Human-Controlled Fuzzing with AFL

Maxim Grishin

Igor Korkin

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WHO WE ARE

Maxim Grishin

- Bachelor of Information Security
- National Research Nuclear University MEPhI
- Cryptology and Cybersecurity Department

Igor Korkin, PhD

- Independent Security Researcher
- Speaker at CDFSL, BlackHat, HITB, SADFE
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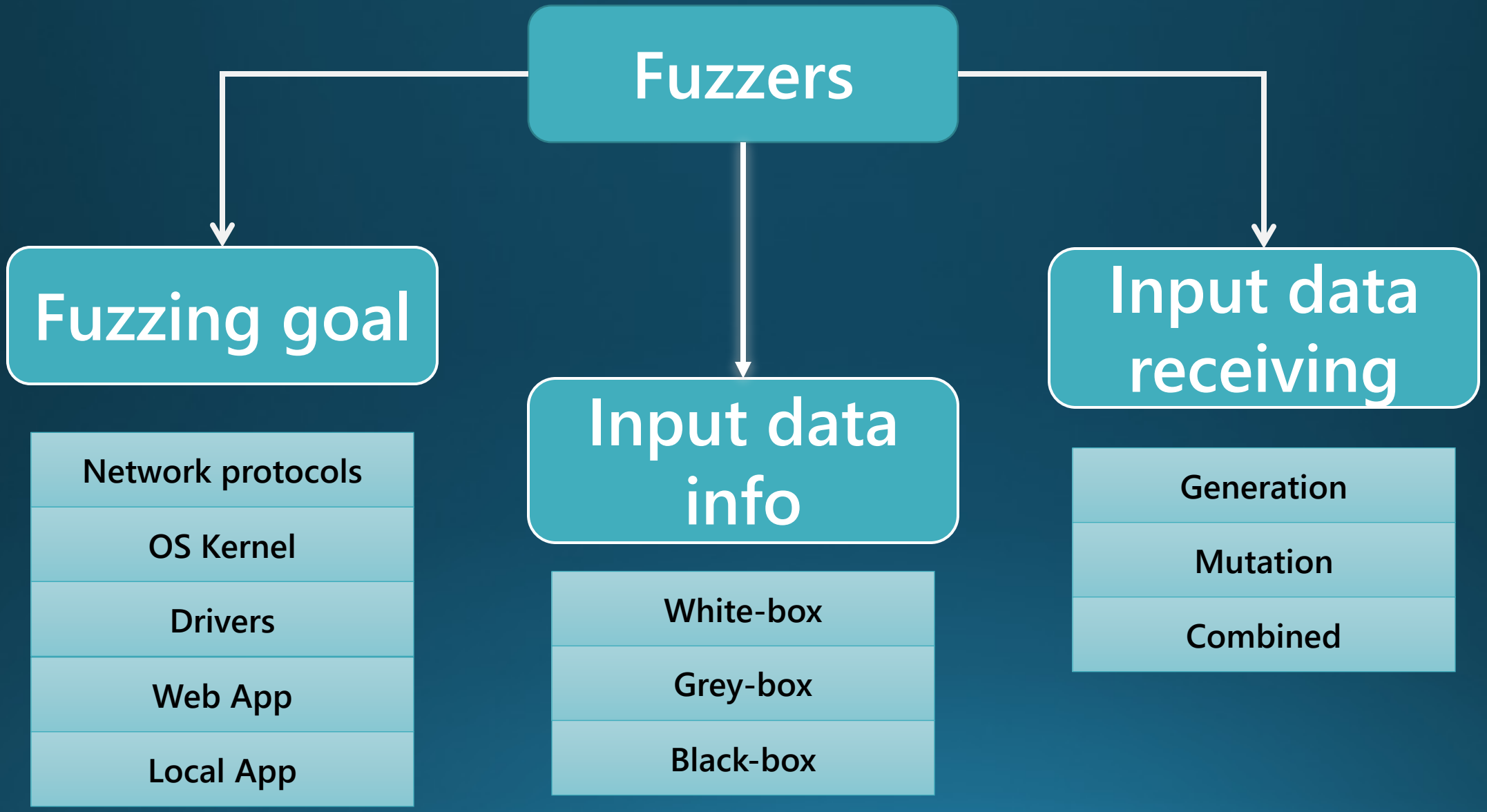
AGENDA

- Fuzzing and classification of fuzzers
- The main fuzzing strategy
- Fuzzing with AFL. The problem of analyzing identical code sections
- The proposed tool. The algorithm and details of the work
- Execution traces registration
- Test results
- Future plans

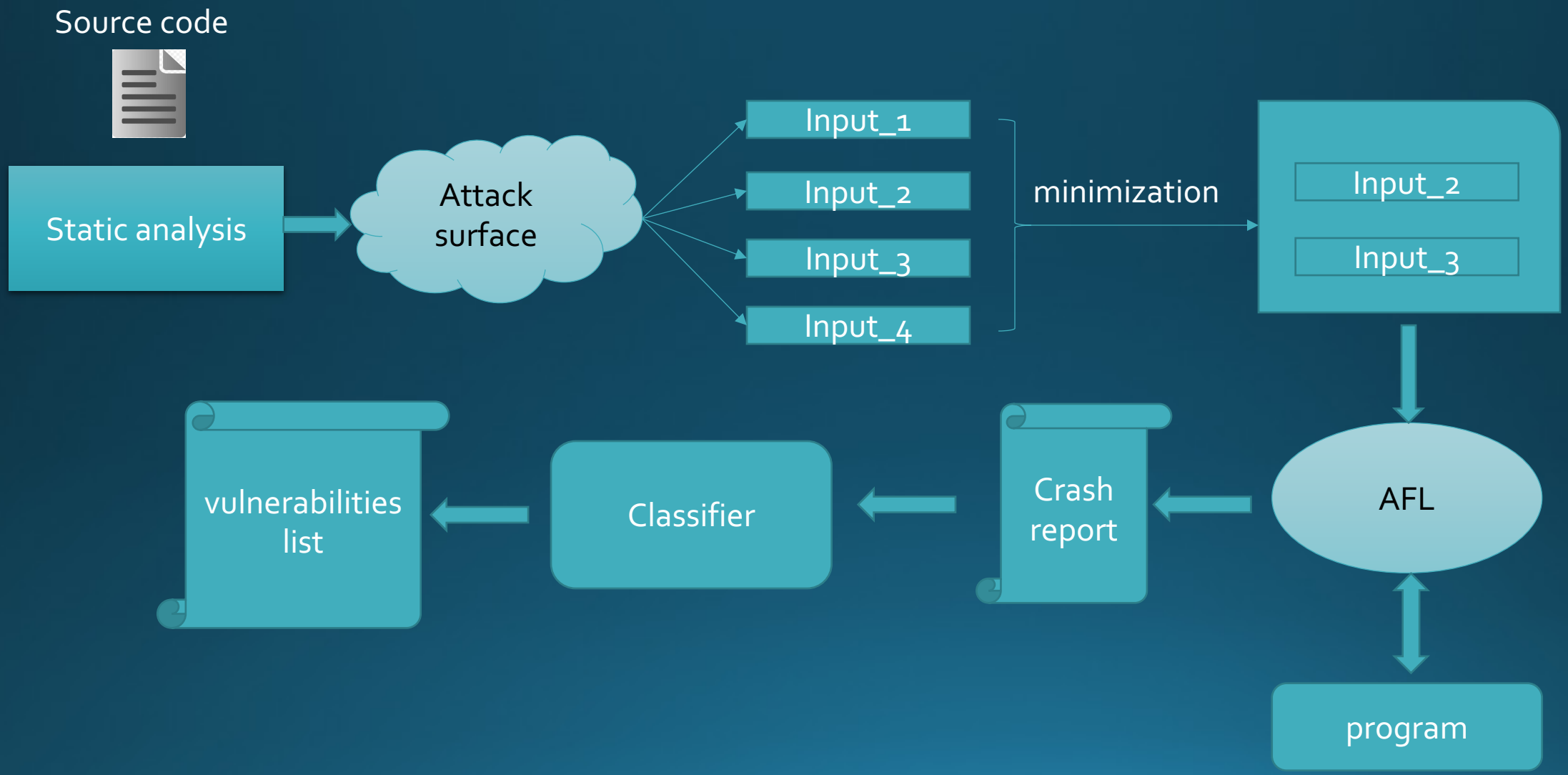
WHAT IS FUZZING?

- Fuzzing is a technique of automated testing when a program receives specially modified, incorrect data.

