GIL

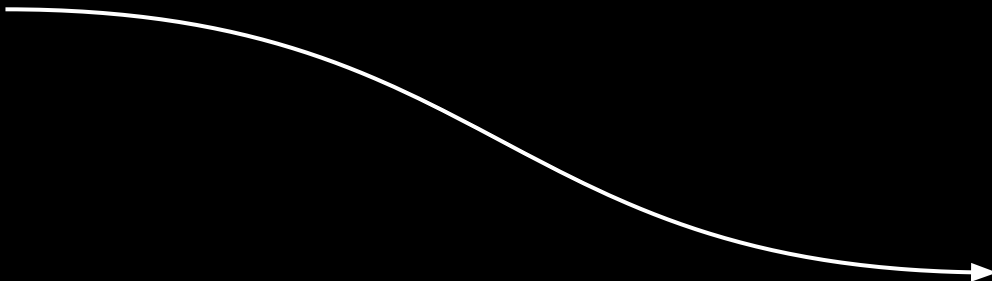
Google: can Python into threads?

„CPython doesn't support multi-threading"

1992

1992

- me



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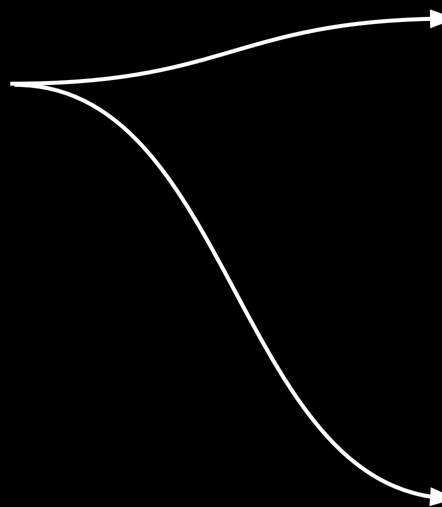
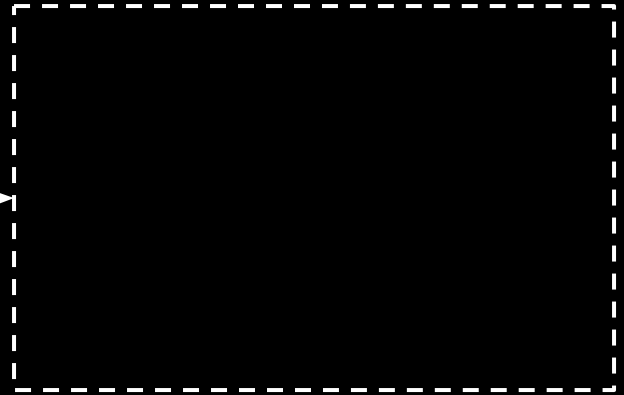

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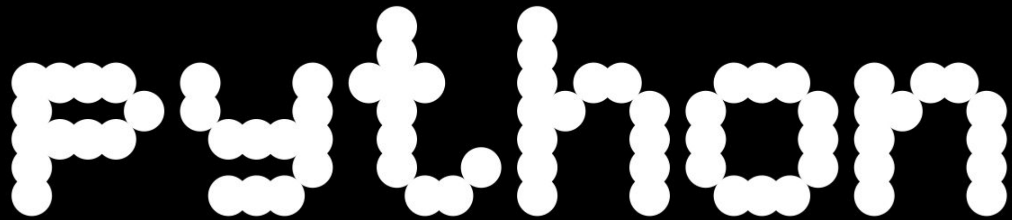
- Python (with threading support)



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kolodziejj.info
@unit03

GIL

GIL: prerequisites

Parallelism

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- requires multiple cores

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Thread 0 on core 0

Parallelism

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Thread 1 on core 1

Parallelism

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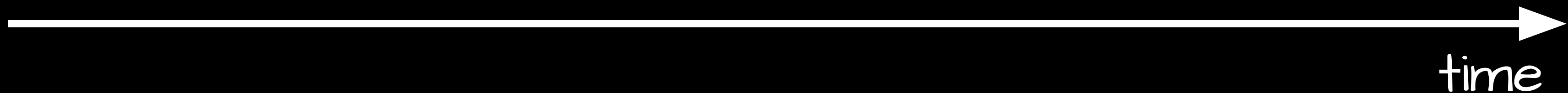
Thread 0 on core 0

Thread 1 on core 1

- as opposed to concurrency

Single core



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- thread state:
  - ready/runnable
  - running
  - waiting/blocked

Locks
and system calls

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  - can be blocking (e.g.: I/O access, sleeping...)

Memory management

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  - JVM or C#

Python bytecode

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a = 1

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Python bytecode

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                       4 STORE_FAST     0 (a)
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- bytecode -> interpreter -> execution

finally

GIL

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- protects against race conditions:
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  - "C-mutable" Python data structures (dicts, lists, strings, tuples, integers etc.)
  - internal global state
  - atomic APIs
- C extensions/binary modules are written assuming GIL exists

GIL

- holding the GIL not needed when:

GIL

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- holding the GIL not needed when:
    - waiting for I/O
    - executing code that doesn't access Python data structures

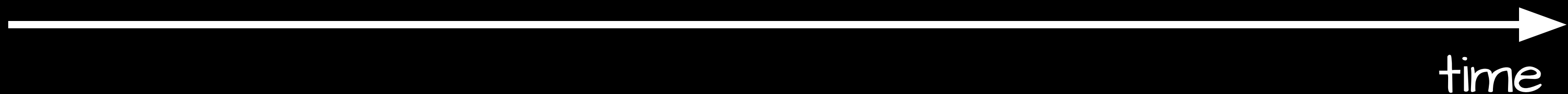
GIL: scenario 1

single thread

GIL: scenario 1

T0 running

GIL: scenario 1

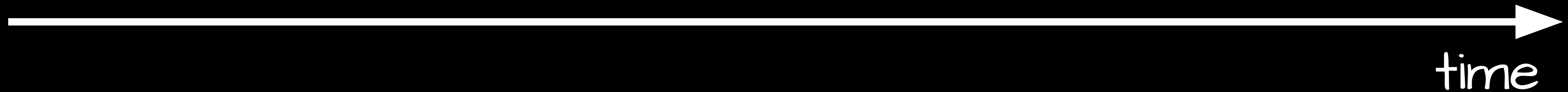


GIL: scenario 2

two threads

GIL: scenario 2

T0 running



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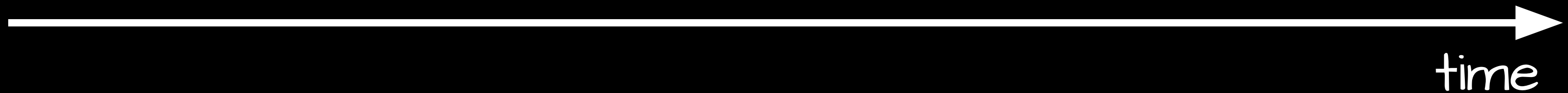

