Homework 1: Multitasking

Multitasking refers to the technology of performing multiple tasks simultaneously through Concurrent Execution or Parallel Execution on a single-core or multi-core computer system. In this homework, you are asked to evaluate the efficiency of performing two different workloads with **Multithreading**, **Multiprocessing**, and **Coroutine** in the Python .

Specification of Workloads

➢ Workload A：Proof of Work

In **Proof of Work** (PoW), your program is asked to perform some time-consuming calculations, and the server will verify the calculations. The process is as follows:

1. The input to your program is a string S of length 5, consisting of "ASCII printable characters " without blanks (i.e. codes 0x21 to 0x7E).
2. You should find a string C with the same length of 5 so that the first 5 digits of $\mathrm{SHA256}(C||S)$ are 0 in hexadecimal.

Example

For the input `abcde`, a correct output would be `u3x"!abcde`
Because $\mathrm{SHA256}(\mathrm{u3x"!abcde}) = 0\mathrm{x}0000036\mathrm{d}66\ldots$
Note that the correct output may not be unique.

➢ Workload B：Retrieve web page title

In this workload, the input is a URL string. Please use the `requests` module of Python to obtain the content of the webpage and print out the title of the webpage.

Example

The input is `https://www.nctu.edu.tw`

The output would be `NCTU 國立交通大學`

Include the following in your homework

submission

➢ Program Code

- The first input of the program specifies the type of workload to be executed, 1 means workload A; 2 means workload B.
- The second input of the program specifies the way to execute the workload, 1 is to use multithreading; 2 is to use multiprocess; 3 is to use coroutine. For multithread/multiprocess, an integer will be followed to specify the number of threads/processes.
- At the end there will be an integer input specifying the number of the workload instances, followed by the parameters of each workload instance.
- For workload 1, please output the $C||S$ corresponding to each string S.
- For workload 2, please output the page title corresponding to the input URL.
- You may output the PoW strings and page titles in arbitrary order.
- At the end, please output the total time it took to execute the workload instances
- Please indicate the version of Python used in the report (Python 3.6 or higher is recommended), if you use additional packages, please indicate in the report.
- The format of filename is: **{student_ID}_hw1.py**

Example

```
INPUT:
1
1 4
1
abcde

OUTPUT:
u3x"!abcde
```

➢ Report

For each type of workload, prepare an input with 100 workload instances (you can use the example input provided by the TA). Then, please perform the following experiments. Please log the execution time and explain the possible reasons for the results in detail. You may need to

average over multiple experiment runs to avoid errors.
Name your report as: **{student_ID}_hw1_report.pdf**

I. The effect of the number of threads on performance:
Please use 1, 2, 4, 100 threads to execute the task, and compare the effects of the number of threads on the two tasks.

II. The effect of the number of processes on performance:
Please use 1, 2, 4, 100 processes to execute the task, and compare the effects of the number of processes on the two tasks.

III. The performance comparison of multithreading, multiprocess, and coroutine
Please use single thread, 100 threads, 100 processes, and coroutines to perform tasks, and compare their performance.

Reference

- hashlib — Secure hashes and message digests
- Requests: HTTP for Humans
- threading — Thread-based parallelism
- multiprocessing — Process-based parallelism
- asyncio — Asynchronous I/O