EXE

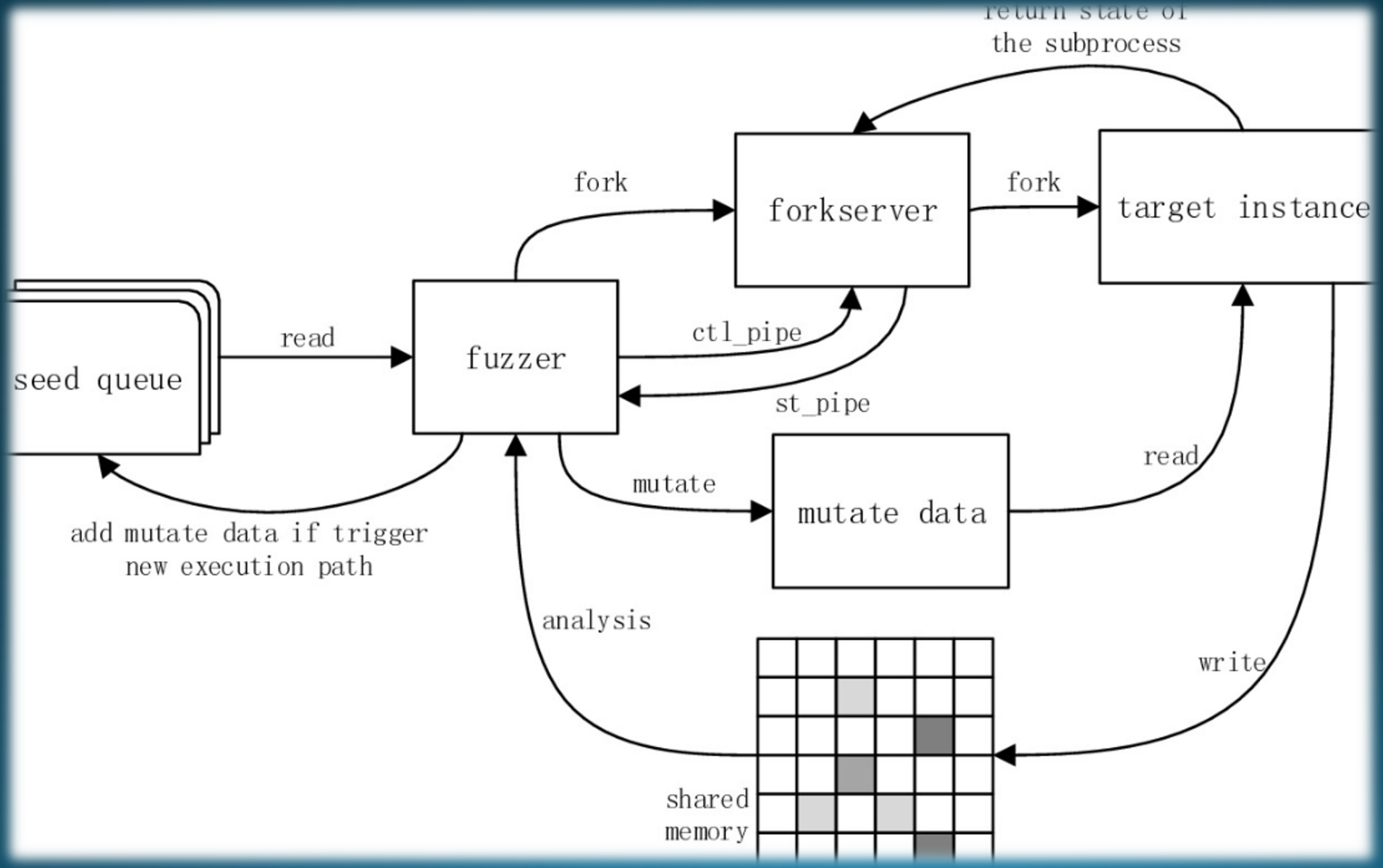

Fuzzers
Fuzzing goal
Input data info
Input data receiving
Network protocols
OS Kernel
Drivers
Web App
Local App
White-box
Grey-box
Black-box
Generation
Mutation
Combined

