

# Day 1: Why Digital Finance?

## From Friction to Innovation

Joerg Osterrieder

Digital Finance

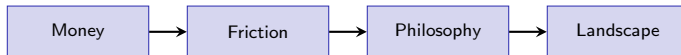
2025

## Where We're Going:

- What is money, really?
- Why is the financial system slow and expensive?
- Two competing visions for fixing it
- A map of digital finance

## By Day's End, You Will:

- Understand why digital money is hard
- Identify key friction points in finance
- Distinguish FinTech from Crypto/DeFi
- Navigate the digital finance landscape



### Trust, Ledgers, and the Problem of Double-Spending

#### Learning Objectives:

- Dissolve assumptions about what money “is”
- Understand why digital money is fundamentally hard
- Grasp the double-spending problem
- Distinguish account-based from token-based money

#### Hands-On Component

We'll use a Colab notebook to simulate a simple ledger and see double-spending in action.

**Imagine you're stranded on an island with 9 strangers...**

**You have skills:**

- Alice: fishing
- Bob: building
- Carol: farming
- Dave: medicine
- ...and so on

**The problem:**

- Alice wants vegetables
- Carol doesn't need fish
- How do you trade?

## The Coincidence of Wants Problem

Direct barter requires both parties to want what the other has, at the same time. This almost never happens.

# Three Solutions to the Barter Problem

## Commodity Money

(shells, gold)

## Credit (IOUs)

(trust-based)

## Shared Ledger

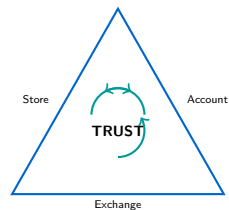
(recordkeeping)

**Key Insight:** All three solutions are really about **trust**.

- Commodity: Trust the material has value
- Credit: Trust the person will repay
- Ledger: Trust the recordkeeper is honest

## The Three Functions of Money:

1. **Medium of Exchange**  
Accepted for transactions
2. **Unit of Account**  
Common measure of value
3. **Store of Value**  
Holds purchasing power over time



## What makes something “money”?

Collective belief that others will accept it.

## Anthropological Fact

Debt and credit systems (ledgers) predate physical currency by thousands of years. Money is fundamentally about **information**, not objects.

# The Ledger: Humanity's Oldest Financial Technology

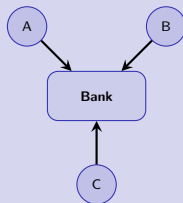
THE LEDGER		
From	To	Amount
Alice	Bob	50
Bob	Carol	30
Carol	Alice	20
...	...	...

**A ledger is simply:** A record of who owes what to whom.

**The critical question:** Who maintains the ledger?

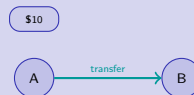
# Account-Based vs. Token-Based Money

## Account-Based (Ledger)



- Identity verified
- Balances in database
- Transfers update records
- **Example:** Bank accounts

## Token-Based (Bearer)



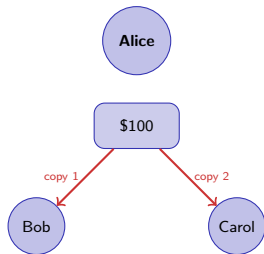
- Possession = ownership
- No identity needed
- Physical handoff
- **Example:** Cash, gold

## The Digital Dilemma

Physical tokens can be handed over. Digital files can be **copied**. How do you hand over a digital token without copying it?



## The Fundamental Challenge of Digital Money



Both get "paid"!

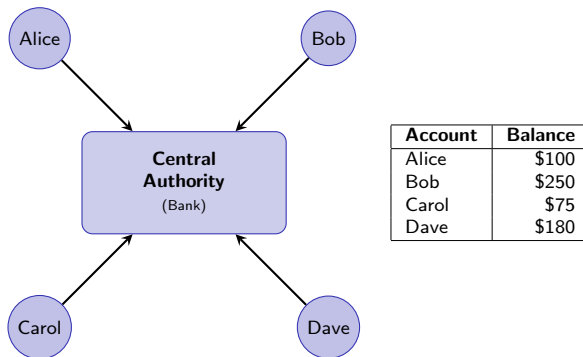
### Why is this hard?

