



Three Sigma

Code Audit



CodeUP DeFi game based on an Ethereum story

Disclaimer

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Disclaimer

The ensuing audit offers no assertions or assurances about the code's security. It cannot be deemed an adequate judgment of the contract's correctness on its own. The authors of this audit present it solely as an informational exercise, reporting the thorough research involved in the secure development of the intended contracts, and make no material claims or guarantees regarding the contract's post-deployment operation. The authors of this report disclaim all liability for all kinds of potential consequences of the contract's deployment or use. Due to the possibility of human error occurring during the code's manual review process, we advise the client team to commission several independent audits in addition to a public bug bounty program.

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Summary

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Summary

Three Sigma audited CodeUP in a 1 person week engagement. The audit was conducted from 23-10-2024 to 27-10-2024.

Protocol Description

CODE UP is a DeFi game where players build towers with different floors, hiring builders with various skills to develop Ethereum 2.0. Builders reside on these floors and generate gameETH. By accumulating 40 builders, players receive a special ERC20 token called Codeup (CUP) as a reward. The game combines tower-building strategy with DeFi elements within the Ethereum ecosystem.

Scope

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Scope

| Filepath | nSLOC |
|---------------------|------------|
| src/Codeup.sol | 357 |
| src/CodeupERC20.sol | 14 |
| Total | 371 |

Assumptions

External libraries such as Solmate are considered safe.

Methodology

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Methodology

To begin, we reasoned meticulously about the contract's business logic, checking security-critical features to ensure that there were no gaps in the business logic and/or inconsistencies between the aforementioned logic and the implementation. Second, we thoroughly examined the code for known security flaws and attack vectors. Finally, we discussed the most catastrophic situations with the team and reasoned backwards to ensure they are not reachable in any unintentional form.

Taxonomy

In this audit we report our findings using as a guideline Immunefi's vulnerability taxonomy, which can be found at immunefi.com/severity-updated/. The final classification takes into account the severity, according to the previous link, and likelihood of the exploit. The following table summarizes the general expected classification according to severity and likelihood; however, each issue will be evaluated on a case-by-case basis and may not strictly follow it.

| Severity / Likelihood | LOW | MEDIUM | HIGH |
|-----------------------|--------|----------|----------|
| NONE | None | | |
| LOW | Low | | |
| MEDIUM | Low | Medium | Medium |
| HIGH | Medium | High | High |
| CRITICAL | High | Critical | Critical |

Project Dashboard

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Project Dashboard

Application Summary

| | |
|----------|---|
| Name | CodeUP |
| Commit | e5b84d00a3d87195f2ab225e9a16c371ac6c803c |
| Language | Solidity |
| Platform | Arbitrum, Ethereum, Optimism, Base, Polygon |

Engagement Summary

| | |
|----------------|--------------------------|
| Timeline | 23-10-2024 to 27-10-2024 |
| Nº of Auditors | 2 |
| Review Time | 1 person week |

Vulnerability Summary

| Issue Classification | Found | Addressed | Acknowledged |
|----------------------|-------|-----------|--------------|
| Critical | 3 | 3 | 0 |
| High | 1 | 1 | 0 |
| Medium | 1 | 1 | 0 |
| Low | 2 | 2 | 0 |

| | | | |
|------|---|---|---|
| None | 5 | 4 | 1 |
|------|---|---|---|

Category Breakdown

| | |
|---------------------|---|
| Suggestion | 3 |
| Documentation | 0 |
| Bug | 5 |
| Optimization | 2 |
| Good Code Practices | 2 |

Code Maturity Evaluation

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Code Maturity Evaluation

Code Maturity Evaluation Guidelines

| Category | Evaluation |
|--------------------------|---|
| Access Controls | The use of robust access controls to handle identification and authorization and to ensure safe interactions with the system. |
| Arithmetic | The proper use of mathematical operations and semantics. |
| Centralization | The presence of a decentralized governance structure for mitigating insider threats and managing risks posed by contract upgrades |
| Code Stability | The extent to which the code was altered during the audit. |
| Upgradeability | The presence of parameterizations of the system that allow modifications after deployment. |
| Function Composition | The functions are generally small and have clear purposes. |
| Front-Running | The system's resistance to front-running attacks. |
| Monitoring | All operations that change the state of the system emit events, making it simple to monitor the state of the system. These events need to be correctly emitted. |
| Specification | The presence of comprehensive and readable codebase documentation. |
| Testing and Verification | The presence of robust testing procedures (e.g., unit tests, integration tests, and verification methods) and sufficient test coverage. |

