

DeFi Ecosystem: Rebuilding Finance Without Permission

AMMs, Lending, Stablecoins, and the Art of Not Getting Rekt

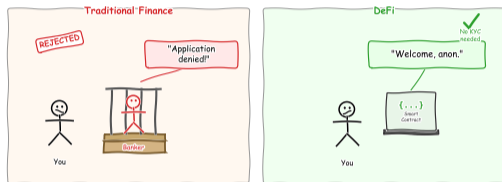
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BSc Blockchain, Crypto Economy & NFTs

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[Cartoon] The Bank Is Closed. DeFi Is Open.

Bank vs DeFi



Traditional finance asks for permission. DeFi asks for a wallet.

It is Saturday night. You need to move \$50,000 across borders. Your bank is closed. Western Union charges 7%. The wire takes 3–5 business days.

You open a browser. Connect a wallet. Swap tokens on Uniswap. The transaction settles in 12 seconds. The fee is \$0.47.

No account. No approval. No human involved.

A set of smart contracts just did what an entire bank cannot do on weekends — and it charged you less than a cup of coffee.

This lecture is about how that works, and what can go wrong.

DeFi processed over \$1 trillion in volume in 2024 — without a single employee, branch, or banking license.

By the end of this lecture, you will be able to:

1. **Describe** the four-layer DeFi stack and explain composability. [Understand]
2. **Explain** how AMMs replace order books using the constant product formula. [Understand]
3. **Calculate** slippage and impermanent loss for concrete pool scenarios. [Apply]
4. **Compare** lending, stablecoin, and DEX mechanisms and their risk profiles. [Analyze]
5. **Evaluate** a DeFi protocol's sustainability using a 6-question framework. [Evaluate]

Prerequisites: Basic blockchain concepts (Blockchain Foundations lecture) and tokenomics fundamentals (Tokenomics lecture).

Bloom's levels covered: Understand, Apply, Analyze, Evaluate

These objectives progress from definitions to judgment — the same path you follow when evaluating any DeFi protocol.

What this lecture covers:

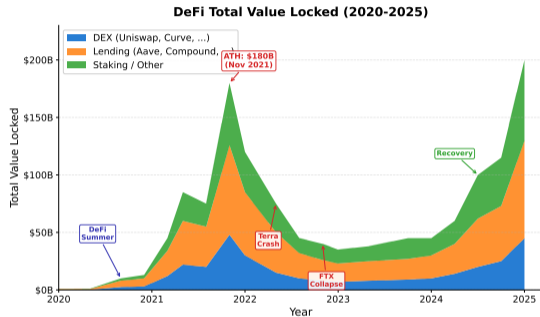
This lecture synthesizes Module E (Lessons 33–40). We cover AMMs, lending, stablecoins, risk cascades, and the market landscape.

Start: What is DeFi and why does it exist?

End: You can evaluate any DeFi protocol using a structured 6-question framework.

The journey:

- Definition → Stack → AMMs
- Lending → Stablecoins → Risks
- Market landscape → Evaluation framework



Core tension: How do you rebuild the entire financial system on code — and what breaks when you try?

A Thought Experiment

You wake up and your bank has frozen your account. No warning. No explanation. Your savings, your payments, your mortgage — all inaccessible.

This is not hypothetical. In 2022, Celsius Network froze \$4.7 billion in customer deposits. Voyager Digital followed. Then FTX collapsed, taking \$8 billion in customer funds.

Millions of people trusted centralized platforms with their money. The platforms said “no.”

The promise of DeFi is simple: **no one can freeze your funds** because no one holds custody. Your assets sit in smart contracts, not in someone else's database.

But removing the middleman does not remove the risk. It moves the risk from *trusting people* to *trusting code*.

Think about where your money is right now. Who can deny you access?

Celsius, Voyager, and FTX collectively froze over \$15 billion in customer funds in 2022. DeFi protocols kept running.

Definition: DeFi

Decentralized Finance (DeFi) is a system of financial applications built on public blockchains that replicate traditional financial services — lending, borrowing, trading, insurance — using smart contracts instead of intermediaries.

