CyStack

PUBLIC ACCESS

CYBERSECURITY AUDIT REPORT

Version v1.2

This document details the process and results of the smart contract audit performed independently by CyStack from 03/11/2021 to 10/11/2021.

Audited for

Rice Token

Audited by

Vietnam CyStack Joint Stock Company

Contents

Independent Audit Report Disclaimer

This document is an independent smart contract audit report, which is the result of CyStack's independent security assessment for a smart contract. This conducted audit strictly follows terms and conditions, publicly stated by the smart contract issuer.

Disclaimer

Smart Contract Audit only provides findings and recommendations for an exact commitment of a smart contract codebase. The results, hence, is not guaranteed to be accurate outside of the commitment, or after any changes or modifications made to the codebase. The evaluation result does not guarantee the nonexistence of any further findings of security issues.

Time-limited engagements do not allow for a comprehensive evaluation of all security controls, so this audit does not give any warranties on finding all possible security issues of the given smart contract(s). CyStack prioritized the assessment to identify the weakest security controls an attacker would exploit. We recommends Rice Decentralized Finance ecosystem conducting similar assessments on an annual basis by internal, third-party assessors, or a public bug bounty program to ensure the security of smart contract(s).

This security audit should never be used as an investment advice.

Version History

Version	Date	Status/Change
1.0	07/11/2021	Confidential Report with Open Issues
1.1	09/11/2021	Confidential Report with Unresolved Issues
1.2	10/11/2021	Public Access Report with Unresolved Issues

Auditors

Fullname	Role	Email address	Phone number
Nguyen Huu Trung	Head of Security	trungnh@cystack.net	(+84) 974 914 322
Ha Minh Chau	Auditor		
Vu Hai Dang	Auditor		
Nguyen Van Huy	Auditor		
Nguyen Trung Huy Son	Auditor		
Nguyen Ba Tuan Anh	Auditor		

Introduction

From 03/11/2021 to 10/11/2021, CyStack independently evaluated the security posture of the smart contract Rice Token from the Rice Decentralized Finance ecosystem. Our findings and recommendations are detailed here in this initial report.

NOTE: The report will be continually updated to correctly reflect the mitigation and remediation state of each finding.

1.1 Audit Details

Audit Target

Rice Token (RICE) is a utility token that can only be used within the Rice Wallet application and the Rice Decentralized Finance ecosystem.

Rice Wallet is a decentralized financial application that allows users to store and manage their digital assets with absolute control (private key or seed phrase). Besides, Rice Wallet will help make it easier for investors to access the decentralized financial (Defi) market. With the carefully selected decentralized applications (Dapps) and customized UX/UI such as Swap (DEX), Staking, Investing, Pooling, etc you can explore the entire Defi market from one place.

The basic information of RICE is as follows:

Item	Description
Project Name	Rice Token
Issuer	Rice Decentralized Finance ecosystem
Website	https://ricewallet.io/
Platform	Ethereum Smart Contract
Language	Solidity
Codebase	https://etherscan.io/address/0xBCD515D6C5de70D3A31D999A7FA6a299657De294#code
Commit	N/A
Audit method	Whitebox

Audit Service Provider

CyStack is a leading security company in Vietnam with the goal of building the next generation of cybersecurity solutions to protect businesses against threats from the Internet. CyStack is a member of Vietnam Information Security Association (VNISA) and Vietnam Alliance for Cybersecurity Products Development.

CyStack's researchers are known as regular speakers at well-known cybersecurity conferences such as BlackHat USA, BlackHat Asia, Xcon, T2FI, etc. and are talented bug hunters who discovered critical vulnerabilities in global products and acknowledged by their vendors.