- Digital = perfectly copyable
- No physical scarcity
- Can't "hand over" a file
- Need to prevent copies from both being valid

**Before 2008, only one solution existed:**

A trusted central authority

# The Traditional Solution: Trusted Third Parties



## How it prevents double-spending:

1. Alice requests: "Send \$100 to Bob"
2. Bank checks: Does Alice have \$100?
3. Bank updates: Alice  $-\$100$ , Bob  $+\$100$
4. Transaction complete—Alice can't spend it again

## What we gain:

- Double-spending prevented
- Transaction records
- Dispute resolution
- Reversibility (chargebacks)

## What we lose:

- Privacy (bank sees everything)
- Autonomy (bank can freeze accounts)
- Inclusion (need bank approval)
- Speed (bank's hours, processes)
- Cost (bank's fees)

## The Trust Assumption

We must trust that the central authority:

- Won't steal our money
- Won't censor transactions
- Won't fail or get hacked
- Will always be available
- Will treat everyone fairly

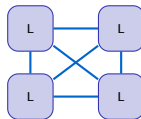
## 2008 Financial Crisis:

Many questioned whether this trust was warranted.

## What if we could prevent double-spending without a central authority?

### Satoshi Nakamoto's insight:

1. Replicate the ledger everywhere
2. Use cryptography to verify
3. Use economic incentives to secure
4. Achieve consensus without trust



Everyone has the ledger

### We'll Explore This in Day 3

For now, understand that **blockchain** is one answer to: "How do we have digital money without trusting a single party?"

### Let's See Double-Spending in Action

**In the Colab notebook, we will:**

1. Build a simple ledger with account balances
2. Process valid transactions
3. Attempt a double-spend attack
4. See how a central authority prevents it
5. Discuss: What happens without the authority?

#### Access the Notebook

`day_01/notebooks/01_ledger_simulation.ipynb`

Or scan QR code / click link provided

**Time: 15-20 minutes for guided exploration**

## Questions to Consider:

1. Is Bitcoin “real money”? Why or why not?
2. What makes you trust your bank?
3. If you could design money from scratch, what would it look like?
4. Is privacy a feature or a bug?

## Key Takeaways:

- Money = trust infrastructure
- Digital money needs double-spend protection
- Central authorities work but have costs
- Blockchain offers an alternative

## The Central Question of This Course

How should we build the trust infrastructure for a digital economy?

### Where Friction Creates Opportunity

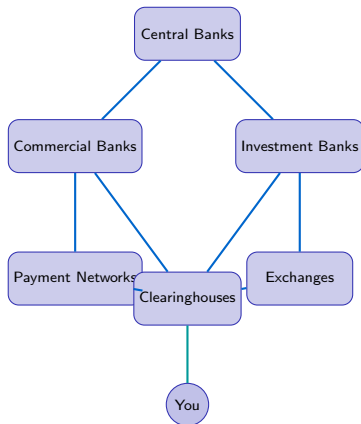
#### Learning Objectives:

- Identify 4-5 core frictions in traditional finance
- Understand who bears the cost of each friction
- See friction as the *motivation* for digital finance innovation

#### Why This Matters

Every FinTech and DeFi innovation targets a specific friction. Understanding the frictions helps you understand the solutions.

# The Global Financial System: A Marvel of Complexity



This system moves **\$9.6 trillion daily**, serves billions, rarely fails catastrophically... but has significant frictions.