Five defining properties:

1. **Non-custodial** — users retain control of their assets at all times
2. **Permissionless** — anyone with a wallet can participate, no application or approval
3. **Transparent** — all transactions and contract logic are publicly auditable
4. **Composable** — protocols can be combined like building blocks (“money legos”)
5. **Programmable** — financial logic is encoded in smart contracts, not policy manuals

DeFi does not eliminate risk. It replaces counterparty risk (trusting people) with smart contract risk (trusting code).

As of January 2026, DeFi protocols hold over \$90 billion in Total Value Locked (TVL) across 200+ chains.

Dimension	Traditional Finance (TradFi)	Decentralized Finance (DeFi)
Access	Application, KYC, credit check	Wallet address — no identity required
Custody	Bank holds your funds	You hold your private keys
Hours	Mon–Fri, 9am–5pm	24/7/365 — no downtime
Settlement	T+1 to T+3 (days)	Seconds to minutes
Transparency	Closed books, periodic audits	On-chain, real-time, auditable by anyone
Failure mode	Bank run, fraud, mismanagement	Smart contract bug, oracle failure, governance attack

The trade-off:

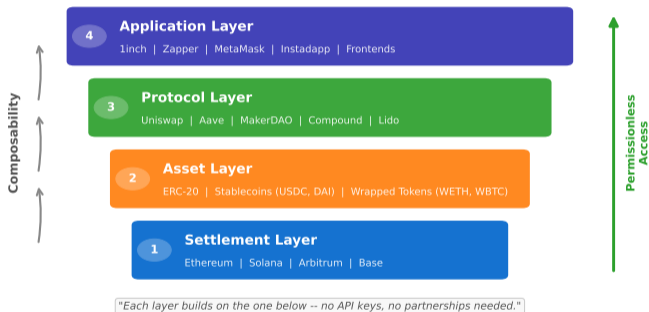
TradFi gives you *consumer protection* (deposit insurance, fraud reversal, legal recourse).

DeFi gives you *sovereignty* (no one can freeze, censor, or confiscate your assets).

You cannot have both. Every DeFi design decision is a position on this spectrum.

DeFi trades consumer protection for self-sovereignty. Understanding this trade-off is the first step to evaluating any protocol.

The DeFi Stack



- **What you see:** Four layers building upward — Settlement (blockchain), Asset (tokens), Protocol (smart contracts), Application (user interfaces)
- **Key pattern:** Each layer depends on those below it; a bug in the Settlement layer cascades through every layer above
- **Takeaway:** DeFi is a stack, not a single product — composability means one protocol's output becomes another's input

Layer 1: Settlement (Ethereum, Solana) → Layer 2: Asset (ERC-20 tokens, stablecoins) → Layer 3: Protocol (Uniswap, Aave, MakerDAO) → Layer 4: Application (wallets, dashboards, aggregators)

The DeFi stack mirrors the internet stack: infrastructure at the bottom, user experience at the top.

What is composability?

Any DeFi protocol can use any other DeFi protocol as a building block — without permission.

Example chain:

1. Deposit ETH into Lido → receive stETH
2. Deposit stETH into Aave as collateral
3. Borrow USDC against it
4. Swap USDC for ETH on Uniswap
5. Repeat (leverage loop)

Five protocols. One transaction. Zero intermediaries.

Why it matters:

In traditional finance, each institution is a walled garden. Banks do not let you use your savings account balance as collateral at a brokerage *automatically*.

In DeFi, every protocol reads from the same blockchain. Your position in Aave is visible to Uniswap, Curve, and every other contract.

The risk: Composability is also contagion. If Lido's stETH depegs, Aave liquidations cascade, Uniswap pools drain, and the entire chain unwinds — in minutes.

Composability is DeFi's superpower and its Achilles' heel. Building blocks that break can bring down the entire structure.

Definition: Automated Market Maker (AMM)

A smart contract that holds reserves of two (or more) tokens and uses a mathematical formula to determine the exchange rate between them — replacing the traditional order book with a deterministic pricing function.

