Foundations of FinTech
Fall 2024

INTA-GB.2380.10
Tuesdays 6pm – 9pm
KMEC 2-80

Professors:
Yannis Bakos: bakos@stern.nyu.edu
David Yermack: dy1@stern.nyu.edu

Teaching Fellow:
Harsh Pooniwala hp2664@stern.nyu.edu

When you email us, please start the subject line with "Langone Fintech"

Office Hours:
by appointment

Pre-requisite: Foundations of Finance

Course Description:
"FinTech" refers to financial sector innovations involving technology-enabled business models that can facilitate disintermediation, revolutionize how existing firms create and deliver products and services, address privacy, regulatory and law-enforcement challenges, provide new gateways for entrepreneurship, and seed opportunities for inclusive growth.

FinTech is also the label for increasingly technological approaches to the main financial intermediation functions: payments, capital raising, remittances, managing uncertainty and risk, market price discovery, and mediating information asymmetry and incentives. In today's FinTech businesses, consumers bank via mobile apps integrated into social media, institutions trade electronically, and robo-advisers make decisions about investment portfolios.

This course provides an introduction to the emerging FinTech discipline. It is intended to be the starting point for Stern students who may take additional electives in the FinTech area, while also providing an overview of the area for students who intend to take only one FinTech course.

Attendance and participation:
Attendance is mandatory for this class. Participation is expected and is an important part of your grade. Participation is more than just attendance. Participation means coming to class prepared, and contributing via class discussion to the advancement of knowledge in the class (not just having the right answer, you are here to learn!).

Covid Policy:
Please don't come to class if you do not feel well or have been exposed to Covid, etc., as per the NYU policy. All the work is available on Brightspace, and all the classes are recorded. Thanks for your patience as Stern policy adapts and thanks for keeping us all safe.

Case Assignments
There will be 3 case assignments which are structured in the sense that you will be asked to answer specific questions that will be provided on Brightspace. We expect evidence-based analytic answers. Think of your case assignment as an assessment, not an editorial. Please draw upon quantitative and qualitative evidence to support your argument. Make sure you use evidence from the time of the case (not with today's perfect hindsight), unless otherwise required by the question. Make sure to cite references (Smith, 2020). We will accept bullet point answers, but you must still present a logical argument.

Case questions will be posted 1-2 weeks before the case is due. We recommend that you start working on them allowing ample time before the due date. Some questions may require your own independent research. Cases must be submitted to Brightspace as PDF files; we will not accept emailed assignments.

Case assignments are due by 5pm on the days indicated below:

1. 10/1 (Class 3): CBDC case
2. 10/29 (Class 7): PayPal case
3. 12/3 (Class 11): Wirecard case

In-class Quizzes
There will be 3 in-class quizzes, on classes 4, 8 and 12. There will be no make-up quizzes.

Grading:

30% for the 3 In-Class Quizzes
30% for the 3 Case Studies
20% for the take-home Final Exam
20% for Class participation

Excessive grade litigation is a tax on the professor, teaching fellow and the rest of the class and is discouraged. Any regrades will be for the entire assignment or quiz, and may result in a lower grade.

Course Readings:
Please see **both** the syllabus below and Brightspace for required readings. Not all readings are posted in Brightspace, and you may have to access the reading yourself or via a syllabus link or Google search. You are responsible for all the indicated readings regardless of their location. We have marked readings when optional or may be skimmed. Because fintech is evolving rapidly, we occasionally post additional readings or links to the Brightspace site resources folder or via announcements.

Class slides:
Posted in Brightspace: we post pre-class slides (latest by 5pm the night before the class) and we sometimes update the class slides post-class. When cases are due and/or discussed in class some slides may be posted only after case submissions are made.

Cases:
We will use two HBS cases, *PayPal Merchant Services* (9-806-188) and *Wirecard: The Downfall of a German Fintech Star* (9-121-058). We will provide you with more details about acquiring these cases.

