INFO 6205-PROGRAM STRUCTURE AND ALGORITHMS
ASSIGNMENT-5

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Task:

A merge sort algorithm with parallel sorting capability is realized. A sequence of cutoff values pertaining to the array size parameter of the sort function is decided, such that when the array size is lesser or equal to the cutoff, system sort method is enforced rather than the recursive parallel sort approach.
The number of active threads allocated to the program is changed periodically by changing the thread parameter of Executor implementing object, inorder to observe the change in execution times of the program.
Several cutoff-thread count combinations are tested on 3 different array sizes, by observing the execution times.

Relationship Conclusion:

The relationship between available threads to be made available and recursion depth is

$$\textbf{threads}=2^{d}$$

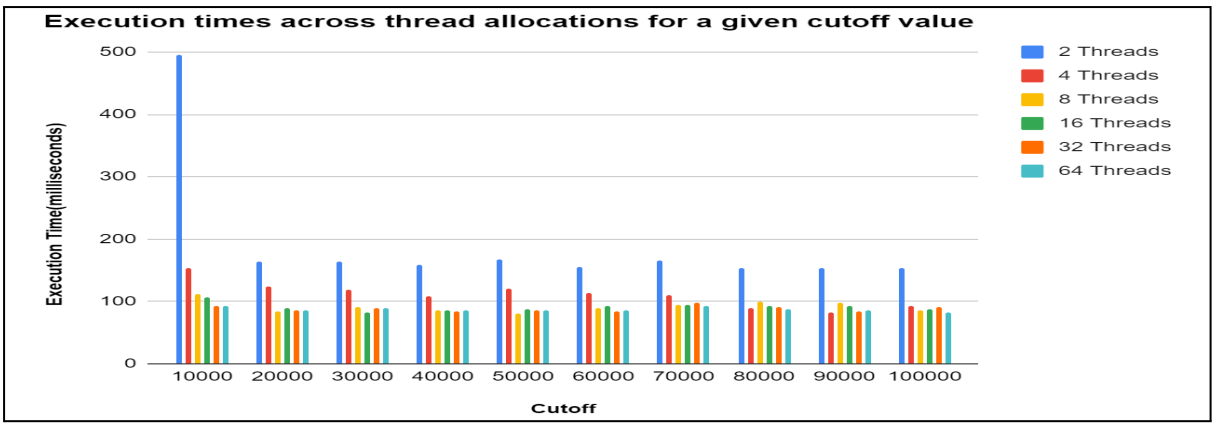
where d=depth of recursion

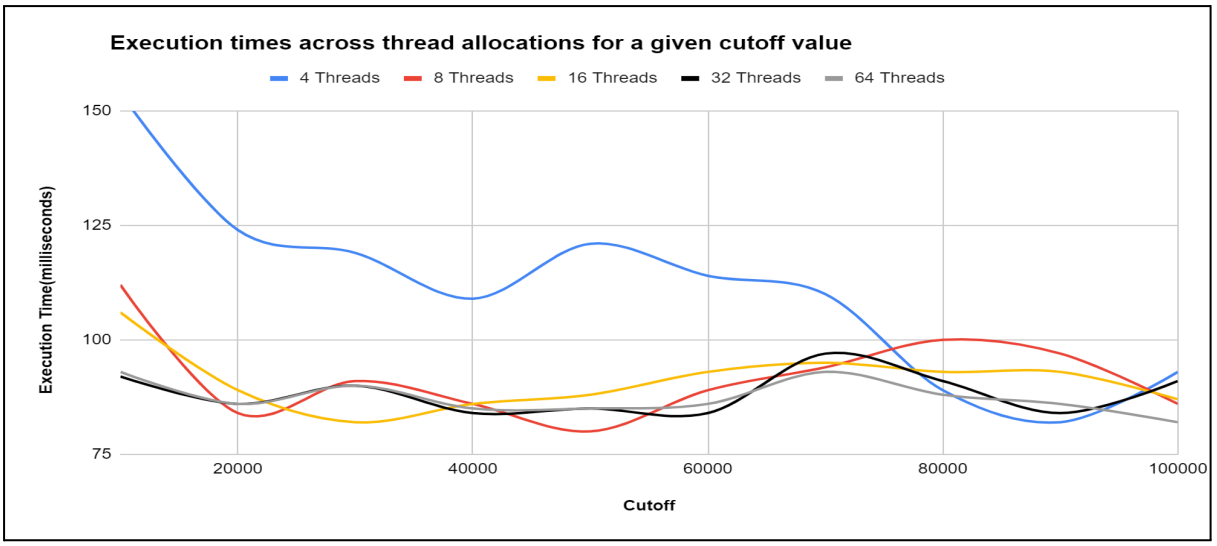
Depth of recursion is expected to be **lg(array size/cutoff)**.
By observing the execution time across various combinations of cutoff and thread count values, a cutoff of around 0.25 times array size and parallel thread limit between 4 and 8 yielded the best performance.

