DeFi Lending: The Automated Pawn Shop

Borrowing Without a Bank

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Learning Objectives

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

1. **Explain** how DeFi lending works without a credit check [Understand]
2. **Describe** health factor and why it matters [Understand]
3. **Explain** what oracles do and why they are critical [Understand]
4. **Evaluate** DeFi lending risks vs traditional lending [Evaluate]

No math required. Main slides use only plain English and pictures.
Technical formulas are in the Appendix for those who want them.

Bloom's levels covered: Understand, Evaluate. The Appendix adds Apply (formulas and worked examples).

What You Need to Know Before This Lecture

DeFi

Financial services built on blockchains — no bank, no middleman. Software replaces the institution.

Liquidity Pool

A shared pot of tokens locked in a smart contract. Users deposit tokens; the protocol lends them out.

Smart Contract

A program stored on the blockchain that executes automatically when conditions are met. The "robot banker."

TVL (Total Value Locked)

The total dollar value of crypto deposited in a DeFi protocol. A rough measure of trust and size.

Collateral

Something valuable you hand over as a guarantee. If you do not repay, the lender keeps it.

All terms from previous DeFi lectures (Decks 1–2). If any term is unfamiliar, review those materials first.

The Problem

You own 10,000 dollars of ETH. You need 5,000 dollars in cash — rent, tuition, an emergency.

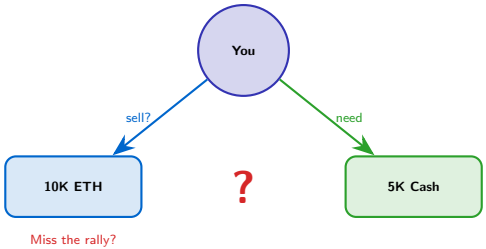
Option A — Sell your ETH:

- You get the cash
- But if ETH rallies 50% next month, you miss 2,500 dollars of gains

Option B — Ask a bank:

- Credit check, paperwork, days of waiting
- Banks do not accept crypto as collateral

Is there another way?



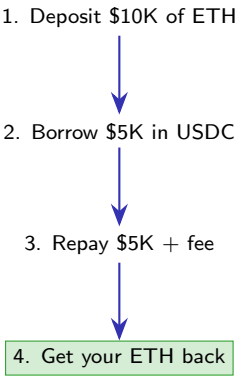
In traditional finance, you would need a bank, a credit check, and days of paperwork. DeFi offers a third option.

The Pawn Shop Analogy

DeFi lending = automated pawn shop.

1. **Deposit** your valuables (crypto) as collateral
2. **Receive** a loan (stablecoins)
3. **Repay** the loan plus a small fee
4. **Reclaim** your collateral

The pawn shop does not check your credit history. It does not care who you are. It only checks one thing: **is the collateral worth enough?**



The pawn shop does not check your credit. It only checks: is the collateral worth enough? Same principle in DeFi.

How DeFi Lending Works

Two sides, one smart contract:

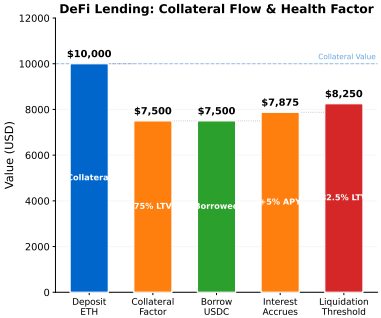
Depositors (Lenders)

Supply tokens to the pool. Earn interest automatically. Can withdraw anytime.

Borrowers

Deposit collateral (crypto). Borrow other tokens against it. Pay interest over time.

The smart contract matches them automatically. No bank. No credit score. No paperwork.



No bank. No credit score. The smart contract enforces the rules. Interest rates adjust by supply and demand.

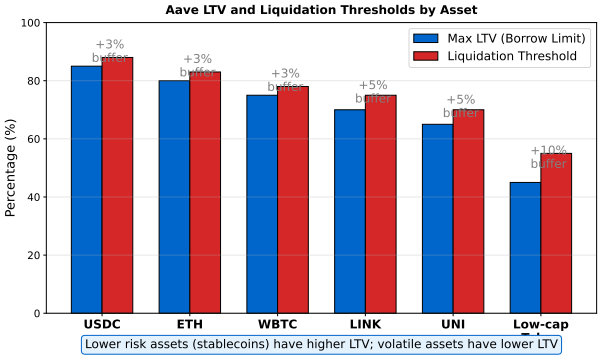
The Rules: Over-Collateralization

You must deposit **MORE** than you borrow. This is called **over-collateralization**.

