COURSE DESCRIPTIONS 科目簡介

COURSES FOR 4-YEAR UNDERGRADUATE PROGRAMMES

CDS1001 Introduction to Programming for Data Science (3 credits)

This course is designed for students to provide an introduction to data science in the digital age. Data science concerns using data to understand and analyse actual phenomena. The course covers basic IT skills, such as computer programming to assist data manipulation, data analysis and data communication. Turing award winner Jim Gray predicts that data science will be a "fourth paradigm" of science, which is data-driven and can be differentiated from empirical, theoretical and computational paradigms. Students will learn the fundamentals and appreciate the importance of data science.

The first half of the course is about learning the programming language. The topics will include: the basic Python language syntax, variable declaration, basic operators, program flow and control, Python data structures, defining and using functions and recursion, file and operating system interface. In the second half of the course, basic Python packages designed for data science will be introduced, such as NumPy, SciPy, Pandas, and Matplotlib.

CDS1002 Calculus (3 credits)

(Restriction(s): Students are not allowed to take both this course and SSC2114 Calculus.)
Calculus plays an important role in the understanding of today's world. This is an introductory course that presents the ideas and techniques of calculus using an informal, intuitive and geometric approach. Students need to learn both differential calculus and integral calculus and their applications to real-life situations in business, economics, the social sciences, natural sciences and visual arts. This course will equip students with the calculus background required for further study in many disciplines.

CDS1003 Probability and Statistics 1 (3 credits)

(Note: Students should take CDS1002 Calculus previously or take both this course and CDS1002 Calculus in the same term)
Probability and Statistics are fundamentals of quantitative analysis. This course introduces the basic theory of probability and statistics to students. It provides a strong mathematical background for students to understand the quantitative techniques used in the analysis of practical problems across different disciplines. Emphasis is placed on the underlying mathematical theories of probability and statistics. The topics covered include descriptive statistics, basic probability, probability distributions, correlation and the use of statistical software for data science.

CDS1004 Mathematical Fundamentals for Data Science (3 credits)

The Mathematical Fundamentals for Data Science course offers a comprehensive introduction to the essential mathematical foundations required for data science, with a focus on probability and statistics. The course covers fundamental concepts such as sets, functions, and basic algebra, while delving into probability theory, descriptive and inferential statistics, common probability distributions, and data visualization techniques. By the end of the course, students will have the skills necessary to apply these mathematical principles to real-world data analysis scenarios, making them well-prepared for careers in data science, analytics, or any field requiring statistical reasoning.

CDS1101 Innovative Design Fundamentals (3 credits) (from 2027-28)
Design Thinking is a human-centered iterative approach to innovation that empowers students to tackle complex, real-world challenges through creativity and collaboration. This course is structured around the five core modules of the Design Thinking process (i.e., Empathize, Define, Ideate, Prototype, and Test) and emphasizes experiential, project-based learning. Students will work in teams to apply design thinking principles to real-world problems, engaging in activities such as user research, need-finding, brainstorming, rapid prototyping, and user testing. Through group projects, students will explore topics like designing innovative products. The course fosters practical skill development in communication, teamwork, analytical thinking, and project management. By the end of the course, students will have gained hands-on experience in creating innovative solutions, preparing them to contribute effectively to diverse professional and academic contexts.

CDS2001 Probability and Statistics 2 (3 credits)
(Prerequisite: CDS1003 Probability and Statistics 1 or BUS1102 Statistics for Business)
Probability and Statistics are fundamentals of quantitative analysis. This course covers statistical techniques for inferential statistics, such as estimation and hypothesis testing for population parameters. The topics covered include point estimate and interval estimate of population parameters, comparing means, non-parametric techniques and the use of statistical software for data science.

CDS2002 Introduction to Artificial Intelligence (3 credits)
(Prerequisites: CDS1001 Introduction to Programming for Data Science)
Artificial intelligence is the study of intelligent agents. Due to the continued success of applying artificial intelligence to different challenging problems requiring high-level intelligence, there is an explosive interest in this field for scientists, dreamers, entrepreneurs and educators. This course is designed for students to understand and appreciate the basic principles of artificial intelligence. It covers computational intelligent systems, which can support decision making, interact with humans, navigate vehicles and achieve many other interesting and useful tasks. These intelligent systems are extremely useful in business, science, the humanities and other fields.

