for prediction (e.g. Pilot's decision during flights) 3) Develop a platform to analyze specific meteorology data such as wind speed/direction and corresponding warnings such as windshear, designed for aviation co-workers to take appropriate actions.	System Development	Machine learning and Data analytics, Web-based and Mobile development	Yes	Individual/ Group
C	LXP1	LUO Daniel		Security Assessment of IoT devices	2	7, 20, 29	In this project, the students will develop tools to assess the security and privacy issues in IoT devices.	Security assessment tool and the reports on a set of IoT devices.	Very familiar with C/C++ and Android Programming and Python	No	Individual
C	LXP2	LUO Daniel		Security Assessment of Blockchain and Smart Contracts devices	2	7, 20, 29	In this project, the students will develop tools to assess the security and privacy issues in blockchain and smart contracts	Security assessment tool and the reports on selected blockchain platforms and smart contracts	Very familiar with programming languages used to develop blockchain platforms and their smart contracts	No	Individual

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Project Category (for Round 1):

BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

BSc Information Security: Category C

BSc FTAI: Category A or D

Project Category	Project Code	Supervisor Name	Proposed co-supervisor, if any	Project Title	Quota: Number of Students	Area Code	Description of the Project	Expected Outcome	Knowledge/ Skill/ Tools Required	Industrial Elements in the Capstone Project	Group/ Individual Project
A	LMS1	LYU Mingsong		Efficient Intermittent DNN Inference on Energy Harvesting Devices	1	28	Nowadays, more and more IoT devices are powered by energy harvesting. A problem is that such devices can only carry small energy harvesters and the harvesting power is very low and unstable. The result is that the software task running on the device may experience frequent power failures, and may never make progress. This project considers DNN inference as application tasks. The target of the project is to design a new execution approach that enables a DNN inference task to execute intermittently so that it can make incremental progress across multiple power cycles. Of course, the extra overhead of achieving this target should be as small as possible, and this requirement will be considered in the design of the execution approach.	An execution approach and its implementation; demonstrations to show that the DNN inference can progress incrementally.	C programming, work with embedded boards.	No	Individual
A	LMS2	LYU Mingsong		An LLM-Based Question Generation System for the Introduction to Computer Systems Course	1	1,4	This project aims to design a system that automatically generates test questions for the course "Introduction to Computer Systems" using a Large Language Model (LLM). Based on extracted course knowledge points and question types, the system enables instructors to specify target topics and generate relevant questions such as multiple choice, short answer, or code-based problems. Through systematic experimentation and evaluation, the project aims to derive effective prompt templates and identify limitations in LLM-based question generation. The outcome will offer practical insights into integrating LLMs into educational assessment workflows, contributing to more efficient and adaptive test creation.	Software implementation with demonstratable system. Specialized prompts for the target task.	Large language models, python programming, LLM framework (such as Langchain)	No	Individual
A	LMS3	LYU Mingsong		An LLM-Based Question Generation System for the Data Structures Course	1	1,4	This project aims to design a system that automatically generates test questions for the course "Data Structures" using a Large Language Model (LLM). Based on extracted course knowledge points and question types, the system enables instructors to specify target topics and generate relevant questions such as multiple choice, short answer, or code-based problems. Through systematic experimentation and evaluation, the project aims to derive effective prompt templates and identify limitations in LLM-based question generation. The outcome will offer practical insights into integrating LLMs into educational assessment workflows, contributing to more efficient and adaptive test creation.	Software implementation with demonstratable system. Specialized prompts for the target task.	Large language models, python programming, LLM framework (such as Langchain)	No	Individual
A	MA1	MOHAMMED Aquil Mirza		INTEGRATING MQTT AND ESP32-S3 FOR IoT EDGE COMPUTING ON RASPBERRY PI WITH MACHINE LEARNING CAPABILITIES	2	1, 7, 15, 17, 27, 100	This project focuses on the integration of MQTT protocol and ESP32-S3 microcontroller to enhance IoT applications through edge computing. By leveraging the computational power of Raspberry Pi, the system will collect, analyze, and process data locally before sending it to the cloud. Machine learning algorithms will be implemented to predict and optimize device behavior based on user patterns. The project aims to improve response times and reduce latency, making it suitable for real-time applications. Additionally, the system will include a user-friendly interface for monitoring and controlling connected devices, showcasing the synergy between MQTT, ESP32-S3, and Raspberry Pi in a cohesive IoT ecosystem.	A responsive IoT system enabling real-time data processing and interaction through MQTT and machine learning.	Python Programming	Yes	Group

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Project Category (for Round 1):

BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

BSc Information Security: Category C

BSc FTAI: Category A or D

Project Category	Project Code	Supervisor Name	Proposed co-supervisor, if any	Project Title	Quota: Number of Students	Area Code	Description of the Project	Expected Outcome	Knowledge/ Skill/ Tools Required	Industrial Elements in the Capstone Project	Group/ Individual Project
A	MA2	MOHAMMED Aquil Mirza		DEPLOYING SPIKING NEURAL NETWORKS ON M5STICKC PLUS2 FOR AIoT APPLICATIONS IN FOG COMPUTING ENVIRONMENTS	2	1, 7, 15, 17, 27, 100	This capstone project investigates the deployment of spiking neural networks (SNNs) on the M5StickC Plus2 microcontroller to enhance AIoT applications within fog computing environments. SNNs, known for their bio-inspired processing capabilities, will be utilized to perform complex tasks such as pattern recognition and decision making at the edge. The M5StickC Plus2 will serve as a compact and efficient platform to process data locally, reducing the need for cloud resources and minimizing latency. By integrating fog computing principles, the project aims to demonstrate how SNNs can facilitate real-time data processing and intelligent decision-making in resource-constrained settings, paving the way for smarter IoT devices.	An advanced AIoT application utilizing spiking neural networks for efficient real-time decision-making at the edge.	Python Programming	Yes	Group
A	MA3	MOHAMMED Aquil Mirza		DEVELOPING A SMART AUTOMATION SYSTEM USING ARDUINO UNO AND iOS SHORTCUTS FOR EFFICIENT EDGE COMPUTING SOLUTIONS	2	1, 7, 15, 17, 27, 100	This project aims to create a smart automation system utilizing Arduino Uno and iOS shortcuts to enhance edge computing solutions. The system will enable users to automate various tasks, such as controlling home appliances or monitoring environmental conditions, through a mobile application. By leveraging iOS shortcuts, users can create personalized automation routines that trigger Arduino-controlled devices based on specific conditions. The project focuses on developing a user-friendly interface and integrating sensors to gather real-time data. This innovative approach combines the simplicity of Arduino with the convenience of iOS, promoting efficient and customizable automation in smart homes.	An intuitive automation system that combines Arduino and iOS shortcuts for seamless task management in smart homes.	Python Programming	Yes	Group
A	MA4	MOHAMMED Aquil Mirza		SMART DOOR AND WINDOW AUTOMATION SYSTEM USING AIoT FOR REAL-TIME ACCESS CONTROL	3	1, 7, 15, 17, 27, 100	This capstone project explores the development of a smart door and window automation system that utilizes AIoT techniques for real-time access control. The system will incorporate various sensors, including motion detectors and RFID readers, to enhance security and user convenience. Users can control access through a mobile application, allowing them to open or close doors and windows remotely. Additionally, the project will implement machine learning algorithms to analyze user behavior and optimize access patterns. By integrating AIoT technologies, the system aims to provide a seamless experience for users while ensuring safety and efficiency in managing access to their homes or offices.	A secure access control system automating doors and windows in real-time through AIoT technologies.	Python Programming	Yes	Group
A	MA5	MOHAMMED Aquil Mirza		DEVELOPMENT OF A ROS-BASED MOBILE ROBOT FOR ENVIRONMENTAL MONITORING AND DATA ANALYSIS	3	1, 7, 15, 17, 27, 100	This project aims to develop a mobile robot utilizing the Robot Operating System (ROS) for environmental monitoring. The robot will be equipped with various sensors, including temperature, humidity, gas, and light sensors, to collect real-time environmental data. The robot will navigate autonomously using ROS navigation stack capabilities, allowing it to traverse predefined paths and avoid obstacles in its environment. Data collected will be processed and analyzed using ROS packages, enabling efficient data visualization and reporting. Additionally, the project will implement a user interface for monitoring the robot's status and environmental data remotely via a web application. The combination of ROS with a mobile robot provides valuable insights into environmental conditions while showcasing the flexibility and power of ROS in robotic applications.	A functional mobile robot utilizing ROS for real-time environmental monitoring and data analysis, showcasing innovative robotic applications.	ROS / Python Programming	Yes	Group