Loan-to-Value (LTV) = how much you can borrow per dollar of collateral:

Asset	Max LTV
ETH	75%
WBTC	73%
USDC	77%

Example: Deposit $100 of ETH, borrow up to $75. The extra $25 is your safety buffer.



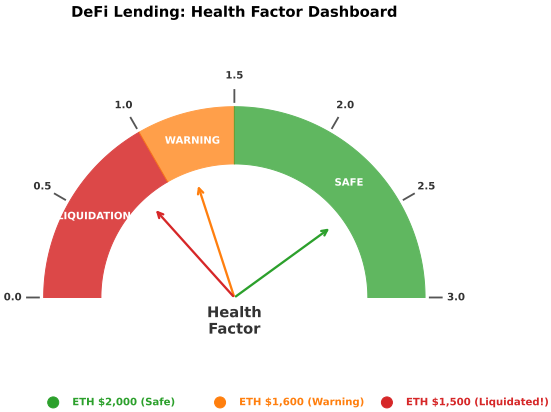
Over-collateralization protects lenders. If your collateral drops in value, the protocol can sell it to repay the loan.

Health Factor: Your Safety Meter

Health Factor tells you how safe your loan is. Think of it like a fuel gauge.

- **Above 2.0:** Plenty of margin. Relax.
- **1.0 – 2.0:** Getting close. Add more collateral.
- **At 1.0:** LIQUIDATED. Your collateral gets sold.

It changes every time the price of your collateral moves. Check it daily.



Check your health factor daily. It changes every time the collateral price moves. See Appendix A1 for the formula.

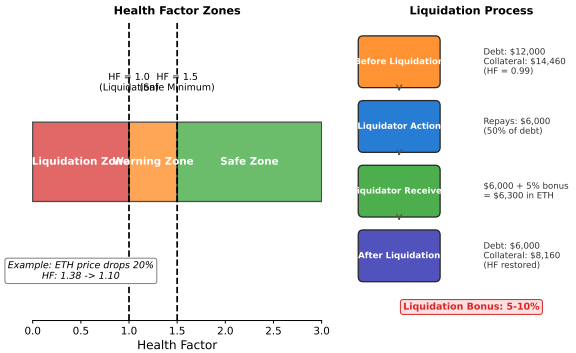
What Happens When HF Hits 1.0?

When your health factor reaches 1.0, the protocol sells your collateral to repay your debt. This is **liquidation**.

How it works:

1. A "liquidator" bot detects your low HF
2. The bot repays part of your debt
3. The bot takes your collateral at a **5% discount**
4. You keep the borrowed tokens but lose collateral

Automatic, instant, and irreversible.



Liquidation penalties: ETH 5%, WBTC 6.5%, USDC 4.5%. Source: Aave V3 Ethereum parameters.

A Loan Going Wrong: Alice's Story

Alice deposits 10 ETH at $2,000 each ($20K). She borrows $12,000 USDC.

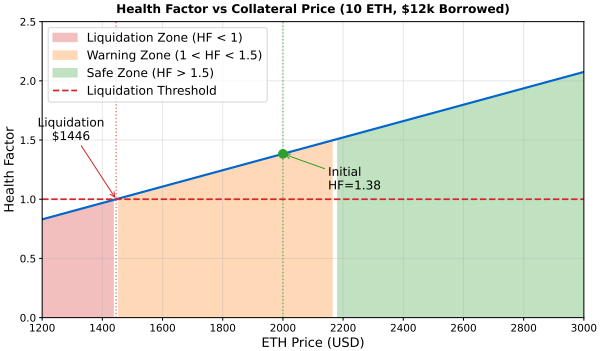
HF = 1.33 Safe

ETH drops to **$1,600**: HF = 1.07 Caution

ETH drops to **$1,500**: HF = 1.00 **LIQUIDATED**

Alice loses a 5% penalty: **$750** gone.