CDS2003 Data Structures and Object-Oriented Programming (3 credits)
(Prerequisite: CDS1001 Introduction to Programming for Data Science)
Computer algorithms manipulate data to solve a variety of problems. For example, data scientists create algorithms to extract valuable insights from data. Data structures are essential for organizing, storing, accessing, and processing data effectively. The judicious selection of appropriate data strcutures significantly impacts the design and performance of an algorithm. Object-oriented programming (OOP) is a programming paradigm based on the concepts of “objects”, which are data structures that can exhibit “behaviour”. Students will learn the basics of algorithms, data structures, and language models for data science and generative artificial intelligence (AI), and acquire the skills needed to design software using OOP.

CDS2004 Quantitative Decision Making (3 credits)
(Prerequisites: CDS1003 Probability and Statistics 1 or BUS1102 Statistics for Business)
Organisations often need to make decisions in their best interests in various situations. This course provides an introduction to modelling, analysing and solving decision problems under certainty and uncertainty. Students will develop the concepts of spreadsheet modelling, optimisation and uncertainty, and learn how to apply quantitative techniques of optimisation, and decision-making under uncertainty and forecasting to solve a variety of problems that arise in business settings. Microsoft Excel will be used to

model and solve most of these problems. Through practising these techniques and Excel functions, students are expected to develop basic analytical skills and managerial insights, and also acquire competency in Excel.

CDS2005 Operating Systems for Data Science (3 credits) (from 2027-28)
(Prerequisites: CDS1001 Introduction to Programming for Data Science and CDS1004 Mathematical Fundamentals for Data Science)
This course provides a comprehensive foundation in operating system principles and architecture, with a specific focus on their application and importance in data science contexts. Students will explore the fundamental components of modern operating systems including process management, memory allocation, file systems, and resource scheduling—all essential for understanding how data science applications interact with underlying computing resources. The curriculum emphasises both theoretical concepts and practical skills, enabling students to optimise system performance for data-intensive tasks. By examining how operating systems manage hardware resources and provide abstractions for software applications, students will gain critical knowledge for developing efficient data science solutions across various computing environments, from personal workstations to distributed cloud systems. This course bridges the gap between theoretical computer science and practical data science applications, preparing students to design and implement computationally efficient data analysis workflows.

CDS2101 C++ Programming (3 credits) (from 2028-29)
As software development continues to drive innovation across industries, mastering programming fundamentals is essential for building efficient and reliable applications. This course is designed to teach students the fundamentals of programming using the C++ language. The course begins with the fundamentals of language syntax, variables, data types, and control structures, then progresses to more advanced topics including functions, arrays, pointers, and dynamic memory management. Students will also learn about data structures and file structures, including techniques for organizing and manipulating data efficiently. The course covers input/output operations, interaction with devices, and file handling to enable students to build programs that manage data from various sources. In addition, the course introduces object-oriented programming principles such as classes, inheritance, polymorphism, and encapsulation, which are essential for creating modular and maintainable software. Throughout the course, emphasis is placed on problem-solving, algorithmic thinking, and writing clean, efficient code. Students will gain practical experience through assignments and projects that simulate real-world applications.

CDS2102 Networking (3 credits) (from 2028-29)
(Prerequisite: CDS1001 Introduction to Programming for Data Science)
As modern communication systems evolve to support high-speed connectivity and emerging technologies, understanding networking fundamentals has become essential for computing and engineering professionals. This course is designed to introduce the principles, architecture, and technologies behind networking. The course covers fundamental concepts such as network models, protocols, and standards, with a focus on the OSI and TCP/IP architectures. Students will learn about data transmission, addressing, routing, and switching, as well as the role of network devices such as routers, switches, and hubs. Topics include error detection and correction, flow control, congestion management, and the basics of network security. The course also examines physical and logical network structures, including wired and wireless technologies, and introduces advanced topics such as 5G networks and their role in enabling high-speed, low-latency communication for emerging applications. Students will explore Industrial Internet of Things (IIoT) concepts, focusing on how networking technologies support smart manufacturing, automation, and real-time data exchange in industrial environments.

Common networking services such as DNS, DHCP, and HTTP are also covered. Practical exercises will involve configuring networks, analysing packet flows, and troubleshooting connectivity issues using industry-standard tools.