FUZZING STRATEGY

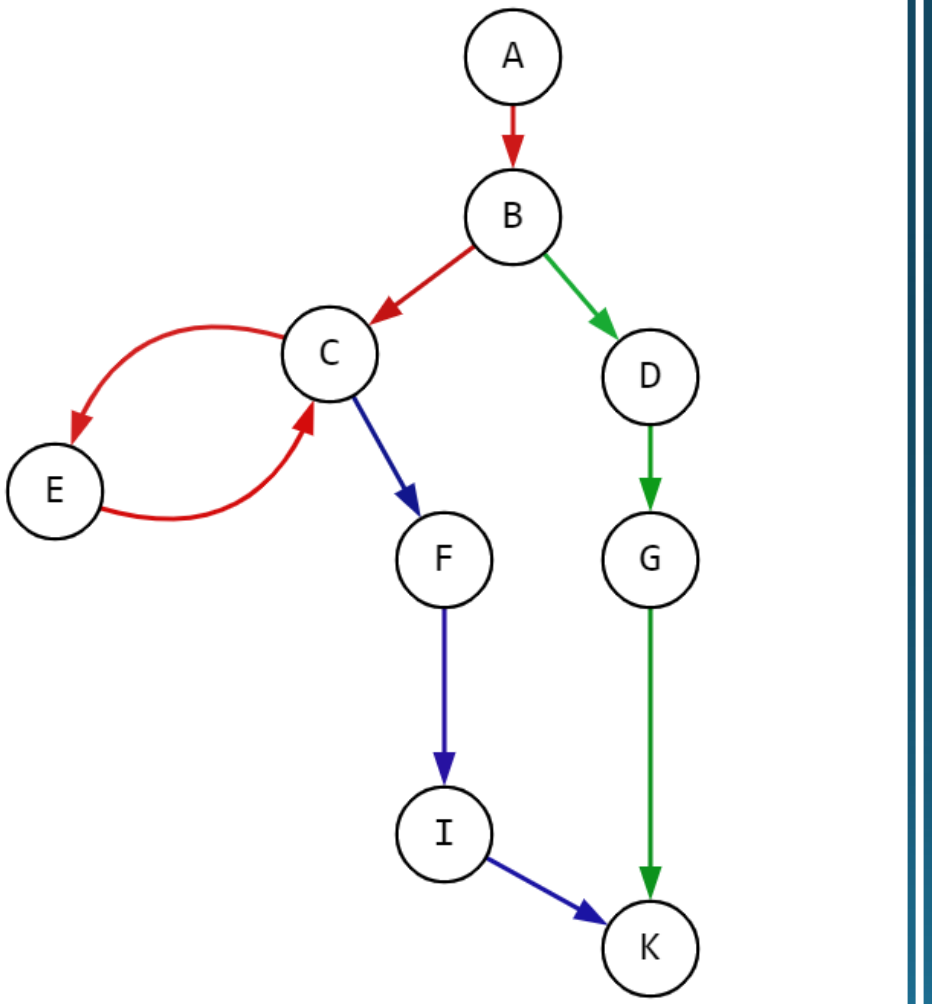


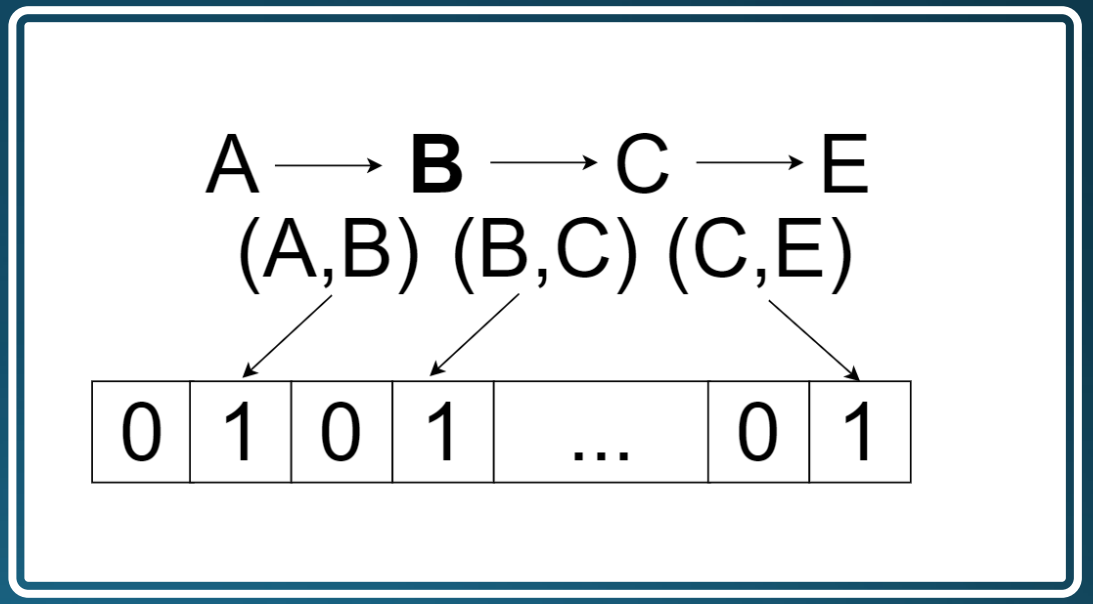
American Fuzzy Lop

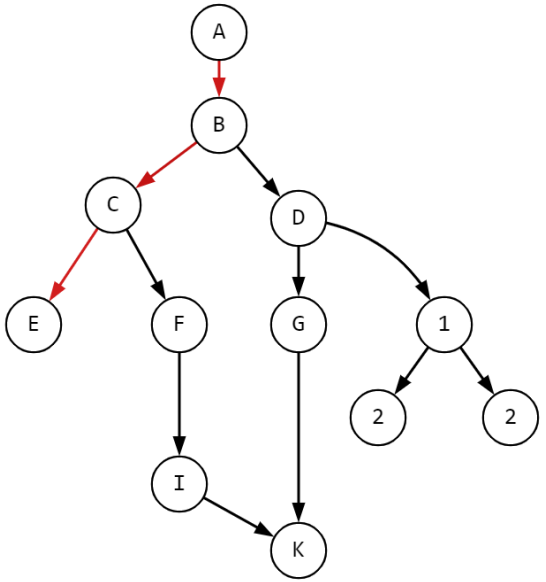
AFL – PROCESS STANDARD CYCLE



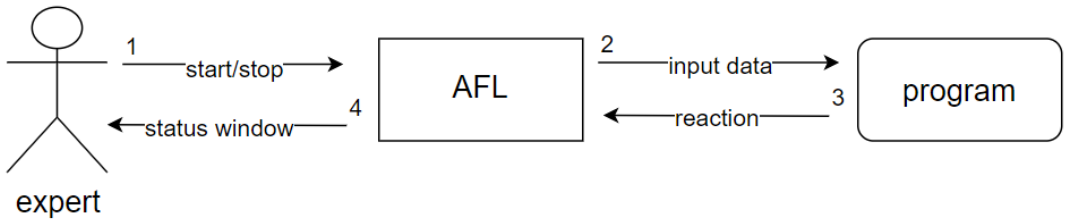
EXECUTION TRACE



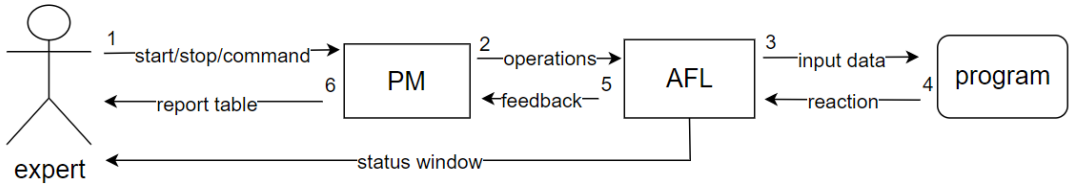




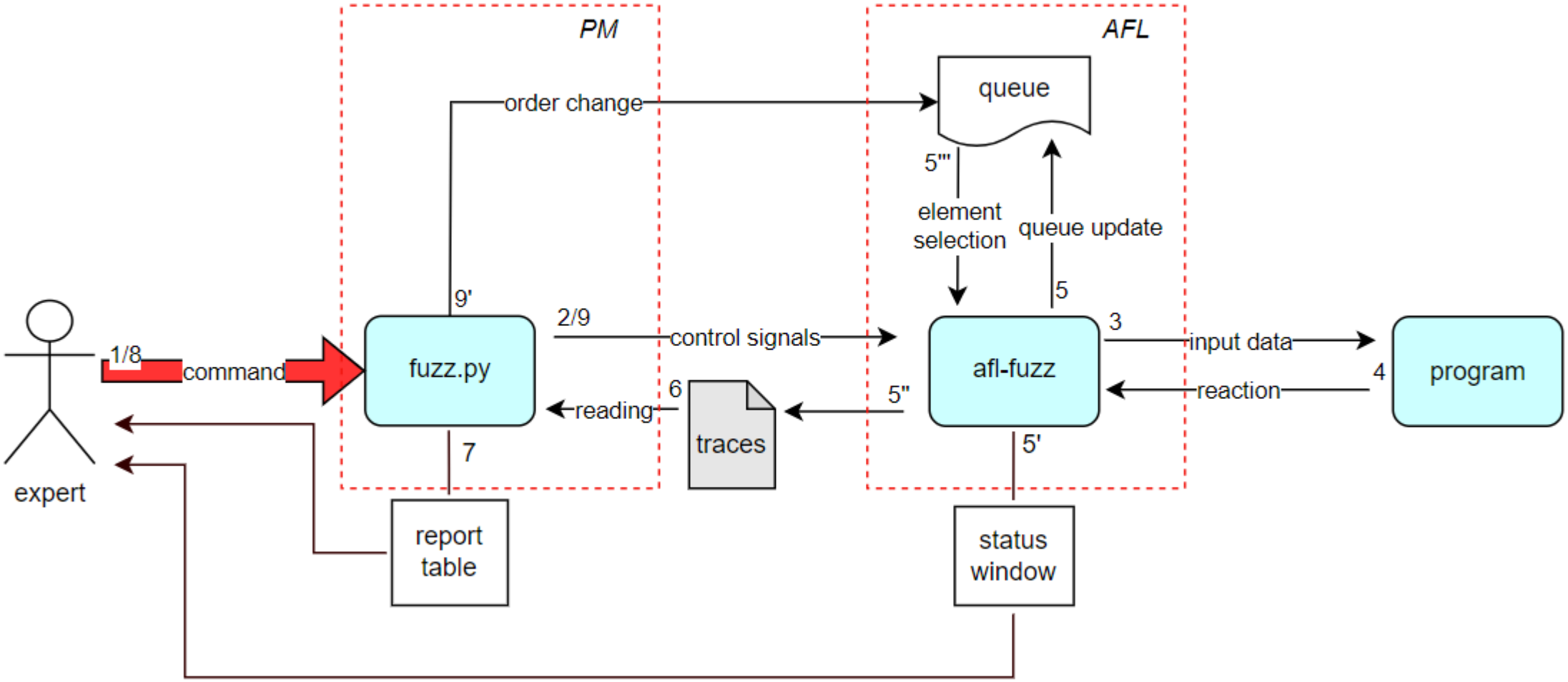
(A,B) (B,C) (C,E)
(A,B) (B,C) (C,E)
...
(A,B) (B,C) (C,E)



