

COURSE OUTLINES: BF3223 Blockchain and AI in Finance

Academic Year	2022-2023	Semester	2
Course Coordinator	Deng Xin		
Course Code	BF3223		
Course Title	Blockchain and AI in Finance		
Pre-requisites	AB1202 Statistics & Analysis;		
No of AUs	3		
Contact Hours	39		
Proposal Date	Nov 29, 2021		
A) Course Aims			
<p>This course provides the foundation for developing new financial business models and trading strategies using blockchain and artificial intelligence (AI) technologies. It is designed for students who are interested in the applications of blockchain and AI in finance. Experience with linear algebra, basic probability theory and basic calculus is necessary to complete assignments in this course. You will learn the basics of blockchain and AI technologies and related practical topics, such as CBDC, crypto economics, digital asset management. You will also learn how to use open-source Python packages to design, test, and implement algorithms in finance. With relevant knowledge and skills, you will be ready for more advanced courses such as smart contract for finance, computational law in token economy, reinforcement learning in finance.</p>			
B) Intended Learning Outcomes (ILO)/Objectives			
<p>By the end of this course, you should be able to:</p> <ol style="list-style-type: none"> 1. Describe recent developments of blockchain and AI technologies and analyze their impact on the financial services 2. Explain the technologies underlying cryptocurrencies and blockchains, and the concepts of AI, machine learning, supervised learning, unsupervised learning, deep learning, and reinforcement learning 3. Design smart contracts and decentralized applications 4. Valuate blockchain project and other ventures 5. Compare stable coins, CBDC, Libra and other digital currencies 6. Apply data mining and AI techniques in FinTech and develop applications 			
C) Course Content			
<ol style="list-style-type: none"> 1. Blockchain technology – characteristics of public, private, consensus algorithms, blockchain cryptography for distribution of trust and protection of privacy 2. Create smart contract on Ethereum network 3. Token Economics, digital asset management and valuation analysis of the drivers of returns 4. CBDC, stable coins 5. Data Structure and data mining 6. Supervised learning - Logistic model, boosting, random forest, and support vector machines 7. Unsupervised learning: risk control and anti-fraud 8. Graph theory and networks: valuation of venture firms* 9. Reinforcement learning: trading strategy* <p>*advanced topics that depend on students' progress.</p>			

D) Assessment (includes both continuous and summative assessment)

Component	ILO Tested	NBS Learning Goal (Refer to Annex E for list)	Weighting	Team/Individual	Assessment Rubrics (Please insert rubrics as Appendix)
1. Quizzes	ILO1,2, 4,5	Acquisition of knowledge, Problem Solving	40%	Individual	N.A
2. Group project (written report and in-class presentation *)	ILO3,4, 5,6	Critical Thinking, Creative Thinking, Oral Communication, Teamwork & Interpersonal Skills	30%	Group	Critical Thinking, Creative Thinking, Problem Solving, Oral Communication, Teamwork & Interpersonal Skills
3. Homework Assignments	ILO1,2, 4,6	Acquisition of knowledge, Decision Making	20%	Individual	Acquisition of knowledge, Critical Thinking
4. Class Participation	ILO1-6	Oral Communication	10%	Individual	Oral Communication
Total			100%		

** Every member is required to present. Peer evaluation is mandatory and project work marks will be adjusted if there are unequal contributions among members. The peer evaluation forms and assessment rubrics are in appendix.*

Description of Assessment Components:

Quizzes: You will have two quizzes that mainly covers the key concepts, important development of technology, new market demands of financial services, and coding techniques. The first quiz is close book and will be given at the beginning of the class in week 7. It will have multiple choice questions and open-ended questions. The second quiz is open book and will be given after week 13. It will have mainly open-ended questions including coding and data analysis. Students will have 24 hours to submit their answers..