Traditional Order Book:

- Buyers and sellers post limit orders
- A matching engine pairs them
- Requires active market makers (professionals)
- Works poorly with low liquidity

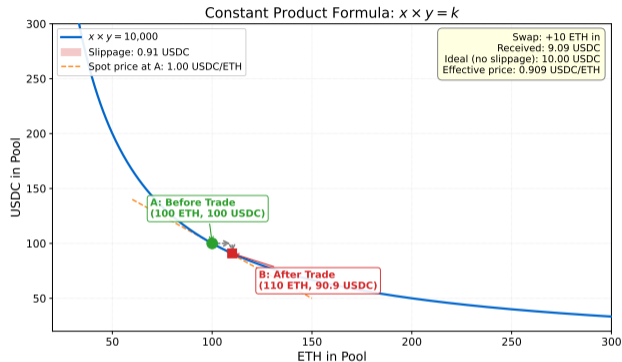
AMMs replaced humans with math. The formula is always available, always solvent, and never takes a lunch break.

AMM (Uniswap Model):

- Liquidity providers deposit token pairs
- A formula sets the price automatically
- Anyone can provide liquidity (earn fees)
- Works with any liquidity level (price adjusts)

Uniswap V1 launched in November 2018 with \$30K in liquidity. By 2024, Uniswap had processed over \$2 trillion in cumulative volume.

The Constant Product Formula: $x \times y = k$



The formula:

$$\underbrace{x}_{\text{ETH in Pool}} \times \underbrace{y}_{\text{USDC in Pool}} = \underbrace{k}_{\text{Constant}}$$

- **What you see:** A hyperbolic curve — as you buy ETH (x decreases), the USDC price (y) rises along the curve
- **Key pattern:** Large trades move the price more because they travel further along the curve (slippage)
- **Takeaway:** The formula guarantees the pool never runs dry — but the last token costs infinitely more than the first

Uniswap's constant product formula is 8 lines of Solidity. It replaced billion-dollar trading infrastructure.

Worked Example: Swapping ETH for USDC

Scenario: A Uniswap pool holds 100 ETH and 300,000 USDC. You want to buy 10 ETH.

Variable	Value	Meaning
ETH in pool (x)	100	Token reserve A
USDC in pool (y)	300,000	Token reserve B
Constant (k)	30,000,000	$x \times y = k$
Implied ETH price	\$3,000	$300,000 / 100$

Step 1: After buying 10 ETH, the pool has 90 ETH remaining.

Step 2: New USDC balance = $k / \text{new ETH} = 30,000,000 / 90 = \mathbf{333,333 \text{ USDC}}$

Step 3: You paid $333,333 - 300,000 = \mathbf{33,333 \text{ USDC}}$ for 10 ETH.

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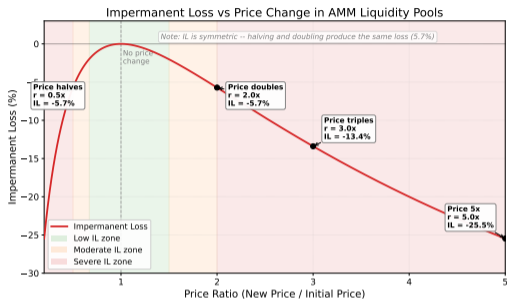
Effective price: $33,333 / 10 = \mathbf{\$3,333 \text{ per ETH}}$ (vs ideal price of \$3,000)

Slippage: $(3,333 - 3,000) / 3,000 = \mathbf{11.1\%}$ (you overpaid by \$3,333)

The larger the trade relative to the pool, the worse the price. This is why deep liquidity matters.

Slippage is the hidden cost of AMMs. A 10% trade against pool reserves produces 11.1% slippage in constant product pools.

Impermanent Loss: The LP's Hidden Cost



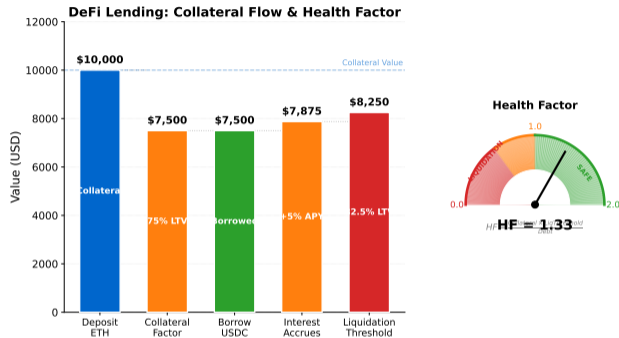
The formula:

$$IL = \frac{\sqrt{2 \cdot \text{Price Ratio}}}{1 + \frac{\text{Price Ratio}}{2}} - 1 \quad \text{where } r = \text{new price} / \text{original price}$$

