# VRust

## Security Assessment

O2Lab VRust Team

11/04/2022 16:49:16

# Contents

## Summary

This report has been prepared for O2Lab VRust Team to discover issues and vulnerabilities in the source code of the O2Lab VRust Team 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:

- 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.

# Overview

## Project Summary

| | |
|---|---|
| Project Name | O2Lab VRust Team |
| Platform | Ethereum |
| Language | Solana |
| Crate | binary_option |
| GitHub Location | https://github.com/parasol-aser/vrust |
| sha256 | Unknown |

## Audit Summary

| | |
|---|---|
| Delivery Date | 11/04/2022 |
| Audit Methodology | Static Analysis |
| Key Components | |

## Vulnerability Summary

| Vulnerability Level | Total |
|---|---|
| Critical | 11 |
| Major | 0 |
| Medium | 0 |
| Minor | 0 |
| Informational | 0 |
| Discussion | 0 |

## Findings

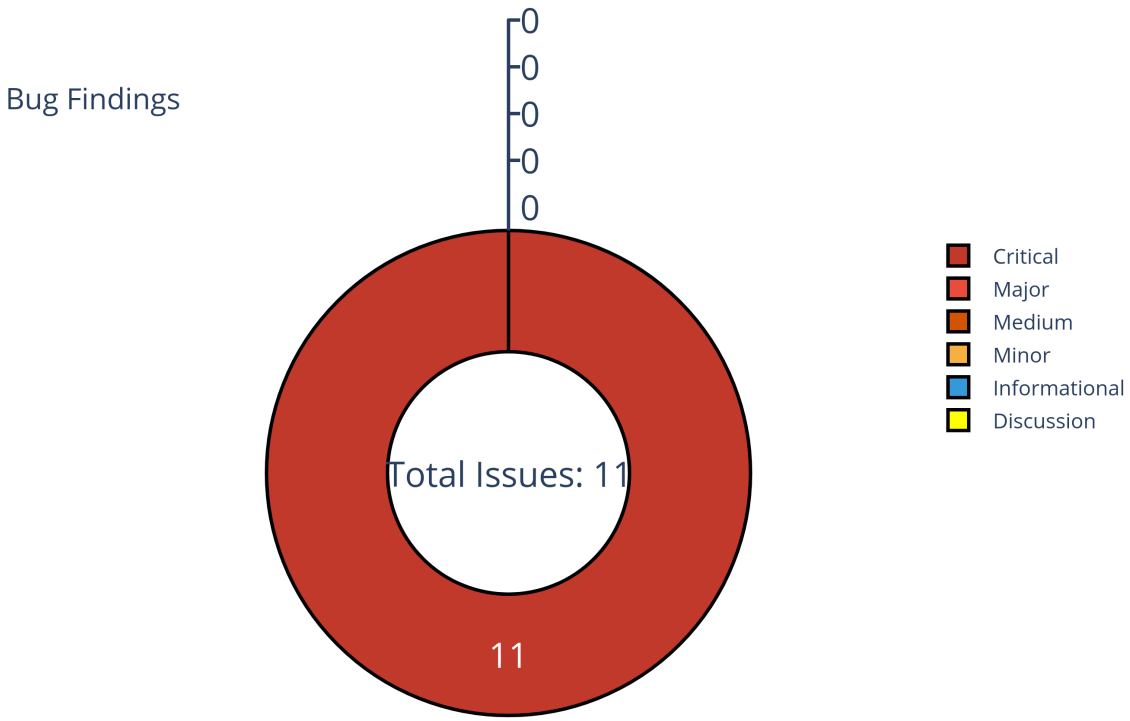


**Figure 1:** Findings

## Finding Statistic

| Category | Count |
|---|---|
| IntegerFlow | 4 |
| MissingKeyCheck | 6 |
| TypeConfusion | 1 |

