CERTIK

Security Assessment

Baby Shark Universe - Audit

CertiK Assessed on May 9th, 2024

CertiK Assessed on May 9th, 2024

Baby Shark Universe - Audit

The security assessment was prepared by CertiK, the leader in Web3.0 security.

Executive Summary

TYPES	ECOSYSTEM	METHODS
GameFi	Ethereum (ETH)	Formal Verification, Manual Review, Static Analysis

LANGUAGE	TIMELINE	KEY COMPONENTS
Solidity	Delivered on 05/09/2024	N/A

CODEBASE

https://github.com/Babysharkuniverse/BSU_contracts/blob/85969ff7ef6d6945ea3323cba3133091fffb3a97/BSU_Token.sol

https://etherscan.io/token/0x53432C750e93569ae119F99E7Af9588a16

View All in Codebase Page

Highlighted Centralization Risks

- Transfers can be paused
- Initial owner token share is 100%

Vulnerability Summary

3	0	0	0	3	0
Total Findings	Resolved	Mitigated	Partially Resolved	Acknowledged	Declined

0	Critical		Critical risks are those that impact the safe functioning of a platform and must be addressed before launch. Users should not invest in any project with outstanding critical risks.
2	Major	2 Acknowledged	Major risks can include centralization issues and logical errors. Under specific circumstances, these major risks can lead to loss of funds and/or control of the project.
0	Medium		Medium risks may not pose a direct risk to users' funds, but they can affect the overall functioning of a platform.
0	Minor		Minor risks can be any of the above, but on a smaller scale. They generally do not compromise the overall integrity of the project, but they may be less efficient than other solutions.
1	Informational	1 Acknowledged	Informational errors are often recommendations to improve the style of the code or certain operations to fall within industry best practices. They usually do not affect the overall functioning of the code.

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CODEBASE | BABY SHARK UNIVERSE - AUDIT

Repository

https://github.com/Babysharkuniverse/BSU_contracts/blob/85969ff7ef6d6945ea3323cba3133091fffb3a97/BSU_Token.sol

https://etherscan.io/token/0x53432C750e93569ae119F99E7Af9588a16634495#code

AUDIT SCOPE | BABY SHARK UNIVERSE - AUDIT

2 files audited ● 1 file with Acknowledged findings ● 1 file without findings

ID	Repo	File	SHA256 Checksum
● BUT	mainnet	BabysharkUniverseToken.sol	104ad3010bc6dd52e32aba148e971fb714f2219751a40956704b9f2f00ead881
● BST	Babysharkuniverse/BSU_contracts	BSU_Token.sol	8cb3625de01444c434a4763d0023d7d3fc4db51b83079924e6a1d2a4874c26d5

APPROACH & METHODS | BABY SHARK UNIVERSE - AUDIT

This report has been prepared for Baby Shark to discover issues and vulnerabilities in the source code of the Baby Shark Universe - Audit project as well as any contract dependencies that were not part of an officially recognized library. A comprehensive examination has been performed, utilizing Static Analysis and Manual Review techniques.

The auditing process pays special attention to the following considerations:

- Testing the smart contracts against both common and uncommon attack vectors.
- Assessing the codebase to ensure compliance with current best practices and industry standards.
- Ensuring contract logic meets the specifications and intentions of the client.
- Cross referencing contract structure and implementation against similar smart contracts produced by industry leaders.
- Thorough line-by-line manual review of the entire codebase by industry experts.

The security assessment resulted in findings that ranged from critical to informational. We recommend addressing these findings to ensure a high level of security standards and industry practices. We suggest recommendations that could better serve the project from the security perspective:

- Testing the smart contracts against both common and uncommon attack vectors;
- Enhance general coding practices for better structures of source codes;
- Add enough unit tests to cover the possible use cases;
- Provide more comments per each function for readability, especially contracts that are verified in public;
- Provide more transparency on privileged activities once the protocol is live.

FINDINGS | BABY SHARK UNIVERSE - AUDIT

3	0	2	0	0	1
Total Findings	Critical	Major	Medium	Minor	Informational

This report has been prepared to discover issues and vulnerabilities for Baby Shark Universe - Audit. Through this audit, we have uncovered 3 issues ranging from different severity levels. Utilizing the techniques of Static Analysis & Manual Review to complement rigorous manual code reviews, we discovered the following findings:

ID	Title	Category	Severity	Status
BUT-01	**Initial Token Distribution**	**Centralization**	**Major**	**Acknowledged**
BUT-02	**Centralization Risks In BabysharkUniverseToken**	**Centralization**	**Major**	**Acknowledged**
BUT-03	AccessControl._setupRole() Is Deprecated	Volatile Code	Informational	Acknowledged

BUT-01 | INITIAL TOKEN DISTRIBUTION

Category	Severity	Location	Status
Centralization	**Major**	**BabysharkUniverseToken.sol (v1): 1746; BSU_Token.sol (v 1): 19**	**Acknowledged**

Description

All of the BSU tokens are sent to the contract deployer. This is a centralization risk because the deployer can distribute tokens without obtaining the consensus of the community. Any compromise to these addresses may allow a hacker to steal and sell tokens on the market, resulting in severe damage to the project.

