VRust

Security Assessment

O2Lab VRust Team

11/02/2022 21:03:13

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	wormhole_migration
GitHub Location	https://github.com/parasol-aser/vrust
sha256	Unknown

Audit Summary

Delivery Date	11/02/2022
Audit Methodology	Static Analysis
Key Components	

Vulnerability Summary

Vulnerability Level	Total
Critical	13
Major	0
Medium	0
Minor	0
Informational	0
Discussion	0

Findings

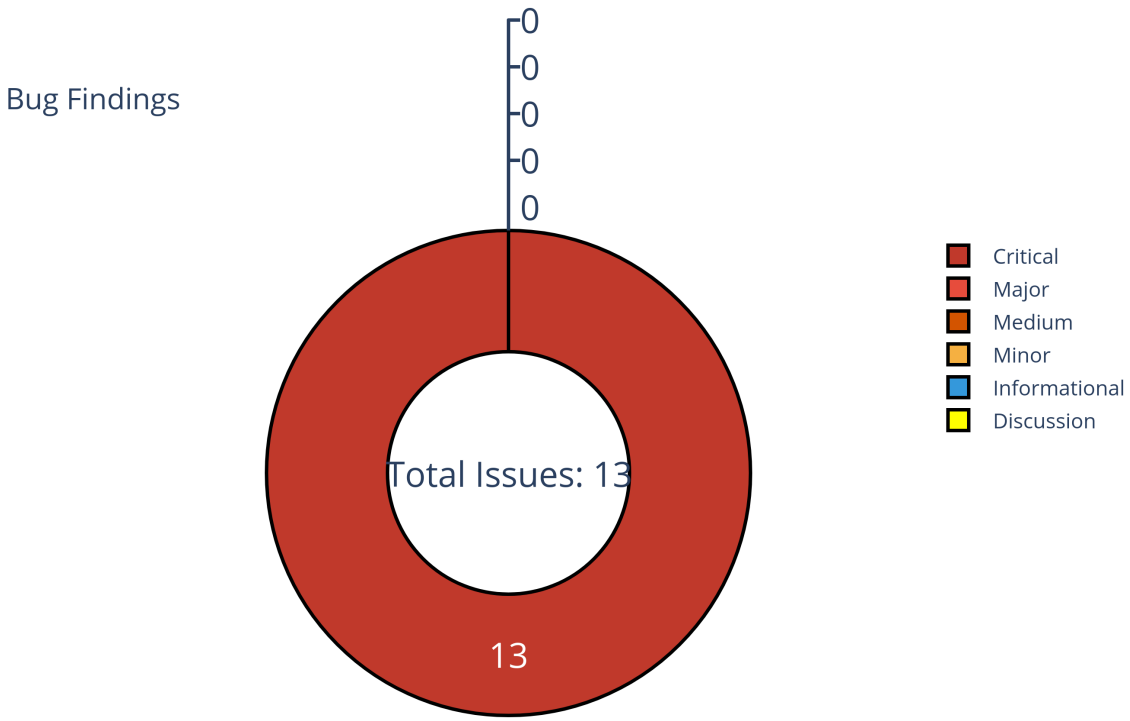

Figure 1: Findings

Finding Statistic

Category	Count
IntegerFlow	1
MissingKeyCheck	1
CrossProgramInvocation	11

ID	Category	Severity	Status
0	IntegerFlow	Critical	UnResolved
1	MissingKeyCheck	Critical	UnResolved
2	CrossProgramInvocation	Critical	UnResolved
3	CrossProgramInvocation	Critical	UnResolved
4	CrossProgramInvocation	Critical	UnResolved
5	CrossProgramInvocation	Critical	UnResolved
6	CrossProgramInvocation	Critical	UnResolved
7	CrossProgramInvocation	Critical	UnResolved
8	CrossProgramInvocation	Critical	UnResolved
9	CrossProgramInvocation	Critical	UnResolved
10	CrossProgramInvocation	Critical	UnResolved
11	CrossProgramInvocation	Critical	UnResolved
12	CrossProgramInvocation	Critical	UnResolved

Issue: 0: IntegerFlow

Category	Severity	Status
IntegerFlow	Critical	UnResolved

- Location

src/api/add_liquidity.rs:81:9: 82:98

```
81 data.amount
82             - (data.amount % 10u64.pow((accs.to_mint.decimals -
   ↪ accs.from_mint.decimals) as u32))
83
```

- Code Context

Vulnerability at Line: 79

```
74             to: accs.pool.to,
75         },
76     )?;
77
78     let to_tokens_in = if accs.from_mint.decimals > accs.to_mint.decimals {
79         data.amount
80     } else {
81         data.amount
82             - (data.amount % 10u64.pow((accs.to_mint.decimals -
   ↪ accs.from_mint.decimals) as u32))
83     };
84
```