CDS2103 Machine Learning for Innovative Design (3 credits) (from 2028-29)
(Prerequisites: CDS1001 Introduction to Programming for Data Science, and CDS1004 Mathematical Fundamentals for Data Science)
This course is designed to help students understand the principles of artificial intelligence (AI) and machine learning, with a strong emphasis on their applications in innovative design. It focuses on creative design generation and data-informed design exploration, enabling students to explore how recent advances in AI (particularly machine learning) support more natural, performance-driven design processes. Students will learn to identify different categories of machine learning algorithms, explain supervised, unsupervised, and reinforcement learning, and apply model selection techniques. Hands-on experience with modern AI frameworks will be emphasized. The course culminates in an open-ended applied design project, where students demonstrate an original, creative use of machine learning for innovative design in fields such as business, engineering, or art.

CDS2104 Internet of Things (3 credits) (from 2029-30)
(Prerequisite: CDS1001 Introduction to Programming for Data Science)
The Internet of Things (IoT) is transforming our physical world into a complex and dynamic system of connected devices on an unprecedented scale. This course introduces students to the principles, architecture, and applications of IoT technologies. Students will learn how IoT enables communication between physical devices, sensors, and cloud platforms to create intelligent, data-driven systems. The course covers IoT architecture layers, communication protocols, and device integration, along with data acquisition, processing, and security considerations. Topics include sensor networks, wireless communication technologies (such as Wi-Fi, Bluetooth, Zigbee, and 5G), edge and cloud computing, and IoT platforms. Students will explore real-world applications in smart homes, industrial automation, healthcare, and transportation. Practical exercises and projects will involve designing and implementing IoT solutions using microcontrollers, sensors, and cloud services.

CDS2205 Introduction to Programming (3 credits)
(recoded to ORM2205 from 2025-26)

CDS2209 Digital Video Editing and Movie Making (3 credits)
(recoded to ORM2209 from 2025-26)

CDS2215 Internet Technology (3 credits)
(recoded to ORM2215 from 2025-26)

CDS2250 Electronic Business: Supply Chain Applications (3 credits)
(recoded to ORM2250 from 2025-26)

CDS2251 Digital Imaging and Photography (3 credits)
(recoded to ORM2251 from 2025-26)

CDS2252 Wireless Technology (3 credits)
(recoded to ORM2252 from 2025-26)

CDS2253 Electronic Publishing and 3D Modelling (3 credits)
(recoded to ORM2253 from 2025-26)

CDS3001 Databases and Data Warehouses (3 credits)
(Prerequisite: CDS2003 Data Structures and Object-Oriented Programming)
This course is designed to introduce the concepts and principles of database and data warehouse. Various types of databases will be thoroughly discussed in this course, such as objected-oriented, relational, document-oriented, graph, NoSQL, and New SQL. Popular database management systems such as Microsoft SQL Server and/or Oracle will be described and implemented. Topics include data models (ER, relational, and others); query language (Structured Query Language); implementation techniques of database management systems (index structures and query processing); management of semi-structured and complex data; distributed and NoSQL databases; the dimensional modeling technique for designing a data warehouse, and data warehouse architectures, OLAP and the project planning aspects in building a data warehouse.

CDS3002 Operations Simulation with Decision Analysis (from Term 2, 2022-23)/ **Simulation** (in Term 1, 2022-23 or before) **(3 credits)**
(Prerequisites: CDS1003 Probability and Statistics 1 or BUS1102 Statistics for Business)
This course is designed for Data Science students. They are required to have previous knowledge of probability and statistics. Simulation is a commonly used and practical technique for modelling and analysing real operating systems to make more effective decisions. Examples of such systems include transportation, supply chain networks, job flow, airports, banks, ocean terminals, information systems, emergency response systems and human behaviour in a social network. Due to the considerable complexity of real systems, many people and organisations find it difficult to investigate human activities, manufacturing and service designs and processes without a computer simulation model. More than 89% of Fortune 500 firms have used simulation for system improvement and have experienced the benefits for a long time. This course is designed to introduce basic concepts of system modelling and computer simulation. The process and methodology of using simulation for problem solving and decision making are emphasised. Moreover, the course would utilise interactive Colab notebooks and the Python programming language to help students better understand simulation system modeling. Some assignments may require students to write simple Python programs to build a simulation pipeline.