Her mistake: borrowing too close to the maximum. Conservative = borrow only 50% of LTV.



Alice's mistake: borrowing too close to the maximum. Conservative = borrow only 50% of your LTV limit.

Interest Rates Set Themselves

DeFi interest rates are not set by a committee. They follow **supply and demand**, automated by a formula.

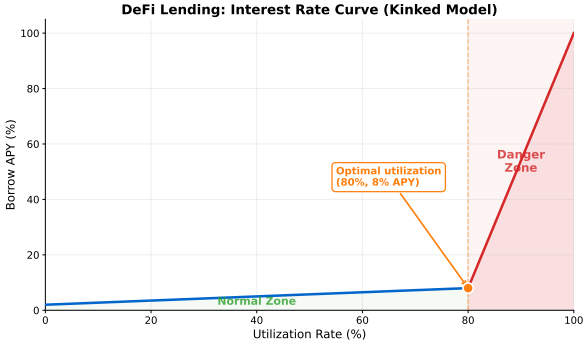
When few people borrow:

- Utilization is low
- Rates are low (to encourage borrowing)

When many people borrow:

- Utilization is high
- Rates spike (to encourage deposits)

There is a "kink" in the curve where rates jump sharply. This protects depositors.



At low utilization: rates are low (encouraging borrowing). At high utilization: rates spike (encouraging deposits). See Appendix A2 for the math.

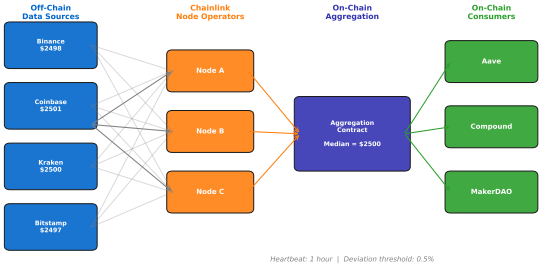
Oracles: The Price Feed

A DeFi protocol lives on the blockchain. It **cannot see the real world**. It does not know what ETH costs on Coinbase or Binance.

Oracles are services that feed real-world prices to the blockchain. The most widely used is **Chainlink** (63% market share).

Why it matters:

- Wrong price = wrong liquidations
- Delayed price = unfair advantage
- Manipulated price = stolen funds



If the oracle gives a wrong price, liquidations happen incorrectly. Oracle quality is critical to DeFi safety.

Oracle Manipulation: Mango Markets

October 2022: An attacker manipulated the price oracle on Mango Markets (Solana).

The attack in three steps:

1. Bought illiquid MNGO token on two exchanges simultaneously
2. Pumped the price from \$0.03 to \$0.91 (30x)
3. Used the inflated collateral to borrow \$117M from the protocol

The borrowed money was real. The collateral was fake. The oracle could not tell the difference.

1. Buy MNGO on two exchanges

↓

2. Pump price 30x (**\$**0.03 → **\$**0.91)

↓

3. Oracle reports inflated price

↓

4. Borrow **\$**117M on fake collateral

Oracle manipulation is one of the most common DeFi attacks. \$117M stolen from Mango Markets. Attacker later convicted.

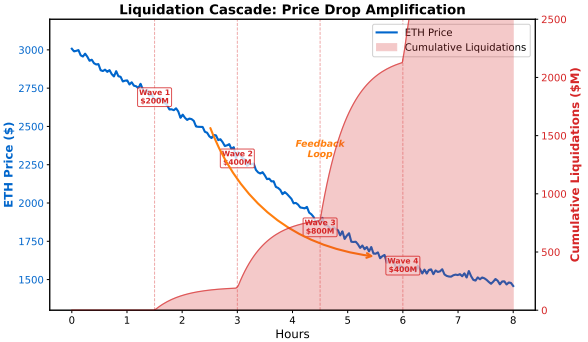
Black Thursday: March 12, 2020

ETH crashed 43% in a single day. The entire DeFi system was stress-tested for the first time.

What happened on MakerDAO:

- Thousands of vaults hit liquidation
- Network congestion spiked gas fees to 200+ gwei
- Liquidation bots could not submit transactions
- Some collateral sold for **zero dollars** (zero-bid auctions)

Total losses: **$8.32 million** in zero-bid liquidations.