Other Use Case for Variable: data.amount

```
81         data.amount
```

```
82             - (data.amount % 10u64.pow((accs.to_mint.decimals -
   ↪ accs.from_mint.decimals) as u32))
```

```
98          data.amount
```

```
102         data.amount
```

- Call Stack

```
1  fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
   ↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
   ↪  }
2      fn instruction::solitaire(){//
       ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
       ↪  108:14 }
3          fn instruction::dispatch(){//
           ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
           ↪  99:14 }
4              fn instruction::AddLiquidity::execute(){//
               ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
               ↪  74:22 }
5                  fn api::add_liquidity::add_liquidity(){//
                   ↪  src/api/add_liquidity.rs:44:1: 119:2 }
6
```

- description:
- link:
- alleviation:

Issue: 1: MissingKeyCheck

Category	Severity	Status
MissingKeyCheck	Critical	UnResolved

- Location

/home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/processors/peel.rs:211:22:211:50

```
211 ctx.info().lamports.borrow()
212
```

- Code Context

– Function Definition:

```
192 fn peel<I>(ctx: &'c mut Context<'a, 'b, 'c, I>) -> Result<Self>
193
```

Vulnerability at Line: 202

```
197         }
198
199         // If we're initializing the type, we should emit system/rent as
            ↪  deps.
200         let (initialized, data): (bool, T) = match IsInitialized {
201             AccountState::Uninitialized => {
202                 if **ctx.info().lamports.borrow() != 0 {
203                     return
                        ↪  Err(SolitaireError::AlreadyInitialized(*ctx.info().key));
204                 }
205                 (false, T::default())
206             }
207
```

Other Use Case for Variable: ctx.info().lamports.borrow()

```
211                 if **ctx.info().lamports.borrow() == 0 {
```

- Call Stack

```
1  fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
   ↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
   ↪  }
2      fn instruction::solitaire(){//
       ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
       ↪  108:14 }
3          fn instruction::dispatch(){//
           ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
           ↪  99:14 }
4              fn instruction::AddLiquidity::execute(){//
               ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
               ↪  74:22 }
5                  fn <api::add_liquidity::AddLiquidity<'b> as
                   ↪  solitaire::FromAccounts<'a, 'b, 'c>>::from(){//
                   ↪  src/api/add_liquidity.rs:25:10: 25:22 }
6                      fn <solitaire::Data<'b, T, IsInitialized> as
                       ↪  solitaire::Peel<'a, 'b, 'c>>::peel(){//
                       ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/p
                       ↪  236:6 }
7
```

- description:
- link:
- alleviation:

Issue: 2: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/add_liquidity.rs
```

- Code Context

```
44 pub fn add_liquidity(
45     ctx: &ExecutionContext,
46     accs: &mut AddLiquidity,
47     data: AddLiquidityData,
48 ) -> Result<()> {
49     if *accs.from_mint.info().key != accs.pool.from {
50         return Err(WrongMint.into());
51     }
52     if *accs.to_mint.info().key != accs.pool.to {
53         return Err(WrongMint.into());
54     }
55     if accs.lp_share_acc.mint != *accs.share_mint.info().key {
56         return Err(WrongMint.into());
57     }
58     accs.to_token_custody.verify_derivation(
59         ctx.program_id,
60         &ToCustodyTokenAccountDerivationData {
61             pool: *accs.pool.info().key,
62         },
63     )?;
64     accs.share_mint.verify_derivation(
65         ctx.program_id,
66         &ShareMintDerivationData {
67             pool: *accs.pool.info().key,
68         },
69     )?;
70     accs.pool.verify_derivation(
```

```
71          ctx.program_id,
72          &MigrationPoolDerivationData {
73              from: accs.pool.from,
74              to: accs.pool.to,
75          },
76      )?;
77
78      let to_tokens_in = if accs.from_mint.decimals > accs.to_mint.decimals {
79          data.amount
80      } else {
81          data.amount
82              - (data.amount % 10u64.pow((accs.to_mint.decimals -
    ↪ accs.from_mint.decimals) as u32))
83      };
84
85      // Transfer out-tokens in
86      let transfer_ix = spl_token::instruction::transfer(
87          &spl_token::id(),
88          accs.to_lp_acc.info().key,
89          accs.to_token_custody.info().key,
90          accs.authority_signer.key,
91          &[],
92          to_tokens_in,
93      )?;
94      invoke_seeded(&transfer_ix, ctx, &accs.authority_signer, None)?;
95
96      // The share amount should be equal to the amount of from tokens an lp
        ↪ would be getting
97      let share_amount = if accs.from_mint.decimals > accs.to_mint.decimals {
98          data.amount
99              .checked_mul(10u64.pow((accs.from_mint.decimals -
    ↪ accs.to_mint.decimals) as u32))
100             .unwrap()
101     } else {
102         data.amount
103             .checked_div(10u64.pow((accs.to_mint.decimals -
    ↪ accs.from_mint.decimals) as u32))
104             .unwrap()
105     };
106
107     // Mint LP shares
108     let mint_ix = spl_token::instruction::mint_to(
```

