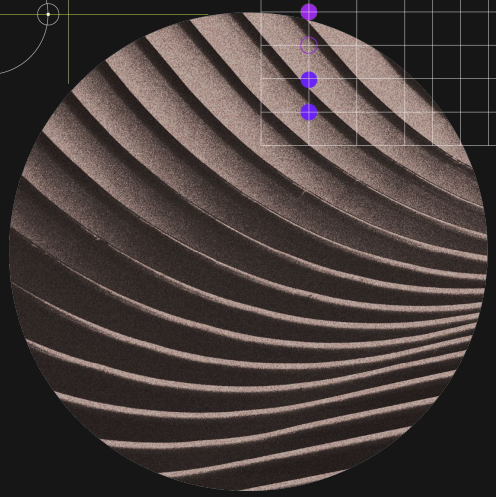

0xcbf0b0c0000000000
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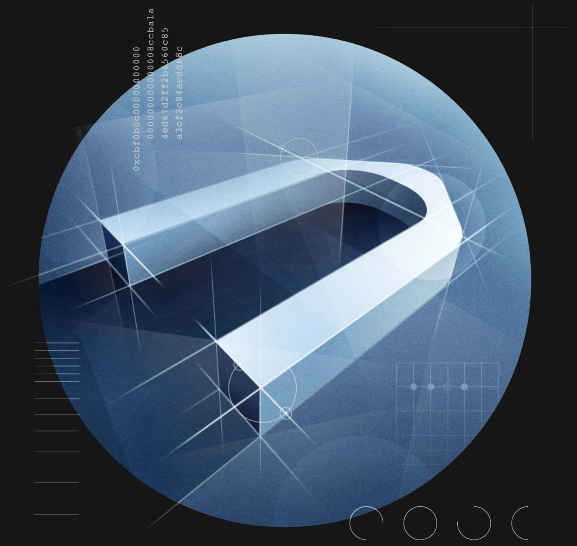
Thanks for all the bugs!

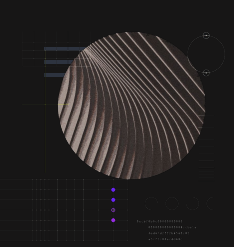
Yannis Smaragdakis

DEDAUB



DEDAUB

contract-library.com



Our Research and Technology

- Static Analysis
  - trying to create a model of all possible program behaviors
- All analyses specified declaratively
  - logical rules (thousands of them)

```
LoopBoundBy(loop, var) ←
  InductionVar(i, loop),
  !InductionVar(var, loop),
  Flows(var, condVar),
  Flows(i, condVar),
  LoopExitCond(condVar, loop).
```

Vulnerability Disclosures

Vulnerability Disclosures (since 2021)

Yield Skimming: Forcing Bad Swaps on Yield Farming

Vulnerability Disclosures (since 2021)

Yield Skimming: Forcing
Swaps on Yield Farming

Inside the War Room That Saved Primitive Finance

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Vulnerability Disclosures (since 2021)

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"Look ma', no source!" Hacking a DeFi Service with No Source Code Available

Vulnerability Disclosures (since 2021)

Ethereum Pawn Stars: “$5.7M in hard assets? Best I can do is $2.3M”

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Vulnerability Disclosures (since 2021)

Ethereum Pawn Stars: “$5
hard assets? Best I can do i
$2.3M”

Killing a Bad (Arbitrage) Bot

... to save its owners

urce!” Hacking a
n No Source

Vulnerability Disclosures (since 2021)

Ethereum Pawn Stars: “$5
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$2.3M”

Vulnerability Disclosures (since 2021)