- **What you see:** IL increases as the price ratio diverges from 1 — a 2x price move causes 5.7% loss, a 5x move causes 25.5%
- **Key pattern:** IL is symmetric — the loss is the same whether price doubles or halves
- **Takeaway:** LPs earn trading fees but lose from price divergence. Profit = fees earned — impermanent loss

“Impermanent” because the loss reverses if prices return to the original ratio. “Loss” because they usually do not.

DeFi Lending: Borrow Without a Bank



- **What you see:** A flow diagram — depositors supply assets, borrowers post collateral, the protocol sets interest rates algorithmically
- **Key pattern:** Interest rates adjust automatically based on pool utilization — high demand → higher rates → more deposits
- **Takeaway:** No credit checks, no applications — the collateral *is* the creditworthiness. Overcollateralization replaces trust

How it works: Deposit **\$15,000** ETH → borrow up to **\$10,000** USDC (75% LTV) → pay variable interest → repay to unlock collateral.

Aave and Compound together hold over \$15 billion in deposits. Neither has a single loan officer.

Definition: Health Factor

Health Factor = Collateral Value (adjusted by liquidation threshold) / Outstanding Debt. When Health Factor drops below 1.0, the position is eligible for liquidation.

Worked example:

Variable	Value	Meaning
Collateral deposited	\$10,000 ETH	Your deposit
Liquidation threshold	80%	Protocol parameter
Amount borrowed	\$6,000 USDC	Your debt
Health Factor	$10,000 \times 0.80 / 6,000 = 1.33$	Safe (above 1.0)

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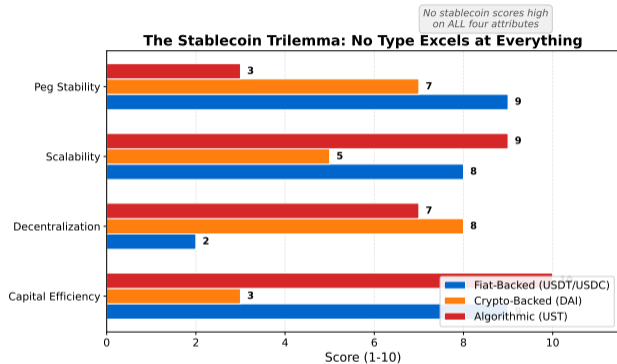
Now ETH drops 25%: Collateral = \$7,500. Health Factor = $7,500 \times 0.80 / 6,000 = 1.00$

→ **Liquidation triggered.** A bot repays part of your debt and claims your collateral at a 5–10% discount.

In DeFi, there is no margin call. There is no phone ringing. The smart contract just takes your collateral.

Liquidation bots earned over \$300M in profits in 2022–2023. They are the immune system of DeFi lending.

Stablecoins: Three Approaches to Stability



- **What you see:** Three stablecoin models plotted against decentralization, capital efficiency, and stability
- **Key pattern:** Fiat-backed (USDC, USDT) maximize stability but sacrifice decentralization; algorithmic models maximize efficiency but risk collapse
- **Takeaway:** No stablecoin achieves all three — every design picks two and compromises the third

Fiat-backed: USDC, USDT (\$1 in bank per \$1 token) **Crypto-backed:** DAI (\$1.50+ collateral per \$1 token) **Algorithmic:** UST (\$0 collateral, algorithm adjusts supply)

Stablecoins are the backbone of DeFi. Over \$160 billion in stablecoins circulate as of January 2026.

Three mechanisms keep DAI at \$1.00:

1. **Overcollateralization:** Every DAI is backed by at least 150% in crypto collateral (ETH, WBTC, stablecoins). If you deposit \$15,000 ETH, you can mint up to 10,000 DAI.
2. **Stability Fee:** Borrowers pay an annual interest rate (set by MKR governance) to mint DAI. When DAI trades above \$1, the fee decreases (encouraging minting). When below \$1, the fee increases (discouraging minting).
3. **Liquidation:** When collateral value drops below the threshold, keepers liquidate the vault — repaying DAI and removing it from circulation, which supports the peg.

