School of InfoComm Technology

DIPLOMA IN DATA SCIENCE

Data is being created every minute - from clicks, likes, and shares, to rides, transactions and browsing content. Such data can help businesses to better understand their customers and improve their bottom lines. In the Diploma of Data Science (DS), seize the chance to benefit from the school's expertise in analytics and learn how to transform data into value.

In your first year, you will focus on building core computing skills in programming, networking, databases and use of analytics in enterprise information systems. You will also learn statistical concepts and how to create effective visualisations for analyses and presentations.

In your second year, you will learn how to prepare data for analysis and modelling purposes and propose scalable solutions. You'll also get a chance to apply programming knowledge learnt in your first year in the area of analytics.

In your third year, you will embark on the Industry Kickstart Programme, which will give you an overview of emerging trends in the industry. Also, you will get to apply the skills that you have learnt through industry-based projects and an internship. For example, you will embark on data science projects that are contributed by the industry to develop an IT solution.

YEAR 1 COURSE MODULES

LEVEL 1.1

Computing Mathematics
This module introduces the basic concepts of relations and functions, matrices, statistical methods and relevant applications. The main emphasis is to develop students' ability in solving quantitative problems in computing mathematics, probability and statistic.

Cyber Security Fundamentals
This module provides an overview of the various domains of cyber security. It helps to develop an understanding of the importance of cyber security in today's digital world. It aims to provide an appreciation of cyber security from an end-to-end perspective. It covers fundamental security concepts, tools and techniques in domains such as data, end-user, software, system, network, physical, organisation, and digital forensics. It also helps to develop knowledge and skills in identifying common cyber threats and vulnerabilities, and to apply techniques to tackle these issues.

Data Science Fundamentals
This module provides an overview of Data Science, its importance in the world of data and how it affects the competitiveness of organisations. Learners will learn about the different areas within Data Science and the core pillars essential to practise in the area. Students will also be introduced to Design Thinking. Indicative topics include Introduction to Data Science, Big Data and Analytical Design Thinking.

Design Principles
This module introduces students to basic elements and principles of design. Students will practice visual communication and self-branding through aesthetic use of line, shape, form, color, texture, typography, scale, contrast, rhythm and balance. Students will be trained in the usage of digital design tools and application of modern industrial practices to communicate the concepts, designs and solutions.

School of InfoComm Technology

Fundamentals for IT Professionals 1

This module provides a broad introduction to the field of ICT by exploring the roles, professional practice, ethical expectations and career development paths of IT professionals. Through a guided inculcation of interpersonal and teamwork skills with strong team bonding spirit, the module aims to deepen students' commitment to the sector that the course prepares them for. In addition, students will be required to begin charting their career path in the ICT industry by considering crucial aspects such as personal preferences and aptitude, job roles and responsibilities, skills needed and further education.

Programming 1

This module introduces the fundamentals of programming and how to develop programs using appropriate problem-solving techniques in a modular style. In this practice-oriented module, students are taught how to apply problem-solving skills using a top-down structured programming methodology and given ample practice in translating solutions into computer programs, then test and debug the programs. Topics include data types, variables, expressions, statements, selection structures, loops, simple computation and algorithms, and the use of libraries. Students will also practise the use of pseudocodes, best practices of programming, debugging techniques with the help of tools, development of test cases, and suitable program documentation. In addition, they will study various areas where application software plays a prominent part in helping organisations solve problems. Student will be given ample opportunity for independent and self-directed learning.

LEVEL 1.2

Databases

Today's business organisations depend on information systems in virtually all aspects of their businesses. Corporate databases are set up to hold the voluminous business transactions generated by these information systems. This module introduces students to the underlying concepts of database systems and how to model and design database systems that reflect business requirements. Students will be taught how to analyse data needs, model the relationships amongst the data entities, apply the normalisation process to relations and create the physical database. Skills taught include data modelling technique, transformation of data model to relations, normalisation technique and SQL (Structured Query Language).

Data Discovery & Visualisation

This module discusses the principles and techniques for creating effective visualisations based on graphic design and perceptual psychology. Using widely adopted tools and analytical programming, learners will apply these principles and techniques to create rich visualisations for analysis and presentation. Indicative topics include Principles of Visualization, Dashboard Design Techniques and Designing for an Audience.

Mathematics for Data Science

In this module, students will first be exposed to statistical concepts, including hypothesis testing, probability distribution and more. Students will be able to perform univariate, multivariate and correlation analysis in order to identify inherent patterns and derive key insights from business data. Indicative topics include Normal Distribution, Sampling and Sampling Distributions and Correlation Analysis.