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Project Category (for Round 1):

BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

BSc Information Security: Category C

BSc FTAI: Category A or D

Project Category	Project Code	Supervisor Name	Proposed co-supervisor, if any	Project Title	Quota: Number of Students	Area Code	Description of the Project	Expected Outcome	Knowledge/ Skill/ Tools Required	Industrial Elements in the Capstone Project	Group/ Individual Project
A/B	PN1	NG Peter		Immersive Virtual Tourism with 3DGS and Digital Humans	4	1, 6, 15, 104	This capstone project leverages 3D Game Scene (3DGS) reconstruction technology and lifelike digital humans to create an immersive virtual tourism experience. By digitally recreating real-world cultural landmarks and integrating interactive digital guides, the project offers users an engaging and educational journey through historically and culturally significant sites—all accessible from any device. This innovation bridges physical distance and enhances cultural preservation through cutting-edge 3D visualization and storytelling.	Entertainment application	C# and Unity 3D or C++ and Unreal	Yes	Group
A	PWM1	PANG Wai Man	External Advisor: Dr. Kin Chung Kwan Assistant Professor, Computer Science Department, California State University, Sacramento, USA	Food Component Detection for Dietary Recommendation	3	1,15, 22, 30, 102	This project aims to create a system that helps people make better food choices by identifying what's in their meals. With many people facing health issues related to diet, this tool will be useful for anyone looking to eat healthier. The project will use technology to recognize and estimate nutrients like proteins, fats, vitamins, and minerals from pictures or descriptions of food. By combining this information with personal health goals, the system will offer customized dietary advice. This could help with goals like losing weight, boosting energy, or managing specific health conditions. The project will build a database of foods and their nutritional values and develop smart algorithms to analyze food data.	A database of foods and their nutrients. A system that can recognize food components from images. A simple interface for users to enter their dietary preferences and health goals. Personalized dietary advice based on the food detected. Reports on what nutrients users are consuming and tips for improvement. Compatibility with mobile devices for dietary tracking and recommendation.	Python, pytorch, opencv, mySQL(or other DB system) and kotlin	No	Group
A	PWM2	PANG Wai Man	External Advisor: Mr. YIU Chi Wai, Senior Engineer, Hong Kong Logistics and Supply Chain MultiTech R&D Centre	Embedded AI for the Multifunctional Delivery Robot	2	1,15, 22, 30, 102	This project will collaborate with the LSCM R&D center to enrich the multifunctional delivery robot with AI functionalities. The focus will be on integrating AI chatbot capabilities, object recognition, and autonomous navigation to enhance the robot's interaction and operational efficiency. By embedding AI chatbot functions, the robot will be able to communicate effectively with users, providing information and assistance during deliveries. Object recognition will enable the robot to identify and classify items accurately, ensuring precise handling and delivery. Advanced navigation algorithms will allow the robot to autonomously traverse complex environments, optimizing delivery routes and avoiding obstacles. The project will involve developing and implementing machine learning models to facilitate these functionalities, ensuring the robot can learn and adapt to its surroundings. The ultimate goal is to create a versatile delivery robot that can operate seamlessly in various settings, such as hospitals, warehouses, and urban areas	Integration of AI chatbot functions for enhanced user interaction. Development of object recognition capabilities for accurate item identification. Implementation of autonomous navigation algorithms for efficient route optimization. A multifunctional delivery robot capable of operating in diverse environments. Collaboration with LSCM R&D center to leverage cutting-edge technologies.	Python or kotlin, ROS (Robotics OS), ollama	Yes	Group
A	PWM3	PANG Wai Man		Mobile App Tour Guide with Vision and LLM for University Campus	2	1,15, 22, 30	This project aims to create a smart mobile application that enhances the visitor experience on university campuses. This app will use computer vision technology to recognize landmarks and buildings on campus through the visitor's smartphone camera. Once a location is identified, the app will provide real-time information, historical context, and interesting facts via audio or text. By integrating a Large Language Model (LLM), the app will also be able to answer questions and engage in natural language conversations, offering a personalized and interactive tour experience. This project will help prospective students, visitors, and new students navigate the campus while learning about its history, culture, and academic offerings in an engaging way.	A mobile app that uses vision technology to recognize campus landmarks. Integration of LLM for interactive and conversational capabilities. Real-time delivery of information and tour guidance based on recognized locations. Personalized tour experiences tailored to user preferences and interests. A user-friendly interface for easy navigation and interaction. Increased visitor engagement and satisfaction with campus tours.	Python, pytorch, opencv, mySQL(or other DB system) and kotlin	No	Group

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Project Category (for Round 1):

BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

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Project Category	Project Code	Supervisor Name	Proposed co-supervisor, if any	Project Title	Quota: Number of Students	Area Code	Description of the Project	Expected Outcome	Knowledge/ Skill/ Tools Required	Industrial Elements in the Capstone Project	Group/ Individual Project
A	PWM4	PANG Wai Man		RPA (robotic process automation) for Screen Control Automation	2	1,15, 22, 30	This project aims to develop a sophisticated system that utilizes Robotic Process Automation (RPA) combined with Large Language Models (LLMs) to automate repetitive screen-based tasks. This project will focus on creating intelligent bots that can understand and execute tasks involving user interfaces, such as data entry, form filling, and navigation across applications. By integrating LLMs, the system will be capable of interpreting natural language instructions and adapting to changes in screen layouts or workflows, making it highly versatile and efficient. The solution will be designed to streamline operations, reduce manual effort, and minimize errors in tasks that require frequent interaction with software interfaces. This approach will benefit businesses by freeing up human resources for more strategic activities and improving overall productivity.	Development of RPA bots capable of controlling and automating screen based tasks. Integration of LLMs for understanding and executing natural language instructions. Automation of repetitive tasks such as data entry and form filling. Adaptability to changes in screen layouts and workflows. Improved accuracy and efficiency in screen-based operations.	Python, ollama and other tools and frameworks related	No	Group
A	PWM5	PANG Wai Man		A MCP Server for handwritten quiz or assignments	3	1,15, 22, 30	This project aims to develop an innovative platform that leverages the Model Context Protocol (MCP) to enhance the interaction between AI models and educational data. MCP serves as a standardized framework for providing context to large language models (LLMs), much like how it standardizes access to diverse data sources such as local files and databases. By implementing an MCP server, we will enable the reading and recognition of content in handwritten quizzes and assignments. The server will integrate advanced optical character recognition (OCR) technology to digitize handwritten content, while MCP ensures consistent and accurate context delivery to AI models. This will facilitate precise grading, personalized feedback, and efficient management of educational materials. For more details on MCP, please refer to this link.	Implementation of an MCP server capable of accessing scanned images of quizzes and assignments. Robust integration of OCR technology to accurately digitize handwritten content. Reliable delivery of digitized results to LLMs for processing and evaluation. Development of a simple demo application that utilizes the server to request comments, grading, or other feedback from the LLM on the quizzes.	Python, MCP (Model Context Protocol), Claude desktop app, PaddleOCR or other OCR libraries	No	Group
D	AK1	PATHAK Kumar		Detection of Fake Samples during Contactless Finger Knuckle (or Palm) Identification	2	1, 26	This project will develop algorithms to automatically detect fake samples during the contactless finger-knuckle (/palm) identification. The deformation corrected knuckle images will be matched against the registered images to improve the matching accuracy.	Development and implementation of computer vision based algorithm to Detect Fake finger-knuckle (or Palm) Samples, Performance Analysis for the Fake Detection	Computer vision or Image processing background, Python/C/C++ programming	No	Individual
D	AK2	PATHAK Kumar		Smart Phone Based Detection of Contactless Palm (or Fingerprint) for Biometrics Identification	1	1, 15	This project proposes to develop a smartphone based solution to accurately detect contactless palm region of interest (or Fingerprint) to assist in their accurate identification. It will develop a computationally simpler and accurate approach for the detection, normalization and enhancement of the respective biometric trait.	Online Smartphone based Screening Application to Categorize Acquired Images into Red, Green and Yellow Categories	Deep Neural Networks, Python programming, PyTorch	No	Individual
D	AK3	PATHAK Kumar		Detection of Sophisticated Fake Images Synthesized by Generative Models	1	1, 15	This project will develop accurate methods to automatically detect sophisticated and real look-like fake images generated by the advanced generative AI techniques. Developed method will be independently evaluated on unseen images and videos from the unseen generative AI models.	Design and development of algorithm to detect real-look like fake images synthesized using generative AI techniques	Deep Neural Networks, Python programming, PyTorch	No	Individual
A	YP1	PEI Max		Automatic Slide Publication for PowerPoint	2	15,29	In this project, a student needs to extend the functionality of PowerPoint through VBA so that, during a presentation, slides that have been shown are automatically made available online.	A PowerPoint add-in	VBA programming	No	Individual
A	YP2	PEI Max		Teaching-Oriented Online Code Editor	2	15,29	In this project, a student needs to develop an online code editor with syntax highlighting. An editing window can be shared by the teacher with read-only access to students so that any edit in the window becomes immediately visible to the students. Students can easily create their own copies of the code, make modifications, and submit the modified code.	A web application	Web programming	No	Individual

