

HUPYY TEMPORAL - SMT-LIB VERIFICATION REPORT

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Query ID: query_1762245510

Status: UNSAT

Execution Time: 63 ms

1. PROBLEM STATEMENT

Given: Trading algorithm executed 1,247 trades between 9:30 AM and 4:00 PM EST on March 15, 2025. Given: SEC Rule 15c3-5 requires pre-trade risk controls including margin requirements \leq 50% of account equity. Given: Account equity = \$10M at market open. Given: Algorithm attempted trade #1,248 requiring \$5.5M margin at 3:58 PM. Question: Did this trade violate SEC margin requirements?

2. PHASE ANALYSIS (AI CONVERSION)

```
; =====
; SMT-LIB v2.7 Encoding
; Logic: QF_LIA (Quantifier-Free Linear Integer Arithmetic)
; Problem: SEC Rule 15c3-5 Margin Requirement Violation Detection
; Query: Did trade #1,248 violate margin requirements?
; =====

(set-logic QF_LIA)
(set-option :produce-models true)
(set-option :produce-unsat-cores true)

; =====
; SECTION 1: GROUND TRUTH (from problem data)
; =====
; These are FACTS extracted from the problem statement.

; Account equity at market open on March 15, 2025
; Source: "Account equity = $10M at market open"
(declare-const account_equity Int)
(assert (= account_equity 10000000))

; SEC Rule 15c3-5 margin limit as percentage
; Source: "SEC Rule 15c3-5 requires pre-trade risk controls
;           including margin requirements  $\leq$  50% of account equity"
(declare-const margin_limit_percent Int)
(assert (= margin_limit_percent 50))

; Trade #1,248 margin requirement in USD
; Source: "Algorithm attempted trade #1,248 requiring $5.5M margin"
(declare-const trade_1248_margin_required Int)
(assert (= trade_1248_margin_required 5500000))

; =====
; SECTION 2: DERIVED LOGIC & CONSTRAINTS
; =====

; Constraint 1: Calculate maximum allowable margin
; Formal:  $\text{max\_allowable\_margin} = (\text{account\_equity} * \text{margin\_limit\_percent}) / 100$ 
(declare-const max_allowable_margin Int)
(assert (= max_allowable_margin
        (div (* account_equity margin_limit_percent) 100)))

; Constraint 2: Determine violation status
```

```

;; Formal: marginViolation ? (trade_1248_margin_required > max_allowable_margin)
(declare-const marginViolation Bool)
(assert (= marginViolation
        (> trade_1248_margin_required max_allowable_margin)))

=====
;; QUERY: Did trade #1,248 violate SEC margin requirements?
=====

;; Negation-based proof approach:
;; Assert that the trade is compliant (not marginViolation)
;; UNSAT result proves the violation is inevitable
(assert (not marginViolation))

(check-sat)
(get-model)

```

3. GENERATED SMT-LIB CODE

Logic: QF_LIA

```

(set-logic QF_LIA)
(set-option :produce-models true)
(set-option :produce-unsat-cores true)

; Ground truth facts from problem statement

; Account equity at market open on March 15, 2025
; Source: "Account equity = $10M at market open"
(declare-const accountEquity Int)
(assert (= accountEquity 10000000))

; SEC Rule 15c3-5 margin limit as percentage
; Source: "SEC Rule 15c3-5 requires pre-trade risk controls
;           including margin requirements <= 50% of account equity"
(declare-const marginLimitPercent Int)
(assert (= marginLimitPercent 50))

; Trade #1,248 margin requirement in USD
; Source: "Algorithm attempted trade #1,248 requiring $5.5M margin"
(declare-const trade1248MarginRequired Int)
(assert (= trade1248MarginRequired 5500000))

; Derived logic and constraints

; Calculate maximum allowable margin
; Formal: maxAllowableMargin = (accountEquity * marginLimitPercent) / 100
(declare-const maxAllowableMargin Int)
(assert (= maxAllowableMargin
        (div (* accountEquity marginLimitPercent) 100)))

; Determine violation status
; Formal: marginViolation ? (trade1248MarginRequired > maxAllowableMargin)
(declare-const marginViolation Bool)
(assert (= marginViolation
        (> trade1248MarginRequired maxAllowableMargin)))

; Query: Did trade #1,248 violate SEC margin requirements?
; Negation-based proof approach: assert the trade is compliant
; UNSAT result proves the violation is inevitable
(assert (not marginViolation))

(check-sat)
(get-model)

```

4. VERIFICATION RESULTS

Status: UNSAT

Wall Time: 63 ms

5. HUMAN-READABLE EXPLANATION

Proof:

- SEC Rule 15c3-5 margin limit: $\leq 50\%$ of account equity
- Account equity at market open: \$10,000,000
- Maximum allowable margin: $\$10,000,000 \times 50\% = \$5,000,000$
- Trade #1,248 margin requirement: \$5,500,000
- Compliance check: Is \$5,500,000 $\leq \$5,000,000$?
- Verification: \$5,500,000 $> \$5,000,000$ []
- VIOLATION CONFIRMED: Trade #1,248 exceeded SEC margin requirements by \$500,000

UNSAT Result: The solver proved that no valid assignment exists where the trade is compliant. The constraint contradiction demonstrates the trade necessarily violates SEC Rule 15c3-5 margin requirements.

6. AUTO-CORRECTION HISTORY

Total corrections: 1

Correction 1:

Error: (error "Parse Error: /var/folders/0s/tfrwn0013mv7f4msz96r_2z40000gn/T/tmpf5gqjec0.smt2:1.2: Expected SMT-LIBv2 command, got `Quantifier-Free` (SYMBOL).")

7. TECHNICAL DETAILS (APPENDIX)

cvc5 Standard Output:

```
unsat
(error "cannot get model unless after a SAT or UNKNOWN response.")
```

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