Videos:
Classes are recorded and videos will be posted to Brightspace

Typical Class Structure

Classes without a Quiz:
6-7:20pm: part 1
7:20-7:35pm: break
7:35-9pm: part 2

Classes with Quizzes:
6-7:05pm: part 1
7:05-7:10pm: break
7:10-7:40pm: In-class Quiz (**taken on your laptop on Brightspace**)
7:40-7:50pm: break
7:50-9pm: part 2

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ACADEMIC INTEGRITY AND STERN CODE OF CONDUCT

We take pride in our well-rounded education and approach our academics with honesty and integrity. Indeed, integrity is critical to all that we do here at NYU Stern. As members of our community, all students agree to abide by the ***NYU Academic Integrity Policies*** *as well as the NYU Stern Student Code of Conduct, which includes a commitment to:*

- *Exercise integrity in all aspects of one's academic work including, but not limited to, the preparation and completion of exams, papers and all other course requirements by not engaging in any method or means that provides an unfair advantage.*

- *Clearly acknowledge the work and efforts of others when submitting written work as one's own. Ideas, data, direct quotations (which should be designated with quotation marks), paraphrasing, creative expression, or any other incorporation of the work of others should be fully referenced.*

- *Refrain from behaving in ways that knowingly support, assist, or in any way attempt to enable another person to engage in any violation of the Code of Conduct. Our support also includes reporting any observed violations of this Code of Conduct or other School and University policies that are deemed to adversely affect the NYU Stern community.*

The Stern Code of Conduct and Judiciary Process applies to all students enrolled in Stern courses and can be found here: https://www.stern.nyu.edu/portal-partners/student-engagement/student-life/life-stern/code-conduct. To help ensure the integrity of our learning community, prose assignments you submit to NYU Brightspace will be submitted to Turnitin. Turnitin will compare your submission to a database of prior submissions to Turnitin, current and archived Web pages, periodicals, journals, and publications. Additionally, your document will become part of the Turnitin database.

USE OF GENERATIVE AI

You can use AI at your own risk, but you are responsible for the accuracy and integrity of anything that you submit. Any use of chatbots or other type of generative AI in assignments must be disclosed in a citation that explains how the AI was used. Students who hand in vague assignments without appropriate references to data or statistics can expect to receive poor grades. Importantly, citations to non-existent sources are considered "ghost plagiarism" and will get an F grade. Use of AI during the in-class quizzes is considered cheating, is strictly prohibited and will result in disciplinary proceedings and an F grade in the course.

GENERAL CONDUCT & BEHAVIOR

Students are also expected to maintain and abide by the highest standards of professional conduct and behavior. Please familiarize yourself with Stern's Policy in Regard to Behavior & Expectations (https://www.stern.nyu.edu/portal-partners/registrar/policies-procedures/general-policies/code-conduct) and the

NYU Student Conduct Policy (https://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/university-student-conduct-policy.html).

GRADING GUIDELINES

Grading Information for Stern ***Elective Courses***
At NYU Stern, we strive to create courses that challenge students intellectually and that meet the Stern standards of academic excellence. To ensure fairness and clarity of grading, the Stern faculty have agreed that for elective courses the individual instructor or department is responsible for determining reasonable grading guidelines.

STUDENT ACCESSIBILITY
If you will require academic accommodation of any kind during this course, you must notify me at the beginning of the course and provide a letter from the Moses Center for Student Accessibility (212-998-4980, mosescsa@nyu.edu) verifying your registration and outlining the accommodations they recommend. If you will need to take an exam at the Moses Center for Student Accessibility, you must submit a completed Exam Accommodations Form to them at least one week prior to the scheduled exam time to be guaranteed accommodation. For more information, visit the CSA website: https://www.nyu.edu/students/communities-and-groups/student-accessibility.html

STUDENT WELLNESS
Our aim is for students to be as successful academically as they can, and to help them overcome any impediments to that. Any student who may be struggling and believes this may affect their performance in this course is urged to contact the Moses Center for Student Accessibility (see also the Student Accessibility section of this syllabus) at 212-998-4980 to discuss academic accommodations. If mental health assistance is needed, call the NYU's 24/7 Wellness Exchange hotline 212-443-9999. Furthermore, please approach me if you feel comfortable doing so. This will enable me to provide relevant resources or referrals. There are also drop in hours and appointments. Find out more at http://www.nyu.edu/students/health-and-wellness/counseling-services.html
You can also reach out to the Academic Advising team at academicaffairs@stern.nyu.edu if you would like to receive more information or further support.

