# NUS School of Computing

**Master of Science in Digital Financial Technology (MSc DFinTech)**

## Core/Essential Courses (28 units)

FT5001 to FT5013 are new courses designed to instill core FinTech competencies covering *Artificial Intelligence, Blockchain, and Data Analytics*. Students are required to complete 12 units out of the available 40 units.

| Courses | *Units* | *Available in Semester 1* | *Available in Semester 2* |
|---|---|---|---|
| FT5001 Fintech Innovations for Consumers | 4 | ✓ | |
| FT5002 Digital Transformation at Financial Institutions | 4 | ✓ | |
| FT5003 Blockchain Innovations | 4 | | ✓ |
| FT5004 Programming for Blockchain Applications | 4 | | ✓ |
| FT5005 Machine Learning for Finance | 4 | | ✓ |
| FT5009 Contemporary Topics in Financial Data Analytics | 4 | ✓ | |
| FT5010 Algorithmic Trading Systems Design and Deployment | 4 | | ✓ |
| FT5011 Deep Learning for Finance | 4 | **TBC** | |
| FT5012 Risk, Security and Compliance in Banking and Finance | 4 | ✓ | |
| FT5013 Digital Asset Innovations in Finance | 4 | **TBC** | |

Among the 28 units core/essential courses, BMD5301 and BMD5302 cover the basics of finance and are offered by the NUS Business School. IT5001 and IT5003 cover the basics of computing. The objective is to ensure all students graduate with solid training in both *computing* and *finance* foundation.

| Courses | *Units* | *Available in Semester 1* | *Available in Semester 2* |
|---|---|---|---|
| BMD5301 Introduction to Finance for FinTech Professionals | 4 | ✓ | |
| BMD5302 Financial Modelling for FinTech Professionals | 4 | | ✓ |
| IT5001 Software Development Fundamentals | 4 | ✓ | ✓ |
| IT5003 Data Structures and Algorithms | 4 | ✓ | ✓ |

Students who have taken courses similar to BMD5301, IT5001, and IT5003 can replace these courses by taking the following replacement courses*:

| Courses | *Units* | *Available in Semester 1* | *Available in Semester 2* |
|---|---|---|---|
| IT5004 Enterprise Systems Architecture Fundamentals | 4 | ✓ | ✓ |
| IT5005 Artificial Intelligence | 4 | ✓ | ✓ |
| IT5006 Fundamentals of Data Analytics | 4 | ✓ | ✓ |

***Note**: Students who wish to take replacement courses are required to submit their request to the School of Computing for prior approval. All other core courses are required for all students.

Students are generally advised to read IT5001 to strengthen conceptual foundations and prepare for advanced courses later in the programme. Nevertheless, to allow better learning experience in merited cases, eligible students may apply to replace IT5001 with another IT course listed above by taking an in-person proficiency test (non-refundable administrative fee applies) to assess their eligibility.

The following are the criteria for the replacement of BMD5301 and IT5003:

- Passed a similar full-semester programming course as shown on an official transcript (from either an undergraduate or master's degree programme).
- Has at least two years of work experience as a programmer. The student needs to provide sufficient evidence that the job role involved programming. Roles such as project manager or product manager without programming responsibilities do not qualify.
- Certificates from online courses or training programmes are not accepted.

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## Course Descriptions (Core/Essential Courses)

### *FT5001 - Fintech Innovations for Consumers (4 units)*

The objective of this course is to provide a technological overview of the eco-system of FinTech innovations for consumers. Particularly, this course will cover important business models and innovations in payment solutions, crowd-funding platforms, investment and robo-advisors, and other important FinTech innovations that affect the personal finance of individual consumers.

### *FT5002 - Digital Transformation at Financial Institutions (4 units)*

The objective of this course is to provide a technological overview of the business functions and technology operations of modern banking, insurance, and investment sectors. Students will learn how FinTech is transforming the business operations in these financial firms. Particularly, this course covers the transformation of legacy core financial systems, payment services and channels together with the associated data, security, risks, regulatory compliance and infrastructure challenges associated with financial institutions. Other new topics of FinTech at large financial institutions with regional and international exposure will also be discussed.

### *FT5003 - Blockchain Innovations (4 units)*

Blockchain technologies could be the most disruptive FinTech technologies. This course covers the important topics of blockchain innovations. Students will learn the architecture of blockchain, the history and evolution of blockchain applications, and the case studies of state-of-art blockchain applications in the industry.

### *FT5004 - Programming for Blockchain Applications (4 units)*

This course provides an overview of the essential concepts for blockchain application development. Students will be able to understand how blockchain applications function and the differences compared to traditional applications. Additionally, they will gain knowledge of the standards, key libraries, and services required for blockchain application development and be able to utilize them effectively.

### *FT5005 - Machine Learning for Finance (4 units)*

This course covers foundation knowledge in machine learning and data mining for solving practical analytics problems or building AI applications at FinTech firms. Some topics covered including supervised learning models, time series forecasting methods, basics of natural language processing, and unsupervised learning.

### *FT5009 - Contemporary Topics in Financial Data Analytics (4 units)*

The objective of this course is to provide students with an overview of recent advances in financial data analytics. In addition, the lecturer may provide an in-depth discussion of selected important topics in financial data analytics that is the focus of industry-oriented research at financial institutions or start-ups. From this course, students will learn advanced data mining algorithms, financial statistical models, fintech programming knowledge, and business cases or academic papers on modern financial applications.