Graphical Interpretations:

FOR ARRAY SIZE- 250000

	EXECUTION TIMES(ms)					
Cutoff	2 Threads	4 Threads	8 Threads	16 Threads	32 Threads	64 Threads
10000	495	154	112	106	92	93
20000	163	124	84	89	86	86
30000	164	119	91	82	90	90
40000	159	109	86	86	84	85
50000	167	121	80	88	85	85
60000	155	114	89	93	84	86
70000	166	110	94	95	97	93
80000	154	89	100	93	91	88
90000	154	82	97	93	84	86
100000	154	93	86	87	91	82

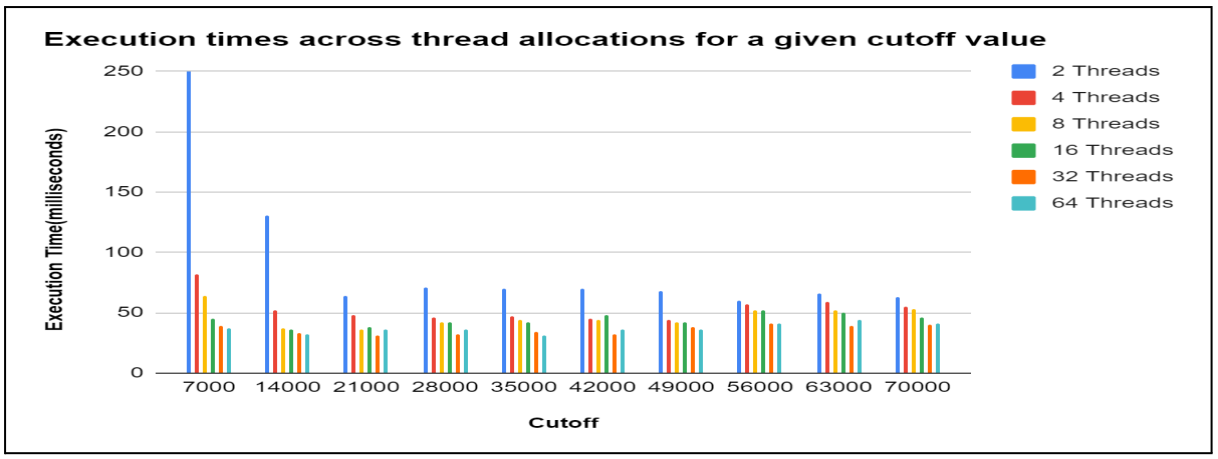


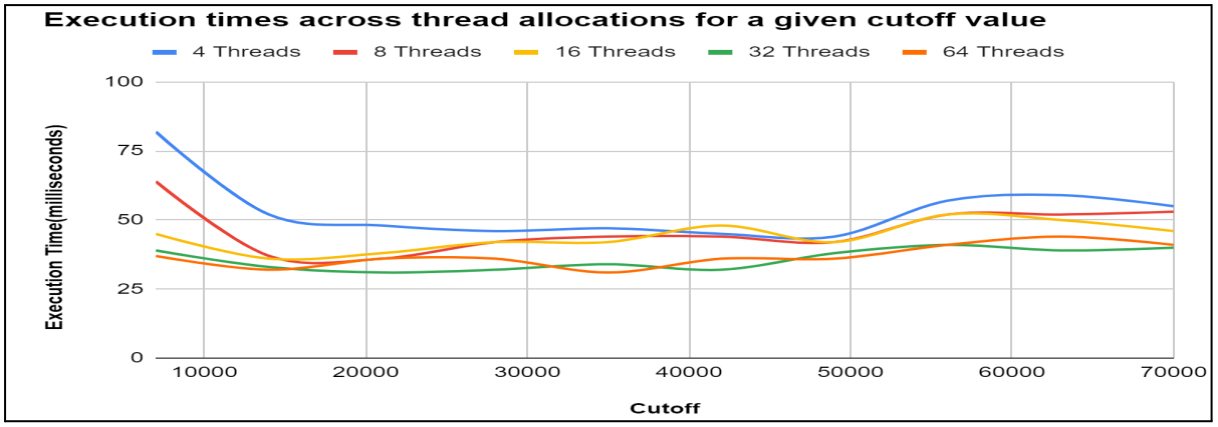


(The readings pertaining to thread-2 has been excluded in the above plot as such a condition exhibited larger execution times, making the plot of other threads to become indistinguishable)