Group Project: Each group can choose either option

i) submit a report on any blockchain ventures or CBDC. You should summarize the technical

feature and analyze the business prospect. More important, you need to focus on the competitive advantage of the project and be critical.
 ii) develop Business Proposal by applying either blockchain technology or AI techniques to financial services, such as design smart contracts for automated transactions, data mining for credit rating, or fraud detection.
 iii) develop trading strategies by applying a web crawler and analyzing the data using AI algorithms.

Home Assignments: You will be given two assignments to evaluate blockchain and AI fintech ventures, respectively.

Class participation: Attendance will be recorded. In-class discussion performance will be considered as well.

E) Formative feedback

You will receive formative feedback through written responses to your reports and assignments. You will receive summative group feedback on the presentation following the conclusion of the module.

F) Learning and Teaching approach

Approach	How does this approach support you in achieving the learning outcomes?
Seminars	The interactive seminar session where there are ample opportunities for open discussion on the conceptual questions raised in the class allows you to think critical and share their ideas and concept with the class. This also allows me to get the concepts clearly through the entire class by involving you and ensure that the targeted learning outcomes are being achieved
Individual assignment(s)	The assignments require you to generate, analyze and deliver humorous materials in a guided manner.
In-Class activities	Some learning outcomes for this course are skills which are practical in nature and cannot be achieved by reading and writing. The achievement of such learning outcomes requires hands-on experience, in-class activities provide such opportunities.

G) Reading and References

We will depend heavily on class slides. The following textbooks are recommended as reading materials and references.

1. A.Geron, Hands-On Machine Learning with Scikit-Learn and TensorFlow
2. C. Bishop, Pattern Recognition and Machine Learning
3. A. Antonopoulos, Mastering Bitcoin

4. T. Mitchell, Machine Learning
5. A. Narayanan et al., Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction
6. H. Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations
7. A. Bahga and V. Madisetti, Blockchain Applications: A Hands-on Approach
8. G. James, et al., An Introduction to Statistical Learning: with Applications in R

H) Course Policies and Student Responsibilities

(1) General

You are expected to complete all assigned pre-class readings and activities, attend all seminar classes punctually and take all scheduled assignments and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments and course related announcements for seminar sessions they have missed. You are expected to participate in all seminar discussions and activities.

(2) Absenteeism

Absence from class without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies.

If you miss a lecture, you must inform the course instructor via email prior to the start of the class.

I) Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [academic integrity website](#) for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

J) Course Instructors

Instructor	Office Location	Phone	Email	Consultation Hours
Deng Xin	B1A-32	67904718	Xin.deng@ntu.edu.sg	By prior appointment via email

K) Planned Weekly Schedule			
Week	Topic	ILO	Readings/ Activities
1	Overview of the application of Blockchain and AI in Finance	ILO1	"Mastering Bitcoin", Ch7&9 "Hands-On Machine Learning",
2	Blockchain technology: characteristics of public, private, consensus algorithms, blockchain cryptography for distribution of trust and protection of privacy	ILO2	"Mastering Bitcoin", Ch6-8
3	Smart contract: creating smart contract on Ethereum network	ILO1,ILO 3	"Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations"
4	Token Economics and valuation analysis: crypto-token fundraising methods and analysis of the drivers of returns.	ILO2, ILO4	"Mastering Bitcoin", Ch9&10 http://tfageeks.com/2020/05/31/digital-economyand-blockchainprofessor-david-lee-kuochuen-professor-offinance-programmesingapore-universitofsocial-sciences/
5	Digital asset management: alternative investment	ILO1,ILO 2	"Blockchain Applications: A Har Approach"
6	CBDC and stable coins	ILO2,ILO 5	https://jupiterchain.tech/ https://libra.org/enUS/wpaper/9 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3608752
7	AI: Data Structure, Neural Network, Machine Learning, Deep Learning, web crawling	ILO1,ILO 2	"Hands-On ML" Ch1
8	Supervised learning - Logistic model, boosting, random	ILO2,ILO 6	"Hands-On ML", Ch 9 Ch 4