1.2 Audit Goals

The focus of the audit was to verify that the smart contract system is secure, resilient and working according to its specifications. The audit activities can be grouped in the following three categories:

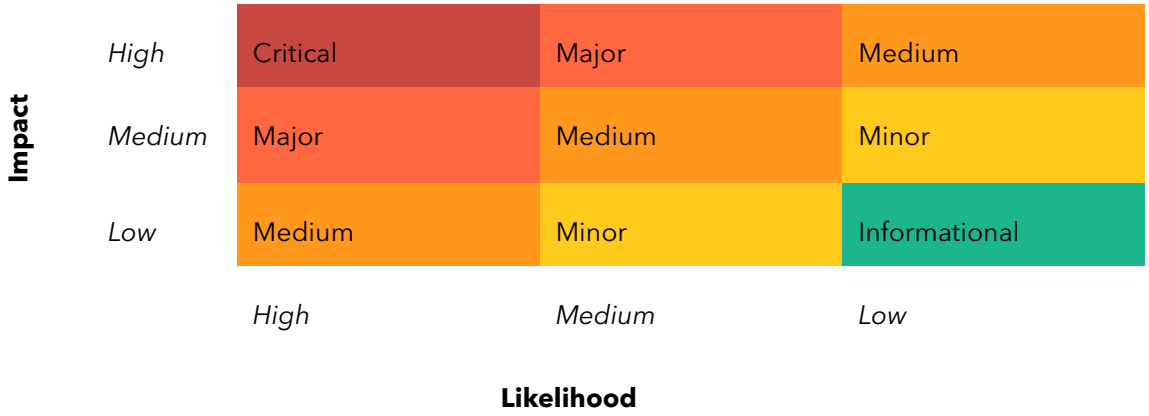
1. **Security:** Identifying security related issues within each contract and within the system of contracts.
2. **Sound Architecture:** Evaluation of the architecture of this system through the lens of established smart contract best practices and general software best practices.
3. **Code Correctness and Quality:** A full review of the contract source code. The primary areas of focus include:
    - Correctness
    - Readability
    - Sections of code with high complexity
    - Improving scalability
    - Quantity and quality of test coverage

1.3 Audit Methodology

To standardize the evaluation, we define the following terminology based on OWASP Risk Rating Methodology:

- **Likelihood** represents how likely a particular vulnerability is to be uncovered and exploited in the wild;
- **Impact** measures the technical loss and business damage of a successful attack;
- **Severity** demonstrates the overall criticality of the risk.

Likelihood and impact are categorized into three ratings: High, Medium and Low, i.e., H, M and L respectively. Severity is determined by likelihood and impact and can be classified into four categories accordingly, i.e., Critical, Major, Medium, Minor and Informational (Info) as the table below:



CyStack firstly analyses the smart contract with open-source and also our own security assessment tools to identify basic bugs related to general smart contracts. These tools include Slither, securify, Mythril, Sūrya, Solgraph, Truffle, Geth, Ganache, Mist, Metamask, solhint, mythx, etc. Then, our security specialists will verify the tool results manually, make a description and decide the severity for each of them.

After that, we go through a checklist of possible issues that could not be detected with automatic tools, conduct test cases for each and indicate the severity level for the results. If no issues are found after manual analysis, the contract can be considered safe within the test case. Else, if any issues are found, we might further deploy contracts on our private testnet and run tests to confirm the findings. We would additionally build a PoC to demonstrate the possibility of exploitation, if required or necessary.

The standard checklist, which applies for every SCA, strictly follows the Smart Contract Weakness Classification Registry (SWC Registry). SWC Registry is an implementation of the weakness classification scheme proposed in The Ethereum Improvement Proposal project under the code EIP-1470. The checklist of testing according to SWC Registry is shown in Appendix A.

In general, the auditing process focuses on detecting and verifying the existence of the following issues:

- **Coding Specification Issues:** Focusing on identifying coding bugs related to general smart contract coding conventions and practices.
- **Design Defect Issues:** Reviewing the architecture design of the smart contract(s) and working on test cases, such as self-DoS attacks, incorrect inheritance implementations, etc.
- **Coding Security Issues:** Finding common security issues of the smart contract(s), for example integer overflows, insufficient verification of authenticity, improper use of cryptographic signature, etc.
- **Coding Design Issues:** Testing the code logic and error handlings in the smart contract code base, such as initializing contract variables, controlling the balance and flows of token transfers, verifying strong randomness, etc.
- **Coding Hidden Dangers:** Working on special issues, such as data privacy, data reliability, gas consumption optimization, special cases of authentication and owner permission, fallback functions, etc.