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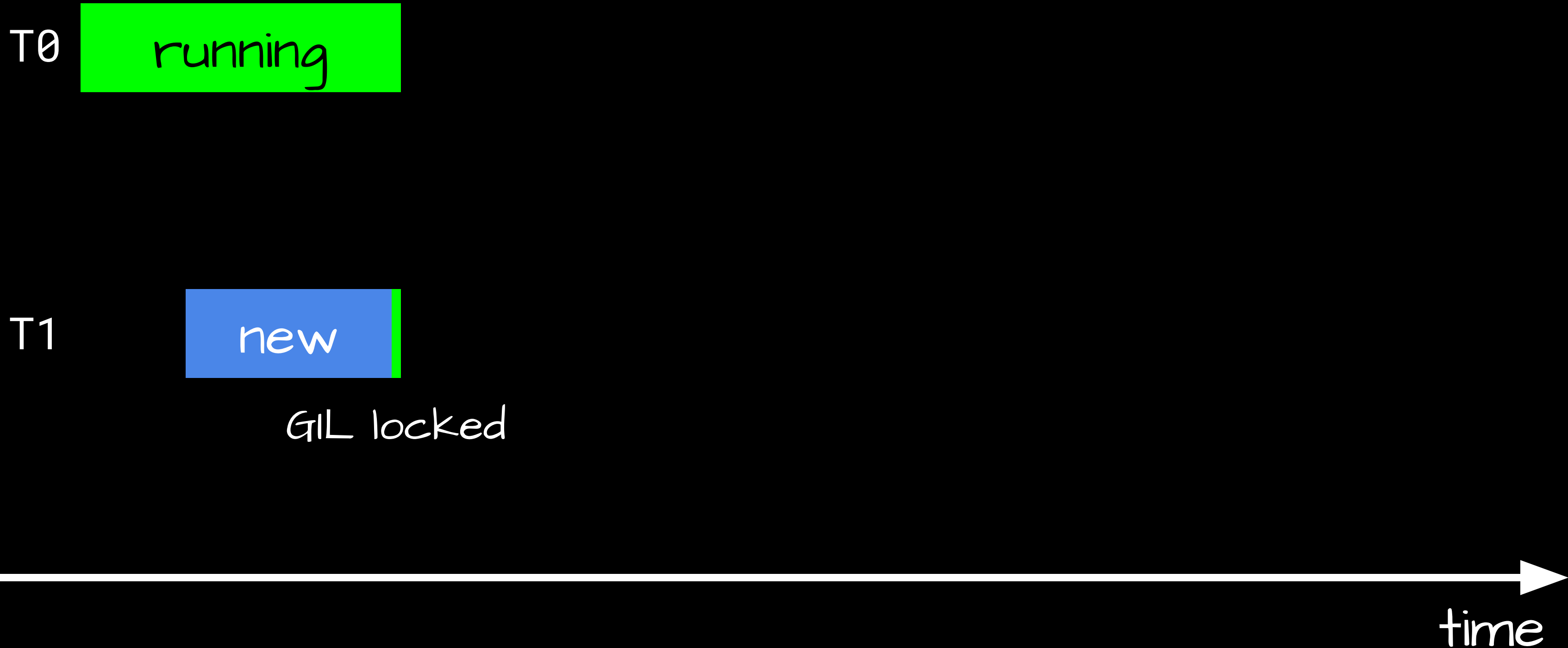
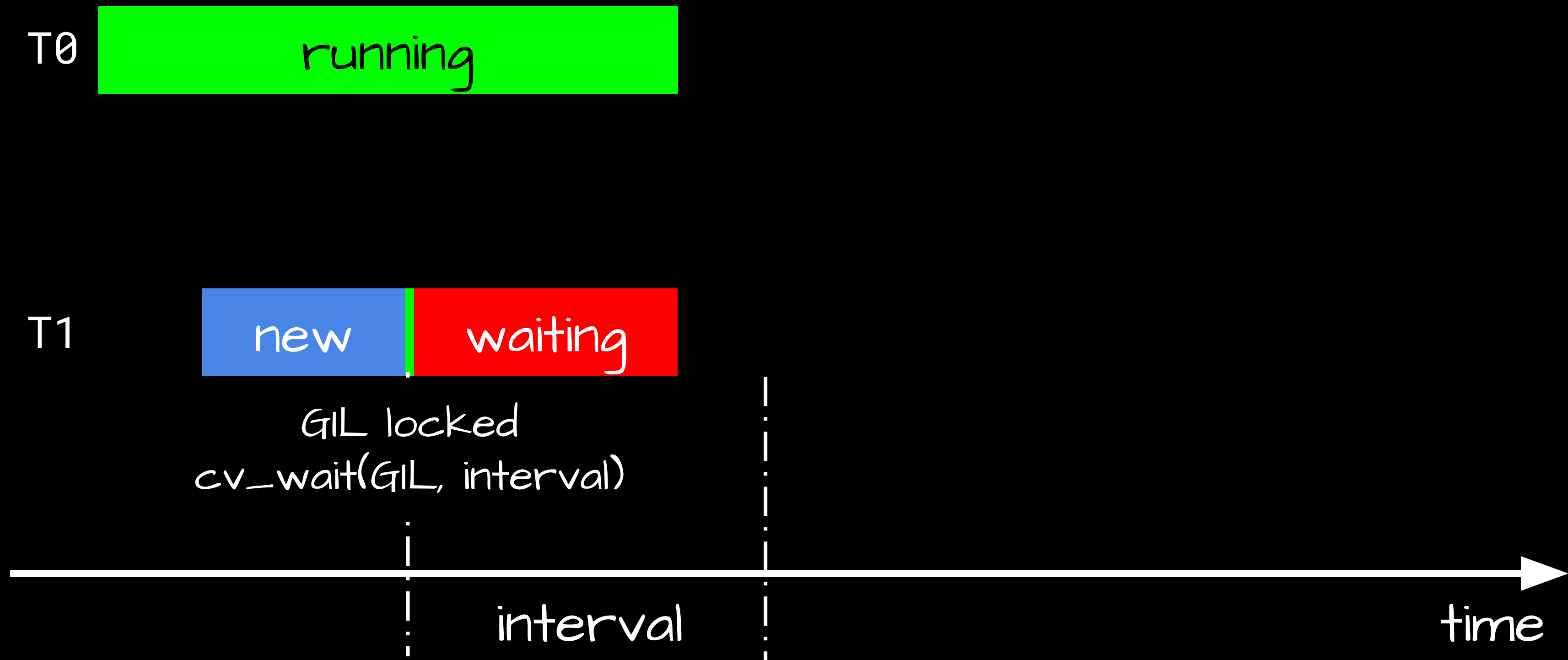