Recommendation

It is recommended that the team be transparent regarding the initial token distribution process. The token distribution plan should be published in a public location that the community can access. The team should make efforts to restrict access to the private keys of the deployer account or EOAs. A multi-signature (⅔, ⅗) wallet can be used to prevent a single point of failure due to a private key compromise. Additionally, the team can lock up a portion of tokens, release them with a vesting schedule for long-term success, and deanonymize the project team with a third-party KYC provider to create greater accountability.

Alleviation

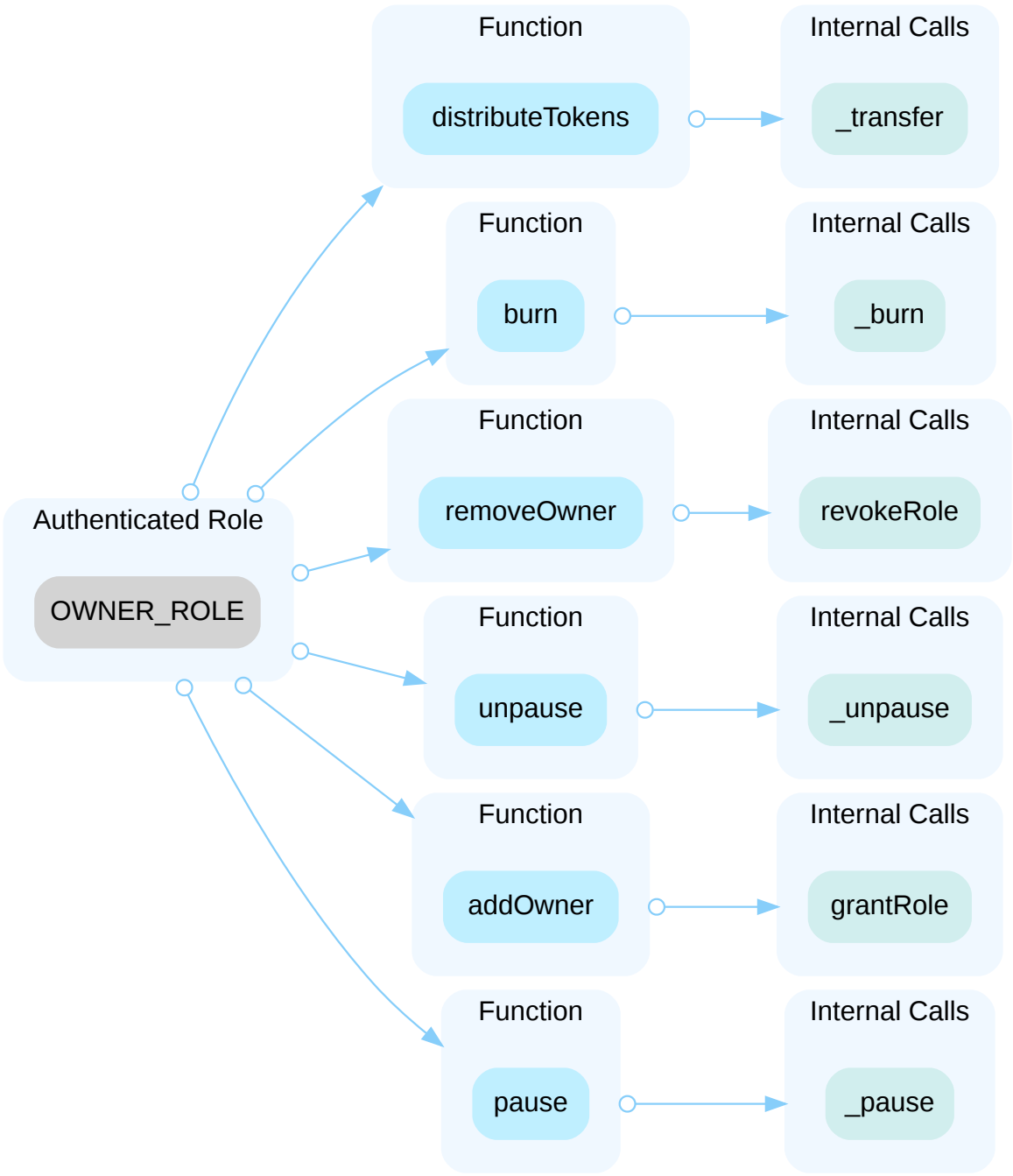
[Baby Shark Universe Team, 05/07/2024]: We issue tokens in a centralized manner. The BSU Foundation manages initial distribution and owner rights through a cold wallet. (Not dealing with tokens in a decentralized DAO manner).

BUT-02 | CENTRALIZATION RISKS IN BABYSHARKUNIVERSETOKEN

Category	Severity	Location	Status
Centralization	**Major**	**BabysharkUniverseToken.sol (v1): 1749, 1764, 1768, 1776, 1792, 1796; BSU_Token.sol (v1): 22, 37, 41, 49, 66, 70**	**Acknowledged**

Description

In the contract `BabysharkUniverseToken` the role `OWNER_ROLE` has authority over the functions shown in the diagram below. Any compromise to the `OWNER_ROLE` account may allow the hacker to take advantage of this authority and add/remove owners, pause/unpause token transfers.