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BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

BSc Information Security: Category C

BSc FTAI: Category A or D

Project Category	Project Code	Supervisor Name	Proposed co-supervisor, if any	Project Title	Quota: Number of Students	Area Code	Description of the Project	Expected Outcome	Knowledge/ Skill/ Tools Required	Industrial Elements in the Capstone Project	Group/ Individual Project
A	YP3	PEI Max		Zotero Settings Sync	2	15,29	In this project, a student needs to develop a settings sync service for the Zotero reference manager (similar to VS Code Settings Sync at https://github.com/shanalikhian/code-settings-sync).	A Zotero plugin	Java programming	No	Individual
A	SD1	SAXENA Divya		Computing Project	3	8	Spatio-temporal Data Prediction	Real-time system	Java/Python/Django	No	Individual
A	SJ1	SHI Jieming		Heterogeneous Information Network Representation Learning	1	8	In this project, it aims to conduct a thorough analysis of heterogeneous information networks, and study existing representation learning methods on such networks. The participant is expected to review existing methods, develop a comprehensive set of evaluation metrics, and perform experimental evaluation to compare the performance of existing methods.	Outcome1: get a comprehensive understanding of representation learning on heterogeneous information network; Outcome 2: build up the skills of implementing and evaluating existing solutions; Outcome 3: produce a comprehensive performance evaluation report.	Python/C++ Programming	No	Individual
A	SJ2	SHI Jieming		Knowledge Graph Embedding	1	8	In this project, it aims to manage and process knowledge graphs by leveraging the latest development of knowledge graph representation learning. The participant is expected to review existing methods, and develop knowledge graph embedding algorithms.	Outcome1: get a comprehensive understanding of knowledge graph processing and knowledge graph representation learning; Outcome 2: build up the skills of designing representation learning solutions on knowledge graphs; Outcome 3: implement a runnable method to handle knowledge graph learning.	Python/C++ Programming	No	Individual
A	SJ3	SHI Jieming		Stock Data Analysis from Time Series Modeling	1	8	Stock market data are important in financial services. This project involves in-depth analysis on the characteristics of stock data that are modeled as time series data, review of existing time-series prediction algorithms, and design and implementation of new time series prediction algorithms.	Outcome 1: understand the features of stock data in time-series model; Outcome 2: acquire the knowledge of designing time-series prediction methods; Outcome 3: implement a runnable time series algorithm on stock data.	Java/C++ Programming	No	Individual
A	SJ4	SHI Jieming		Anomaly Detection on Graphs	1	8	There are many types of graph data, e.g. social networks, web graph, transaction networks, which are all important in real applications. This project aims to develop effective methods to detect abnormal activities on such networks. The participant is expected to review existing anomaly detection solutions, and design and implement anomaly detection solutions.	Outcome1: get a comprehensive understanding of anomaly detection problems; Outcome 2: build up the skills of designing anomaly detection solutions; Outcome 3: implement a runnable anomaly detection method on network data	Python/C++ Programming	No	Individual
A	SJ5	SHI Jieming		Financial Knowledge Graph Augmented Retrieval	1	8	In this project it aims to use financial knowledge graph as an augmented data source to let large language models better answer financial related questions.	Outcome 1: understand the features of financial knowledge graph data; Outcome 2: acquire the knowledge of designing graph augmented retrieval methods; Outcome 3: implement a runnable system.	Python/C++ Programming	No	Individual
A	SJ6	SHI Jieming		Blockchain Data Mining and Analysis	1	8	In this project, it aims to acquire large-scale blockchain open data, model the data as blockchain networks, and conduct comprehensive analysis, to identify the unique features of blockchain networks, and develop classification solutions on such data.	Outcome1: collect a large dataset of blockchain open data; Outcome2: get a comprehensive understanding of the unique features of blockchain data; Outcome 3: build up the skills of evaluating existing blockchain solutions; Outcome 4: develop a classification solution using the generated blockchain dataset.	Python/C++ Programming	No	Individual

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BSc Computing/ Computer Science/ IT: Category A

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A	SPT1	SIN Zackary		Photorealistic Game Development with Neural Rendering	1	6, 104	<p>Photorealistic rendering is a holy grail among AAA games, and is often beyond the reach of indie developers. However, with the recent advancement of neural rendering, 3D Gaussian Splatting provides a practical solution for rendering photorealistic scenes with reasonable computational and labor costs. Students joining this project will be among the pioneers in exploring how to adopt this state-of-the-art technology for game development. Via a mix-and-match approach, for example, mixing a scene from 3D Gaussian and MetaHuman from Unreal, we will be able to develop a graphically impressive game prototype. We will also work together on what game to actually design, which can range from FPS, City Building games and simulation games. A preliminary idea is to capture many objects from the real world and use them as photorealistic art assets to develop a life simulation game like the Sims.</p> <p>This project can help students grow their development skills. In the meantime, we will also address some current technical issues persisting in this novel game development methodology. The ability to identify a technical issue and overcome it is a mark of a good developer.</p>	(1) A photorealistic game prototype that is graphically impressive (2) Explore some of the challenges of game development with neural rendering technologies	Required: Unreal / Unity / game development Plus: computer graphics	No	Individual/ Group
A	SPT2	SIN Zackary		Design and Development of LLM-empowered Games	1	1, 15, 104	<p>Large-language models (LLMs) have various potential applications for games. For example, LLM can be used for simulating the non-playable characters (NPC), dynamic storytelling or quest generation. Students joining this project will be among the pioneers in exploring how to adapt LLM for game development/design. This project can help students grow their development skills. In the meantime, we will address some current technical issues that persist in this novel game development methodology. The ability to identify a technical issue and overcome it is a mark of a good developer.</p>	(1) A novel game prototype that showcase interesting application for LLM (2) Explore some of the challenges of game development with LLMs	Required: Unreal / Unity / game development Plus: prior LLM app experience	No	Individual/ Group
A	SPT3	SIN Zackary		Investigating the Application of AI for Game Development	1	1, 6, 15, 104	<p>This is a research project that aims to investigate how the era of AI can effect game design and development. Referring to SPT1 and SPT2, there are many research gaps in applying (generative) AI for game development. For example, other than LLM or neural rendering, applying diffusion models can be helpful for (dynamic) content generation. We will look into the current research trend and discover research gaps, and we will conduct research that caters to the student's interest. On the other hand, this project can also assist SPT1 or SPT2 by developing novel technologies to aid in their applications. Interested students are encouraged to contact me for further details.</p>	(1) A small-scale research project on game development and design (2) If the student has put enough effort, it is also hoped that a research paper can be generated	Required: Unreal / Unity / game development ; an interest for game/graphics/HCI research	No	Individual/ Group