Code Maturity Evaluation Results

| Category | Evaluation |
|--------------------------|--|
| Access Controls | Satisfactory. The codebase has a strong access control mechanism. |
| Arithmetic | Moderate. The codebase uses Solidity version >0.8.0, but some rounding issues were found. |
| Centralization | Satisfactory. The protocol has no centralization points. |
| Code Stability | Satisfactory. The codebase was stable during the course of the audit. |
| Upgradeability | Weak. The price feed is not upgradeable. |
| Function Composition | Satisfactory. Functionality is well split into different helpers. |
| Front-Running | Satisfactory. No front-running issues were found. |
| Monitoring | Satisfactory. Events were correctly emitted. |
| Specification | Satisfactory. The code matched the design specifications. |
| Testing and Verification | Satisfactory. Tests were present for most functionality. |

Findings

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Findings

3S-CodeUP-C01

Codeup::claimCodeupERC20() may be forever DoSed by creating the **Uniswap** pool before it is called

| | |
|----------------|---|
| Id | 3S-CodeUP-C01 |
| Classification | Critical |
| Severity | Critical |
| Likelihood | High |
| Category | Bug |
| Status | Addressed in #4864ad9 . |

Description

Uniswap pools may be created without the underlying tokens existence, which means that someone may do this before **Codeup::claimCodeupERC20()** is ever called, making it revert when **UniswapV2Factory::createPair()** is called as the pool has already been created.

Recommendation

UniswapV2Router::addLiquidity() creates the pool if it does not yet exist, so there is no need to directly create it. The only concern is setting the **uniswapV2Pool** variable, which may be performed for example by doing:

```
...
if (uniswapV2Pool == address(0)) {
    ... // added liquidity
    uniswapV2Pool = IUniswapV2Factory(uniswapV2Factory).getPair(
        wethMemory,
        codeupERC20Memory
    );
    emit PoolCreated(uniswapV2Pool);
...
}
```

3S-CodeUP-C02

tower.gameETHForWithdraw should be reduced pro-rata when there is not enough **ETH**

| | |
|----------------|---|
| Id | 3S-CodeUP-C02 |
| Classification | Critical |
| Severity | Critical |
| Likelihood | High |
| Category | Bug |
| Status | Addressed in #31359b8 . |

Description

Codeup::withdraw() and **Codeup::reinvest()** cap the withdrawn amount to the available **ETH** balance, but always set the **tower.gameETHForWithdraw** to **0**, which means that a user can have a significant amount of **gameETH** for withdraw, but due to the contract having low **ETH** balance, most of these funds could be lost.

This is relevant because blockchains often have concurrency issues, which means, for example, 2 users trying to withdraw more than the contract balance at the same time could lead to one of them getting much less **ETH** than expected.

Recommendation

When there is not enough **ETH**, **tower.gameETHForWithdraw** should be reduced by the **amount** before subtracting the commission divided by the price, rounded up.

3S-CodeUP-C03

Total **ETH**, **WETH** and **gameETH** are not tracked which will lead to insolvency

| | |
|----------------|---|
| Id | 3S-CodeUP-C03 |
| Classification | Critical |
| Severity | Critical |
| Likelihood | High |
| Category | Bug |
| Status | Addressed in #6020c6f . |

Description

Users may upgrade their towers so they receive **gameETH** over time which can later be withdrawn for **ETH**. However, there is no actual tracking in either of the funds, which means that eventually once users stop entering the protocol, there will not be enough ETH to pay everyone for their yield. A [poc](#) was created showing that after just **16** hours a user receives more **ETH** as yield than their initial deposit when buying **gameETH**.

Thus, initial users that upgrade their towers will just get all yield very quickly from new users, eventually making the protocol insolvent as everyone has yield to claim but nobody wants to deposit.

Another related concern is that users have no option to withdraw their **gameETH**, even if they have for example upgraded their towers to the max level. It does not make sense to ever deposit more than the max cost to upgrade all builders.

Lastly, the remaining **weth** balance will be impossible to withdraw because the last user that has upgraded their towers to the max builders will withdraw these funds and pay a commision to the pool in **amountForPool**, which will never be recovered.

Recommendation

Users not being able to always get their yield due to the contract not having enough eth is a design choice, as users need to be quick to claim their yield. However, it never makes sense to add more game eth than the amount left needed to fully upgrade their tower, so a check could be added. Additionally, a way to add as liquidity the last weth from commisions should be added.

3S-CodeUP-H01

Significant rounding errors due to **gameETH** not having precision

| | |
|----------------|---|
| Id | 3S-CodeUP-H01 |
| Classification | High |
| Severity | High |
| Likelihood | Medium |
| Category | Bug |
| Status | Addressed in #a5bd528 . |

Description

In **Codeup::addGameETH()** and **Codeup::reinvest()**, **gameETH** is obtained as **gameETH = amount / gameETHPrice**, which means there may be rounding errors. **gameETH** has no decimals as can be confirmed by the return values of **Codeup::_getUpgradePrice()** and **Codeup::_getYield()**, which have no extra precision.

Thus, as **gameETHPrice** may be a big value - currently **1e12** in the tests, the rounding error may be up to **1e12 - 1**, which is approx **0.0023 USD**. If the price is increased, the rounding error grow to bigger values causing significant loss of funds for users.