| ID | Category | Severity | Status |
|---|---|---|---|
| 0 | IntegerFlow | Critical | UnResolved |
| 1 | IntegerFlow | Critical | UnResolved |
| 2 | IntegerFlow | Critical | UnResolved |
| 3 | IntegerFlow | Critical | UnResolved |
| 4 | MissingKeyCheck | Critical | UnResolved |
| 5 | MissingKeyCheck | Critical | UnResolved |
| 6 | MissingKeyCheck | Critical | UnResolved |
| 7 | MissingKeyCheck | Critical | UnResolved |
| 8 | MissingKeyCheck | Critical | UnResolved |
| 9 | MissingKeyCheck | Critical | UnResolved |
| 10 | TypeConfusion | Critical | GitHub Link to be added. |

## Issue: 0: IntegerFlow

| Category | Severity | Status |
| --- | --- | --- |
| IntegerFlow | Critical | UnResolved |

- Location

binary-option/program/src/processor.rs:710:22: 710:54

```
710 (reward * escrow_account.amount)
711
```

- Code Context

Vulnerability at Line: 710

```
705         escrow_authority_info,
706         collector_short_token_account.amount,
707         seeds,
708     )?;
709     if reward > 0 {
710         let amount = (reward * escrow_account.amount) /
            ↪  binary_option.circulation;
711         spl_token_transfer_signed(
712             token_program_info,
713             escrow_account_info,
714             collector_account_info,
715
```

- Call Stack

```
1 fn entrypoint::process_instruction(){//
  ↪  binary-option/program/src/entrypoint.rs:10:1: 16:2 }
2     fn processor::Processor::process(){//
       ↪  binary-option/program/src/processor.rs:30:5: 60:6 }
3         fn processor::process_collect(){//
           ↪  binary-option/program/src/processor.rs:611:1: 723:2 }
4
```

- description:

- link:
- alleviation:

## Issue: 1: IntegerFlow

| Category | Severity | Status |
| --- | --- | --- |
| IntegerFlow | Critical | UnResolved |

- Location

binary-option/program/src/state.rs:39:9: 39:30

```
39 self.circulation -= n
40
```

- Code Context

Vulnerability at Line: 39

```
35 pub fn decrement_supply(&mut self, n: u64) -> ProgramResult {
36         if self.circulation < n {
37             return Err(BinaryOptionError::InvalidSupply.into());
38         }
39         self.circulation -= n;
40         Ok(())
41     }
42
```

- Call Stack

```
1 fn entrypoint::process_instruction(){//
  ↪  binary-option/program/src/entrypoint.rs:10:1: 16:2 }
2     fn processor::Processor::process(){//
      ↪  binary-option/program/src/processor.rs:30:5: 60:6 }
3         fn processor::process_collect(){//
          ↪  binary-option/program/src/processor.rs:611:1: 723:2 }
4             fn state::BinaryOption::decrement_supply(){//
              ↪  binary-option/program/src/state.rs:35:5: 41:6 }
5
```

- description:
- link:
- alleviation:

## Issue: 2: IntegerFlow

| Category | Severity | Status |
| --- | --- | --- |
| IntegerFlow | Critical | UnResolved |

- Location

binary-option/program/src/processor.rs:237:8: 237:30

```
237 buy_price + sell_price
238
```

- Code Context

Vulnerability at Line: 237

```
232         program_id.as_ref(),
233         &[bump_seed],
234     ];
235
236     // Validate data
237     if buy_price + sell_price != u64::pow(10, binary_option.decimals as
    ↪  u32) {
238         return Err(BinaryOptionError::TradePricesIncorrect.into());
239     }
240     if binary_option.settled {
241         return Err(BinaryOptionError::AlreadySettled.into());
242
```

- Call Stack

```
1 fn entrypoint::process_instruction(){//
  ↪  binary-option/program/src/entrypoint.rs:10:1: 16:2 }
2     fn processor::Processor::process(){//
      ↪  binary-option/program/src/processor.rs:30:5: 60:6 }
3         fn processor::process_trade(){//
          ↪  binary-option/program/src/processor.rs:183:1: 578:2 }
4
```