Black Thursday led to protocol upgrades: circuit breakers, better auction mechanisms, gradual liquidations.

Discussion Break: Would You Trust a Smart Contract With Your Savings?

Think about it:

You can earn 3–5% interest by depositing ETH into Aave.
Your bank savings account pays 0.5%.

But: your funds sit in a smart contract.
No deposit insurance. No customer service.
If the code has a bug, your money could vanish.

Would you do it? Why or why not?

Arguments FOR

Higher returns. Transparent rules. You keep custody. No identity required.

Arguments AGAINST

Smart contract risk. No insurance. Oracle failures. Regulatory uncertainty.

There is no right answer. The point is to weigh risk vs reward — the core question of all finance.

Aave: The Largest Lending Protocol

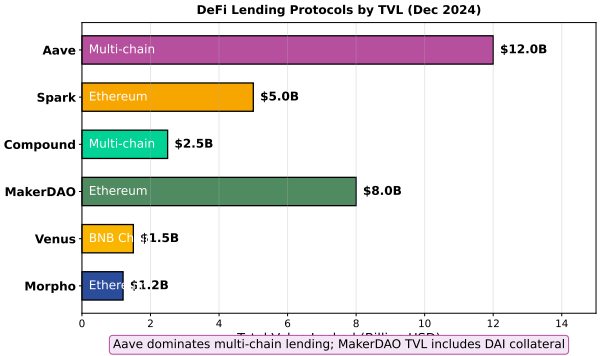
Aave (Finnish for "ghost") is the largest DeFi lending protocol.

Key facts (2026):

- TVL: $57 billion
- 100+ assets on 10+ chains
- V4 launched March 30, 2026

Innovations:

- Flash loans (borrow and repay in one tx)
- Rate switching (fixed or variable)
- Cross-chain lending (V4)



Aave dominates multi-chain lending; MakerDAO TVL includes DAI collateral

Aave = "ghost" in Finnish. Founded by Stani Kulechov in 2017. V4 introduces unified liquidity and cross-chain features.

DeFi vs Traditional Lending

	DeFi Lending	Bank Loan
Speed	Seconds (one transaction)	3–10 business days
Collateral	Crypto tokens only	Property, income, credit history
Credit check	None required	Mandatory
Interest rate	Algorithmic (supply/demand)	Fixed or variable (bank sets it)
Minimum loan	Any amount (even $1)	Bank minimums (often $1,000+)
Access	Anyone with a wallet, 24/7	Bank hours, ID required

The catch: DeFi requires over-collateralization. You need $133 of crypto to borrow $100. A bank might lend you $100,000 on a $100,000 house (100% LTV).

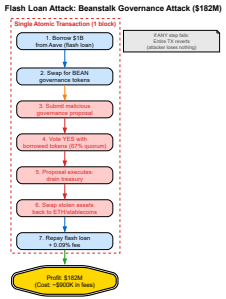
DeFi lending is faster and more accessible, but requires over-collateralization and has no deposit insurance.

Flash Loans: Borrow Everything, Repay Instantly

A **flash loan** lets you borrow any amount with **zero collateral**. Catch: you must repay in the **same transaction**. If you cannot, the whole thing reverts.

Used for:

- Arbitrage between exchanges
- Self-liquidation (save on penalties)
- Collateral swaps
- Also: price manipulation attacks



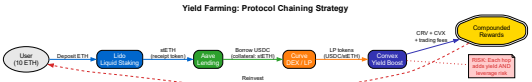
Flash loans are uniquely DeFi — impossible in traditional finance. See Appendix A4 for the Euler Finance attack.

Yield Farming: Chasing Returns

Yield farming = stacking returns across multiple protocols.

1. Deposit ETH into Aave (earn 3%)
2. Borrow USDC against it
3. Deposit USDC into another protocol (earn 5%)
4. Earn governance tokens on top

Warning: If the APY looks too good to be true, it probably is. Anchor offered 20% on UST. It collapsed.



High APY = high risk. The "yield" often comes from token emissions that dilute over time, not real revenue.

Try It Yourself (Read-Only)

Visit `app.aave.com`

You can browse without connecting a wallet. Just explore.

Step 1

Find the ETH supply rate. What interest do depositors earn today?

Step 2

Find the ETH borrow rate. How much does it cost to borrow?