Phantom Functions and the Billion-Dollar No-op

By the Dedaub team

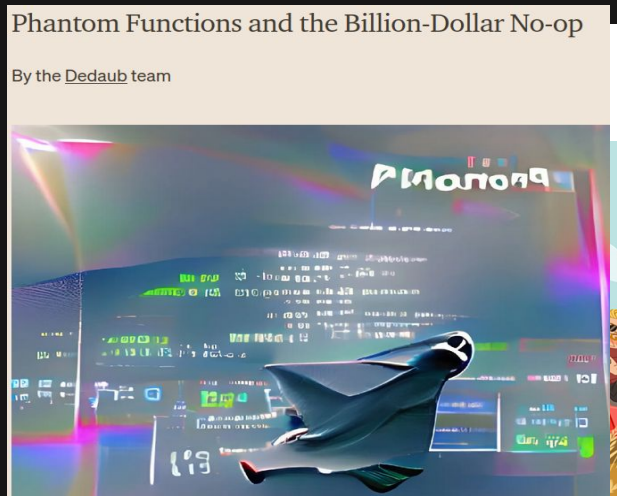
Harvest Finance

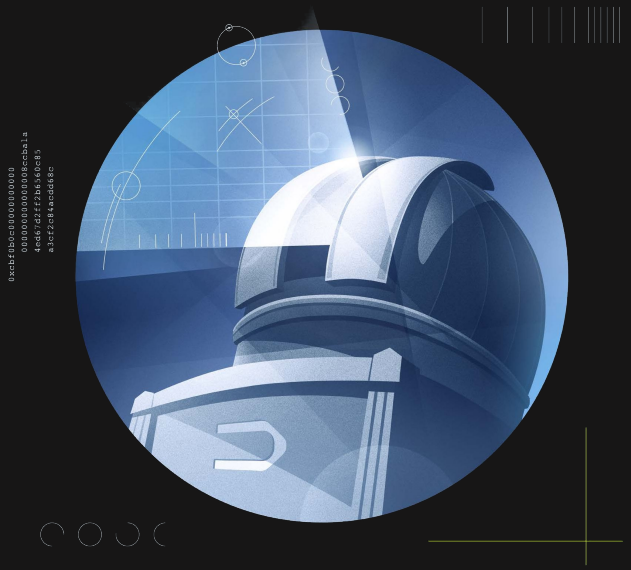
Uninitialized Proxies

Bug Fix Postmortem

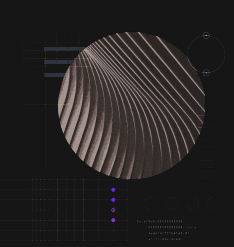
Vulnerability Disclosures (since 2021)

- Several major security vulnerabilities, 9 bug bounties of ~$3M total
  - by DeFi Saver, Dinngo/Furucombo, Primitive, Armor, Vesper, BT Finance, Harvest, Multichain/Anyswap, Rari/Tribe DAO



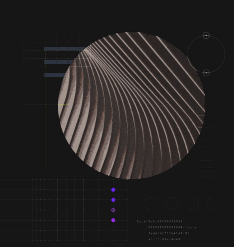


Solidity/EVM Traps



Solidity/EVM Traps: `this`

- In most OO languages
  `this.fun();`
  and
  `fun();`
  are synonyms



Solidity/EVM Traps: `this`

- In most OO languages
  `this.fun();`
  and
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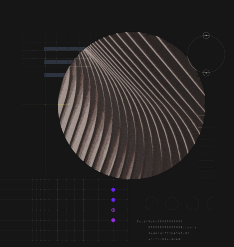
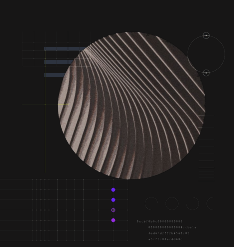
  are synonyms

- Not in Solidity: external call, `msg.sender` changes



Solidity/EVM Traps: Phantom Functions

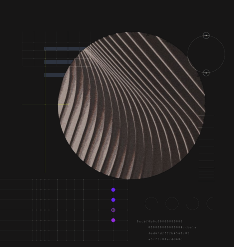
- The source of our largest vulnerability to date
  - >$1B value



The Billion-Dollar Bug

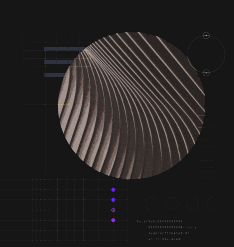
```
function deposit() external { …
  underlying.transferFrom(msg.sender, this, amount);
  …
}

function depositWithPermit(…) external {
  underlying.permit(…, v, r, s);
  underlying.transferFrom(target, this, amount);
}
```



Phantom Permit (in WETH9)

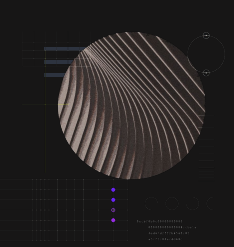
```
function() public payable {
  deposit();
}
```



Phantom Permit (in WETH9)

```
function() public payable {
  deposit();  // not reverting
}
```

A phantom function is one that the contract does not define but accepts calls to it without reverting



The Billion-Dollar Bug

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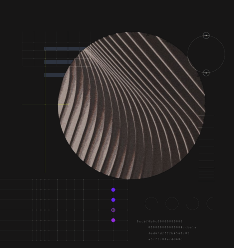
}