Programming 2

This module builds upon the knowledge and skills acquired in Programming I. It aims to provide opportunities for the students to develop medium-scale applications based on the Object-Oriented (OO) approach. A suitable object-oriented high-level programming language will be used by students to apply in their problem-solving skills. The main concepts of OO and the implementation of applications using the OO approach will be taught in this module.

The module may cover the concepts of Abstract Data Types (ADTs) and the implementation of some selected ADTs using the OO approach. Suitable sorting and search algorithms and the use of Application Protocol Interface (API) will be introduced when required. Other key topics include the introduction of system design concepts such as the class diagram. Software robustness and correctness, and good programming practices will be emphasised throughout the module. Independent and self-directed learning will also be encouraged.

School of InfoComm Technology

YEAR 1 COURSE CURRICULUM

Module Name	Credit Units
Level 1.1 (21 hours per week)	
Computing Mathematics	4
Cyber Security Fundamentals	2
Design Principles	2
Data Science Fundamentals	2
Fundamentals for IT Professionals 1	2
Programming 1	5
Health & Wellness^	1
Innovation Made Possible^	3
English Language Express*	NA
Level 1.2 (19 hours per week)	
Data Discovery & Visualisation	4
Communication Essentials^	3
Databases	4
Mathematics for Data Science	4
Programming 2	4

Notes:

^ For more details on Interdisciplinary Studies (IS) electives, please log on to www.np.edu.sg/is

* For selected students only

IS Modules

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YEAR 2 COURSE MODULES

LEVEL 2.1

Intelligent Enterprise Systems

The use of intelligent enterprise systems has become a necessity in multi-national companies as well as small and medium enterprises. This module introduces students to the different components that build up an intelligent enterprise system. Students will be able to appreciate the complexity of business processes, how IT can help organisations to be more competitive and gain basic management skills that are required to manage business processes in an organisation.

Data Exploration & Analysis

In this module, students will experience the process of exploratory data analysis, normalization of data and data distribution analysis, which will be crucial for subsequent understanding of machine learning concepts and models. Students will explore data using a combination of statistical and visualisation techniques. Indicative topics include Data Warehousing, Data Dimensional Modelling and Data Mining.

Data Wrangling

This module focuses on the use programming libraries and shell scripting techniques to clean and prepare data for analysis and modelling purposes. Emphasis will be placed on the Extraction, Transformation, and Loading (ETL) of data sets. Indicative topics include Storage and Database Connections, Manipulation of Datasets and Web Scraping.

Fundamentals for IT Professionals 2

This module gives a course-based experience in which students can engage with the local community and industry. This includes participation in community service events or in Service-Learning projects that leverages on students' discipline knowledge and skills to meet identified needs. Through iterative and guided reflection on the service experience, students gain a broader appreciation of their discipline and an enhanced sense of personal voice, empathy and civic responsibility. Industry talks and seminars are organised to keep students up to-date with emerging trends and develop their interpersonal, team and networking skills with the community and industry.

LEVEL 2.2

Agile DataOps

This module explores the end-to-end cycle of data analytics through a DataOps framework. Students will be introduced to the motivations behind DataOps such as the Agile framework, how DataOps can add significant value to analytics development and deployment, and also the best practices in DataOps. Indicative topics include Agile Data Warehousing, Innovation for DataOps and Test Automation.

Machine Learning

This module allows students to use leading software and associated libraries, to develop supervised learning and unsupervised learning models in order to solve the real-life problems. Emphasis will be placed on machine learning model selection, training and development of predictive models and model evaluation. Indicative topics include Supervised Learning Models, Unsupervised Learning Models and Model Evaluation and Improvement Techniques.

Distributed Data Pipelines

This module will introduce various aspects of data engineering concepts through the building of resilient distributed databases, such as Hadoop and Spark platforms. Students will understand how to extract valuable data from multiple sources and propose scalable solutions where appropriate. Indicative topics include Tools and Platforms for Big Data, Structures and Schemas for Big Data and Streaming Tools and Platforms.

Fundamentals for IT Professionals 3

This module provides a stepping stone to the students in their IT career. Students are given an insight into the infocomm industries and are kept abreast of the updates and the necessary skill sets required in their IT career path. They also have the opportunity to be exposed to the various institutes of higher learning to further enhance their skill sets.