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D	TKC1	TAN KC		Evolutionary Algorithms for Multi-Objective Routing and Packing Optimization Problems	1	1, 23	Numerous combinatorial multi-objective optimization problems require optimizing multiple objectives and handling various constraints. A prime example is the vehicle routing and packing problem, which incorporates 3-D loading constraints. This problem is a daily hurdle for logistics service providers and combines elements of vehicle routing, 3D-bin packing, and multiple objectives. Establishing the feasibility of a route necessitates the resolution of several NP-hard 3D-bin packing problems. In this context, the 3-D constraint implies that the container of a truck is a rectangular box with length, height, and width. The cargoes must not overlap each other and must be loaded within the truck container. The two primary objectives are to minimize the total travel distance and maximize the average loading rate of used trucks. The crux of the challenge is to devise a suitable encoding scheme for routing and solutions, formulate an efficient algorithm for managing constraints, and optimize multiple objectives. Consequently, these challenges necessitate the creation of sophisticated optimization algorithms and techniques. The successful application of these advanced methods in resolving 3D-bin routing and packing problems can significantly contribute to the evolution of optimization techniques for addressing real-world logistics problems.	Develop an efficient multi-objective evolutionary algorithm to solve packing and vehicle routing problems constrained by 3D-bin packing.	Java/Python/Matlab/C++ Programming	No	Individual
D	TKC2	TAN KC		Evolutionary Algorithms for Muti-Objective Flexible Job-Shop Scheduling Problems	1	1, 23	The multi-objective flexible job-shop scheduling problem is of paramount importance in the fields of production management and combinatorial optimization. This problem involves the concurrent scheduling of multiple jobs across various machines or workstations, considering conflicting objectives such as minimizing makespan, reducing total tardiness, and maximizing resource utilization. The vast array of potential combinations of jobs, machines, and processing sequences results in a highly combinatorial problem, making it computationally challenging to find an optimal solution. Moreover, the existence of multiple conflicting objectives categorizes it as a multi-objective optimization problem. In essence, addressing these challenges necessitates the design of advanced optimization algorithms. The successful application of these advanced methods in solving multi-objective flexible job-shop scheduling problems significantly contributes to the advancement of optimization techniques for addressing real-world production management problems.	Develop an efficient multi-objective evolutionary algorithm to address multi-objective flexible job-shop scheduling problems. It will also explore the impact of varying algorithm parameters on the quality of the solutions obtained.	Java/Python/Matlab/C++ Programming	No	Individual

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D	TKC3	TAN KC		Solving Traveling Salesman Problems Using Deep Reinforcement Learning	1	1, 23	The traveling salesman problem (TSP) is a classic combinatorial optimization problem where the objective is to identify the shortest possible route that visits a series of cities exactly once and returns to the origin. Deep reinforcement learning (DRL) has recently emerged as a novel approach to tackle the TSP, showcasing the ability to learn solution strategies without relying on specific heuristic knowledge. The objective of this project is to use DRL to solve the TSP and build an accurate and efficient DRL model to predict a path that visits all cities with the shortest possible total distance. Here, DRL includes three key components: state, action, and reward. The state is represented as a graph or sequence, including information about cities. The action is choosing the next city to visit. A reward function evaluates the effectiveness of an action, often using negative travel distance as a reward. The aim of DRL is to learn a policy that minimizes the total travel distance. Despite some success for DRL, its performance and efficiency remain challenged as the problem size increases. Thus, the students are encouraged to develop a more efficient DRL algorithm to solve a large-scale TSP.	Develop an effective deep reinforcement learning algorithm to solve traveling salesman problems and compare the proposed deep reinforcement learning algorithm with the traditional heuristic methods such as evolutionary algorithms.	Java/Python/Matlab/C++ Programming	No	Individual
A	JT1	TANG Jeff		Interactive Augmented Reality and Mixed Reality Guidance System with Virtual Avatars	2	1, 6, 15, 104	This project aims to develop an innovative Augmented Reality (AR) and Mixed Reality (MR) application that enhances user experiences through interactive 3D avatars and computer vision technologies. With the surge in AR/MR applications, there is a growing demand for solutions that blend the physical and digital worlds seamlessly. The primary objectives include creating customizable 3D avatars that can engage users in real-time, applying and fine-tuning artificial intelligence to cater to specific user needs, and leveraging computer vision to enable intuitive interactions. An example of this application is a virtual tour guide for the Hong Kong Polytechnic University (PolyU), utilizing Apple's Vision Pro. This guide will navigate users to various scenic spots on campus, allowing them to verbally interact with the avatar for information and directions. By integrating voice recognition and natural language processing, users can ask questions, receive personalized recommendations, and experience a dynamic, informative tour that enhances their understanding of the campus environment. This development-oriented project requires students to have strong skills in VR/3D development.	The final product will be an immersive AR/MR virtual tour guide for PolyU, offering engaging explorations. It will also include a virtual teacher or lab technician to guide students through laboratory experiments interactively, providing real-time instructions and feedback to enhance learning and accessibility.	AR, MR and 3D modeling using Unity, C#, Python, LLM, voice recognition, text-to-speech, etc. (It's fine not to possess all the knowledge but to be eager to learn new techniques.)	No	Individual

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A	JT2	TANG Jeff		Enhancing Student Engagement in Higher Education Through Flipped Classrooms in the Metaverse	2	4, 6, 15, 104	<p>The project recognizes that today's students have different learning styles and demands compared to the past. Many students find traditional lectures and labs less useful, often preferring to stay at home and watch recorded lectures. This approach limits their opportunities to ask questions and interact with professors. By leveraging a Metaverse platform, learning can be gamified and made more engaging. The flipped classroom model encourages students to self-learn and prepare before attending lectures, enhancing their understanding of the material and boosting their confidence.</p> <p>Key objectives include promoting active participation, enhancing collaboration, and improving learning outcomes. Students will implement self-directed learning strategies and engage in interactive discussions during class. The platform will feature components such as virtual labs for hands-on experiments, historical simulations for immersive learning experiences, and gamified assessments to reinforce knowledge. For instance, a history module might allow students to explore ancient civilizations interactively, while a science module could simulate lab experiments in a virtual environment. By integrating these elements, the project aims to create a vibrant learning community that bridges the gap between traditional education and modern technology, making higher education more engaging and accessible for today's digital generation.</p>	<p>The expected outcome is an engaging virtual learning platform that enhances student participation and collaboration, featuring interactive components that facilitate real-time interactions between classmates and professors. This immersive environment will integrate gamified content and collaborative experiences to improve learning outcomes in higher education.</p>	<p>Unity3D, 3D modeling tools, real-time tools such as WebRTC, etc. (It's fine not to possess all the knowledge but to be eager to learn new techniques.)</p>	No	Individual
A	JT3	TANG Jeff		Innovation Topics on Low-altitude Economy	2	8, 18, 101	<p>This project addresses the growing demand for innovative applications of drones and flying vehicles across various sectors, including logistics, agriculture, and environmental monitoring. As drone technology advances, understanding its economic impact and establishing standards for safe and effective use becomes increasingly important. This study will explore how low-altitude operations, supported by cloud computing, can enhance efficiency, reduce costs while maintaining safety, and create new opportunities in emerging markets, emphasizing the critical role of technology in shaping future industries.</p> <p>Students participating in this project will have the opportunity to engage in either theoretical research or practical implementation. They can choose to define regulatory standards or develop software and hardware prototypes that utilize drones for specific tasks. For instance, one potential application could involve designing a drone system that monitors buildings for fraud in hard-to-reach areas, leveraging cloud infrastructure for efficient communication between the drone and the central system. This setup will facilitate efficient inspections and data collection while improving safety and accuracy.</p>	<p>The expected outcome includes either the implementation of a cloud-enabled drone system for real-time monitoring and data analysis or theoretical research, including necessary simulations, to develop standards for safe low-altitude operations.</p>	<p>Python, cloud computing, system simulation, drone technologies, data analysis (Pandas, TensorFlow), and aviation safety regulations. (It's fine not to possess all the knowledge but to be eager to learn new techniques.)</p>	No	Individual

