
GIL

Google: can Python into threads?

"CPython doesn't support multi-threading"

1992

1992

- me

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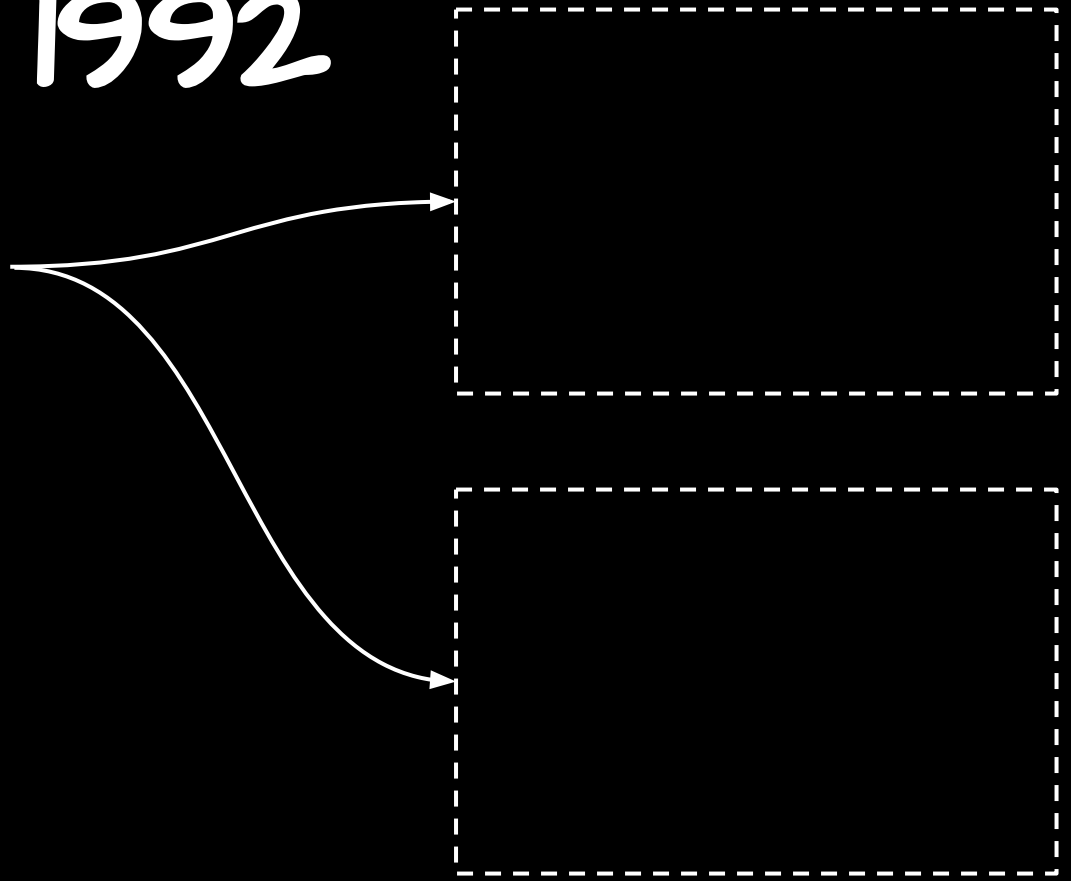
- Java & JavaScript



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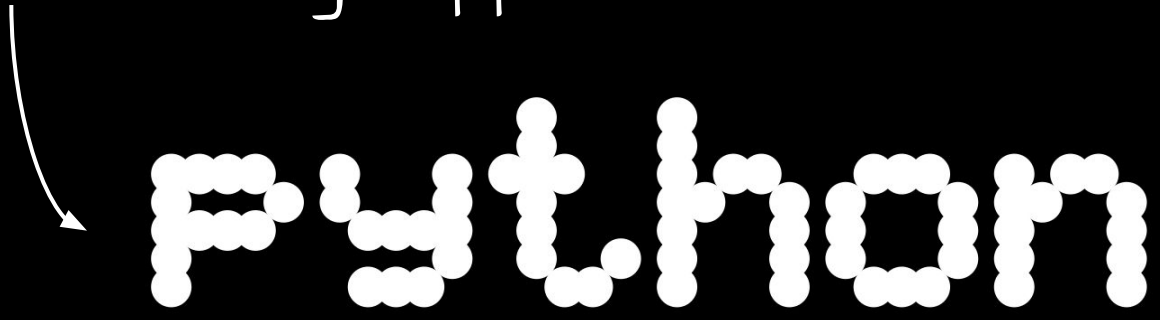
- Python (with threading support)



