

Group 7: GIL-free Python

Motivation:

Code: github.com/sueszli/nogil

- Memory/Network-bound tasks: Asynchronous I/O with `asyncio`, very competitive.
- Compute-bound tasks: Very slow interpreter, hard to parallelize with GIL. → recently removed in PEP 703

Research question:

- How useful is GIL-free Python for compute-bound tasks?
- How does it compare to alternatives (multiprocessing, C-Python interopt, C-Python extensions)?

Chosen algorithm: hashcat

- on password storage: https://cheatsheetseries.owasp.org/cheatsheets/Password_Storage_Cheat_Sheet.html
- we use a simpler one
- no algorithmic optimizations (e.g. rainbow tables, bloom filters, etc.) just brute-force

Cpython dependency `Python.h`: <https://github.com/python/cpython/blob/main/Include/Python.h>

Motivation

Experiments

Target hash: `aaa`

Warmup: 3 runs

Docker with Python 3.13t experimental build

	type	command	mean	stddev	median	user	system	min	max
0	plain	itertools.py	0.567469	0.0119883	0.570065	0.559903	0.0074184	0.549638	0.586569
1	plain	lib.py	0.10037	0.0026018	0.0995592	0.0950988	0.00515048	0.0976092	0.108629
2	plain	plain.py	0.563118	0.00854626	0.560743	0.55741	0.0056163	0.556415	0.586366
3	multiprocessing	imap_unordered.py	0.225802	0.0085966	0.223588	0.545673	0.166191	0.218431	0.244969
4	multiprocessing	imap.py	0.232832	0.00656316	0.230609	0.555453	0.162511	0.223567	0.242637
5	multiprocessing	map_async.py	0.452833	0.024858	0.448565	1.01004	0.110811	0.431474	0.516788
6	multiprocessing	map.py	0.440075	0.00433147	0.440577	0.985363	0.108434	0.432938	0.446772
7	multithreading	GIL=1 executor.py	0.369659	0.0103798	0.365851	0.359792	0.00922382	0.362101	0.396862
8	multithreading	GIL=0 executor.py	0.21027	0.0104267	0.212105	0.43898	0.0105094	0.196279	0.232185
9	multithreading	GIL=1 workers.py	0.130465	0.00717258	0.129265	0.11784	0.00817749	0.124226	0.158233
10	multithreading	GIL=0 workers.py	0.167735	0.00768393	0.168563	0.1931	0.0202853	0.142996	0.176028
11	ctypes	invoke_hashcat.py	0.0934947	0.00314156	0.0929726	0.0882496	0.00491642	0.0891827	0.0996272
12	ctypes	invoke_hashcat.py	0.102134	0.00563781	0.100363	0.0986943	0.00838276	0.0976012	0.126973
13	cpython	invoke_hashcat.py	0.100606	0.00435792	0.0997623	0.0950439	0.00523102	0.0943297	0.108179

Addendum

System Specifications

\$ system_profiler SPSoftwareDataType SPHardwareDataType

Software:

```
System Software Overview:

System Version: macOS 14.6.1 (23G93)
Kernel Version: Darwin 23.6.0
Boot Volume: Macintosh HD
Boot Mode: Normal
Computer Name: Yahya's MacBook Pro
User Name: Yahya Jabary (sueszli)
Secure Virtual Memory: Enabled
System Integrity Protection: Enabled
Time since boot: 79 days, 22 hours, 26 minutes
```

Hardware:

```
Hardware Overview:

Model Name: MacBook Pro
Model Identifier: Mac14,10
Model Number: Z174001ABD/A
Chip: Apple M2 Pro
Total Number of Cores: 12 (8 performance and 4 efficiency)
Memory: 16 GB
System Firmware Version: 10151.140.19
OS Loader Version: 10151.140.19
Serial Number (system): VCYQD0HHOG
Hardware UUID: BEA4D09D-6651-54E1-A3F7-7FB78A7BF1AB
Provisioning UDID: 00006020-001A284901E8C01E
Activation Lock Status: Disabled
```

```
$ docker compose exec main lscpu
Architecture:          x86_64
CPU op-mode(s):        32-bit
Byte Order:             Little Endian
CPU(s):                12
On-line CPU(s) list:   0-11
Thread(s) per core:    1
Core(s) per socket:    12
Socket(s):              1
Vendor ID:              0x61
Model:                  0
Stepping:               0x0
BogoMIPS:               48.00
Vulnerability Gather data sampling: Not affected
Vulnerability Itlb multihit: Not affected
Vulnerability L1tf:     Not affected
Vulnerability Mds:      Not affected
Vulnerability Meltdown: Not affected
Vulnerability Mmio stale data: Not affected
Vulnerability Reg file data sampling: Not affected
Vulnerability Retbleed: Not affected
Vulnerability Spec rstack overflow: Not affected
Vulnerability Spec store bypass: Mitigation; Speculative Store Bypass disabled via prctl
Vulnerability Spectre v1: Mitigation; __user pointer sanitization
Vulnerability Spectre v2: Not affected
Vulnerability Srbds:     Not affected
Vulnerability Tsx async abort: Not affected
Flags:                  fp asimd evtstrm aes pmull sha1 sha2 crc32 atomics fphp asimdhp cpuid asimdrmn jscvt fcma lrcpc dcpop sha3 asimddp sha512 asimdfrm dit uscat
                        ilrcpc flagm ssbs sb paca pacg dcpodp flagm2 frint
```