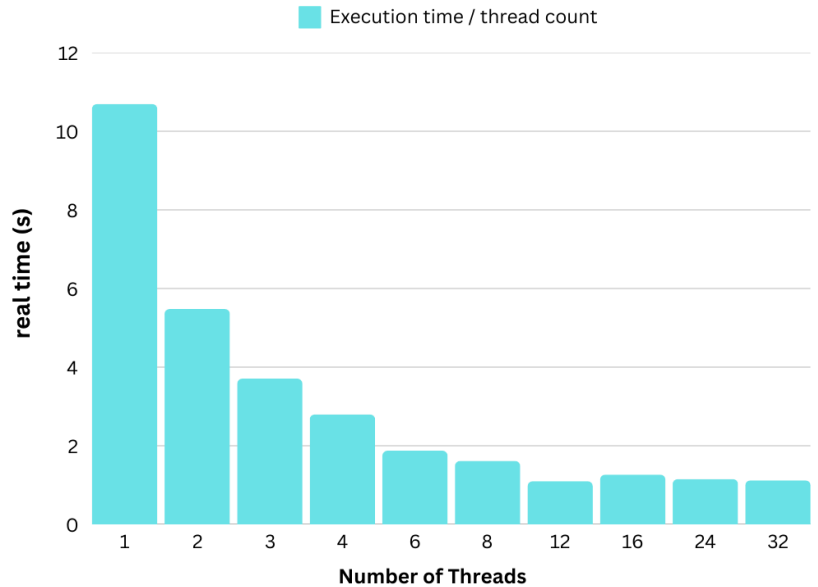


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Q2. Written answer

A)

Threads	Timing (s)
1 (original)	13.585
1	10.694
2	5.479
3	3.707
4	2.799
6	1.873
8	1.614
12	1.098
16	1.267
24	1.151
32	1.120



B)

I see that for thread numbers 2-12, I do get a result similar to an N-times speed-up when compared to the original single-threaded time. However, for thread numbers 16-32, they do not receive an N-times speed-up; this could happen because the number of threads we created outnumber the actual physical CPU cores, so when threads try to access resources from a core, there may not be enough resources to be shared, ie not enough CPU resources for all the generated threads.

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Q4. Written question

`Observed speedup compared to original` calculated as `observed timing` / `time of original program`

Input file	medium.txt
Timing of original program:	17.9149s

# threads	Observed timing	Observed speedup compared to original	Expected speedup
1	18.1500s	1.0131	1.0
2	9.2957s	0.5189	2.0
3	6.3006s	0.3517	3.0
4	4.7526s	0.2653	4.0
8	3.1785s	0.1774	8.0
16	2.4507s	0.1368	16.0

Input file	hard.txt
Timing of original program:	6.1087s

# threads	Observed timing	Observed speedup compared to original	Expected speedup
1	6.1861s	1.0126	1.0
2	3.1645s	0.5180	2.0
3	2.1218s	0.3473	3.0
4	1.6215s	0.2654	4.0
8	1.0736s	0.1757	8.0
16	0.8077s	0.1322	16.0

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Input file	hard2.txt
Timing of original program:	6.1070s

# threads	Observed timing	Observed speedup compared to original	Expected speedup
1	6.1381s	1.005	1.0
2	3.1762s	0.5201	2.0
3	2.1470s	0.3516	3.0
4	1.6197s	0.2652	4.0
8	0.8088s	0.1324	8.0
16	0.5714s	0.09356	16.0

The results in all three tables were close to the expected speedup. The reason why they were close and not on or faster than expected is, I expect, due to run-to-run variation, along with background tasks that can affect the lab computer's CPU performance. I can also probably get my program to run a bit faster with small variable optimizations. Also, higher thread count doesn't equate to guaranteed speed-ups; it can slow down the computation if the input size is small and the thread count is high. For example, running with 12 threads instead of 16 for medium.txt resulted in a quicker turn out time of on average ~0.2 seconds.