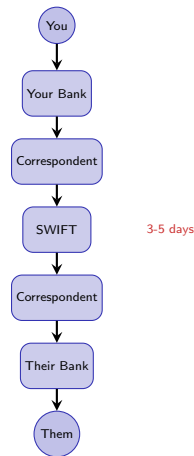
# Friction #1: Slow Settlement

## The Problem:

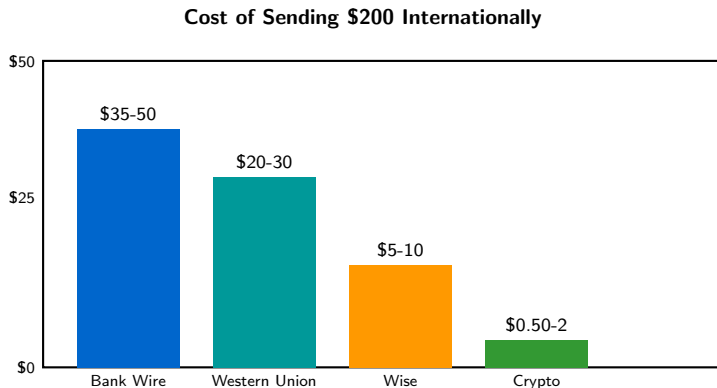
- Stock trade: T+1 (1 business day to settle since May 2024)
- International wire: 1-5 business days
- ACH transfer: 2-3 business days
- Even “instant” payments take hours behind scenes

## Why so slow?

- Multiple intermediaries
- Batch processing (not real-time)
- Timezone differences
- Manual compliance checks
- Legacy systems from 1970s



## Friction #2: High Fees (Especially Cross-Border)



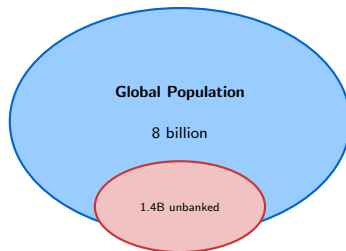
**Who pays?** Migrant workers sending money home. The global remittance market is **\$700+ billion/year**, with **\$50+ billion** lost to fees.

### The Unbanked and Underbanked:

- **1.4 billion** adults globally have no bank account
- **Additional 1+ billion** are underbanked
- In the US: 6% unbanked, 18% underbanked

### Why excluded?

- No ID documents
- No fixed address
- Minimum balance requirements
- Poor credit history
- Geographic distance from banks
- Distrust of institutions



### The Paradox

Those who need financial services most have the least access to them.

### What you don't know:

- True cost of financial products
- Where your money goes
- How prices are determined
- What risks you're taking
- How algorithms affect you

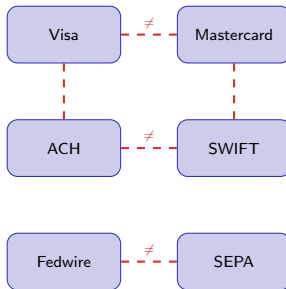
### Examples:

- Hidden fees in mutual funds (expense ratios)
- Payment for order flow in stock trading
- Credit card interchange fees
- Insurance pricing algorithms



**Information asymmetry** = one party knows more than the other.  
Usually favors financial institutions.

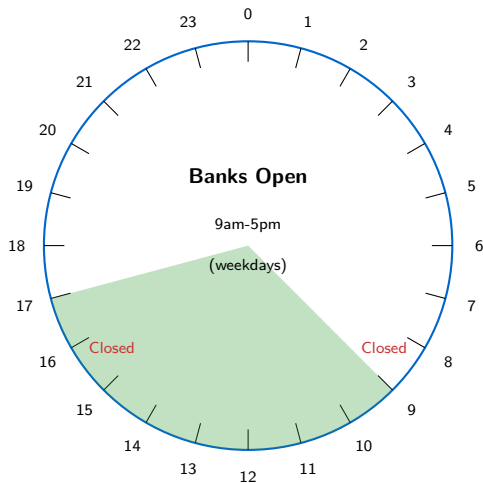
## Friction #5: Fragmentation and Incompatibility



### The result:

- Moving money between systems is expensive
- Data doesn't flow smoothly
- Innovation is slow (must work with legacy systems)
- Lock-in effects (hard to switch providers)

## Friction #6: Limited Operating Hours



**Traditional finance operates on:**

- Business hours only (no nights, weekends, holidays)

## Who Bears the Cost?

Friction	Primary Cost Bearer	Impact
Slow settlement	Businesses, traders	Tied-up capital, missed opportunities
High fees	Consumers, migrants	Reduced purchasing power
Exclusion	Poor, rural, undocumented	No access to savings, credit, insurance
Opacity	Retail investors	Worse outcomes, exploitation
Fragmentation	Everyone	Inefficiency, higher costs
Limited hours	Global businesses	Delays, cash flow problems

### Key Insight

Friction costs are **regressive**—they hurt those with less money more than those with more.