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A	JT4	TANG Jeff		Investigating Collaborative Problem-Solving Among AI Agents	2	1, 8, 104	<p>As artificial intelligence continues to evolve, understanding how AI agents interact and collaborate has become increasingly vital. The demand for AI systems that can function effectively in team settings mirrors the complexities of human collaboration. By studying these interactions, we can uncover insights into collective intelligence among AI agents, potentially leading to systems that outperform human teams in specific tasks. This research holds promise for various applications, ranging from automated workflows in businesses to collaborative robotics in manufacturing.</p> <p>This research-oriented project requires strong programming skills. Students involved in this project will implement and observe AI agents as they tackle designated tasks, analyzing their teamwork dynamics and comparing them to human behavior. Participants will design experiments to evaluate communication patterns, efficiency, and decision-making processes among the agents. For instance, in a simulated workplace scenario, students can explore how AI agents collaborate to solve complex problems, offering insights into their performance and limitations.</p>	The expected outcome of this project is to develop a game featuring a comprehensive framework for analyzing AI agent interactions as they tackle complex problems.	Python, data analysis (Pandas, TensorFlow), game programming tools (It's fine not to possess all the knowledge but to be eager to learn new techniques.)	No	Individual
A	JT5	TANG Jeff		Exploring Innovative Applications of IoT Technology in Everyday Life	2	8, 19, 20, 30	<p>This project examines the growing demand for the Internet of Things (IoT), which connects everyday objects embedded with sensors and software to exchange data over the internet. As IoT technology evolves, there is an increasing need for innovative solutions that address real-world challenges, from enhancing home automation to improving industrial efficiency. The goal of this project is to harness IoT's potential to address common pain points in our daily lives.</p> <p>Students will develop prototype products that meet specific market demands by leveraging IoT technology. They will identify everyday challenges, design innovative solutions using sensors to collect environmental data, and provide meaningful feedback to users or systems. This hands-on experience will require programming skills, basic hardware assembly, and 3D printing techniques. Potential applications include an in-house farming system that monitors plant health and optimizes growth conditions, as well as a remote-controlled claw machine that allows users to catch dolls for fun and entertainment. These projects will demonstrate how IoT can transform ordinary activities into smarter, more engaging experiences.</p>	The expected outcome of this project is a functional prototype that demonstrates an innovative IoT application, effectively addressing a specific real-world problem while showcasing seamless integration of sensors, user feedback mechanisms, and data analytics.	Python, Arduino, Raspberry Pi, IoT protocols, data analytics, 3D printing, and user interface design. (It's fine not to possess all the knowledge but to be eager to learn new techniques.)	No	Individual

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A	JT6	TANG Jeff		Interactive Simulation and Training for Mastering Driving Skills and Enhancing Road Safety Awareness	2	6, 104	<p>In Hong Kong, obtaining a driver's license requires passing a written test and a road test that assesses basic driving skills. Applicants must successfully complete all components of the driving test before they can apply for a probationary or full license. Given the importance of road safety and the need for effective learning tools, there is a growing demand for innovative applications that help learners master essential driving skills. An engaging platform can enhance awareness of road safety and better prepare individuals for their driving tests, ultimately contributing to safer roads.</p> <p>Students will develop an application that includes a driving exam simulation, capable of automatically detecting when learners fail to perform specific tasks during the test, such as not checking their blind spot while turning. This application will combine elements like games, street view hyperlapse, and mixed reality training to create an interactive learning experience. Additionally, it should feature practice scenarios that help learners remember the shortest and safest routes to well-known locations. For instance, students could implement a mixed reality component that simulates real driving conditions, allowing users to practice in a safe environment and improve their skills for personal driving or as aspiring taxi drivers.</p>	Develop a VR or mixed reality application that helps learners master driving test materials, providing the knowledge and skills needed to become confident, responsible drivers.	Google API, Web technology, 3D skills (optional)	No	Individual
A	TM1	TAYYAB Muhammad		Intelligent Educational Systems	4	1,4,12, 15, 101	<p>Developing systems that enhance teaching and learning experiences through automation and AI. It includes several fields such as AI-powered tutoring systems, Adaptive learning platforms, Personalized study assistants, and Automated assessment and feedback systems</p>	Smart education system	Web development, AI development and integration, strong programming background	No	Group
A	TM2	TAYYAB Muhammad		Automated Educational Management and Decision Support	4	1,4,8, 29	<p>It aims to optimize institutional operations through automation using AI and data analytics. By integrating predictive analytics and ML, we can manage scheduling, resource allocation, performance tracking, and much more efficiently. Innovations include intelligent scheduling tools, automated resource management solutions, comprehensive student performance dashboards, data-driven decision support systems designed to enhance overall operational effectiveness.</p>	Advanced learning and management system	Strong programming background, AI, ML, data analytics, web development, systems integration	No	Group
A	TM3	TAYYAB Muhammad		Automated code evaluation	4	1,4,12, 23, 29, 101	<p>Coding evaluation platform systems must accurately assess diverse coding approaches, accommodate different styles and efficient solutions, and generate comprehensive test suites to cover both common and edge cases. In parallel, robust plagiarism detection and code similarity analysis are crucial to ensure academic integrity. Creating a secure and isolated software development environment is essential to safely execute untrusted code while maintaining realistic developer tools and managing resource allocation effectively. Providing detailed, actionable feedback in university environment not only assists both professors and students.</p>	Advanced coding and learning environment	Strong programming background, AI finetuning, custom ML,fuzzy systems	No	Group
A/B	DW1	WANG Dan		Industry analytics	2	1,8,10	We will develop data analytic mechanisms for industry data	An AI model for industry analytics	Good knowledge in data analytics	No	Individual
A/B	DW2	WANG Dan		Edge computing	2	7,19,22,100	We will develop new mechanisms in edge computing for video analytics acceleration	A edge-side video analytics system	Embedded programming skills, image processing	No	Individual
A	WQ1	WANG Qixin		An online reservation system for teaching	6	10,19,32	In this project, the student is expected to build a website for groups of students to reserve time slots to meet with the teacher. For example, the website will be used for semester project demo time slot reservation.	A runnable dockerized or virtual machine-nized website (on PolyU's campus network) that allows time slot reservation to make semester project demos.	Linux programming, familiar with 3-tier website programming.	No	Individual