Classic AFL scheme



Proposed fuzzing system scheme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order change
5'''
element selection
queue update
5
9'
2/9
control signals
3
input data
1/8
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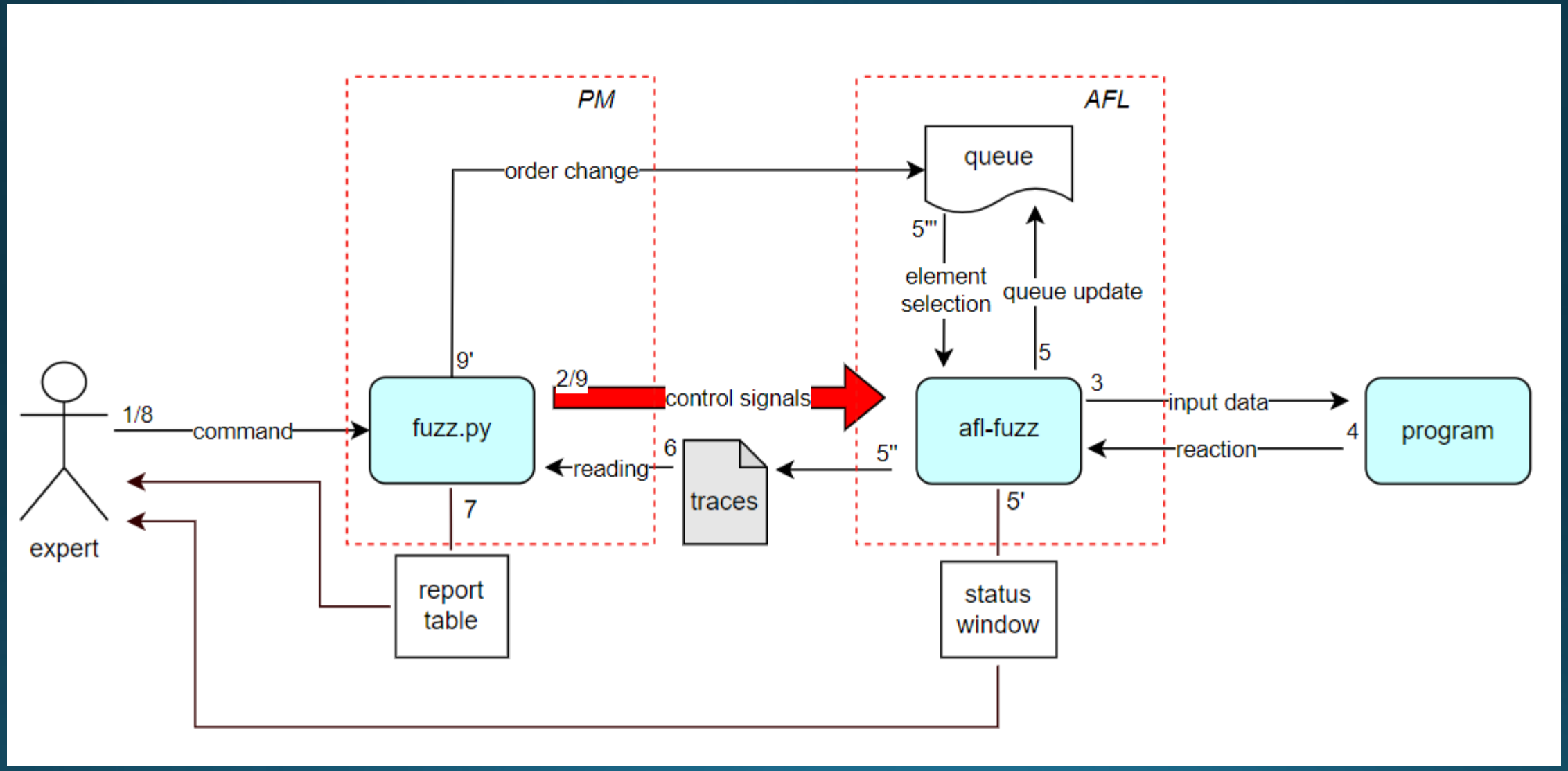
afl-fuzz
program
4
reaction
6
reading
5''
traces