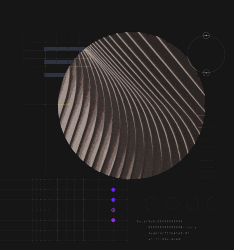
function depositWithPermit(…) external {
  underlying.permit(…, v, r, s);
  underlying.transferFrom(target, this, amount);
}
```

Writing
~~Correct~~
~~Secure~~
Well-Auditable
Code



Unpleasant Truth #1

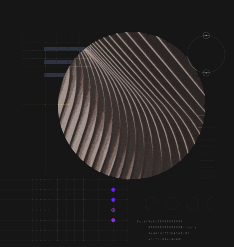
- *Not all audits are equal:*
  there is a wide range in the auditors' confidence
  - an audit stops when the time allotted is over, not when confidence is 100%
    - *confidence is never 100%*



Lots of Good Practices for High Audit Confidence

- Documentation
- Comments!
- Informative variable names
- Well-tested code
- Good communication channel

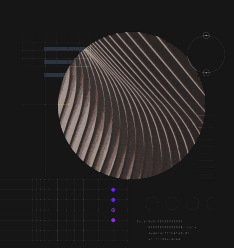
Most top-quality projects do ok in all these



Big Difference-Maker: Invariants

Properties that should hold no matter what

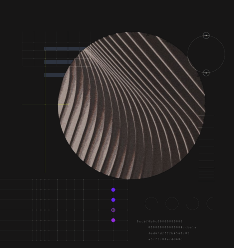
- Temporal/State:
  - “*we only get here with* `lock` *called before*”
  - “*only reachable from methods called by the hub*”
  - “*no ETH balance to remain here*”



Big Difference-Maker: Invariants

Properties that should hold no matter what

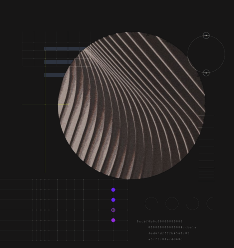
- Functional
  - “*denominated in the last of the tokens in the array*”
  - “*if positive it means input amt, if negative, output*”
  - “*e5 scale*”



Big Difference-Maker: Invariants

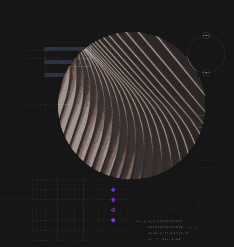
Properties that should hold no matter what

- Structural
  - “*strategies have to override functions* `reinvest` *and* `reportProfit`”
  - “*if a strategy issues rewards, it should override the* `rewardToken` *function AND the* `rewardRate` *function*”



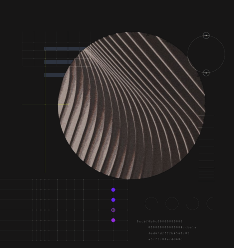
Example Documentation/Invariants

- `subUntilZero(x,y)`
  // returns pair of two elements:
  // (how much is left of x if we subtract y,
  // how much are we missing from x to reach y).
  // One of the two is zero
- `t.liquidityLowerD8`
  // A delta of how much liquidity is added when crossing
  // this tick left to right. Meaning, we go from tick `t-1`, to `t`,
  // we add this much to `currentLiquidity`



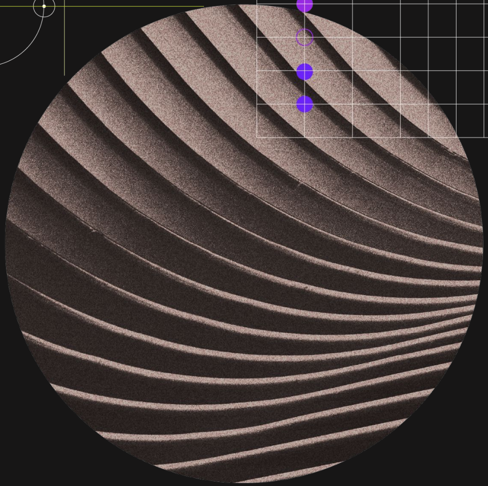
Invariants

- `liquidityOutside`
  // “outside” = the region from the tick to infinity (positive
  // or negative) *away* from the current tick.
  // E.g., if the current tick is below tick t, then “outside” is
  // from t to positive infinity. If it’s above,
  // “outside” is from negative infinity to t.
- `curRewardAmount`
  // rewards per token accumulated since the beginning
  // of time, both paid out and not



Unpleasant Truth #2

- *Auditors are not owners of your project, you are!*
  - the auditor can help you see things differently
  - but you have to follow the questions deeply yourself, not do the least possible just to dismiss them



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00000000000008ccba1a
4ed67d2ff2b6560c85
a3cf2c84acdd68c

Thanks for all the bugs!

Yannis Smaragdakis

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