Enhance your Python Code to go beyond GIL

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What is Global Interpreter Lock?

The mechanism used by the CPython interpreter to assure that only one thread executes Python bytecode at a time.

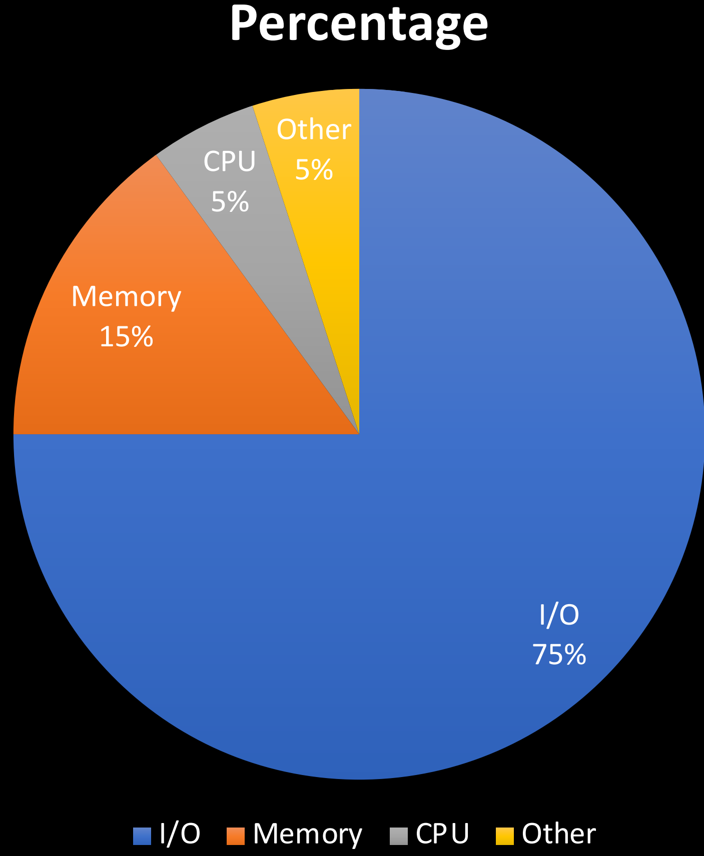
More about GIL

- Lock at Interpreter Level
- Prevents true parallelism
- Few Exceptions
  - Extensions Modules
- No GIL in I/O
- Past Efforts

Positive Side of GIL

- Thread Safe
- Single-threaded Programs
- Easy integration of C libraries
- Simplified Garbage Collection