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✓ "CPython process can execute Python bytecode in one thread at the time"

kolodziejj.info
@unit03


allegro


allegro

GIL

GIL: prerequisites

Threads

Threads

- process

Threads

- process:
  - instance of an application

Threads

- process:
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  - one or more threads

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- process:
  - instance of an application
  - one or more threads
  - shared memory
- `import threading`
  - system (kernel/native/Posix) threads
  - vs. green threads, greenlets, coroutines etc.
- thread state:
  - ready/runnable
  - running
  - blocked/waiting (e.g. for system calls, e.g. I/O)

Parallelism

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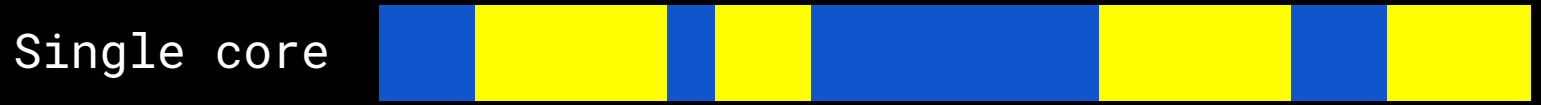
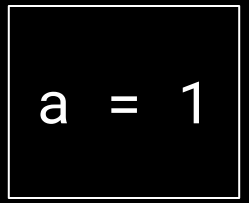
- other forms:



Race conditions and locks

Race conditions



Race conditions

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Thread 0
a = a - 1
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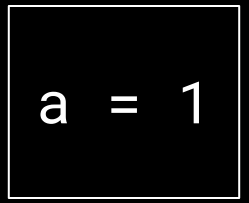


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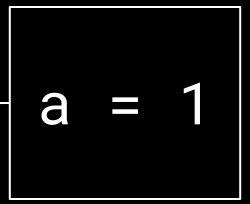


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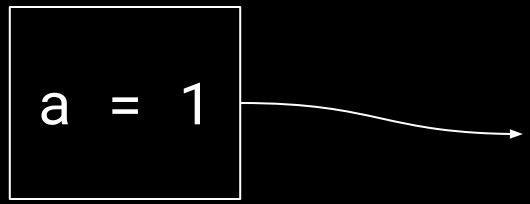


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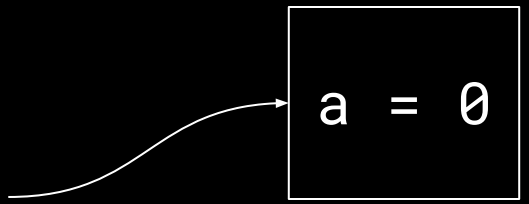


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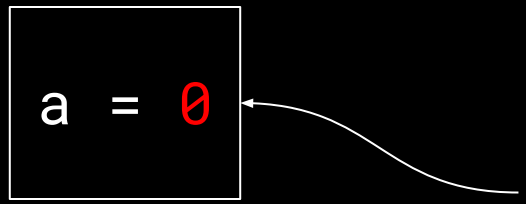


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Locks

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- or: mutex - **mut**ual **ex**clusion
- tool for preventing race-conditions
- lock (hold) and unlock (release)

Locks

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lock = threading.Lock()
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with lock:
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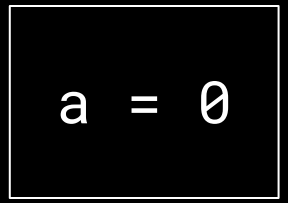