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A/D	WJB1	WU Jibin		Toward Next-Generation EEG Decoding Algorithms: From Specialized Models to EEG Foundation Models	6	1,3,8,12,15	Brain-computer interfaces (BCIs) enable direct communication between the brain and external devices by decoding neural signals, with electroencephalogram (EEG) being one of the most widely used modalities due to its non-invasive nature. However, EEG data has a low signal-to-noise ratio, and data collection is time-consuming, making most EEG decoding approaches dependent on specialized models trained with limited data. These models often struggle to generalize across different subjects, datasets, and tasks. Inspired by the success of foundation models in domains such as natural language processing and computer vision, a growing trend in BCI research is leveraging large-scale EEG data collected from diverse tasks, subjects, and datasets to develop EEG foundation models—capable of learning robust and transferable representations of EEG signals. This project aims to develop a scalable and generalizable EEG foundational model by leveraging large-scale EEG data and advanced deep learning techniques. By capturing the underlying structure of brain activity across diverse contexts, the model will improve EEG decoding performance and generalization. Its effectiveness will be evaluated across diverse subjects, datasets, and tasks to ensure adaptability and robustness, ultimately enhancing BCI systems for real-world applications.	1.Understand the data structure and data preprocessing pipeline of EEG datasets. 2.Develop traditional expert EEG decoding models for EEG classification tasks. 3. Conduct research on EEG foundation models using the processed data.	Python Programming, Deep Learning, PyTorch, MATLAB	No	Individual
D	WXM1	WU Xiaoming		User Satisfaction Estimation in Task-oriented Dialogue Systems	3	1,26	In this project, students will learn how to estimate user satisfaction for task-oriented dialogue systems. They are expected to explore and apply techniques in natural language processing such as pre-trained language models and multi-task learning for dialogue analysis.	1. Understand related concepts in dialogue systems and recent popular techniques in natural language processing. 2. Explore and implement deep learning models such as LSTM and BERT for user satisfaction estimation.	Python Programming & deep learning	Yes	Individual
D	WXM2	WU Xiaoming		Emotion Recognition in Conversation with Deep Learning	3	1,26	The aim of this project is to identify each utterance's emotion from a conversation. Students are expected to explore deep learning techniques for natural language processing such as pre-trained language models, gated recurrent unit, or LSTM to classify utterances into different emotion.	1. Learn related concepts about dialogue comprehension and emotion recognition. 2. Explore and implement deep learning models (e.g., GRU, LSTM) for dialogue comprehension emotion recognition.	Python Programming & deep learning	Yes	Individual
D	WYJ1	WU Yujie		Financial Time Series Prediction Using Advanced Neural Network Models	3	1	Predicting financial time series is challenging yet crucial for financial technology. Traditional approaches, such as Linear Regression and basic Recurrent Neural Networks (RNN), often fail to effectively capture the complex, nonlinear relationships inherent in financial data. Recent advancements in neural network models—including Spiking Neural Networks (SNNs), Long Short-Term Memory (LSTM) and Transformers—offer promising solutions for capturing complex temporal dependencies in financial time-series tasks. In this project, each team member will apply two advanced neural network models to handle a specific financial prediction scenario, addressing distinct prediction tasks. Evaluation will consider code reproducibility, model performance analysis, classification accuracy, and reporting of training and testing loss.	1. To be familiarize with advanced neural network models, from foundational concepts to sophisticated applications, cultivating comprehensive insight into the domain. 2. Proficient application of neural network models to address time series prediction tasks	Basic knowledge of neural network models (e.g., MLP and RNN); PyTorch programming framework.	No	Individual

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C	XX1	XIA Xianjin		Design and Implementation of LoRa Gateway	1	7,11	The project aims to build a prototype of LoRa gateway and IoT network system. You will use the gateway to connect a large number of IoT devices using LoRa technology and connect gateway to Internet based IoT application servers. You need to build a testbed LoRa network consisting of one gateway and many LoRa nodes. You will use the testbed to do a series of experiment studies to test the communication performance of LoRa in terms of energy performance, reliability, maximum transmission range, etc.	(1) Build a LoRa based IoT network using commodity LoRa gateway and LoRa nodes; (2) Write programs to control LoRa nodes and gateways to send and receive packets; (3) Perform experiments to test the communication performance of LoRa.	Matlab/C programming; Embedded system development using Arduino	No	Individual
C	XX2	XIA Xianjin		Low Earth Orbit Satellite IoT	1	7,11	The project aims to build a prototype testbed system of Satellite IoT system. You will use LoRa based IoT devices to connect directly to Low Earth Orbit (LEO) Satellites, and receive data from the Satellites. You need to build a testbed system consisting of one Satellite ground station, many IoT nodes, and a cloud based satellite scheduling system. You will use the testbed to do a series of experiment studies to test the performance of Satellite IoT in terms of energy performance, reliability, etc.	(1) Build a Satellite IoT networking testbed using a ground station and many LoRa based end IoT nodes; (2) Write programs to control LoRa nodes and satellite ground station to send and receive packets; (3) Perform experiments to test the communication performance of Satellite IoT.	Matlab/C programming; Embedded system development using Arduino	No	Individual
C	XX3	XIA Xianjin		LLM for Smart Agriculture	1	7,11	The project aims to build a AI driven smart agriculture system. You will fine-tune open-source LLM with agricultural data, build agricultural AI agent to analyze agricultural data, automatically plan agriculture tasks, and execute various agricultural tasks. You need to build a prototype system of one generic AI agent for agriculture. You will use the system to do a series of case studies, such as irrigation scheduling, crop disease diagnosis, to evaluate the performance of the system.	(1) Fine-tuning open-source LLM for agriculture; (2) Build AI Agent for agricultural tasks; (3) Perform experiments to test the effectiveness of the agricultural AI agent.	Python; Matlab/C programming	No	Individual
A/C	XB1	XIAO Bin		AI Security and Privacy	2	1, 7, 8, 20	Artificial Intelligence (AI) technology has been broadly applied today and will take a more important role in the near future in our daily lives. However, the AI models, e.g., deep learning models/LLM, may be attacked and those models can generate false results. How to launch attacks on an AI model or to defend against those attacks will be analyzed. Moreover, AI models should not leak user/data information. How to protect data privacy in AI models, e.g., LLM, is critical. Students can choose either a security or privacy topic to conduct the project.	AI model security/privacy analysis	Programming skill and deep learning knowledge	No	Individual/ Group
A/C	XB2	XIAO Bin		Blockchain System Security and Web3 DApps development	2	7, 12, 20, 30	The blockchain technique has been applied to a wide span of industrial applications, such as DeFi, NFT, Web3.0. In this project, you are expected to build a small-scale blockchain system or a Web3 application (individual or within a group). You can carry out a study like (either one): 1. wallet design in a Web3 application. 2. a blockchain application development, e.g. E-Voting. 3. the blockchain/Web3 system security analysis. For instance, authentication in Web3?	To have experience in a blockchain/Web3 system and corresponding problem-solving skills.	Java/python Programming, network security	No	Individual/ Group

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Project Category (for Round 1):

BSc Computing/ Computer Science/ IT: Category A

BSc EIS: Category B

BSc Information Security: Category C

BSc FTAI: Category A or D

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C	XH1	XIE Hongcheng		A Secure End-to-End Instant Chat Application	4	7,10,19,20	<p>Instant chatting is one of the most popular applications nowadays. People send anything they want to say to each other. Since a chat dialog may contain sensitive information, it is very important to keep our communications safe.</p> <p>This project involves developing a secure, cross-platform messaging application compatible with iOS, Android and desktop (Windows/macOS). Designed for practical learning, it focuses on end-to-end encryption (E2EE) to protect messages, voice/video calls, and file transfers, ensuring only authorized users can access content. Built with modern tools, students will integrate cryptographic protocols to guarantee tamper-proof communication.</p> <p>For students, this project offers hands-on experience in full-stack development, including UI design, API integration, database management, and cybersecurity practices. It encourages teamwork by dividing tasks into modular components, such as encryption logic implementation or cloud backup systems.</p> <p>By completing this project, students gain industry-relevant skills in secure app development, enhancing their resumes and understanding of real-world privacy challenges.</p>	The software implementation	C++/Python/Java/Javascript; network protocols; cryptography	No	Individual
C	XH2	XIE Hongcheng		Privacy-preserving Cloud Storage Gateway for Secure File Sharing	4	7,10,19,20,32	<p>This project aims to build a secure gateway system that encrypts user files before uploading them to public cloud storage (e.g., AWS S3) while enabling fine-grained access control. Key features include client-side encryption to ensure cloud providers cannot access raw data, and encryption to enforce dynamic sharing policies (e.g., "Only R&D members can edit"). Users define access rules via a browser extension or mobile app, and the gateway automatically encrypts files, binds decryption keys to policies, and manages secure file transfers.</p> <p>The system includes a proxy server for policy validation, a logging module for GDPR-compliant audits, and integration with mainstream cloud APIs. Students will learn cryptographic techniques, cloud storage protocols, and full-stack development. The project emphasizes balancing security with performance, such as optimizing encryption latency and handling large file chunking. Deliverables include a functional prototype with user management, encrypted file sharing, policy-driven access controls, tamper-proof audit logs, and other features.</p> <p>This hands-on experience prepares students for privacy-focused software roles, combining cutting-edge cryptography with scalable cloud architecture.</p>	The software implementation	C++/Python/Java/Javascript; network protocols; cryptography	No	Individual