**Slow settlement** →

Real-time payments, instant settlement

**High fees** →

Low-cost transfers, crypto rails

**Exclusion** →

Mobile money, neobanks

**Opacity** →

Transparent protocols, open data

**Fragmentation** →

APIs, interoperability standards

**Limited hours** →

24/7 digital infrastructure



### Think-Pair-Share:

1. **Think** (2 min): Have you personally experienced any of these frictions?
  - Waiting for a transfer?
  - Paying unexpected fees?
  - Difficulty opening an account?
  - Not understanding financial products?
2. **Pair** (3 min): Share your experience with a neighbor
3. **Share**: What patterns emerge?

### Discussion Questions

- Which friction affects you most?
- Which friction causes the most societal harm?
- Are any of these frictions *features* rather than bugs?

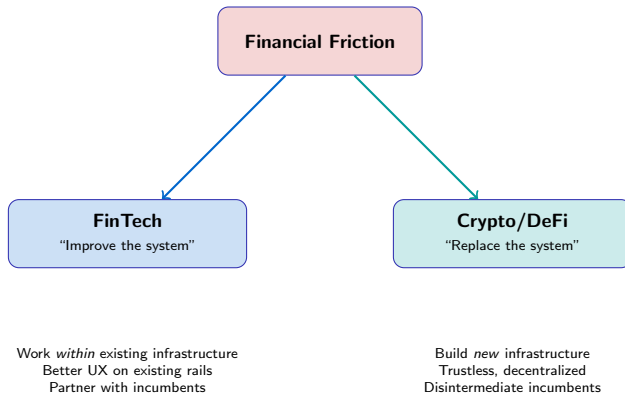
### FinTech vs. Crypto/DeFi

#### Learning Objectives:

- Understand the fundamental difference between two approaches
- Classify innovations as FinTech or Crypto/DeFi
- Articulate tradeoffs of each philosophy

#### The Central Fork

Both FinTech and Crypto/DeFi target the same frictions.  
They differ fundamentally in **how** they approach the solution.



## “Better UX on Existing Rails”

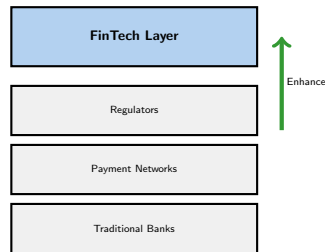
### Core Belief:

The existing financial infrastructure works. It just needs:

- Better user interfaces
- More efficient processes
- Smarter technology
- New business models

### Key Technologies:

- APIs and Open Banking
- Mobile apps
- Cloud computing
- Machine learning
- Big data analytics



FinTech builds *on top of* the existing system

## Payments:

- PayPal, Stripe, Square
- Venmo, Cash App
- Wise (TransferWise)

## Banking:

- Chime, N26, Revolut
- Nubank, Monzo
- SoFi, Ally

## Lending:

- LendingClub, Prosper
- Affirm, Klarna (BNPL)
- Upstart, Kabbage

## Investing:

- Robinhood, Webull
- Betterment, Wealthfront
- Acorns, Stash

## Insurance:

- Lemonade, Oscar
- Root, Hippo

## Common Thread:

All use traditional rails (ACH, card networks, bank accounts) with better interfaces and processes.