For better understanding of found issues' details and severity, each SWC ID is mapped to the most closely related Common Weakness Enumeration (CWE) ID. CWE is a category system for software weaknesses and vulnerabilities to help identify weaknesses surrounding software jargon. The list in Appendix B provides an overview on specific similar software bugs that occur in Smart Contract coding.

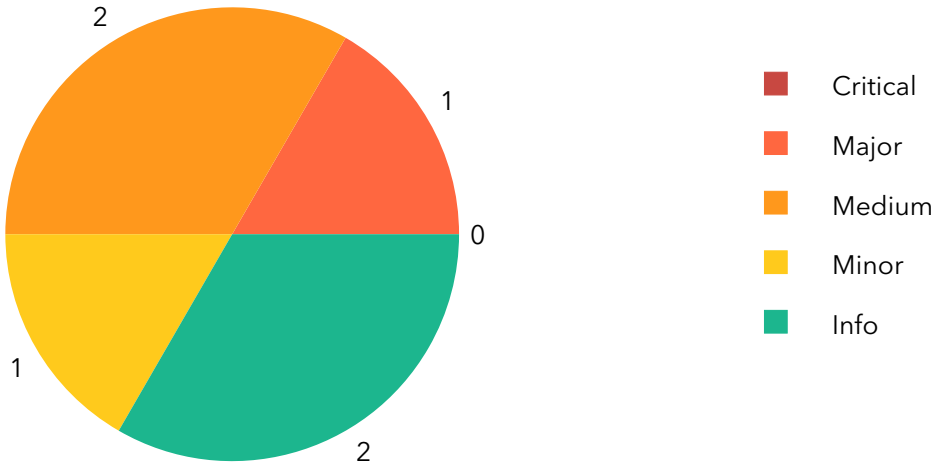
The final report will be sent to the smart contract issuer with an executive summary for overview and detailed results for acts of remediation.

1.4 Audit Scope

Assessment	Details	Type
White-box testing	RICEToken.sol	Solidity code file

Executive Summary

Security issues by severity



Security issues by SWC

Integer Overflow and Underflow (SWC-101)	1
State Variable Default Visibility (SWC-108)	1
Requirement Violation (SWC-123)	1
Incorrect Inheritance Order (SWC-125)	1
DoS With Block Gas Limit (SWC-128)	1
Unexpected Ether Balance (SWC-132)	1

Security issues by CWE

Uncontrolled Resource Consumption (CWE-400)	1
Improper Following of Specification by Caller (CWE-573)	1
Improper Locking (CWE-667)	1
Incorrect Calculation (CWE-682)	1
Incorrect Behavior Order (CWE-696)	1
Improper Adherence to Coding Standards (CWE-710)	1

Table of security issues

ID	Status	Vulnerability	Severity
#rice-001	Unresolved	Logical issue of *transferWithLock()*	MAJOR
#rice-002	Unresolved	Unbound release date	MEDIUM
#rice-003	Unresolved	Division before multiplication	MEDIUM
#rice-004	Unresolved	Passable *pause()* on transfers of tokens	MINOR
#rice-005	Unresolved	Missing Mutability Specifiers	INFO
#rice-006	Unresolved	Missing Error Messages	INFO

Recommendations

Based on the results of this smart contract audit, CyStack has the following high-level key recommendations:

Key recommendations	
Issues	CyStack has conducted SCA for Rice Token and detected some significant issues that require immediate acts of mitigation, listed below: • Several functions can be executed without checking essential conditions. • Variables are initialized and *require()* is called without considering of optimization. • Math operations are incorrectly performed.
Recommendations	• Carefully check for conditions with *require()* before every function execution. • Optimize the use of variables and *require()*. • Perform math operation correctly, this could be improve by using publicly provided math libraries.
References	• https://consensys.github.io/smart-contract-best-practices/known_attacks • https://consensys.github.io/smart-contract-best-practices/recommendations/ • https://media.consensys.net/when-to-use-revert-assert-and-require-in-solidity-61fb2c0e5a57

Detailed Results

1. Logical issue of *transferWithLock()*

Issue ID	#rice-001
Category	SWC-132 - Unexpected Ether Balance
Description	By the function *transferWithLock()*, any members of the FoundingTeam, PrivateSales, or the owner are allowed to send tokens without verifying whether they are locked or unlocked. Moreover, members with the mentioned roles can send tokens to themselves.
Severity	MAJOR
Location(s)	RICEToken.sol:974~984
Status	Unresolved
Reference	CWE-667 - Improper Locking
Remediation	Revise the design and implementation of the function *transferWithLock()*. Improve centralized privileges or roles in the protocol via a decentralized mechanism, e.g., via multisignature wallet.