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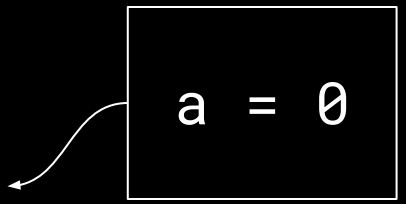


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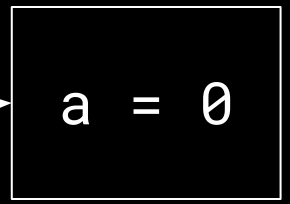


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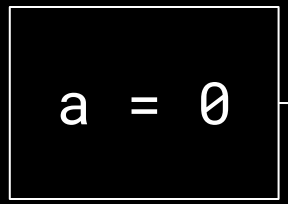


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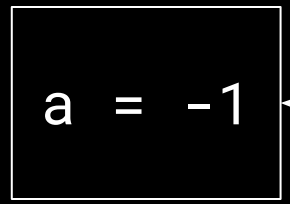


```
Thread 1
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    a = 0 - 1
    a = -1
```

Memory management

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- CPython: reference counting

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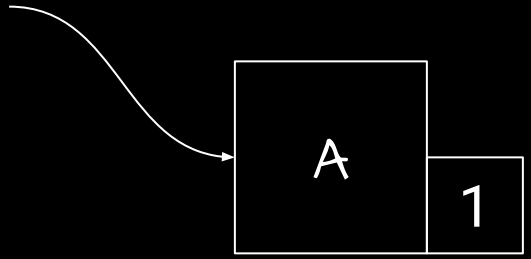

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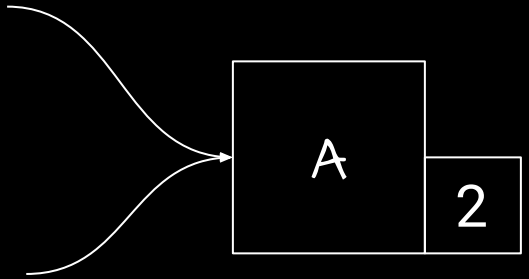

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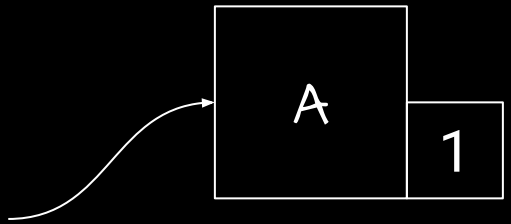

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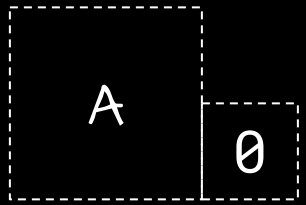

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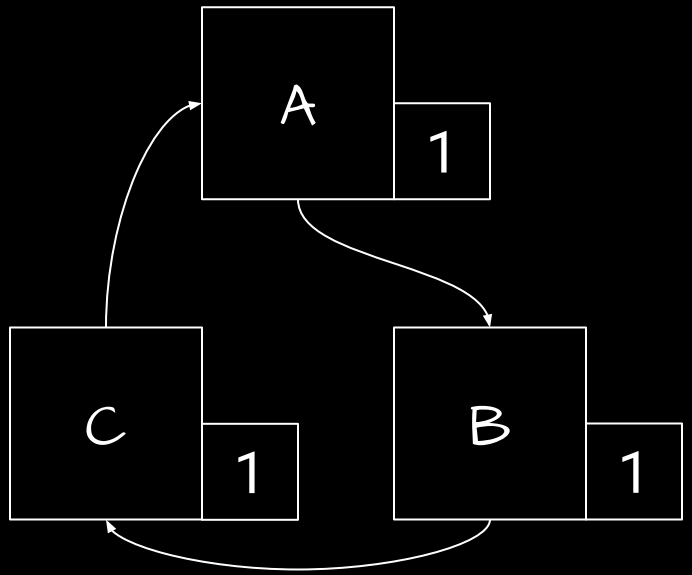

