GB.3360
Introduction to Decentralized Finance (DeFi)

Preliminary Short-Form Syllabus

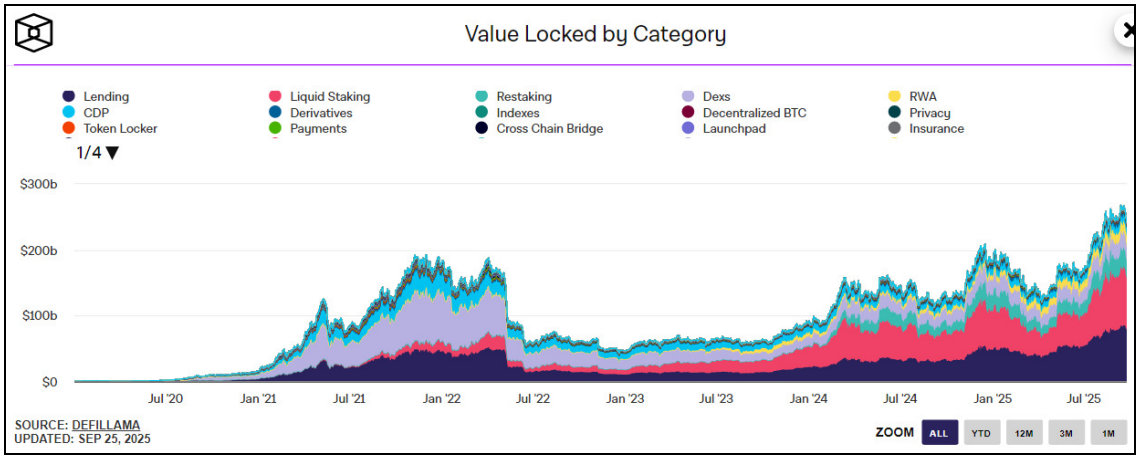
Instructors:
Clinical Professor Ian D'Souza
Adjunct Assistant Professor J. Austin Campbell

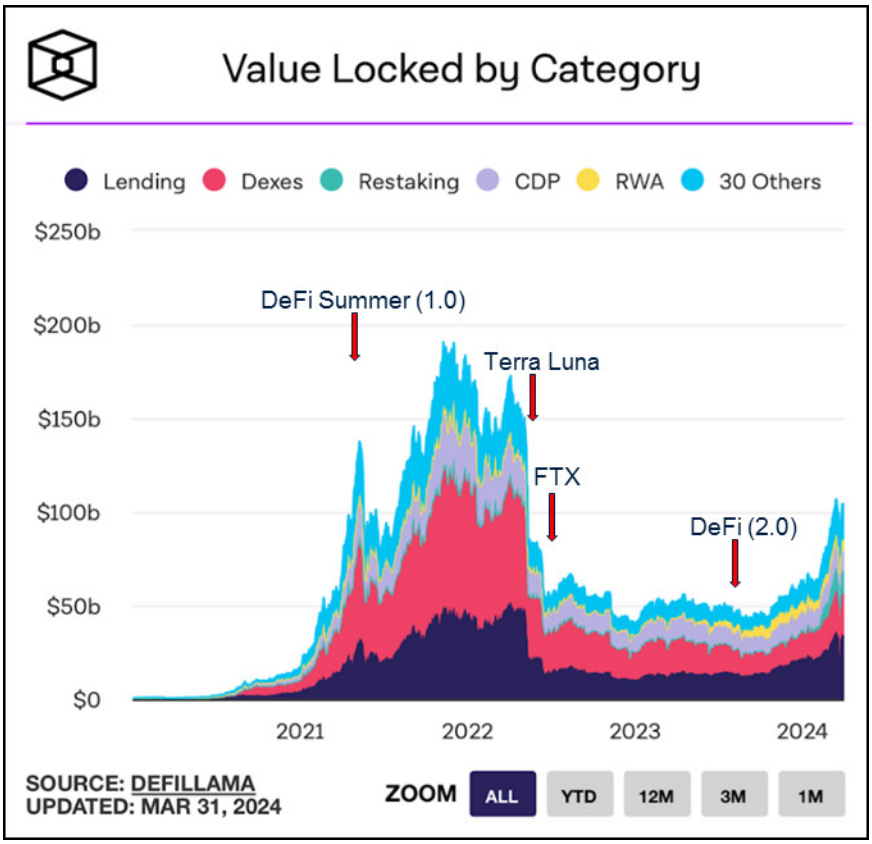
Spring Each Year
In-person Instruction, 12 classes, 6-9pm (full credit course)