	forest, and support vector machines			
9	Application in credit risk modeling	ILO2,ILO 6	“Hands-On ML”, Ch 9 Ch 4	
10	Unsupervised learning		“Hands-On ML”Ch5-7 “An Introduction to Statistical Learning” Ch8- 9	
11	Application in risk control and anti-fraud	ILO2,ILO 6	“Hands-On ML”Ch5-7 “An Introduction to Statistical Learning” Ch8- 9	
12	Graph theory and networks: valuation of venture firms	ILO2,ILO 6	“Hands-On ML”Ch9 “An Introduction to Statistical Learning” Ch10	
13	Presentations by Students (15- 20 mins per group)			

ANNEX B: ASSESSMENT CRITERIA FOR _____**Appendix 1: Assessment Criteria for Group Project**

The written report stands for 20% and is evaluated from 4 aspects including problem statement, creativity, feasibility, and writing. In-class presentation stands for 10%. In total, the Group Project stands for 30%.

For written report

Traits	Performance										
	Scant	1	2	3	4	5	6	7	8	9	10
<u>1. Problem statement 5%</u> Identifies the problem and analyze the market prospect.	Scant Unable to identify any real problem. Demonstrates limited understanding of the problem or related contextual factors.	Substantially Developed Problem is clearly identified and stated. Demonstrates the ability to construct a clear and insightful problem statement with evidence of all relevant contextual factors. The market prospect is properly analyzed.									
<u>2. Creativity 5%</u> Solves the problem with creativity.	Scant Ideas are not developed in original and unique ways. Reformulates a collection of available ideas.	Substantially Developed Ideas developed are original. Able to extend a novel idea to create new knowledge that crosses boundaries.									
<u>3. Feasibility 5%</u> Solves the problem with feasibility.	Scant The proposed solution lacks of feasibility in either technology realization or business model. Does not specify how the implementation will be monitored and controlled. No indicators or instruments to review or analyze the success of the action.	Substantially Developed The proposed solution is achievable in either technology realization or business model. Able to state how the implementation will be monitored effectively; identifies the stages at which progress should be measured and specify what results are expected to have been achieved at these stages.									
<u>4. Writing 5%</u> The report should be well organized with supporting evidence and proper analysis. It should be clear without grammar errors and typos.	Scant The report is difficult to follow and has many grammar errors or typos.	Substantially Developed The report is well-written and supplemented with figures, tables, or demos of app.									

For presentation,

Traits	Performance	
	Evaluation: Scant 1 2 3 4 5 6 7 8 9 10 Substantially Developed	
	Scant	Substantially Developed
<p><u>Content 5%</u></p> <ul style="list-style-type: none"> • Presents relevant information • Supports main points with strong evidence 	<p>Content is erroneous or irrelevant; references and supporting materials are absent. Lacks of depth in content and little insights are exhibited. Presentation falls outside set time parameters.</p>	<p>Content is accurate, thorough, and directly on point; strong support and references are provided. Exhibits depth and insight in content. Effective use of time and stays within time parameters.</p>
<p><u>Verbal 3%</u></p> <ul style="list-style-type: none"> • Speaks at appropriate speed and volume • Uses correct grammar and pronunciation 	<p>Grammar, pronunciation and word choice are deficient. Vocal delivery is too soft or too fast to understand; gap-fillers interfere with expression.</p>	<p>Free of errors in grammar and pronunciation; good choices of word enhance clarity of expression. Vocal delivery is varied and dynamic. Speech rate, volume, and tone facilitate audience comprehension. Minimal gap fillers.</p>
<p><u>Non-Verbal 2%</u></p> <ul style="list-style-type: none"> • Establishes eye contact • Uses gestures and movement to convey energy and confidence 	<p>Eye contact, posture, gestures, movement and facial expressions are inappropriate and significantly distracting.</p>	<p>Eye contact, posture, gestures, movement and facial expressions make the presentation compelling, and speaker appears polished and confident.</p>

Peer Evaluation Instructions

All members are required to complete a peer evaluation for each member of the team (i.e., including a self-assessment). The completed peer evaluation form must be submitted individually to the instructor immediately after the team project has been submitted for grading. Identity of appraisers will be kept **confidential** and will not be revealed to other team members.

