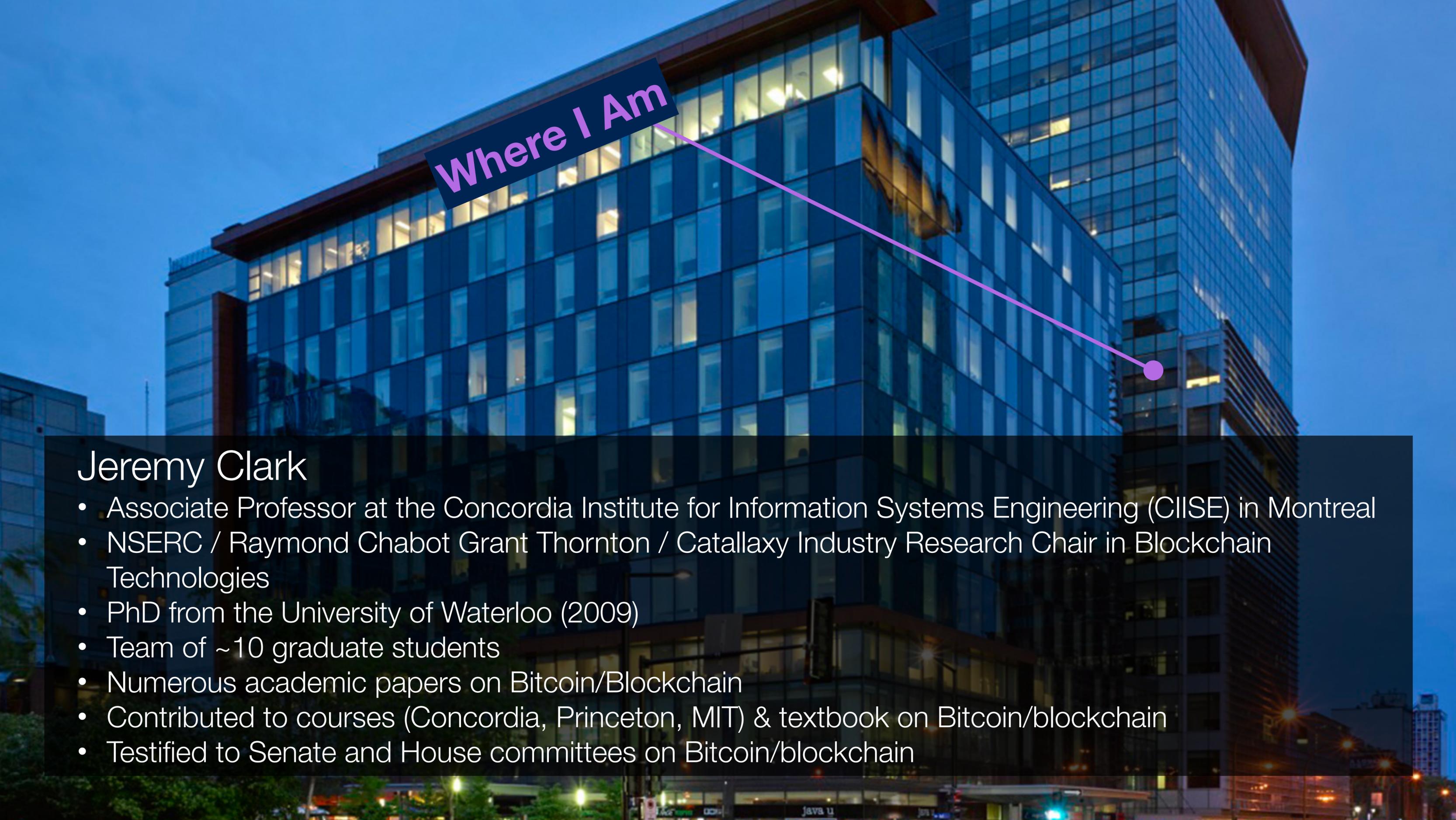


# Decentralized Finance (DeFi): Landscape & Future Directions

Jeremy Clark

A photograph of a modern glass skyscraper at dusk. The building's windows are illuminated from within, and the sky is a deep blue. A purple callout box with the text "Where I Am" is positioned in the upper left, with a purple line extending from it to a purple dot on the right side of the building.

Where I Am

## Jeremy Clark

- Associate Professor at the Concordia Institute for Information Systems Engineering (CIISE) in Montreal
- NSERC / Raymond Chabot Grant Thornton / Catallaxy Industry Research Chair in Blockchain Technologies
- PhD from the University of Waterloo (2009)
- Team of ~10 graduate students
- Numerous academic papers on Bitcoin/Blockchain
- Contributed to courses (Concordia, Princeton, MIT) & textbook on Bitcoin/blockchain
- Testified to Senate and House committees on Bitcoin/blockchain



**GINA CODY**  
SCHOOL OF ENGINEERING  
AND COMPUTER SCIENCE

## Funding & Partners:



**catallaxy**



Office of the  
Privacy Commissioner  
of Canada

- You code your financial service and push it to a public blockchain like **Ethereum**
- The **Ethereum's** global network of servers runs your code for you
- While it is slow and can only run (relatively) simple code, it will run exactly as coded
  
- In **2020**, decentralized finance (**DeFI**) services hold **\$10B USD** on **Ethereum**

**FEB 2020**



Julien Bouteloup  
@bneiluj

~353k net profit using 'Sophisticated' arb on Fulcrum

@bzxHQ

1. he took \$2.7M Flash loan. @dydxprotocol 10kETH

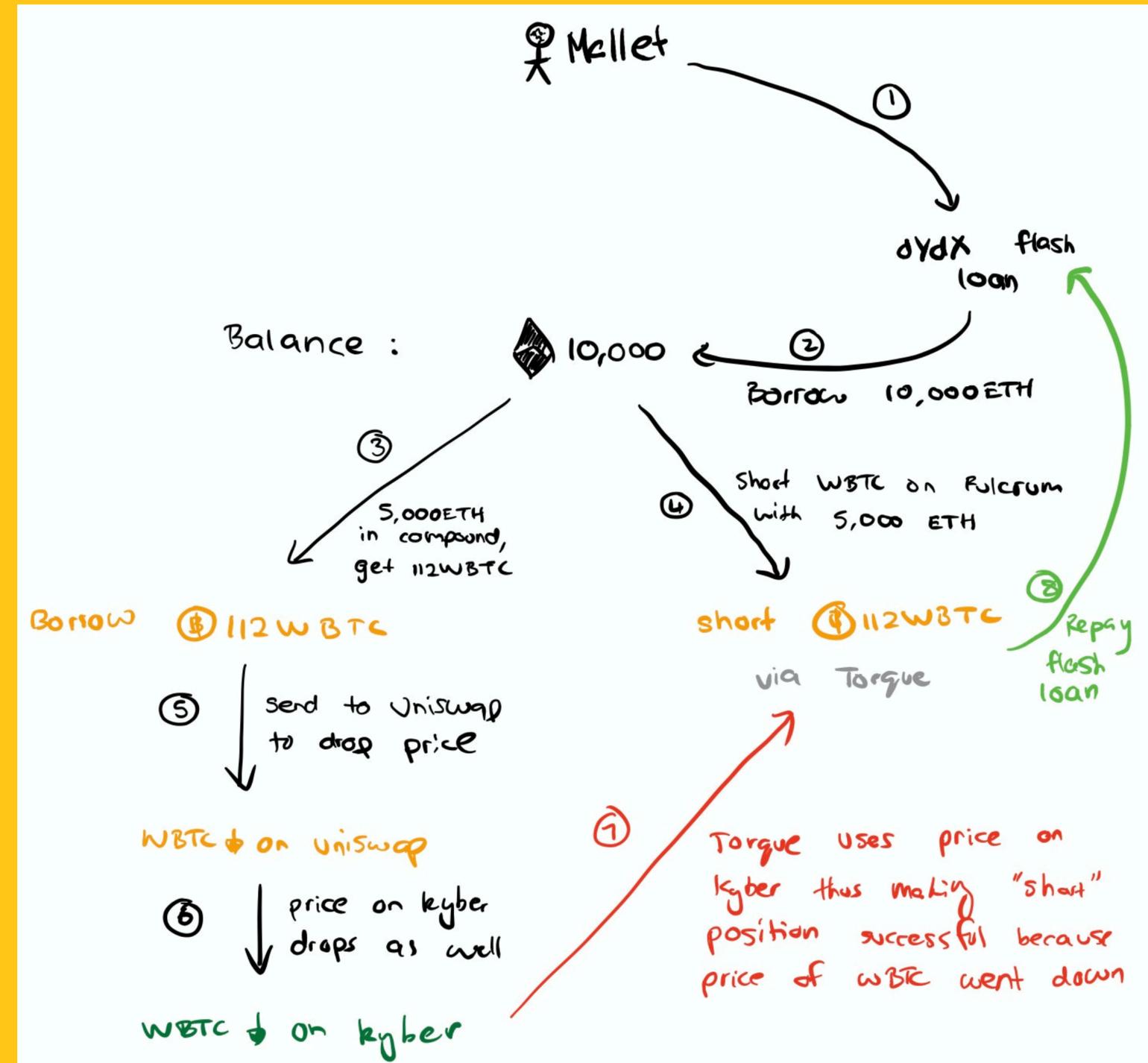
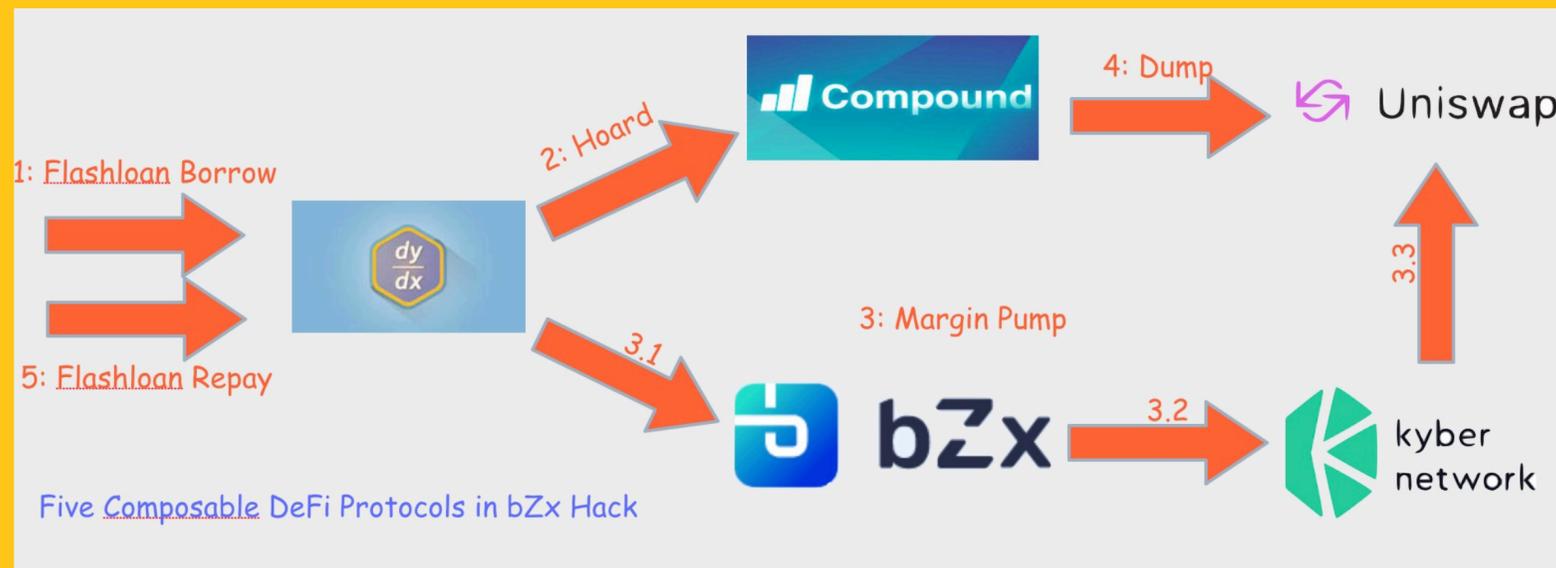
2. put 5.5k ETH @compoundfinance, borrowed 112 WBTC

3. short WBTC on bzx #sETHwBTC5x

4. dumped 112 wBTC on #KyberUniswap to trigger short(oasis?)

