Underhanded Solidity '22

Evaluation Order in Solidity

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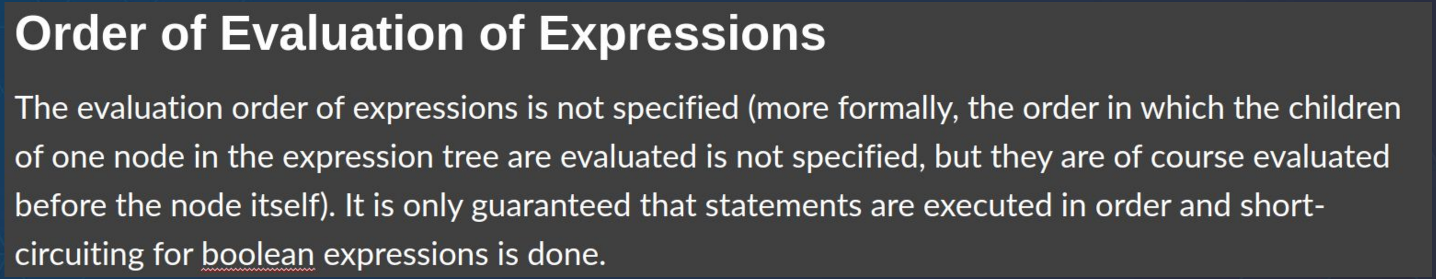
Evaluation Order in Solidity



Order of Evaluation of Expressions

The evaluation order of expressions is not specified (more formally, the order in which the children of one node in the expression tree are evaluated is not specified, but they are of course evaluated before the node itself). It is only guaranteed that statements are executed in order and short-circuiting for boolean expressions is done.

f(g(...), h(...)) -> Unclear if g or h is evaluated first

Evaluation Order

```
function fun(uint a) returns (uint) {
    return a + a++;
}
```

- What is the result of fun(2)?
- In this case, we will get 2 + 2 = 4
- But the compiler could give us (2+1) + 2 = 5
- Not specified, so we shouldn't rely on it

In Practice

- This only matters if we can get `unexpected` results
- (Un-)fortunately, there are three cases of unusual evaluation orders
- Found by analyzing the code generator

`addmod` and `mulmod`

```
addmod(a, b, N); // returns (a + b) mod N
mulmod(a, b, N); // returns (a * b) mod N
```

- Arguments evaluated right to left.
- This is documented in the IR-based Codegen Changes
- For example: `f(2)` is evaluated as `addmod(3, 2, 5) = 0`

```
function f(uint a) returns (uint) {
    return addmod(a, a++, 5);
}
```

Events

```
event Hello(uint indexed a, uint b, uint indexed c, uint d);
```

- The parameters of events are evaluated in a bizarre order
- First, the `indexed` params are evaluated right to left
- Then, the remaining params are evaluated left to right
- In the `Hello` event, the order is `c → a → b → d`
- For example: `g(2)` emits `Hello(2, 3, 2, 3)`

```
function g(uint a) {
    emit Hello(a++, a, a, a);
}
```

Underhanded Solidity `22

- Constant product DEX
- Each trade has a fee, which goes to liquidity pool
- Admin fee is proportional to the liquidity increase since the last claim
- Wait for liquidity to increase, raise fees, then steal profits

```
event AdminFeeChanged(uint256 indexed oldFee, uint256 indexed newFee);
function changeAdminFees(uint256 newAdminFee) external onlyAdmin nonReentrant {
    emit AdminFeeChanged(retireOldAdminFee(), setNewAdminFee(newAdminFee));
}
function retireOldAdminFee() internal returns (uint256) {
    // Claim admin fee before changing it
    _claimAdminFees();
    // Let people withdraw their funds if they don't like the new fee
    nextFeeClaimTimestamp = block.timestamp + 7 days;

    return adminFee;
}
function setNewAdminFee(uint256 newAdminFee) internal returns (uint256) {
    adminFee = newAdminFee;
    return newAdminFee;
}
```

About ChainSecurity

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- Smart contract audits
- Some of our clients:
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  - Curve.fi
  - Compound
  - Aave
  - Yearn
  - 1inch
  - Lido

Thank you!

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Section 1

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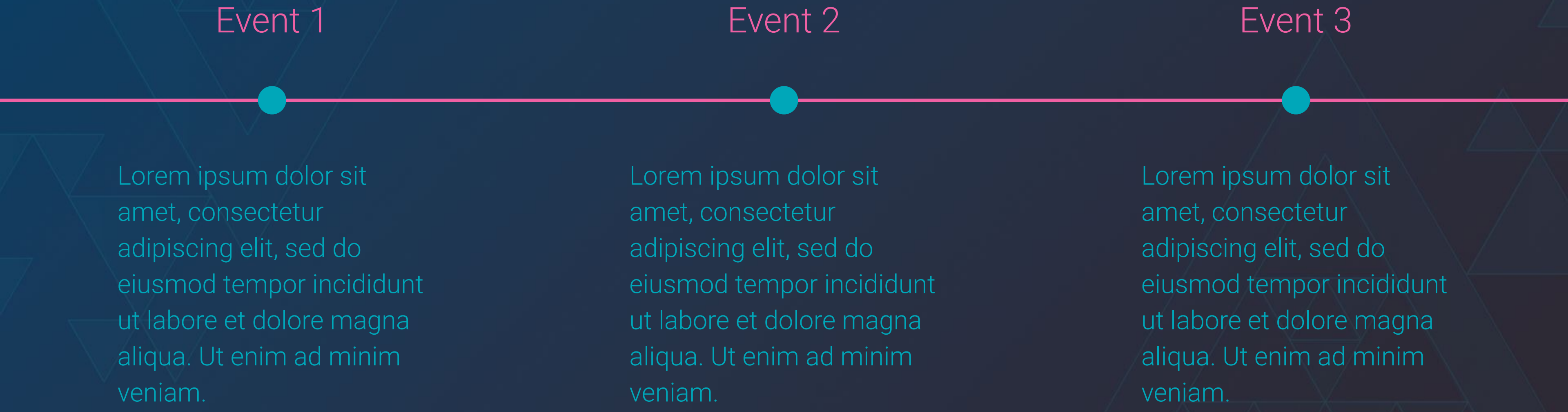
Here’s the timeline.



Event 1

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