Recommendation

The risk describes the current project design and potentially makes iterations to improve in the security operation and level of decentralization, which in most cases cannot be resolved entirely at the present stage. We advise the client to carefully manage the privileged account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol be improved via a decentralized mechanism or smart-contract-based accounts with enhanced security practices, e.g., multisignature wallets. Indicatively, here are some feasible suggestions that would also mitigate the potential risk at a different level in terms of short-term, long-term and permanent:

Short Term:

Timelock and Multi sign (⅔, ⅗) combination *mitigate* by delaying the sensitive operation and avoiding a single point of key management failure.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
  AND
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key compromised;
  AND
- A medium/blog link for sharing the timelock contract and multi-signers addresses information with the public audience.

Long Term:

Timelock and DAO, the combination, *mitigate* by applying decentralization and transparency.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
  AND
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.
  AND
- A medium/blog link for sharing the timelock contract, multi-signers addresses, and DAO information with the public audience.

Permanent:

Renouncing the ownership or removing the function can be considered *fully resolved*.

- Renounce the ownership and never claim back the privileged roles.
  OR
- Remove the risky functionality.

Alleviation

[Baby Shark Universe Team, 05/07/2024]: We issue tokens in a centralized manner. The BSU Foundation manages initial distribution and owner rights through a cold wallet. (Not dealing with tokens in a decentralized DAO manner).

[CertiK, 05/07/2024]: It is suggested to implement the aforementioned methods to avoid centralized failure. Also, CertiK strongly encourages the project team to periodically revisit the private key security management of all addresses related to centralized roles.

BUT-03 | ACCESSCONTROL._SETUPROLE() IS DEPRECATED

Category	Severity	Location	Status
Volatile Code	Informational	BabysharkUniverseToken.sol (v1): 1742; BSU_Token.sol (v1): 16	Acknowledged

Description

The contract attempts to use the `AccessControl._setupRole` function that is no longer defined in recent versions of OpenZeppelin's [AccessControl] (https://github.com/OpenZeppelin/openzeppelin-contracts/blob/master/contracts/access/AccessControl.sol) contract since version `v5.0.0`, and the corresponding Solidity used is `^0.8.20`. The function has been deprecated and replaced by `_grantRole` in the earlier version.

Recommendation

It's recommended using `_grantRole`.

Alleviation

[Baby Shark Universe Team, 05/07/2024]: The team acknowledged the finding and decided not to change the current codebase.

FORMAL VERIFICATION | BABY SHARK UNIVERSE - AUDIT

Formal guarantees about the behavior of smart contracts can be obtained by reasoning about properties relating to the entire contract (e.g. contract invariants) or to specific functions of the contract. Once such properties are proven to be valid, they guarantee that the contract behaves as specified by the property. As part of this audit, we applied formal verification to prove that important functions in the smart contracts adhere to their expected behaviors.

Considered Functions And Scope

In the following, we provide a description of the properties that have been used in this audit. They are grouped according to the type of contract they apply to.

Verification of AccessControl-Enumerable v4.2

We verified properties of the public interface of contracts that provide an AccessControl-Enumerable-v4.2 compatible API. This involves:

- The `hasRole` function, which returns `true` if an account has been granted a specific `role`.
- The `getRoleAdmin` function, which returns the admin role that controls a specific `role`.
- The functions `getRoleMember` and `getRoleMemberCount` retrieve an account with a specified `role` and count the total accounts with that `role`, respectively.
- The `grantRole` and `revokeRole` functions, which are used for granting a `role` to an account and revoking a `role` from an `account`, respectively.
- The `renounceRole` function, which allows the calling account to revoke a `role` from itself.

The properties that were considered within the scope of this audit are as follows:

Property Name	Title
accesscontrol-revokerole-succeed-for-valid-inputs	`revokeRole` Function Succeeds for Valid Inputs
accesscontrolenumerable-renouncerole-not-member-already	`renounceRole` Does Not Remove Non-Member
accesscontrolenumerable-renouncerole-remove-member	`renounceRole` Removes Member from Role
accesscontrolenumerable-revokerole-not-member-already	`revokeRole` Does Not Remove Non-Member
accesscontrolenumerable-revokerole-remove-member	`revokeRole` Removes Member from Role

Property Name	Title
accesscontrolenumerable-grantRole-member-already	`grantRole` Does Not Add Member Already in Role
accesscontrolenumerable-grantRole-add-member	`grantRole` Adds Member to Role
accesscontrol-getroleadmin-succeed-always	`getRoleAdmin` Function Always Succeeds
accesscontrol-renouncerole-revert-not-sender	`renounceRole` Reverts When Caller Is Not the Confirmation Address
erc165-supportsinterface-correct-false	`supportsInterface` Returns `False` for Id 0xffffffff
accesscontrolenumerable-getrolemembercount-succeed-always	`getRoleMemberCount` Always Succeeds
accesscontrol-supportsinterface-correct-accesscontrol	`supportsInterface` Signals that AccessControl is Implemented
accesscontrolenumerable-supportsinterface-correct-accesscontrolenumerable	`supportsInterface` Signals Support for `AccessControlEnumerable`
accesscontrol-getroleadmin-change-state	`getRoleAdmin` Function Does Not Change State
erc165-supportsinterface-succeed-always	`supportsInterface` Always Succeeds
accesscontrol-hasrole-succeed-always	`hasRole` Function Always Succeeds
erc165-supportsinterface-correct-erc165	`supportsInterface` Signals Support for ERC165
accesscontrolenumerable-getrolemembercount-change-state	`getRoleMemberCount` Changes No State Variables
erc165-supportsinterface-no-change-state	`supportsInterface` Does Not Change the Contract's State
accesscontrol-hasrole-change-state	`hasRole` Function Does Not Change State