FOR ARRAY SIZE- 100000

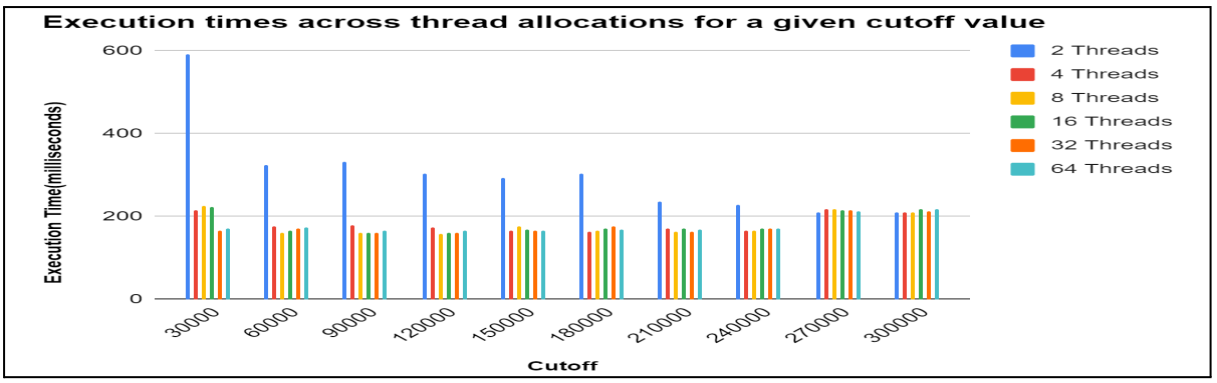
	EXECUTION TIMES(ms)					
Cutoff	2 Threads	4 Threads	8 Threads	16 Threads	32 Threads	64 Threads
7000	265	82	64	45	39	37
14000	131	52	37	36	33	32
21000	64	48	36	38	31	36
28000	71	46	42	42	32	36
35000	70	47	44	42	34	31
42000	70	45	44	48	32	36
49000	68	44	42	42	38	36
56000	60	57	52	52	41	41
63000	66	59	52	50	39	44
70000	63	55	53	46	40	41