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Python bytecode

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```
a = 1

print(a)
```

Python bytecode

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a = 1                   2 LOAD_CONST    1 (1)
                        4 STORE_FAST    0 (a)
print(a)                6 LOAD_GLOBAL   1 (NULL + print)
                       18 LOAD_FAST     0 (a)
                       20 PRECALL       1
                       24 CALL          1
```

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- bytecode -> interpreter -> execution


finally
GIL

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  - atomic APIs
- C extensions/binary modules assumes GIL

GIL

- holding the GIL not needed when:

GIL

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GIL

- holding the GIL not needed when:
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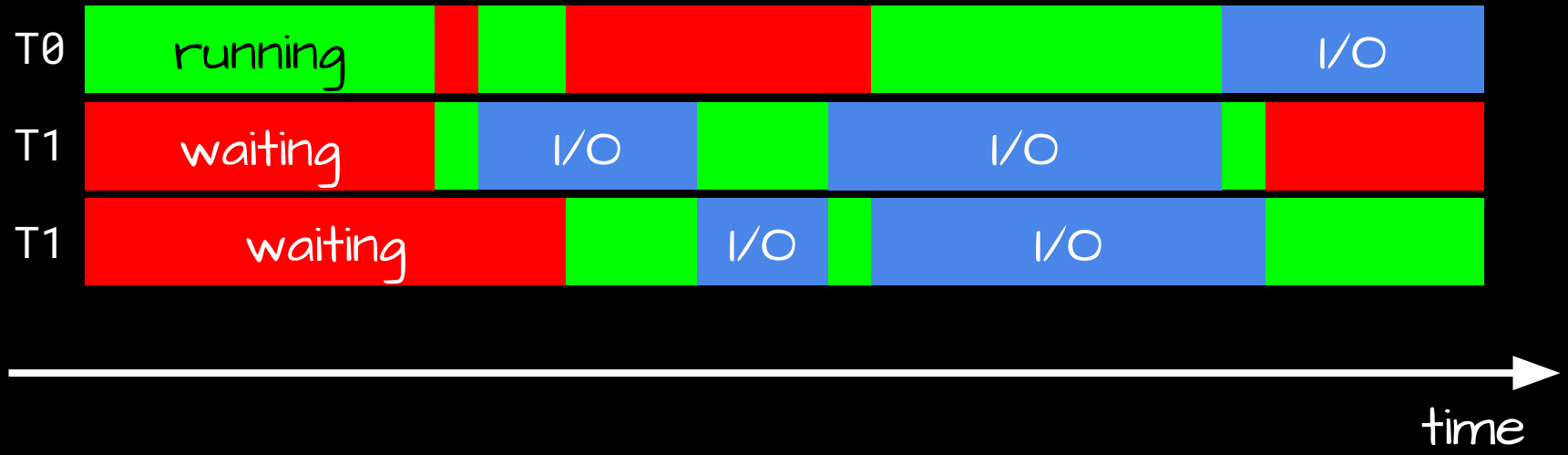
  - executing code that doesn't access Python objects


T0
running
T1
waiting
T1
waiting
time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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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- 2016: GILectomy