NAME PRONUNCIATION AND PRONOUNS
NYU Stern students now have the ability to include their pronouns and name pronunciation in Albert. We encourage you to share your name pronunciation and preferred pronouns this way. Please utilize this link for additional information: Pronouns & Name Pronunciation

RELIGIOUS OBSERVANCES AND OTHER ABSENCES (OPTION 2)
NYU's Calendar Policy on Religious Holidays states that members of any religious group may, without penalty, absent themselves from classes when required in compliance with their religious obligations. You must notify the teaching team in advance of religious holidays or observances that might coincide with exams, assignments, or class times to schedule mutually acceptable alternatives. Students may also contact religiousaccommodations@nyu.edu for assistance.

Except for religious observances or other absences that may be required in compliance with nondiscrimination law, this class otherwise requires attendance and participation and cannot accommodate conflicts. Please review all class dates at the start of the semester and review all course requirements to identify any foreseeable conflicts with exams, course assignments, projects, or other items required for participation and attendance. If you are aware of a potential conflict, it is strongly recommended that you do not take this class.

INCLUSION STATEMENT
This course strives to support and cultivate diversity of thought, perspectives, and experiences. The intent is to present materials and activities that will challenge your current perspectives with a goal of understanding how others might see situations differently. By participating in this course, it is the expectation that everyone commits to making this an inclusive learning environment for all.

Class Schedule
Tuesdays 6-9pm, KMEC-2-80

Class	Date	Topics
Class 1	9/17	**1A: Course Introduction: Innovation and the Six Functions of Finance (DY)** **1B: Encryption, hashing, basic blockchain concepts (YB)**
Class 2	9/24	**2A: Blockchain 1—Blockchain and Bitcoin mechanics (YB)** **2B: Blockchain 2—Bitcoin transactions, Ethereum, other cryptocurrencies (YB)**
Class 3	10/1	**CBDC Case Assignment Due 5pm** **3A: What is Money, Banking and Payments, CBDCs (DY)** **3B: Money Transfer, Payment Systems, U.S. and International (DY)**
Class 4	10/8	**QUIZ 1 (30 min)** **4A: Blockchain 3—Smart Contracts, tokens, dApps (YB)** **4B: Blockchain 4—Enterprise blockchains, tokenization (YB)**
Class 5	10/15	**5A: Fintech valuation and Unicorns (DY)** **5B: Fintech Venture funding (DY)**
Class 6	10/22	**6A: The Future of Markets: Exchanges and trading (DY)** **6B: Blockchain 5—DeFi (Decentralized Finance) (YB)**
Class 7	10/29	**PayPal Case Assignment Due 5pm** **7A: Tech Strategy and Platforms (YB)** **7B: Financial Services Platforms (YB)**
	11/5	**NO CLASS**
Class 8	11/12	**QUIZ 2 (30 minutes)** **8A: Capital Allocation and Investing (DY)** **8B: Behavioral FinTech (DY)**
Class 9	11/19	**9A: Digital India and Digital China—Financial Inclusion, Financial Surveillance (DY)** **9B: Machine Learning Basics Part 1 (YB)**
Class 10	11/26	**10A: Machine Learning Basics Part 2 (YB)** **10B: Machine Learning Basics Part 3—Neural Networks and AI (YB)**
Class 11	12/3	**Wirecard Case Assignment Due 5pm** **11A: Government Regulation of FinTech, and FinTech Tools for Government Regulators ("RegTech") (DY)** **11B: FinTech Risks and Famous Failures (DY)**
Class 12	12/10	**QUIZ 3 (30 minutes)** **12A: TBD; 12B: Course Wrap-up**

TAKE HOME FINAL EXAM WILL BE POSTED AFTER CLASS 12 AND WILL BE DUE 3 DAYS LATER

DETAILED CLASS SCHEDULE AND READINGS:
(Always Check Brightspace for Latest Version)