```
109         &spl_token::id(),
110         accs.share_mint.info().key,
111         accs.lp_share_acc.info().key,
112         accs.custody_signer.key,
113         &[],
114         share_amount,
115     )?;
116     invoke_seeded(&mint_ix, ctx, &accs.custody_signer, None)?;
117 
118     Ok(())
119 }
120 
```

- Call Stack

```
1 fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
  ↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
  ↪  }
2     fn instruction::solitaire(){//
       ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
       ↪  108:14 }
3         fn instruction::dispatch(){//
           ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
           ↪  99:14 }
4             fn instruction::AddLiquidity::execute(){//
               ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
               ↪  74:22 }
5                 fn api::add_liquidity::add_liquidity(){//
                   ↪  src/api/add_liquidity.rs:44:1: 119:2 }
6 
```

- description:
- link:
- alleviation:

Issue: 3: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/add_liquidity.rs
```

- Code Context

```
44 pub fn add_liquidity(
45     ctx: &ExecutionContext,
46     accs: &mut AddLiquidity,
47     data: AddLiquidityData,
48 ) -> Result<()> {
49     if *accs.from_mint.info().key != accs.pool.from {
50         return Err(WrongMint.into());
51     }
52     if *accs.to_mint.info().key != accs.pool.to {
53         return Err(WrongMint.into());
54     }
55     if accs.lp_share_acc.mint != *accs.share_mint.info().key {
56         return Err(WrongMint.into());
57     }
58     accs.to_token_custody.verify_derivation(
59         ctx.program_id,
60         &ToCustodyTokenAccountDerivationData {
61             pool: *accs.pool.info().key,
62         },
63     )?;
64     accs.share_mint.verify_derivation(
65         ctx.program_id,
66         &ShareMintDerivationData {
67             pool: *accs.pool.info().key,
68         },
69     )?;
70     accs.pool.verify_derivation(
```

```
71          ctx.program_id,
72          &MigrationPoolDerivationData {
73              from: accs.pool.from,
74              to: accs.pool.to,
75          },
76      )?;
77
78      let to_tokens_in = if accs.from_mint.decimals > accs.to_mint.decimals {
79          data.amount
80      } else {
81          data.amount
82              - (data.amount % 10u64.pow((accs.to_mint.decimals -
    ↪ accs.from_mint.decimals) as u32))
83      };
84
85      // Transfer out-tokens in
86      let transfer_ix = spl_token::instruction::transfer(
87          &spl_token::id(),
88          accs.to_lp_acc.info().key,
89          accs.to_token_custody.info().key,
90          accs.authority_signer.key,
91          &[],
92          to_tokens_in,
93      )?;
94      invoke_seeded(&transfer_ix, ctx, &accs.authority_signer, None)?;
95
96      // The share amount should be equal to the amount of from tokens an lp
        ↪ would be getting
97      let share_amount = if accs.from_mint.decimals > accs.to_mint.decimals {
98          data.amount
99              .checked_mul(10u64.pow((accs.from_mint.decimals -
    ↪ accs.to_mint.decimals) as u32))
100             .unwrap()
101     } else {
102         data.amount
103             .checked_div(10u64.pow((accs.to_mint.decimals -
    ↪ accs.from_mint.decimals) as u32))
104             .unwrap()
105     };
106
107     // Mint LP shares
108     let mint_ix = spl_token::instruction::mint_to(
```

```
109         &spl_token::id(),
110         accs.share_mint.info().key,
111         accs.lp_share_acc.info().key,
112         accs.custody_signer.key,
113         &[],
114         share_amount,
115     )?;
116     invoke_seeded(&mint_ix, ctx, &accs.custody_signer, None)?;
117 
118     Ok(())
119 }
120 
```

- Call Stack

```
1 fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
  ↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
  ↪  }
2     fn instruction::solitaire(){//
       ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
       ↪  108:14 }
3         fn instruction::dispatch(){//
           ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
           ↪  99:14 }
4             fn instruction::AddLiquidity::execute(){//
               ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
               ↪  74:22 }
5                 fn api::add_liquidity::add_liquidity(){//
                   ↪  src/api/add_liquidity.rs:44:1: 119:2 }
6 
```

- description:
- link:
- alleviation:

Issue: 4: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/remove_liquidity.rs
```

- Code Context

```
49 pub fn remove_liquidity(
50     ctx: &ExecutionContext,
51     accs: &mut RemoveLiquidity,
52     data: RemoveLiquidityData,
53 ) -> Result<()> {
54     if *accs.from_mint.info().key != accs.pool.from {
55         return Err(WrongMint.into());
56     }
57     if *accs.to_mint.info().key != accs.pool.to {
58         return Err(WrongMint.into());
59     }
60     if accs.lp_share_acc.mint != *accs.share_mint.info().key {
61         return Err(WrongMint.into());
62     }
63     accs.to_token_custody.verify_derivation(
64         ctx.program_id,
65         &ToCustodyTokenAccountDerivationData {
66             pool: *accs.pool.info().key,
67         },
68     )?;
69     accs.share_mint.verify_derivation(
70         ctx.program_id,
71         &ShareMintDerivationData {
72             pool: *accs.pool.info().key,
73         },
74     )?;
75     accs.pool.verify_derivation(
```