5. Paid back loan

6. profit



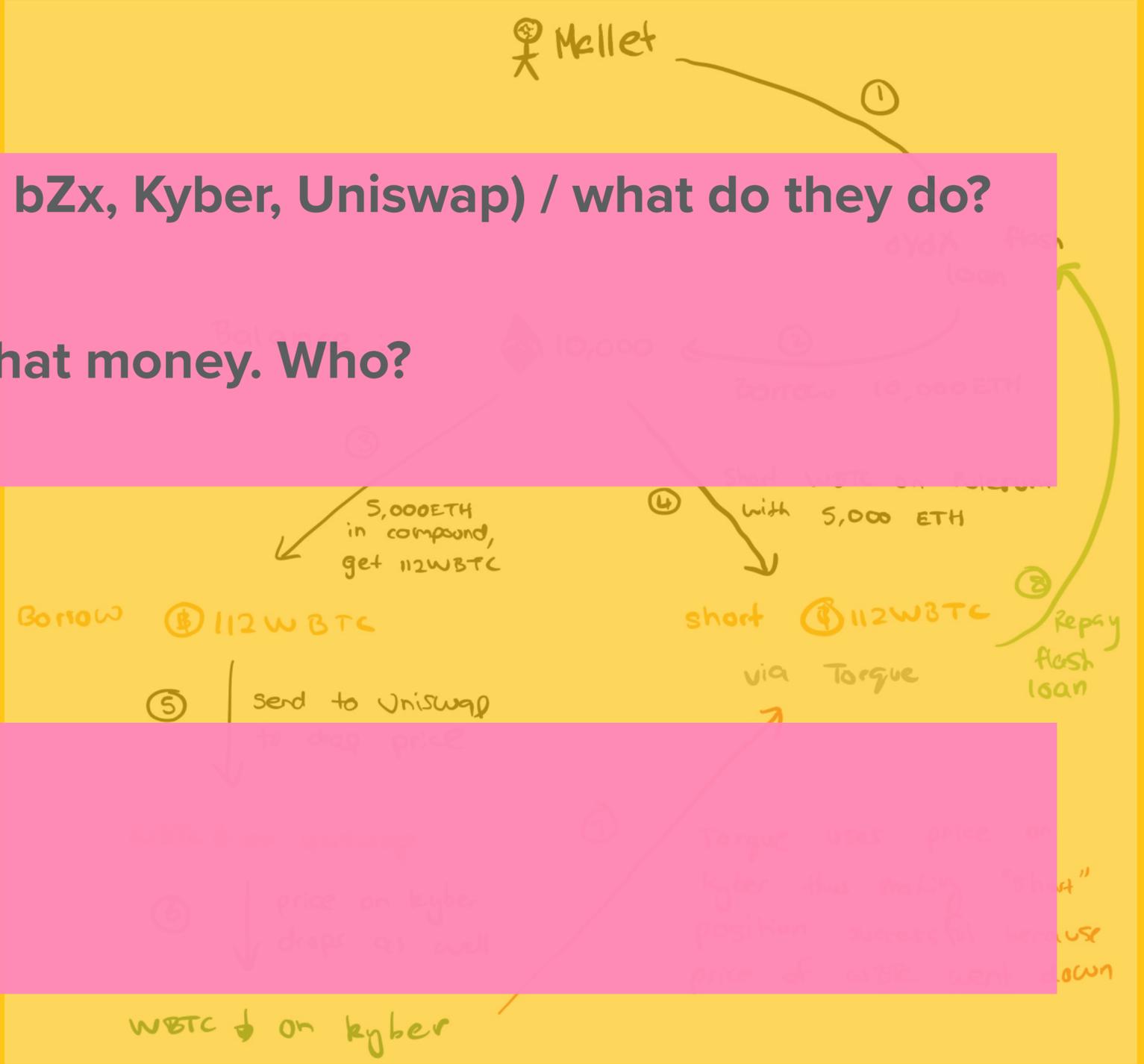
Julien Bouteloup  
@bneiluj

~352k net profit using 100k collateral on Euler

- 1. he
- 2. pu
- WB
- 3. sh
- 4. du
- short(oasis?)
- 5. Paid back loan
- 6. profit

- Who are all these services (dydx, Compound, bZx, Kyber, Uniswap) / what do they do?
- Was this just arbitrage? Or an attack?
- If the instigator made \$300K, someone lost that money. Who?
- What variations of this are possible?

- \$300K is (relatively) small
- \$600K theft days later, \$8.1M last month



**STABLECOINS**

- **Cryptocurrencies like ETH (Ether) and BTC (Bitcoin)**
- **Stablecoins like USDT**

...meets monetary policy.  
BY JEREMY CLARK, DIDEM DEMIRAG,  
AND SEYEDEHMAHSA MOOSAVI

# Demystifying Stablecoins

- Cryptocurrencies like ETH (Ether) and BTC (Bitcoin)
- Stablecoins like USDT

- Article in Communications of the ACM

THE FIRST WAVE of cryptocurrencies, starting in the 1980s, attempted to digitize government-issued currency (or *fiat currency*, as cryptocurrency enthusiasts say).<sup>8</sup> The second wave, represented prominently by Bitcoin,<sup>7</sup> provide their own separate currency—issued and operated independently of any existing currencies, governments, or financial institutions. Bitcoin’s currency (BTC) is issued in fixed quantities according to a hard-coded schedule in the protocol.

In the words of Bitcoin’s pseudonymous inventor: “There is nobody to act as a central bank... to adjust the money supply... that would have required a trusted party to determine the value of things. If there was some clever way, or if we wanted to trust someone to actively manage the money supply to peg it to something, the rules could have been programmed for that. In this sense, it’s more typical of a precious metal. Instead, the supply changing to keep the value of the metal constant, the supply is predetermined.”

Without active management, the exchange rate of BTC with governmental currencies has been marked by extreme volatility. Figure 1 shows a comparison of fiat currencies and bitcoin. The values were retrieved daily between Jan. 1, 2016 and Jan. 1, 2019. (Note that 1,000 mBTC = 1 BTC). Squint at the chart to notice how the GBP (British pound) drops around June 2016: This mild-looking pinch is actually the so-called “sharp decline” and “severe swing” that followed the Brexit referendum in the U.K. It is completely overshadowed, however, when placed beside BTC’s large fluctuations.



# ETHEREUM LENDING

- **First type of loan**
  - **Bob borrows 80 ETH because he has a good reputation / credit rating / income / etc**
-

- **First type of loan**
  - **Bob borrows 80 ETH because he has a good reputation / credit rating / income / etc**
- **Does not exist on Ethereum**

- **Second type of loan**
  - **Alice deposits 100 ETH into a “decentralized bank” to earn interest**
  - **Bob wants to borrow 80 ETH from the bank (80 ETH = \$30K)**

- **Second type of loan**
  - Alice deposits 100 ETH into a “decentralized bank” to earn interest
  - Bob wants to borrow 80 ETH from the bank (80 ETH = \$30K)
  - Bob deposits \$40K in BTC
  - Bob repays with interest, which is partially passed onto Alice
  - Any credit event: the bank sells his \$40K collateral to repay the loan
- **Bank is autonomous. It is just code.**

- **Third type of loan**
- **Flash loan**
- **Not possible in the real world!**

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- **Not possible in the real world!**

```
{  
  
  TRANSACTION:  
  
    RUN FUNCTION 1  
    RUN FUNCTION 2  
    RUN FUNCTION 3  
    RUN FUNCTION 4  
  
}
```

- **Third type of loan**
- **Flash loan**
- **Not possible in the real world!**

```
{
```

```
    TRANSACTION:
```

```
        RUN FUNCTION 1
```

```
        RUN FUNCTION 2
```

```
        RUN FUNCTION 3 => FAILS
```

```
        RUN FUNCTION 4
```

```
}
```

- Third type of loan
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```

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```

```
}
```

```
SKIP: 1, 2, 4
```

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```

```
ABORT: 1, 2
```

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```
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```
SKIP: 1, 2, 4
```

```
ABORT: 1, 2
```

```
REVERT: NONE
```

- **Third type of loan**
- **Flash loan**
- **Not possible in the real world!**
- **One transaction at a time**

```
{
```

```
    TRANSACTION:
```

```
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```

```
        RUN FUNCTION 2
```

```
        RUN FUNCTION 3 => FAILS
```

```
        RUN FUNCTION 4
```

```
}
```

```
SKIP: 1, 2, 4
```

```
ABORT: 1, 2
```

```
REVERT: NONE
```

- **Third type of loan**
- **Flash loan**
- **Not possible in the real world!**
- **One transaction at a time**

```
{
```

```
TRANSACTION:
```

```
BORROW XXX ETH
```

```
DO WHATEVER YOU WANT
```

```
REPAY XXX ETH
```

```
REPAY COMPLETE? => REVERT IF FAIL
```

```
}
```

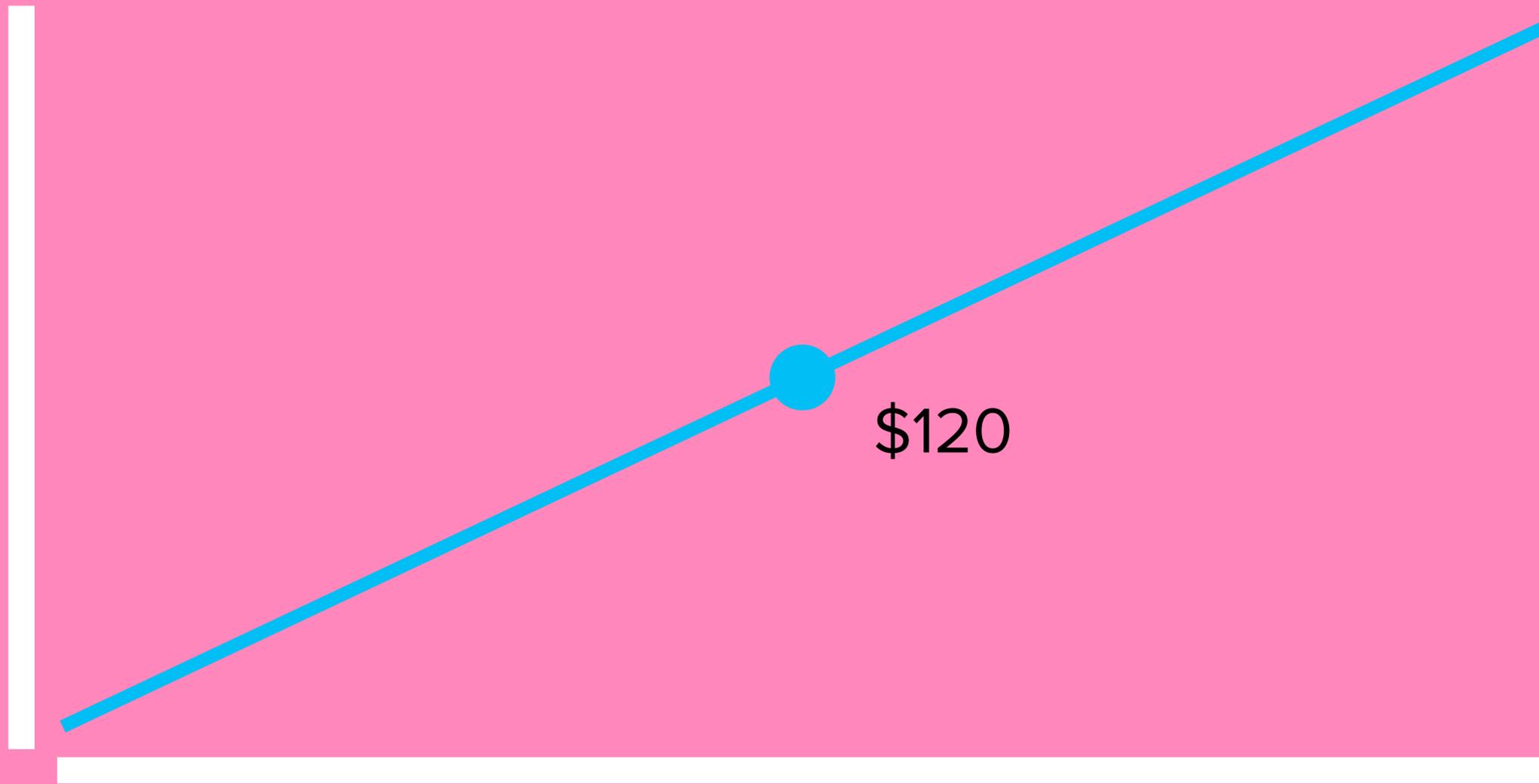
- **Third type of loan**
- **Flash loan**
- **Not possible in the real world!**
- **One transaction at a time**

```
{  
  
  TRANSACTION:  
  
    BORROW XXX ETH  
    DO WHATEVER YOU WANT  
    REPAY XXX ETH  
    REPAY COMPLETE? => REVERT IF FAIL  
  
}
```

- **No risk, no collateral, anonymous, borrow maximum amount available (no one can use it while your transaction is running)**