Property Name	Title
accesscontrol-renouncerole-succeed-role-renouncing	`renounceRole` Successfully Renounces Role
accesscontrolenumerable-getrolemember-change-state	`getRoleMember` Changes No State Variables
accesscontrolenumerable-getrolemember-succeed-for-valid-inputs	`getRoleMember` Succeeds for Valid Inputs
accesscontrol-grantrole-succeed-for-valid-inputs	`grantRole` Function Succeeds for Valid Inputs
accesscontrol-grantrole-correct-role-granting	`grantRole` Correctly Grants Role
accesscontrol-revokerole-revert-no-admin	`revokeRole` Reverts When Sender Is Not Admin
accesscontrol-revokerole-correct-role-revoking	`revokeRole` Correctly Revokes Role
accesscontrol-grantrole-revert-no-admin	`grantRole` Reverts When Sender Is Not Admin
accesscontrol-renouncerole-succeed-for-valid-inputs	`renounceRole` Function Succeeds for Valid Inputs

Verification of ERC-20 Compliance

We verified properties of the public interface of those token contracts that implement the ERC-20 interface. This covers

- Functions `transfer` and `transferFrom` that are widely used for token transfers,
- functions `approve` and `allowance` that enable the owner of an account to delegate a certain subset of her tokens to another account (i.e. to grant an allowance), and
- the functions `balanceOf` and `totalSupply`, which are verified to correctly reflect the internal state of the contract.

The properties that were considered within the scope of this audit are as follows:

Property Name	Title
erc20-transfer-recipient-overflow	`transfer` Prevents Overflows in the Recipient's Balance
erc20-approve-succeed-normal	`approve` Succeeds for Valid Inputs
erc20-totalsupply-succeed-always	`totalSupply` Always Succeeds

Property Name	Title
erc20-approve-correct-amount	`approve` Updates the Approval Mapping Correctly
erc20-allowance-correct-value	`allowance` Returns Correct Value
erc20-allowance-change-state	`allowance` Does Not Change the Contract's State
erc20-transfer-false	If `transfer` Returns `false`, the Contract State Is Not Changed
erc20-transferfrom-false	If `transferFrom` Returns `false`, the Contract's State Is Unchanged
erc20-transfer-never-return-false	`transfer` Never Returns `false`
erc20-balanceof-change-state	`balanceOf` Does Not Change the Contract's State
erc20-totalsupply-change-state	`totalSupply` Does Not Change the Contract's State
erc20-transfer-exceed-balance	`transfer` Fails if Requested Amount Exceeds Available Balance
erc20-transfer-revert-zero	`transfer` Prevents Transfers to the Zero Address
erc20-transferfrom-revert-zero-argument	`transferFrom` Fails for Transfers with Zero Address Arguments
erc20-transferfrom-fail-exceed-allowance	`transferFrom` Fails if the Requested Amount Exceeds the Available Allowance
erc20-transferfrom-fail-exceed-balance	`transferFrom` Fails if the Requested Amount Exceeds the Available Balance
erc20-transferfrom-correct-amount	`transferFrom` Transfers the Correct Amount in Transfers
erc20-transferfrom-correct-allowance	`transferFrom` Updated the Allowance Correctly
erc20-transfer-correct-amount	`transfer` Transfers the Correct Amount in Transfers
erc20-transferfrom-fail-recipient-overflow	`transferFrom` Prevents Overflows in the Recipient's Balance
erc20-approve-never-return-false	`approve` Never Returns `false`
erc20-totalsupply-correct-value	`totalSupply` Returns the Value of the Corresponding State Variable
erc20-approve-false	If `approve` Returns `false`, the Contract's State Is Unchanged
erc20-balanceof-succeed-always	`balanceOf` Always Succeeds
erc20-approve-revert-zero	`approve` Prevents Approvals For the Zero Address

Property Name	Title
erc20-transferfrom-never-return-false	`transferFrom` Never Returns `false`
erc20-allowance-succeed-always	`allowance` Always Succeeds
erc20-balanceof-correct-value	`balanceOf` Returns the Correct Value

Verification Results

In the remainder of this section, we list all contracts where formal verification of at least one property was not successful. There are several reasons why this could happen:

- False: The property is violated by the project.
- Inconclusive: The proof engine cannot prove or disprove the property due to timeouts or exceptions.
- Inapplicable: The property does not apply to the project.

