# YAML-Based Format for Violation Witnesses

(work in progress)

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VeWit 2023

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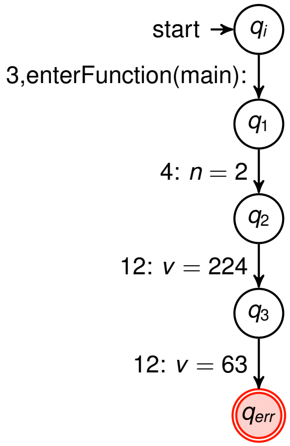
## Existing format

- introduced in 2015
- based on GraphML


$$\begin{tikzcd}[row sep=large]
\text{start} \arrow[r] & q_i \arrow[d, "\text{3,enterFunction(main):}"'] \\
& q_1 \arrow[d, "4{:}\ n = 2"'] \\
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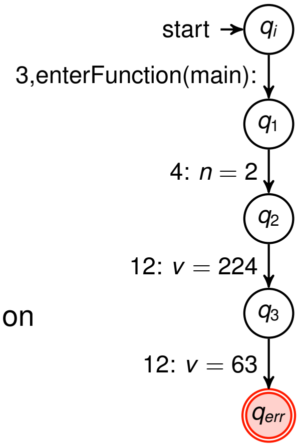
+ improved the quality of verification tools
+ other applications, e.g. cooperative verification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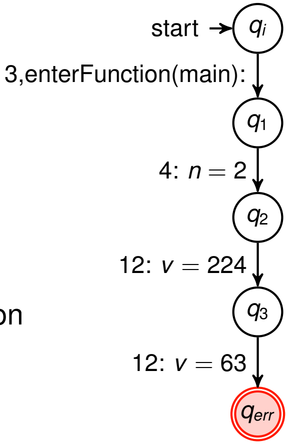
– witness validators do not support all features
– verifiers do not use the whole power of the format
– semantics given on Control Flow Automata (CFA), but translation to CFA is ambiguous



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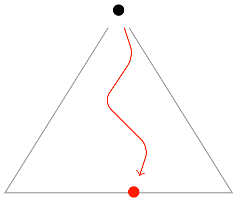
$\Longrightarrow$ the format needs to be as simple as possible

## Design decisions

- start with the support of the most common properties and sequential programs and then extend it
- integrate the format to the existing YAML format for correctness witnesses

## Design decisions

How many runs should a violation witness describe?



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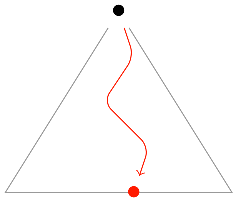

single violating run

- a lot of detailed information
  - values of all inputs
  - order of evaluation: `f(x) + g(y)`
  - addresses of allocations: `p = malloc(10)`
  - ...

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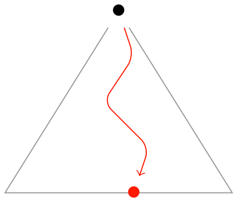

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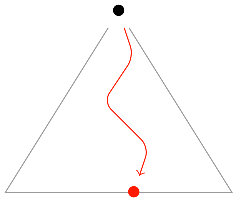
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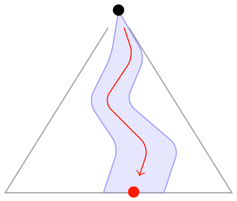
multiple runs,
at least one violating ✓

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each waypoint has 4 aspects:

- action - the meaning in the witness
- location - code location it is associated to
  - filename
  - line number
  - column (optional, the default is the first suitable column)
- type - the type of constraint it puts on runs
- constraint - the constraint itself

## Waypoint types

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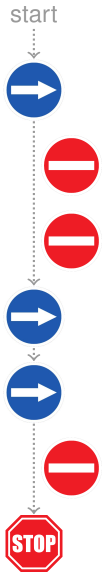
4. function_return
   - location: the right parenthesis after the function call
   - constraint: `\return` *op* *const*, where $op \in \{==, !=, <=, \ldots\}$ and *const* is a constant