GIL: scenario 2

GIL locked
cv_wait(GIL, interval)

GIL: scenario 2



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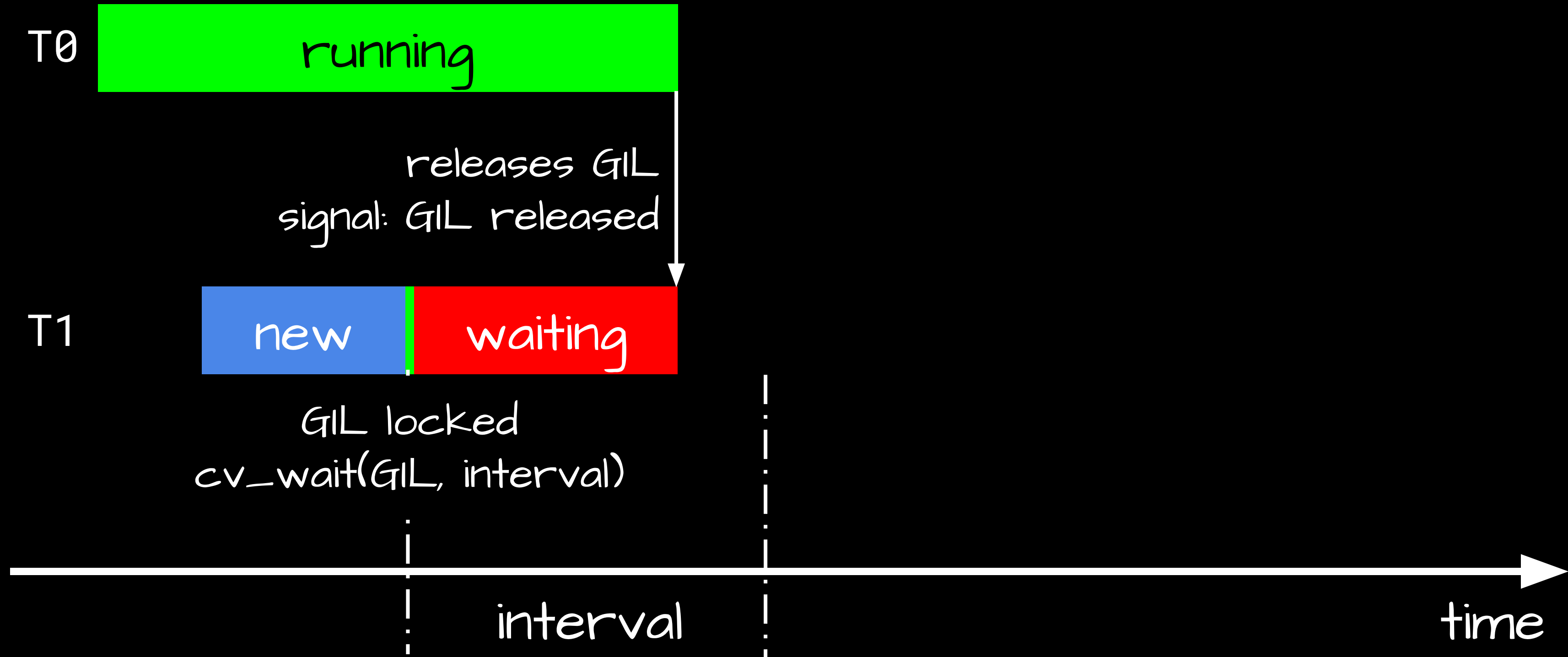

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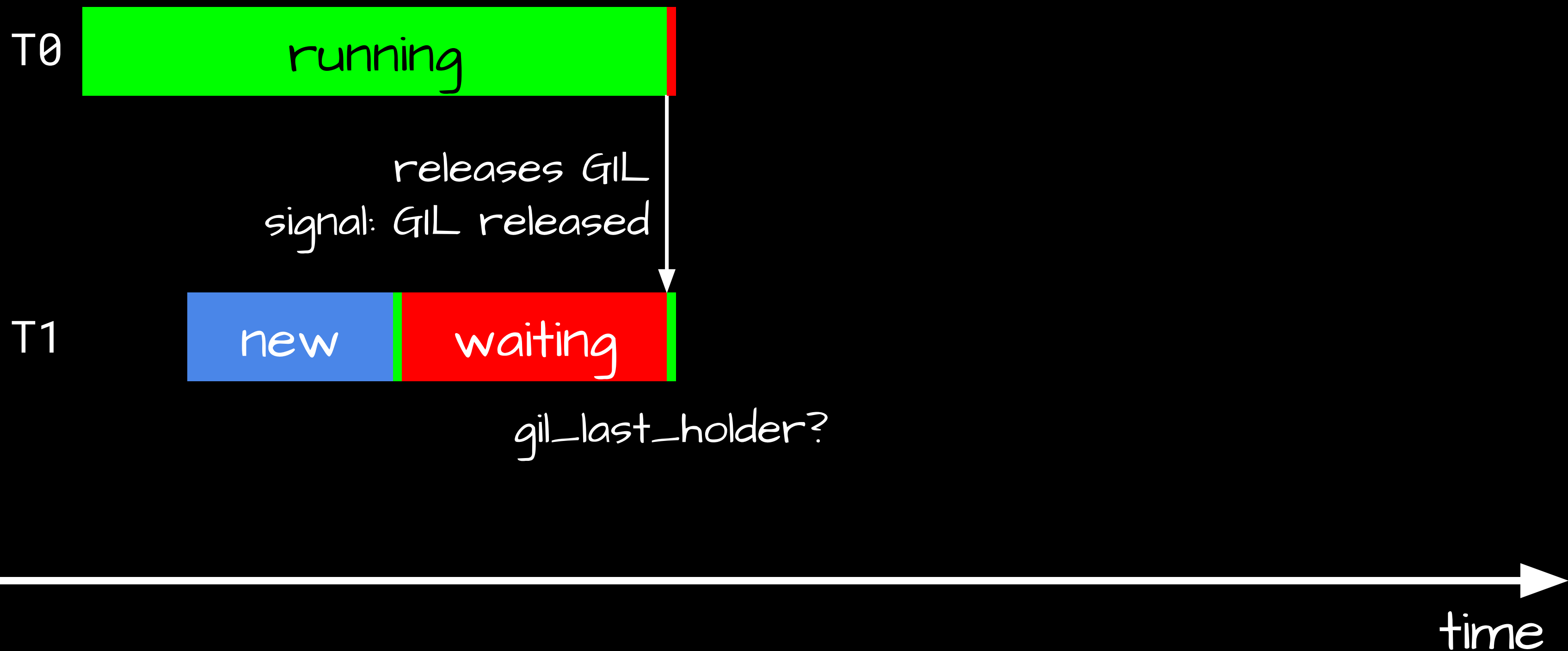