7
5'
expert
report table
status window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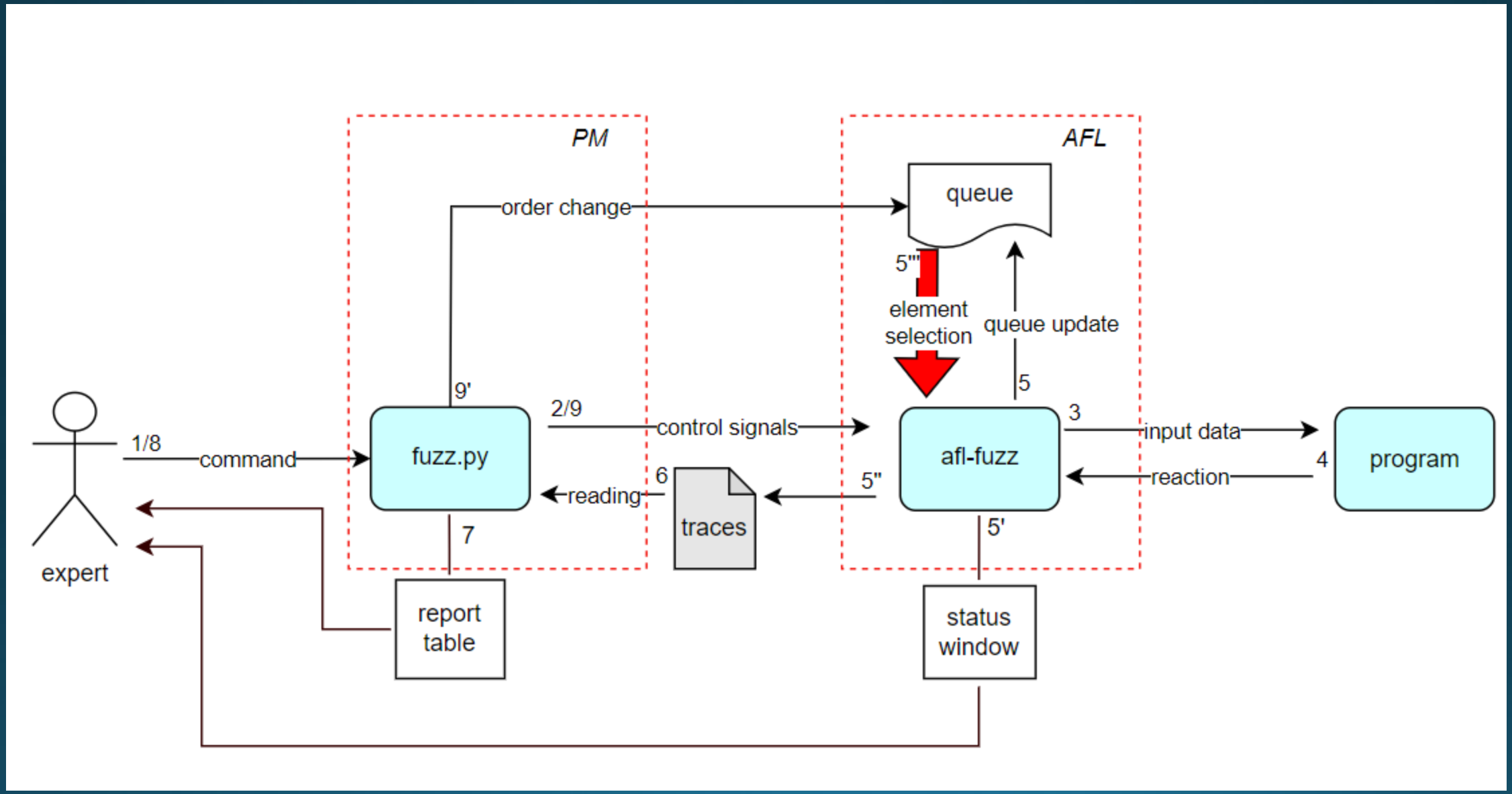
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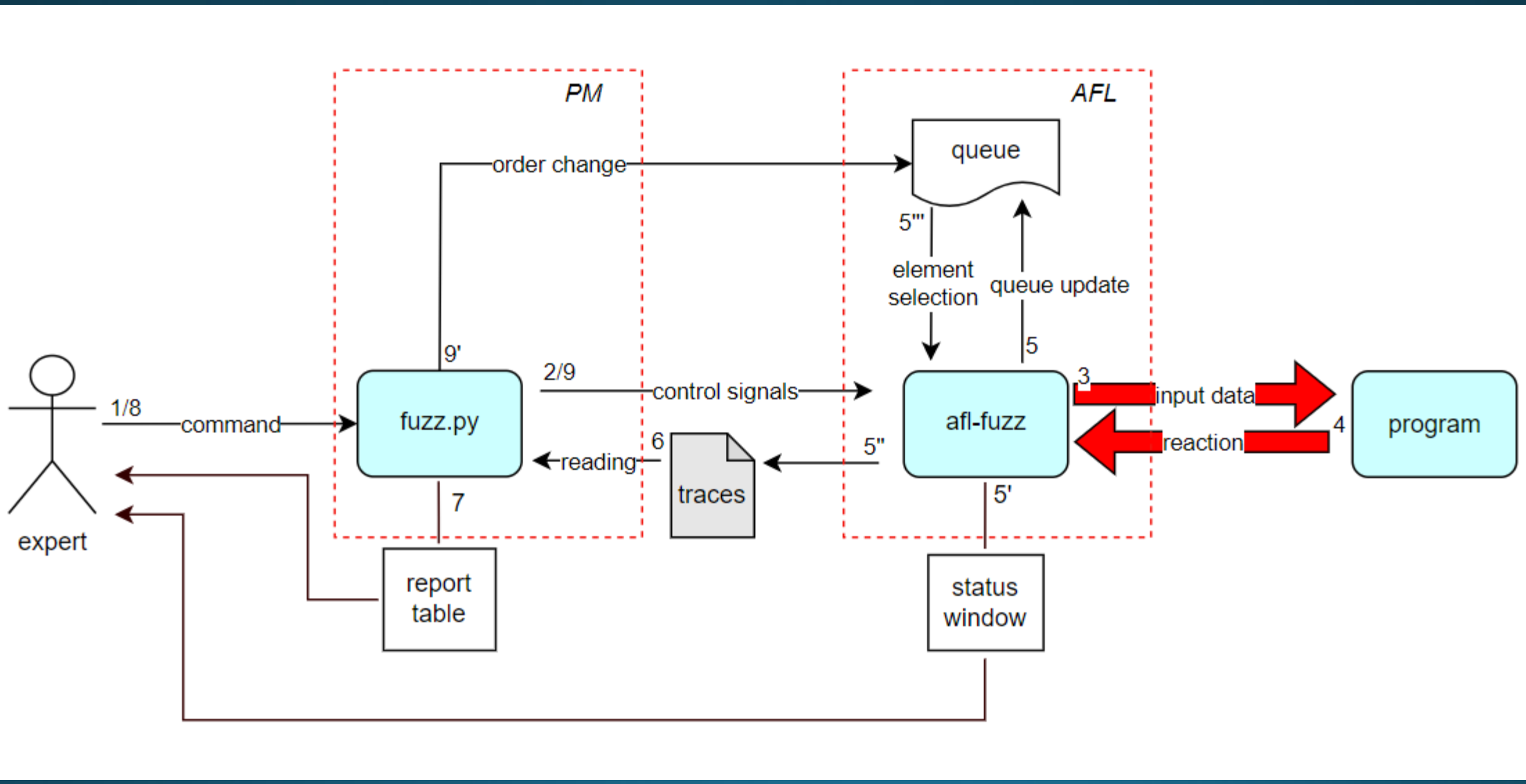
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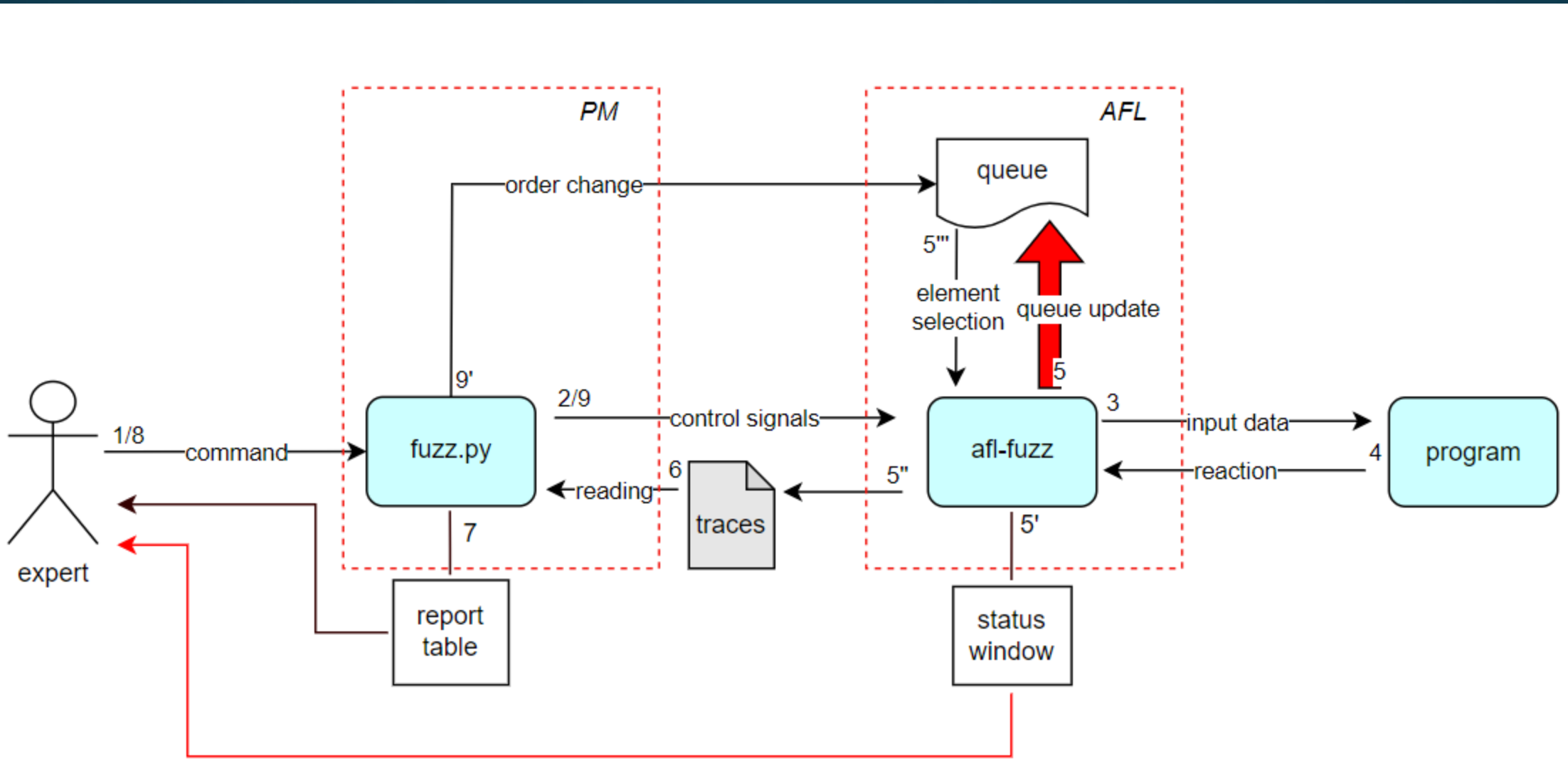