DAI vs UST — why one survived and one did not:

	DAI (MakerDAO)	UST (Terra)
Backing	150%+ crypto collateral	0% collateral (algorithmic)
Peg defense	Liquidation + stability fee	Mint/burn LUNA (reflexive)
Outcome	Survived every crash since 2019	Collapsed May 2022 (\$40B lost)

DAI has maintained its peg through multiple market crashes. UST collapsed in five days. The difference: real collateral.

What Can Go Wrong in DeFi?

Technical Risks:

- **Smart contract bugs** — code is immutable; bugs cannot be patched. The DAO hack (2016): \$60M drained from a single re-entrancy vulnerability
- **Oracle manipulation** — if a price feed is wrong, liquidations fire on false data. Mango Markets (2022): \$114M stolen via oracle attack
- **MEV extraction** — bots front-run your trades, sandwich-attacking you for profit

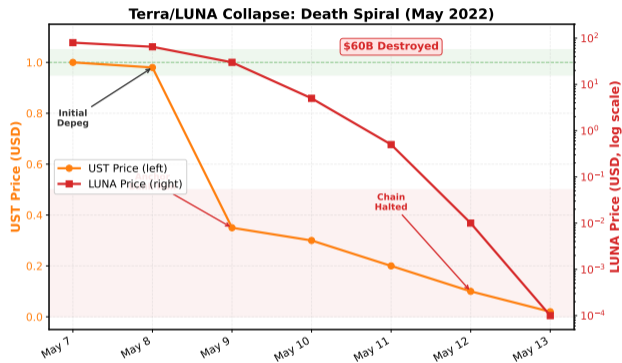
Economic Risks:

- **Governance attacks** — buy enough tokens, vote to drain the treasury. Beanstalk (2022): \$182M stolen via flash-loan governance attack
- **Liquidity drain** — LPs withdraw simultaneously, collapsing pool depth and amplifying price swings
- **Contagion** — composability means one protocol's failure cascades through every protocol connected to it

Key insight: DeFi did not eliminate financial risk. It replaced *trusted intermediary risk* with *smart contract risk*. The losses can be just as catastrophic.

DeFi hacks and exploits totaled over \$3.8 billion in 2022 alone (Chainalysis). Code is law — including the bugs.

The Terra/Luna Death Spiral



- **What you see:** UST and LUNA prices collapsing in lockstep over five days in May 2022
- **Key pattern:** The death spiral — UST depegs → LUNA minted to absorb pressure → LUNA price crashes → UST depegs further → repeat until both reach zero
- **Takeaway:** An algorithmic stablecoin backed only by its own ecosystem token is circular — the lifeboat sinks with the ship

The mechanism: 1 UST could always be redeemed for \$1 of LUNA. When UST traded below \$1, arbitrageurs redeemed UST for LUNA and sold it. This minted billions of new LUNA, crashing its price, which further undermined confidence in UST. Total loss: \$40 billion in 5 days.

Terra/Luna proved that reflexive token models create death spirals. \$40 billion vanished in five days.

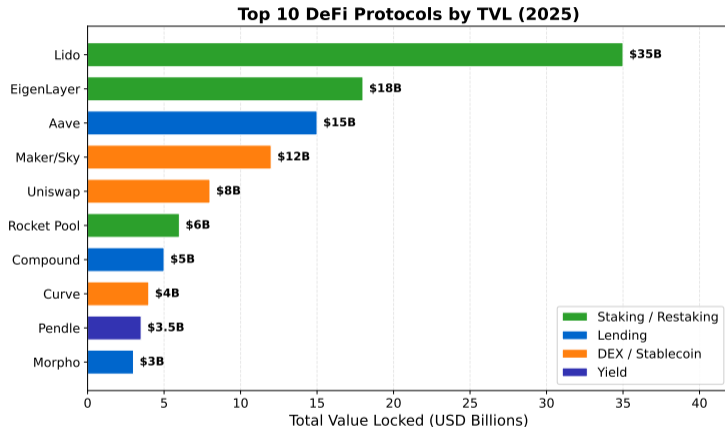
Contagion: How One Failure Cascades

The 2022 crypto contagion chain — each domino knocked over the next:

1. **May 2022: Terra/Luna collapses** — \$40 billion wiped out. Funds exposed to UST and LUNA face massive losses.
2. **June 2022: Three Arrows Capital (3AC) defaults** — the hedge fund had leveraged bets on LUNA and stETH. Losses exceed \$3 billion. Lenders who loaned to 3AC are now insolvent.
3. **July 2022: Celsius and Voyager freeze withdrawals** — both had lent heavily to 3AC. Celsius: \$4.7B frozen. Voyager: \$1.3B frozen.
4. **November 2022: FTX collapses** — Alameda Research (FTX's trading arm) was already weakened by contagion. Bank run reveals \$8B shortfall. FTX files for bankruptcy.

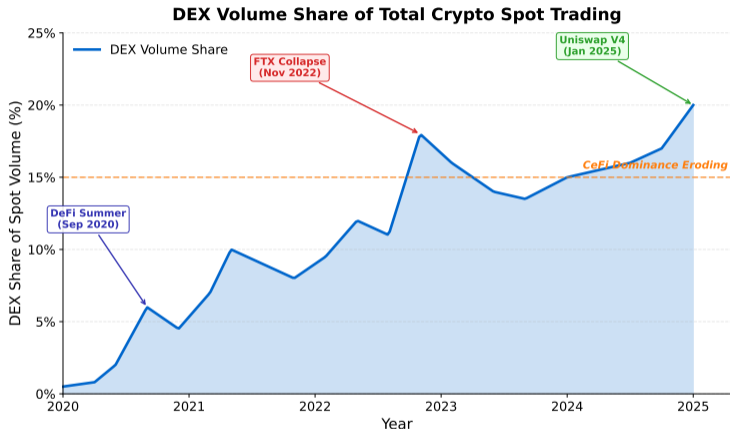
Total estimated losses: \$60+ billion across the contagion chain. One algorithmic stablecoin's failure triggered the largest wealth destruction event in crypto history.

Contagion in crypto follows the same pattern as 2008 in traditional finance: leverage + interconnection + panic = cascade.



- **What you see:** TVL (Total Value Locked) distribution across major DeFi protocols — Lido, Aave, MakerDAO, and Uniswap dominate
- **Key pattern:** Liquid staking (Lido) has become the largest DeFi category, followed by lending (Aave) and DEXs (Uniswap)
- **Takeaway:** DeFi is concentrating — the top 10 protocols hold over 60% of total TVL. Winner-take-most dynamics apply

Check defillama.com for current TVL data. Protocol rankings shift, but the concentration pattern persists.



- **What you see:** DEX trading volume as a percentage of total crypto spot volume, trending upward from under 1% (2020) to 15–20% (2025)
- **Key pattern:** DEX share spikes during CeFi crises (FTX collapse, Celsius freeze) — users flee to self-custody when trust breaks
- **Takeaway:** DEXs are gaining structural market share, not just crisis-driven spikes. The trend is toward self-custody trading

After FTX collapsed in November 2022, DEX volume share jumped from 8% to 18% in one month. Trust, once broken, migrates.

Definition: Flash Loan

An uncollateralized loan that must be borrowed and repaid within a single blockchain transaction. If the borrower cannot repay, the entire transaction reverts as if it never happened.

Legitimate uses:

- **Arbitrage** — exploit price differences across DEXs in one atomic transaction
- **Collateral swaps** — change your collateral type without closing a position
- **Self-liquidation** — repay your own debt to avoid liquidation penalties

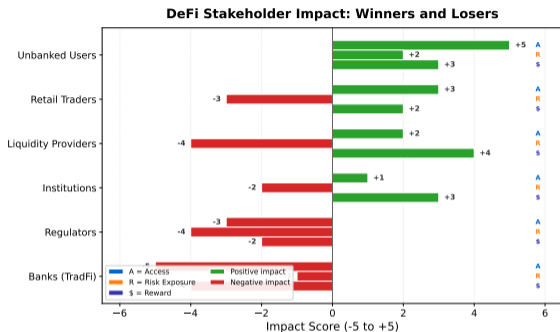
Flash loans democratize capital — anyone can temporarily become a whale. This is powerful and dangerous.