```
76          ctx.program_id,
77          &MigrationPoolDerivationData {
78              from: accs.pool.from,
79              to: accs.pool.to,
80          },
81      )?;
82
83      // The out amount needs to be decimal adjusted
84      let out_amount = if accs.from_mint.decimals > accs.to_mint.decimals {
85          data.amount
86              .checked_div(10u64.pow((accs.from_mint.decimals -
    ↪ accs.to_mint.decimals) as u32))
87              .unwrap()
88      } else {
89          data.amount
90              .checked_mul(10u64.pow((accs.to_mint.decimals -
    ↪ accs.from_mint.decimals) as u32))
91              .unwrap()
92      };
93
94      // Transfer removed liquidity to LP
95      let transfer_ix = spl_token::instruction::transfer(
96          &spl_token::id(),
97          accs.to_token_custody.info().key,
98          accs.to_lp_acc.info().key,
99          accs.custody_signer.key,
100         &[],
101         out_amount,
102     )?;
103     invoke_seeded(&transfer_ix, ctx, &accs.custody_signer, None)?;
104
105     // Burn LP shares
106     let mint_ix = spl_token::instruction::burn(
107         &spl_token::id(),
108         accs.lp_share_acc.info().key,
109         accs.share_mint.info().key,
110         accs.authority_signer.key,
111         &[],
112         data.amount,
113     )?;
114     invoke_seeded(&mint_ix, ctx, &accs.authority_signer, None)?;
115
```

```
    Ok(())
}

```

- Call Stack

```
fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
↪  }
    fn instruction::solitaire(){//
    ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
    ↪  108:14 }
        fn instruction::dispatch(){//
        ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
        ↪  99:14 }
            fn instruction::RemoveLiquidity::execute(){//
            ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
            ↪  74:22 }
                    fn api::remove_liquidity::remove_liquidity(){//
                    ↪  src/api/remove_liquidity.rs:49:1: 117:2 }

```

- description:
- link:
- alleviation:

Issue: 5: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/remove_liquidity.rs
```

- Code Context

```
49 pub fn remove_liquidity(
50     ctx: &ExecutionContext,
51     accs: &mut RemoveLiquidity,
52     data: RemoveLiquidityData,
53 ) -> Result<()> {
54     if *accs.from_mint.info().key != accs.pool.from {
55         return Err(WrongMint.into());
56     }
57     if *accs.to_mint.info().key != accs.pool.to {
58         return Err(WrongMint.into());
59     }
60     if accs.lp_share_acc.mint != *accs.share_mint.info().key {
61         return Err(WrongMint.into());
62     }
63     accs.to_token_custody.verify_derivation(
64         ctx.program_id,
65         &ToCustodyTokenAccountDerivationData {
66             pool: *accs.pool.info().key,
67         },
68     )?;
69     accs.share_mint.verify_derivation(
70         ctx.program_id,
71         &ShareMintDerivationData {
72             pool: *accs.pool.info().key,
73         },
74     )?;
75     accs.pool.verify_derivation(
```

```
76          ctx.program_id,
77          &MigrationPoolDerivationData {
78              from: accs.pool.from,
79              to: accs.pool.to,
80          },
81      )?;
82
83      // The out amount needs to be decimal adjusted
84      let out_amount = if accs.from_mint.decimals > accs.to_mint.decimals {
85          data.amount
86              .checked_div(10u64.pow((accs.from_mint.decimals -
    ↪ accs.to_mint.decimals) as u32))
87              .unwrap()
88      } else {
89          data.amount
90              .checked_mul(10u64.pow((accs.to_mint.decimals -
    ↪ accs.from_mint.decimals) as u32))
91              .unwrap()
92      };
93
94      // Transfer removed liquidity to LP
95      let transfer_ix = spl_token::instruction::transfer(
96          &spl_token::id(),
97          accs.to_token_custody.info().key,
98          accs.to_lp_acc.info().key,
99          accs.custody_signer.key,
100         &[],
101         out_amount,
102     )?;
103     invoke_seeded(&transfer_ix, ctx, &accs.custody_signer, None)?;
104
105     // Burn LP shares
106     let mint_ix = spl_token::instruction::burn(
107         &spl_token::id(),
108         accs.lp_share_acc.info().key,
109         accs.share_mint.info().key,
110         accs.authority_signer.key,
111         &[],
112         data.amount,
113     )?;
114     invoke_seeded(&mint_ix, ctx, &accs.authority_signer, None)?;
115
```

```
    Ok(())
}