- description:

- link:
- alleviation:

## Issue: 3: IntegerFlow

| Category | Severity | Status |
| --- | --- | --- |
| IntegerFlow | Critical | UnResolved |

- Location

binary-option/program/src/state.rs:32:9: 32:30

```
32 self.circulation += n
33
```

- Code Context

Vulnerability at Line: 32

```
31 pub fn increment_supply(&mut self, n: u64) {
32         self.circulation += n;
33     }
34
```

- Call Stack

```
1 fn entrypoint::process_instruction(){//
  ↪  binary-option/program/src/entrypoint.rs:10:1: 16:2 }
2     fn processor::Processor::process(){//
       ↪  binary-option/program/src/processor.rs:30:5: 60:6 }
3         fn processor::process_trade(){//
           ↪  binary-option/program/src/processor.rs:183:1: 578:2 }
4             fn state::BinaryOption::increment_supply(){//
               ↪  binary-option/program/src/state.rs:31:5: 33:6 }
5
```

- description:
- link:
- alleviation:

## Issue: 4: MissingKeyCheck

| Category | Severity | Status |
| --- | --- | --- |
| MissingKeyCheck | Critical | UnResolved |

- Location

binary-option/program/src/validation_utils.rs:32:43: 32:69

```
32 account_info.data.borrow()
33
```

- Code Context

Vulnerability at Line: 32

```
29 pub fn assert_initialized<T: Pack + IsInitialized>(
30     account_info: &AccountInfo,
31 ) -> Result<T, ProgramError> {
32     let account: T = T::unpack_unchecked(&account_info.data.borrow())?;
33     if !account.is_initialized() {
34         Err(BinaryOptionError::UninitializedAccount.into())
35     } else {
36         Ok(account)
37
```

- Call Stack

```
1 fn entrypoint::process_instruction(){//
  ↪  binary-option/program/src/entrypoint.rs:10:1: 16:2 }
2     fn processor::Processor::process(){//
       ↪  binary-option/program/src/processor.rs:30:5: 60:6 }
3         fn processor::process_collect(){//
           ↪  binary-option/program/src/processor.rs:611:1: 723:2 }
4             fn validation_utils::assert_initialized(){//
               ↪  binary-option/program/src/validation_utils.rs:29:1: 38:2 }
5
```

- description:

- link:
- alleviation:

## Issue: 5: MissingKeyCheck

| Category | Severity | Status |
| --- | --- | --- |
| MissingKeyCheck | Critical | UnResolved |

- Location

binary-option/program/src/processor.rs:631:39: 631:83

```
631 binary_option_account_info.data.borrow_mut()
632
```

- Code Context

Vulnerability at Line: 631

```
626     let collector_short_token_account: Account =
627         assert_initialized(collector_short_token_account_info)?;
628     let collector_account: Account =
        ↪  assert_initialized(collector_account_info)?;
629     let escrow_account: Account = assert_initialized(escrow_account_info)?;
630     let mut binary_option =
631         BinaryOp-
            ↪  tion::try_from_slice(&binary_option_account_info.data.borrow_mut())?;
632
633     // Get program derived address for escrow
634     let (escrow_owner_key, bump_seed) = Pubkey::find_program_address(
635         &[
636
```

Other Use Case for Variable: binary_option_account_info.data.borrow_mut()

```
721     binary_option.serialize(&mut
↪   *binary_option_account_info.data.borrow_mut())?;
```

- Call Stack

```
fn entrypoint::process_instruction(){//
↪  binary-option/program/src/entrypoint.rs:10:1: 16:2 }
    fn processor::Processor::process(){//
    ↪  binary-option/program/src/processor.rs:30:5: 60:6 }
        fn processor::process_collect(){//
        ↪  binary-option/program/src/processor.rs:611:1: 723:2 }