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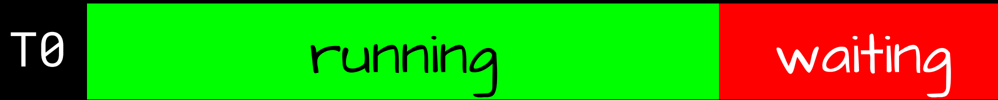
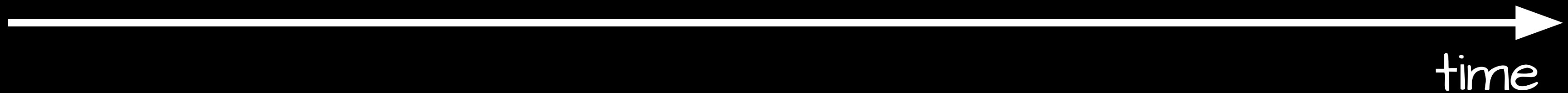
T0


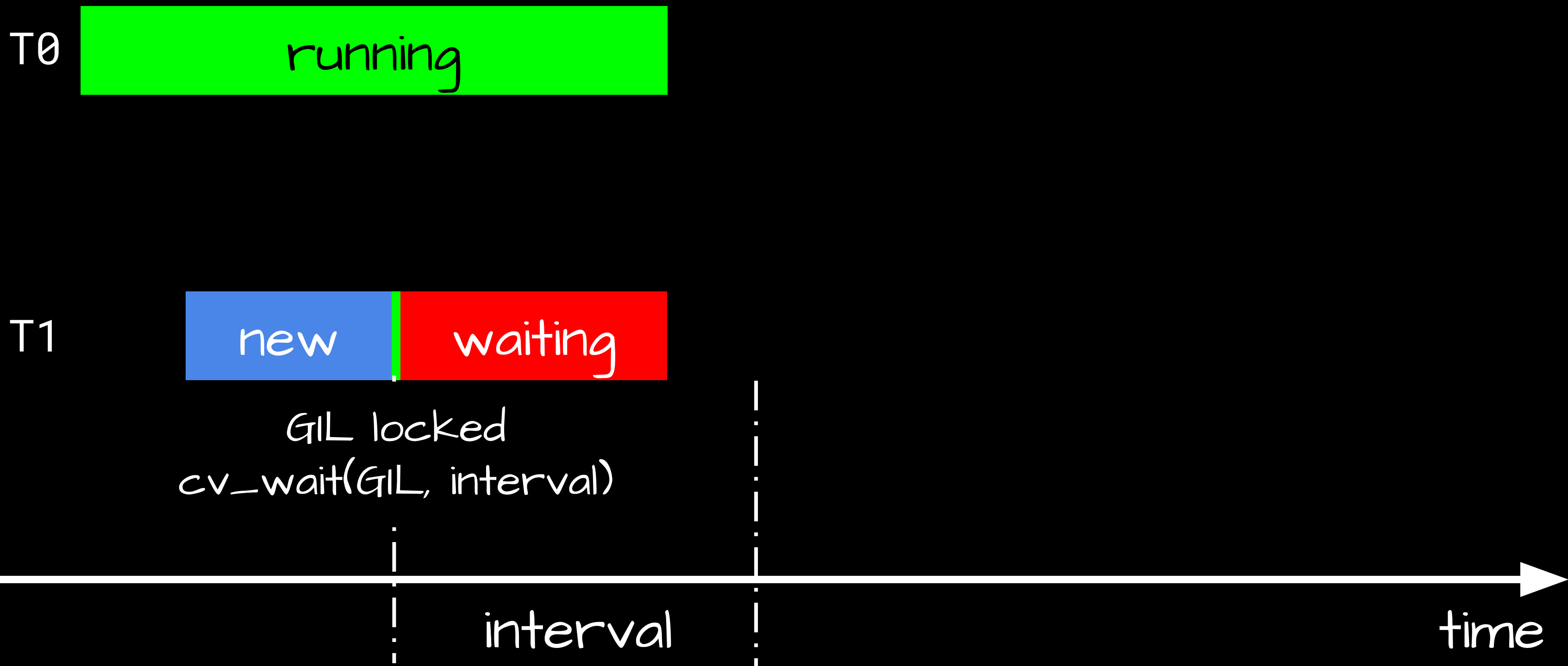
T1



GIL: scenario 3

two threads and timeout

GIL: scenario 3



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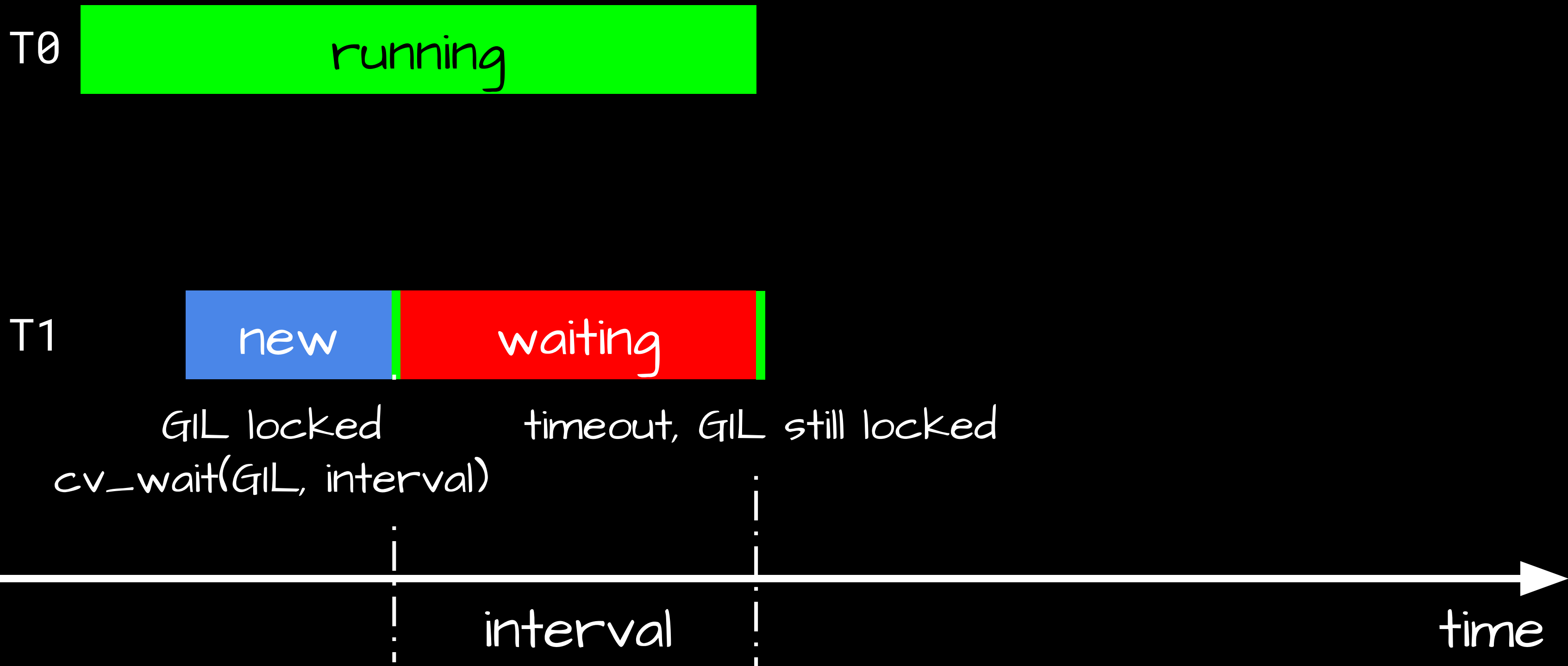

