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Concurrent Data Structures for Multi-Core Systems

Programming Assignment 1

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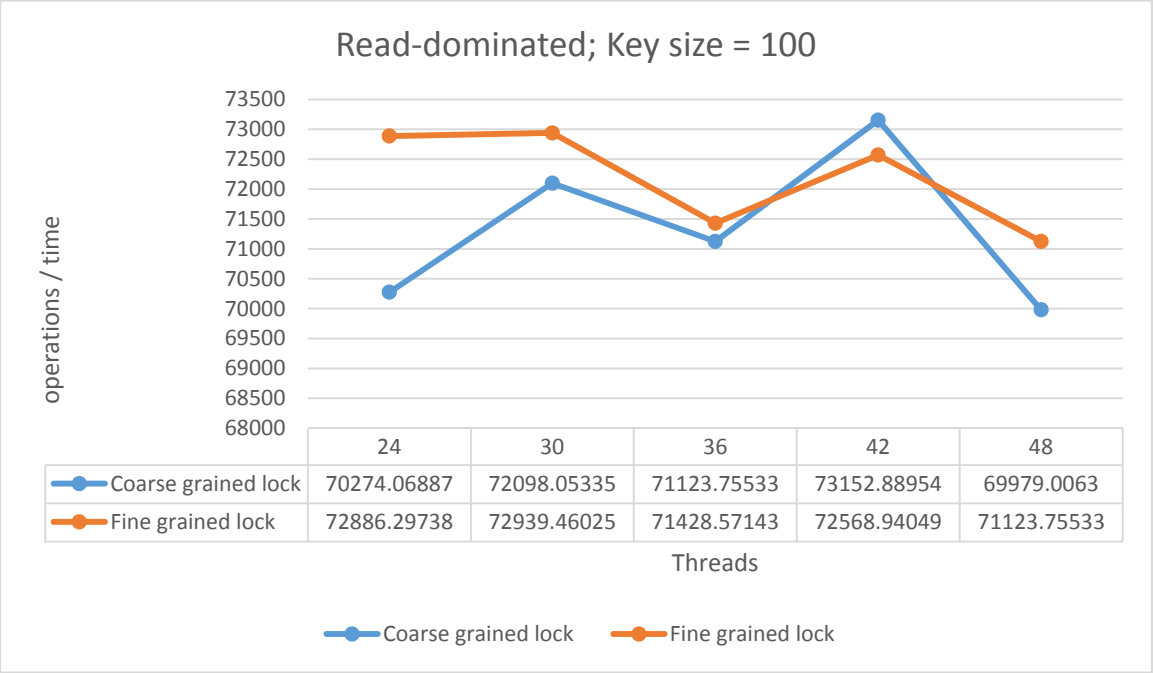
Experiment:

- Linked List Key size = 100
- Read-dominated work load
    - 90% search, 9% insert and 1% delete
- Number of Threads: 24, 30, 36, 42, 48