```

- Call Stack

```
fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
↪  }
    fn instruction::solitaire(){//
    ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
    ↪  108:14 }
        fn instruction::dispatch(){//
        ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
        ↪  99:14 }
            fn instruction::RemoveLiquidity::execute(){//
            ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
            ↪  74:22 }
                    fn api::remove_liquidity::remove_liquidity(){//
                    ↪  src/api/remove_liquidity.rs:49:1: 117:2 }

```

- description:
- link:
- alleviation:

Issue: 6: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/claim_shares.rs
```

- Code Context

```
45 pub fn claim_shares(
46     ctx: &ExecutionContext,
47     accs: &mut ClaimShares,
48     data: ClaimSharesData,
49 ) -> Result<()> {
50     if accs.lp_share_acc.mint != *accs.share_mint.info().key {
51         return Err(WrongMint.into());
52     }
53     accs.from_token_custody.verify_derivation(
54         ctx.program_id,
55         &FromCustodyTokenAccountDerivationData {
56             pool: *accs.pool.info().key,
57         },
58     )?;
59     accs.share_mint.verify_derivation(
60         ctx.program_id,
61         &ShareMintDerivationData {
62             pool: *accs.pool.info().key,
63         },
64     )?;
65     accs.pool.verify_derivation(
66         ctx.program_id,
67         &MigrationPoolDerivationData {
68             from: accs.pool.from,
69             to: accs.pool.to,
70         },
71     )?;
```

```
72
73      // Transfer claimed tokens to LP
74      let transfer_ix = spl_token::instruction::transfer(
75          &spl_token::id(),
76          accs.from_token_custody.info().key,
77          accs.from_lp_acc.info().key,
78          accs.custody_signer.key,
79          &[],
80          data.amount,
81      )?;
82      invoke_seeded(&transfer_ix, ctx, &accs.custody_signer, None)?;
83
84      // Burn LP shares
85      let mint_ix = spl_token::instruction::burn(
86          &spl_token::id(),
87          accs.lp_share_acc.info().key,
88          accs.share_mint.info().key,
89          accs.authority_signer.key,
90          &[],
91          data.amount,
92      )?;
93      invoke_seeded(&mint_ix, ctx, &accs.authority_signer, None)?;
94
95      Ok(())
96  }
97
```

- Call Stack

```
1  fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
   ↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
   ↪  }
2      fn instruction::solitaire(){//
       ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
       ↪  108:14 }
3          fn instruction::dispatch(){//
           ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
           ↪  99:14 }
4              fn instruction::ClaimShares::execute(){//
               ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
               ↪  74:22 }
5                  fn api::claim_shares::claim_shares(){//
                   ↪  src/api/claim_shares.rs:45:1: 96:2 }
```

6

- description:
- link:
- alleviation:

Issue: 7: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/claim_shares.rs
```

- Code Context

```
45 pub fn claim_shares(
46     ctx: &ExecutionContext,
47     accs: &mut ClaimShares,
48     data: ClaimSharesData,
49 ) -> Result<()> {
50     if accs.lp_share_acc.mint != *accs.share_mint.info().key {
51         return Err(WrongMint.into());
52     }
53     accs.from_token_custody.verify_derivation(
54         ctx.program_id,
55         &FromCustodyTokenAccountDerivationData {
56             pool: *accs.pool.info().key,
57         },
58     )?;
59     accs.share_mint.verify_derivation(
60         ctx.program_id,
61         &ShareMintDerivationData {
62             pool: *accs.pool.info().key,
63         },
64     )?;
65     accs.pool.verify_derivation(
66         ctx.program_id,
67         &MigrationPoolDerivationData {
68             from: accs.pool.from,
69             to: accs.pool.to,
70         },
71     )?;
```

```
72
73      // Transfer claimed tokens to LP
74      let transfer_ix = spl_token::instruction::transfer(
75          &spl_token::id(),
76          accs.from_token_custody.info().key,
77          accs.from_lp_acc.info().key,
78          accs.custody_signer.key,
79          &[],
80          data.amount,
81      )?;
82      invoke_seeded(&transfer_ix, ctx, &accs.custody_signer, None)?;
83
84      // Burn LP shares
85      let mint_ix = spl_token::instruction::burn(
86          &spl_token::id(),
87          accs.lp_share_acc.info().key,
88          accs.share_mint.info().key,
89          accs.authority_signer.key,
90          &[],
91          data.amount,
92      )?;
93      invoke_seeded(&mint_ix, ctx, &accs.authority_signer, None)?;
94
95      Ok(())
96  }
97
```

- Call Stack

```
1  fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
   ↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
   ↪  }
2      fn instruction::solitaire(){//
       ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
       ↪  108:14 }
3          fn instruction::dispatch(){//
           ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
           ↪  99:14 }
4              fn instruction::ClaimShares::execute(){//
               ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
               ↪  74:22 }
5                  fn api::claim_shares::claim_shares(){//
                   ↪  src/api/claim_shares.rs:45:1: 96:2 }
```