Recommendation

Add some precision to **gameETH** by scaling the values in the functions **Codeup::_getUpgradePrice()** and **Codeup::_getYield()** and decreasing the **gameETHPrice** so **gameETH** inherits the decimals of **ETH**.

3S-CodeUP-M01

Codeup::claimCodeupERC20() may revert whenever the **weth** balance is very low

| | |
|----------------|---|
| Id | 3S-CodeUP-M01 |
| Classification | Medium |
| Severity | Medium |
| Likelihood | Medium |
| Category | Bug |
| Status | Addressed in #389b655 . |

Description

Codeup::claimCodeupERC20() adds liquidity to the **Uniswap** pool whenever the **weth** balance is bigger than **1**. However, an amount bigger than **1** may still lead to reverts if it is low enough. If it is exactly 1, it will shift right to get the amount of **weth** to swap for **CodeupERC20**, trying to swap an amount of **0** and reverting. If it is bigger than 2, but still low, it may swap this for an even smaller amount of **CodeupERC20**, reverting when adding liquidity due to not providing enough liquidity to mint a single share.

A [poc](#) is available to confirm the finding.

Recommendation

Instead of setting **1**, a slightly bigger dust amount could be used to ensure it does not revert.

3S-CodeUP-L01

Codeup::claimCodeupERC20() is vulnerable to sandwich attacks

| | |
|----------------|---|
| Id | 3S-CodeUP-L01 |
| Classification | Low |
| Severity | Low |
| Likelihood | Low |
| Category | Suggestion |
| Status | Addressed in #4168f79 . |

Description

Codeup::claimCodeupERC20() does not set minimum values for adding liquidity or swapping (sets 0) and places a deadline of **block.timestamp**, which means mev bots may sandwich these calls for profit for the protocol's loss.

Recommendation

Send the minimum amounts as an argument as well as the deadline.

3S-CodeUP-L02

Missing key zero value check

| | |
|----------------|---|
| Id | 3S-CodeUP-L02 |
| Classification | Low |
| Severity | Low |
| Likelihood | Low |
| Category | Suggestion |
| Status | Addressed in #f32b6f5 . |

Description

`gameETHForWithdrawRate` is set in `Codeup::constructor()` to `_gameETHPrice / 1000` but a zero check is missing.

Recommendation

Add the `_checkValue()` function to `gameETHForWithdrawRate = _checkValue(_gameETHPrice / 1000)`.

3S-CodeUP-N01

Unused **TransferFailed** error in **CodeupERC20**

| | |
|----------------|---|
| Id | 3S-CodeUP-N01 |
| Classification | None |
| Category | Optimization |
| Status | Addressed in #094b944 . |

Description

The **TransferFailed** error in **CodeupERC20** is not used and can be removed.

Recommendation

Remove this error.

3S-CodeUP-N02

Ownable is unused in **CodeupERC20** and could be removed

| | |
|----------------|---------------|
| Id | 3S-CodeUP-N02 |
| Classification | None |
| Category | Optimization |
| Status | Acknowledged |

Description

CodeupERC20 inherits **Ownable** but does not use any of its functionalities.

Recommendation

Remove **Ownable** as it is not used.

3S-CodeUP-N03

All functions could have a **started** modifier as they should not be called before the start time

| | |
|----------------|---|
| Id | 3S-CodeUP-N03 |
| Classification | None |
| Category | Suggestion |
| Status | Addressed in #b50f821 . |

Description

Only `Codeup::addGameETH()` checks if the protocol has started in `require(block.timestamp > startUNIX, NotStarted());`, but the same checks could be applied to the remaining functions. Although this presents no vulnerability as these functions will not do anything before adding `gameETH`, it is a good practice to prevent unwanted behaviours.

Recommendation

Create a modifier having `require(block.timestamp > startUNIX, NotStarted());` and place it in all functions.

3S-CodeUP-N04

Hardcoded values present in the codebase

| | |
|----------------|---|
| Id | 3S-CodeUP-N04 |
| Classification | None |
| Category | Good Code Practices |
| Status | Addressed in #9734cd9 . |

Description

Hardcoded values should be avoided for better readability.

Recommendation

The following instances were found: ([tokenAmount * 10](#)) / 100 (1, 2),
[Codeup::__syncTower\(\)](#), [Codeup::__getUpgradePrice\(\)](#), [Codeup::__getYield\(\)](#)

3S-CodeUP-N05

Typos in the codebase

| | |
|----------------|---|
| Id | 3S-CodeUP-N05 |
| Classification | None |
| Category | Good Code Practices |
| Status | Addressed in #8f66046 . |

Description

There are typos in the codebase that could be fixed.

Recommendation

The following instances were found: [available](#), [spend](#), [luqidity](#), [spended](#), [emitted](#) ([1](#), [2](#), [3](#), [4](#), [5](#), [6](#), [7](#), [8](#), [9](#), [10](#), [11](#)), hrs (should be [mins](#), [1](#), [2](#)), [totallInvestedBedore](#).