Description

The codelines where the issue occurs:

```
…
974     function transferWithLock(address _receiver, uint256 _amount, uint256
        ↪  _releaseDate) public returns (bool success) {
975         require(msg.sender == FoundingTeam || msg.sender == PrivateSales || msg.sender
            ↪  == owner());
976         ERC20._transfer(msg.sender,_receiver,_amount);
977
978         if (lockList[_receiver].length==0) lockedAddressList.push(_receiver);
979
980         LockTime memory item = LockTime({amount:_amount, releaseDate:_releaseDate});
981         lockList[_receiver].push(item);
982
983         return true;
984     }
…
```

The amount of locked tokens stored in *lockList[_receiver]*, with a sufficiently high release date, is used by the *getLockedAmount()* function to compute the *getAvailableBalance()* function, which checks if a transfer can take place. If a privileged member sends too much token to himself/herself, the locked amount of that member will be falsely increased, so *getAvailableBalance()* will be reverted due to a subtraction overflow. In consequence, *transfer()* and *transferFrom()* will become unworkable with the member address as a sender. This problem can also happen if two or more privileged members make token transfers between themselves in a certain way, using this function.

The code can be revised as following:

```
…
974     function transferWithLock(address _receiver, uint256 _amount, uint256
        ↪ _releaseDate) public returns (bool success) {
975         require(msg.sender == FoundingTeam || msg.sender == PrivateSales || msg.sender
            ↪ == owner());
976         require(getAvailableBalance(_msgSender()) >= _amount, "transferWithLock:
            ↪ transfer amount exceeds available balance ");
977         ERC20._transfer(msg.sender,_receiver,_amount);
978
979         if (lockList[_receiver].length==0) lockedAddressList.push(_receiver);
980
981         LockTime memory item = LockTime({amount:_amount, releaseDate:_releaseDate});
982         lockList[_receiver].push(item);
983
984         return true;
985     }
…
```

2. Unbound release date

Issue ID	#rice-002
Category	SWC-128 - DoS With Block Gas Limit
Description	The function *transferWithLock()* allows members of the FoundingTeam, PrivateSales and the owner to transfer and block a quantity of tokens for a certain period of time. However, since *_releaseDate* has no upper bound, tokens could be blocked for an extremely long time.
Severity	MEDIUM
Location(s)	RICEToken.sol:974~984
Status	Unresolved
Reference	CWE-400 - Uncontrolled Resource Consumption
Remediation	Set an upper bound to *_releaseDate* in the function *transferWithLock()* to avoid extreme dates.

Description

The codelines where the issue occurs:

```
…
974     function transferWithLock(address _receiver, uint256 _amount, uint256
        ↪ _releaseDate) public returns (bool success) {
975         require(msg.sender == FoundingTeam || msg.sender == PrivateSales || msg.sender
            ↪ == owner());
976         ERC20._transfer(msg.sender,_receiver,_amount);
977
978         if (lockList[_receiver].length==0) lockedAddressList.push(_receiver);
979
980         LockTime memory item = LockTime({amount:_amount, releaseDate:_releaseDate});
981         lockList[_receiver].push(item);
982
983         return true;
984     }
…
```

3. Division before multiplication

Issue ID	#rice-003
Category	SWC-101 - Integer Overflow and Underflow
Description	In the file RICEToken.sol, division is performed before multiplication. Multiplication should be performed before division in order to avoid loss of precision.
Severity	MEDIUM
Location(s)	RICEToken.sol:1055
Status	Unresolved
Reference	CWE-682 - Incorrect Calculation
Remediation	Reorder the two operations: perform multiplication before division.