# MARGIN LENDING

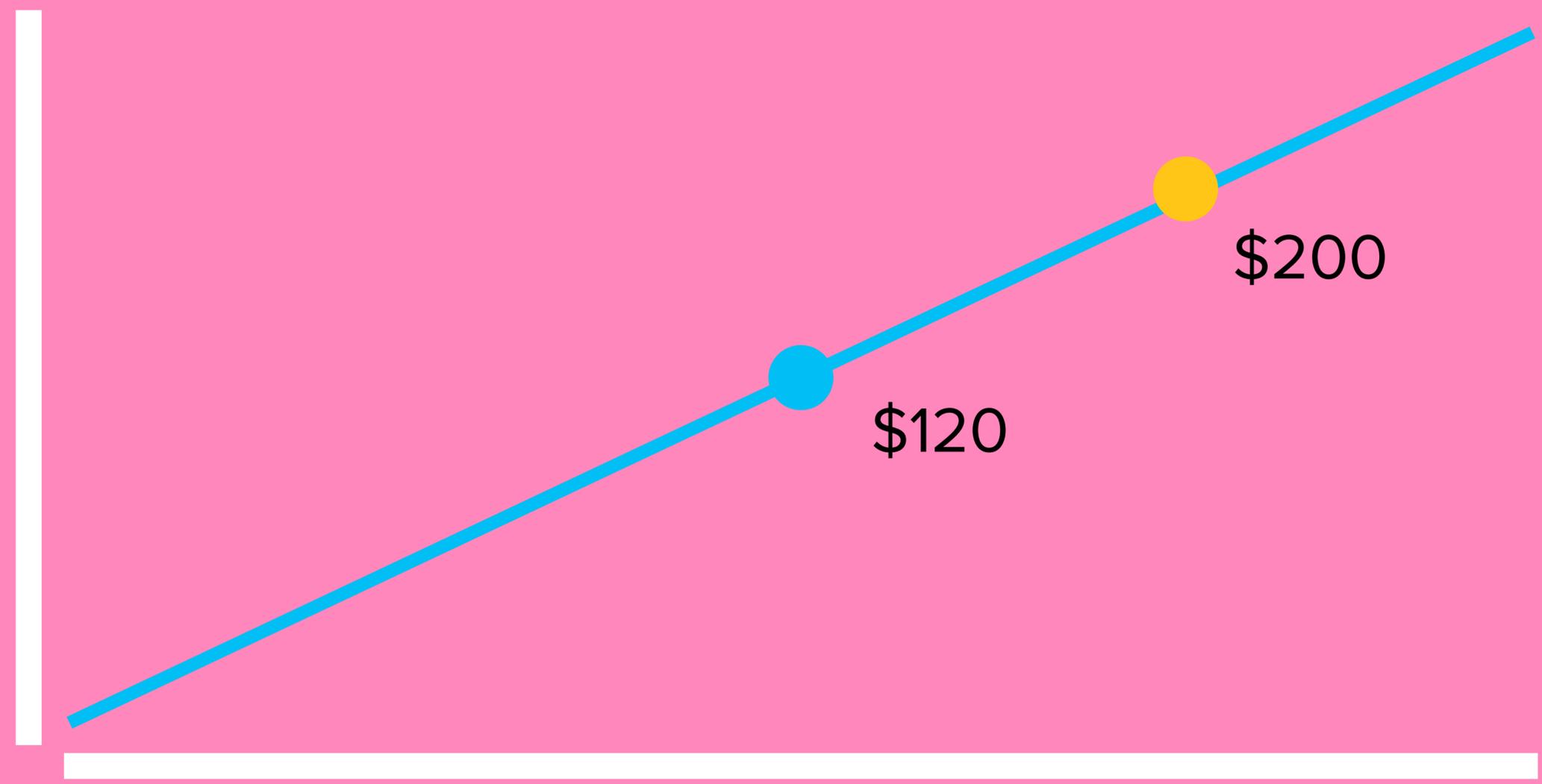
Profit



\$120

APPL Price

Profit



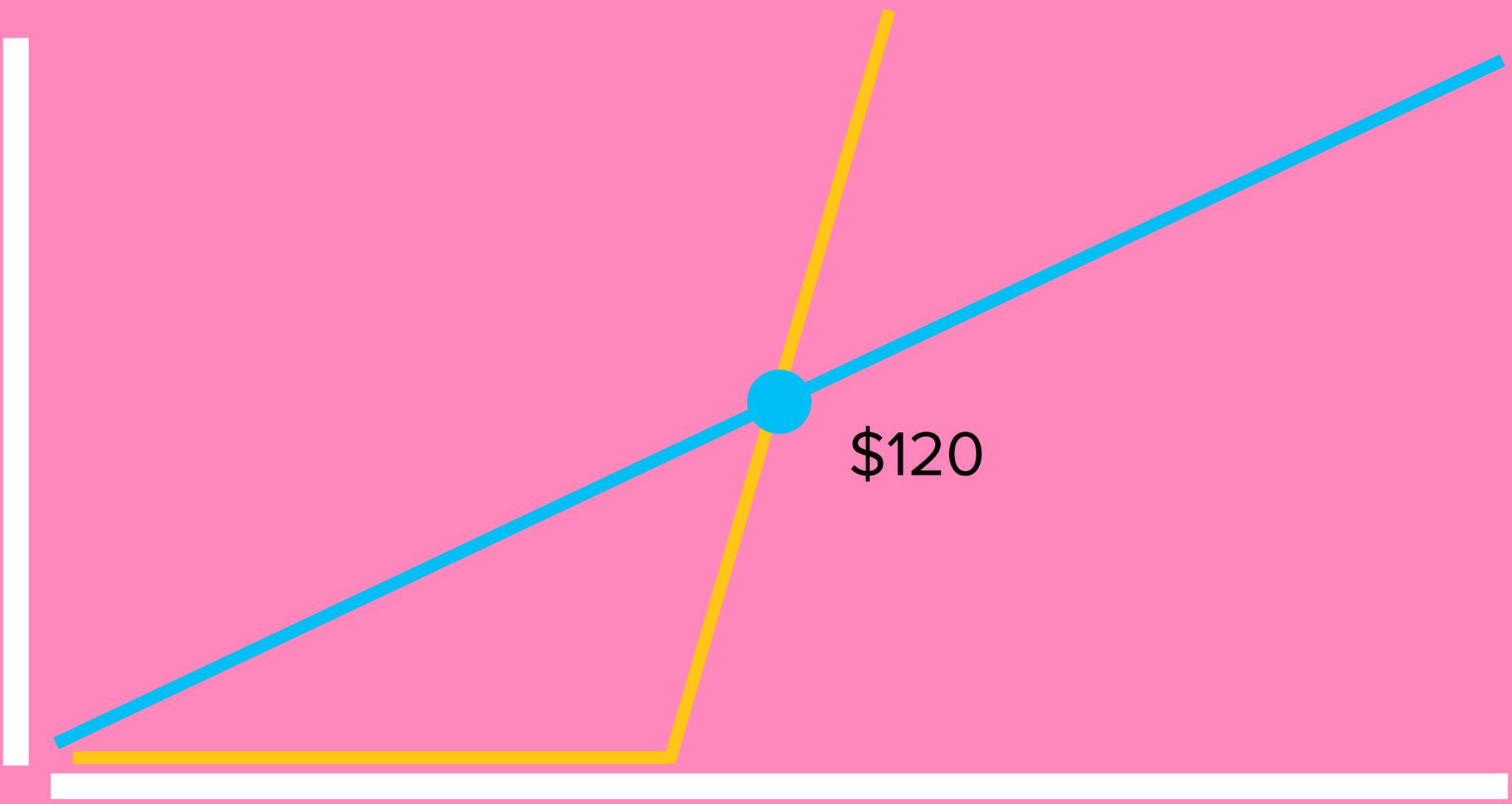
\$120

\$200

APPL Price

Profit

Borrow \$1200 against \$120

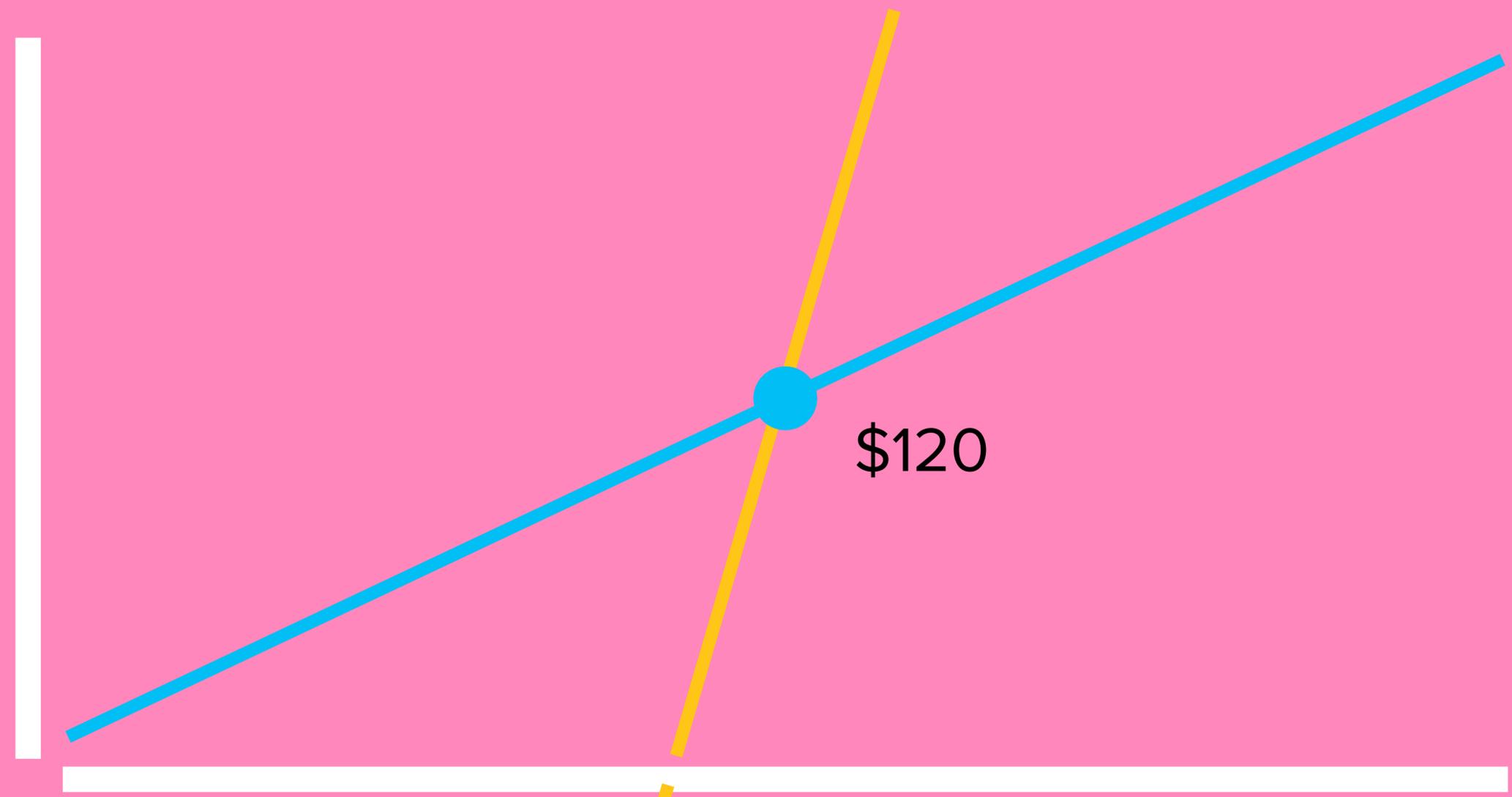