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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
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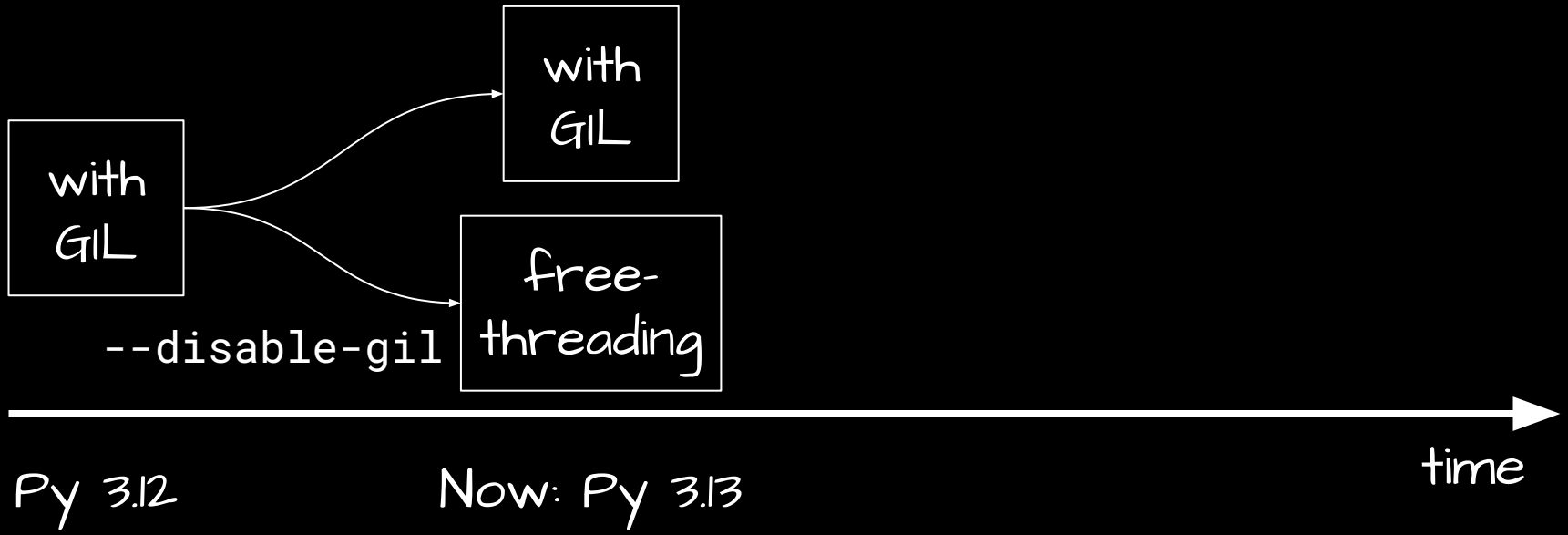

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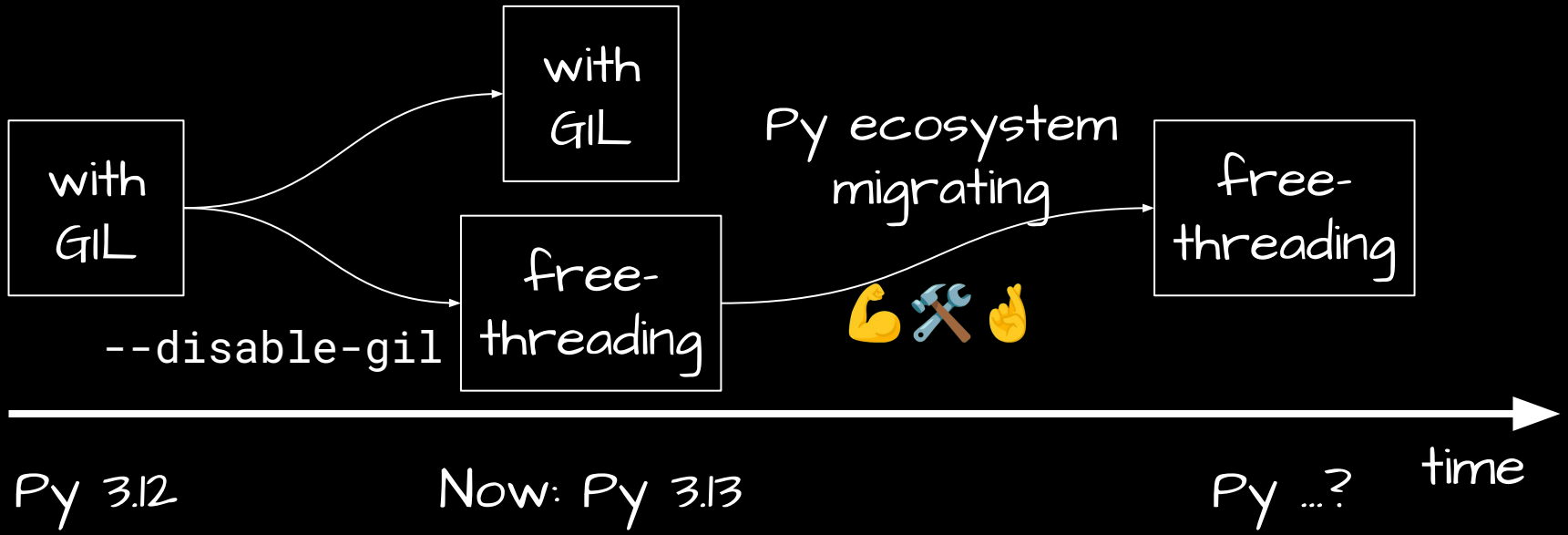