We will use a member's ratings (on a scale ranging from 1 to 7) to award marks for the team project to other members by computing the average rating that a member receives from other members (i.e., excluding each member's self-rating). Each member will be informed of his/her average rating. A member's mark for the team project will be computed as follows:

1. If a member's average rating is ≥ 5 , the member will receive **100%** of the overall mark awarded to the team project.
2. If a member's average rating is < 5 but ≥ 3 , the member will receive **80%** of the overall mark awarded to the team project.
3. If a member's average rating is < 3 but ≥ 2 , the member will receive **50%** of the overall mark awarded to the team project.
4. If a member's average rating is < 2 , the member will receive **30%** of the overall mark awarded to the team project.

If a team member scores an overall average rating of 3 or below (i.e., the mean of the average ratings from all other team member), the instructor will engage directly with all the team members about the issue(s) at hand. If the instructor deems that a team member has not contributed sufficiently after looking into the matter, a penalty will be dealt to the offending team member. This process is meant to ensure that no student is unfairly accused of not contributing to the team projects without clear supporting evidence.

A member who has concerns with the ratings given by other team members and/or his/her average rating should immediately consult his/her instructor upon receiving his/her peer evaluation feedback.

CONFIDENTIAL PEER EVALUATION FORM FOR TEAM PROJECT

Member’s name: _____

Seminar group and team number: _____

Please use the attached Peer Evaluation Rubric to evaluate yourself and your team members on each of the 5 stated attributes (on a scale of 1 to 7). State your ratings for yourself and each of your team members in the table below. For your self-assessment, insert “(Self)” after your name in the table below.

Index #	Name of team members	1 - RR	2 - CM	3 - CR	4 - CT	5 - RS	Average Rating
1							
2							
3							
4							
5							
6							

If any of your ratings above is < 4, please provide a brief explanation to justify the ratings.

Index #	Brief explanation to justify a rating of < 4

You may attach supporting documents (like emails and screen shots), if any, to support your explanations above.

Teamwork & Interpersonal Skills (Peer Evaluation) Rubric

Learning Objective: The ability to work effectively with others in a group setting.

Traits	Performance	
<p><u>1. Roles and Responsibility (RR)</u> Behaves professionally by upholding responsibility and assuming accountability for self and others in progressing towards the team's goal.</p>	<p>Scant Unclear about his/her own role; refuses to take a role in the group; insists to work individually and has limited coordination or communication with others.</p>	<p>Substantially Developed Always fulfills responsibilities; performs his/her role within the group with enthusiasm and demonstrates willingness to work collaboratively.</p>
Evaluation: Scant <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> Substantially Developed		
<p><u>2. Communication (CM)</u> Identifies appropriate mechanisms to coordinate and correspond with team members.</p>	<p>Scant Modes of communication are not appropriate, causing confusion and miscommunication among team members.</p>	<p>Substantially Developed Modes of communication are appropriate, and maintaining timely communication and correspondence with team members.</p>
Evaluation: Scant <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> Substantially Developed		
<p><u>3. Conflict Resolution (CR)</u> Resolves conflicts using a variety of approaches.</p>	<p>Scant Does not recognize conflicts or is unwilling to resolve conflicts.</p>	<p>Substantially Developed Consistently resolves conflicts through facilitating open discussion and compromise.</p>
Evaluation: Scant <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> Substantially Developed		
<p><u>4. Contributions (CT)</u> Contributes positive input for the team; effectively utilizes one's knowledge and expertise.</p>	<p>Scant Largely disinterested in working in a group and refuses to participate; observes passively or is unwilling to share information with other team members.</p>	<p>Substantially Developed <u>Actively attends and participates in all activities and provides meaningful contribution in articulating ideas and opinions.</u></p>
Evaluation: Scant <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> Substantially Developed		
<p><u>5. Relationship (RS)</u> Maintains cooperative interaction with other team members regardless of individual /cultural differences and respects diverse perspectives.</p>	<p>Scant Rarely listens to others and does not acknowledge the opinions that differ from his/her own.</p>	<p>Substantially Developed Engages in respectful relationships with all other members in the team. Embraces and accepts diverse points of view without prejudice.</p>
Evaluation: Scant <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> Substantially Developed		