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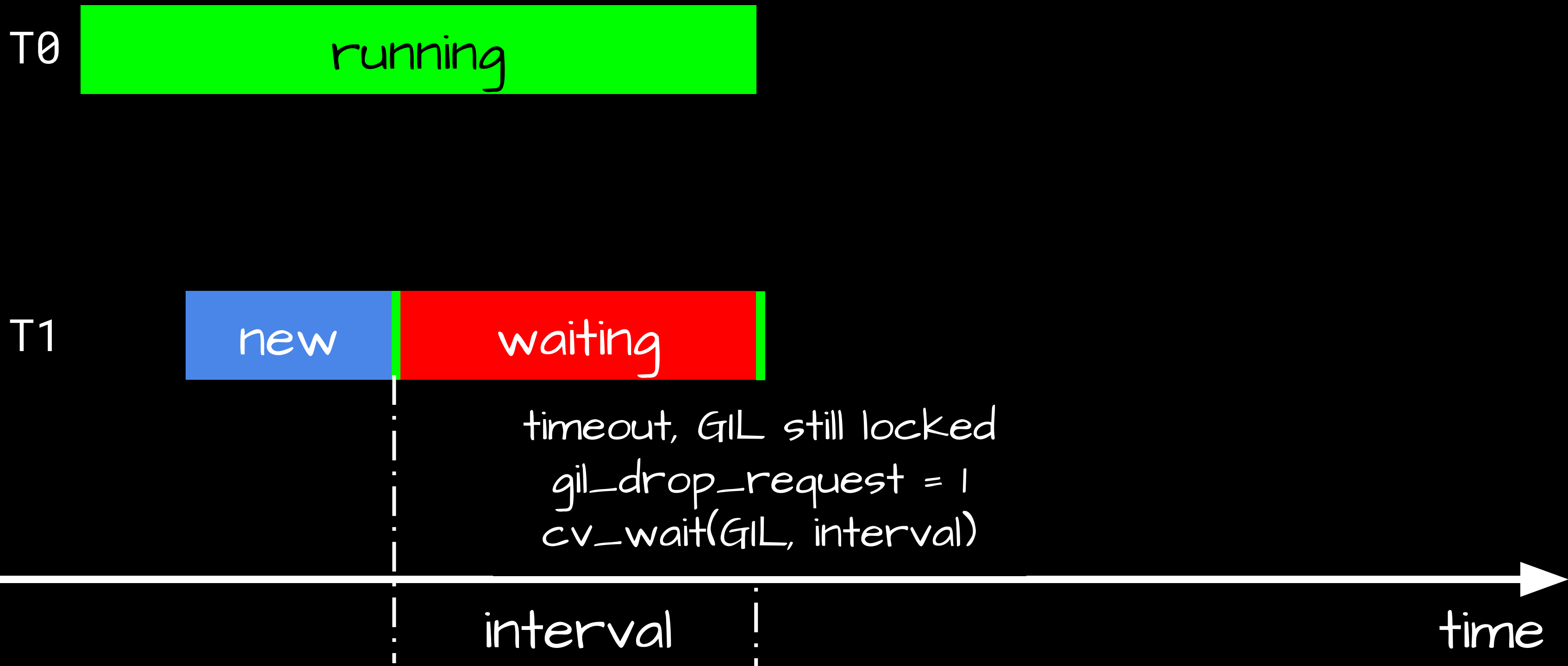

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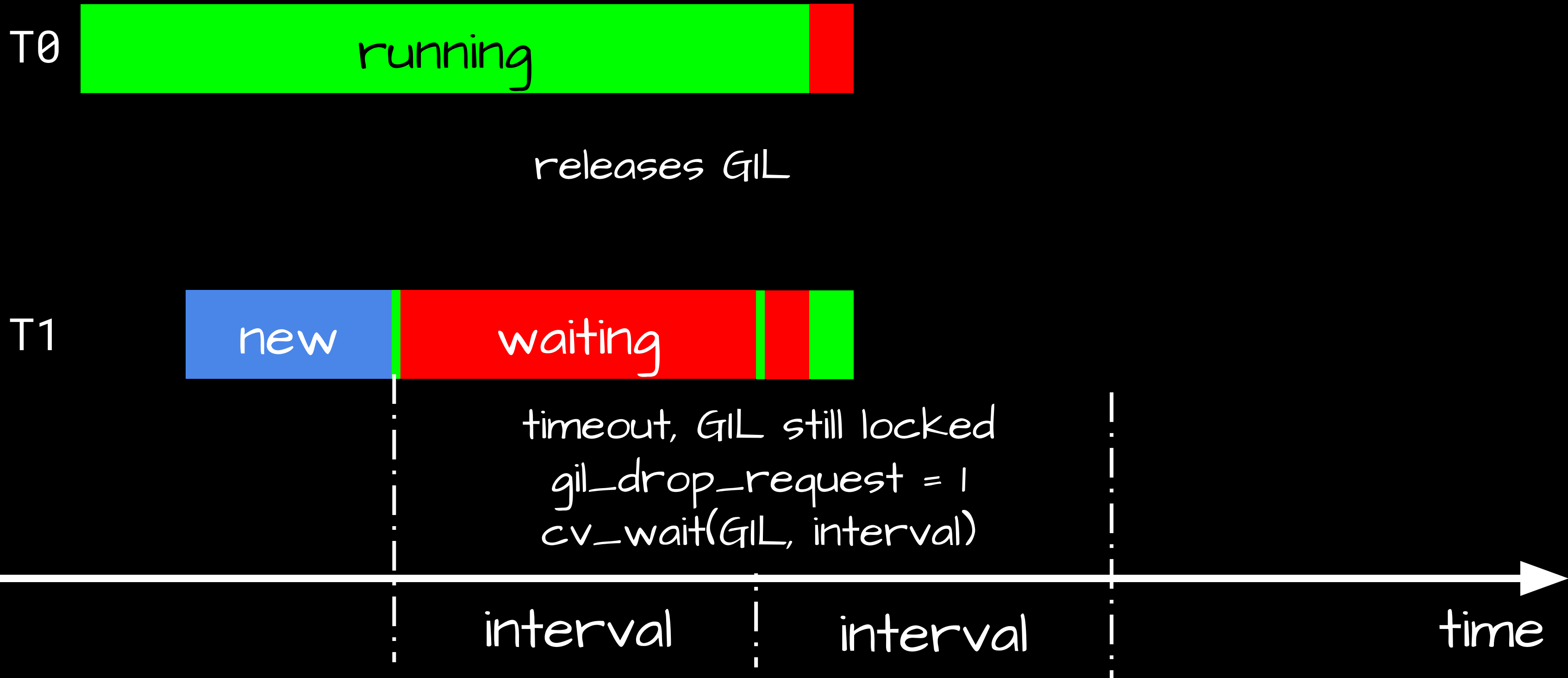

