



Foundations of FinTech

Course #INTA-GB.2380.20 and .21

Classroom TBD

Spring 2018-weekly dates will be updated

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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.¹

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 inter-departmental course provides an introduction to the emerging FinTech discipline. It is intended to be the starting point for Stern students who may take

¹ See: <http://www.stern.nyu.edu/programs-admissions/full-time-mba/academics/specializations/fintech>

additional electives in the FinTech area, while also providing an overview of the area for students who intend to take only one FinTech course.

The course will study:

- How is financial innovation different than industrial innovation? How is financial innovation evolving? What are the light sides and dark sides of financial innovation?
- Will traditional financial intermediaries be able to adapt? Or will upstart FinTechs disrupt them, re-imagining business models just as Amazon reshaped book-selling and Uber transformed taxi-rides?
- What are the critical technology strategies and foundational technologies in FinTech?
- What are the core and novel sources of FinTech data, how are they managed? How is data visualization evolving?
- What are the primary FinTech data science methods and tools? How do they apply to real FinTech problems and questions today?
- How is FinTech reconfiguring financial services business models? What are the key disruption points? What determines success in FinTech?
- Where are the limits, risks, and broader policy and social implications of FinTech?

Grading:

45% Problem sets and case questions
15% from classes 3-15
30% from classes 17-20-case studies
35% Midterm: October 26th
20% Final Exam: TBD December 18-22
Class participation is expected

Course Readings and Cases:

Please see syllabus below and NYU classes (resources, by week for all course readings, case studies, and lecture slides)

General Conduct and Behavior

Students are expected to maintain and abide by the highest standards of professional conduct and behavior. Please familiarize yourself with Stern's Policy in Regard to In-Class Behavior & Expectations (<http://www.stern.nyu.edu/portal-partners/current-students/undergraduate/resources-policies/academic->

<policies/index.htm>) and the NYU Disruptive Behavior Policy (<http://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/bullying--threatening--and-other-disruptive-behavior-guidelines.html>).

In particular this means: (a) attendance is mandatory – if you cannot make it you must get permission from the instructor to miss class, (b) no personal use of electronic devices in class (only note taking is allowed), and (c) display your name cards at your seat so the instructor can get to know you.

Academic Integrity Above All:

Integrity is critical to the learning process and to all that we do here at NYU Stern. As members of our community, all students agree to abide by the NYU Stern Student Code of Conduct, which includes a commitment to: (a) 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. (b) 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. (c) 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 entire Stern Student Code of Conduct applies to all students enrolled in Stern courses and can be found here:

www.stern.nyu.edu/uc/codeofconduct

To help ensure the integrity of our learning community, all assignments that you submit via the course's NYU Classes website will be routed through Turnitin, which will compare your submission to a database of prior submissions, current and archived Web pages, periodicals, journals, and publications. Your document will automatically become part of the Turnitin database.

Students with Disabilities:

If you have a qualified disability and will require academic accommodation of any kind during this course, you must notify the instructor at the beginning of the course and provide a letter from the Moses Center for Students with Disabilities (CSD) at Tel. (212) 998-4980 or www.nyu.edu/csd verifying your registration and outlining the accommodations the Center staff recommends. If you will need to take an exam at the CSD, you must submit a completed Exam Accommodations Form (EAF) to them at least one week prior to the scheduled exam time to be guaranteed the alternative venue.

Syllabus:

Week 1

1. Class 1: DY: Course Introduction: the FinTech opportunity to improve the financial system

- **Read:** Satoshi Nakamoto, 2008, "Bitcoin: A Peer-to-Peer Electronic Cash System," unpublished, available at <https://bitcoin.org/bitcoin.pdf>
- **Read:** Citi GPS, 2016, *Digital Disruption: How FinTech Is Forcing Banking to a Tipping Point*, available at <https://ir.citi.com/SEBhgbdvxes95HWZMmFbjGiU%2FydQ9kbvEbHlruHR%2Fe%2F2Wza4cRvOQUNX8GBWVsV>

2. Class 2: KD: Financial Innovation: Theory, History, Today

- **Read:** The Economist, To do with the price of fish, <http://www.economist.com/node/9149142>
- **Read:** Christensen, Clayton M., and Bower, Joseph L. (1995). Disruptive Technologies: Catching the Wave. *Technology & Operations*. Harvard Business School.
- **Read:** Christensen, Clayton M., Raynor, Michael E. and McDonald, Rory. (2015). What is Disruptive Innovation? *Harvard Business Review*. December 2015.
- **Read:** Frame, W. Scott, and White, Lawrence J. (2014). Technological Change, Financial Innovation, and Diffusion in Banking. Chapter prepared for *The Oxford Handbook of Banking*, 2nd edition. Available at www.ssrn-id2380060.pdf (

Week 2

3. Class 1: YB: Encryption and Information Security

- **Read:** 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>.