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C	XH3	XIE Hongcheng		Enterprise Data Leakage Prevention System	4	7,20,29,32	This project develops an enterprise-level security system to combat sensitive data leaks (e.g., financial records, contracts) by integrating AI-driven detection, dynamic watermarking, and self-destruction. The system employs hybrid AI models to classify sensitive data across documents, images, and code, ensuring high accuracy with minimal false alarms. Files are protected via encryption, with invisible steganographic watermarks or visible user tags embedded to trace leaks. A blockchain smart contract automatically invalidates files when unauthorized access occurs—triggered by geofencing breaches or expiration timelines—by revoking decryption keys stored in a distributed key management system. Students will implement a cross-platform prototype featuring a centralized policy console for real-time monitoring, USB access controls, and tamper-proof audit logs compliant with GDPR. Key evaluation metrics include watermark robustness against cropping/compression attacks, encryption latency, and self-destruction reliability. This project bridges data anonymization, cryptography, and decentralized systems, offering hands-on experience in modern defense mechanisms against insider threats and external breaches.	The software implementation	C++/Python/Java/Javascript; Solidity; Blockchain; network protocols; cryptography	No	Individual
A	YB1	YANG Bo		Semantic Segmentation of 3D Point Clouds	2	1,23	This project aim to learn the semantic segmentation of large-scale 3D scenes. This is a fundamental necessity for autonomous driving, augmented reality, and robotics.	(1) To reproduce the results of a top tier conference paper; (2) To improve the efficiency or accuracy of the existing method.	Linux, Python Programming, Tensorflow or Pytorch	No	Individual
A	YB2	YANG Bo		Object Segmentation of 3D Point Clouds	2	1,23	This project aim to learn the object segmentation of large-scale 3D scenes. This is a fundamental necessity for autonomous driving, augmented reality, and robotics.	(1) To reproduce the results of a top tier conference paper; (2) To improve the efficiency or accuracy of the existing method.	Linux, Python Programming, Tensorflow or Pytorch	No	Individual
A	YB3	YANG Bo		Robot Manipulation	2	1,23	This project aim to learn robot manipulation skills using deep learning.	(1) To reproduce the results of a top tier conference paper; (2) To improve the efficiency or accuracy of the existing method.	Linux, C++, ROS, Python Programming, Tensorflow or Pytorch	No	Individual
A	YH1	YANG Hongxia		LLM for Healthcare	4	1,8	The project establishes a comprehensive Hepatocellular carcinoma (HCC) research pipeline spanning from multimodal database creation, AI-enhanced diagnostics framework, and novel biomarker identification to tailored cancer vaccine development for HCC patient, precision medicine advancement and clinical outcome improvement.	Task 1 Establishment of Multimodal HCC Cohort Task 2 HCC Diagnostic Model Development Task 3 Novel Biomarker and Therapeutic Target Discovery and Validation	Python & SQL	No	Group
A	YL1	YANG Ray		Understanding indoor localization by deep learning	1	7,23	This project aims to use deep learning for positioning a wireless device.	A Bluetooth based localization system	Python, Mobile computing Knowledge	Yes	Individual
A	YL2	YANG Ray		Web Study Platform	2	11	This project aims to develop a web study website, which supports students to edit/compile/run html/JS/CSS code online.	A website	Web development	No	Group
C	YL4	YANG Ray		Attack on Voice Assistant	3	1,15	This is a project aims to explore vulnerabilities and potential security threats in voice assistant technologies.	Attack and defence solution	Java or other programming language	No	Individual
A	YK1	YIU Ken		Simulator for a data storage device	2	5	The goal of this project is to implement a simulator for a data storage device (e.g., hard disk or SSD). Your simulator should reflect the characteristics of the storage device (e.g., sector, cylinder, the speed of sequential/random data access, data layout for hard disk). Your simulator should have a graphical user interface.	Simulator for a data storage device	Computer architecture	No	Individual
A	YK2	YIU Ken		Tool for learning a programming language	2	9,27	The goal of this project is to develop a tool to help your fellow students to learn a specific programming language. The implementation language of your tool can be different from the target language for students. You will also need to evaluate the effectiveness of your tool on fellow students.	Tool (app/website) for learning a programming language	Web programming or app programming	No	Individual

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BSc Information Security: Category C

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A/B	ZC1	ZHANG Jason		Computing Project	4	1, 8, 15	This project aims to develop efficient algorithms for explainable artificial intelligence (XAI) that can provide accurate and interpretable explanations for AI models' decisions while minimizing the impact on performance. The project will explore various XAI techniques such as LIME, SHAP, decision trees, and gradient-based attribution methods and identify ways to optimize their performance by reducing the time taken to generate explanations and minimizing the computational resources required. The project will involve data collection, preprocessing, model selection and training, algorithm development, and evaluation. The expected outcomes of the project include the development of efficient XAI algorithms, the improvement of the interpretability of AI models, and the potential applications of the XAI techniques in real-world scenarios.	By the end of the project, we aim to contribute to the growing field of XAI by developing efficient algorithms that can be used to improve the transparency and accountability of AI models in various domains.	Python	No	Individual
A	Zhang-Zhaorui3	ZHANG Zhaorui		Large Language Model Fine-Tuning and Inference, AI Infrastructure	3	1,15	With the rapid development of Large Language Models and the increasing of the model scale, training and inference for large-scale machine learning models become highly time-consuming tasks. Thus, providing an efficient fine-tuning and inference approach in distributed environments becomes more and more critical. This project aims to provide an efficient large language model fine-tuning and inference system to reduce the time and resource consumption for large language models, such as reducing communication and computation overhead.	Research paper and efficient large language model fine-tuning and inference systems	Python, Pytorch/Tensorflow, Large Language Model	Yes	Individual/ Group
A	ZYQ1	ZHENG Yuanqing		LLM based Program Synthesis	6	1, 27	This project aims to leverage LLMs to automatically synthesize programs for various applications. The students are expected to propose novel ideas about applications that they are interested in, and design and implement the project. Students may leverage LLMs to synthesize python programs to process data, C/C++ programs for IoT devices, Java programs for mobile applications, etc. Students can fine-tune open source local models, or use remote LLM servers. The project is expected to deliver a real demo that showcases how to automatically synthesize the target programs.	1) Students are expected to deliver a real demo that showcases how to automatically synthesize the target programs, and deliver artifacts including tools, prompts, and programs developed in the project. 2) Students are expected to write reports and deliver presentations.	Java Programming, C/C++ Programming, Python Programming, AI, LLM	No	Individual
A	ZA1	ZHOU Alexander Tiannan		Sign Prediction on Social Networks	1	1,8,9	The task will be to predict whether two users on a social network are friends or enemies based on pre-existing information on the system. To accomplish this task will require an analysis of both deterministic methods as well as learning-based approaches.	Understanding Signed Graph Theory, Implementation of algorithms for sign prediction, Implementation of learning methods for sign prediction, Analysis and comparison of different techniques for the same goal	Graph Theory, Programming (Python and C++), Machine Learning	No	Individual
A	ZA2	ZHOU Alexander Tiannan		A Platform for Smart Data Storage and Retrieval for the Benefit of PolyU Students	2	8,9,32	This project will involve developing a web platform and/or a mobile application to benefit students of PolyU. The student will be required to consider the needs of students (with an eye of identifying what currently is not available) and create a new platform to fit that need, with the main goal of storing data that students may want to query in an efficient manner. This project will require web/app development skills combined with an understanding of complex data structures and their theoretical complexity analysis. Data may also need to be gathered by the student.	Implementation of Web/App Development, Designing and Implementing Complex Data Structures, Developing UI/UX that can visualise complex data	Web/App Development, Complexity Analysis, Advanced Data Structures (i.e. smart indexes)	No	Individual