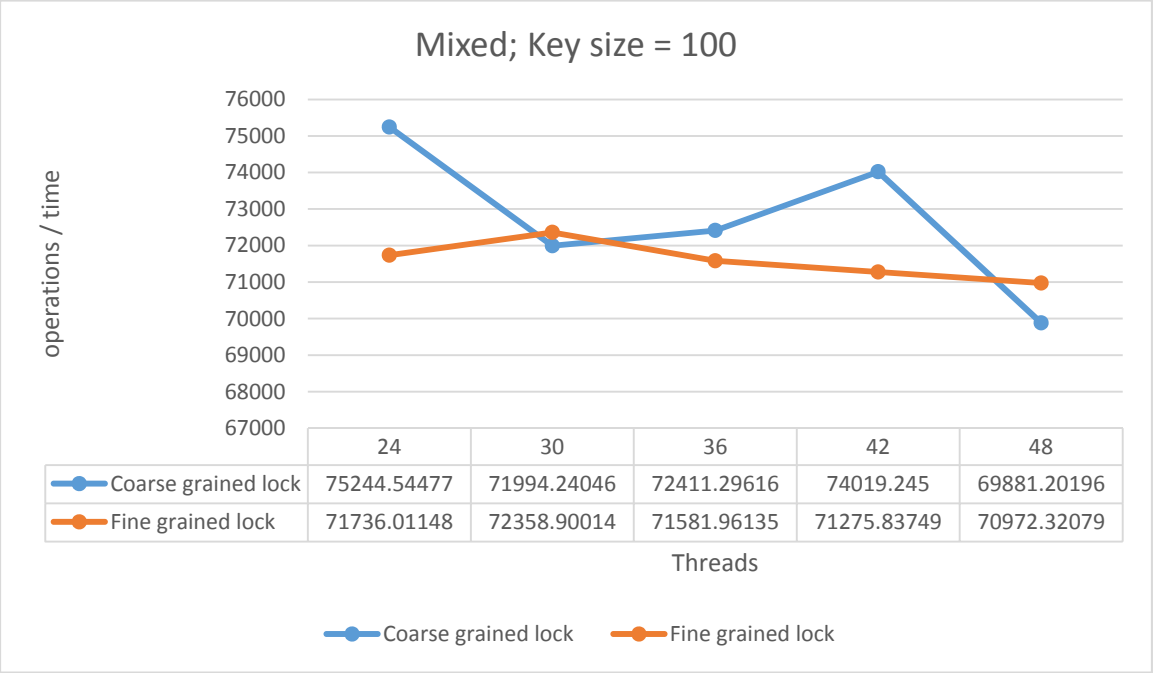


Thread	Coarse grained lock		Fine grained lock	
	Insert	Remove	Insert	Remove
24	97	1	100	0
30	64	46	98	0
36	84	1	100	0
42	84	1	98	0
48	79	1	98	0

The table compares the successful operations performed for Insert and Delete on the Linked List using Coarse grained and Fine grained locks; a total of 100,000 operations were performed on the linked list.

Experiment:

- Linked List Key size = 100
- Mixed work load
    - 70% search, 20% insert and 10% delete
- Number of Threads: 24, 30, 36, 42, 48



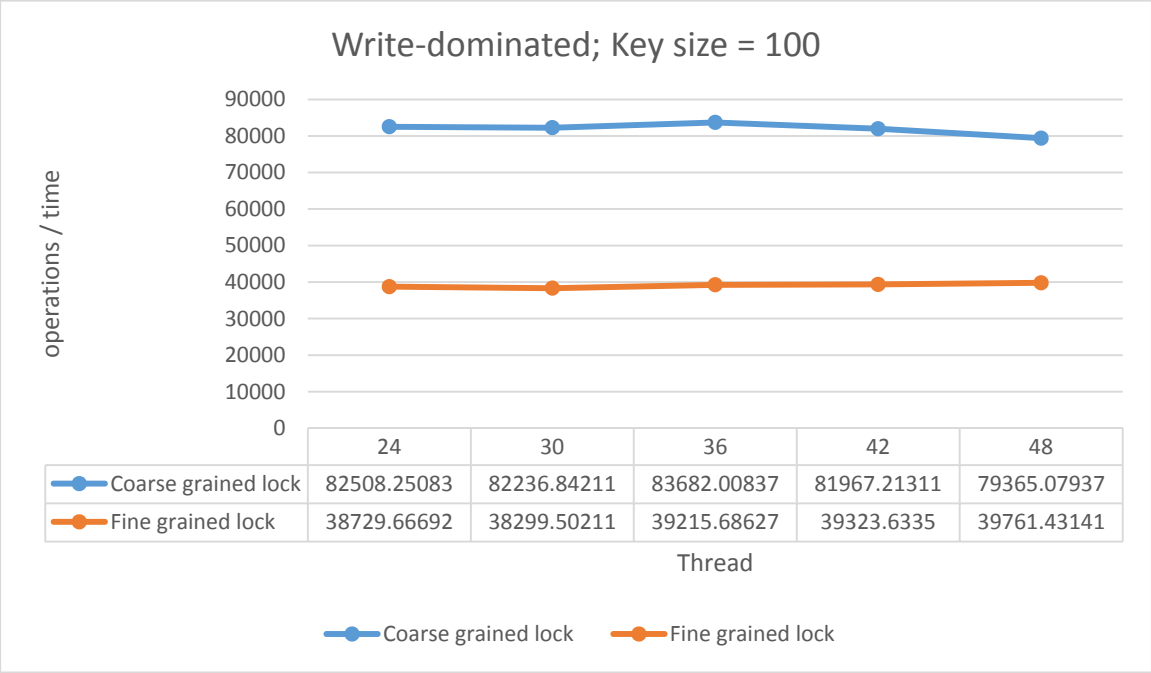
Thread	Coarse grained lock		Fine grained lock	
	Insert	Remove	Insert	Remove
24	101	32	289	226
30	98	3	239	178
36	89	4	252	186
42	86	4	231	166
48	86	5	192	120

The table compares the successful operations performed for Insert and Delete on the Linked List using Coarse grained and Fine grained locks; a total of 100,000 operations were performed on the linked list.