### “New Rails, New Rules”

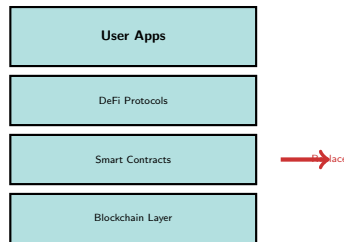
#### Core Belief:

The existing infrastructure is fundamentally flawed. We need:

- New trust model (cryptographic, not institutional)
- Decentralization (no single point of control)
- Programmable money (smart contracts)
- Permissionless access

#### Key Technologies:

- Blockchain and distributed ledgers
- Public-key cryptography
- Consensus mechanisms
- Smart contracts



Crypto/DeFi builds a *parallel* system

## Currencies/Tokens:

- Bitcoin, Ethereum
- Stablecoins (USDC, USDT, DAI)
- Layer 2s (Polygon, Arbitrum)

## Exchanges:

- Uniswap, SushiSwap (DEX)
- Coinbase, Binance (CEX bridges)
- 0x, dYdX

## Lending:

- Aave, Compound
- MakerDAO
- Liquity

## Derivatives:

- Synthetix
- GMX, Perp Protocol

## Infrastructure:

- Chainlink (oracles)
- The Graph (indexing)
- IPFS (storage)

## Common Thread:

All operate on blockchain rails, using smart contracts, without traditional intermediaries.

<b>Dimension</b>	<b>FinTech</b>	<b>Crypto/DeFi</b>
<b>Trust model</b>	Institutions	Code/Math
<b>Infrastructure</b>	Existing rails	New rails
<b>Permission</b>	Licensed, regulated	Permissionless
<b>Identity</b>	Required (KYC)	Optional (pseudonymous)
<b>Reversibility</b>	Chargebacks possible	Transactions final
<b>Speed to market</b>	Faster (use existing)	Slower (build new)
<b>Regulatory clarity</b>	Higher	Lower
<b>User experience</b>	Polished	Improving
<b>Censorship resistance</b>	Low	High



## Advantages:

- ✓ Familiar UX
- ✓ Regulatory compliance
- ✓ Consumer protections
- ✓ Fiat integration
- ✓ Customer support
- ✓ Fast iteration
- ✓ Proven business models

## Disadvantages:

- ✗ Still intermediated
- ✗ Geographic restrictions
- ✗ Can be censored/frozen
- ✗ Limited innovation ceiling
- ✗ Data centralization
- ✗ Dependent on banks
- ✗ Exclusion still possible

## Best For

Users who want **better** financial services within the existing system, with familiar protections and convenience.

## Advantages:

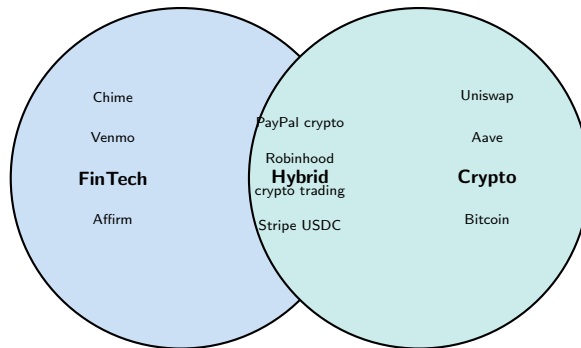
- ✓ Permissionless access
- ✓ Censorship resistant
- ✓ Transparent (open-source)
- ✓ Composable (“money legos”)
- ✓ 24/7 global operation
- ✓ Self-custody possible
- ✓ Programmable money

## Disadvantages:

- ✗ Complex UX
- ✗ Regulatory uncertainty
- ✗ No chargebacks
- ✗ Smart contract risks
- ✗ Volatility (non-stablecoins)
- ✗ Scalability challenges
- ✗ “Code is law” rigidity

## Best For

Users who need **different** financial infrastructure—global access, self-sovereignty, censorship resistance, or programmable finance.



## Increasingly:

- FinTech companies add crypto features
- Crypto projects improve UX toward FinTech standards
- Traditional banks explore blockchain
- Lines blur, but philosophies remain distinct

**For each innovation, decide: FinTech or Crypto/DeFi?**

1. A mobile app that rounds up purchases and invests the change in ETFs

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4. A system where you can trade tokenized stocks 24/7 **Crypto/DeFi** (synthetic assets, blockchain settlement)

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5. A service that uses AI to approve loans faster **FinTech** (better process, same infrastructure)

# Discussion: Which Philosophy Do You Prefer?

## Team FinTech argues:

- “If it ain’t broke, don’t rebuild it”
- Regulatory protection matters
- Most users want convenience, not sovereignty
- Crypto is too volatile and risky

## Team Crypto argues:

- “The system IS broke for billions”
- Financial freedom requires autonomy
- Permissionless access is a human right
- Code is more trustworthy than institutions

## Discussion Questions

- Is there room for both philosophies?
- Under what circumstances would you choose each?
- What would make you switch from one to the other?