ELECTIVE MODULES

Accounting
This module introduces the basic theory and concepts of accounting through the introduction of Business Structures and Financial Institutions. Basic accounting concepts and principles form the foundation of the module, and students will be taught the complete accounting cycle; setting up the chart of accounts, balancing the trial balance and preparing financial statements. It also introduces risk and controls, and accounting standards and regulations governing the financial services industry. Students will also learn about the differences between financial and management accounting as well as funding methods and financial ratios for business and banks.

Advanced Databases
This module covers analysis, design, and implementation of polyglot persistence for modern software applications. Latest data storage methods and techniques, both relational and non-relational NoSQL databases, such as Key-Value, Document, Column-Oriented, Graph, Blob, and Queue storages will also be discussed. Students will also be exposed to de-normalisation, transactions, concurrency control, and database recovery techniques. The module also discusses Stored Procedures and how to migrate and deploy an on-premises database to a cloud database. In addition, this module will introduce parallel and distributed database technologies which include the concepts, structures, and the design objectives of distributed databases. Factors relating to data partitioning and placement across regions will also be discussed. In order to facilitate students in understanding the distributed database design, data placement and polyglot persistence, their implementation will be introduced through hands-on practical activities using products such as Microsoft Azure. This module will further explore data security, laws and regulations governing data access, usage, storage and transmission.

Applied Analytics
This module provides students with an introduction to unsupervised machine learning methods such as Clustering. Students are taught how these methods are used to segment customers for targeted cross-sell, up-sell and pricing. The module also introduces students to supervised machine learning methods such as Decision Trees and how these methods are used to predict customer churn, credit risk etc.

Open-source tools like R and/or Python will be used for data analysis and modelling. Students will also be exposed to enterprise analytics tools for interactive data visualisation and data wrangling. Data from various domains (Retail, Banking & Finance, Telcos etc) will be used to provide students with an introduction to domain-specific analytics.

Banking Applications and Processes
This module aims to provide students with an overview of the business processes and transaction workflows in banking and financial institutions. The module begins with a look at the various organisational structures within different types of banking and financial institutions, and the roles and responsibilities of key front office and back office functions across various business lines. Students will subsequently explore the end-to-end workflow processes for banking and financial transactions, and their supporting IT applications and systems.

Cloud Architecture & Technologies
This module gives insight into the key concepts and technologies of cloud computing which include cloud characteristics, service models (SaaS, PaaS, and IaaS), deployment models (Public cloud, Private cloud, Community cloud, and Hybrid cloud), and the features of cloud computing technologies. It also covers the cloud computing architecture, emerging trends and issues such as clouds for mobile applications, cloud portability and interoperability, scalability, manageability, and service delivery in terms of design and implementation issues.

The module discusses the benefits and challenges of cloud computing, standards of cloud computing service delivery, and Service Level Agreement (SLAs) for cloud services. Hands-on activities are included to expose students to various cloud computing services offered by major cloud computing providers such as Amazon Web Services (AWS), Google App Engine (GAE), and Microsoft Windows Azure.

Customer Decision-Making & Negotiation Skills
Students will be introduced to soft skills in understanding customer biases and concerns, building rapport, handling objections, identifying informal and formal decision makers, selling functions/features/ benefits, negotiating and closing

sales techniques. They will also learn about reference selling and proofs of concept as well as pick up presentation and communication skills. The module offers opportunities to role play and develop value proposition in sales calls within the context of ICT.

Customer Experience Management
With SMAC (Social, Mobility, Analytics and Cloud) technologies resulting in a new competitive environment, the control has shifted from the seller to buyer. This module provides students with the knowledge and understanding of Customer Experience Management (CXM) as a business strategy in this new environment. The buyer's experience is not limited to a single transaction but includes the sum of all experiences across all touch points and channels between a buyer and a seller over the duration of their relationship.

This strategy aims to achieve a sustainable competitive advantage to help sellers manage the buyer's experience in a collaborative and personalised manner. Students will have an opportunity to gain hands-on experience with customer management systems used by sellers that collect and create customer data, segment that data into manageable data sets, make sense of the data and make it available for timely delivery. This allows companies to deliver consistent customer experiences that delight customers and/or achieve other organisational goals.

Deep Learning

This module introduces the fundamentals of Deep Learning and its applications and provides students with essential context and background knowledge around Artificial Intelligence and its subset, Deep Learning. Students will learn about relevant models such as Neural Networks and experience the practical applications of these models in areas such as computer vision and natural-language processing. These models will be implemented using leading softwares and associated libraries.