- **Read:** The Mozilla Foundation, Encryption and Decryption. Last updated June 4, 2015. Available at https://developer.mozilla.org/en-US/docs/Archive/Security/Encryption_and_Decryption.
 - **Read:** The Mozilla Foundation, Introduction to Public-Key Cryptography. Last updated March 21, 2015. Available at https://developer.mozilla.org/en-US/docs/Archive/Security/Introduction_to_Public-Key_Cryptography.
- 4. Class 2: YB: Blockchains and Cryptocurrencies, Part 1: Bitcoin**
- **Read:** Michael Scott, The Essence of the Blockchain. Published 30 August 2016. Available at <http://www.miracl.com/hubfs/block.pdf?hsCtaTracking=41b86e7e-0bc6-48f0-889a-61bd43021a32%7Cab2522ad-e26f-4487-b0f3-b251481190c8>
 - **Read:** Chapter 2: Blockchain Technology, in Matteo Biela and Vittorio Zinetti, Blockchain Technology and Applications from a Financial Perspective. Available from NYU Classes.
 - **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>

Week 3

- 5. Class 1 YB: Blockchains and Cryptocurrencies, Part 2: The cryptocurrency ecosystem, present and future**
- **Read:** Ethereum, a Virtual Currency, Enables Transactions That Rival Bitcoin's. New York Times, March 27, 2016. <https://www.nytimes.com/2016/03/28/business/dealbook/ethereum-a-virtual-currency-enables-transactions-that-rival-bitcoins.html>
 - **Read:** 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>
 - **Read:** Chapter 11: Decentralized Institutions: The Future of Bitcoin? In *Bitcoin and Cryptocurrency Technologies* (a.k.a. the "Princeton Bitcoin book"). Available from NYU Classes.
- 6. Class 2: YB: Blockchains and Cryptocurrencies, Part 3: Payment Systems; Blockchain as infrastructure**
- **Read:** Chapter 3: Financial Use Cases, in Matteo Biela and Vittorio Zinetti, Blockchain Technology and Applications from a Financial Perspective. February 26, 2016. Available from NYU Classes. Read 3.1: Payments; rest of chapter is optional reading.
 - **Read:** Sally Percy, What is the Cheapest Way to Send Money Abroad? *The Telegraph*, 7 April 2016 <http://www.telegraph.co.uk/money/transferwise/the-cheapest-way-to-send-money-abroad/>
 - **Read:** 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>
 - **Read:** Gideon Greenspan, Ending the bitcoin vs. blockchain debate. Blog post July 20, 2015. Available at <https://www.linkedin.com/pulse/ending-bitcoin-vs-blockchain-debate-gideon->

[greenspan](#).

Week 4

7. Class 1: YB: Privacy and financial data

- **Read:** Big data, financial services and privacy. The Economist, February 9, 2017. Available at <https://www.economist.com/news/finance-and-economics/21716621-should-our-bankers-and-insurers-be-our-facebook-friends-big-data-financial>
- **Read:** Cybersecurity and Data Privacy in 2017: Eight Topics to Follow. By McGuireWoods LLP, January 31, 2017. Available at <http://www.jdsupra.com/legalnews/cybersecurity-and-data-privacy-in-2017-32602/>
- **Read:** EU-U.S. Privacy Shield Fact Sheet. European Commission, July 2016. Available at http://ec.europa.eu/justice/data-protection/files/factsheets/factsheet_eu-us_privacy_shield_en.pdf

8. Class 2: YB: Platforms: Economics and Strategy

- **Read:** Strategies for Two-Sided Markets. Thomas Eisenmann, Geoffrey Parker, and Marshall W. Van Alstyne. Harvard Business Review, October 2006. Available from NYU Classes.
- **Read:** PayPal Merchant Services. HBS Case 9-806-188. Available from NYU Classes.