CDS3003 Machine Learning (3 credits)
(Prerequisites: CDS2001 Probability and Statistics 2, CDS2002 Introduction to Artificial Intelligence and SSC2113 Linear Algebra)
This course is designed to introduce methods in machine learning (i.e., the study of how to create a machine that is capable of improving its performance in some tasks, such as perception, cognition and action, by learning from experience and data). This makes computers more intelligent. Machine learning is a powerful tool for recognising hidden and potentially useful relationships in data. It is essential in many organisations, as they can generate huge amounts of data in their daily operations and machine learning enables them to discover important knowledge from this data. The students will learn some powerful software packages for performing machine learning including generative artificial intelligence (AI) models and apply these packages to handle different kinds of problems, culminating in a group project to solve a real-world problem.

CDS3004 Data Mining (3 credits)
(Prerequisite: CDS2002 Introduction to Artificial Intelligence)
Data mining is an important component of data science that discovers knowledge from huge databases. Data mining is an interdisciplinary field, integrating statistics, pattern recognition, neuro-computing, machine learning and databases. It is also one of the fundamentals to extracting interesting knowledge (domain-specific rules, patterns, constraints and regularity). Students will learn the basic principles and core ideas of data

mining. This course also covers many data mining approaches to discovering knowledge from a vast amount of valuable databases in business, finance, urban and medicine. Quantitative analytical skills are taught to interpret data mining models. Current IT skills are also covered in the course.

CDS3005 Data Science Project Management (3 credits)

From 2028-29

The principles of project management, largely developed and tested on engineering projects, are being successfully applied to projects of all sizes and types in all fields. Furthermore, the role of project management in a cross section of applications, such as IT, product development and construction, is now emphasised. This course introduces students to the principles and practices of managing data science projects. It introduces software engineering process, project management frameworks, and quality assurance practices tailored to the unique challenges of data-driven applications. Students will learn how to plan, design, implement, test, and maintain scalable and trustworthy data science solutions in a team-based setting.

In 2027-28 or before

The principles of project management, largely developed and tested on engineering projects, are being successfully applied to projects of all sizes and types in all fields. Furthermore, the role of project management in a cross section of applications, such as IT, product development and construction, is now emphasised. This course addresses the fundamental principles of project management and the tools and techniques at our disposal to help achieve our goals. The topics covered include project definition and start up; project attribute estimation; planning and scheduling; resource selection and allocation; implementation; post-project evaluation; project management as a career; skills and knowledge required by professionals, such as decision making and resource allocation appropriate to project phases; integration with other disciplines, such as accounting and finance. The Microsoft Project software tool will be introduced for project scheduling and management.

CDS3007 Introduction to Digital Transformation (from 2025-26)/ **Introduction to e-Business** (in 2024-25 or before) **(3 credits)**
(recoded to BAI3007 from 2025-26)

CDS3008 Business Analytics for e-Business (3 credits)
(recoded to BAI3008 from 2025-26)

CDS3009 Social Media and Customer Relationship Management for e-Business (3 credits)
(recoded to BAI3009 from 2025-26)

CDS3010 Information Systems Security Engineering and Management (3 credits) (from 2027-28)

(Prerequisites: CDS2005 Operating Systems for Data Science)

This course offers a comprehensive examination of information security from both system and management perspectives, addressing its definition, the factors driving its requirements, and strategies for integrating security into the systems design process and lifecycle management of information systems. A key component of the course is an in-depth analysis of foundational federal policies, such as the Federal Information Security Modernization Act (FISMA), which mandates that federal agencies develop, document, and implement comprehensive programs to secure their information and information systems. The curriculum encompasses vital topics including information-security risk

management, the formulation and enforcement of security policies, the incorporation of security measures within the systems-engineering process, pertinent laws governing information security, and the management of operational systems. By delving into these areas, the course aims to equip students with the knowledge and skills necessary to navigate the complex and dynamic field of information security, ensuring the protection of critical information assets in an increasingly interconnected world.

CDS3101 Intelligent Sensing and Control (3 credits) (from 2029-30)
(Prerequisites: CDS1002 Calculus and CDS2102 Networking)
This course is designed to introduce the principles and applications of intelligent sensing technologies and advanced control systems. The course covers the fundamentals of sensors and transducers, signal acquisition, and data processing for real-time monitoring and decision-making. Students will explore various sensing modalities, including optical, acoustic, and inertial sensors, and learn how these technologies are integrated into intelligent systems. The control component focuses on classical and modern control strategies, including PID control, state-space methods, and intelligent control techniques such as fuzzy logic and neural networks. Emphasis is placed on the interaction between sensing and control in autonomous systems, robotics, and industrial automation. Practical exercises and projects involve designing and implementing sensor-based control systems using simulation tools and hardware platforms.