```

- description:
- link:
- alleviation:

## Issue: 6: MissingKeyCheck

| Category | Severity | Status |
| --- | --- | --- |
| MissingKeyCheck | Critical | UnResolved |

- Location

binary-option/program/src/processor.rs:590:39: 590:83

```
590 binary_option_account_info.data.borrow_mut()
591
```

- Code Context

Vulnerability at Line: 590

```
585     let binary_option_account_info = next_account_info(account_info_iter)?;
586     let winning_mint_account_info = next_account_info(account_info_iter)?;
587     let pool_owner_info = next_account_info(account_info_iter)?;
588
589     let mut binary_option =
590         BinaryOp-
            ↪  tion::try_from_slice(&binary_option_account_info.data.borrow_mut())?;
591     if !pool_owner_info.is_signer {
592         return Err(ProgramError::MissingRequiredSignature);
593     }
594     if binary_option.settled {
595
```

Other Use Case for Variable: binary_option_account_info.data.borrow_mut()

```
607     binary_option.serialize(&mut
↪   *binary_option_account_info.data.borrow_mut())?;
```

- Call Stack

```
1  fn entrypoint::process_instruction(){//
   ↪  binary-option/program/src/entrypoint.rs:10:1: 16:2 }
2      fn processor::Processor::process(){//
       ↪  binary-option/program/src/processor.rs:30:5: 60:6 }
```

```
3         fn processor::process_settle(){//
          ↪  binary-option/program/src/processor.rs:580:1: 609:2 }
4
```

- description:
- link:
- alleviation:

## Issue: 7: MissingKeyCheck

| Category | Severity | Status |
| --- | --- | --- |
| MissingKeyCheck | Critical | UnResolved |

- Location

binary-option/program/src/processor.rs:216:39: 216:83

```
216 binary_option_account_info.data.borrow_mut()
217
```

- Code Context

Vulnerability at Line: 216

```
211     let seller_long_token_account: Account =
        ↪  assert_initialized(seller_long_token_account_info)?;
212     let seller_short_token_account: Account =
        ↪  assert_initialized(seller_short_token_account_info)?;
213     let buyer_account: Account = assert_initialized(buyer_account_info)?;
214     let seller_account: Account = assert_initialized(seller_account_info)?;
215     let mut binary_option =
216         BinaryOp-
            ↪  tion::try_from_slice(&binary_option_account_info.data.borrow_mut())?;
217
218     // Get program derived address for escrow
219     let (authority_key, bump_seed) = Pubkey::find_program_address(
220         &[
221
```

Other Use Case for Variable: binary_option_account_info.data.borrow_mut()

```
576     binary_option.serialize(&mut
↪   *binary_option_account_info.data.borrow_mut())?;
```

- Call Stack

```
1 fn entrypoint::process_instruction(){//
  ↪  binary-option/program/src/entrypoint.rs:10:1: 16:2 }
2     fn processor::Processor::process(){//
       ↪  binary-option/program/src/processor.rs:30:5: 60:6 }
3         fn processor::process_trade(){//
           ↪  binary-option/program/src/processor.rs:183:1: 578:2 }
4
```

- description:
- link:
- alleviation:

## Issue: 8: MissingKeyCheck

| Category | Severity | Status |
| --- | --- | --- |
| MissingKeyCheck | Critical | UnResolved |

- Location

/home/yifei/.cargo/registry/src/github.com-1ecc6299db9ec823/solana-program-1.9.9/src/account_info.rs:66:11: 66:33

```
66 self.lamports.borrow()
67
```

- Code Context

Vulnerability at Line: 66

```
65 pub fn lamports(&self) -> u64 {
66         **self.lamports.borrow()
67     }
68
```