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C	ZH1	ZHOU Hao		Security Assessment of MQTT Protocol	3	7,20,29	The increasing prevalence of IoT techniques and devices in various industries and everyday life in Hong Kong underscores the importance of ensuring the security of these technologies. As the city continues to advance in smart city initiatives, the digital economy, and new industrialization, the reliance on IoT for data transfer and communication has become integral. Despite the efforts of academia and industry to assess the security of IoT systems and devices, there remains a critical gap in the comprehensive analysis of IoT messaging protocols, which are fundamental to IoT and Vehicle-to-Vehicle communication. This project aims to address this gap by designing innovative approaches and developing practical tools to assess the security of the standard IoT messaging protocol MQTT. By employing program analysis and testing techniques, the project seeks to effectively identify memory bugs and semantic bugs in real-world MQTT implementations. The ultimate goal is to enhance the security of IoT devices, thereby contributing to the overall safety and reliability of IoT technologies in Hong Kong and beyond. Through this initiative, the project aims to support the continued development and integration of IoT in various sectors while prioritizing security and resilience.	(1) Understanding the common security problems in implementations of network protocols, especially for MQTT. (2) Understanding the fundamental approaches to assessing the security of implementations of network protocols, especially for MQTT. (3) Designing and implementing the approach to finding memory/semantic bugs in real-world MQTT implementations.	Network Protocol, Program Analysis, Program Testing, C/C++ or Python.	No	Group
C	ZK1	ZHOU Kai		Malware detection: the case study of Android malware	1	8,20	Malware is software intentionally designed by adversaries to cause all kinds of damages to computer systems. The detection of malware is thus a critical task to ensure information security. Modern malware detection systems rely on machine learning and data mining techniques to identify common patterns of malware for the purpose of detection. In this project, we will research state-of-the-art malware detection systems with android malware detection as a case study. The study consists of the following essential components. First, understand the working mechanisms of typical malware in android systems. Second dig into the details of popular detection techniques underneath the systems, including the most advanced graph-based detection systems based on graph neural networks. Third, implement the detection systems to detect real-world android malware, with the purpose of understanding the end-to-end workflow of malware detection in practise. Finally, document important findings in the project.	1 A in-depth understanding of the workflow of malware detection in the real world. 2 Understand and master several popular techniques used for malware detection. 3 A software that can effectively detect real-world android malware.	1 Knowledge in information security, machine learning, and data mining. 2 Programming skills in Python (preferably, also in pytorch)	No	Individual

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C	ZK2	ZHOU Kai		Evasion attack and defense in PDF malware detection	1	20,26	<p>PDF malware is malicious executable code hidden in PDF files. When PDF files are opened in a digital system such as a computer, the malware would then cause all kinds of damages to the system. Thus, researchers have developed various detection tools to detect the malware. This development process is not static – it is more like an arms race between the defender and the attacker: a defender deployed some detection tools to detect malware, then an attacker improves the malware to evade the detection tools, and the defender further enhances the tools to detect the improved malware, and this arms race goes on.</p> <p>In this project, we will take a close examination of this arms race between the defender and attacker using PDF malware detection as a case study. The project consists of four major components: (1) understand the working mechanism of PDF malware; (2) develop PDF malware detection tools based on machine learning techniques (3) design and implement attacks to allow malware to evade detection; (4) design and implement defense strategies to enhance the detection tools.</p>	<p>1 Design detection tools based on machine learning techniques to detect real-world PDF malware.</p> <p>2 Design and implement attack algorithms to evade PDF malware detection tools.</p> <p>3 Design and implement defense strategies to enhance PDF malware detection tools to better detect malware.</p>	<p>1 Knowledge in information security and machine learning.</p> <p>2 Experiences in designing and implementing machine learning algorithms.</p> <p>3 Programming skills in Python.</p>	No	Individual
C	ZK3	ZHOU Kai		An Empirical Study of Attacks Against Graph Learning Models	1	8,20	Currently, there are many existing attacks against machine learning models (e.g., GNNs) over graphs. Essentially, these attacks take effects by manipulating the input graph. The primary goal of this project is to measure how existing attacks would change the properties of the graphs. Specifically, we will learn to design and identify useful metrics to measure the changes of graphs.	<p>1 Understanding and Use of machine learning models over graphs;</p> <p>2 Deep understanding of the security aspect of those models;</p> <p>3 Programming experience in Python;</p> <p>4 Possibly a survey paper</p>	<p>1 Knowledge in information security and machine learning.</p> <p>2 Experiences in designing and implementing machine learning algorithms.</p> <p>3 Programming skills in Python.</p>	No	Individual
C	ZK4	ZHOU Kai		Robust Graph Neural Networks for node classification under attack	1	8,20	Data in various domains are naturally represented as attributed graphs, where nodes denote entities and edges indicate the relations among them. One essential task in graph data analysis is to classify those nodes into different categories. Node classification is the backbone of various applications such as fake accounts detection in social networks, documents classification in citation networks, and so on. Graph Neural Networks (GNNs) have become the state-of-the-art tools for node classification due to their superior performance. However, recent studies show that GNNs are vulnerable to unnoticeable perturbations on the graph structures. That is, an attacker can slightly modify the topology of the graph to mislead the classification by GNNs. This project investigates possible approaches to enhance the adversarial robustness of GNNs under attacks. The project consists of the following key components. First, implement representative GNN models for node classification. Second, implement effective structural attacks against GNN models. Third, survey, implement, and improve most recent defense approaches to enhance the robustness of GNNs.	<p>1 A comprehensive understanding of GNN models and their application in node classification tasks.</p> <p>2 An in-depth understanding of the vulnerabilities of GNN models under structural attacks</p> <p>3 Approaches that can defend against structural attacks, resulting in robust GNN models.</p>	<p>1 Knowledge in security, deep learning, especially in graph representation learning</p> <p>2 Programming skills in Python and Pytorch</p>	No	Individual

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C	ZK5	ZHOU Kai		The framework of federated machine learning to enhance data privacy	1	12,1	<p>The success of machine learning, especially deep learning, crucially depends on the availability of large amounts of training data. In the real world, the data is usually collected from multiple data owners. In cases where the data is private, the data owner would not be willing to contribute the data, making the trained machine learning model less effective. Federated learning is proposed as a solution framework to mitigate this issue. Specifically, in federated learning, multiple data owners will train the model locally based on their own data, and then cooperate to train a refined model by changing parameters, during which the data belonging to one party would not be exposed to other parties.</p> <p>In this project, we will investigate the mechanism of utilizing this federated learning framework in enhancing data privacy. Specifically, we will understand basic theories of federated learning. Then, we will design and implement effective multi-party protocols to realize the framework to protect data. At last, we will conduct extensive experiments to test the proposed protocols on real-world datasets.</p>	<p>1 In-depth understanding of the framework of federated learning.</p> <p>2 Efficient federated learning protocols to enhance data privacy.</p> <p>3 In-depth understanding of the trade-off between data privacy and the performance of machine learning models.</p>	<p>1 Basic knowledge in machine learning (deep learning) and algorithms design.</p> <p>2 Programming skills in Python (pytorch).</p> <p>3 Experience in developing machine learning systems.</p>	No	Individual
C	ZK6	ZHOU Kai		Detecting Financial Crimes in Transaction Networks based on Machine Learning	1	8,103	<p>In the modern digital era, the widespread adoption of online transactions, particularly in the realm of cryptocurrencies, has brought about a surge in financial crimes. The advent of this new financial landscape has exposed individuals and organizations to a range of fraudulent activities, including money laundering, phishing scams, and Ponzi schemes. As a result, it has become imperative to develop robust strategies to counter these attacks effectively.</p> <p>This project aims to equip you with the necessary knowledge and skills to tackle these financial crimes head-on. You will embark on a journey to understand how transaction data can be transformed into graph representations, enabling a more comprehensive analysis of interconnected financial networks. By leveraging machine learning techniques, you will explore innovative approaches to detect and prevent these malicious activities.</p> <p>Through this project, you will delve into the intricacies of graph-based data modeling and gain insights into the underlying patterns and relationships within financial transactions. Armed with this understanding, you will learn to design and implement advanced machine learning algorithms capable of identifying suspicious activities and flagging potential threats in real-time.</p>	<p>1 Understanding how to model financial transaction data as graphs;</p> <p>2 Understanding how to design and implement machine learning models over graphs</p> <p>3 Programming experience in Python; 4 Possibly a short research paper</p>	<p>1 General knowledge in FinTech; 2 Familiar with the pipeline of machine learning systems; 3 Programming skills in Python (preferably, also in pytorch)</p>	No	Individual