Class 1A: Course Introduction: Innovation and the Six Functions of Finance (DY)

- Merton, 1995, "A functional perspective of financial intermediation."
- The Economist, 2007, "To do with the price of fish."
- Philippon, 2015, "Has the U.S. finance industry become less efficient?"
- Christensen, 1997, *The Innovator's Dilemma* (optional, background)

Class 1B: Encryption, hashing, basic blockchain concepts (YB)

- Panayotis Vryonis, Public-key cryptography for non-geeks. August 28, 2013. Available at https://blog.vrypan.net/2013/08/28/public-key-cryptography-for-non-geeks.
- Red Hat Customer Portal, Introduction to Public-Key Cryptography. Available at https://access.redhat.com/documentation/en-us/red_hat_certificate_system/9/html/planning_installation_and_deployment_guide/introduction_to_public_key_cryptography. Read through section 1.3.3.2.
- Patrick Nohe, The difference between Encryption, Hashing and Salting. Published 19 December 2018. Available at https://www.thesslstore.com/blog/difference-encryption-hashing-salting/
- OPTIONAL: A more advanced introduction to encryption in the context of blockchains can be found in the Princeton Bitcoin Book, available at https://www.lopp.net/pdf/princeton_bitcoin_book.pdf. Skim (or, if interested, read) Chapter 1 (ignore everything about Merkle trees).

Class 2A: Blockchain 1—Blockchain and Bitcoin mechanics (YB)

- Michael Scott, The Essence of the Blockchain. Published 30 August 2016. Available at https://miracl.com/blog/the-essence-of-the-blockchain/
- WATCH: Scott Driscoll, How bitcoin works under the hood (22 minute video; July 14, 2013). Available, including transcript, at http://www.imponderablethings.com/2013/07/how-bitcoin-works-under-hood.html
- SKIM: Satoshi Nakamoto, 2008, *Bitcoin: A Peer-to-Peer Electronic Cash System*, unpublished, available at https://bitcoin.org/bitcoin.pdf
- SKIM: Guillaume Haeringer and Hanna Halaburda, Bitcoin: A Revolution? Published in Digital Economy 2018. Available on SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3133346 ***Notice that even though SSRN suggests to create a free account, you can download the papers without it—you may need to look for a smaller button on the page***

Class 2B: Blockchain 2—Bitcoin transactions, Ethereum, other cryptocurrencies (YB)

- What is Ethereum, Coinbase (2021), https://www.coinbase.com/learn/crypto-basics/what-is-ethereum
- Bitcoin vs. Ethereum in 2024: Comparison & Outlook (2024), https://www.vaneck.com/us/en/blogs/digital-assets/bitcoin-vs-ethereum/

Class 3A: What is Money, Banking and Payments, CBDCs (DY)

- **CBDC case discussion. CBDC case assignment due before class (5pm).**
- Harris, 2021, "The future of money: A complete revolution."
- Dyson & Hodgson, 2016, "Digital cash."
- Giancarlo et al, 2020, "Digital dollar project."
- Website: https://www.atlanticcouncil.org/cbdctracker/
- Venkataramakrishnan, 2023, "How digital cash got caught up in the culture wars."

Class 3B: Money Transfer, Payment Systems, U.S. and International (DY)

- World Bank, 2024, *Remittance Prices Worldwide Quarterly (issue 49, March 2024)*
- Hawkins, 2023, "How digital assets are changing the global remittance market, and how to invest in it."
- Chainalysis, 2023, *Geography of Cryptocurrency Report* (see information on remittances reported at various places in the document).