\$120

APPL Price

Borrow \$1200 against \$120

Profit



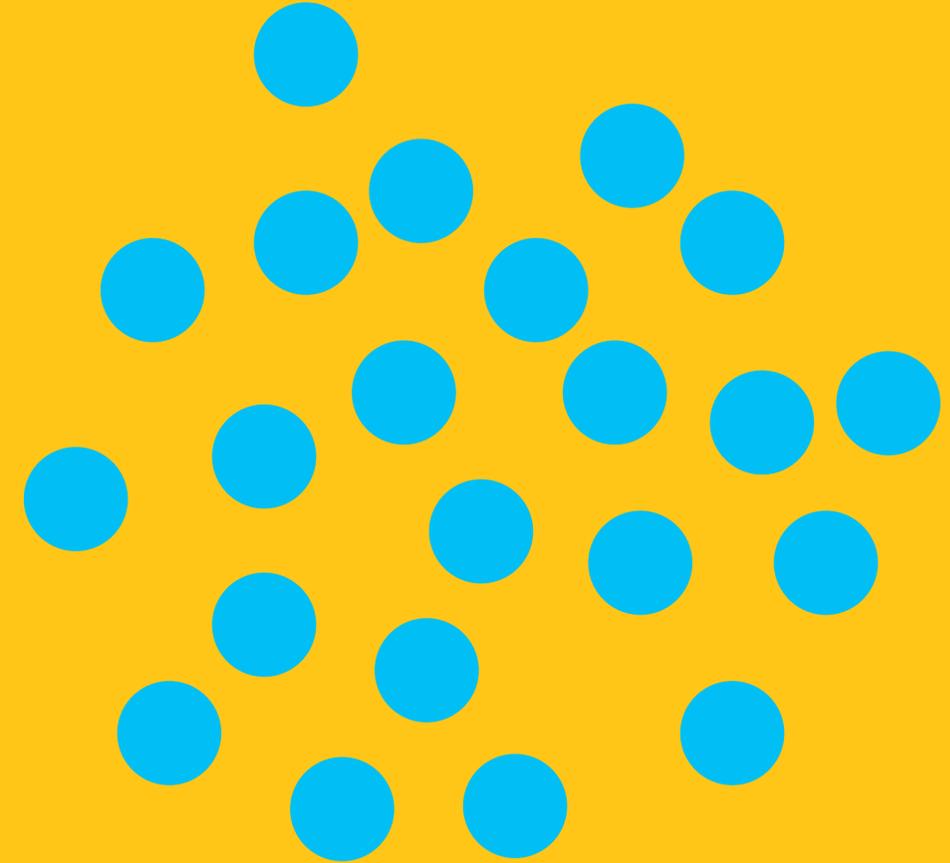
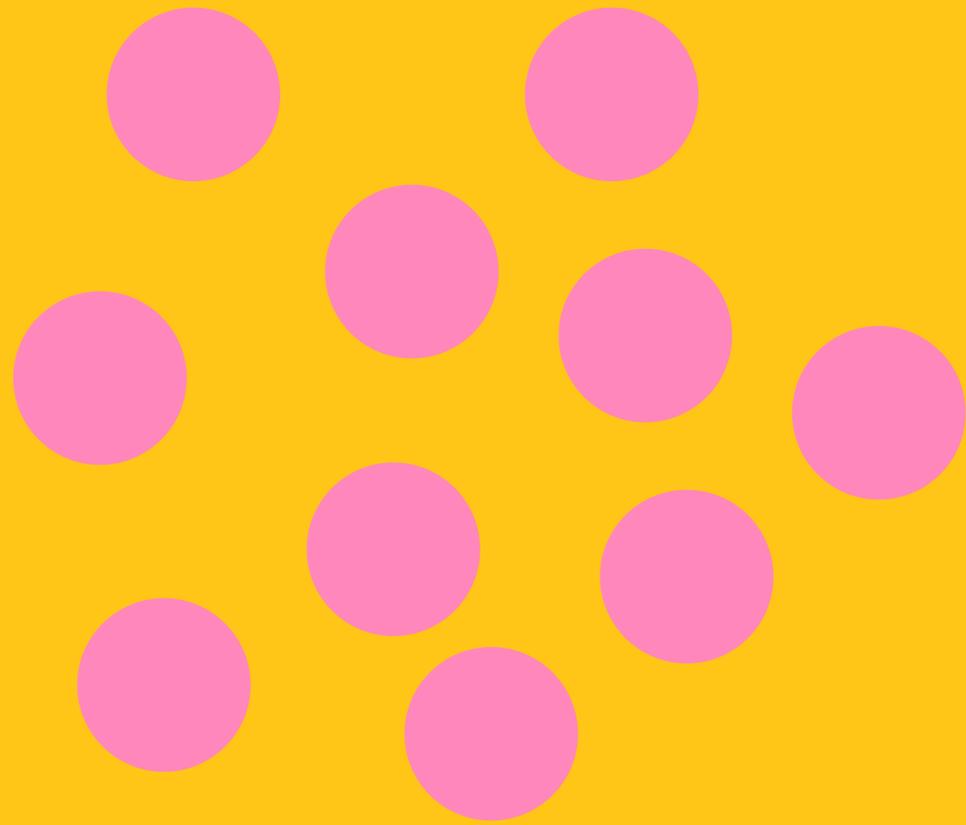
\$120

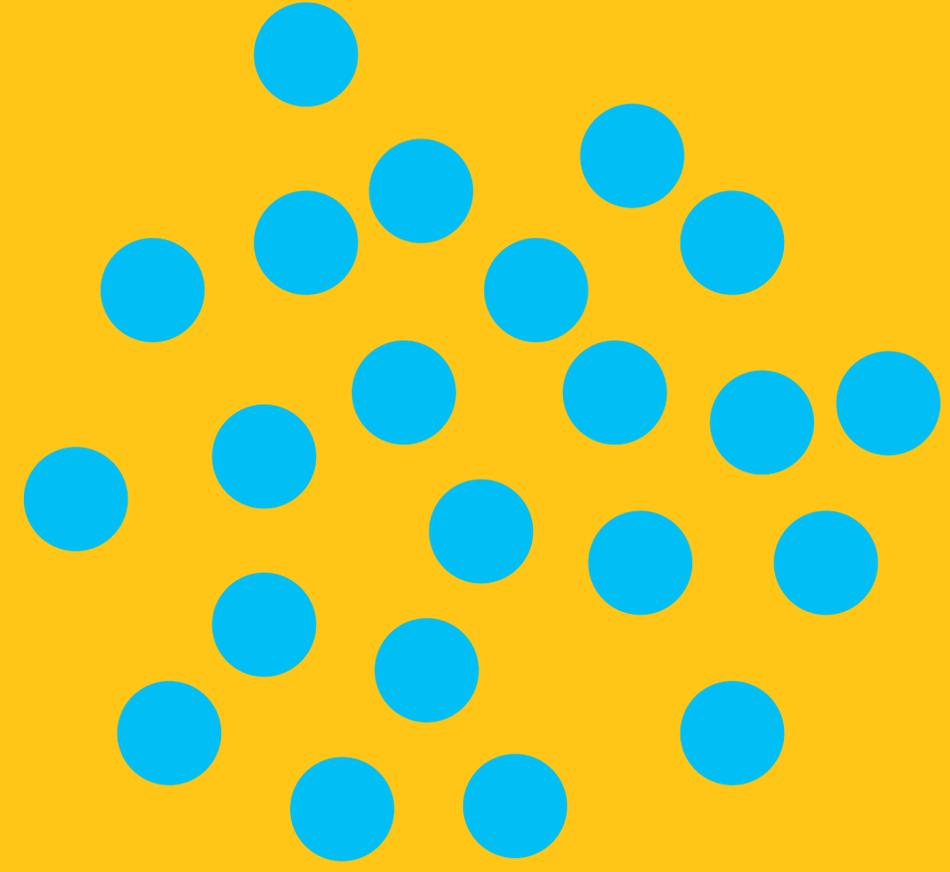
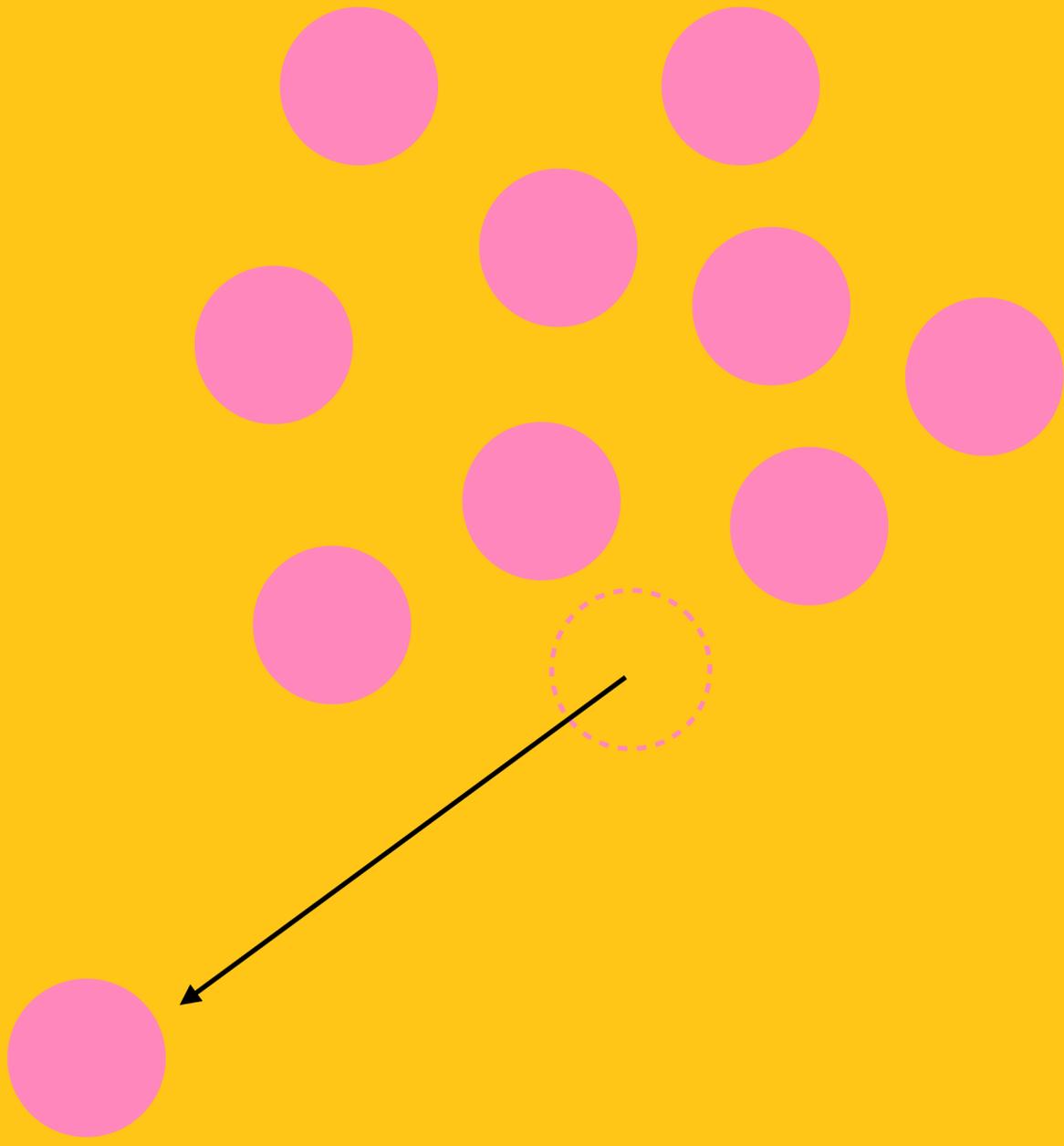
APPL Price