CDS3102 Image Processing (3 credits) (from 2029-30)
(Prerequisites: CDS1001 Introduction to Programming for Data Science, and CDS1003 Probability and Statistics 1)
As digital imaging becomes central to fields such as healthcare, multimedia, and artificial intelligence, understanding image processing techniques is essential for modern engineers and computer scientists. This course is designed to introduce the fundamental concepts, techniques, and applications of digital image processing. The course begins with an overview of image formation and representation, including colour models, sampling, and quantization. Students will learn essential operations such as image enhancement, filtering, and restoration in both spatial and frequency domains. Topics include histogram equalization, convolution, Fourier transforms, and noise reduction techniques. The course also covers image segmentation, edge detection, morphological operations, and feature extraction, which are critical for object recognition and computer vision applications. Students will explore compression methods, image coding standards, and practical considerations for storing and transmitting images. Hands-on exercises and projects will involve implementing algorithms using programming tools and applying them to real-world problems such as medical imaging, remote sensing, and multimedia systems.

CDS3103 GPU and Parallel Computing (3 credits) (from 2029-30)
(Prerequisites: CDS2005 Operating Systems for Data Science, and CDS2101 C++ Programming)
Modern applications demand high-performance computing for AI, graphics, and scientific simulations, which makes understanding GPU architectures and parallel programming essential. This course introduces the principles, techniques, and applications of GPU and parallel computing. Students will learn the fundamentals of parallel programming models, including thread-level and data-level parallelism, and explore how GPUs accelerate computation through massively parallel architectures. The course covers key topics such as CUDA programming, memory hierarchy and optimization, synchronization, and workload distribution. Students will also study parallel algorithms for common computational tasks and learn how to leverage GPU computing for domains such as machine learning, image processing, and scientific simulations. Additional topics include performance analysis, scalability, and emerging trends in heterogeneous computing

environments. Hands-on exercises and projects will involve implementing parallel programs using GPU frameworks and evaluating their performance compared to traditional CPU-based solutions.

CDS3104 Visualization (3 credits) (from 2029-30)
(Prerequisite: CDS1001 Introduction to Programming for Data Science)
As data-driven decision-making and product design become increasingly important in science, engineering, and industry, the ability to transform complex information and models into clear, interactive visual representations is essential. This course introduces the principles, techniques, and tools for effective data and product visualization. Students will learn the fundamentals of visual perception, design principles, and graphical representation of data, focusing on how to communicate information accurately and intuitively. The course covers a range of visualization methods, including charts, graphs, interactive dashboards, and advanced techniques for visualizing multidimensional and large-scale datasets. In addition, students will explore product visualization, which involves creating realistic and interactive visual models for design, manufacturing, and marketing purposes. Topics include colour theory, layout design, 3D modelling, and best practices for storytelling with data and product visuals. Students will also work with visualization frameworks and libraries and modern interactive tools, as well as software for 3D product visualization. Hands-on exercises and projects will involve designing and implementing visualizations using real-world datasets and product models.

CDS3105 Human-Computer Interaction (3 credits) (from 2029-30)
(Prerequisite: CDS2101 C++ Programming)
Designing intuitive and user-friendly interfaces is critical for enhancing user experience and productivity. This course introduces the principles, methods, and tools of Human Computer Interaction (HCI), focusing on how people interact with computers and how systems can be designed to support these interactions effectively. Students will learn the fundamentals of user-centred design, usability principles, and cognitive models that influence interface design. The course covers topics such as interaction styles, input/output devices, visual design, accessibility, and evaluation techniques. Students will explore prototyping methods, usability testing, and design frameworks for web, mobile, and emerging platforms such as AR/VR. Emphasis is placed on understanding user needs and applying design thinking to create interfaces that are efficient, engaging, and inclusive. Hands-on projects will involve designing and evaluating interactive systems using industry-standard tools and methodologies.

CDS3106 Cloud Computing (3 credits) (from 2029-30)
(Prerequisite: CDS2003 Data Structures and Object-oriented Programming)
Cloud computing has become the backbone of modern IT infrastructure, enabling scalable, secure, and cost-effective solutions for businesses worldwide. This course introduces the fundamental concepts, architecture, and technologies of cloud computing. Students will explore how cloud services enable scalable, on-demand computing resources and transform modern IT infrastructure. Topics include cloud service models (IaaS, PaaS, SaaS), virtualization, containerization, distributed systems, and cloud storage. The course also covers deployment strategies, security considerations, cost optimization, and emerging trends such as serverless computing and edge computing. Through hands-on labs and projects, students will gain practical experience with leading cloud platforms (e.g., AWS, Azure, or Google Cloud), learning how to provision resources, manage workloads, and implement cloud-native applications.

