HW 2

Sahar Eitam 318283116

Q1

1)P=0.75 ,N = 4

$$S = \frac{1}{(1-0.75) + \frac{0.75}{4}}$$

$$S = \frac{1}{0.25 + 0.1875}$$

$$S = \frac{1}{0.4357}$$

S≈2.2857

2)P=0.6 , S = 3

$$3 = \frac{1}{(1-0.6) + \frac{0.6}{N}}$$

$$3 = \frac{1}{0.4 + \frac{0.6}{N}}$$

$$1.2 + \frac{1.8}{N} = 1$$

$$\frac{1.8}{N} = -0.2$$

$$-9 = N$$

This is not possible since the result is negative, indicating a calculation error or an unreachable speedup for this proportion of parallel and sequential code.

3)P=0.9, N = 32

$$S = \frac{1}{(1-0.9) + \frac{0.9}{32}}$$

$$S = \frac{1}{0.1 + 0.028125}$$

S≈ 7.8049

4)P=0.85**,** N = ∞

$$S = \frac{1}{(1-0.85) + \frac{0.85}{\infty}}$$

$$S = \frac{1}{0.15}$$

S≈ 6.6667

5)P=0.8, N = 4

$$S4 = \frac{1}{(1-0.8) + \frac{0.8}{4}}$$

$$S4 = \frac{1}{0.4}$$

S4≈ 2.5

$$S32 = \frac{1}{(1-0.8) + \frac{0.8}{32}}$$

$$S4 = \frac{1}{0.225}$$

S32≈ 4.4444

ΔS=4.4444−2.5
ΔS=4.4444−2.5 = 1.9444

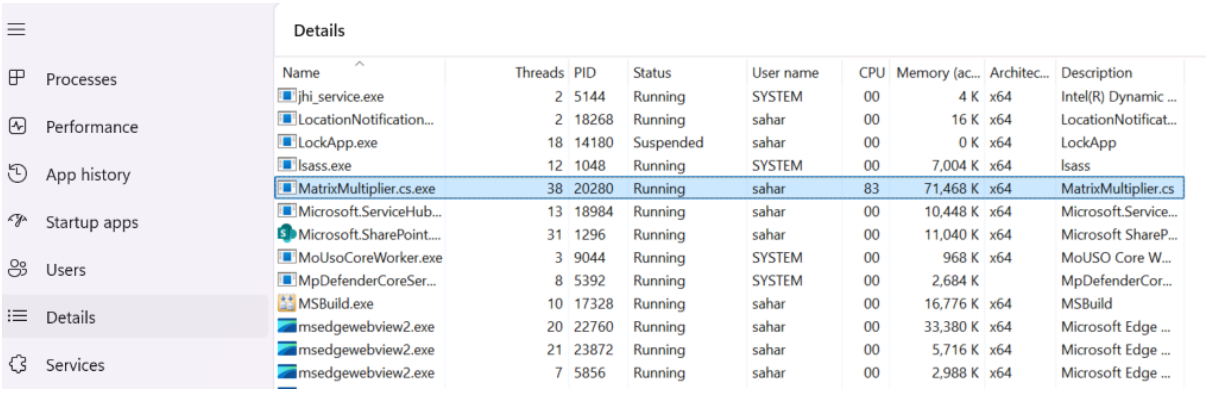
Q2

Run	Process Time (ms)	Thread Time (ms)
1	13	1
2	15	2
3	16	1
4	14	2
5	15	3
6	14	1
7	17	3
8	15	2
9	14	2
10	15	1

Explanation: Each process operates in its own memory space and utilizes dedicated resources. Starting a process requires allocating these resources, which takes more time. Threads within the same process share the same memory space and resources, making them more lightweight. Creating a thread involves less overhead since it uses the resources of the parent process. Additionally,

context switching between processes is more costly, as it involves switching the entire memory space and resources. Context switching between threads is faster because they share the same memory space, reducing the overall overhead.