6

- description:
- link:
- alleviation:

Issue: 8: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/create_pool.rs
```

- Code Context

```
42 pub fn create_pool(
43     ctx: &ExecutionContext,
44     accs: &mut CreatePool,
45     _data: CreatePoolData,
46 ) -> Result<()> {
47     // Create from custody account
48     accs.from_token_custody.create(
49         &FromCustodyTokenAccountDerivationData {
50             pool: *accs.pool.info().key,
51         },
52         ctx,
53         accs.payer.key,
54         Exempt,
55     )?;
56 
57     let init_ix = spl_token::instruction::initialize_account(
58         &spl_token::id(),
59         accs.from_token_custody.info().key,
60         accs.from_mint.info().key,
61         accs.custody_signer.info().key,
62     )?;
63     invoke_signed(&init_ix, ctx.accounts, &[])?;
64 
65     // Create to custody account
66     accs.to_token_custody.create(
67         &ToCustodyTokenAccountDerivationData {
68             pool: *accs.pool.info().key,
```

```
        },
        ctx,
        accs.payer.key,
        Exempt,
    )?;

    let init_ix = spl_token::instruction::initialize_account(
        &spl_token::id(),
        accs.to_token_custody.info().key,
        accs.to_mint.info().key,
        accs.custody_signer.info().key,
    )?;
    invoke_signed(&init_ix, ctx.accounts, &[])?;

    // Create to pool mint
    accs.pool_mint.create(
        &ShareMintDerivationData {
            pool: *accs.pool.info().key,
        },
        ctx,
        accs.payer.key,
        Exempt,
    )?;

    let init_ix = spl_token::instruction::initialize_mint(
        &spl_token::id(),
        accs.pool_mint.info().key,
        accs.custody_signer.info().key,
        None,
        accs.from_mint.decimals,
    )?;
    invoke_signed(&init_ix, ctx.accounts, &[])?;

    // Set fields on pool
    accs.pool.from = *accs.from_mint.info().key;
    accs.pool.to = *accs.to_mint.info().key;

    // Create pool
    accs.pool.create(
        &MigrationPoolDerivationData {
            from: *accs.from_mint.info().key,
            to: *accs.to_mint.info().key,
```

```
        },
        ctx,
        accs.payer.key,
        Exempt,
    )?;

    Ok(())
}

```

- Call Stack

```
fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
↪  }
    fn instruction::solitaire(){//
    ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
    ↪  108:14 }
        fn instruction::dispatch(){//
        ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
        ↪  99:14 }
            fn instruction::CreatePool::execute(){//
            ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
            ↪  74:22 }
                    fn api::create_pool::create_pool(){//
                    ↪  src/api/create_pool.rs:42:1: 118:2 }

```

- description:
- link:
- alleviation:

Issue: 9: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/create_pool.rs
```

- Code Context

```
42 pub fn create_pool(
43     ctx: &ExecutionContext,
44     accs: &mut CreatePool,
45     _data: CreatePoolData,
46 ) -> Result<()> {
47     // Create from custody account
48     accs.from_token_custody.create(
49         &FromCustodyTokenAccountDerivationData {
50             pool: *accs.pool.info().key,
51         },
52         ctx,
53         accs.payer.key,
54         Exempt,
55     )?;
56 
57     let init_ix = spl_token::instruction::initialize_account(
58         &spl_token::id(),
59         accs.from_token_custody.info().key,
60         accs.from_mint.info().key,
61         accs.custody_signer.info().key,
62     )?;
63     invoke_signed(&init_ix, ctx.accounts, &[])?;
64 
65     // Create to custody account
66     accs.to_token_custody.create(
67         &ToCustodyTokenAccountDerivationData {
68             pool: *accs.pool.info().key,
```

```
        },
        ctx,
        accs.payer.key,
        Exempt,
    )?;

    let init_ix = spl_token::instruction::initialize_account(
        &spl_token::id(),
        accs.to_token_custody.info().key,
        accs.to_mint.info().key,
        accs.custody_signer.info().key,
    )?;
    invoke_signed(&init_ix, ctx.accounts, &[])?;

    // Create to pool mint
    accs.pool_mint.create(
        &ShareMintDerivationData {
            pool: *accs.pool.info().key,
        },
        ctx,
        accs.payer.key,
        Exempt,
    )?;

    let init_ix = spl_token::instruction::initialize_mint(
        &spl_token::id(),
        accs.pool_mint.info().key,
        accs.custody_signer.info().key,
        None,
        accs.from_mint.decimals,
    )?;
    invoke_signed(&init_ix, ctx.accounts, &[])?;

    // Set fields on pool
    accs.pool.from = *accs.from_mint.info().key;
    accs.pool.to = *accs.to_mint.info().key;

    // Create pool
    accs.pool.create(
        &MigrationPoolDerivationData {
            from: *accs.from_mint.info().key,
            to: *accs.to_mint.info().key,
```

```
        },
        ctx,
        accs.payer.key,
        Exempt,
    )?;

    Ok(())
}