## Waypoint actions

- follow - the waypoint has to be passed as soon as the location is entered
- avoid - the run represented by the witness must not pass the waypoint (“sink node”)
- target - the property violation

## Witness example



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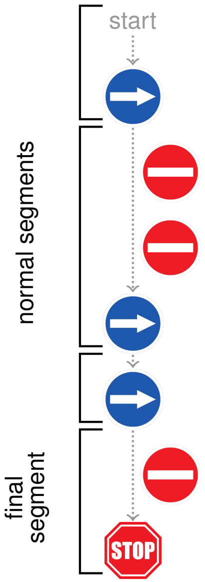

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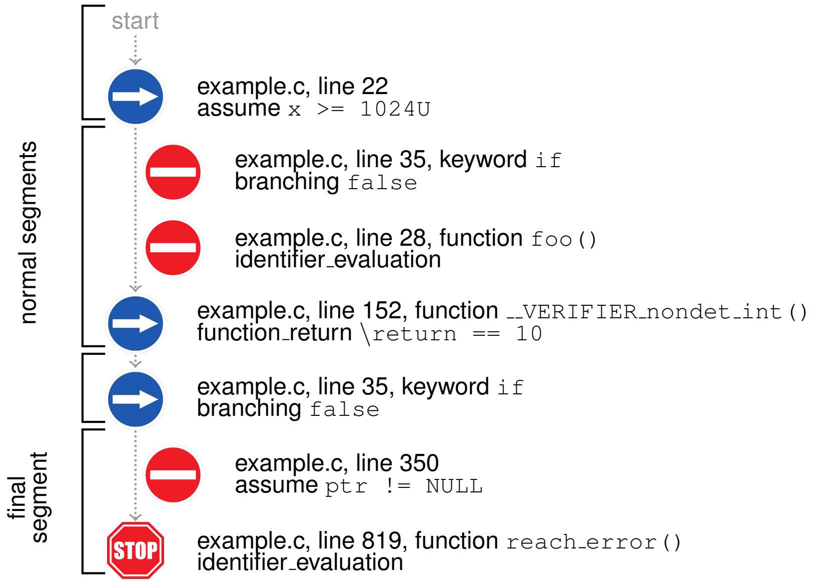


example.c, line 22
assume `x >= 1024U`

example.c, line 35, keyword `if`
branching `false`

example.c, line 28, function `foo()`
identifier_evaluation

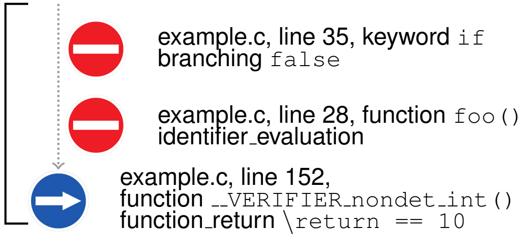
example.c, line 152, function `__VERIFIER_nondet_int()`
function_return `\return == 10`

example.c, line 35, keyword `if`
branching `false`

example.c, line 350
assume `ptr != NULL`

example.c, line 819, function `reach_error()`
identifier_evaluation

# Witness example - YAML notation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```
- segment:
  - waypoint:
    action: avoid
    type: branching
    location:
      file_name: example.c
      line: 35
    constraint:
      string: false
  - waypoint:
    action: avoid
    type: identifier_evaluation
    location:
      file_name: example.c
      line: 28
  - waypoint:
    action: follow
    type: function_return
    location:
      file_name: example.c
      line: 152
    constraint:
      string: \return == 10
```

## Current status and future plans

- informal textual description and an example of a witness
- supports only violation witnesses of reachability safety, memory safety, and no overflows on sequential programs
- three independent validators under development
- support of this format by several verifiers under development

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**plans**

- write a documentation (expected availability in September 2023)
- use it in SV-COMP 2023 (in addition to the GraphML format)
- extend it to support parallel programs and other properties
- add some features that will be requested by the community (repetitions of segment, Kleene star, . . . ?)

## Conclusion

- new violation witness format in YAML
- very simple and easy to implement
- easier to read by humans
- clear semantics
- extendable