### *FT5010 - Algorithmic Trading Systems Design and Deployment (4 units)*

The course teaches students financial market fundamentals and best practices in systematic trading, covering the distinction between discretionary and systematic methods. It emphasizes designing and developing rule-based trading strategies and systems, utilizing financial trading and app development concepts. It focuses on best practices for backtesting and hypothesis testing for different trading strategies derived from technical analysis, fundamental analysis, and machine learning. The course also addresses investor biases and ways to overcome them through data-driven decision-making and risk management.

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### *FT5011 - Deep Learning for Finance (4 units)*

This course will introduce the foundational concepts and applications of major deep learning algorithms. This course aims to bridge the gap between the rapidly evolving world of deep learning technologies and the unique challenges presented by the financial industry. Through a combination of theoretical lessons, practical case studies, hands-on exercises, and discussions, students will explore the potential, limitations, and implications of employing deep learning solutions in various financial scenarios. By the end of this course, participants will have hands-on experience in designing, training, and implementing deep learning models for financial applications.

### *FT5012 - Risk, Security and Compliance in Banking and Finance (4 units)*

Globally, the banking and finance sector has witnessed many rapid changes in recent years. These includes advancements in digital technologies, evolving practices in delivering digital financial services, shifts in the security threat and risk landscape, heightened connectivity with ecosystem partners, and increasing expectations from government and financial regulators. Consequently, it is of utmost importance that financial institutions and other critical sectors of the economy implement robust enterprise-level risk governance and strong risk management practices, safeguarding critical services against cybercriminals and digital fraud. Such a multipronged strategy will ensure that digital financial services remain resilient and provide adequate protection for personal information and privacy. Furthermore, as the adoption of Artificial Intelligence in financial services grows alongside ecosystem partnerships, it is necessary for financial institutions to understand the emerging risks they face and to mitigate these in order to achieve their business objectives. This course will prepare students to tackle these global challenges effectively.

### *FT5013 – Digital Asset Innovations in Finance (4 units)*

This course offers an in-depth exploration of the technological innovations driving the emergence and growth of digital assets in finance. Students will delve into the foundational concepts of digital assets, understand the mechanics of decentralized finance (DeFi), and examine the cutting-edge technologies shaping the future of the financial industry. The course is structured to build knowledge progressively, starting from basic principles and advancing to complex applications and future trends.

### *BMD5301 - Introduction to Finance for FinTech Professionals (4 units)*

This course aims to provide students with the foundation to understand the key concepts and tools used in Finance, which are necessary for managers and analysts to make sound financial decisions. Topics covered include discounted cash flow models, risk and return, capital budgeting, valuation of stocks and other financial securities, as well as an overview of financial markets and financial institutions.

### *BMD5302 - Financial Modelling for FinTech Professionals (4 units)*

This course introduces Finance models used in corporate finance, portfolio management, derivatives and bonds. It takes an applied approach by implementing through Excel, VBA and Python.

### *IT5001 - Software Development Fundamentals (4 units)*

This course aims to introduce non-computing students to the principles and concepts of software development at an accelerated pace. Students will be introduced to the basics of programming (control flow, code and data abstraction, recursion, types, OO), development methodology (ensuring correctness, testing, debugging), simple data structures and algorithms (lists, maps, sorting), and software engineering principles. Through hands on assignments and projects, students will learn good software development practices (documentation, style) and experience a typical software engineering cycle.

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### *IT5003 - Data Structures and Algorithms (4 units)*

This course introduces non-computing students to efficient computational problem solving in an accelerated pace. Students will learn to formulate a computational problem, identify the data required and come up with appropriate data structures to represent them, and apply known strategies to design an algorithm to solve the problem. Students will also learn to quantify the space and time complexity of an algorithm, prove the correctness of an algorithm, and the limits of computation. Topics include common data structures and their algorithms (lists, hash tables, heap, trees, graphs), algorithmic problem solving paradigms (greedy, divide and conquer, dynamic programming), and NP-completeness.

### *IT5004 - Enterprise Systems Architecture Fundamentals (4 units)*

This course aims to equip non-computing students with fundamental knowledge in architecting and designing modern Enterprise Systems in organisations that can be reasonably complex, scalable, distributed, component-based and mission critical. Students will develop an understanding of high-level concepts such as enterprise architecture and software architecture. They will then move on to acquire fundamental systems analysis and design techniques such as object-oriented requirements analysis and design using the Unified Modelling Language.

### *IT5005 - Artificial Intelligence (4 units)*

The study of artificial intelligence, or AI, aims to make machines achieve human-level intelligence. This course provides a comprehensive introduction to the fundamental components of AI, including how problem-solving, knowledge representation and reasoning, planning and decision making, and learning. The course prepares students without any AI background to pursue advanced courses in AI.

### *IT5006 - Fundamentals of Data Analytics (4 units)*

This graduate-level course provides a comprehensive foundation to the fundamentals of data analytics; namely exploratory data analysis, predictive modeling, and result interpretation. The syllabus emphasizes the translation of real-world scenarios into tractable analytical problems. Students are equipped with a robust toolkit of statistical methods for exploratory analysis. They will delve into the frameworks of both classical and Bayesian learning to tackle analytical challenges. Additionally, the course provides hands-on experience building end-to-end data analytics pipelines using Python. This well-balanced approach integrates technical expertise with business-oriented applications, establishing a strong foundation for pursuing advanced studies in machine learning or business analytics.

***Important: Courses in this list may be subject to change as decided by the Schools/Departments.***