Attack examples:

- **Beanstalk (Apr 2022)**: Flash-borrowed governance tokens → voted to drain treasury → \$182M stolen
- **Euler Finance (Mar 2023)**: Flash loan exploited a liquidation flaw → \$197M drained
- **Multiple oracle attacks**: Flash loans manipulate prices on low-liquidity pools

Flash loans are unique to blockchain: a financial instrument impossible in traditional finance. You borrow with zero collateral for zero time.

Who Wins, Who Loses in DeFi?



Stakeholder	Wins When...	Loses When...
Liquidity Providers	Trading fees exceed IL	Price divergence causes IL > fees
Borrowers	Leverage amplifies gains	Liquidation wipes collateral
Protocol Teams	TVL grows, token appreciates	Hack/exploit destroys reputation
Retail Users	Access to global finance	Complexity leads to costly mistakes

DeFi is not inherently fair. Sophisticated users (bots, whales) consistently extract value from less informed participants.

	EU (MiCA)	US (SEC)	Asia-Pacific
Framework	MiCA (Dec 2024)	No comprehensive law	Varies widely
DeFi stance	"Truly decentralized" may be exempt	Enforcement first (Uniswap, Lido investigations)	Singapore: licensing; Japan: strict; HK: sandbox
Stablecoins	Must hold 1:1 reserves, EU-regulated	Case-by-case enforcement	Country-specific
Key question	Who is the issuer if no one is in charge?	Are governance tokens securities?	Innovation vs consumer protection

The DeFi regulation paradox:

Regulators want to identify a responsible party. DeFi is designed so there is none.

If a protocol is truly decentralized, who do you sue? If it is not truly decentralized, is it really DeFi?

MiCA provides the first comprehensive framework (full EU implementation Dec 30, 2024) but explicitly struggles with "truly decentralized" protocols.

Apply these 6 questions to evaluate any DeFi protocol:

1. Is it truly decentralized?

Who controls the admin keys? Is there a multisig? Can one entity pause or upgrade the contracts?

2. Where does the yield come from?

Trading fees, lending interest, staking rewards — or new token emissions? Sustainable yield has a source; Ponzi yield has victims.

3. What is the collateral?

Overcollateralized (safe, capital-inefficient) vs undercollateralized (efficient, fragile) vs uncollateralized (algorithmic, dangerous).

4. What is the smart contract risk?

Audited? Bug bounty? Time in production? Upgradeable or immutable? How much TVL at stake?

5. Who controls upgrades?

DAO vote, multisig, single admin key? Timelocks on changes? Can governance be captured via flash loan?

6. What happens if the oracle fails?

Single oracle vs multi-oracle? Chainlink, Pyth, or custom? What is the fallback if the feed goes stale?

If you cannot answer all six, you do not understand the protocol you are using.

Apply these 6 questions to any DeFi protocol. Unanswered questions represent unquantified risk.

Five principles that separate protocols that survive from those that collapse:

- 1. Yield must come from economic activity, not token emissions.**
If the yield disappears when the token price drops, the yield was never real. Real yield comes from trading fees, lending interest, or liquidation penalties.
- 2. Overcollateralize or explain why not.**
Every undercollateralized system (Terra, Celsius) eventually faced a bank run. Overcollateralization is expensive but survivable.
- 3. Assume your smart contracts have bugs.**
Multiple audits, bug bounties, timelocks on upgrades, and gradual TVL growth. The safest protocols are the ones that assume they are unsafe.
- 4. Design for the worst day, not the average day.**
Protocols that work in a bull market but break in a crash are not robust. Stress-test against 50% price drops, oracle failures, and mass withdrawals.
- 5. Decentralize governance progressively.**
Start with training wheels (multisig + timelock), then transfer control to the DAO as the protocol matures.

Every DeFi protocol that collapsed in 2022 violated at least two of these five principles.