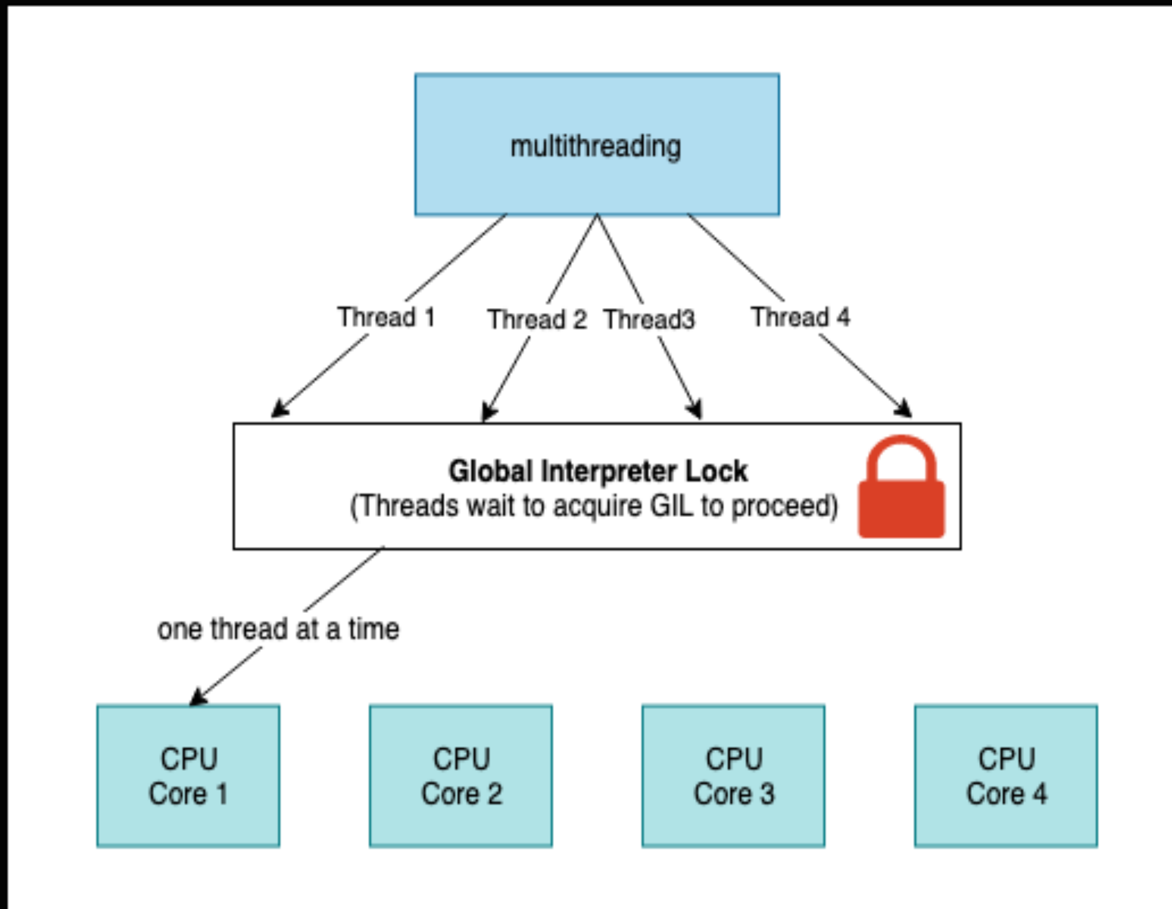
Automation Workloads



How to Solve

- Multithreading
- Multiprocessing
- AsyncIO
- AsyncIO with Multithreading
- AsyncIO with Multiprocessing

Multithreading



- Multiple child threads
- Shared Memory
- But threads waits for GIL

Advantages

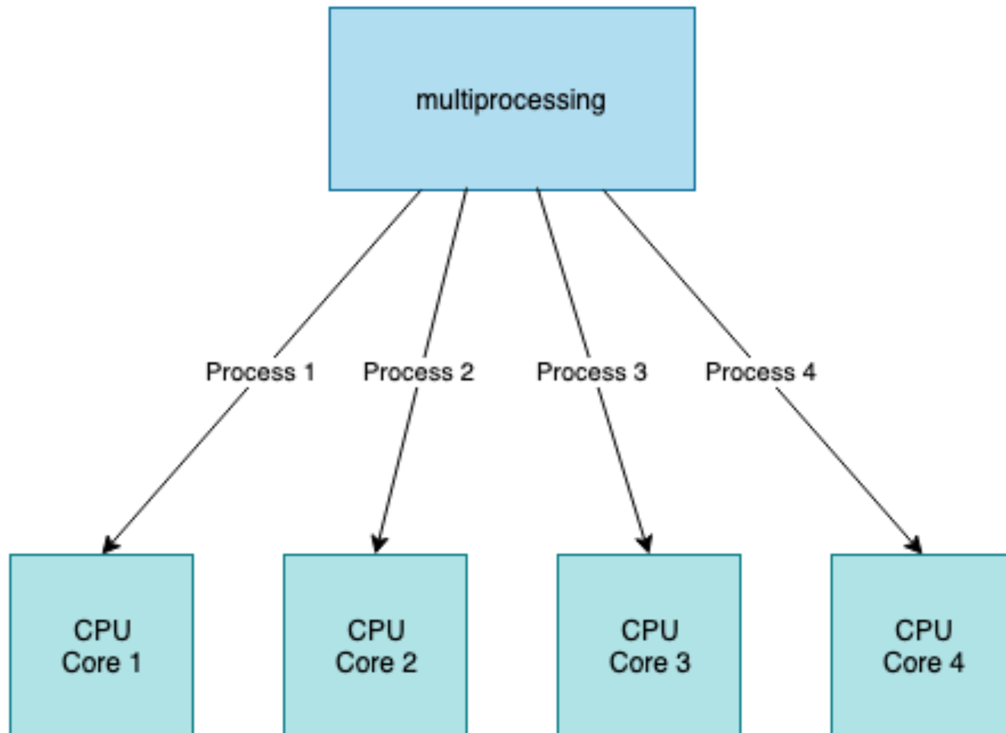
- Lesser memory
- Good for Blocking I/O

Multithreading(how)

- Python's ***threading*** module.
- ***concurrent.futures.ThreadPoolExecutor*** – abstracts queuing and distributing tasks to threads.

```
executors = concurrent.futures.ThreadPoolExecutor(max_workers=10)

jobs = [executors.submit(call, url) for url in urls]

for job in concurrent.futures.as_completed(jobs):
    # do something with job.result()
```

Multiprocessing



- Multiple child processes
- Message Passing
- Might require more Memory compared to multi-threading.