CDS3107 3D Modelling and Animation (3 credits) (from 2029-30)(Prerequisite: CDS2103 Machine Learning for Innovative Design)

With the growing demand for immersive digital experiences in gaming, film, and interactive media, three-dimensional (3D) modelling and animation have become essential skills for creative and technical professionals. This course offers a comprehensive introduction to the principles and techniques used to create and animate 3D content. Students will learn how to design 3D objects using industry-standard modelling tools, apply textures and materials for realistic surfaces, and implement lighting and rendering workflows to produce visually compelling scenes. The course also explores animation fundamentals, including keyframing, rigging, and motion paths, enabling students to bring static models to life through dynamic movement. Emphasis is placed on both technical proficiency and artistic creativity, preparing students to work within professional production pipelines. Through hands-on projects and assignments, students will develop 3D environments and animated sequences, culminating in a portfolio-ready project.

CDS3108 Algorithms (3 credits) (from 2029-30)
(Prerequisite: CDS2003 Data Structures and Object-Oriented Programming)
Algorithms form the backbone of computer science, enabling efficient problem-solving and powering applications from data processing to artificial intelligence. This course provides a rigorous introduction to the design, analysis, and implementation of algorithms. Students will learn fundamental techniques such as divide-and-conquer, dynamic programming, greedy methods, and graph algorithms, as well as strategies for analysing algorithmic complexity using Big-O notation. Students will explore how algorithmic choices impact performance and scalability, and they will gain experience implementing algorithms in a programming language. Topics include sorting and searching, graph traversal, shortest paths, and optimization problems, along with discussions on NP-completeness and approximation algorithms. Through problem-solving exercises and programming assignments, students will develop the ability to design efficient algorithms for real-world challenges.

CDS3350e-Procurement and e-Customer Relationship Management (3 credits)
(recoded to ORM3350 from 2025-26)

CDS3352 Inventory Management (3 credits)
(recoded to ORM3352 from 2025-26)

CDS3353 Logistics and Transportation (3 credits)
(recoded to ORM3353 from 2025-26)

CDS4001 Best Practices of Data Science (3 credits)
(Prerequisites: CDS3001 Databases and Data Warehouses and CDS3004 Data Mining)
Data science is the study of where information comes from, what it represents and how it can be turned into a valuable resource in the creation of business and IT strategies. Mining large amounts of structured and unstructured data to identify patterns can help an organization rein in costs, increase efficiency, recognize new market opportunities and increase the organization's competitive advantage. This course elaborates on data science problems in science, social science, arts and business. The appropriate methods of delivering data science results to different domain users and the right processes for deploying results in information and/or intelligent systems are described. Practitioners in different fields, such as marketing and finance, will be invited to share their experience in applying the data science approach to solve their problems.

CDS4002 Data Management (3 credits)
(Prerequisite: CDS3001 Databases and Data Warehouses)
Companies need to have more efficient systems to support their decision-making. This is

critical to their competitiveness, and has become a critical component of their business strategy. Generally, large organizations have a vast and complex landscape of systems. More often than expected, such companies have multiple and silo-based business systems to support their operations, finance, accounting, and analytical business processes. As the scale of systems in an organization's landscape increases, the complexity for managing the underlying data becomes even more complicated. This course covers the essential concepts, options, and best practices for data administration, data protection, privacy control, user security and management, system configurations, and data activity and status monitoring. The focus is on issues and principles of managing organizational data. Students will get extensive experience in developing data models, creating relational databases, and formulating and executing complex queries.

CDS4003 Project (3 credits)
(Prerequisites: CDS3001 Databases and Data Warehouses and CDS3004 Data Mining)
This course provides an opportunity for students to integrate their knowledge obtained in other courses in a data science process that involves the preparation, analysis, reflection and dissemination of data in a chosen application setting. The emphasis is on the management and execution of a well-defined project of a suitable scale. Such projects may involve either real-world or experimental data and students may engage in such projects individually or in groups.

