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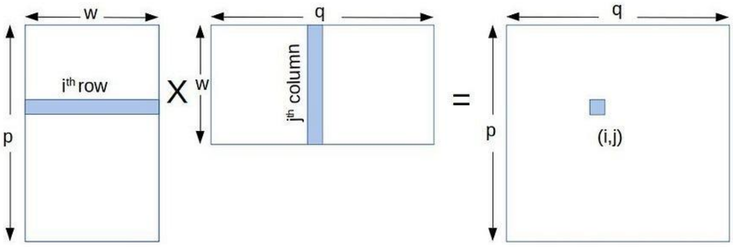
Assignment No. 6

Aim : Implement multithreaded matrix multiplication.

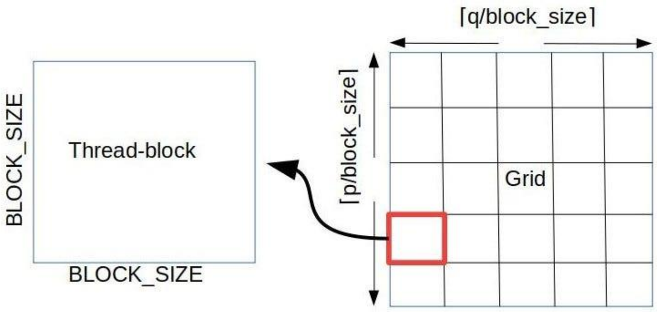
Theory:

- **What is multithreaded matrix multiplication?**

1) Multithreaded matrix multiplication is a technique for multiplying two matrices using multiple threads, or parallel processing. Matrix multiplication is a computationally intensive task, and for large matrices, it can take a long time to perform. By dividing the computation among multiple threads, we can speed up the computation and reduce the overall time required.



2) In a multithreaded matrix multiplication implementation, the two input matrices are divided into smaller sub-matrices, which are then processedin parallel by different threads. Each thread computes a portion of the resulting matrix by performing a subset of the required scalar multiplications and additions. Once all threads have finished their computations, the resulting sub-matrices are combined to produce the final result.



3) The number of threads used for the computation can depend on various factors such as the size of the matrices, the number of available CPU cores, and the overall system load. While multithreaded matrix multiplication can improve performance, it also comes with some overhead in terms ofthread creation and synchronization, and may not always be faster than aserial implementation for small matrices or systems with limited resources.

Implementation of multithreaded matrix multiplication in Python using threads:

```
import threading
import random
import time

def multiply_matrices(A, B):
    m = len(A)
    n = len(B[0])
    result = [[0] * n for _ in range(m)]
    threads = []

    def multiply_rows(start, end):
        for i in range(start, end):
            for j in range(n):
                for k in range(len(B)):
                    result[i][j] += A[i][k] * B[k][j]

    num_threads = min(m, threading.active_count() + 1)
    chunk_size = m // num_threads

    for i in range(num_threads):
        start = i * chunk_size
        end = start + chunk_size if i < num_threads - 1 else m
        thread = threading.Thread(target=multiply_rows, args=(start, end))
        threads.append(thread)
        thread.start()

    for thread in threads:
        thread.join()

    return result

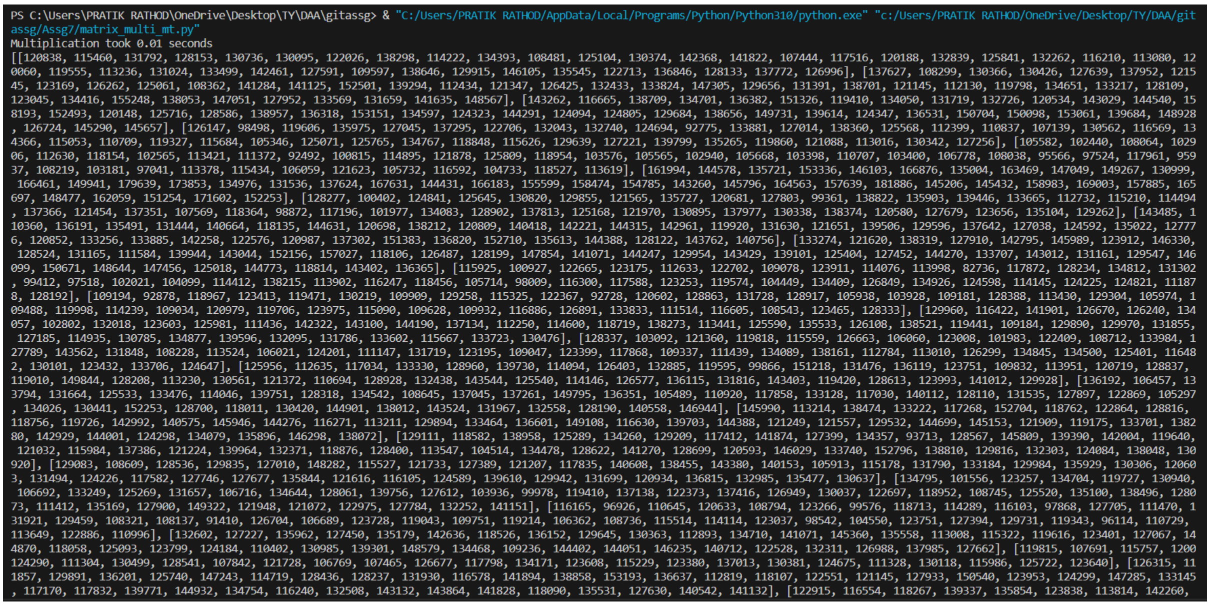
# Generate two random 1000x1000 matrices
A = [[random.randint(0, 100) for j in range(50)] for i in range(40)]
B = [[random.randint(0, 100) for j in range(40)] for i in range(50)]

# Run the multiplication with timing
start_time = time.time()
result = multiply_matrices(A, B)
end_time = time.time()

print(f"Multiplication took {end_time - start_time:.2f} seconds")

print(multiply_matrices(A, B))
```

Output :



```
PS C:\Users\PRATIK RATHOD\OneDrive\Desktop\TY\DAA\gitassg> & "C:/Users/PRATIK RATHOD/AppData/Local/Programs/Python/Python310/python.exe" "c:/Users/PRATIK RATHOD/OneDrive/Desktop/TY/DAA/git
assg/Assg7/matrix_multi_mt.py"
Multiplication took 0.01 seconds
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