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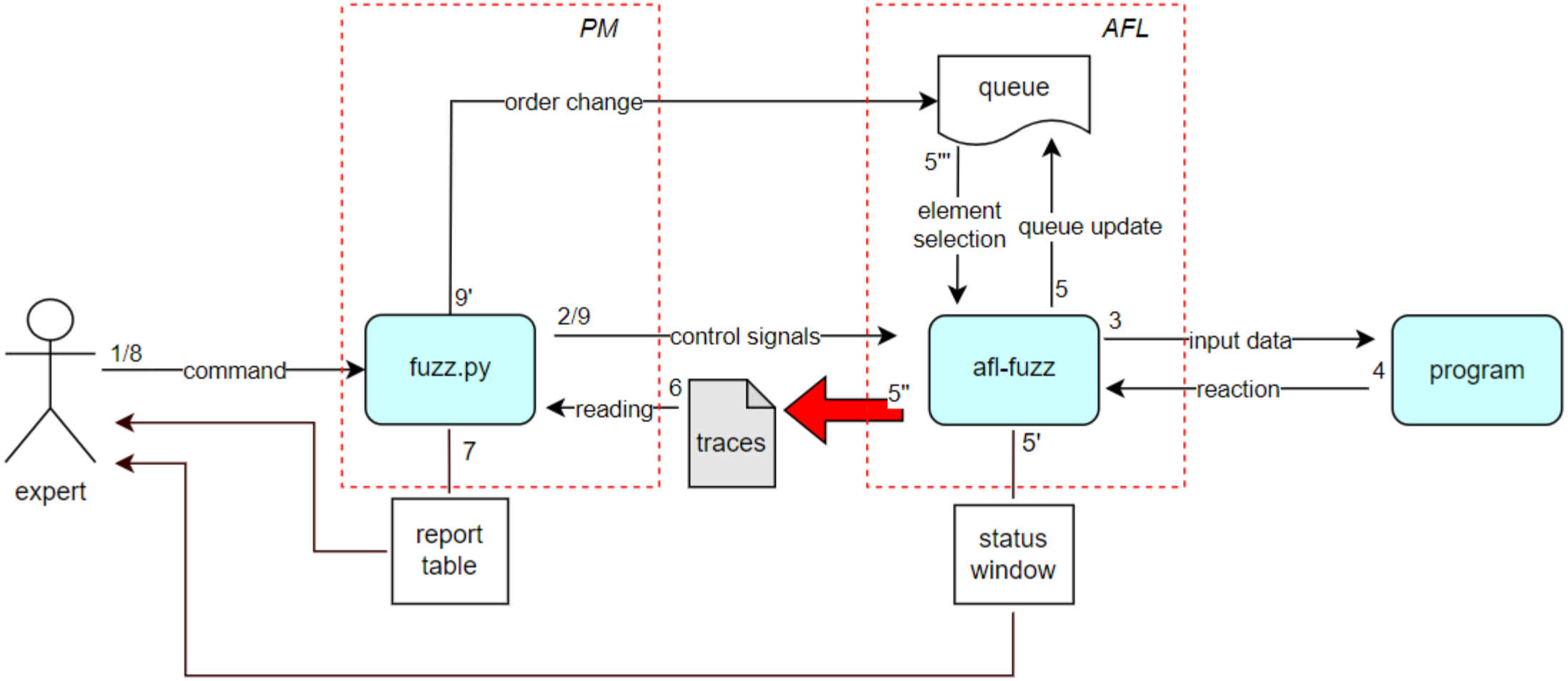
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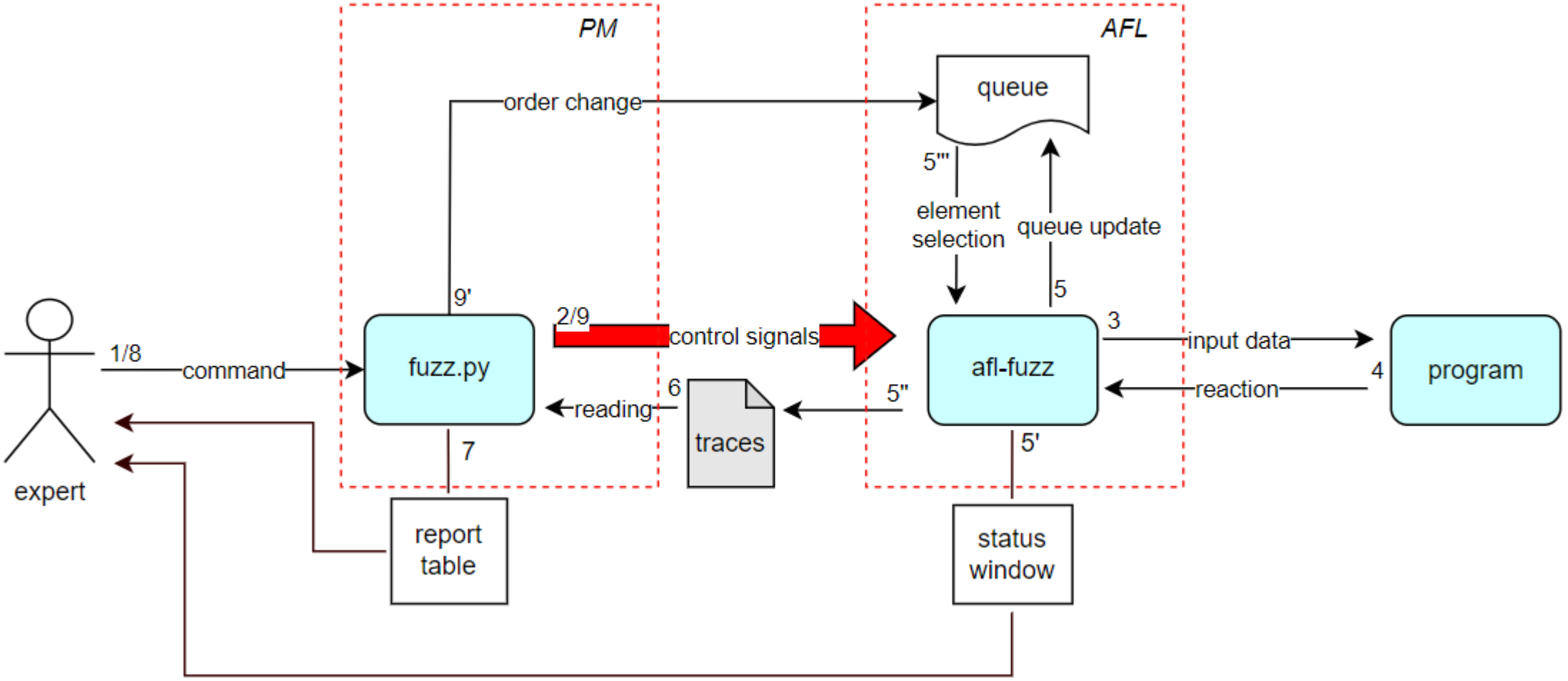
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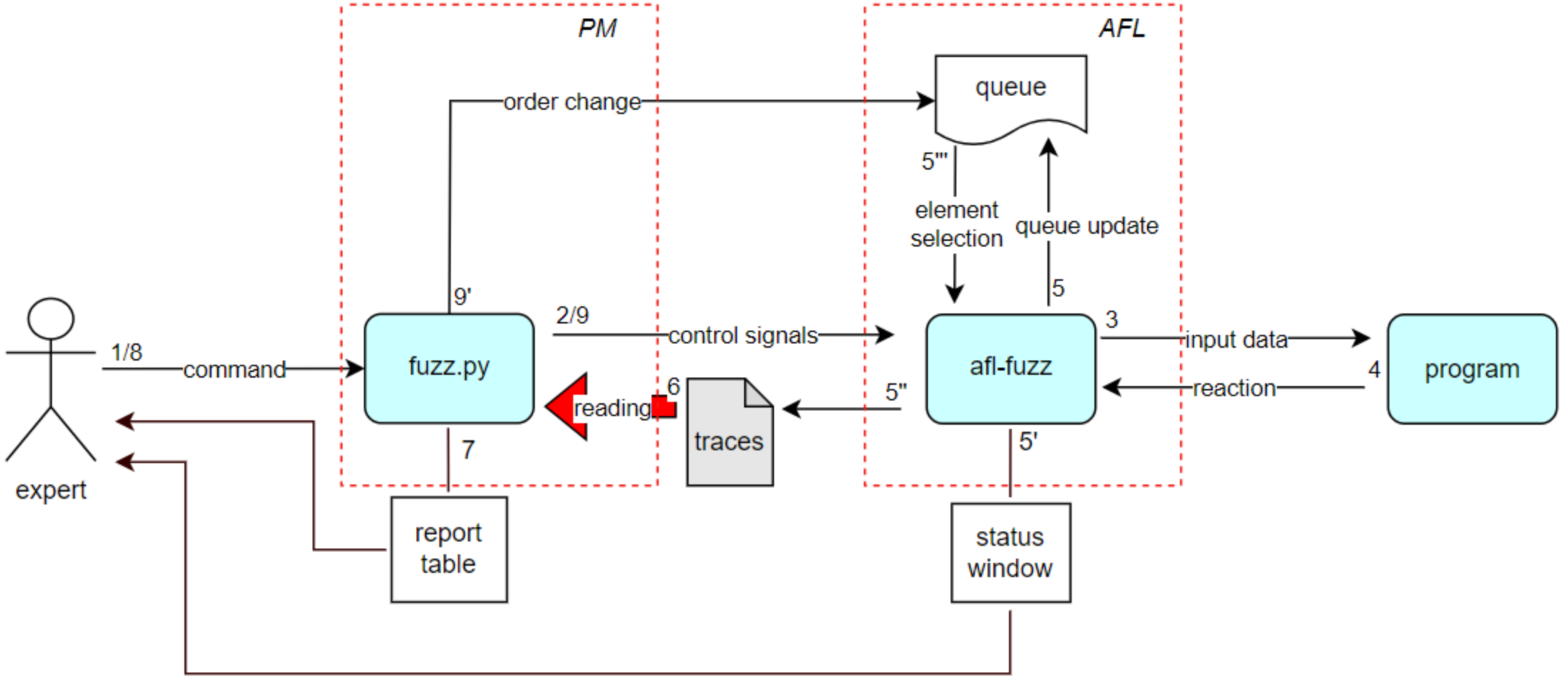
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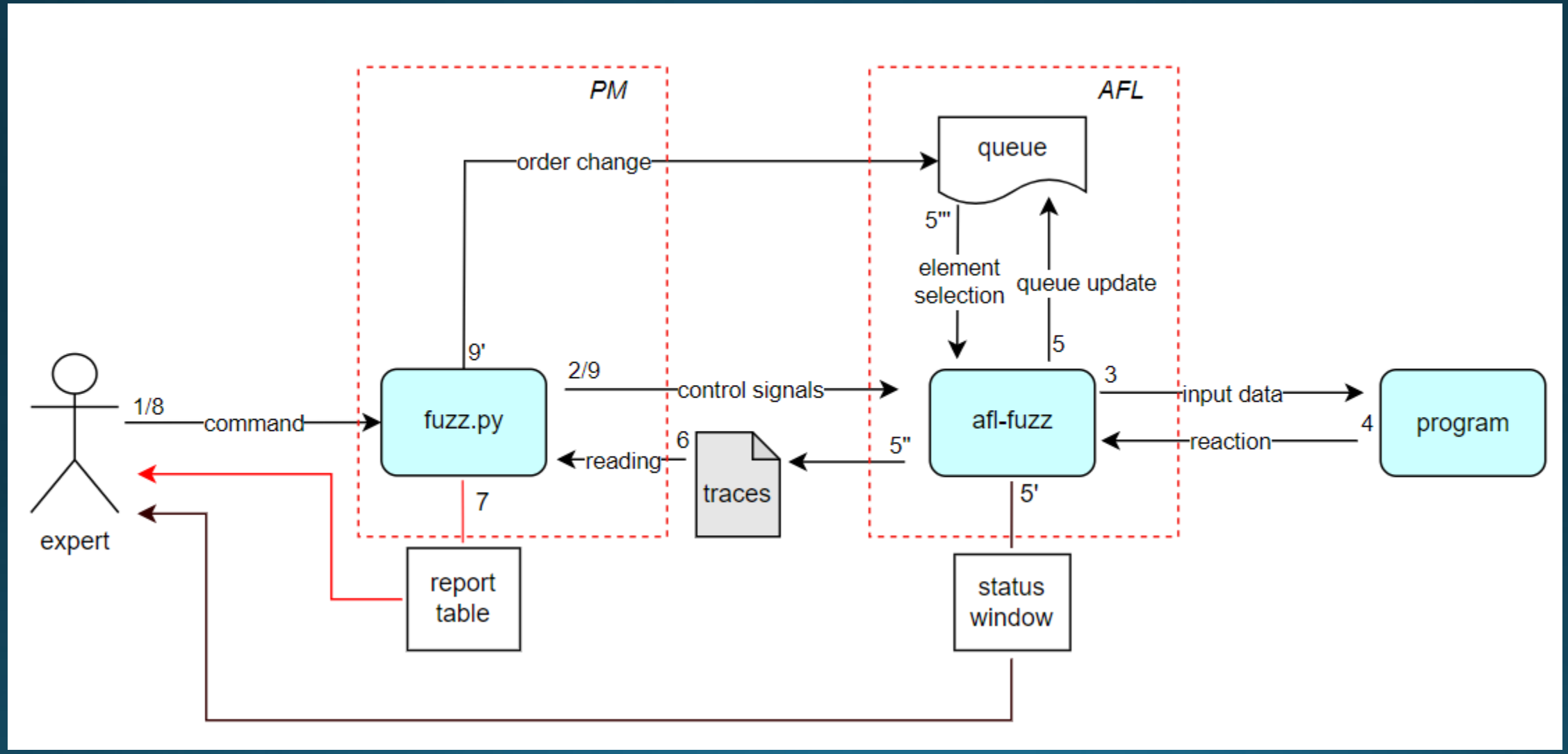