References: Teamwork Value Rubric - Association of American Colleges and Universities. Retrieved from <http://www.aacu.org/value/rubrics/pdf/teamwork.pdf>

Appendix 2: Assessment Criteria for Homework Assignment

There are two assignments, each stand for 10%. In total, homework assignment stands for 20%.

Traits	Performance	
	Evaluation: Scant 1 2 3 4 5 6 7 8 9 10 Substantially Developed	
	Scant	Substantially Developed
Identifies and summarizes the issue at hand.	Does not identify and summarize the issue, is confused or represents the issue inaccurately.	Identifies the main issue and its implicit aspects, addresses their relationships to each other and recognizes nuances of the issue.
The valuation and analysis are accurate.	The analysis uses wrong methods or wrong models.	The analysis is accurate with good reasoning. Correct model is adopted
The analysis is comprehensive.	The analysis is incomplete and narrow. Deals only with a single perspective and fails to discuss other possible perspectives, especially those salient to the issue.	The analysis is sophisticated with theory and calculation from a number of standpoints. Addresses perspectives noted previously, and additional diverse perspectives drawn from outside information.
Assesses conclusions, implications and consequences.	Fails to assess conclusions, implications, and consequences of the issue or the key relationships among the various elements such as context, evidence or assumptions. Regardless of the evidence or reasons, maintains or defends views based on self-interest or preconceptions.	Identifies and discusses conclusions, implications, and consequences, considering context, assumptions, data, and evidence. Objectively reflects upon own assertions. Draws warranted, judicious, non-fallacious conclusions.

Appendix 3: Assessment Criteria for Class Participation

Attendance and punctuality stand for 5%. In-class discussion stands for 5%. In total, class participation stands for 10%.

For in-class discussion,

Traits	Performance									
	Evaluation: Scant 1 2 3 4 5 6 7 8 9 10 Substantially Developed									
	Scant					Substantially Developed				
<u>Attitude</u>	Rarely pays attention to what others have to say or present. Often engages in distracting activities (such as text messaging, web surfing, side conversations etc.)					Demonstrates active listening behaviours when others present perspectives and materials by making comments and asking questions that build on others' contributions.				
<u>Behaviour</u>	Pays little attention to the viewpoints of others. Often displays inappropriate behaviours that communicates disrespect, belligerence, or defensiveness. Often late for class.					Pays close attention to the viewpoints of others. Able to engage in constructive dialogue. Always punctual for class.				
<u>Quality of Contribution</u>	Regularly makes comments and asks questions that are ambiguous, rhetorical and reflect little preparation. Rarely speaks up.					Often advances the level and depth of the classroom conversation by making insightful and constructive comments. Often proactively offer these insights with little or no prompting.				

ANNEX C: CURRENT COURSE OUTLINE

Academic Year	2021-2022	Semester	2
Course Coordinator	Deng Xin		
Course Code	BF3222		
Course Title	Blockchain and AI in Finance		
Pre-requisites	AB1202 Statistics & Analysis; To be M.E. with BC3409		
No of AUs	4		
Contact Hours	52		
Proposal Date	Sep 10, 2021		

A) Course Aims

This course provides the foundation for developing new financial business models and trading strategies using blockchain and artificial intelligence (AI) technologies. It is designed for students who are interested in the applications of blockchain and AI in finance. Experience with linear algebra, basic probability theory and basic calculus is necessary to complete assignments in this course. You will learn the basics of blockchain and AI technologies and related practical topics, such as CBDC, crypto economics, digital asset management. You will also learn how to use open-source Python packages to design, test, and implement algorithms in finance. With relevant knowledge and skills, you will be ready for more advanced courses such as smart contract for finance, computational law in token economy, reinforcement learning in finance.