Week 5

9. Class 1 VD: How "Traditional" Machine Learning Works: Part 1

- **Concepts covered:** deduction versus induction, supervised and unsupervised learning, target variable, classification versus regression (Learning versus specifying a model, Feature engineering, Decision Trees, Bayesian thinking)
- **Broad questions**
Q11: What does it mean for a machine to generate and test hypotheses? Are machines capable of doing Science?
Q12: How is machine learning different from database querying?
- **Read:** Dhar, V., Data Science and Prediction, Communications of the ACM, volume 56, number 12, December 2013
- **Read:** Provost and Fawcett, Data Science for Business, Chapter 3, Introduction to Predictive Modeling: From Correlation to Supervised Segmentation

10. Class 2 VD: How "Traditional" Machine Learning Works: Part 2

- **Concepts covered:** feature engineering, model bias, overfitting, randomness and baseline performance, in-sample performance versus generalization performance, learning curve, fitting curve (Learning Curves, Fitting Curves, Overfitting Avoidance, Comparing Learned Models)
- **Broad questions**
Q21: What is feature engineering and why is it essential to machine learning?
Q22: Does more data lead to better predictive models?
Q23: What is "overfitting" and how can it be avoided?
- **Read:** Provost and Fawcett, Data Science for Business, Chapter 5, Overfitting and its Avoidance

- **Read:** Provost, F., Predictive Modeling With Big Data: Is Bigger Really Better? *Big Data*, volume 1, issue 4, Jan 2014;
<http://online.liebertpub.com/doi/pdfplus/10.1089/big.2013.0037>

Week 6

11. Class 1 VD: How Do We Evaluate Machine Learning Models?

- **Concepts covered** ROC curves and AUC for classification, MSE, MAPE, Sharpe Ratios for regression
- **Broad questions**
 - Q31: How can you compare classifiers when costs and benefits are known?
 - Q32: How can you compare classifiers more generally?
 - Q33: Under what conditions do false positives and false negatives matter?
- **Read:** Provost and Fawcett, *Data Science for Business*, Chapter 8, Visualizing Model Performance
- **Read:** Dhar, V., *Big Data and Predictive Analytics in Healthcare*, *Big Data*, volume 2, issue 3, September 2014
<http://online.liebertpub.com/doi/pdf/10.1089/big.2014.1525>

12. Class 2: VD: How "Deep" Machine Learning Works

- **Concepts covered:** Neural Nets, Convolutional Nets, how perception works, local correlation structure, role of data in DL)
- **Broad questions**
 - Q41: How can deep nets do automated feature engineering?
 - Q42: (How) can automated feature engineering be done on "traditional" business data?
- **Read:** Dhar, V., and Stein, R., Chapter 6 "Neural Networks" from *Seven Methods for Transforming Corporate Data Into Business Intelligence*, Prentice-Hall, 1997.
- **Read:** 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>

Week 7

13. Class 1: VD: How Big Data Changes Things

- **Concepts covered:** expected value framework, autonomous learning systems, predictability, error cost, trust
- **Broad questions**
 - Q51: When Should We Trust Machines With Decision-Making?
 - Q52: How Can Leaders Prioritize Potential Data Science Initiatives?
- **Read:** 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>
- **Read:** <https://www.bloomberg.com/news/articles/2017-08-02/john-mack-backed-data-startup-announces-new-funding-and-partners>

14. Class 2 VD: AI Platforms and Fintech data & applications

- **Concepts covered:** Machine Learning Tools and Platforms, FinTech Platforms and Processes

- **Broad questions**
Q61: How does AI shift the boundaries of work between machines and humans?
Q62: What is the likely impact of AI on FinTech and jobs in Finance?
- **Read:** Dhar, V., Robots Will Soon Do Your Taxes: Bye Bye Accounting Jobs, Wired, Feb 2017 <https://www.wired.com/2017/02/robots-will-soon-taxes-bye-bye-accounting-jobs/>
- **Read:** <https://www.predictiveanalyticstoday.com/artificial-intelligence-platforms/>