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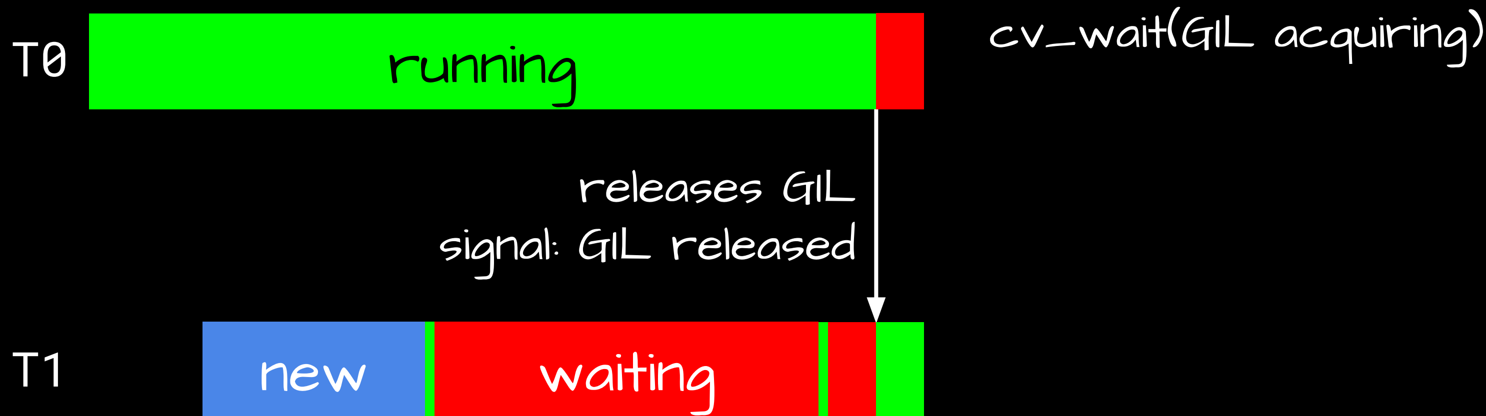

time

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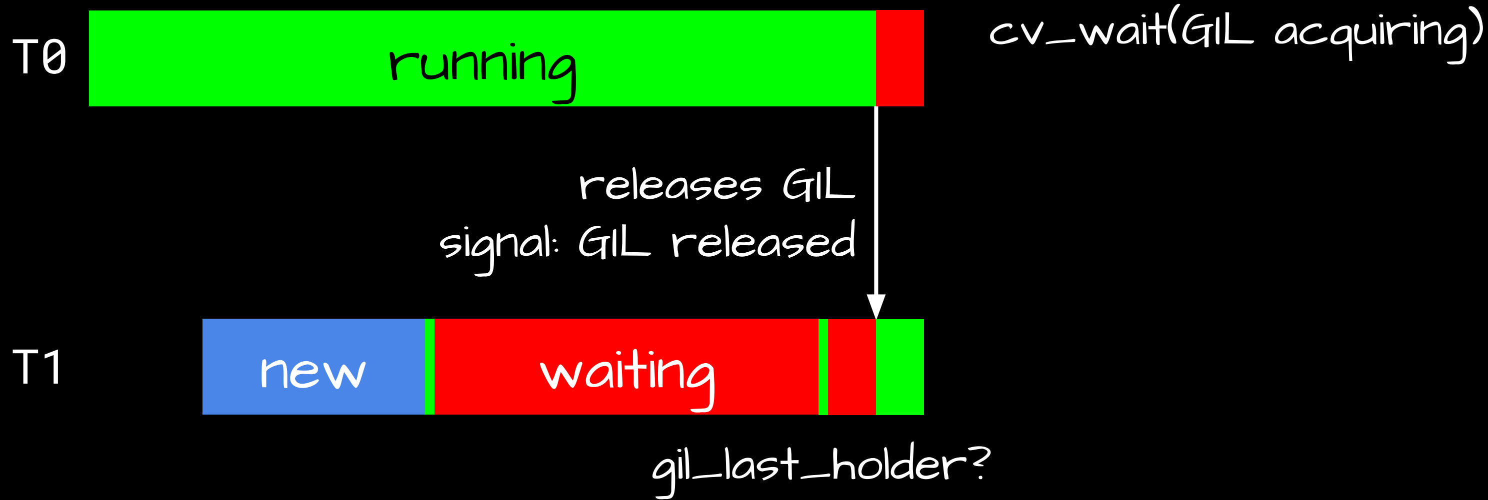