Detailed Results For Contract BabysharkUniverseToken (BabysharkUniverseToken.sol) In Commit 0x53432c750e93569ae119f99e7af9588a16634495

Verification of AccessControl-Enumerable v4.2

Detailed Results for Function `revokeRole`

Property Name	Final Result	Remarks
accesscontrol-revokerole-succeed-for-valid-inputs	Inconclusive	
accesscontrolenumerable-revokerole-not-member-already	Inconclusive	
accesscontrolenumerable-revokerole-remove-member	Inconclusive	
accesscontrol-revokerole-revert-no-admin	True	
accesscontrol-revokerole-correct-role-revoking	True	

Detailed Results for Function `renounceRole`

Property Name	Final Result	Remarks
accesscontrolenumerable-renouncerole-not-member-already	Inconclusive	
accesscontrolenumerable-renouncerole-remove-member	Inconclusive	
accesscontrol-renouncerole-revert-not-sender	True	
accesscontrol-renouncerole-succeed-role-renouncing	True	
accesscontrol-renouncerole-succeed-for-valid-inputs	Inconclusive	

Detailed Results for Function `grantRole`

Property Name	Final Result	Remarks
accesscontrolenumerable-grantRole-member-already	Inconclusive	
accesscontrolenumerable-grantRole-add-member	Inconclusive	
accesscontrol-grantrole-succeed-for-valid-inputs	True	
accesscontrol-grantrole-correct-role-granting	True	
accesscontrol-grantrole-revert-no-admin	True	

Detailed Results for Function `getRoleAdmin`

Property Name	Final Result	Remarks
accesscontrol-getroleadmin-succeed-always	True	
accesscontrol-getroleadmin-change-state	True	

Detailed Results for Function `supportsInterface`

Property Name	Final Result	Remarks
erc165-supportsinterface-correct-false	True	
accesscontrol-supportsinterface-correct-accesscontrol	True	
accesscontrolenumerable-supportsinterface-correct-accesscontrolenumerable	True	
erc165-supportsinterface-succeed-always	True	
erc165-supportsinterface-correct-erc165	True	
erc165-supportsinterface-no-change-state	True	

Detailed Results for Function `getRoleMemberCount`

Property Name	Final Result	Remarks
accesscontrolenumerable-getrolemembercount-succeed-always	True	
accesscontrolenumerable-getrolemembercount-change-state	True	

Detailed Results for Function `hasRole`

Property Name	Final Result	Remarks
accesscontrol-hasrole-succeed-always	True	
accesscontrol-hasrole-change-state	True	

Detailed Results for Function `getRoleMember`

Property Name	Final Result	Remarks
accesscontrolenumerable-getrolemember-change-state	True	
accesscontrolenumerable-getrolemember-succeed-for-valid-inputs	True	

Detailed Results For Contract ERC20 (BabysharkUniverseToken.sol) In Commit 0x53432c750e93569ae119f99e7af9588a16634495

Verification of ERC-20 Compliance

Detailed Results for Function `transfer`

Property Name	Final Result	Remarks
erc20-transfer-recipient-overflow	Inconclusive	
erc20-transfer-false	True	
erc20-transfer-never-return-false	True	
erc20-transfer-exceed-balance	True	
erc20-transfer-revert-zero	True	
erc20-transfer-correct-amount	True	

Detailed Results for Function `approve`

Property Name	Final Result	Remarks
erc20-approve-succeed-normal	True	
erc20-approve-correct-amount	True	
erc20-approve-never-return-false	True	
erc20-approve-false	True	
erc20-approve-revert-zero	True	

Detailed Results for Function `totalSupply`

Property Name	Final Result	Remarks
erc20-totalsupply-succeed-always	True	
erc20-totalsupply-change-state	True	
erc20-totalsupply-correct-value	True	

Detailed Results for Function `allowance`

Property Name	Final Result	Remarks
erc20-allowance-correct-value	True	
erc20-allowance-change-state	True	
erc20-allowance-succeed-always	True	

Detailed Results for Function `transferFrom`

Property Name	Final Result	Remarks
erc20-transferfrom-false	True	
erc20-transferfrom-revert-zero-argument	True	
erc20-transferfrom-fail-exceed-allowance	True	
erc20-transferfrom-fail-exceed-balance	True	
erc20-transferfrom-correct-amount	True	
erc20-transferfrom-correct-allowance	True	
erc20-transferfrom-fail-recipient-overflow	Inconclusive	
erc20-transferfrom-never-return-false	True	

Detailed Results for Function `balanceOf`

Property Name	Final Result	Remarks
erc20-balanceof-change-state	True	
erc20-balanceof-succeed-always	True	
erc20-balanceof-correct-value	True	

APPENDIX | BABY SHARK UNIVERSE - AUDIT

Finding Categories

Categories	Description
Volatile Code	Volatile Code findings refer to segments of code that behave unexpectedly on certain edge cases and may result in vulnerabilities.
Centralization	Centralization findings detail the design choices of designating privileged roles or other centralized controls over the code.

Checksum Calculation Method

The "Checksum" field in the "Audit Scope" section is calculated as the SHA-256 (Secure Hash Algorithm 2 with digest size of 256 bits) digest of the content of each file hosted in the listed source repository under the specified commit.

The result is hexadecimal encoded and is the same as the output of the Linux "sha256sum" command against the target file.

Details on Formal Verification

Some Solidity smart contracts from this project have been formally verified. Each such contract was compiled into a mathematical model that reflects all its possible behaviors with respect to the property. The model takes into account the semantics of the Solidity instructions found in the contract. All verification results that we report are based on that model.