Class 4: QUIZ 1 (30 min)

Class 4A: Blockchain 3—Smart Contracts, tokens, dApps (YB)

- Christopher Burniske, Bitcoin and Ethereum: How smart contracts work. ARK Research blog, May 29, 2016. Available at https://ark-invest.com/research/smart-contracts-work
- Introduction to Smart Contracts. https://ethereum.org/en/smart-contracts/
- The difference between coins and tokens (2019), available at https://www.ledger.com/academy/crypto/what-is-the-difference-between-coins-and-tokens
- OPTIONAL: Bob Mason. What is an ICO (Initial Coin Offering) and How Does it Work? FXEmpire blog post, June 2017. Available at https://www.fxempire.com/education/article/ico-initial-coin-offering-work-418446
- Clark (2021), "NFTs, explained," The Verge, https://www.theverge.com/22310188/nft-explainer-what-is-blockchain-cryptoart-faq
- Introduction to Dapps https://ethereum.org/en/developers/docs/dapps/

Class 4B: Blockchain 4—Enterprise blockchains, tokenization (YB)

- Blockchain Goes To Work At Walmart, Amazon, JPMorgan, Cargill and 46 Other Enterprises, *Forbes*, April 2019 https://www.forbes.com/sites/michaeldelcastillo/2019/04/16/blockchain-goes-to-work/#4e5dd2922a40
- Walmart is betting on blockchain to improve food safety, *TechCrunch*, September 2018 https://techcrunch.com/2018/09/24/walmart-is-betting-on-the-blockchain-to-improve-food-safety/
- Walmart / IBM's supply chain "blockchain" is missing the point, Medium, September 2018 https://medium.com/@jonelcordero/walmart-ibms-supply-chain-blockchain-is-missing-the-point-c4685b4939de
- OPTIONAL: Blockchain trends to watch: https://www.cbinsights.com/research/blockchain-trends-2019/

Class 5A: Fintech valuation and Unicorns (DY)

- Gornall & Strebulaev, 2020, "Squaring venture capital valuations with reality."
- Kareem, 2023, "The alchemy of FinTech valuations."
- CB Insights 2024, Unicorn Market Map

Class 5B: Fintech Venture funding (DY)

- Howell, Niessner & Yermack, 2020, "Initial coin offerings."
- Klausner, Ohlrogge & Ruan, 2022, "A sober look at SPACs."
- Chipolina, 2023, "Venture capital not done with crypto yet."

Class 6A: The Future of Markets: Exchanges and trading (DY)

- Bessembinder, Spatt & Venkataraman, 2020, "A survey of the microstructure of fixed-income markets."
- Malinova & Park, 2023, "Tokenized stocks for trading and capital raising."
- Greyscale Investments, 2024, *Tokenization Report.*

Class 6B: Blockchain 5—DeFi (Decentralized Finance) (YB)

- What is DeFi? https://www.coinbase.com/learn/crypto-basics/what-is-defi
- Arcane Research on the crypto trading ecosystem**:** https://lmaxdigital.com/documents/The-Bitcoin-Trading-Ecosystem.pdf
- OPTIONAL: Carter & Jeng: DeFi Protocol Risks: The Paradox of DeFi (available on SSRN). This FT article provides a helpful summary: https://www.ft.com/content/00ee2bf6-3c19-4e81-ad0c-dd5b66606b3f
- An excellent book on DeFi if you are interested is Campbell Harvey's *Defi and the future of finance*, on Amazon for about $15

Class 7A: Tech Strategy and Platfroms (YB)

Learning objectives: core platform concepts and strategies

- James Currier, The Network Effects Manual: 13 Different Network Effects (and counting). Medium, January 9, 2018. Available at https://medium.com/@nfx/the-network-effects-manual-13-different-network-effects-and-counting-a3e07b23017d
- Strategies for Two-Sided Markets. Thomas Eisenmann, Geoffrey Parker, and Marshall W. Van Alstyne. Harvard Business Review, October 2006. Available from Brightspace
- Platform Envelopment. Thomas Eisenmann, Geoffrey Parker, and Marshall Van Alstyne. Strategic Management Journal, December 2011. Available from Brightspace.
- OPTIONAL: Hanna Halaburda and Felix Oberholzer-Gee, Limits to Scale, published in HBR April 2014, available at https://hbr.org/2014/04/the-limits-of-scale

Class 7B: Financial Services Platfroms (YB)

- PayPal Merchant Services. HBS Case 9-806-188.
- **PayPal Case Assignment is due before class (5pm)**

Class 8: QUIZ 2 (30 minutes)

Class 8A: Capital Allocation and Investing (DY)

- D'Acunto & Rossi, 2019, "Robo-Advising."
- Niszczota & Abbas, 2023, "GPT has become financially literate: Insights from financial literacy tests of GPT and a preliminary test of how people use it as a source of advice."
- Motley Fool, 2024, "Best Robo Advisors." (click through to read reviews)

Class 8B: Behavioral FinTech (DY)

- Ravina, 2019, "Love and loans."
- Ernst & Young, 2021, *Behavioral Economics Applied to the Financial Sector*.
- Howell et al, 2024, "Lender automation and racial disparities in credit access."