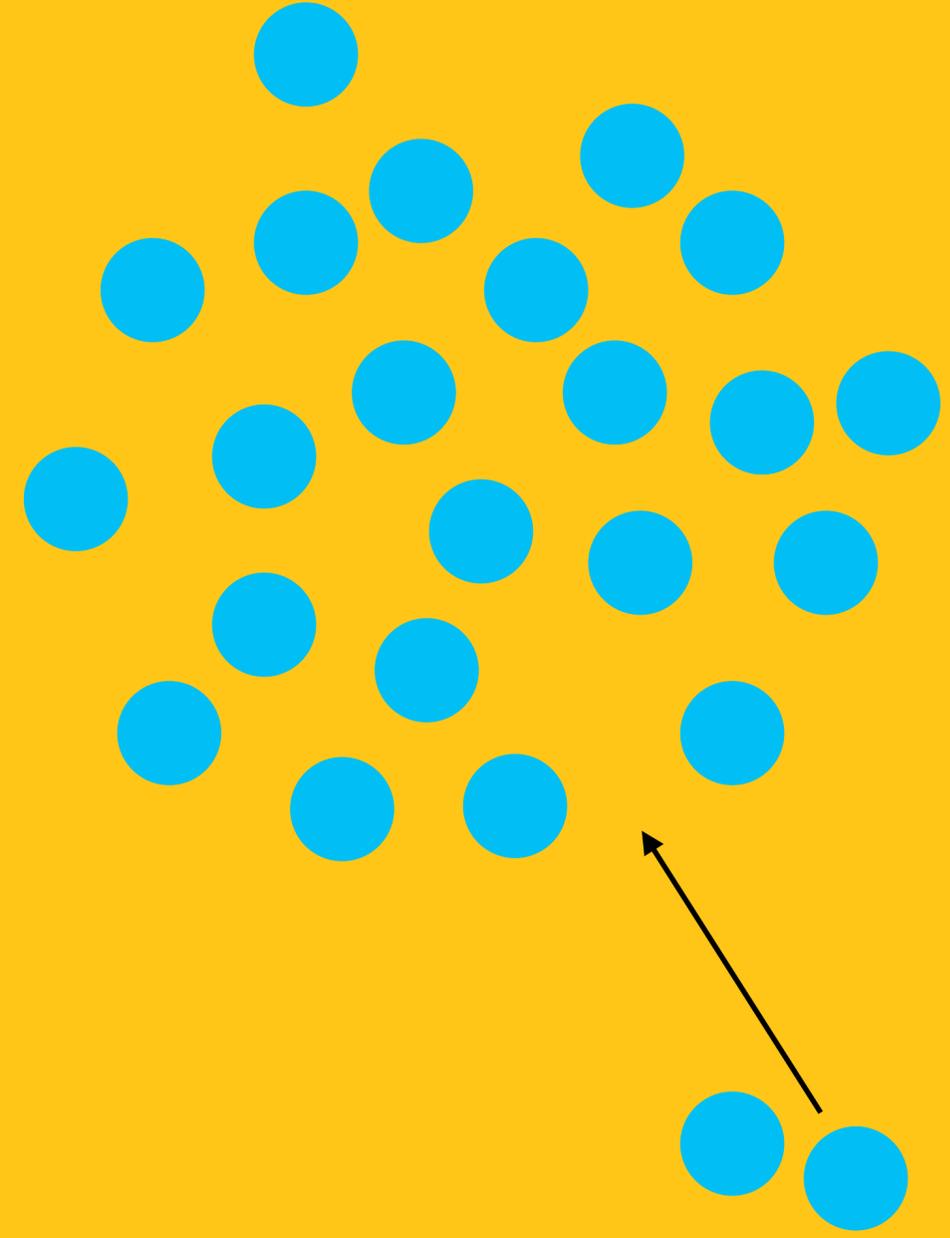
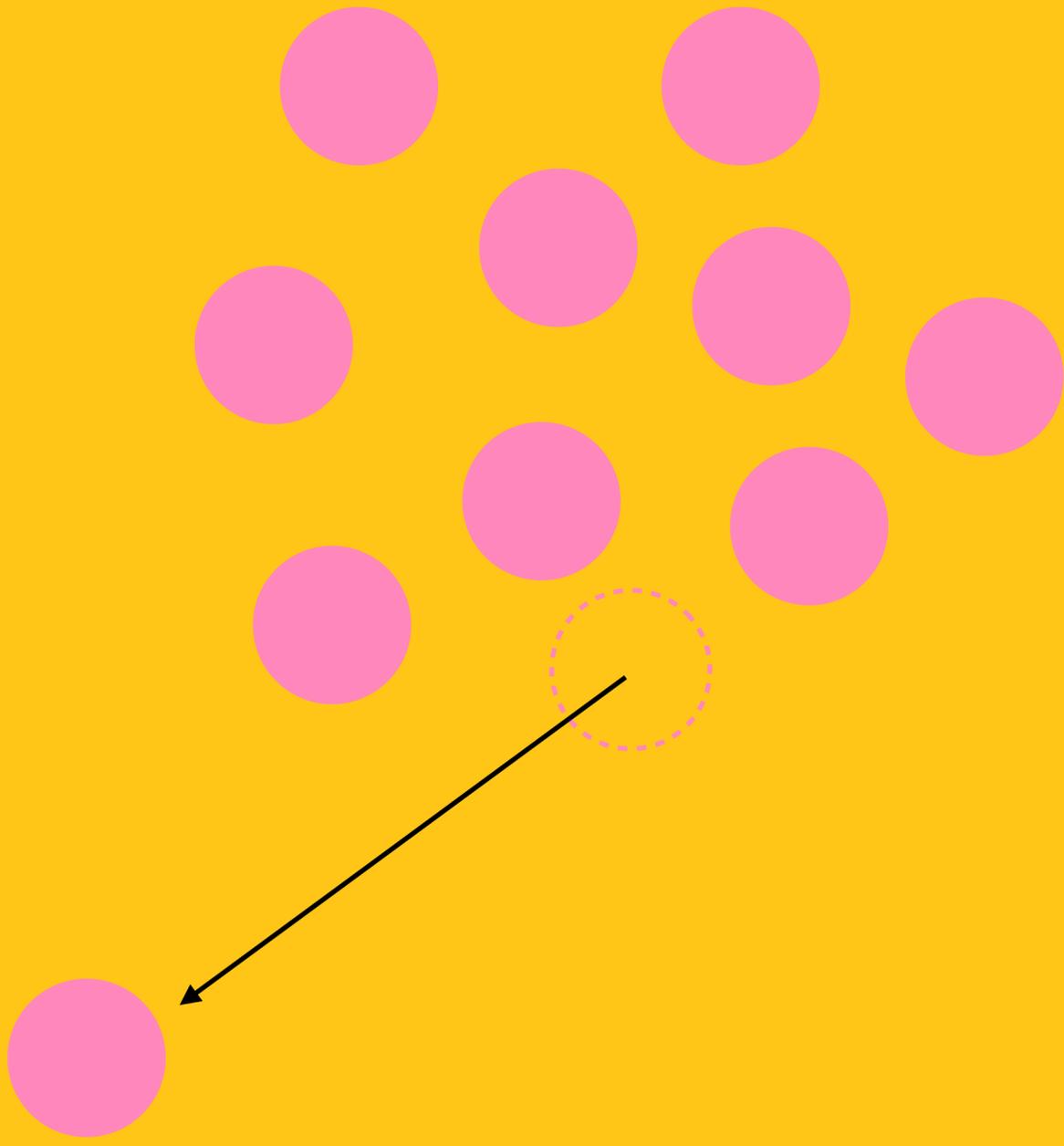
APPL +\$10: make \$100  
APPL +\$120: make \$1200  
APPL -\$10: lose \$100  
APPL -\$12: broke

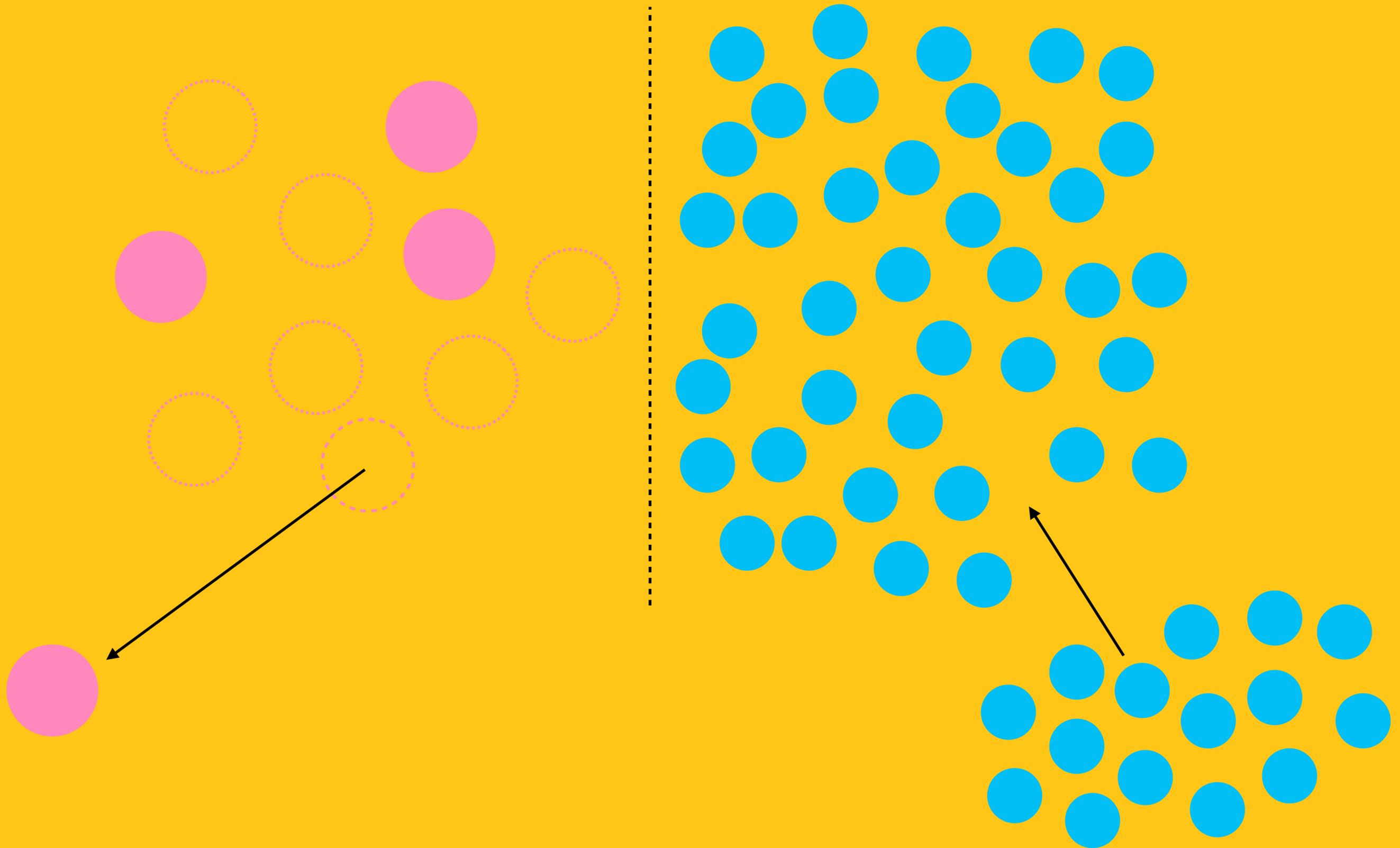
# TOKEN EXCHANGES

- Normally you go off-chain for exchange
- For instant exchange, you can use an **Automated Market Maker (AMM)**



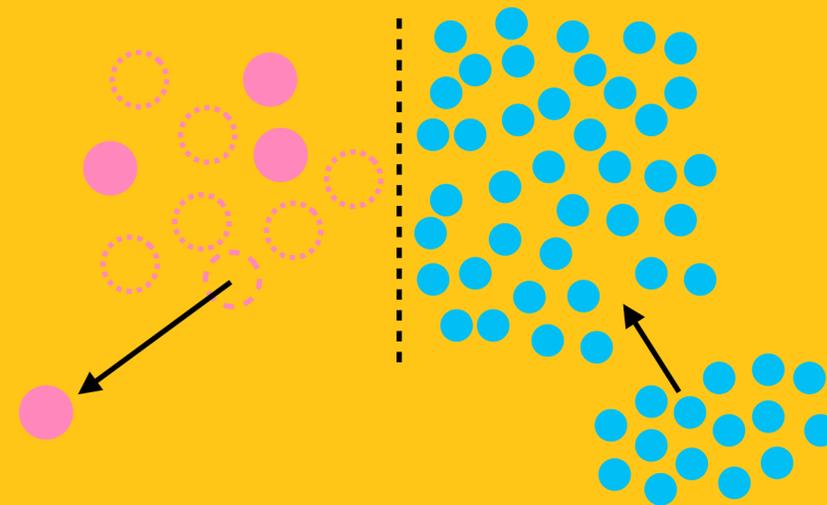






- More tokens you buy, more you pay (slippage)
- Buy a lot of tokens, you will pay way too much

- Next person can get blue coins for cheap



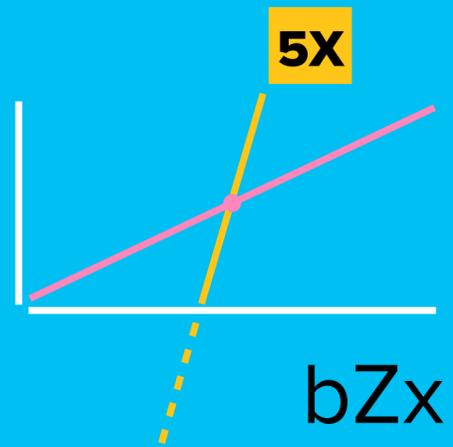
# FEB 2020 INCIDENT

- **Mallory tricks Alice into overpaying for something with Alice's money**

*Note: simplified and re-ordered*

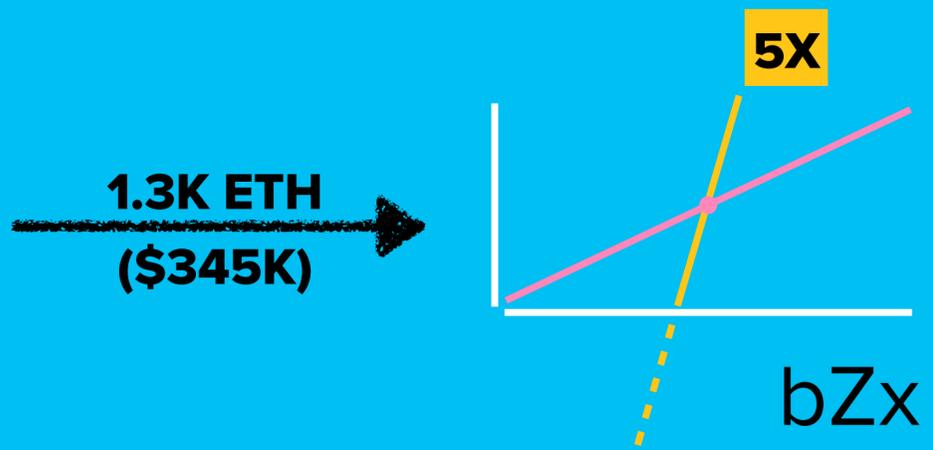
- **Mallory tricks Alice into overpaying for something with Alice's money**
- **Mallory sells to Alice**