The following assumptions and simplifications apply to our model:

- Certain low-level calls and inline assembly are not supported and may lead to a contract not being formally verified.
- We model the semantics of the Solidity source code and not the semantics of the EVM bytecode in a compiled contract.

Formalism for property specifications

All properties are expressed in a behavioral interface specification language that CertiK has developed for Solidity, which allows us to specify the behavior of each function in terms of the contract state and its parameters and return values, as well as contract properties that are maintained by every observable state transition. Observable state transitions occur when the contract's external interface is invoked and the invocation does not revert, and when the contract's Ether balance is changed by the EVM due to another contract's "self-destruct" invocation. The specification language has the usual Boolean connectives, as well as the operator `\old` (used to denote the state of a variable before a state transition), and several types of specification clause:

Apart from the Boolean connectives and the modal operators "always" (written `[]`) and "eventually" (written `<>`), we use the following predicates to reason about the validity of atomic propositions. They are evaluated on the contract's state

whenever a discrete time step occurs:

- `requires [cond]` - the condition `cond`, which refers to a function's parameters, return values, and contract state variables, must hold when a function is invoked in order for it to exhibit a specified behavior.
- `ensures [cond]` - the condition `cond`, which refers to a function's parameters, return values, and both `\old` and current contract state variables, is guaranteed to hold when a function returns if the corresponding requires condition held when it was invoked.
- `invariant [cond]` - the condition `cond`, which refers only to contract state variables, is guaranteed to hold at every observable contract state.
- `constraint [cond]` - the condition `cond`, which refers to both `\old` and current contract state variables, is guaranteed to hold at every observable contract state except for the initial state after construction (because there is no previous state); constraints are used to restrict how contract state can change over time.

Description of the Analyzed AccessControl-Enumerable-v4.2 Properties

Properties related to function `revokeRole`

accesscontrol-revokerole-correct-role-revoking

After execution, `revokeRole` must ensure the specified account no longer has the revoked role.

Specification:

```
ensures !hasRole(role, account);
```

accesscontrol-revokerole-revert-no-admin

The `revokeRole` function must revert if the sender does not have the appropriate admin role.

Specification:

```
reverts_when !hasRole(getRoleAdmin(role), msg.sender);
```

accesscontrol-revokerole-succeed-for-valid-inputs

The `revokeRole` function must succeed when the sender has the appropriate admin role.

Specification:

```
requires hasRole(getRoleAdmin(role), msg.sender);
reverts_only_when false;
also
ensures true;
```

accesscontrolenumerable-revokerole-not-member-already

The `revokeRole` function in contract BabysharkUniverseToken must not remove a member from the role if the member is not present.

Specification:

```
requires !hasRole(role, account);
ensures \old(getRoleMemberCount(role)) == getRoleMemberCount(role);
also
ensures true;
```

accesscontrolenumerable-revokerole-remove-member

The `revokeRole` function in contract BabysharkUniverseToken must remove a member from the specified role.

Specification:

```
requires hasRole(role, account);
ensures \old(getRoleMemberCount(role)) - 1 == getRoleMemberCount(role);
also
ensures true;
```

Properties related to function `renounceRole`

accesscontrol-renouncerole-revert-not-sender

The `renounceRole` function must revert if the caller is not the same as `account`.

Specification:

```
reverts_when account != msg.sender;
```

accesscontrol-renouncerole-succeed-for-valid-inputs

The `renounceRole` function must succeed when the caller is the same as the `account`.

Specification:

```
requires account == msg.sender;
reverts_only_when false;
also
ensures true;
```

accesscontrol-renouncerole-succeed-role-renouncing

After execution, `renounceRole` must ensure the caller no longer has the renounced role.

Specification:

```
ensures !hasRole(role, account);
```

accesscontrolenumerable-renouncerole-not-member-already

The `renounceRole` function in contract BabysharkUniverseToken must not remove a member from the role if the member is not present.

Specification:

```
requires !hasRole(role, account);
ensures \old(getRoleMemberCount(role)) == getRoleMemberCount(role);
also
ensures true;
```

accesscontrolenumerable-renouncerole-remove-member

The `renounceRole` function in contract BabysharkUniverseToken must remove a member from the specified role.

Specification:

```
requires hasRole(role, account);
ensures \old(getRoleMemberCount(role)) - 1 == getRoleMemberCount(role);
also
ensures true;
```

Properties related to function `grantRole`

accesscontrol-grantrole-correct-role-granting

After execution, `grantRole` must ensure the specified account has the granted role.

Specification:

```
ensures hasRole(role, account);
```

accesscontrol-grantrole-revert-no-admin

The `grantRole` function must revert if the sender does not have the appropriate admin role.

Specification:

```
reverts_when !hasRole(getRoleAdmin(role), msg.sender);
```

accesscontrol-grantrole-succeed-for-valid-inputs

The `grantRole` function must succeed when the sender has the appropriate admin role.

Specification:

```
requires hasRole(getRoleAdmin(role), msg.sender);
reverts_only_when false;
also
ensures true;;
```

accesscontrolenumerable-grantRole-add-member

The `grantRole` function in contract BabysharkUniverseToken must add a member to the specified role.