Description

The codeline where the issue occurs:

```
...
1053    function lockInvestor(uint256 investorId) public onlyOwner {
1054        for(uint y = 3; y <= 10; y++) {
1055        transferWithLock(investorsList[investorId].wallet,
            ↪ (investorsList[investorId].amount / 8) * 10 ** uint256(decimals()),
            ↪ PrivateSalesMap[y]);
1056        }
1057    }
...
```

The operations should be reorder, so that multiplication is applied before division in the calculation:

```
...
1053    function lockInvestor(uint256 investorId) public onlyOwner {
1054        for(uint y = 3; y <= 10; y++) {
1055        transferWithLock(investorsList[investorId].wallet,
            ↪ (investorsList[investorId].amount) * 10 ** uint256(decimals()) / 8,
            ↪ PrivateSalesMap[y]);
1056        }
1057    }
...
```

4. Passable *pause()* on transfers of tokens

Issue ID	#rice-004
Category	SWC-125 - Incorrect Inheritance Order
Description	The functions *transfer()* and *transferFrom()* of the RICEToken contract invoke the functions transfer() and transferFrom() from the ERC20 module. This bypasses the Pausable module from the ERC20Pausable inheritance and allows the transfer of these tokens to successfully pass even when *paused()* returns *true*.
Severity	MINOR
Location(s)	RICEToken.sol:963, 971
Status	Unresolved
Reference	CWE-696 - Incorrect Behavior Order
Remediation	Invoke *super.transfer()* and *super.transferFrom()* in the functions *transfer()* and *transferFrom()* instead of those from the ERC20 module.

Description

The codelines where the issue occurs:

```
…
960     function transfer(address _receiver, uint256 _amount) public returns (bool
        ↪ success) {
961         require(_receiver != address(0));
962         require(_amount <= getAvailableBalance(msg.sender));
963         return ERC20.transfer(_receiver, _amount);
964     }
965
966     function transferFrom(address _from, address _receiver, uint256 _amount) public
        ↪ returns (bool) {
967         require(_from != address(0));
968         require(_receiver != address(0));
969         require(_amount <= allowance(_from, msg.sender));
970         require(_amount <= getAvailableBalance(_from));
971         return ERC20.transferFrom(_from, _receiver, _amount);
972     }
…
```

If the mentioned functions were designed to be pausable, it is recommended to follows the above remediation. Otherwise, it should be clearly commented in the codebase.

5. Missing Mutability Specifiers

Issue ID	#rice-005
Category	SWC-108 - State Variable Default Visibility
Description	The linked variables are assigned to only once, either during their contract-level declaration or during the constructor's execution. This unnecessarily increases the gas cost of utilizing the variables.
Severity	INFO
Location(s)	RICEToken.sol:891, 892, 893, 894, 912, 913, 914
Status	Unresolved
Reference	CWE-710 - Improper Adherence to Coding Standards
Remediation	Optimize the gas cost involved in utilizing the variables with the use of the additional keyword *immutable* for lines 891-894 (Solidity up to and above v0.6.5.) and the use of keyword *constant* for lines 912-914 instead of *private*.

Description

The codelines where the issue occurs:

```
…
891     address FoundingTeam = 0x12B8665E7b4684178a54122e121B83CC41d9d9C3;
892     address UserAcquisition = 0xdf7E62218B2f889a35a5510e65f9CD4288CB6D6E;
893     address PublicSales = 0x876443e20778Daa70BFd2552e815A674D0aA7BF8;
894     address PrivateSales = 0x20b803C1d5C9408Bdc5D76648A6F23EB519CD2bD;
…
912     uint8 private _d = 18;
913     uint256 private totalTokens = 1000000000 * 10 ** uint256(_d);
914     uint256 private initialSupply = 600000000 * 10 ** uint256(_d);
…
```

Our recommendation:

```
…
891     address immutable FoundingTeam = 0x12B8665E7b4684178a54122e121B83CC41d9d9C3;
892     address immutable UserAcquisition = 0xdf7E62218B2f889a35a5510e65f9CD4288CB6D6E;
893     address immutable PublicSales = 0x876443e20778Daa70BFd2552e815A674D0aA7BF8;
894     address immutable PrivateSales = 0x20b803C1d5C9408Bdc5D76648A6F23EB519CD2bD;
…
912     uint8 constant _d = 18;
913     uint256 constant totalTokens = 1000000000 * 10 ** uint256(_d);
914     uint256 constant initialSupply = 600000000 * 10 ** uint256(_d);
…
```