Course Background

- *"Decentralized finance (DeFi) aims to provide financial services without intermediaries, using automated protocols on blockchains and stablecoins to facilitate fund transfers" (BIS Quarterly Review, December 2021)*
- *The aim [of DeFi] is to democratize finance by replacing centralized institutions such as banks, brokers, and exchanges with direct, peer-to-peer relationships" (Bitwise, 2021)*

This full-credit course provides an *Introduction to DeFi – What, Why, When, How?* and explicitly focuses on the DeFi stack & Dapps that run on Ethereum (ETH), as it is the oldest chain for DeFi and also has the most capital locked into those protocols (TVL) – approximately 70% share. We will discuss key applications given ETH's composability as well as unique DeFi risks & regulations compared to Traditional Finance (TradeFi)





Importantly, we will cover how and why the composition of the DeFi categories have changed significantly from the prior peak in 2021 to 2024 as shown in the tables below (which encompasses DeFi summer through Terra Luna and FTX collapse and renaissance with staking and liquid re-staking and new iterations around RWA):

Nov 28, 2021	
Dexes	$75.784b
Lending	$47.136b
CDP	$29.227b
Bridge	$26.403b
Yield	$7.81b
Yield Aggregator	$3.621b
Derivatives	$2.699b
Payments	$2.533b
Indexes	$2.41b
Algo-Stables	$1.848b
Others	$8.604b

Mar 26, 2024	
Lending	$34.523b
Bridge	$25.748b
Dexes	$21.911b
Restaking	$12.205b
CDP	$11.195b
RWA	$5.691b
Yield	$4.936b
Derivatives	$3.386b
Farm	$2.037b
Launchpad	$1.338b
Others	$7.737b

Learning Objectives:

1. **To explore the fundamental aspects of DeFi and the mechanics behind the protocols**
   - *The questions here: What, why, when and how of DeFi? What is the context behind the rise of DeFi and the implications on trust if there is no intermediary in finance?*
2. **To analyze the DeFi stack and focus on core primitives & elements:**
   - *Yield & Lending – how can yield be so high for DeFi – sometimes 1000% APY? How does lending work without a centralized credit scoring mechanism?*
   - *Dexes & AMM – how does a decentralized exchange work relative to centralized order books?*
   - *Stablecoins – what are they and how are they used within the DeFi ecosystem*
3. **To examine DeFi's governance, regulatory and hack risks**
   - *The questions here: What are the governance issues within DeFi protocols (eg. Are they decentralized? How do oracles work? What are the specific risks with DeFi compared to traditional finance (eg DeFi hacks)?*

Prerequisites:

Due to the more advanced nature of DeFi, students can only undertake this course after having completed one of the following cryptocurrency courses at NYU Stern:

- **GB.3324: Digital Currencies, Blockchains and the Future of Finance**
- **GB.3180: Introduction to Cryptocurrency Investing**

Course Evaluation

Evaluation will be based on:

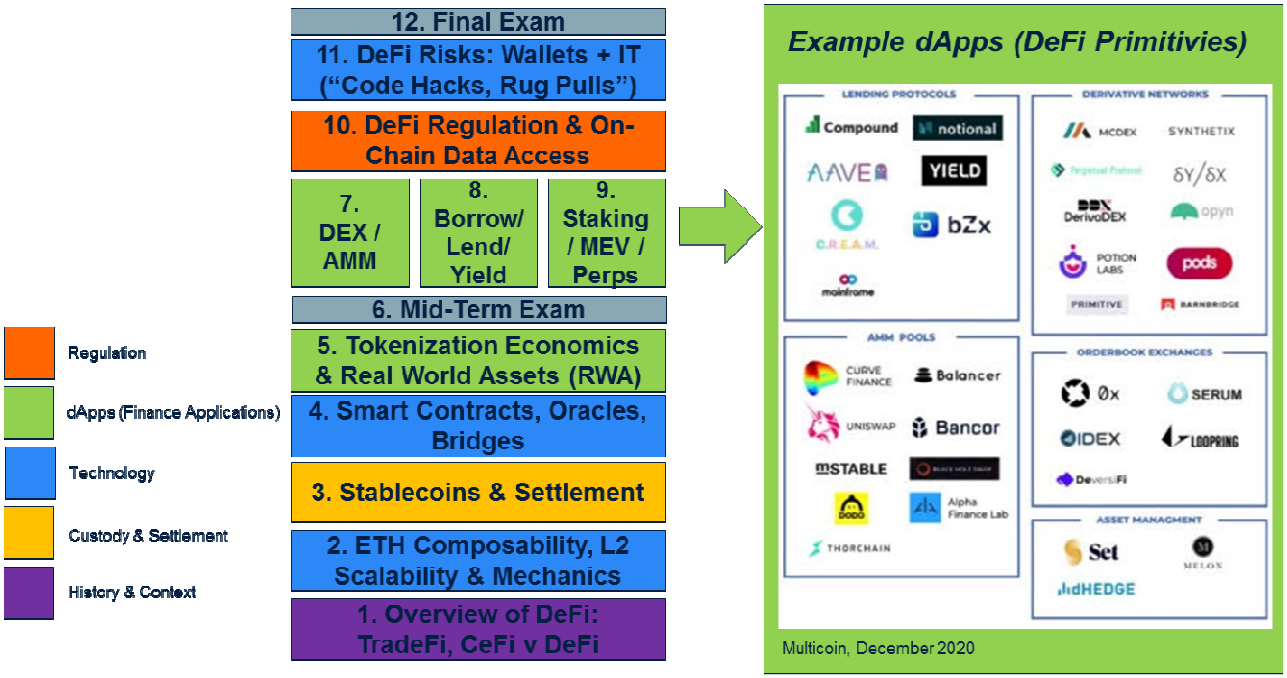
- Assignments: Three to six assignments (30% weight) covering key elements of the DeFi stack discussed earlier. These can be done individually or in a group.