Advantages

- No GIL
- Good for CPU bound

Multiprocessing(how)

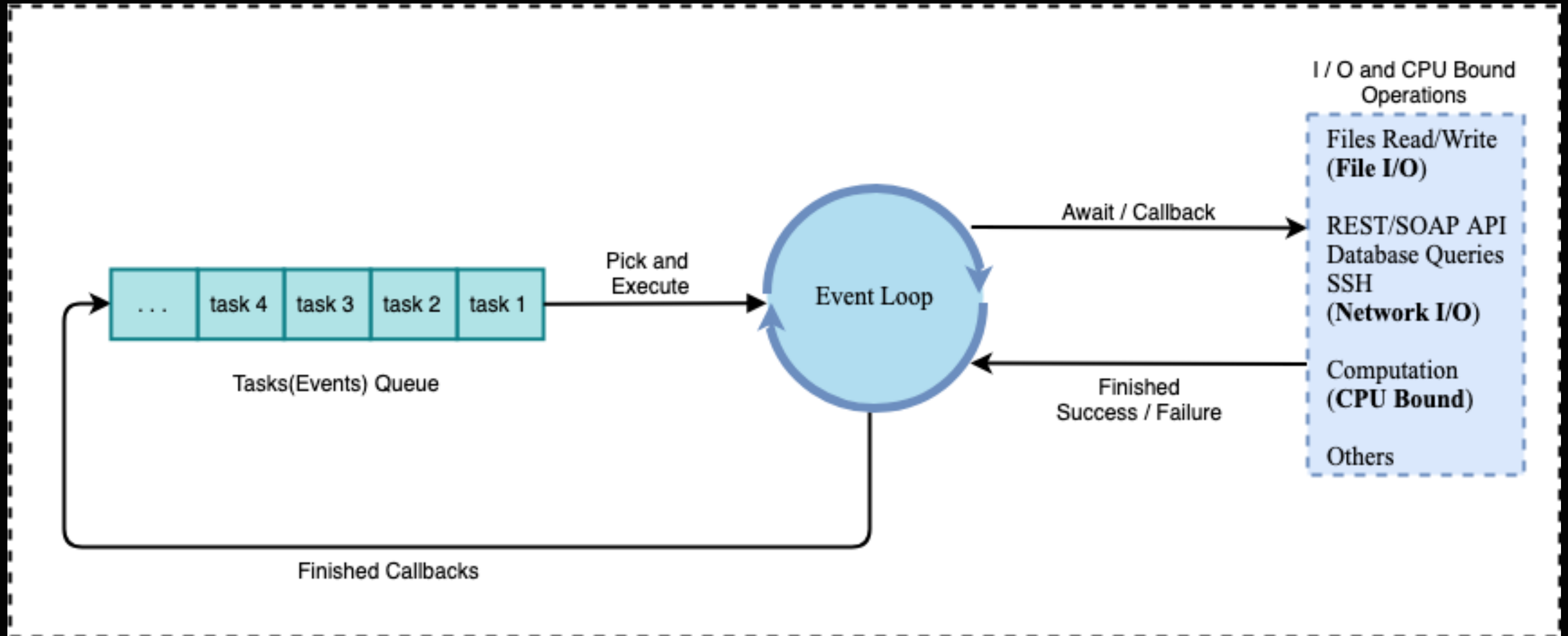
- Python's ***multiprocessing*** module
- ***concurrent.futures.ProcessPoolExecutor*** – abstracts queuing and distributing tasks to processes.

```
executors = concurrent.futures.ProcessPoolExecutor(max_workers=10)

jobs = [executors.submit(call, url) for url in urls)]

for job in concurrent.futures.as_completed(jobs):
    # do something with job.result()
```

Caveats of multithreading & multiprocessing

- Context Switches
  - No. of Threads/Processes -> No. of Context Switches
- Deciding Optimal number of Threads or Processes
  - Varying I/O wait-times

Python AsyncIO



Python AsyncIO(how)

```
import asyncio
from aiohttp import ClientSession

urls = ['https://vmware.com',
        'https://vmc.vmware.com']

async def fetch(url):
    async with ClientSession() as session:
        async with session.get(url) as response:
            response = await response.read()
            # do something with response

loop = asyncio.get_event_loop()

tasks = [asyncio.ensure_future(fetch(url)) for url in urls]

loop.run_until_complete(asyncio.wait(tasks))
```

- Python’s ***asyncio*** module
- ***aiohttp*** **-** Asynchronous HTTP Client/Server for asyncio and Python

Advantages

- No wait (Event Driven)
- Good for non-blocking

AsyncIO with Multithreading/Multiprocessing

```
# Blocking IO - Run eventloops in a thread-pool:
with concurrent.futures.ThreadPoolExecutor() as pool:
    result = await loop.run_in_executor(
        pool, blocking_io)
    print('custom thread pool', result)

# CPU Bound - Run eventloops in a process pool:
with concurrent.futures.ProcessPoolExecutor() as pool:
    result = await loop.run_in_executor(
        pool, cpu_bound)
    print('custom process pool', result)
```

Summary

- Multithreading – Blocking I/O
- Multiprocessing – CPU Bound
- AsyncIO – Non-blocking I/O
- AsyncIO with Multithreading – Blocking and Non Blocking I/O
- AsyncIO with Multiprocessing – CPU Bound with Non Blocking I/O

Reach out to Us

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Thank You!

Q & A