6CS005 Learning Journal - Semester 1 2019/20

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# Parallel and Distributed Systems

## Answer of First Question

Threads are the independent stream of instructions that can be scheduled to run by OS. Threads allow application to perform multiple tasks concurrently. Threads allow to perform multiple computations parallelly.

## Answer of Second Question

The two process scheduling policies are :

1. Pre-emptive: The schedular is in charge of how long a process runs for. If a process exceeds its time slice, it is stopped by the schedular.
2. Co-operative: Each process is in-charge of how long it runs for. When a process feels like co-operating, it will surrender execution.

Pre-emptive is preferable as every process gets their equal execution time. The choice of policies may alter the execution time period of the Java threads.

## Answer of Third Question

1. Centralized Systems
2. Distributed Systems

|  |  |
| --- | --- |
| Centralized Systems | Distributed Systems |
| 1. Centralized Systems uses client-server architecture where one or more clients nodes are directly connected to the central server. | 1. Distributed Systems uses peer-to-peer architecture where every node make its own decision. The final behavior of the system is the aggregate of the decision of every nodes. |
| 1. This system consists of one component with non-autonomous parts. | 1. This system consists of multiple autonomous components. |
| 1. In this system, all the resources are accessible. | 1. In this system, resources may not be accessible. |
| 1. Components are shared by users all the time. | 1. Components are not shared by all the users. |

## Answer of Fourth Question

Transparency in Distributed System is defined to hide something. Transparency is an important issue to realize the single system image which makes systems as easy to use as a single processor system.

Classification of the Transparency:

1. Access Transparency: Data and resources can be used in a consistent way.
2. Location Transparency: A user cannot tell where resources are located.
3. Migration Transparency: Resources can move at will without changing their names.
4. Concurrency Transparency: Multiple users can share resource automatically.
5. Failure Transparency: A user does not notice resource failure.
6. Performance Transparency: Systems are reconfigured to improve performance as loads vary.
7. Scaling Transparency: Systems can expand in size without changing the system structure and the application programs.

## Answer of Fifth Question

Include your code using a text file in the submitted zipped file under name Task1.5

## Answer of Sixth Question

The output of the given program are

# Applications of Matrix Multiplication and Password Cracking using HPC-based CPU system

## Single Thread Matrix Multiplication

* The analysis of the algorithm’s complexity. (1 mark)

Ans.

The time complexity of the given program is O(n^3).

* Suggest at least three different ways to speed up the matrix multiplication algorithm given here. (Pay special attention to the utilisation of cache memory to achieve the intended speed up). (1 marks)

Ans.

There are different approaches present to speed up of the given program. Some of them are described here.

* Write your improved algorithms as pseudo-codes using any editor. Also, provide reasoning as to why you think the suggested algorithm is an improvement over the given algorithm. (1 marks)

Paste your algorithm’s pseudo code here

* Write a C program that implements matrix multiplication using both the loop as given above and the improved versions that you have written. (1marks)

Include your code using a text file in the submitted zipped file under name Task2.1

* Measure the timing performance of these implemented algorithms. Record your observations. (Remember to use large values of N, M and P – the matrix dimensions when doing this task). (1 marks)

Insert a paragraph that hypothesises how long it would take to run the original and improved algorithms. Include your calculations.

Explain your results of running time.

## Multithreaded Matrix Multiplication

* Include your code using a text file in the submitted zipped file under name Task2.2

Paste your algorithm’s pseudo code here

* Insert a table that has columns containing running times for the original program and your multithread version. Mean running times should be included at the bottom of the columns.
* Insert an explanation of the results presented in the above table.

## Password cracking using POSIX Threads

* Include your code using a text file in the submitted zipped file under name Task2.3.1, Task2.3.3, Task2.3.5

The Executed Program of these questions are

Text

Description automatically generated  
Text

Description automatically generated

* Insert a table of 10 running times and the mean running time.

Graphical user interface, application, table, Excel

Description automatically generated

* Insert a paragraph that hypothesises how long it would take to run if the number of initials were to be increased to 3. Include your calculations.

Orginal program of password cracking took 164.4199528499 seconds (2.74033254749833 minutes) mean running time, if we add 1 more initial i.e one more for-loop starting from A-Z in program it might take 4274.918774097 seconds (71.248646235 minutes) for a whole program to executed and generate the all three possible passwords of three alphabets and two numbers. This is because extra for loop will take extra 26 more time then orginal program. Hence, the time cost will increase by 26times.

* Explain your results of running your 3 initial password cracker with relation to your earlier hypothesis.

Text

Description automatically generated  
Text

Description automatically generated

After executing three initials, the program took 4247.023895071 seconds (70.783731585 minutes). Compairing the exact time after the code with above hypothesises, the exact time the program took was 4247.023895071 seconds where estimated time was 4274.918774097 seconds. As we can see that the difference between two is just 27.894879026 seconds. This difference may have arises due multiple process running in background.

* Write a paragraph that compares the original results with those of your multithread password cracker.

Table, Excel

Description automatically generated

Original password cracking program took 164.4199528499 seconds (2.74033254749833 minutes) mean running time to run while it took 129.8691925625 seconds (2.16448654270833 minutes) mean running time to run after inserting POSIX multithread in the same code. Using POSIX multithread, we can see that the cost of time from its initial program has been reduced, which is more effective. This is because it runs asynchronously as a thread.

# Applications of Password Cracking and Image Blurring using HPC-based CUDA System

## Password Cracking using CUDA

* Include your code using a text file in the submitted zipped file under name Task3.1
* Insert a table that shows running times for the original and CUDA versions.

ScreenShot of Password Cracking Using Original Code of 2 Initials

Graphical user interface, application, table, Excel

Description automatically generated  
  
Screen shot of Password Cracking using Thread

Table, Excel

Description automatically generated

Screen shot of password Cracking Using CUDA version.  
  
A picture containing table

Description automatically generated

* Write a short analysis of the results

The mean time of the program using CUDA version is 0.0042635307 second which is very less than the original one which is 164.4199528499 seconds (2.7 minutes) and thread version which is129.8691925625 second (2.1 minutes). It is because the CUDA in C programming is a more efficient package that interacts with GPC to execute the code. Compared to the Processor and GPU core, the CPU core is 42 times faster than the GPU core. Although the GPU core is slow, the task was performed simultaneously and much faster using the GPU core in the password cracker. Large numbers of cores will be split into 16 multicore units that will be able to perform eight operations in a single cycle. For this reason, if any multicore task is performed, 8 cores will run over 4 clock cycles every time. For this purpose, the GPU performs the tasks in a cost-effective manner than the CPU. CUDA is known to be a very strong core material and has the better potential to find productive results than others, such as POSIX. The CUDA processing speed is high, so that the performance is quickly taken out.

## Image blur using multi dimension Gaussian matrices

* Include your code using a text file in the submitted zipped file under name Task3.2
* Insert a table that shows running times for the original and CUDA versions.
* Write a short analysis of the results