- In-Class Attendance: Contribution inside classroom (20% weight) where case studies will be conducted for each class to connect practical and theoretical DeFi aspects as well as interconnection between DeFi and TradeFi (refer next page)

- Exams: One mid-term and one final-term exam (50% in total, 25% each)

Course Construction and Class Teaching Components:

Course construction involves examining the DeFi stack of 10 classes (plus two exam sessions) in a bottom-up process. We also review the real world decentralized applications (dApps) created for DeFi such as in levels 7, 8, 9 as these illustrate how DeFi aims to disintermediate traditional banks, brokers and web2.0 fintech - see below:



Each 3 hour class breaks into two halves:

- First half: Examining typical crypto primitives (via video clips and guest speakers) and/or analyzing select real-world examples, dApps and case studies
- Second half: We provide lecture notes that build on the examples in the first half in a more generic form and guest lecturers where appropriate

Given the discussion aspect of each class, attendance at each class is very important (see course evaluation).

Below is the class-by-class preliminary schedule and includes academic and regulatory readings. Practical readings will be provided closer to course commencement given the rapidly evolving nature of this DeFi space.

Class-by-Class Schedule: Objectives and Reading Material

Class 1: DeFi Overview – History, TradeFi, CeFi vs. DeFi Stack

Learning Objectives
- What, Why, When, How of DeFi?
- What is the DeFi stack?
- What are differences between TradeFi, CeFi and DeFi?

Reading on NYU Brightspace
- "International banking and financial market developments" BIS Quarterly Review (Dec 2021, May 2023)
- "Down the Rabbit Hole: The Promises and perils of decentralized finance", The Economist (Sept 2021)
- "Lessons Learned From DeFi," Meegan T and Koens T (2020)
- "Assessing Macrofinancial Risk for Cryptoassets", Hacibedel B et al, IMF (2023)
- "Tokenization: Overview and Financial Stability Implications", Fed Reserve Discussion (2023)

Class 2: ETH Composability, L2 Scalability and Mechanics

Learning Objectives
- What are key differences btw BTC and ETH? What are the unique elements of Ethereum (relative to Bitcoin) for smart contracts & ENS addresses?
- What is gas? What is EIP-1559? What is MEV?
- What is a smart contract?
- What is gas and staking in crypto?

Reading on NYU Brightspace
- "DeFi and the future of finance", Chapter 2-3, Harvey et al (2021)
- "Ethereum's smart contracts are full of holes," MIT Review (2018)
- "SoK: Decentralized Finance (DeFi)" Werner et al (2022)
- "Could Ethereum Become A Deflationary Asset," Bernstein (2021)
- "On-chain profit strategies and MEV extraction", The Block (2021)

Class 3: Stablecoins & Settlements

Learning Objectives
- What is a money & stablecoin?
- What is relevance of stablecoins in DeFi?
- How do different stablecoins work and interact with DeFi?
- What is GENIUS Act?

Reading on NYU Brightspace

- "Is Bitcoin a real currency," Yermack (2013)
- "Stablecoins: risks, potential and regulation", BIS Working Paper 905 (2020)
- "The capital efficiency era of DeFi", Pranay Mohan (2021)
- "Stablecoins" Carter (2023)
- "Stablecoins: Regulatory Responses To Their Promise of Stability", BIS (2024)
- GENIUS Act (2025)

Class 4: Smart Contracts, Oracles and Bridges

Learning Objectives

- What is an oracle and bridge?
- Why is it important to DeFi and smart contracts?