CDS4004 Web Technologies and Social Networks (3 credits)
(Prerequisite: CDS3004 Data Mining)
This course offers an introduction to the significant role of social networking in the Web 2.0 era. It explores web technologies to enhance user experiences within social networking applications while also facilitating data collection for web and social network analytics. The curriculum focuses on major web technologies that enable immersive user experiences and emphasizes their role in gathering data within social networking platforms. Students will gain insights into the ethical utilization of these technologies, particularly in contexts like social media marketing. Additionally, the course delves into advanced subjects covering emerging web technologies empowered by generative AI.

CDS4005 Big Data Analytics (3 credits)
(Prerequisite: CDS3004 Data Mining)
This course provides an understanding of the concept and challenge of big data. The focus is on the data analytic techniques to tack the V's (volume, velocity, variety, veracity and value) in big data and how these impacts data collection, monitoring, storage, analysis and reporting. Spark is an example of big data management system to manage and process large-scale data. The following topics across the big data domain will be introduced: distributed file systems; similarity search techniques; high-performance processing algorithms for data streams; big data search and query technology. Big data analytics applications in data science will be elaborated. Students will actively participate in the delivery of this course through assignments, portfolio development, and projects.

CDS4006 Deep Learning (3 credits)
(Prerequisite: CDS3003 Machine Learning)
Deep learning is one of the bleeding edge technologies of machine learning. It has been used in the community and industry to solve a number of big data problems in computer vision and natural language processing. Deep learning drives improvement in the precision of medical diagnosis, enhancing digital painting and the development of self-driving vehicles. This course teaches students to understand the theoretical and technical details of deep learning and to design intelligent systems that learn from complex and large-scale datasets.

CDS4007 Stochastic Process (3 credits)
(Prerequisite: CDS2001 Probability and Statistics 2)
The stochastic process is an important tool in modelling and analysing random patterns in data science, with significant ethical implications in its applications. This course aims to equip students with key concepts and theories in stochastic processes, such as sample space, probability (and conditional probability), expectation (and conditional expectation), discrete time Markov chain, continuous time Markov chain and renewal process. The course provides a rigorous development of relevant concepts and models, emphasizing responsible data science practices. In addition to technical rigorousness, we want to develop our students' ability to apply the theories and models in real applications in various disciplines while considering potential biases and societal impact. This course should help build a solid background in stochastic processes and models for students and enable them to solve real problems of a stochastic nature while adhering to ethical considerations.

CDS4008 Optimization (3 credits)
(Prerequisites: CDS1002 Calculus and SSC2113 Linear Algebra)
In a mathematical optimization problem, one seeks to minimize or maximize a real function of real or integer variables, subject to constraints on the variables. Mathematical optimization refers to the study of these problems, their mathematical properties, the development and implementation of algorithms to solve these problems and the application of these algorithms to real-world problems.

The purpose of this course is to cover the parts of calculus that are most relevant to economics and business, with an emphasis on mathematical optimization questions – finding a choice of variables that maximizes a function (e.g., utility or expected return) or minimizes a function (e.g., cost and risk) in the presence of constraints (e.g., feasibility, substainability and limited resources). This course covers foundational topics from multivariable calculus and linear algebra, topics from introductory analysis (e.g., open/closed sets, compactness, maximum theorem and implicit function theorem) and problems in unconstrained and constrained optimization (e.g., Lagrange multipliers, Kuhn-Tucker conditions and applications of convexity). Topics in linear programming and calculus of variations may also be discussed. The course will also cover the application of optimization algorithms to search for optimal and sustainable solutions for some real-world problems. Participants to the course must be aware that this is in part a course of mathematics, where formal statements (definitions, lemmas, propositions, theorems) will be made and formal proofs will be given and illustrated by examples.

CDS4009 e-Business Models and Start-ups (3 credits)
(recoded to BAI4009 from 2025-26)

CDS4010 Web Programming for e-Business (3 credits)
(recoded to BAI4010 from 2025-26)

CDS4011 e-Business Logistics (3 credits)
(recoded to ORM4011 from 2025-26)

CDS4101 Blockchain Technology (3 credits) (from 2030-31)
(Prerequisites: CDS2005 Operating Systems for Data Science and CDS3001 Databases and Data Warehouses)
Blockchain is the first successful technology that enables trust without relying on a central authority, revolutionizing how transactions and data are managed. This course aims to introduce the foundations of blockchain technology and explore its transformative impact

on finance and beyond. It is designed to provide students with a solid understanding of key concepts and developments surrounding cryptocurrencies, distributed ledger systems, and decentralized applications. Students will learn about blockchain structure, cryptographic principles, and smart contracts, as well as how these technologies underpin financial innovations such as digital currencies, decentralized finance (DeFi), and tokenization. The course also highlights emerging applications, such as supply chain management, healthcare, and digital identity. Practical exercises will involve working with blockchain platforms, deploying smart contracts, and analysing real-world use cases in financial services and other industries.