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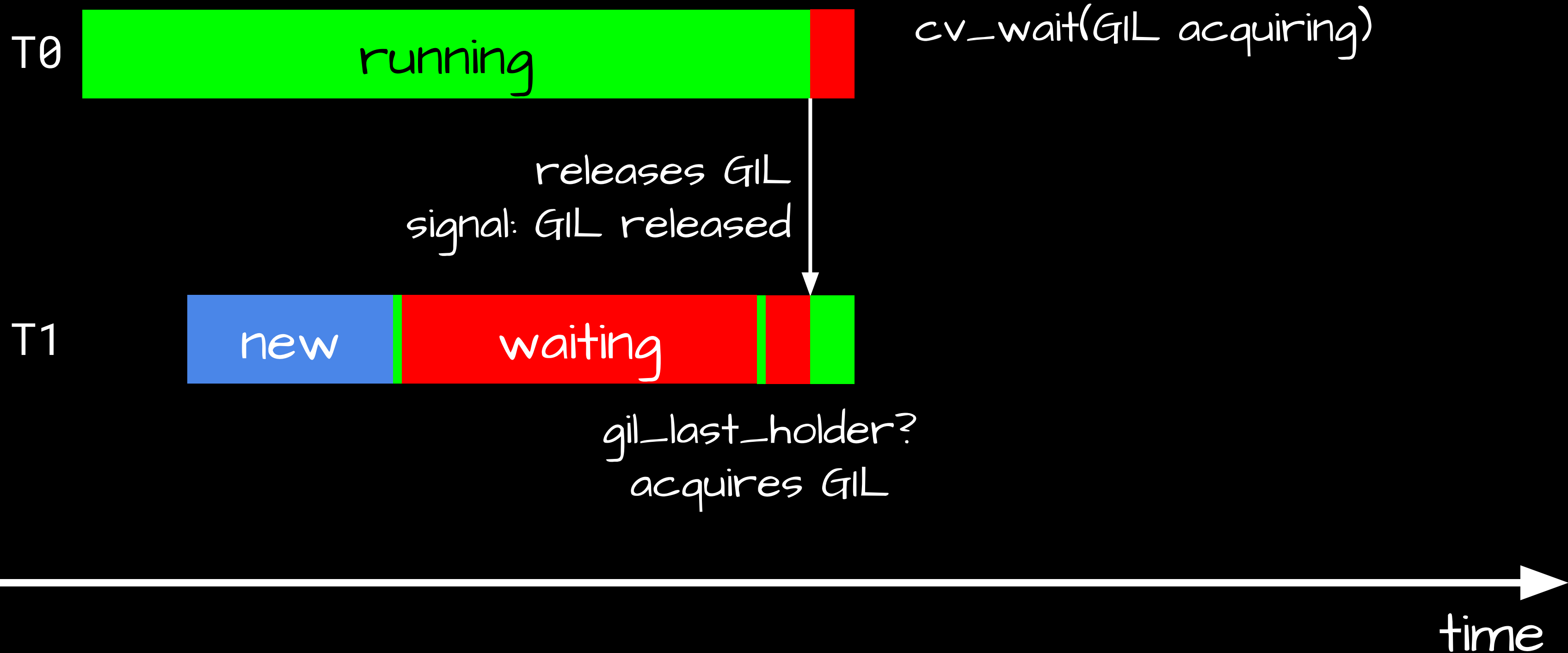

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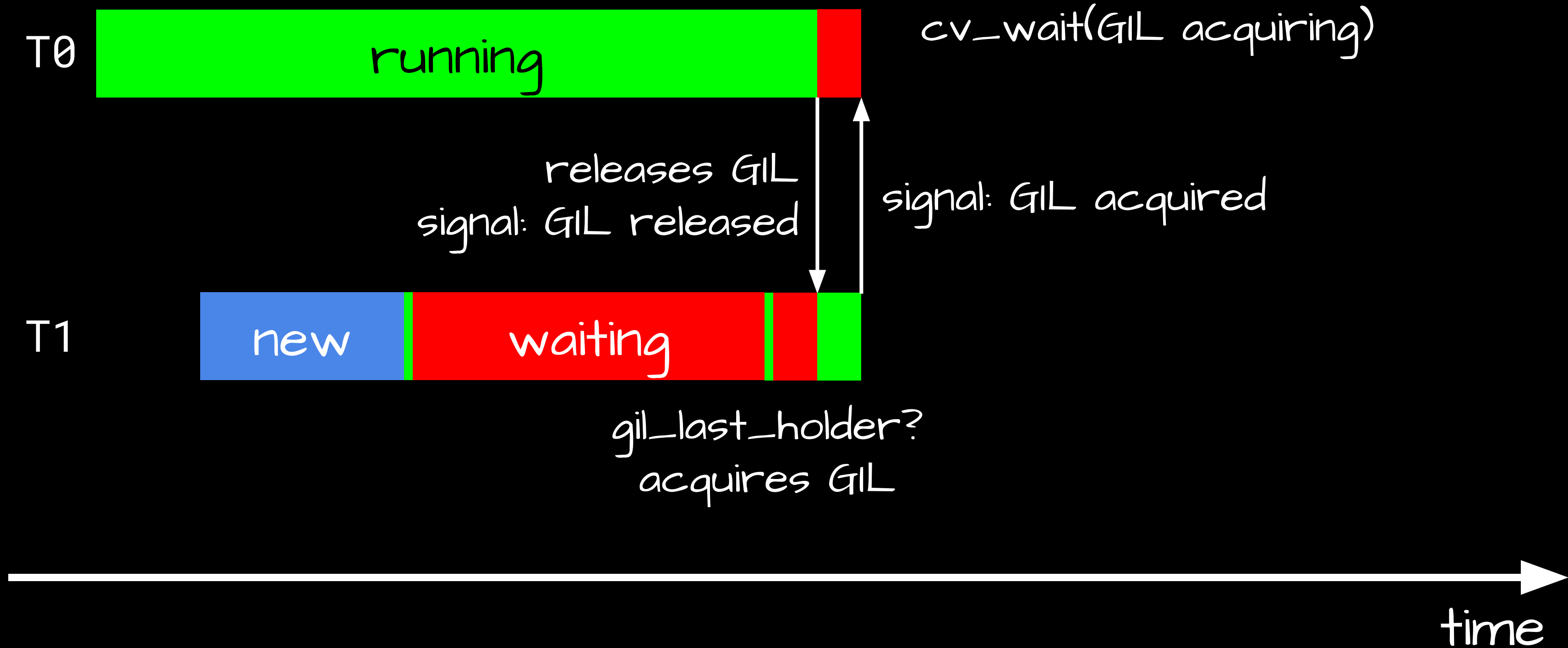