- Call Stack

```
1 fn entrypoint::process_instruction(){//
  ↪  binary-option/program/src/entrypoint.rs:10:1: 16:2 }
2     fn processor::Processor::process(){//
      ↪  binary-option/program/src/processor.rs:30:5: 60:6 }
3         fn processor::process_initialize_binary_option(){//
          ↪  binary-option/program/src/processor.rs:63:1: 181:2 }
4             fn system_utils::create_new_account(){//
              ↪  binary-option/program/src/system_utils.rs:15:1: 40:2 }
5                     fn
                      ↪  solana_program::account_info::AccountInfo::<'a>::lamports(){//
                      ↪  /home/yifei/.cargo/registry/src/github.com-
                      ↪  1ecc6299db9ec823/solana-program-
                      ↪  1.9.9/src/account_info.rs:65:5: 67:6
                      ↪  }
6
```

- description:
- link:
- alleviation:

## Issue: 9: MissingKeyCheck

| Category | Severity | Status |
| --- | --- | --- |
| MissingKeyCheck | Critical | UnResolved |

- Location

binary-option/program/src/processor.rs:169:39: 169:83

```
169 binary_option_account_info.data.borrow_mut()
170
```

- Code Context

Vulnerability at Line: 169

```
164         update_authority_info,
165         BinaryOption::LEN,
166     )?;
167
168     let mut binary_option =
169         BinaryOp-
        ↪  tion::try_from_slice(&binary_option_account_info.data.borrow_mut())?;
170     binary_option.decimals = decimals;
171     binary_option.circulation = 0;
172     binary_option.settled = false;
173     binary_option.long_mint_account_pubkey = *long_token_mint_info.key;
174
```

Other Use Case for Variable: binary_option_account_info.data.borrow_mut()

```
178     binary_option.serialize(&mut
    ↪  *binary_option_account_info.data.borrow_mut())?;
```

- Call Stack

```
1 fn entrypoint::process_instruction(){//
  ↪  binary-option/program/src/entrypoint.rs:10:1: 16:2 }
2     fn processor::Processor::process(){//
       ↪  binary-option/program/src/processor.rs:30:5: 60:6 }
```

```
3       fn processor::process_initialize_binary_option(){//
        ↪  binary-option/program/src/processor.rs:63:1: 181:2 }
4
```

- description:
- link:
- alleviation:

## Issue: 10: TypeConfusion

| Category | Severity | Status |
| --- | --- | --- |
| TypeConfusion | Critical | GitHub Link to be added. |

- Location

binary-option/program/src/instruction.rs:11:1: 13:2

```
pub struct InitializeBinaryOptionArgs {
    pub decimals: u8,
}
binary-option/program/src/state.rs:11:1: 21:2
    pub struct BinaryOption {
    pub decimals: u8,
    pub circulation: u64,
    pub settled: bool,
    pub escrow_mint_account_pubkey: Pubkey,
    pub escrow_account_pubkey: Pubkey,
    pub long_mint_account_pubkey: Pubkey,
    pub short_mint_account_pubkey: Pubkey,
    pub owner: Pubkey,
    pub winning_side_pubkey: Pubkey,
}

```

- Call Stack

```
UnResolved
```

- description:
- link:
- alleviation:

# Appendix

Copied from https://leaderboard.certik.io/projects/aave

## Finding Categories

### Gas Optimization

Gas Optimization findings do not affect the functionality of the code but generate different, more optimal EVM opcodes resulting in a reduction on the total gas cost of a transaction.

### Mathematical Operations

Mathematical Operation findings relate to mishandling of math formulas, such as overflows, incorrect operations etc.

### Logical Issue

Logical Issue findings detail a fault in the logic of the linked code, such as an incorrect notion on how block.timestamp works.

### Language Specific

Language Specific findings are issues that would only arise within Solidity, i.e. incorrect usage of private or delete.

### Coding Style

Coding Style findings usually do not affect the generated byte-code but rather comment on how to make the codebase more legible and, as a result, easily maintainable.

## 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.

## Disclaimer

Copied from https://leaderboard.certik.io/projects/aave

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