Class 9A: Digital India and Digital China—Financial Inclusion, Financial Surveillance (DY)

- Lahiri, 2020, "The great Indian demonetization."
- Alonso et al, 2023, "Stacking up the benefits: Lessons from India's digital journey."
- Yasir & Ives, 2023, "India is scrapping its largest bill. The race is on to spend it."
- Buchanan & Cao, 2018, "Quo vadis? A comparison of the FinTech revolution in China and the West."

Class 9B: Machine Learning Basics Part 1 (YB)

- Machine Learning for Humans (Part 1, Part 2.1, Part 2.2 pages 30-31, Part 2.3 pages 46-52), available at https://everythingcomputerscience.com/books/Machine%20Learning%20for%20Humans.pdf
- SKIM: Dhar V., When to Trust Robots With Decisions and When Not To, Harvard Business Review, May 2016 https://hbr.org/2016/05/when-to-trust-robots-with-decisions-and-when-not-to

- OPTIONAL: Machine Learning for Humans (Part 4, Part 5), available at https://everythingcomputerscience.com/books/Machine%20Learning%20for%20Humans.pdf
- OPTIONAL: Machine Learning is Fun! Part 3: Deep Learning and Convolutional Neural Networks; https://medium.com/@ageitgey/machine-learning-is-fun-part-3-deep-learning-and-convolutional-neural-networks-f40359318721

Class 10A: Machine Learning Basics Part 2 (YB)

- Cohen, M., Guetta, C.D., Jao, K. and Provost, F. Data-Driven Investment Strategies for Peer-to-Peer Lending: A Case Study for Teaching Data Science. Big Data Vol. 6, Number 3, 2018. ***We will discuss this article in class, so make sure to read it!***
- QUICK READ: Provost and Fawcett, Data Science for Business, Chapter 3, Introduction to Predictive Modeling: From Correlation to Supervised Segmentation. Read through p. 70, focusing on entropy and information gain. The rest is optional.
- QUICK READ: Provost and Fawcett, Data Science for Business, Chapter 5, Overfitting and its Avoidance. Read through the second paragraph on p. 122.

Class 10B: Machine Learning Basics Part 3—Neural networks and AI (YB)

- Reading TBD.

Class 11A: Government Regulation of FinTech, and FinTech Tools for Government Regulators ("RegTech") (DY)

- Arner, Barberis & Buckley, 2017, *FinTech and RegTech in a Nutshell, and the Future in a Sandbox* (CFA Institute).
- Cowan, Hammond & Camfield, 2023, *FinTech, RegTech, and the Role of Compliance in 2023* (Thomson Reuters)
- Garcia Ocampo, Branzoli & Cusmano, 2023, *Crypto Tokens and DeFi: Navigating the Regulatory Landscape* (BIS Financial Stability Institute)

Class 11B: FinTech Risks and Famous Failures (DY)

- HBS Case: "Wirecard, The Downfall of a German FinTech Star" (rev. August 2023)
  Wirecard case assignment due before class (5pm).
- Chainalysis, *2024 Crypto Crime Report.*
- U.S. Senate Committee on Homeland Security & Government Affairs, 2022, *Use of Cryptocurrency in Ransomware Attacks, Available Data, and National Security Concerns.*

Class 12: QUIZ 3 (30 minutes)

Class 12A: TBD; 12B: Course wrap-up

- Readings TBD

TAKE HOME FINAL EXAM WILL BE POSTED AFTER CLASS 12 AND WILL BE DUE 3 DAYS LATER