Specification:

```
requires !hasRole(role, account);
ensures \old(getRoleMemberCount(role)) + 1 == getRoleMemberCount(role);
ensures getRoleMember(role, getRoleMemberCount(role) - 1) == account;
also
ensures true;
```

accesscontrolenumerable-grantRole-member-already

The `grantRole` function in contract BabysharkUniverseToken must not add a member to the role if the member is already present.

Specification:

```
requires hasRole(role, account);
ensures \old(getRoleMemberCount(role)) == getRoleMemberCount(role);
also
ensures true;
```

Properties related to function `getRoleAdmin`

accesscontrol-getroleadmin-change-state

The `getRoleAdmin` function must not change any state variables.

Specification:

```
assignable \nothing;
```

accesscontrol-getroleadmin-succeed-always

The `getRoleAdmin` function must always succeed, assuming that its execution does not run out of gas.

Specification:

```
reverts_only_when false;
```

Properties related to function `supportsInterface`

accesscontrol-supportsinterface-correct-accesscontrol

A call of `supportsInterface(interfaceId)` with the interface id of AccessControl must return true.

Specification:

```
requires interfaceId == 0x7965db0b;;
ensures \result;
```

accesscontrolenumerable-supportsinterface-correct-accesscontrolenumerable

Invocations of `supportsInterface(id)` must signal that the interface `AccessControlEnumerable` is implemented.

Specification:

```
requires interfaceId == 0x5a05180f;
ensures \result;
```

erc165-supportsinterface-correct-erc165

Invocations of `supportsInterface(id)` must signal that the interface `ERC165` is implemented.

Specification:

```
requires interfaceId == 0x01ffc9a7;
ensures \result;
```

erc165-supportsinterface-correct-false

Invocations of `supportsInterface(id)` with `id` 0xffffffff must return `false`.

Specification:

```
requires interfaceId == 0xffffffff;
ensures !\result;
```

erc165-supportsinterface-no-change-state

Function `supportsInterface` must not change any of the contract's state variables.

Specification:

```
assignable \nothing;
```

erc165-supportsinterface-succeed-always

Function `supportsInterface` must always succeed if it does not run out of gas.

Specification:

```
reverts_only_when false;
```

Properties related to function `getRoleMemberCount`

accesscontrolenumerable-getrolemembercount-change-state

The `getRoleMemberCount` function in contract BabysharkUniverseToken must not change any state variables.

Specification:

```
assignable \nothing;
```

accesscontrolenumerable-getrolemembercount-succeed-always

The `getRoleMemberCount` function must always succeed, assuming that its execution does not run out of gas.

Specification:

```
reverts_only_when false;
```

Properties related to function `hasRole`

accesscontrol-hasrole-change-state

The `hasRole` function must not change any state variables.

Specification:

```
assignable \nothing;
```

accesscontrol-hasrole-succeed-always

The `hasRole` function must always succeed, assuming that its execution does not run out of gas.

Specification:

```
reverts_only_when false;
```

Properties related to function `getRoleMember`

accesscontrolenumerable-getrolemember-change-state

The `getRoleMember` function in contract BabysharkUniverseToken must not change any state variables.

Specification:

```
assignable \nothing;
```

accesscontrolenumerable-getrolemember-succeed-for-valid-inputs

The `getRoleMember` function in contract BabysharkUniverseToken must succeed when provided with valid inputs.

Specification:

```
requires index < getRoleMemberCount(role);
reverts_only_when false;
```

Description of the Analyzed ERC-20 Properties

Properties related to function `transfer`

erc20-transfer-correct-amount

All non-reverting invocations of `transfer(recipient, amount)` that return `true` must subtract the value in `amount` from the balance of `msg.sender` and add the same value to the balance of the `recipient` address.

Specification:

```
requires recipient != msg.sender;
requires balanceOf(recipient) + amount <= type(uint256).max;
ensures \result ==> balanceOf(recipient) == \old(balanceOf(recipient) + amount)
&& balanceOf(msg.sender) == \old(balanceOf(msg.sender) - amount);
  also
requires recipient == msg.sender;
ensures \result ==> balanceOf(msg.sender) == \old(balanceOf(msg.sender));
```

erc20-transfer-exceed-balance

Any transfer of an amount of tokens that exceeds the balance of `msg.sender` must fail.

Specification:

```
requires amount > balanceOf(msg.sender);
ensures !\result;
```

erc20-transfer-false

If the `transfer` function in contract `ERC20` fails by returning `false`, it must undo all state changes it incurred before returning to the caller.

Specification:

```
ensures !\result ==> \assigned (\nothing);
```

erc20-transfer-never-return-false

The transfer function must never return `false` to signal a failure.

Specification:

```
ensures \result;
```

erc20-transfer-recipient-overflow

Any invocation of `transfer(recipient, amount)` must fail if it causes the balance of the `recipient` address to overflow.

Specification:

```
requires recipient != msg.sender;
requires balanceOf(recipient) + amount > type(uint256).max;
ensures !\result;
```

erc20-transfer-revert-zero

Any call of the form `transfer(recipient, amount)` must fail if the recipient address is the zero address.

Specification:

```
ensures \old(recipient) == address(0) ==> !\result;
```

Properties related to function `approve`

erc20-approve-correct-amount

All non-reverting calls of the form `approve(spender, amount)` that return `true` must correctly update the allowance mapping according to the address `msg.sender` and the values of `spender` and `amount`.