*Note: simplified and re-ordered*

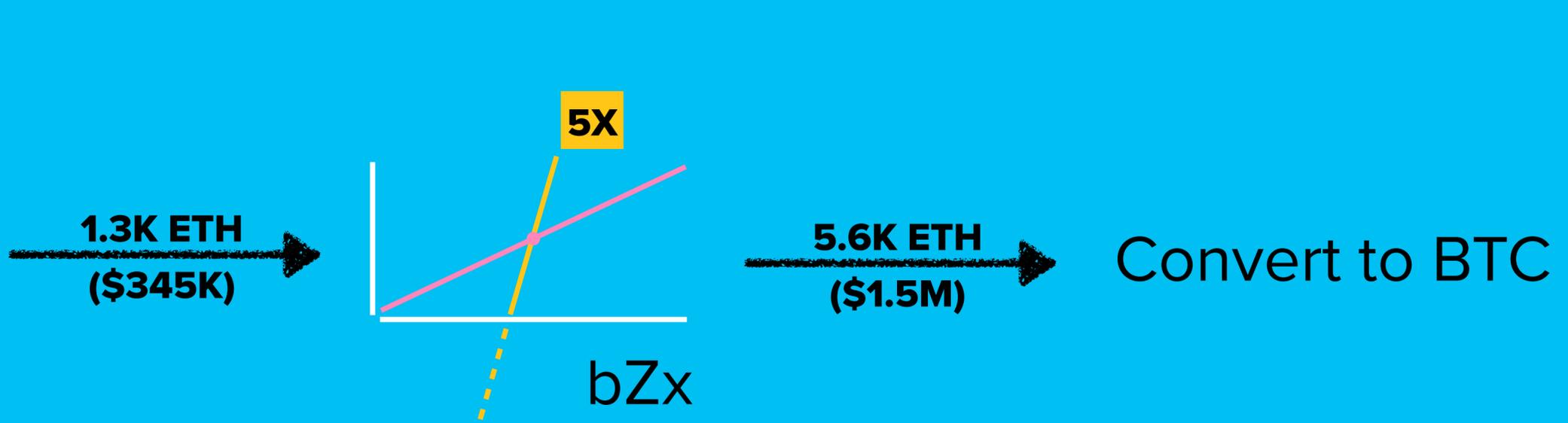


- Mallory tricks Alice into overpaying for something with Alice's money
- Mallory sells to Alice

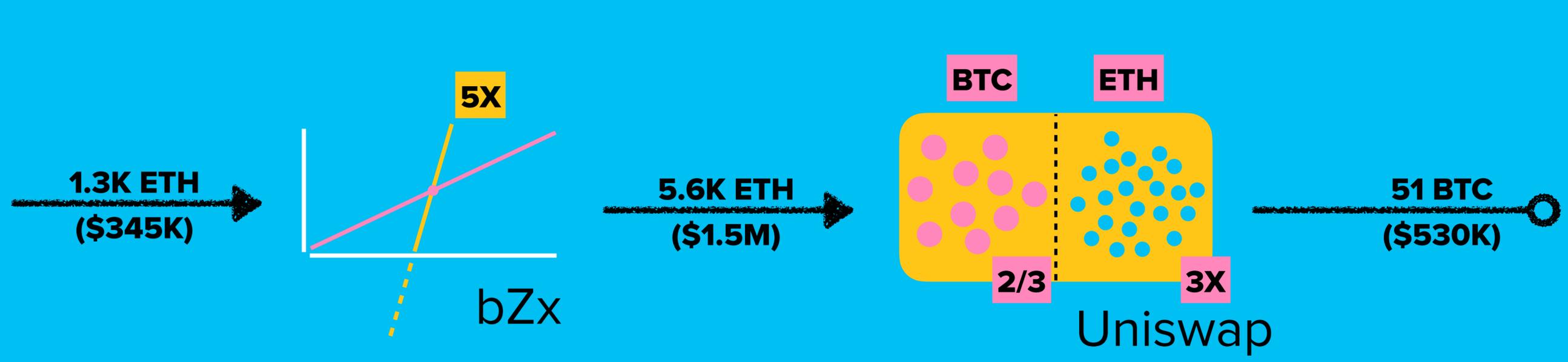
*Note: simplified and re-ordered*



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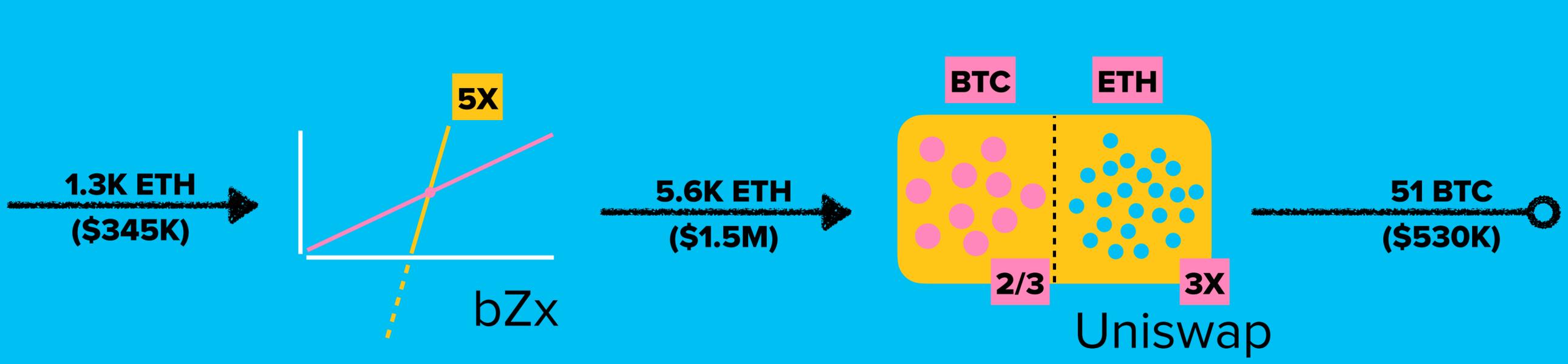


*Note: simplified and re-ordered*

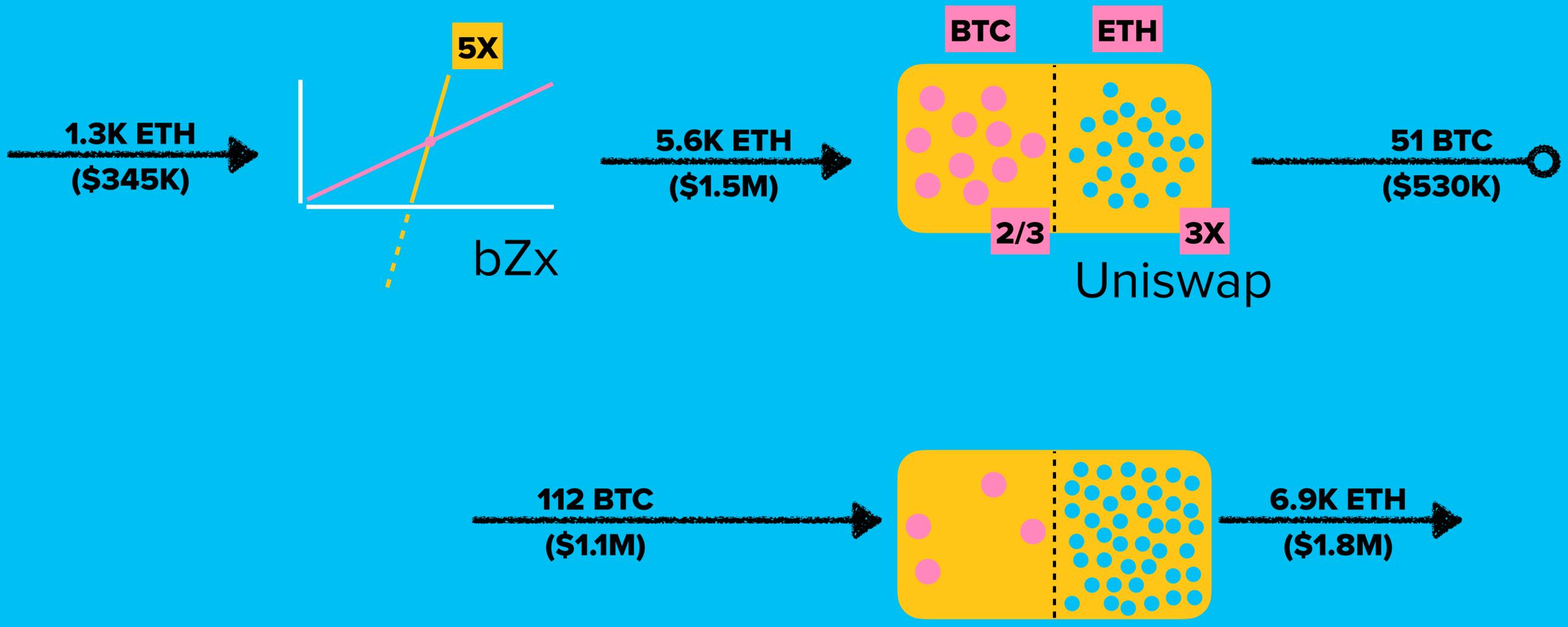


- Trade itself causes a price drop
- After price drop, all collateral is gone and borrowed money too
- Software error in bZx