15. Class 1 VD & YB: Review Session

16. Class 2 ***MIDTERM EXAM***

Week 9

17. Class 1 **KD**: Intro to Disruptive Technology Cases in FinTech (all the below are short)

- **Read:** Haycock, James, and Richmond, Shane. (2015). *Bye Bye Banks? How retail banks are being displaced, diminished, and disintermediated by tech startups- and what they can do to survive*. London, U.K. Wunderkammer, Adaptive Lab
- **Read:** <https://www.fnondon.com/articles/fintech-partnerships-reveal-banks-innovation-insecurities-20170406>
- **Read:** Corkery, Michael. (2016). As Lending Club Stumbles, Its Entire Industry Faces Skepticism. *The New York Times*. Deal Book. May 9. Available at: <http://www.nytimes.com/2016/05/10/business/dealbook/as-lending-club-stumbles-its-entire-industry-faces-skepticism.html>
- **(Read:** Nixon, Brian, (2017) An Inflection Point for Wealth Management <https://search.proquest.com/openview/6eb323d349d9acb19b9841c85ab8fcc1/1?pq-origsite=gscholar&cbl=47754>
- **Read:** Young, Don. (2015). Apple Poised to Beat Visa, PayPal Into China e-Payments. *Forbes*. November 25, 2015. Available at www.forbes.com/sites/dougyoung/2015/11/25/apple-poised-to-beat-visa-paypal-into-china-e-payments/#79b04797642a
- **Read:** <https://www.forbes.com/sites/mergermarket/2017/05/31/b2b-fintech-investment-on-the-rise/>
- **Group in-class work:** Construct competitive maps for the five primary financial functions (Competitors, Profits, and Technology)

18. Class 2 **KD**: Payments and Money Transfers: Pirate Booty

- **Read:** Pirate Booty Case
- **Prepare Case Questions:** individual work, one page bullet point answers
 - Would you invest in Pirate Booty?
 - What is the biggest operational risk in Pirate Booty?
 - Pirate Booty does not have its own banking license. Advantage or disadvantage?

Week 10

19. Class 1 **KD**: Markets and Price Discovery: Trumid

- **Read:** Trumid Case
- **Prepare Case Questions:** individual work, one page bullet point answers

- What is Trumid's competitive advantage?
- What market share does Trumid need to become profitable?
- Why do dealers join the Trumid platform?

20. Class 2 KD: Capital Allocation: Betterment and Stash

- **Read:** Robo Investing Case
- **Prepare Case Questions:** individual work, one page bullet point answers
 - Should Betterment enter the retirement market?
 - How does Betterment use technology to address behavioral finance bias?
 - Is Betterment a "platform"?

Week 11

21. Class 1 DY: FinTech operational, technology, and regulatory risks

- **Read:** Christopher Malmo, 2017, "A Single Bitcoin Transaction Takes Thousands of Times More Energy than a Credit Card Swipe," *Motherboard*, March 7, available at https://motherboard.vice.com/en_us/article/ypkp3y/bitcoin-is-still-un可持续的.
 - See also: Bitcoin Energy Consumption Index, available at <http://digiconomist.net/bitcoin-energy-consumption>
- **Read:** Matthew Leising, 2017, "The Ether Thief," *Bloomberg Markets*, June 13, available at <https://www.bloomberg.com/features/2017-the-ether-thief/>
- **Read:** [Chinese bitcoin exchange rules expected to be issued in June 2017]

22. Class 2 DY: Cyber Security, Fraud, Crime and Law Enforcement in FinTech

- **Read:** David Segal, 2014, "Eagle Scout. Idealist. Drug Trafficker?" *The New York Times*, January 18, available at <https://www.nytimes.com/2014/01/19/business/eagle-scout-idealist-drug-trafficker.html>
 - See also: Joseph Menn, 2016, "Former U.S. Secret Service Agent Suspected in Additional Bitcoin, Thefts," *Reuters*, June 30, available at <http://www.reuters.com/article/us-bitcoin-corruption-bridges-idUSKCN0ZH3FB>
- **Read:** Kim Zetter, 2015, "That Insane, \$81m Bangladesh Bank Heist? Here's What We Know," *Wired*, May 17, available at <https://www.wired.com/2016/05/insane-81m-bangladesh-bank-heist-heres-know/>

Week 12

23. Class 1): DY: Infamous Financial Technology Blow-ups and Failures ~~***NO class*** (11/23 Thanksgiving)~~

- **Read:** Chris Giles, 2015, "Bank of England Attacked Over Payment Systems Failure," *Financial Times*, March 25, available at <https://www.ft.com/content/979f2bf4-d2e0-11e4-a792-00144feab7de?mhq5j=e2>