Specification:

```
requires spender != address(0);
ensures \result ==> allowance(msg.sender, \old(spender)) == \old(amount);
```

erc20-approve-false

If function `approve` returns `false` to signal a failure, it must undo all state changes that it incurred before returning to the caller.

Specification:

```
ensures !\result ==> \assigned (\nothing);
```

erc20-approve-never-return-false

The function `approve` must never returns `false`.

Specification:

```
ensures \result;
```

erc20-approve-revert-zero

All calls of the form `approve(spender, amount)` must fail if the address in `spender` is the zero address.

Specification:

```
ensures \old(spender) == address(0) ==> !\result;
```

erc20-approve-succeed-normal

All calls of the form `approve(spender, amount)` must succeed, if

- the address in `spender` is not the zero address and
- the execution does not run out of gas.

Specification:

```
requires spender != address(0);
ensures \result;
reverts_only_when false;
```

Properties related to function `totalSupply`

erc20-totalsupply-change-state

The `totalSupply` function in contract ERC20 must not change any state variables.

Specification:

```
assignable \nothing;
```

erc20-totalsupply-correct-value

The `totalSupply` function must return the value that is held in the corresponding state variable of contract ERC20.

Specification:

```
ensures \result == totalSupply();
```

erc20-totalsupply-succeed-always

The function `totalSupply` must always succeeds, assuming that its execution does not run out of gas.

Specification:

```
reverts_only_when false;
```

Properties related to function `allowance`

erc20-allowance-change-state

Function `allowance` must not change any of the contract's state variables.

Specification:

```
assignable \nothing;
```

erc20-allowance-correct-value

Invocations of `allowance(owner, spender)` must return the allowance that address `spender` has over tokens held by address `owner`.

Specification:

```
ensures \result == allowance(\old(owner), \old(spender));
```

erc20-allowance-succeed-always

Function `allowance` must always succeed, assuming that its execution does not run out of gas.

Specification:

```
reverts_only_when false;
```

Properties related to function `transferFrom`

erc20-transferfrom-correct-allowance

All non-reverting invocations of `transferFrom(from, dest, amount)` that return `true` must decrease the allowance for address `msg.sender` over address `from` by the value in `amount`.

Specification:

```
ensures \result ==> allowance(\old(sender), msg.sender) == \old(allowance(sender,
msg.sender)) - \old(amount)
                  || (allowance(\old(sender), msg.sender) == \old(allowance(sender,
msg.sender)) && \old(allowance(sender, msg.sender)) == type(uint256).max);
```

erc20-transferfrom-correct-amount

All invocations of `transferFrom(from, dest, amount)` that succeed and that return `true` subtract the value in `amount` from the balance of address `from` and add the same value to the balance of address `dest`.

Specification:

```
requires recipient != sender;
requires balanceOf(recipient) + amount <= type(uint256).max;
ensures \result ==> balanceOf(\old(recipient)) == \old(balanceOf(recipient) +
amount)
                 && balanceOf(\old(sender)) == \old(balanceOf(sender) - amount);
  also
requires recipient == sender;
ensures \result ==> balanceOf(\old(recipient)) == \old(balanceOf(recipient));
```

erc20-transferfrom-fail-exceed-allowance

Any call of the form `transferFrom(from, dest, amount)` with a value for `amount` that exceeds the allowance of address `msg.sender` must fail.

Specification:

```
requires msg.sender != sender;
requires amount > allowance(sender, msg.sender);
ensures !\result;
```

erc20-transferfrom-fail-exceed-balance

Any call of the form `transferFrom(from, dest, amount)` with a value for `amount` that exceeds the balance of address `from` must fail.

Specification:

```
requires amount > balanceOf(sender);
ensures !\result;
```

erc20-transferfrom-fail-recipient-overflow

Any call of `transferFrom(from, dest, amount)` with a value in `amount` whose transfer would cause an overflow of the balance of address `dest` must fail.

Specification:

```
requires recipient != sender;
requires balanceOf(recipient) + amount > type(uint256).max;
ensures !\result;
```

erc20-transferfrom-false

If `transferFrom` returns `false` to signal a failure, it must undo all incurred state changes before returning to the caller.

Specification:

```
ensures !\result ==> \assigned (\nothing);
```

erc20-transferfrom-never-return-false

The `transferFrom` function must never return `false` .

Specification:

```
ensures \result;
```

erc20-transferfrom-revert-zero-argument

All calls of the form `transferFrom(from, dest, amount)` must fail for transfers from or to the zero address.

Specification:

```
ensures \old(sender) == address(0) ==> !\result;
also
ensures \old(recipient) == address(0) ==> !\result;
```

Properties related to function `balanceOf`

erc20-balanceof-change-state

Function `balanceOf` must not change any of the contract's state variables.

Specification:

```
assignable \nothing;
```

erc20-balanceof-correct-value

Invocations of `balanceOf(owner)` must return the value that is held in the contract's balance mapping for address `owner`.

Specification:

```
ensures \result == balanceOf(\old(account));
```

erc20-balanceof-succeed-always

Function `balanceOf` must always succeed if it does not run out of gas.

Specification:

```
reverts_only_when false;
```

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