CDS4102 System Integration, Verification, and Validation (3 credits) (from 2030-31)

(Prerequisites: CDS1101 Innovative Design Fundamentals, and CDS2103 Machine Learning for Innovative Design, and CDS3103 GPU and Parallel Computing)

This course provides a practical learning of system integration, verification, and validation, with a strong emphasis on hands-on practice. This course adopts a blended teaching approach that integrates lectures, in-class activities, and group projects. Lectures enable students to integrate machine learning, sensing, control, and software–hardware systems to solve real-world engineering problems, particularly in Industry 4.0 contexts. Through group projects and case studies in areas such as robotics, human–computer interaction, automated inspection, predictive maintenance, and digital twins, students gain practical experience in system design, implementation, evaluation, and validation using visualization and experimental analysis. By the end of the course, students will have gained hands-on experience in problem formulation, solution development, and applying visualization and experimental analysis to support system verification and validation and to interpret evaluation results.

CDS4103 Web 3D Technology (3 credits) (from 2030-31)

(Prerequisite: CDS2101 C++ Programming)

As interactive and immersive experiences become central to modern web applications, Web 3D technologies are transforming how users engage with digital content. This course introduces students to the principles, tools, and frameworks for creating and deploying 3D graphics on the web. Students will learn the fundamentals of 3D rendering, scene composition, and animation using web-based technologies such as WebGL, Three.js, and related libraries. The course covers essential topics including 3D geometry, lighting, shading, textures, and camera controls, as well as performance optimization for real-time rendering in browsers. Students will also explore interactive techniques, integrating user input and dynamic behaviours to create engaging 3D experiences. Emphasis is placed on practical implementation, enabling students to build visually compelling and interactive web applications. Through hands-on projects, students will design and develop 3D scenes and animations that run seamlessly in modern web environments.

CDS4104 Embedded Systems (3 credits) (from 2030-31)

(Prerequisites: CDS2101 C++ Programming, and CDS3101 Intelligent Sensing and Control)

This course introduces the principles and practices of embedded systems design with a focus on applications in innovative design and AI-driven solutions. Students will learn how to program microcontrollers and single-board computers using Python or C++, interface with sensors and actuators, and implement real-time control for intelligent devices. The course emphasizes hardware-software integration, edge computing, and deploying lightweight AI models on embedded platforms. Through hands-on projects, students will design and prototype smart systems that combine electronics, connectivity, and AI capabilities.

CDS4105 Capstone 1 – Innovation, Technology and Design (3 credits) (from 2030-31)

(Prerequisites: CDS2103 Machine Learning for Innovative Design, and CDS3001 Databases and Data Warehouses, and CDS3101 Intelligent Sensing and Control)

Capstone projects constitute a critical component of undergraduate education, providing students with an opportunity to integrate and apply the knowledge and skills acquired throughout their programme of study. Capstone 1 – Innovation, Technology and Design is the first phase of a two-part capstone sequence, focusing on problem identification, background research, and conceptual system design.

In this course, students work in teams to address real world challenges that require innovative, technology driven solutions. Emphasis is placed on design thinking, user centred design, and the effective use of emerging technologies. Students engage in activities such as needs analysis, stakeholder and market research, ideation, feasibility assessment, and conceptual prototyping. By the end of the course, each team will produce a comprehensive project proposal and preliminary design documentation.

CDS4106 Capstone 2 - Design Challenge (3 credits) (from 2030-31)

(Prerequisite: CDS4105 Capstone 1 - Innovation, Technology and Design)

Capstone projects provide students with an opportunity to synthesize and apply knowledge gained throughout their academic journey. This course centres on the design, implementation, and optimisation of a product-oriented system under real-world constraints. Students undertake a capstone project to conceive, build, and demonstrate an integrated solution that combines software, hardware, data processing, and user interaction. Emphasis is placed on system integration, performance optimisation, and the professional delivery of a functional prototype, reflecting the increased technical complexity and product maturity expected at the final stage of undergraduate study.