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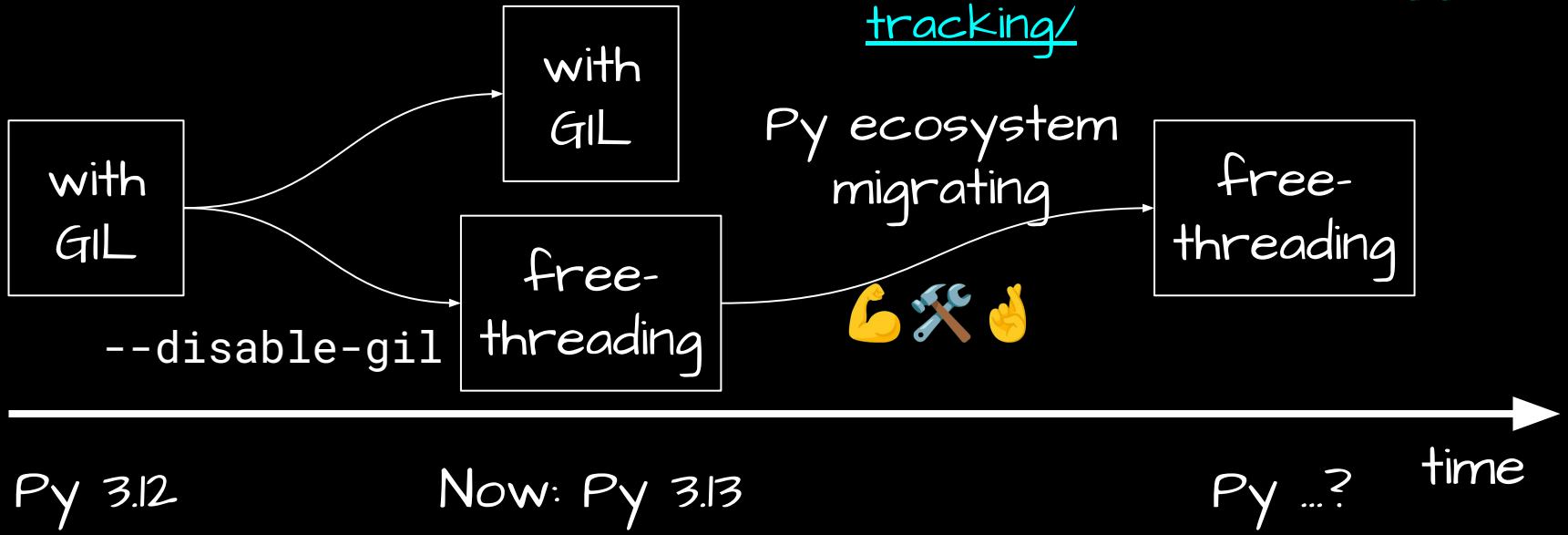

In the meantime: what to do?

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  - non-Python alternatives
  - weigh all pros and cons!

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Thank you! :)
Questions?

kolodziejj.info/talks/gil