Q3



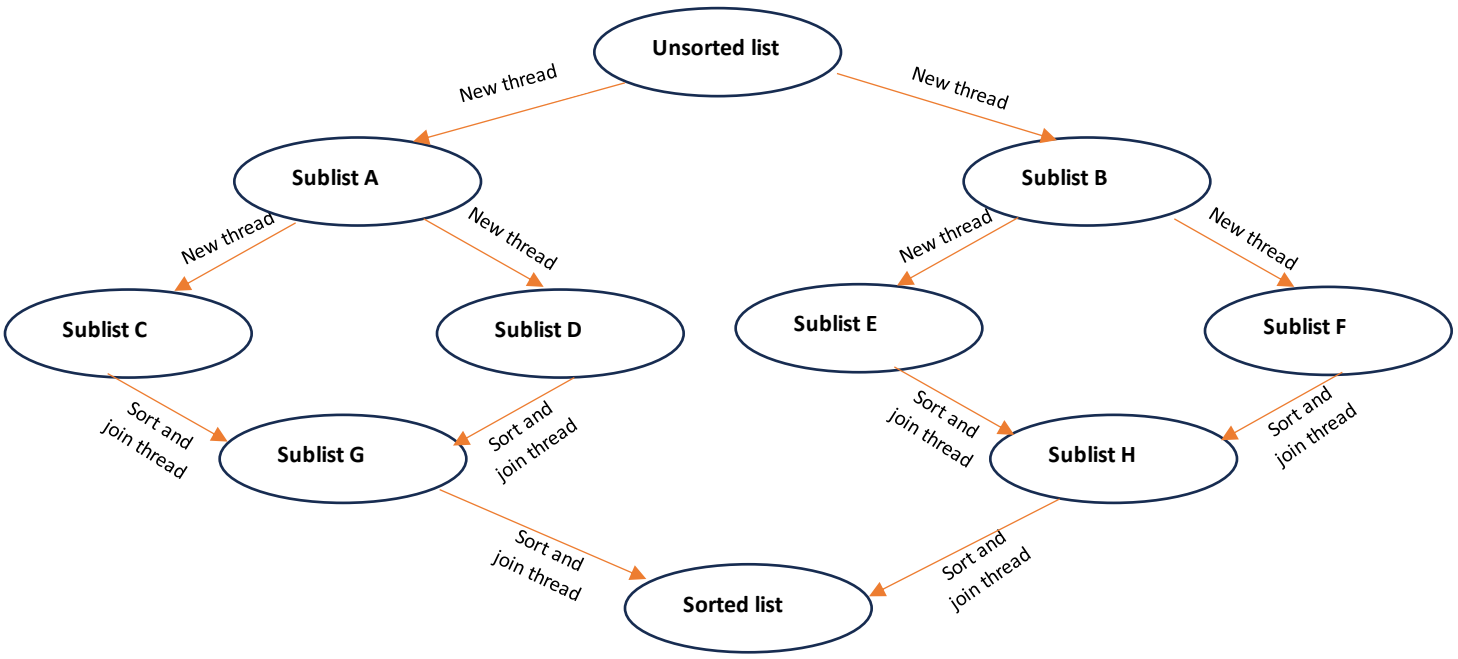
The extra threads in your process are probably the result of overhead from the runtime environment, system operations, or external libraries used during execution.

Q4

A) Multithreading in the merge-sort algorithm allows sorting operations to run concurrently, which can improve performance, especially with large datasets.

1. **Recursive Division**: The input array is split into two halves. This division continues recursively until the size of each subarray is less than or equal to a predefined threshold (nMin).
2. **Parallel Sorting**: If the size of the subarray is larger than the threshold, it is sorted concurrently by creating a new thread. This allows multiple subarrays to be sorted at the same time, utilizing multiple CPU cores for better efficiency.
3. **Thread Creation**: For each half of the array, a new thread is created to perform the sorting on that subarray. As a result, sorting happens in parallel for different parts of the array.
4. **Merging**: Once the subarrays are sorted, they are merged back into a single sorted array. The merge operation is a fundamental part of merge-sort, where two sorted arrays are combined into one sorted array.
5. **Threshold and Efficiency**: The threshold (nMin) determines the minimum size of subarrays that will be sorted using multithreading. If the subarray size is less than or equal to this threshold, sorting is performed sequentially, without creating additional threads. This avoids the overhead of thread creation for small subarrays, which might not benefit much from parallel execution.

B)


Unsorted list
New thread
New thread
Sublist A
Sublist B
New thread
New thread
New thread
New thread
Sublist C
Sublist D
Sublist E
Sublist F
Sort and join thread
Sort and join thread
Sort and join thread
Sort and join thread
Sublist G
Sublist H
Sort and join thread
Sort and join thread
Sorted list