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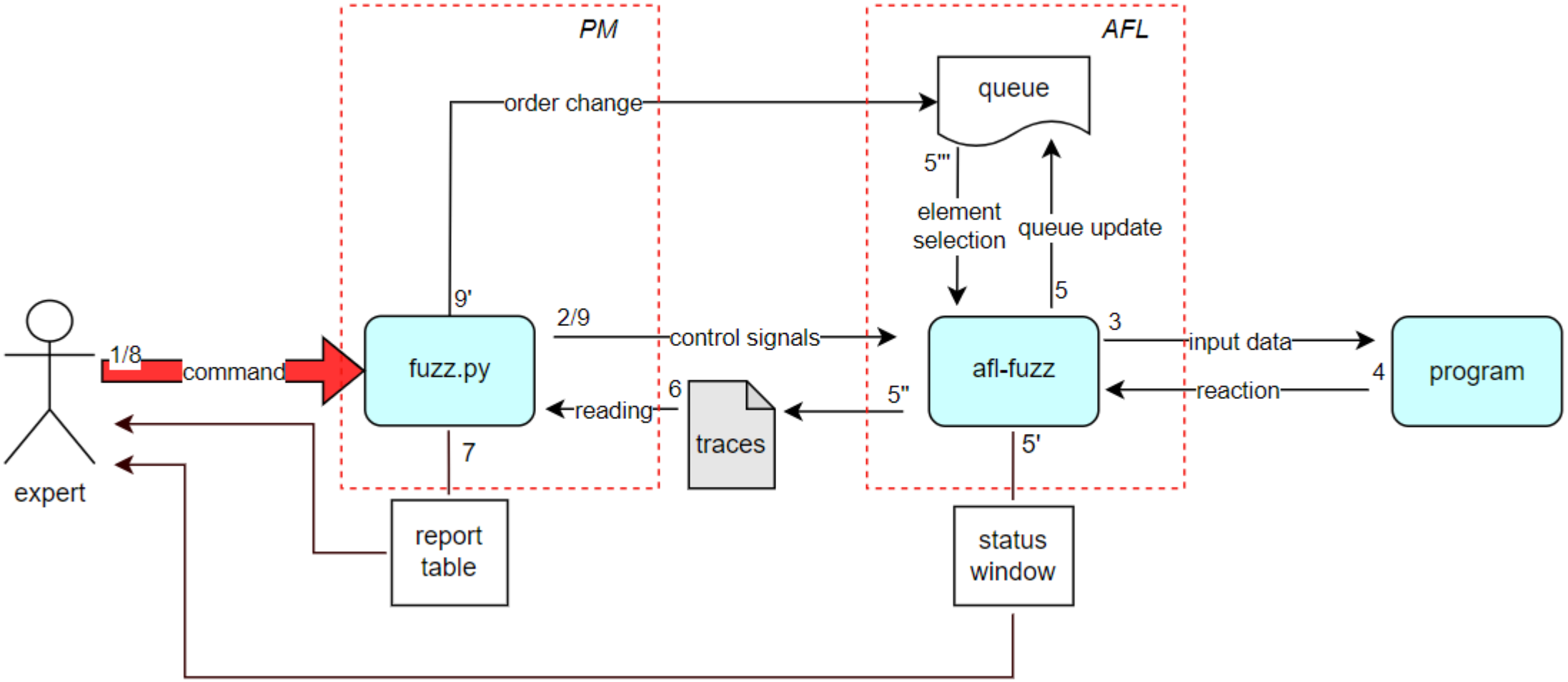
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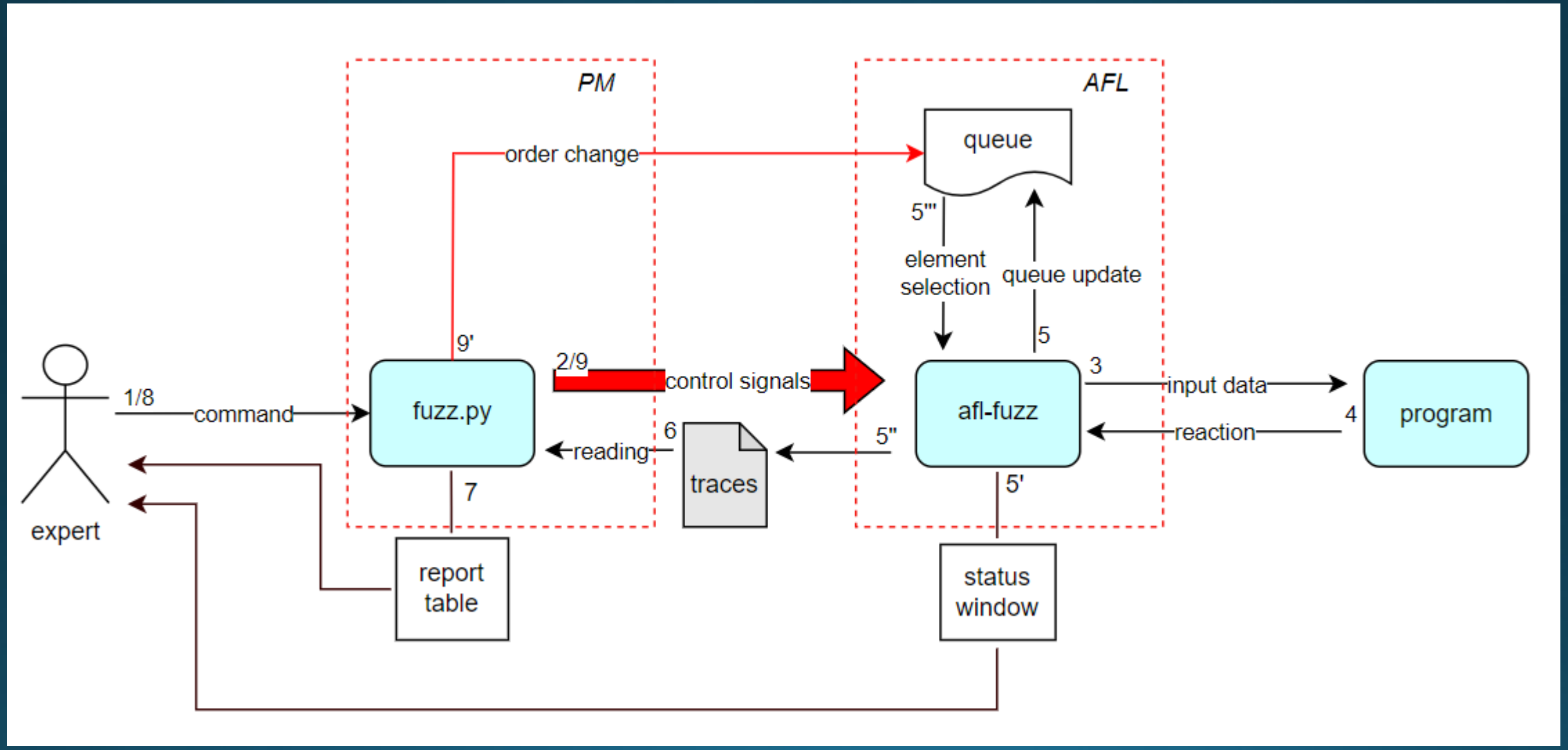
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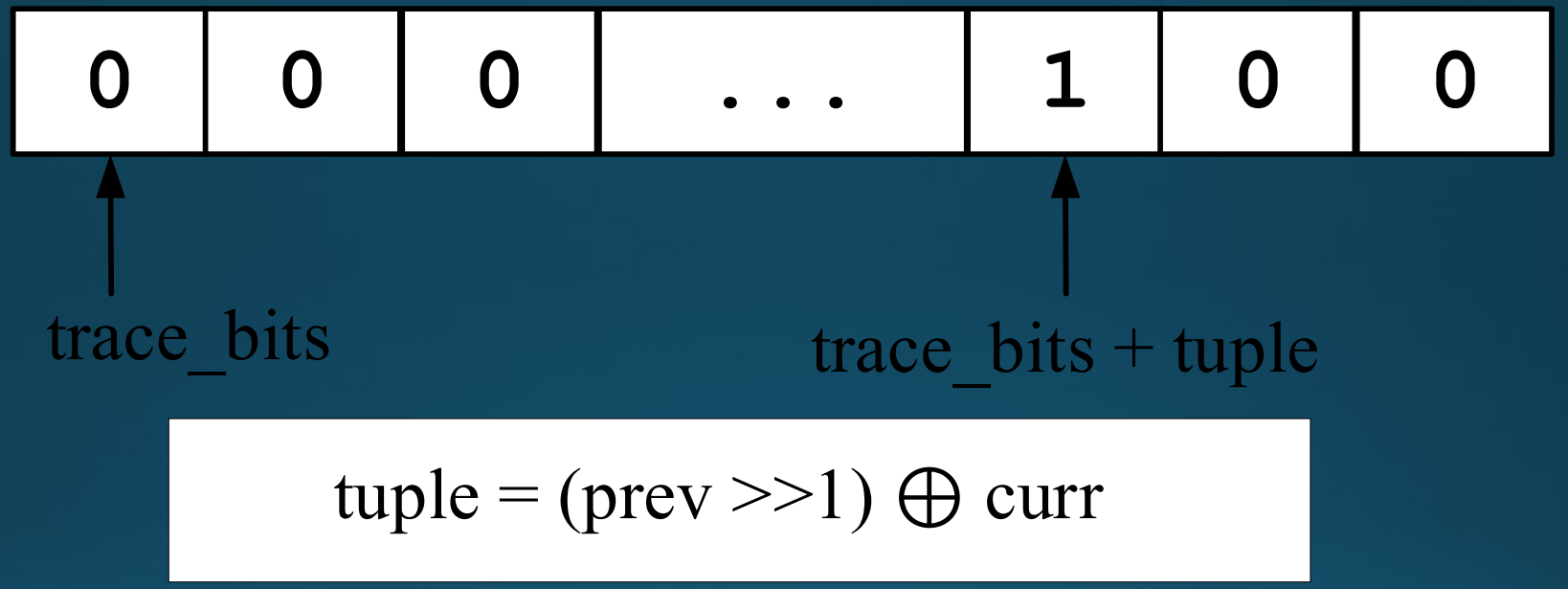
EXECUTION TRACE DETECTION