6. Missing Error Mesages

Issue ID	#rice-006
Category	SWC-123 - Requirement Violation
Description	The *require* can be used to check for conditions and throw an exception if the condition is not met. It is better to provide a string message containing details about the error that will be passed back to the caller.
Severity	INFO
Location(s)	RICEToken.sol:962, 969, 970, 975
Status	Unresolved
Reference	CWE-573 - Improper Following of Specification by Caller
Remediation	Provide a string message containing details about the error.

Description

The codelines where the issue occurs:

```
…
962         require(_amount <= getAvailableBalance(msg.sender));
…
969         require(_amount <= allowance(_from, msg.sender));
970         require(_amount <= getAvailableBalance(_from));
…
975         require(msg.sender == FoundingTeam || msg.sender == PrivateSales || msg.sender
            ↪  == owner());
…
```

Our recommendation:

```
…
962         require(_amount <= getAvailableBalance(msg.sender), ``RICEToken: insufficient
            ↪  funds to transfer'');
…
969         require(_amount <= allowance(_from, msg.sender), ``RICEToken: allowance to
            ↪  low'');
970         require(_amount <= getAvailableBalance(_from), ``RICEToken: insufficient funds
            ↪  to transfer'');
…
975         require(msg.sender == FoundingTeam || msg.sender == PrivateSales || msg.sender
            ↪  == owner(), ``RICEToken: You're not allowed to use this function'');
…
```

Appendices

Appendix A – Security Issue Status Definitions

Status	Definition
Open	The issue has been reported and currently being review by the smart contract developers/issuer.
Unresolved	The issue is acknowledged and planned to be addressed in future. At the time of the corresponding report version, the issue has not been fixed.
Resolved	The issue is acknowledged and has been fully fixed by the smart contract developers/issuer.
Rejected	The issue is considered to have no security implications or to make only little security impacts, so it is not planned to be addressed and won't be fixed.

Appendix B – Severity Explanation

Severity	Definition
CRITICAL	Issues, considered as critical, are straightforwardly exploitable bugs and security vulnerabilities. It is advised to immediately resolve these issues in order to prevent major problems or a full failure during contract system operation.
MAJOR	Major issues are bugs and vulnerabilities, which cannot be exploited directly without certain conditions. It is advised to patch the codebase of the smart contract as soon as possible, since these issues, with a high degree of probability, can cause certain problems for operation of the smart contract or severe security impacts on the system in some way.
MEDIUM	In terms of medium issues, bugs and vulnerabilities exist but cannot be exploited without extra steps such as social engineering. It is advised to form a plan of action and patch after high-priority issues have been resolved.
MINOR	Minor issues are generally objective in nature but do not represent actual bugs or security problems. It is advised to address these issues, unless there is a clear reason not to.
INFO	Issues, regarded as informational (info), possibly relate to “guides for the best practices” or “readability”. Generally, these issues are not actual bugs or vulnerabilities. It is recommended to address these issues, if it make effective and secure improvements to the smart contract codebase.

Appendix C – Smart Contract Weakness Classification Registry (SWC Registry)

ID	Name	Description
	Coding Specification Issues	
SWC-100	Function Default Visibility	It is recommended to make a conscious decision on which visibility type (*external*, *public*, *internal* or *private*) is appropriate for a function. By default, functions without concrete specifiers are *public*.
SWC-102	Outdated Compiler Version	It is recommended to use a recent version of the Solidity compiler to avoid publicly disclosed bugs and issues in outdated versions.
SWC-103	Floating Pragma	It is recommended to lock the pragma to ensure that contracts do not accidentally get deployed using.
SWC-108	State Variable Default Visibility	Variables can be specified as being *public*, *internal* or *private*. Explicitly define visibility for all state variables.
SWC-111	Use of Deprecated Solidity Functions	Solidity provides alternatives to the deprecated constructions, the use of which might reduce code quality. Most of them are aliases, thus replacing old constructions will not break current behavior.
SWC-118	Incorrect Constructor Name	It is therefore recommended to upgrade the contract to a recent version of the Solidity compiler and change to the new constructor declaration (the keyword *constructor*).
	Design Defect Issues	
SWC-113	DoS with Failed Call	External calls can fail accidentally or deliberately, which can cause a DoS condition in the contract. It is better to isolate each external call into its own transaction and implement the contract logic to handle failed calls.