(Note: the Deloitte report, which has been partly redacted by the Bank of England, can be downloaded by those interested at http://www.bankofengland.co.uk/publications/Documents/news/2015/rtgs_deloitte.pdf)

- **Read:** Stephanie Yang, 2015, "Remembering the Flash Crash from the NYSE Trading Floor," *The Wall Street Journal*, May 6, available at <https://blogs.wsj.com/moneybeat/2015/05/06/remembering-the-flash-crash-from-the-nyse-trading-floor/>
- **Read:** Bradley Hope and Andrew Ackerman, 2015, "'Flash Crash' Overhaul Is Snarled in Red Tape," *The Wall Street Journal*, May 5, available at <https://www.wsj.com/articles/flash-crash-overhaul-is-snarled-in-red-tape-1430868811>

(Note: The joint SEC-CFTC report on the flash crash can be downloaded by those interested at <https://www.sec.gov/news/studies/2010/marketevents-report.pdf>)

- **Read:** Jake Adelstein and Nathalie-Kyoko Stucky, 2016, "Behind the Biggest Bitcoin Heist in History: Inside the Implosion of Mt. Gox," *The Daily Beast*, May 19, available at <http://www.thedailybeast.com/behind-the-biggest-bitcoin-heist-in-history-inside-the-implosion-of-mt-gox>

Week 13

24. Class 1 KD: FinTech Company Valuation & Asset Bubbles

- **Read:** Damodaran, Aswath. (2012). *The Dark Side of Valuation*. Available at: www.pages.stern.nyu.edu/~adamodar/pdf/country/darkside2012extended.pdf

25. Class 2 DY: Using Insights from FinTech to Improve Financial Behavior

- **Read:** Vitalik Buterin, 2017, "The Meaning of Decentralization," Medium, February 6, available at <https://medium.com/@VitalikButerin/the-meaning-of-decentralization-a0c92b76a274>
- **Read:** Hugh Son, 2017, "JPMorgan Software Does in Seconds What Took Lawyers 360,000 Hours," Bloomberg Markets, February 27, available at <https://www.bloomberg.com/news/articles/2017-02-28/jpmorgan-marshals-an-army-of-developers-to-automate-high-finance>

Week 14

26. Class 1 DY: Policy Implications for Regulators and Investors

- **Read:** Elsa Mesropyan, 2016 "International FinTech Regulatory Sandboxes Launched by Forward-Thinking Financial Authorities," *Let's Talk Payments*, available at <https://letstalkpayments.com/international-fintech-regulatory-sandboxes-launched-by-forward-thinking-financial-authorities/>
- **Read:** Nathaniel Popper, 2017, "Silicon Valley Tried to Upend Banks. Now it Works with Them," *The New York Times*, February 22, available at <https://www.nytimes.com/2017/02/22/business/dealbook/silicon-valley-tried-to-upend-banks-now-it-works-with-them.html>
- **Read:** Lucy McNulty, 2017, "10 RegTech Firms to Watch," *Financial News*, May 30, available at <https://www.fnlondon.com/articles/the-10-regtech-firms-to-watch-20170530>

27. Class 2 DY: Financial Inclusion and Exclusion

Read: World Bank, 2014, *Global Financial Development Report: Financial Inclusion*, available at http://siteresources.worldbank.org/EXTGLOBALFINREPORT/Resources/8816096-1361888425203/9062080-1364927957721/GFDR- 2014_Complete_Report.pdf.

Week 15

28. ***Last Class***2 KD: Robots, AI and the Labor Market After FinTech, and course wrap-up

- **Read:** Dowd, Maureen (2017) *Elon Musk's Billion-dollar Crusade to stop the AI Apocalypse*. Available at: <https://www.vanityfair.com/news/2017/03/elon-musk-billion-dollar-crusade-to-stop-ai-space-x>
- **Read:** Knight, Will (2017) *Meet the Chinese Finance Giant That's Secretly an AI Company*. Available at: <https://www.technologyreview.com/s/608103/ant-financial-chinas-giant-of-mobile-payments-is-rethinking-finance-with-ai/>
- **Read:** Banks AI plans threaten thousands of jobs. *Financial Times*. Available at: <https://www.ft.com/content/3da058a0-e268-11e6-8405-9e5580d6e5fb>

Final Exam TBD