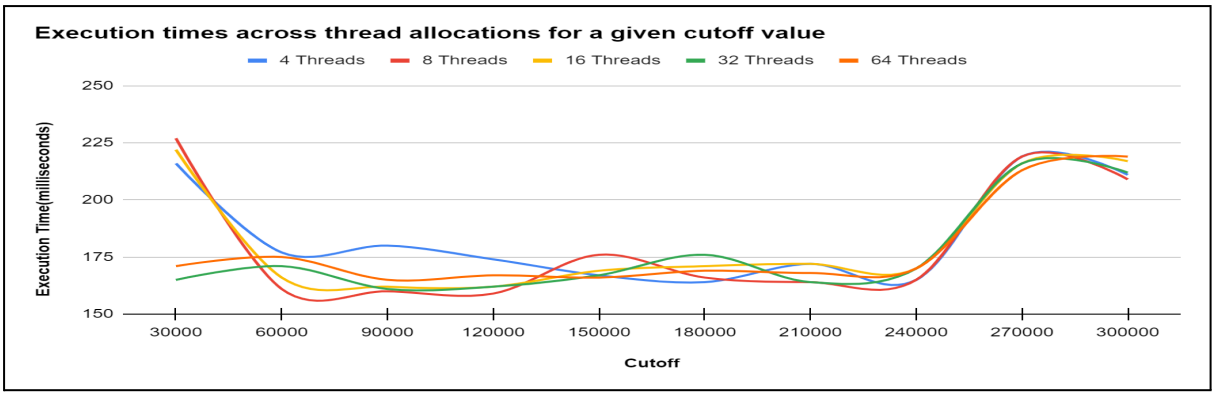




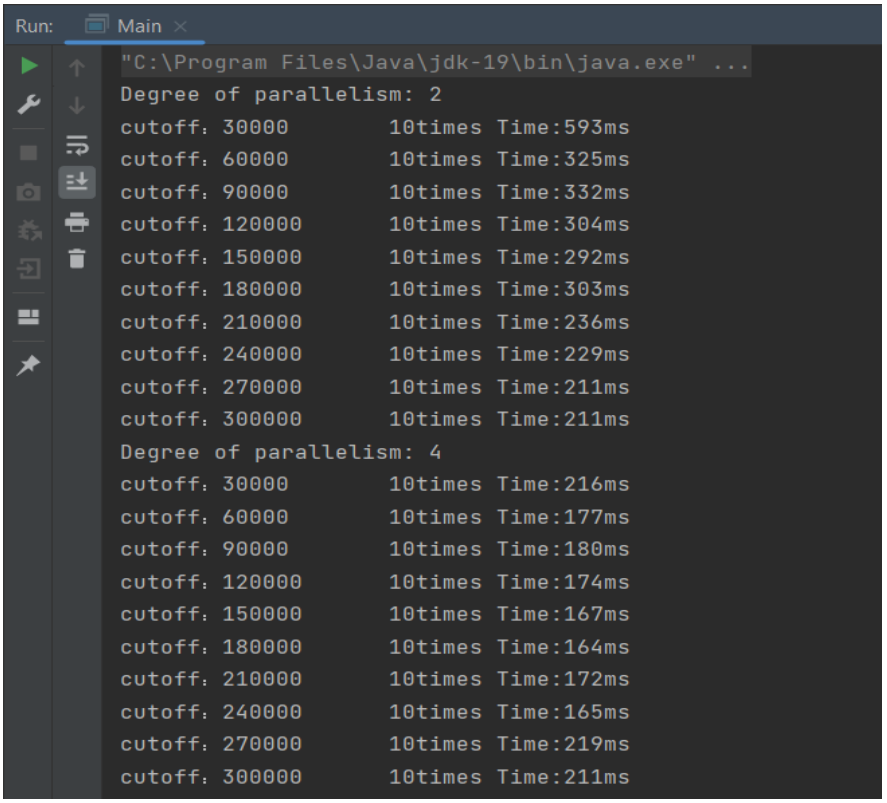
FOR ARRAY SIZE- 500000

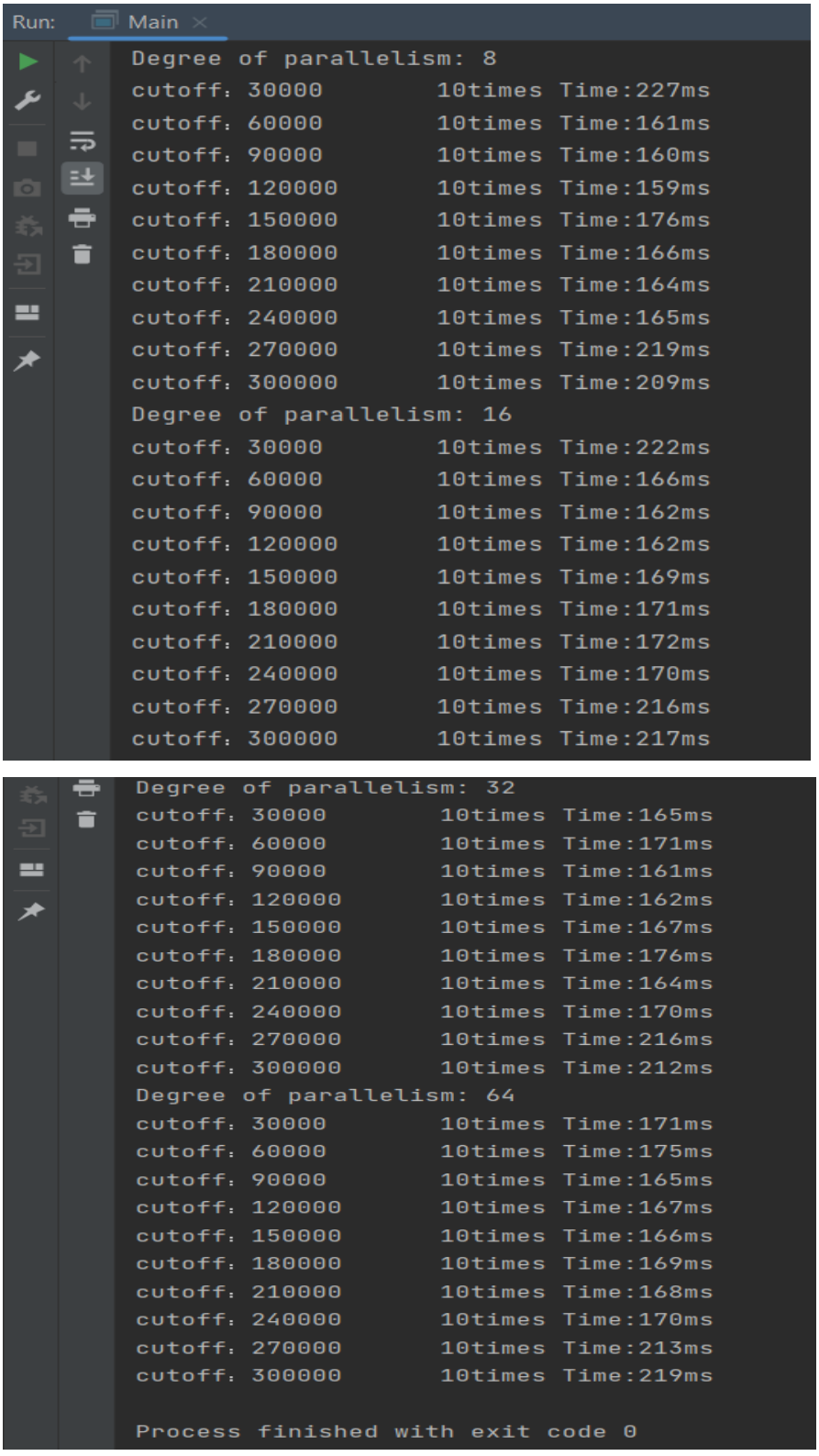
	EXECUTION TIMES(ms)					
Cutoff	2 Threads	4 Threads	8 Threads	16 Threads	32 Threads	64 Threads
30000	593	216	227	222	165	171
60000	325	177	161	166	171	175
90000	332	180	160	162	161	165
120000	304	174	159	162	162	167
150000	292	167	176	169	167	166
180000	303	164	166	171	176	169
210000	236	172	164	172	164	168
240000	229	165	165	170	170	170
270000	211	219	219	216	216	213
300000	211	211	209	217	212	219





Evidence:
(sample run of program for array size-500000)




Run:
Main
Degree of parallelism: 8
cutoff: 30000 10times Time:227ms
cutoff: 60000 10times Time:161ms
cutoff: 90000 10times Time:160ms
cutoff: 120000 10times Time:159ms
cutoff: 150000 10times Time:176ms
cutoff: 180000 10times Time:166ms
cutoff: 210000 10times Time:164ms
cutoff: 240000 10times Time:165ms
cutoff: 270000 10times Time:219ms
cutoff: 300000 10times Time:209ms
Degree of parallelism: 16
cutoff: 30000 10times Time:222ms