SWC-119	Shadowing State Variables	Review storage variable layouts for your contract systems carefully and remove any ambiguities. Always check for compiler warnings as they can flag the issue within a single contract.
SWC-125	Incorrect Inheritance Order	When inheriting multiple contracts, especially if they have identical functions, a developer should carefully specify inheritance in the correct order (from more /general/ to more /specific/).
SWC-128	DoS With Block Gas Limit	Modifying an array of unknown size, that increases in size over time, can lead to such a Denial of Service condition. Actions that require looping across the entire data structure should be avoided.
	Coding Security Issues	
SWC-101	Integer Overflow and Underflow	It is recommended to use safe math libraries for arithmetic operations throughout the smart contract system to avoid integer overflows and underflows.
SWC-107	Reentrancy	Make sure all internal state changes are performed before the call is executed or use a reentrancy lock.
SWC-112	Delegatecall to Untrusted Callee	Use *delegatecall* with caution and make sure to never call into untrusted contracts. If the target address is derived from user input ensure to check it against a whitelist of trusted contracts.
SWC-117	Signature Malleability	A signature should never be included into a signed message hash to check if previously messages have been processed by the contract.
SWC-121	Missing Protection against Signature Replay Attacks	In order to protect against signature replay attacks, store every message hash that has been processed by the smart contract, include the address of the contract that processes the message and never generate the message hash including the signature.
SWC-122	Lack of Proper Signature Verification	It is not recommended to use alternate verification schemes that do not require proper signature verification through *ecrecover()*.

SWC-130	Right-To-Left-Override control character (U+202E)	The character *U+202E* should not appear in the source code of a smart contract.
	Coding Design Issues	
SWC-104	Unchecked Call Return Value	If you choose to use low-level call methods (e.g. *call()*), make sure to handle the possibility that the call fails by checking the return value.
SWC-105	Unprotected Ether Withdrawal	Implement controls so withdrawals can only be triggered by authorized parties or according to the specs of the smart contract system.
SWC-106	Unprotected SELFDESTRUCT Instruction	Consider removing the self-destruct functionality. If absolutely required, it is recommended to implement a multisig scheme so that multiple parties must approve the self-destruct action.
SWC-110	Assert Violation	Consider whether the condition checked in the *assert()* is actually an invariant. If not, replace the *assert()* statement with a *require()* statement.
SWC-116	Block values as a proxy for time	Developers should write smart contracts with the notion that block values are not precise, and the use of them can lead to unexpected effects. Alternatively, they may make use oracles.
SWC-120	Weak Sources of Randomness from Chain Attributes	To avoid weak sources of randomness, use commitment scheme, e.g. RANDAO, external sources of randomness via oracles, e.g. Oraclize, or Bitcoin block hashes.
SWC-123	Requirement Violation	If the required logical condition is too strong, it should be weakened to allow all valid external inputs. Otherwise, make sure no invalid inputs are provided.
SWC-124	Write to Arbitrary Storage Location	As a general advice, given that all data structures share the same storage (address) space, one should make sure that writes to one data structure cannot inadvertently overwrite entries of another data structure.

SWC-132	Unexpected Ether balance	Avoid strict equality checks for the Ether balance in a contract.
SWC-133	Hash Collisions With Multiple Variable Length Arguments	When using *abi.encodePacked()*, it's crucial to ensure that a matching signature cannot be achieved using different parameters. Alternatively, you can simply use *abi.encode()* instead. It is also recommended to use replay protection.
	Coding Hidden Dangers	
SWC-109	Uninitialized Storage Pointer	Uninitialized local storage variables can point to unexpected storage locations in the contract. If a local variable is sufficient, mark it with *memory*, else *storage* upon declaration. As of compiler version 0.5.0 and higher this issue has been systematically resolved.
SWC-114	Transaction Order Dependence	A possible way to remedy for race conditions in submission of information in exchange for a reward is called a commit reveal hash scheme. The best fix for the ERC20 race condition is to add a field to the inputs of approve which is the expected current value and to have approve revert or add a safe approve function.
SWC-115	Authorization through tx.origin	*tx.origin* should not be used for authorization. Use *msg.sender* instead.
SWC-126	Insufficient Gas Griefing	Insufficient gas griefing attacks can be performed on contracts which accept data and use it in a sub-call on another contract. To avoid them, only allow trusted users to relay transactions and require that the forwarder provides enough gas.
SWC-127	Arbitrary Jump with Function Type Variable	The use of assembly should be minimal. A developer should not allow a user to assign arbitrary values to function type variables.