Step 3

Check the utilization rate. Is the pool heavily used or mostly idle?

Bonus: Compare rates across chains (Ethereum, Arbitrum, Polygon). Why are they different?

You can browse Aave without connecting a wallet. No risk. Just explore the rates and parameters.

Key Takeaways

How It Works

Deposit collateral, borrow tokens. No credit check. The smart contract enforces the rules automatically.

Oracles Are Critical

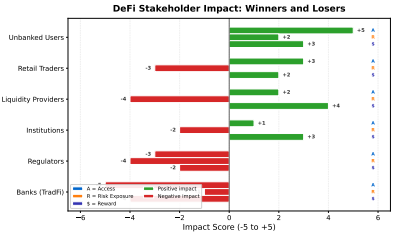
DeFi protocols need real-world prices from oracles. If the oracle is wrong, everything breaks.

Health Factor

Your safety meter. Stay above 1.0 or your collateral gets liquidated. Check it every day.

Over-Collateralization

Protects lenders but limits borrowers. You need more crypto than you borrow. Always.



Next: Stablecoins — making crypto boring (on purpose)

Quick Quiz (1–5)

Q1. Why does DeFi lending not require a credit check?
A) The blockchain encrypts your identity B) Government regulations exempt it
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A) 50% B) 75% C) 82.5% D) 100%

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Answer: D – Oracles bridge the gap between the real world and the blockchain.

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Q6. What happened on Black Thursday (March 12, 2020)?
A) ETH crashed 43% and MakerDAO had $8.3M in zero-bid liquidations
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Answer: A – The attacker pumped the MNGO token price 30x, then borrowed against the inflated value.

Appendix

Technical Deep Dives

The math behind the intuition

Click blue links in appendix slides to jump back to the main deck.

A1: Health Factor — The Formula

$$\text{HF} = \frac{\text{Collateral Value} \times \text{Liquidation Threshold}}{\text{Total Debt}}$$

- $\text{HF} > 1.0$: Loan is safe
- $\text{HF} = 1.0$: Liquidation can begin
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Worked Example: Alice deposits 10 ETH at \$2,000. Liquidation Threshold = 80%. She borrows \$12,000 USDC.

Initial HF: $\frac{(10 \times 2{,}000) \times 0.80}{12{,}000} = \frac{16{,}000}{12{,}000} = \mathbf{1.33}$ **Safe**

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ETH drops to \$1,600: $\frac{(10 \times 1{,}600) \times 0.80}{12{,}000} = \frac{12{,}800}{12{,}000} = \mathbf{1.07}$ **Caution**

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Worked Example: Alice deposits 10 ETH at \$2,000. Liquidation Threshold = 80%. She borrows \$12,000 USDC.

Initial HF: $\frac{(10 \times 2{,}000) \times 0.80}{12{,}000} = \frac{16{,}000}{12{,}000} = \mathbf{1.33}$ **Safe**

ETH drops to \$1,600: $\frac{(10 \times 1{,}600) \times 0.80}{12{,}000} = \frac{12{,}800}{12{,}000} = \mathbf{1.07}$ **Caution**

ETH drops to \$1,500: $\frac{(10 \times 1{,}500) \times 0.80}{12{,}000} = \frac{12{,}000}{12{,}000} = \mathbf{1.00}$ **LIQUIDATED**

← Back to main slide: Health Factor

Liquidation Threshold for ETH on Aave V3: 80%. LTV (max borrow) is 75%. The 5% gap is a safety buffer.

A2: Interest Rate Model — The Utilization Curve

Utilization rate measures how much of the deposited supply is being borrowed:

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$$R_{\text{borrow}} = \begin{cases} R_0 + \frac{U}{U_{\text{opt}}} \cdot R_{\text{s1}} & \text{if } U \leq U_{\text{opt}} \\ R_0 + R_{\text{s1}} + \frac{U - U_{\text{opt}}}{1 - U_{\text{opt}}} \cdot R_{\text{s2}} & \text{if } U > U_{\text{opt}} \end{cases}$$

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ETH on Aave V3: $U_{\text{opt}} = 80\%$, $R_0 = 1\%$, $R_{\text{s1}} = 3.8\%$, $R_{\text{s2}} = 80\%$

← Back to main slide: Interest Rates

At 80% utilization: borrow rate = 1% + 3.8% = 4.8%. At 90% utilization: rate jumps to 4.8% + 8% = 12.8%.