*Note: simplified and re-ordered*



*Note: simplified and re-ordered*

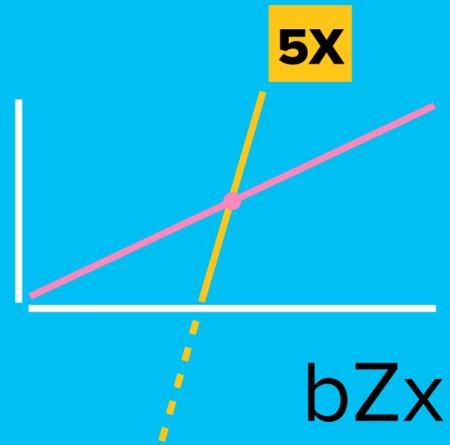


*Note: simplified and re-ordered*

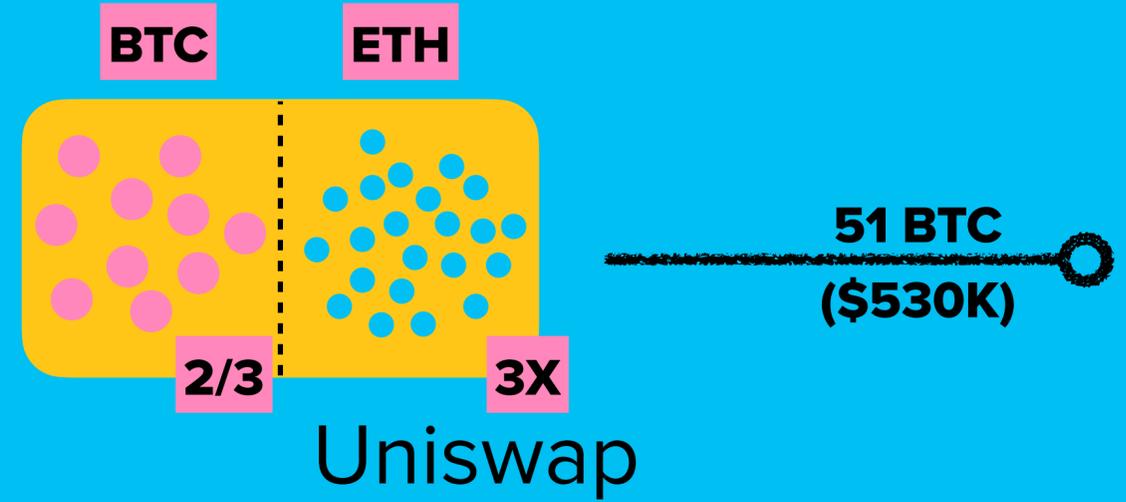
**FLASH LOAN:  
10K ETH (\$2.6M)**

dYdX

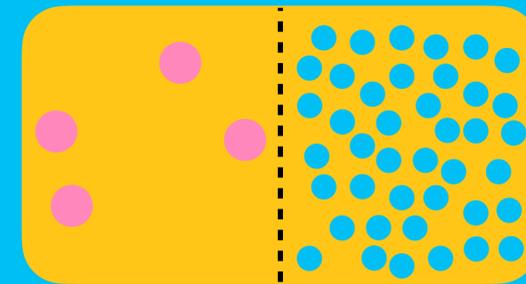
**1.3K ETH  
(\$345K)**



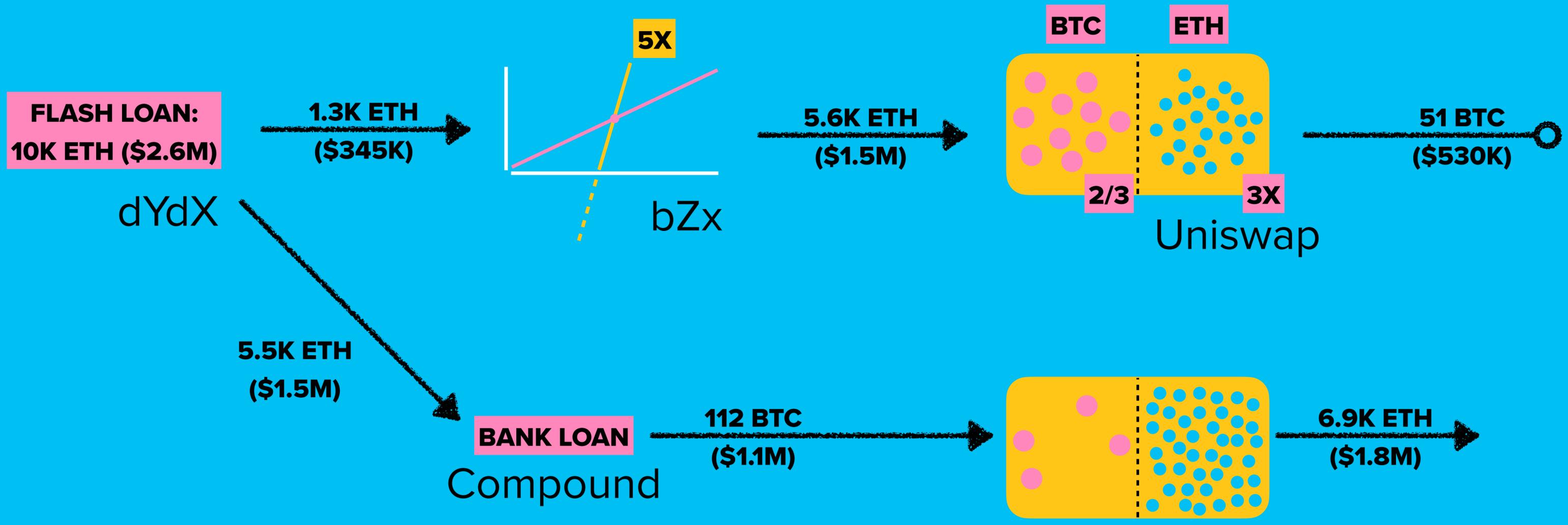
**5.6K ETH  
(\$1.5M)**



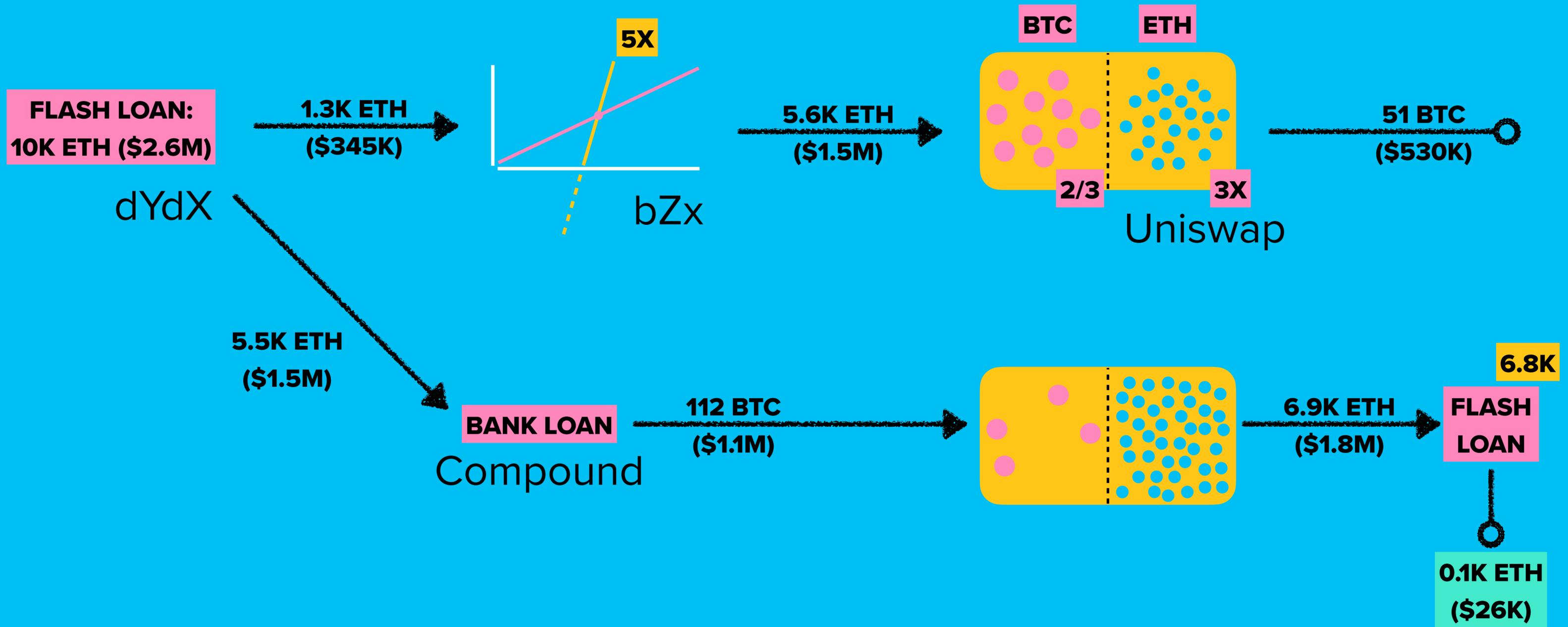
**112 BTC  
(\$1.1M)**



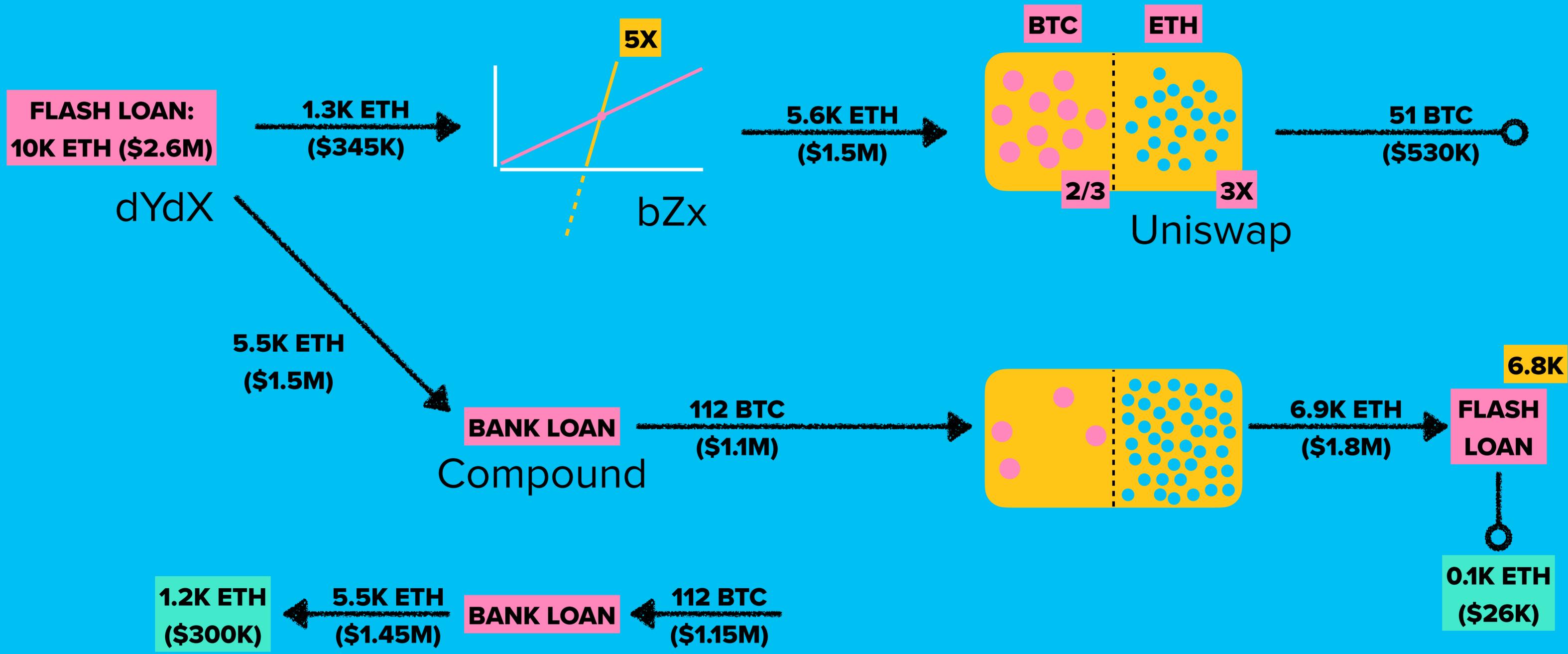
*Note: simplified and re-ordered*



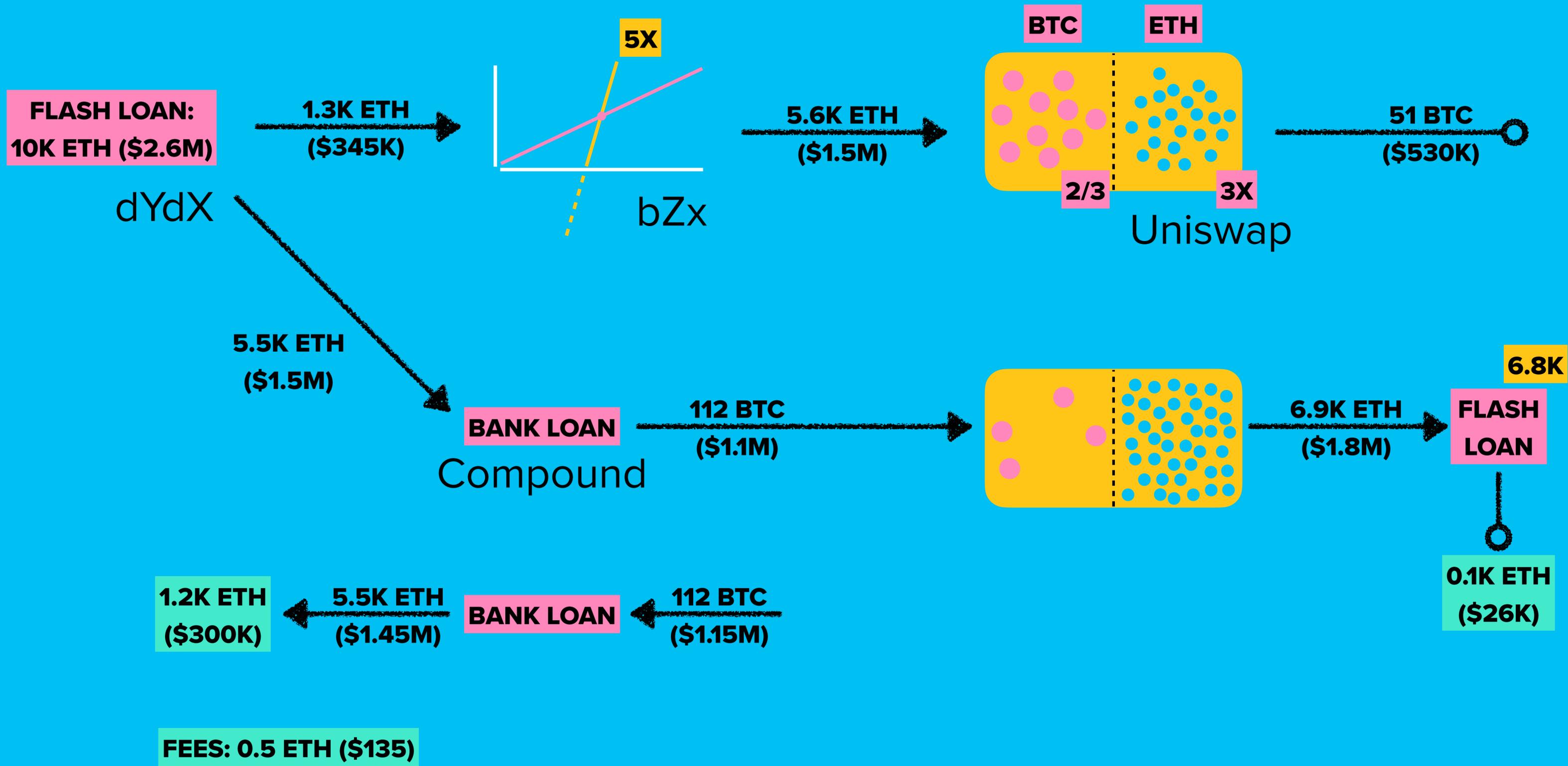
*Note: simplified and re-ordered*



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Note: simplified and re-ordered