Reading on NYU Brightspace

- "Demystifying Blockchain Oracles", Amberdata (2023)
- "Beginner's Guide to DeFi" Mihajlovic (2021)
- "The capital efficiency era of DeFi", Pranay Mohan (2021)

Class 5: Tokenization Economics and RWAs

Learning Objectives

- What is RWA?
- What is tokenization continuum?

Reading on NYU Brightspace

- "Marginal Costs of Different Financial Systems" IMF (2021)
- "RWA Bridge", Binance (2022)
- "The tokenisation continuum", BIS Bulletin, Aldasoro, I et al (2023)
- "Tokenization: Overview and Financial Stability Implications", Fed Reserve (2023)

Class 6: Mid-term Exam

To be online on Brightspace comprising material covered in first half of course

Class 7: DeFi Trading – DEX/AMM

Learning Objectives

- What is CEX v DEX?
- What is AMM? An examination of the process behind the matching engine?
- What is RFQs – request for quotes?
- What is impermanent loss?
- What are DEX aggregators?

Reading on NYU Brightspace

- "Understanding AMM – price impact," Paradigm (2021)
- "SoK: Decentralized Exchanges (DEX) with Automated Market Maker (AMM) Protocols", Xu, Paruch et al (2021)
- "Beginner's Guide to DeFi" Mihajlovic (2021)

Class 8: DeFi Lending and Borrowing Protocols (Yields)

Learning Objectives

- What are liquidity pools? How do they work?
- What are flash loans?
- What is yield farming?

Reading on NYU Brightspace

- "The Limits on Liquidity Mining," Bram (2021)
- "Analyzing Yield Farming" Nansen (2021)
- "Say no to 1300% APY", Blockworks (2021)

Class 9: Staking, MEV and Perpetuals/Derivatives

Learning Objectives

- What is Staking & Liquid Staking?
- What types of derivatives are used in DeFi? Perpetuals?

Reading on NYU Brightspace

- "Staking and centralization" JPM (2023)
- "Understanding perpetuals (perps)", dYdX (2021)

Class 10: DeFi Regulation and On-Chain Data Access

Learning Objectives

- Which US regulatory bodies have jurisdiction on DeFi? SEC v CFTC
- What are their approaches? How have they evolved?
- What is the global DeFi regulatory landscape?
- How does TVL and valuation link?

Reading on NYU Brightspace

- "Aggregation Theory and Value Capture in DeFi", Bianconi (2021)
- "DeFi Valuations", Block (2022)
- "The Tao of DeFi Value", Messari (2021) & "High DeFi Returns Rely on Usage and Value Capture", Crypto Briefing (2020)
- "Statement of DeFi Risk", Commissioner Crenshaw, SEC.gov (2021)
- "DeFi Protocol Risks: The Paradox of DeFi", Carter, Jeng et al (2021)

Class 11: DeFi Risks - Wallets and IT (Code Hacks, Rug Pulls)

Learning Objectives

- What are the root causes of DeFi hacks?
- What are the mitigation techniques? (White hats, code bounties, code audits)

Reading on NYU Brightspace

- "Analyzing the Ronin bridge attack", Bankless (2022)
- "Root cause analysis", Wooded Meter (2022)
- "Blockchains Privacy and Regulatory Compliance: Towards a Practical Equilibrium", Buterin et al (2023)
- "SoK: DeFi Attacks", Shou L et al (2023)

Class 12: Final Exam

To be online on Brightspace comprising material covered during the course

Detailed Syllabus & Guidelines

A detailed syllabus will be provided closer to the class commencement in Spring and be on Brightspace along with all relevant guidelines. This will include Academic Integrity; General Conduct & Behavior; Grading Guidelines; Student Accessibility; Student Wellness; Name Pronunciation and Pronouns; Religious Observances; and Laptop, Cell Phones & Other Electronic Devices.

Instructors

Professor D'Souza is a clinical professor at NYU Stern and previously was the CIO of two investment funds (a hedge fund and a venture capital fund which included crypto investments). He has taught at NYU Stern since 2006 covering subjects in behavioral finance, venture capital, alternative assets, fintech, blockchain & digital currencies. For matters concerning the course content, he can be contacted at: idsouza@stern.nyu.edu

Adjunct Professor Campbell is currently founder and managing partner of Zero Knowledge Consulting. Previously, he ran Stable Value Trading at Citi, and was the head of Portfolio Management at Paxos. He has been an adjunct professor at Columbia Business School teaching cryptocurrencies and is a former NYU Stern MBA graduate.