Where DeFi is heading:

Real-World Assets (RWAs):

- Tokenized Treasury bonds on-chain (BlackRock BUIDL: \$500M+)
- Private credit protocols (Centrifuge, Goldfinch) connect DeFi liquidity to real-world borrowers
- The bridge between DeFi yields and traditional finance returns

Intent-Based Trading:

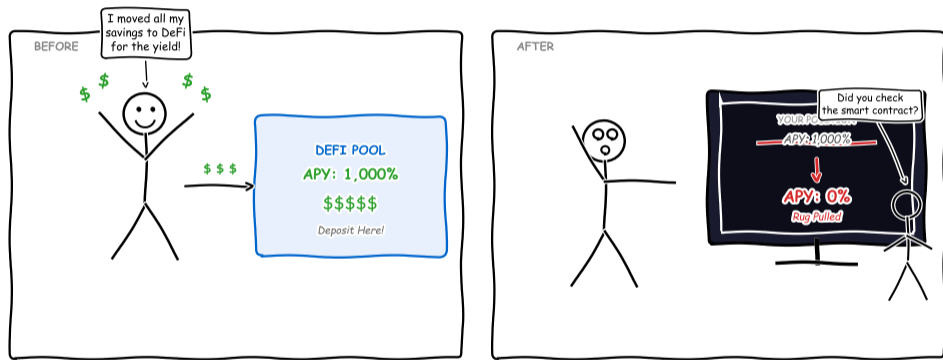
- Users express *what* they want (“swap ETH for best USDC price”), not *how*
- Solvers compete to fill the intent optimally — replacing manual routing with auction-based execution
- UniswapX, CoW Protocol, and 1inch Fusion already use this model

Hooks and Modularity (Uniswap V4):

- Custom logic attached to pools: dynamic fees, limit orders, on-chain oracles
- Launched January 30, 2025 — the most significant AMM upgrade since V2
- Enables DeFi developers to build new financial products *inside* the AMM

DeFi is evolving from “rebuild TradFi on-chain” to “build financial products impossible in TradFi.” Hooks and intents lead the way.

DeFi Yield Farming: A Cautionary Tale



"In DeFi, if you don't understand where the yield comes from, you ARE the yield."

In theory, DeFi removes all intermediaries. In practice, you just replaced your bank with a smart contract you cannot read.

Seven ideas to remember from today:

1. **DeFi replaces intermediaries with smart contracts** — non-custodial, permissionless, composable, but not risk-free.
2. **AMMs use math, not order books** — the constant product formula ($x \times y = k$) prices assets automatically but creates slippage on large trades.
3. **Impermanent loss is the LP's hidden tax** — price divergence erodes LP returns; fees must exceed IL for profitability.
4. **Lending is overcollateralized by design** — Health Factor below 1.0 triggers instant, automated liquidation with no appeals.
5. **Stablecoins face a trilemma** — decentralization, capital efficiency, and stability: every design picks two and compromises the third.
6. **Composability is power and contagion** — money legos build fast but break together. Terra → 3AC → Celsius → FTX.
7. **The 6-Question Framework** lets you evaluate any DeFi protocol's long-term sustainability and risk profile.

Review question: Can you apply the 6-question framework to evaluate Aave's risk profile?

Review question: Can you apply the 6-question framework to evaluate Aave? Try it before the next lecture.

Summary:

DeFi is the most ambitious experiment in financial engineering since the invention of banking. It replaces trust in institutions with trust in code, enables permissionless access to financial services, and creates composable building blocks for novel financial products. It also creates novel risks: smart contract bugs, oracle manipulation, governance attacks, and contagion cascades.

Key Vocabulary:

1. AMM
2. Constant Product
3. Impermanent Loss
4. Health Factor
5. Flash Loan
6. TVL

Next: Module F — Advanced Topics

How DeFi connects to:

- Layer 2 scaling (lower fees, faster trades)
- Cross-chain bridges (multi-chain DeFi)
- Privacy protocols (confidential transactions)
- Security analysis (formal verification)

Connection: Every advanced topic in Module F is motivated by a limitation of the DeFi ecosystem we covered today — high gas fees drive L2 adoption, bridge hacks drive security research, and MEV drives privacy innovation.

You now have the framework to evaluate any DeFi protocol you encounter.

Key vocabulary: Master these 6 terms before moving to Advanced Topics. They form the foundation of everything that follows.