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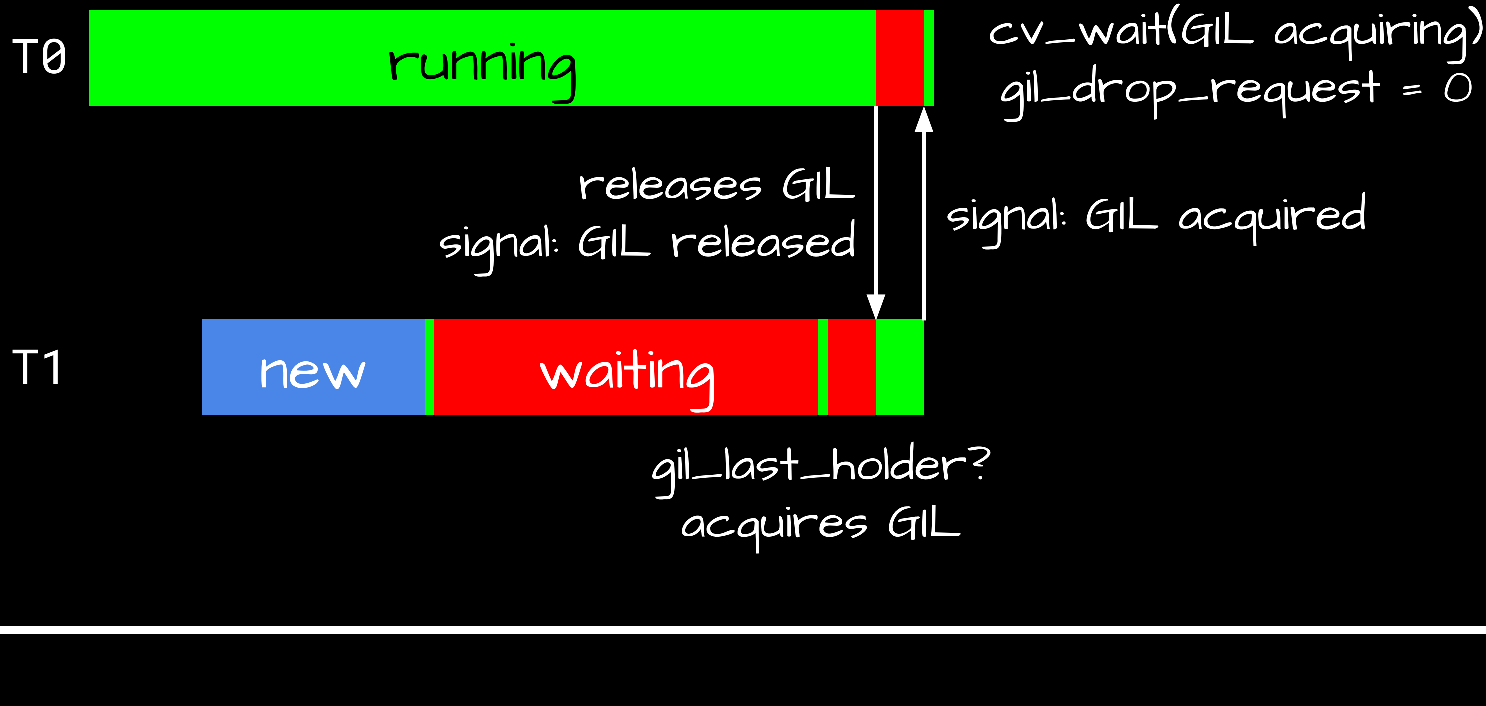

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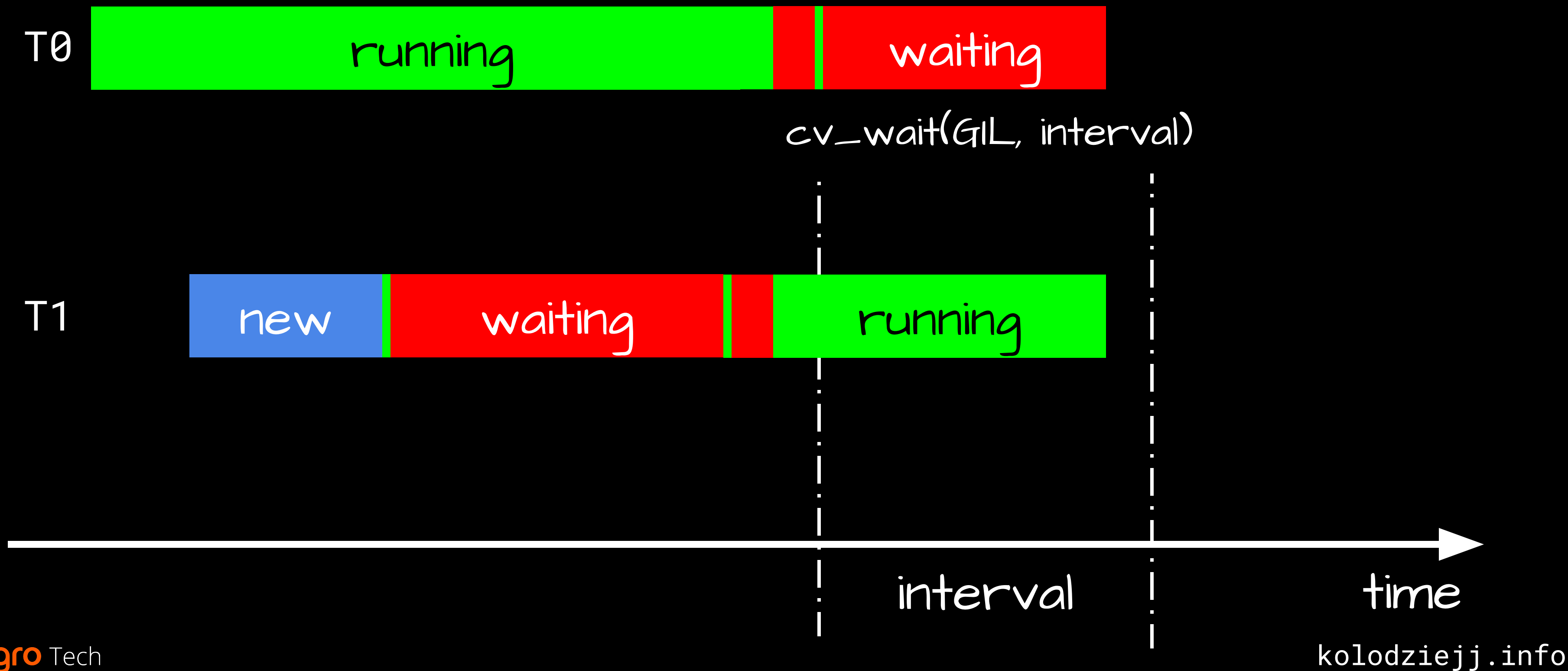

GIL: implementation

- "ceval" loop: Python/ceval.c
  - the GIL part: Python/ceval_gil.c
- GIL data structure: Include/internal/pycore_gil.h

GIL

De-GIL'ing

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De-GIL'ing attempts

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De-GIL'ing expectations

1. Performance:
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    - single-threaded code: not significantly slower
2. Gradual migration path for C-extensions
3. CPython codebase: not significantly more complex than with the GIL

In the meantime: what to do?

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  - research non-Python alternatives, compare pros and cons
- profile, profile, profile (cProfile, timeit, perf...)

Thank you! :)

kolodziejj.info/talks/gil