SWC-129	Typographical Error	The weakness can be avoided by performing pre-condition checks on any math operation or using a vetted library for arithmetic calculations such as SafeMath developed by OpenZeppelin.
SWC-131	Presence of unused variables	Remove all unused variables from the code base.
SWC-134	Message call with hardcoded gas amount	Avoid the use of *transfer()* and *send()* and do not otherwise specify a fixed amount of gas when performing calls. Use *.call.value(...)("")* instead.
SWC-135	Code With No Effects	It's important to carefully ensure that your contract works as intended. Write unit tests to verify correct behaviour of the code.
SWC-136	Unencrypted Private Data On-Chain	Any private data should either be stored off-chain, or carefully encrypted.

Appendix C – Related Common Weakness Enumeration (CWE)

The SWC Registry loosely aligned to the terminologies and structure used in the CWE while overlaying a wide range of weakness variants that are specific to smart contracts.

CWE IDs *, to which SWC Registry is related, are listed in the following table:

CWE ID	Name	Related SWC IDs
CWE-284	**Improper Access Control**	SWC-105, SWC-106
CWE-294	Authentication Bypass by Capture-replay	SWC-133
CWE-664	**Improper Control of a Resource Through its Lifetime**	SWC-103
CWE-123	Write-what-where Condition	SWC-124
CWE-400	Uncontrolled Resource Consumption	SWC-128
CWE-451	User Interface (UI) Misrepresentation of Critical Information	SWC-130
CWE-665	Improper Initialization	SWC-118, SWC-134
CWE-767	Access to Critical Private Variable via Public Method	SWC-136
CWE-824	Access of Uninitialized Pointer	SWC-109
CWE-829	Inclusion of Functionality from Untrusted Control Sphere	SWC-112, SWC-116
CWE-682	**Incorrect Calculation**	SWC-101
CWE-691	**Insufficient Control Flow Management**	SWC-126
CWE-362	Concurrent Execution using Shared Resource with Improper Synchronization (“Race Condition”)	SWC-114
CWE-480	Use of Incorrect Operator	SWC-129
CWE-667	Improper Locking	SWC-132
CWE-670	Always-Incorrect Control Flow Implementation	SWC-110
CWE-696	Incorrect Behavior Order	SWC-125
CWE-841	Improper Enforcement of Behavioral Workflow	SWC-107
CWE-693	**Protection Mechanism Failure**	

CWE-330	Use of Insufficiently Random Values	SWC-120
CWE-345	Insufficient Verification of Data Authenticity	SWC-122
CWE-347	Improper Verification of Cryptographic Signature	SWC-117, SWC-121
CWE-703	**Improper Check or Handling of Exceptional Conditions**	SWC-113
CWE-252	Unchecked Return Value	SWC-104
CWE-710	**Improper Adherence to Coding Standards**	SWC-100, SWC-108, SWC-119
CWE-477	Use of Obsolete Function	SWC-111, SWC-115
CWE-573	Improper Following of Specification by Caller	SWC-123
CWE-695	Use of Low-Level Functionality	SWC-127
CWE-1164	Irrelevant Code	SWC-131, SWC-135
CWE-937	**Using Components with Known Vulnerabilities**	SWC-102

** CWE IDs, which are presented in bold, are the greatest parent nodes of those nodes following it.*

All IDs in the CWE list above are relevant to the view "Research Concepts" (CWE-1000), except for CWE-937, which is relevant to the "Weaknesses in OWASP Top Ten (2013)" (CWE-928).