```

- Call Stack

```
fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
↪  }
    fn instruction::solitaire(){//
    ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
    ↪  108:14 }
        fn instruction::dispatch(){//
        ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
        ↪  99:14 }
            fn instruction::CreatePool::execute(){//
            ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
            ↪  74:22 }
                    fn api::create_pool::create_pool(){//
                    ↪  src/api/create_pool.rs:42:1: 118:2 }

```

- description:
- link:
- alleviation:

Issue: 10: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/create_pool.rs
```

- Code Context

```
42 pub fn create_pool(
43     ctx: &ExecutionContext,
44     accs: &mut CreatePool,
45     _data: CreatePoolData,
46 ) -> Result<()> {
47     // Create from custody account
48     accs.from_token_custody.create(
49         &FromCustodyTokenAccountDerivationData {
50             pool: *accs.pool.info().key,
51         },
52         ctx,
53         accs.payer.key,
54         Exempt,
55     )?;
56 
57     let init_ix = spl_token::instruction::initialize_account(
58         &spl_token::id(),
59         accs.from_token_custody.info().key,
60         accs.from_mint.info().key,
61         accs.custody_signer.info().key,
62     )?;
63     invoke_signed(&init_ix, ctx.accounts, &[])?;
64 
65     // Create to custody account
66     accs.to_token_custody.create(
67         &ToCustodyTokenAccountDerivationData {
68             pool: *accs.pool.info().key,
```

```
        },
        ctx,
        accs.payer.key,
        Exempt,
    )?;

    let init_ix = spl_token::instruction::initialize_account(
        &spl_token::id(),
        accs.to_token_custody.info().key,
        accs.to_mint.info().key,
        accs.custody_signer.info().key,
    )?;
    invoke_signed(&init_ix, ctx.accounts, &[])?;

    // Create to pool mint
    accs.pool_mint.create(
        &ShareMintDerivationData {
            pool: *accs.pool.info().key,
        },
        ctx,
        accs.payer.key,
        Exempt,
    )?;

    let init_ix = spl_token::instruction::initialize_mint(
        &spl_token::id(),
        accs.pool_mint.info().key,
        accs.custody_signer.info().key,
        None,
        accs.from_mint.decimals,
    )?;
    invoke_signed(&init_ix, ctx.accounts, &[])?;

    // Set fields on pool
    accs.pool.from = *accs.from_mint.info().key;
    accs.pool.to = *accs.to_mint.info().key;

    // Create pool
    accs.pool.create(
        &MigrationPoolDerivationData {
            from: *accs.from_mint.info().key,
            to: *accs.to_mint.info().key,
```

```
        },
        ctx,
        accs.payer.key,
        Exempt,
    )?;

    Ok(())
}

```

- Call Stack

```
fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
↪  }
    fn instruction::solitaire(){//
    ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
    ↪  108:14 }
        fn instruction::dispatch(){//
        ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
        ↪  99:14 }
            fn instruction::CreatePool::execute(){//
            ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
            ↪  74:22 }
                    fn api::create_pool::create_pool(){//
                    ↪  src/api/create_pool.rs:42:1: 118:2 }

```

- description:
- link:
- alleviation:

Issue: 11: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/migrate_tokens.rs
```

- Code Context

```
50 pub fn migrate_tokens(
51     ctx: &ExecutionContext,
52     accs: &mut MigrateTokens,
53     data: MigrateTokensData,
54 ) -> Result<()> {
55     if *accs.from_mint.info().key != accs.pool.from {
56         return Err(WrongMint.into());
57     }
58     if *accs.to_mint.info().key != accs.pool.to {
59         return Err(WrongMint.into());
60     }
61     if accs.user_from_acc.mint != accs.pool.from {
62         return Err(WrongMint.into());
63     }
64     if accs.user_to_acc.mint != accs.pool.to {
65         return Err(WrongMint.into());
66     }
67     accs.to_token_custody.verify_derivation(
68         ctx.program_id,
69         &ToCustodyTokenAccountDerivationData {
70             pool: *accs.pool.info().key,
71         },
72     )?;
73     accs.from_token_custody.verify_derivation(
74         ctx.program_id,
75         &FromCustodyTokenAccountDerivationData {
76             pool: *accs.pool.info().key,
```

```
        },
    )?;
    accs.pool.verify_derivation(
        ctx.program_id,
        &MigrationPoolDerivationData {
            from: accs.pool.from,
            to: accs.pool.to,
        },
    )?;

    // Transfer in-tokens in
    let transfer_ix = spl_token::instruction::transfer(
        &spl_token::id(),
        accs.user_from_acc.info().key,
        accs.from_token_custody.info().key,
        accs.authority_signer.key,
        &[],
        data.amount,
    )?;
    invoke_seeded(&transfer_ix, ctx, &accs.authority_signer, None)?;

    // The out amount needs to be decimal adjusted
    let out_amount = if accs.from_mint.decimals > accs.to_mint.decimals {
        data.amount
            .checked_div(10u64.pow((accs.from_mint.decimals -
↪   accs.to_mint.decimals) as u32))
            .unwrap()
    } else {
        data.amount
            .checked_mul(10u64.pow((accs.to_mint.decimals -
↪   accs.from_mint.decimals) as u32))
            .unwrap()
    };

    // Transfer out-tokens to user
    let transfer_ix = spl_token::instruction::transfer(
        &spl_token::id(),
        accs.to_token_custody.info().key,
        accs.user_to_acc.info().key,
        accs.custody_signer.key,
        &[],
        out_amount,
```

```
    )?;
    invoke_seeded(&transfer_ix, ctx, &accs.custody_signer, None)?;

    Ok(())
}