cutoff: 60000 10times Time:166ms
cutoff: 90000 10times Time:162ms
cutoff: 120000 10times Time:162ms
cutoff: 150000 10times Time:169ms
cutoff: 180000 10times Time:171ms
cutoff: 210000 10times Time:172ms
cutoff: 240000 10times Time:170ms
cutoff: 270000 10times Time:216ms
cutoff: 300000 10times Time:217ms
Degree of parallelism: 32
cutoff: 30000 10times Time:165ms
cutoff: 60000 10times Time:171ms
cutoff: 90000 10times Time:161ms
cutoff: 120000 10times Time:162ms
cutoff: 150000 10times Time:167ms
cutoff: 180000 10times Time:176ms
cutoff: 210000 10times Time:164ms
cutoff: 240000 10times Time:170ms
cutoff: 270000 10times Time:216ms
cutoff: 300000 10times Time:212ms
Degree of parallelism: 64
cutoff: 30000 10times Time:171ms
cutoff: 60000 10times Time:175ms
cutoff: 90000 10times Time:165ms
cutoff: 120000 10times Time:167ms
cutoff: 150000 10times Time:166ms
cutoff: 180000 10times Time:169ms
cutoff: 210000 10times Time:168ms
cutoff: 240000 10times Time:170ms
cutoff: 270000 10times Time:213ms
cutoff: 300000 10times Time:219ms
Process finished with exit code 0