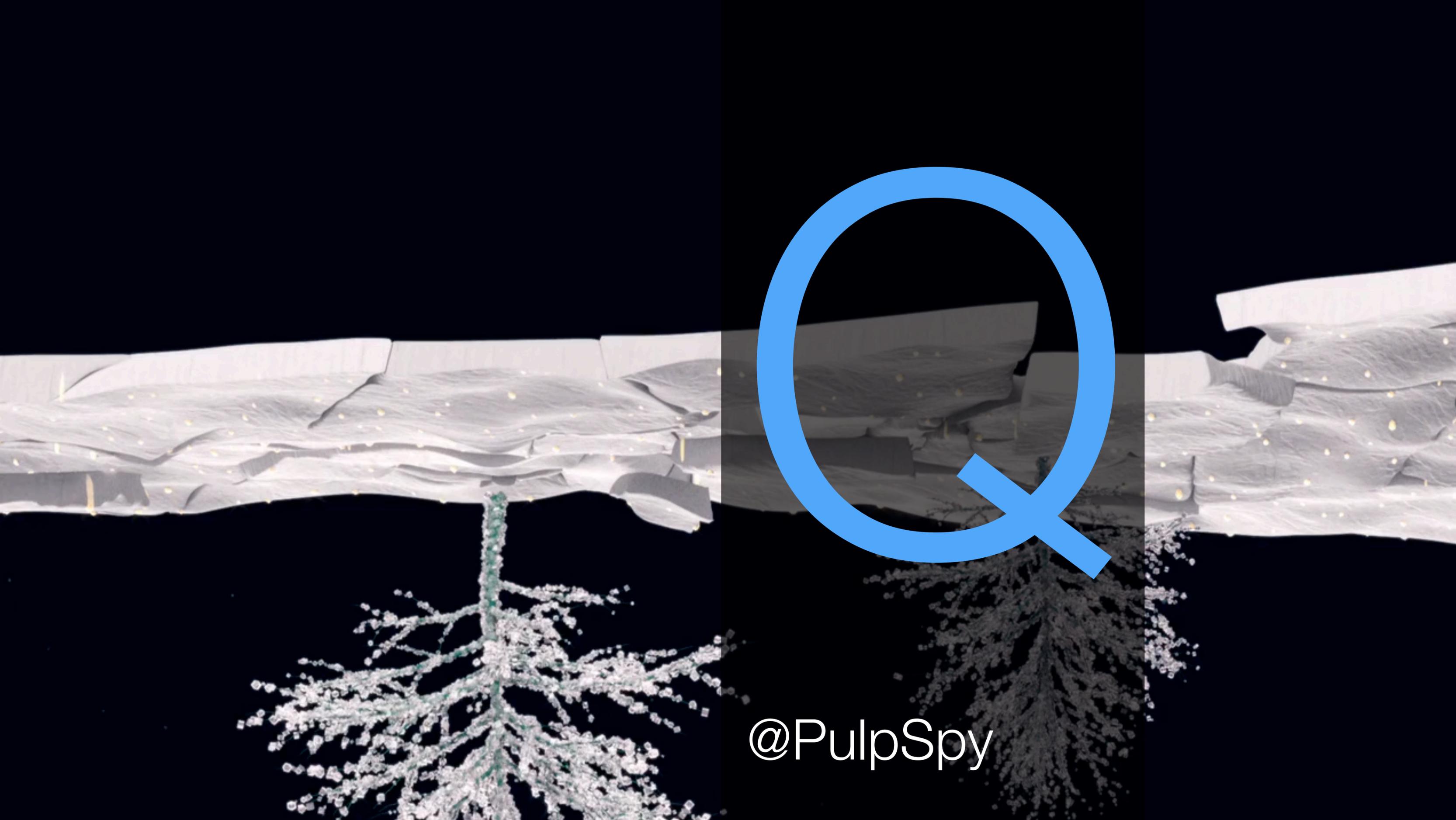
Note: simplified and re-ordered

**WRAP-UP**

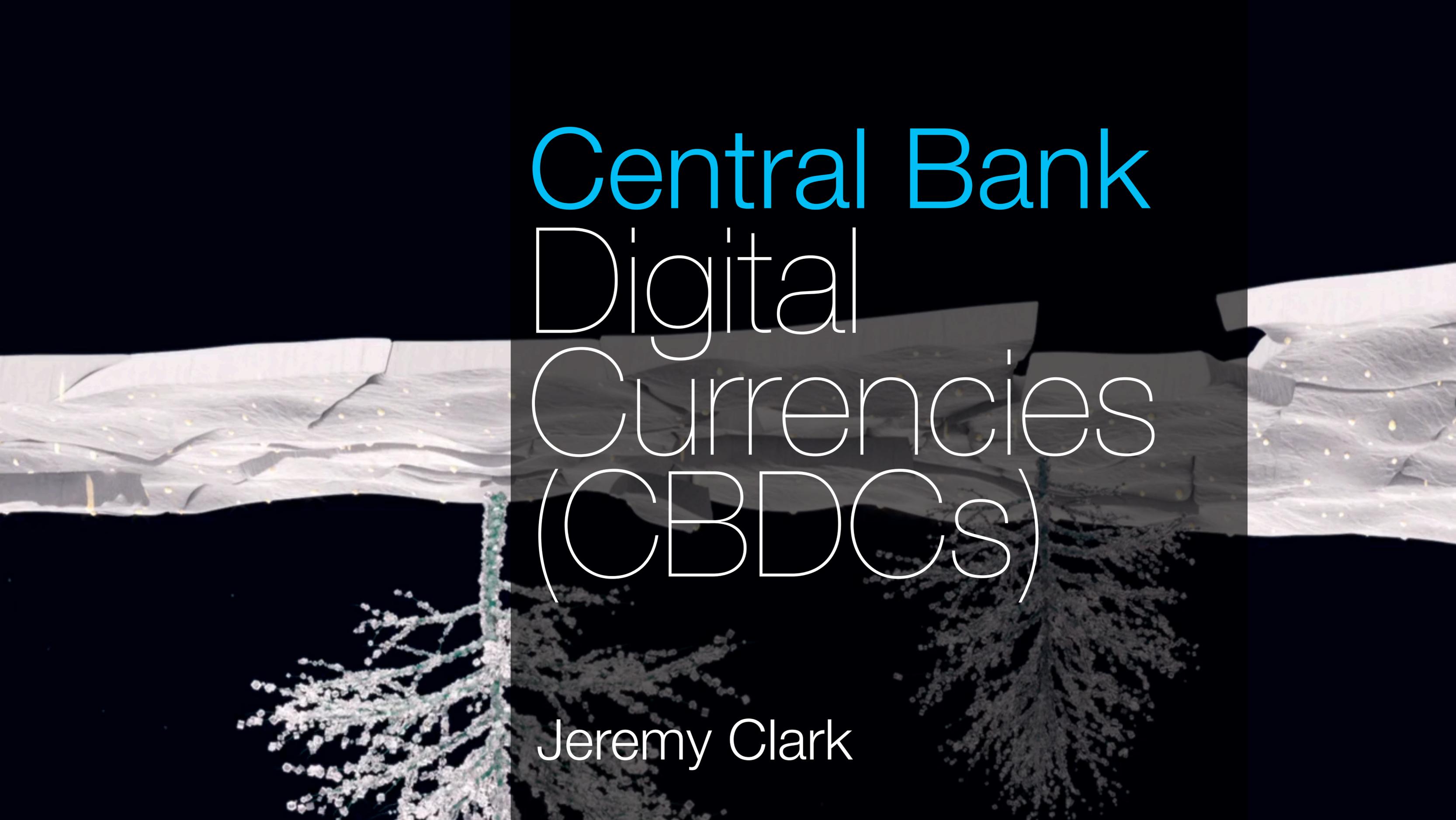
- **A mistake left free tokens in Uniswap. When a researcher tried to redeem them, a miner automatically noticed it was profitable and modified the transaction and stole the tokens.**
- **Celebrity developer pushed unannounced pre-launch code to Ethereum and users noticed it. They used it immediately (despite not knowing what it did exactly), buying up \$15M in tokens. It was then hacked.**
- **“Unaudited” is a selling feature for getting in on the ground floor. A single wrong line in Yam (v2.0) locked \$450K tokens.**

- **Novel techniques**
- **Size of losses are material**
- **Size of losses are growing**
  
- **No takeaways or conclusions... yet**
  
- 



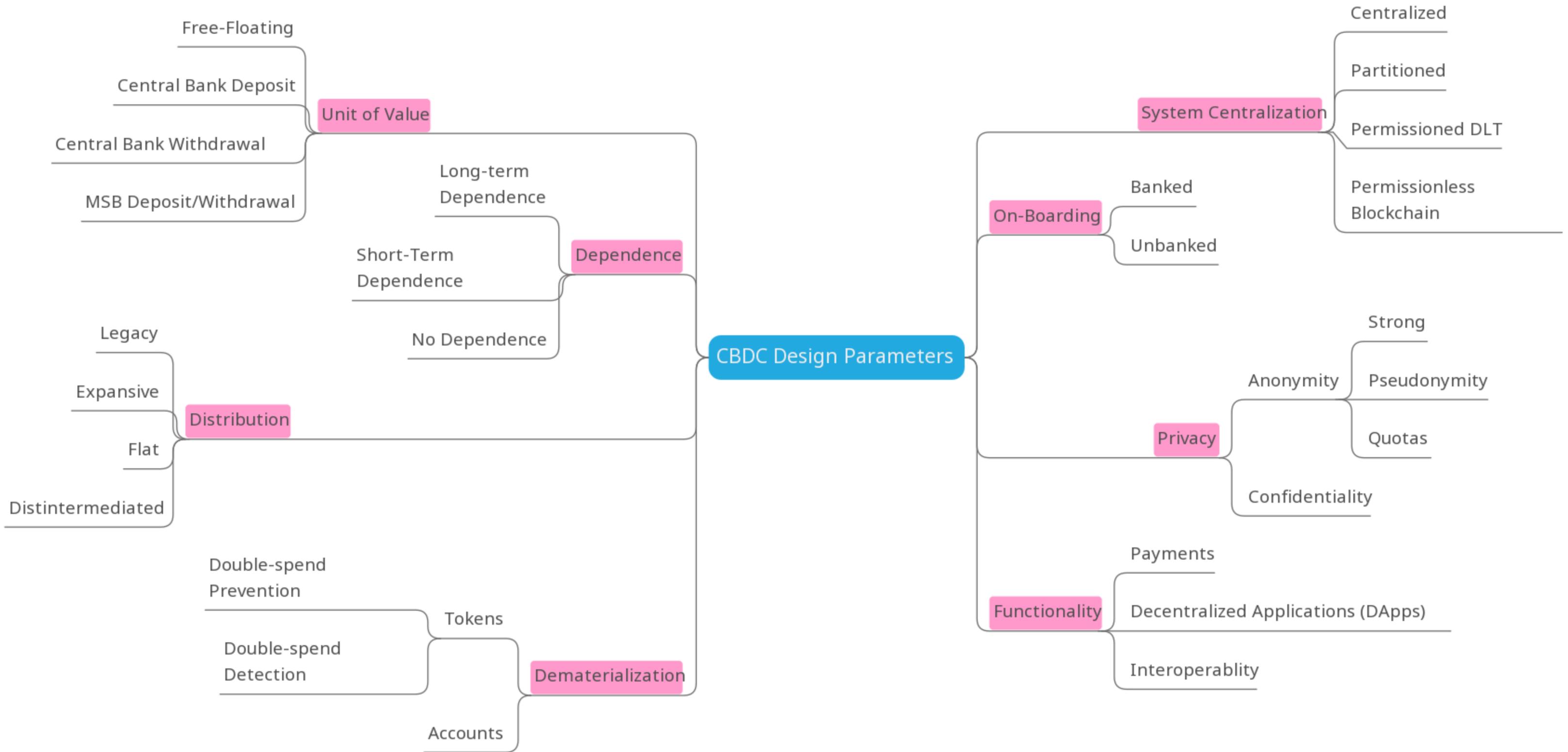


@PulpSpy



# Central Bank Digital Currencies (CBDCs)

Jeremy Clark



Unit of Value

Dependence

Distribution

Dematerialization

CBDC Design Parameters

System Centralization

On-Boarding

Privacy

Functionality

Centralized

Partitioned

Permissioned DLT

Permissionless Blockchain

Banked

Unbanked

Strong

Pseudonymity

Quotas

Anonymity

Confidentiality

Payments

Decentralized Applications (DApps)

Interoperability

Long-term Dependence

Short-Term Dependence

No Dependence

Free-Floating

Central Bank Deposit

Central Bank Withdrawal

MSB Deposit/Withdrawal

Legacy

Expansive

Flat

Distintermediated

Double-spend Prevention

Double-spend Detection

Tokens

Accounts

- **Would you use a CBDC personally?**
- **Which stakeholders do you expect would want CBDCs? Which do not want one?**
- **What do you expect in terms of privacy?**
  
- **Any other thoughts...?**