A3: Liquidation Penalty — Worked Example

Setup: Alice has 10 ETH at \$1,500 (= \$15,000 collateral). Debt: \$12,000 USDC.
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After liquidation:

	Before	**After**
Collateral	10 ETH (\$15,000)	5.8 ETH (\$8,700)
Debt	\$12,000 USDC	\$6,000 USDC
Health Factor	1.00	1.16
Alice's loss	—	**4.2 ETH (\$6,300) seized**
Penalty cost	—	**\$300 (5% of \$6,000)**

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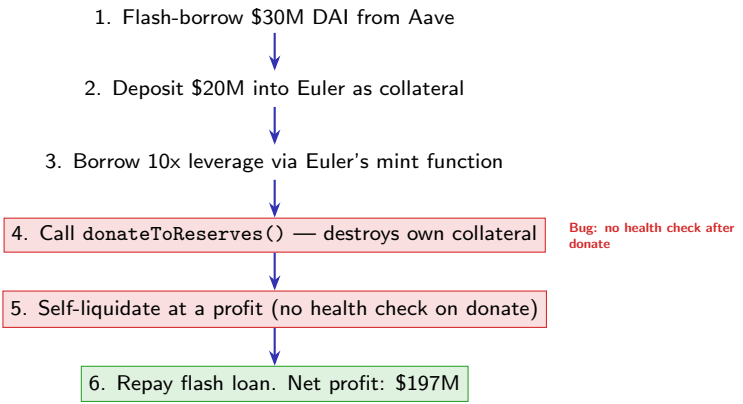
Aave V3 liquidates at most 50% of a position at once ("close factor"), reducing cascade risk compared to 100% liquidation.

A4: Euler Finance Attack — $197M (March 13, 2023)

The largest flash loan attack in DeFi history exploited a missing check in Euler's code:



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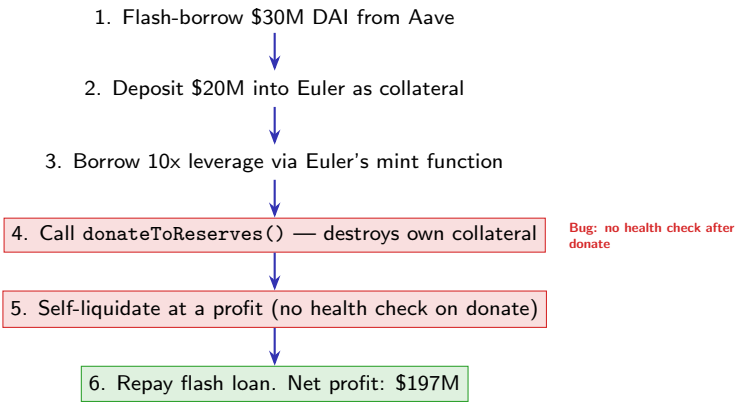

Aftermath: The attacker returned all $197M after 23 days of negotiation. Euler resumed operations.

The bug was a single missing health factor check after `donateToReserves()`. One line of code, $197M at risk.

A5: The Cryptoeconomics Lens Applied to Lending

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Question	Applied to DeFi Lending
1. Problem	How do we provide credit without identity, credit scores, or trusted intermediaries?
2. Incentives	Depositors earn interest. Borrowers get leverage without selling. Liquidators earn bonuses for keeping the system solvent.
3. Benefits / Costs	Benefits: permissionless access, instant settlement, transparent rates. Costs: over-collateralization, smart contract risk, oracle dependence.
4. Failure Mode	Oracle manipulation (Mango, $117M). Cascading liquidations (Black Thursday, $8.3M). Flash loan exploits (Euler, $197M).
5. Design	Over-collateralized (Aave) vs. under-collateralized (TrueFi). Pool-based vs. peer-to-peer (Morpho). Variable vs. fixed rate.
6. Alternatives	Bank lending (credit-based). Social lending (trust-based). Real-world asset collateral (Centrifuge).

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These six questions are the "Cryptoeconomics Lens" — apply them to every blockchain topic you study.