B) Intended Learning Outcomes (ILO)/Objectives

By the end of this course, you should be able to:

1. Describe recent developments of blockchain and AI technologies and analyze their impact on the financial services
2. Explain the technologies underlying cryptocurrencies and blockchains, and the concepts of AI, machine learning, supervised learning, unsupervised learning, deep learning, and reinforcement learning
3. Design smart contracts and decentralized applications
4. Valuate blockchain project and other ventures
5. Compare stable coins, CBDC, Libra and other digital currencies
6. Apply data mining and AI techniques in FinTech and develop applications

C) Course Content

1. Blockchain technology – characteristics of public, private, consensus algorithms, blockchain cryptography for distribution of trust and protection of privacy
2. Create smart contract on Ethereum network
3. Token Economics, digital asset management and valuation analysis of the drivers of returns
4. CBDC, stable coins
5. Data Structure and data mining
6. Supervised learning - Logistic model, boosting, random forest, and support vector machines
7. Unsupervised learning: risk control and anti-fraud
8. Graph theory and networks: valuation of venture firms*
9. Reinforcement learning: trading strategy*

*advanced topics that depend on students' progress.

D) Assessment (includes both continuous and summative assessment)

Component	ILO Tested	NBS Learning Goal (Refer to Annex E for list)	Weighting	Team/Individual	Assessment Rubrics (Please insert rubrics as Appendix)
5. Quizzes	ILO1,2,4,5	Acquisition of knowledge, Problem Solving	40%	Individual	N.A
6. Group project (written report and in-class presentation *)	ILO3,4,5,6	Critical Thinking, Creative Thinking, Oral Communication, Teamwork & Interpersonal Skills	30%	Group	Critical Thinking, Creative Thinking, Problem Solving, Oral Communication, Teamwork & Interpersonal Skills
7. Homework Assignments	ILO1,2,4,6	Acquisition of knowledge, Decision Making	20%	Individual	Acquisition of knowledge, Critical Thinking
8. Class Participation	ILO1-6	Oral Communication	10%	Individual	Oral Communication
Total			100%		

* Every member is required to present. Peer evaluation is mandatory and project work marks will be adjusted if there are unequal contributions among members. The peer evaluation forms and assessment rubrics are in appendix.

Description of Assessment Components:

Quizzes: You will have two quizzes that mainly covers the key concepts, important development of technology, new market demands of financial services, and coding techniques. The first quiz is close book and will be given at the beginning of the class in week 7. It will have multiple choice questions and open-ended questions. The second quiz is open book and will be given after week 13. It will have mainly open-ended questions including coding and data analysis. Students will have 24 hours to submit their answers..

Group Project: Each group can choose either option

i) submit a report on any blockchain ventures or CBDC. You should summarize the technical feature and analyze the business prospect. More important, you need to focus on the competitive advantage of the project and be critical.

ii) develop Business Proposal by applying either blockchain technology or AI techniques to financial services, such as design smart contracts for automated transactions, data mining for credit rating, or fraud detection.

iii) develop trading strategies by applying a web crawler and analyzing the data using AI algorithms.

Home Assignments: You will be given two assignments to evaluate blockchain and AI fintech ventures, respectively.

Class participation: Attendance will be recorded. In-class discussion performance will be considered as well.

E) Formative feedback

You will receive formative feedback through written responses to your reports and assignments. You will receive summative group feedback on the presentation following the conclusion of the module.