Prev – previous base block label;
Cur – current base block label.

EXECUTION TRACE DETECTION

```
#endif /* ^WORD_SIZE_64 */

      }

      *virgin &= ~*current;

    }

    current++;
    virgin++;

  }

  s32 fd;
  fd = open(out_file, OWRONLY | O_CREAT | O_EXCL, 0600);

  FILE *f = fdopen(fd, "w");

  for (u32 i = 0; i < MAP_SIZE; i++){
        if (trace_bits[i] != 0) fprintf(f,"%06u(%u) ",i,trace_bits[i]);
  }

  fclose(f);
```

REPORT TABLE

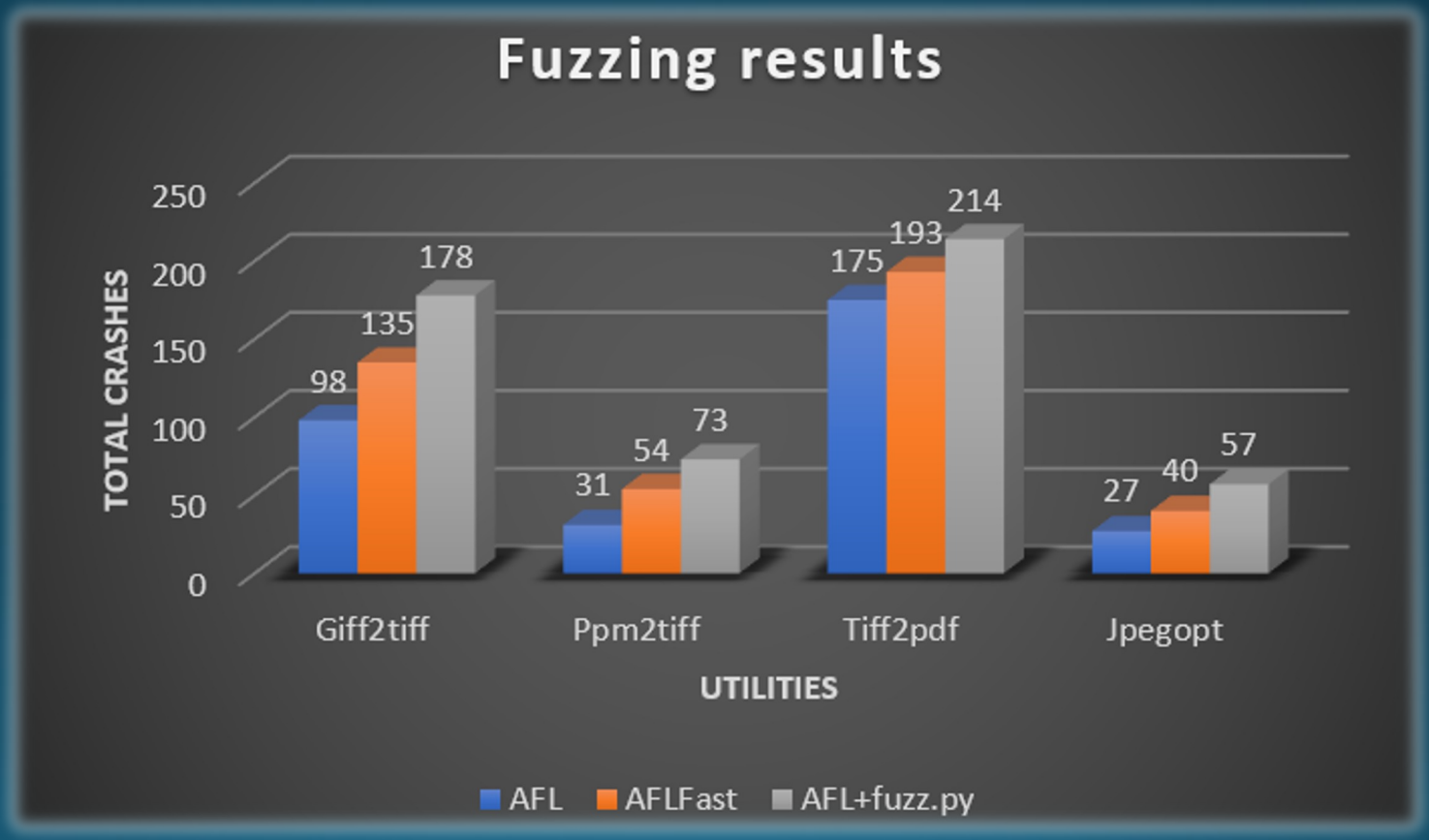
```
+-----------+-------+------+------------+----------+----------+--------+
|   object  |  qrun | qcov | part_execs | part_cov | now_exec |  src   |
+-----------+-------+------+------------+----------+----------+--------+
| id:000002 | 30266 |  1   |     56     |    0     |    +     |  orig  |
| id:000004 |   1   |  1   |     0      |    0     |    -     | 000000 |
| id:000005 |   1   |  1   |     0      |    0     |    -     | 000001 |
+-----------+-------+------+------------+----------+----------+--------+

0 --- Exit
1 --- Continue
2 --- Change flow in format: "2->id"

Enter command > 2->000004
<flow changed> | now_exec -> id:000004
```

FUZZING RESULTS

$T_{RT} = 30\ min$
$T_f = 12\ h$



FUTURE PLANS

- **To consider the scheme of using the proposed solution with static analyzers**
- To add visualization module
- Machine learning elements usage
- To consider the approach in schemes based on other fuzzing tools

THANK YOU FOR YOUR ATTENTION