Enterprise Business Processes
The study of enterprise business processes will illustrate to students the key business processes in typical organisations. Students will learn about the business strategies used in organisations while implementing business processes, the typical deliverables for a business process that each organisation adopts, the importance of integration of information across different departments or organisations and the relationship between the banks and organisations for all payments with customer and vendors. In addition, students are expected to draw detailed activity diagrams for the major business processes. At the end of the module, students will be able to appreciate the complexity of business processes, how IT can help organisations to be more competitive and gain basic management skill that is required to manage business processes in an organisation.

Enterprise Resource Planning
This module aims to train students to improve efficiency of organisations by integrating the different types of transactions from different business processes into one common database. The data can be extracted easily for analysis and decision making. ERP systems have the capability to integrate the data and processes of an organisation with external business partners such as customers, vendors and banks which improved collaborations and workflows. In this module, students will have hands-on exposure to the world market leading ERP software, for example SAP, to learn and demonstrate how basic business processes are represented and integrated in a real-world business setting.

Infocomm Sales & Marketing Strategies
Market IT goods or services to businesses and consumers, develop sales and marketing strategies, and understand sales life cycle management.

Risk Management
The module aims to introduce students to risk management principles, frameworks and practices adopted by financial institutions. Students will learn about the different types of risks faced by financial institutions (credit risk, market risk and operational/technology risk) and their drivers. Students will also be equipped with knowledge on the control processes and measurement techniques for each type of risk, as well as the IT applications and systems associated with them.

Spreadsheet Engineering
The spreadsheet is an indispensable tool for professionals, especially in the banking and finance industry, to solve business problems and make better informed decisions. This module will introduce students to the use of spreadsheets as a reporting and modelling tool. Through hands-on practical sessions in class using a commercial spreadsheet system such as Microsoft Excel, students will explore various spreadsheet functions and simple macros used for analysing, formatting and presenting data.

YEAR 2 COURSE CURRICULUM

Module Name	Credit Units
Level 2.1 (20 hours per week)	
Data Exploration & Analysis	4
Data Wrangling	4
Elective Module 1	4
Fundamentals for IT Professionals 2	2
Intelligent Enterprise Systems	4
World Issues: A Singapore Perspective^	2
Level 2.2 (18 hours per week)	
Agile DataOps	4
Fundamentals for IT Professionals 3	2
Distributed Data Pipelines	4
Elective Module 2	4
Machine Learning	4

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School of InfoComm Technology

YEAR 3 COURSE MODULES

LEVEL 3.1

Emerging Trends in Data Science
This module explores the latest trends and technologies in the areas of Data Science, Artificial Intelligence (AI) and Data Analytics. Students will be exposed to fresh developments and prominent discoveries in machine learning techniques, growth in the areas of AI solutions, as well as ethical issues and governance pertaining to the use of AI solutions and Data Science applications.

Data Science Capstone Project
This module requires students to complete a substantial Data Science project that is the culmination of the concepts learned and skills picked up in the first two years of the course. The project enables students to apply and integrate what they have learnt and give them an opportunity to experience the end-to-end Data Science workflow, and allowing them to delve deeper into topics of interest.

Industry Currency Project
This module requires students to embark on Data Science projects that are contributed by the industry, allowing students to work on real-world Data Science problems yet in an academic environment, with learning facilitated by academics. Depending on the scenarios crafted in collaboration with the industry, the module may be structured as a datathon for rapid ideation and solutioning. Short workshops may be conducted to allow students to be supplemented with knowledge useful for the projects, or to be familiar with tools and understanding more about what are the resources currently available.

LEVEL 3.2

Internship/Project
This module provides students with the opportunity to apply the knowledge and skills gained to develop an IT solution to solve a practical problem. Students may undertake an in-house industry-driven project, a Technopreneurship Enterprise project or a real-life IT project in a local or overseas organisation. These projects may include problem definition, requirements analysis, design, development and testing, delivery and presentation of the solution. Through the project, students will learn to appreciate the finer points of project planning and control issues relating to IT project development.

School of InfoComm Technology

YEAR 3 COURSE MODULES

Module Name	Credit Units
Level 3.1 (22 hours per week)	
Data Science Capstone Project or Elective Module 3 & 4#	8
Emerging Trends in Data Science	2
Industry Currency Project or Elective Module 5 & 6 #	8
Project ID: Connecting the Dots (IS)^	4
Level 3.2 (20 hours per week)	
Internship Final Year Project Technopreneurship Innovation Programme	20

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