F) Learning and Teaching approach

Approach	How does this approach support you in achieving the learning outcomes?
Seminars	The interactive seminar session where there are ample opportunities for open discussion on the conceptual questions raised in the class allows you to think critical and share their ideas and concept with the class. This also allows me to get the concepts clearly through the entire class by involving you and ensure that the targeted learning outcomes are being achieved
Individual assignment(s)	The assignments require you to generate, analyze and deliver humorous materials in a guided manner.
In-Class activities	Some learning outcomes for this course are skills which are practical in nature and cannot be achieved by reading and writing. The achievement of such learning outcomes requires hands-on experience, in-class activities provide such opportunities.

G) Reading and References

We will depend heavily on class slides. The following textbooks are recommended as reading materials and references.

1. A.Geron, Hands-On Machine Learning with Scikit-Learn and TensorFlow
2. C. Bishop, Pattern Recognition and Machine Learning
3. A. Antonopoulos, Mastering Bitcoin
4. T. Mitchell, Machine Learning
5. A. Narayanan et al., Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction
6. H. Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous

Organizations

7. A. Bahga and V. Madisetti, Blockchain Applications: A Hands-on Approach

8. G. James, et al., An Introduction to Statistical Learning: with Applications in R

H) Course Policies and Student Responsibilities

(1) General

You are expected to complete all assigned pre-class readings and activities, attend all seminar classes punctually and take all scheduled assignments and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments and course related announcements for seminar sessions they have missed. You are expected to participate in all seminar discussions and activities.

(2) Absenteeism

Absence from class without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies.

If you miss a lecture, you must inform the course instructor via email prior to the start of the class.

I) Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [academic integrity website](#) for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

J) Course Instructors

Instructor	Office Location	Phone	Email	Consultation Hours
Deng Xin	B1A-32	67904718	Xin.deng@ntu.edu.sg	By prior appointment via email

K) Planned Weekly Schedule

Week	Topic	ILO	Readings/ Activities
------	-------	-----	----------------------

1	Overview of the application of Blockchain and AI in Finance	ILO1	“Mastering Bitcoin”, Ch7&9 “Hands-On Machine Learning”, Ch1
2	Blockchain technology: characteristics of public, private, consensus algorithms, blockchain cryptography for distribution of trust and protection of privacy	ILO2	“Mastering Bitcoin”, Ch6-8
3	Smart contract: creating smart contract on Ethereum network	ILO1,ILO 3	“Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations”
4	Token Economics and valuation analysis: crypto-token fundraising methods and analysis of the drivers of returns.	ILO2, ILO4	“Mastering Bitcoin”, Ch9&10 http://tfageeks.com/2020/05/31/digital-economyand-blockchainprofessor-david-lee-kuochuen-professor-offinance-programmesingapore-university-ofsocial-sciences/
5	Digital asset management: alternative investment	ILO1,ILO 2	“Blockchain Applications: A Hands-on Approach”
6	CBDC and stable coins	ILO2,ILO 5	https://jupiterchain.tech/facebook-libra/ https://libra.org/enUS/white-paper/ 9 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3608752
7	AI: Data Structure, Neural Network, Machine Learning, Deep Learning, web crawling	ILO1,ILO 2	“Hands-On ML” Ch1
8	Supervised learning - Logistic model, boosting, random forest, and support vector machines	ILO2,ILO 6	“Hands-On ML”, Ch 9 Ch 4
9	Application in credit risk modeling	ILO2,ILO 6	“Hands-On ML”, Ch 9 Ch 4
10	Unsupervised learning		“Hands-On ML”Ch5-7 “An Introduction to Statistical Learning” Ch8- 9

11	Application in risk control and anti-fraud	ILO2,ILO 6	“Hands-On ML”Ch5-7 “An Introduction to Statistical Learning” Ch8- 9
12	Graph theory and networks: valuation of venture firms	ILO2,ILO 6	“Hands-On ML”Ch9 “An Introduction to Statistical Learning” Ch10
13	Presentations by Students (15- 20 mins per group)		