### A Map of Digital Finance

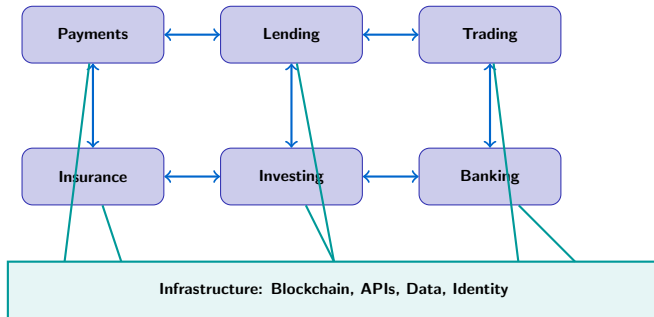
#### Learning Objectives:

- Visualize the full scope of digital finance
- Understand how different sectors connect
- Locate any innovation within the landscape

#### Why a Map Matters

Without structure, digital finance seems like “a collection of cool things.”  
A map lets you see patterns, gaps, and connections.

# The Digital Finance Landscape





### What it covers:

- Person-to-person (P2P)
- Consumer-to-business (C2B)
- Business-to-business (B2B)
- Cross-border remittances
- Point-of-sale systems
- Digital wallets

### Key friction addressed:

Speed, cost, convenience

### FinTech examples:

- Venmo, Zelle, Cash App
- Stripe, Square, Adyen
- Wise, Remitly

### Crypto examples:

- Bitcoin Lightning
- USDC/USDT transfers
- Solana Pay

## Coming in Day 2

Deep dive into payment infrastructure, rails, and the future of money movement.

### What it covers:

- Consumer lending
- SMB lending
- Peer-to-peer lending
- Buy-now-pay-later (BNPL)
- Collateralized lending
- Flash loans

### Key friction addressed:

Access, speed, cost of credit

### FinTech examples:

- LendingClub, Upstart
- Affirm, Klarna, Afterpay
- Kabbage, Funding Circle

### Crypto examples:

- Aave, Compound
- MakerDAO (DAI)
- Liquity, Euler

## Coming in Days 2 & 4

Platform-based lending (Day 2), DeFi lending protocols (Day 4).

### What it covers:

- Stock trading
- Crypto exchanges
- Derivatives
- Forex
- NFT marketplaces
- Tokenized assets

### Key friction addressed:

Access, fees, transparency

### FinTech examples:

- Robinhood, Webull, eToro
- Interactive Brokers
- Public, Alpaca

### Crypto examples:

- Uniswap, Curve, Balancer
- dYdX, GMX
- OpenSea, Blur

## Coming in Days 3 & 4

Decentralized exchanges and AMMs (Days 3-4), trading mechanics.

### What it covers:

- Robo-advisors
- Fractional investing
- Micro-investing
- Alternative investments
- Portfolio management
- Yield aggregation

### Key friction addressed:

Minimums, expertise, access

### FinTech examples:

- Betterment, Wealthfront
- Acorns, Stash
- Fundrise, Republic

### Crypto examples:

- Yearn Finance
- Index Coop
- Enzyme Finance

### Coming in Days 2 & 4

Robo-advisors and platform finance (Day 2), DeFi yield strategies (Day 4).

### What it covers:

- InsurTech platforms
- Parametric insurance
- Peer-to-peer insurance
- Embedded insurance
- Smart contract coverage

### Key friction addressed:

Cost, claims, access, transparency

### FinTech examples:

- Lemonade, Root
- Oscar, Hippo
- Metromile

### Crypto examples:

- Nexus Mutual
- Cover Protocol
- InsurAce

## Coming in Day 5

Insurance technology, parametric insurance, and DeFi coverage.