```

- Call Stack

```
fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
↪  }
    fn instruction::solitaire(){//
    ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
    ↪  108:14 }
        fn instruction::dispatch(){//
        ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
        ↪  99:14 }
            fn instruction::MigrateTokens::execute(){//
            ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
            ↪  74:22 }
                fn api::migrate_tokens::migrate_tokens(){//
                ↪  src/api/migrate_tokens.rs:50:1: 121:2 }

```

- description:
- link:
- alleviation:

Issue: 12: CrossProgramInvocation

Category	Severity	Status
CrossProgramInvocation	Critical	UnResolved

- Location

```
src/api/migrate_tokens.rs
```

- Code Context

```
50 pub fn migrate_tokens(
51     ctx: &ExecutionContext,
52     accs: &mut MigrateTokens,
53     data: MigrateTokensData,
54 ) -> Result<()> {
55     if *accs.from_mint.info().key != accs.pool.from {
56         return Err(WrongMint.into());
57     }
58     if *accs.to_mint.info().key != accs.pool.to {
59         return Err(WrongMint.into());
60     }
61     if accs.user_from_acc.mint != accs.pool.from {
62         return Err(WrongMint.into());
63     }
64     if accs.user_to_acc.mint != accs.pool.to {
65         return Err(WrongMint.into());
66     }
67     accs.to_token_custody.verify_derivation(
68         ctx.program_id,
69         &ToCustodyTokenAccountDerivationData {
70             pool: *accs.pool.info().key,
71         },
72     )?;
73     accs.from_token_custody.verify_derivation(
74         ctx.program_id,
75         &FromCustodyTokenAccountDerivationData {
76             pool: *accs.pool.info().key,
```

```
        },
    )?;
    accs.pool.verify_derivation(
        ctx.program_id,
        &MigrationPoolDerivationData {
            from: accs.pool.from,
            to: accs.pool.to,
        },
    )?;

    // Transfer in-tokens in
    let transfer_ix = spl_token::instruction::transfer(
        &spl_token::id(),
        accs.user_from_acc.info().key,
        accs.from_token_custody.info().key,
        accs.authority_signer.key,
        &[],
        data.amount,
    )?;
    invoke_seeded(&transfer_ix, ctx, &accs.authority_signer, None)?;

    // The out amount needs to be decimal adjusted
    let out_amount = if accs.from_mint.decimals > accs.to_mint.decimals {
        data.amount
            .checked_div(10u64.pow((accs.from_mint.decimals -
↪   accs.to_mint.decimals) as u32))
            .unwrap()
    } else {
        data.amount
            .checked_mul(10u64.pow((accs.to_mint.decimals -
↪   accs.from_mint.decimals) as u32))
            .unwrap()
    };

    // Transfer out-tokens to user
    let transfer_ix = spl_token::instruction::transfer(
        &spl_token::id(),
        accs.to_token_custody.info().key,
        accs.user_to_acc.info().key,
        accs.custody_signer.key,
        &[],
        out_amount,
```

```
    )?;
    invoke_seeded(&transfer_ix, ctx, &accs.custody_signer, None)?;

    Ok(())
}

```

- Call Stack

```
fn entrypoint(){// /home/yifei/.cargo/registry/src/github.com-
↪  1ecc6299db9ec823/solana-program-1.7.0/src/entrypoint.rs:46:9: 53:10
↪  }
    fn instruction::solitaire(){//
    ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macros.rs
    ↪  108:14 }
        fn instruction::dispatch(){//
        ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/macro
        ↪  99:14 }
            fn instruction::MigrateTokens::execute(){//
            ↪  /home/yifei/open/vrust/examples2/wormhole/solana/solitaire/program/src/m
            ↪  74:22 }
                fn api::migrate_tokens::migrate_tokens(){//
                ↪  src/api/migrate_tokens.rs:50:1: 121:2 }

```

- 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

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