### What it covers:

- Neobanks
- Banking-as-a-Service (BaaS)
- Core banking platforms
- Open banking APIs
- Account aggregation

### Key friction addressed:

Fees, UX, bundling, access

### FinTech examples:

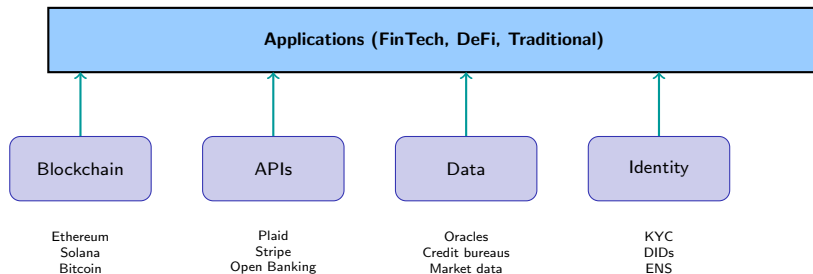
- Chime, N26, Revolut
- Plaid, MX, Yodlee
- Synapse, Unit, Treasury Prime

### Crypto parallels:

- Self-custody wallets
- Account abstraction (ERC-4337)
- On-chain identity

## Coming in Day 2

Platform finance, open banking, and the future of banking infrastructure.



**Key insight:** All applications build on shared infrastructure.  
Understanding the infrastructure helps you understand what's possible.

## Tokenization:

- Real estate tokens
- Art and collectibles
- Carbon credits
- Securities tokenization

## DAOs:

- Decentralized governance
- Treasury management
- Collective investing

## CBDCs:

- Central Bank Digital Currencies
- Government-issued digital money
- Wholesale vs. retail

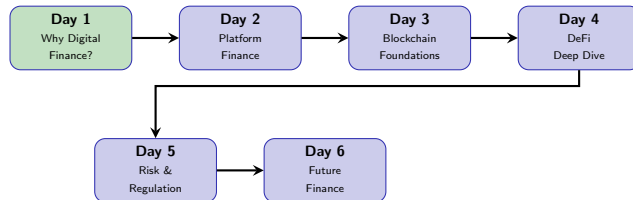
## AI + Finance:

- Algorithmic credit scoring
- Fraud detection
- Automated advising
- Predictive analytics

Coming in Days 5 & 6

Tokenization, DAOs, CBDCs, and the future of digital finance.





**You are here:** Day 1 – building the foundation for everything that follows.

## What We Covered:

1. **Money** is trust infrastructure
2. Digital money faces the **double-spending problem**
3. Traditional finance has **significant frictions**
4. **Two philosophies** address these frictions
5. The landscape spans **six+ sectors**

## Key Takeaways:

- Friction = opportunity
- FinTech: better UX on existing rails
- Crypto/DeFi: new rails, new rules
- Both have tradeoffs
- The future likely involves both

## Central Question Going Forward

For any given use case: Should we improve existing infrastructure or build new infrastructure?

# Platform Finance: How FinTech Reshapes Financial Services

### We'll explore:

- How platforms create value through network effects
- Open banking and API-based innovation
- Neobanks and the unbundling of finance
- Platform business models

### Preparation:

- Complete the Day 1 notebook if you haven't
- Think: What financial apps do you use daily?
- Optional: Read about payment rails (ACH, SWIFT, card networks)

## Notebooks:

- `day_01/notebooks/01_ledger_simulation.ipynb`

## Further Reading:

- Nakamoto, S. (2008). "Bitcoin: A Peer-to-Peer Electronic Cash System"
- World Bank Global Findex Database
- BIS Papers on payments and digital currencies

## Concepts to Review:

- Double-spending problem
- Account-based vs. token-based money
- FinTech vs. Crypto/DeFi distinction
- The six sectors of digital finance

# Questions?

Day 1: Why Digital Finance?

From Friction to Innovation

Next: Day 2 – Platform Finance