Even though the coarse grained lock's execution time is less, the number of successful operations performed by fine grained lock are more than the coarse grained lock. This illustrates that more operations were performed by the search operation (without involving locks) in coarse grained lock.

Experiment:

- Linked List Key size = 100
- Write-dominated work load
    - 0% search, 50% insert and 50% delete
- Number of Threads: 24, 30, 36, 42, 48



Thread	Coarse grained lock		Fine grained lock	
	Insert	Remove	Insert	Remove
24	810	721	25102	25054
30	440	354	24988	24937
36	359	276	25153	25107
42	272	255	25037	24988
48	578	558	25209	25154

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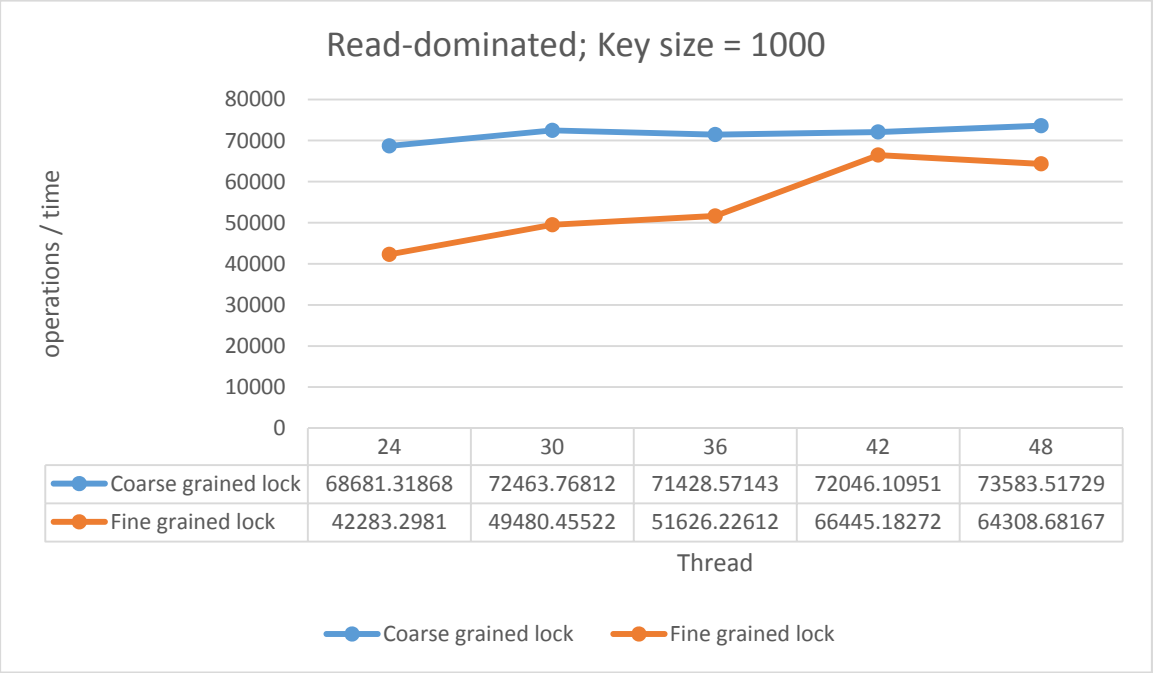
Even though the coarse grained lock has higher throughput, the number of successful operations performed by fine grained lock are more than the coarse grained lock.

Experiment:

- Linked List Key size = 1,000
- Read-dominated work load
    - 90% search, 9% insert and 1% delete
- Number of Threads: 24, 30, 36, 42, 48



Thread	Coarse grained lock		Fine grained lock	
	Insert	Remove	Insert	Remove
24	306	1	1000	0
30	181	0	937	0
36	124	0	883	0
42	116	0	400	0
48	91	0	421	0

The table compares the successful operations performed for Insert and Delete on the Linked List using Coarse grained and Fine grained locks; a total of 100,000 operations were performed on the linked list.

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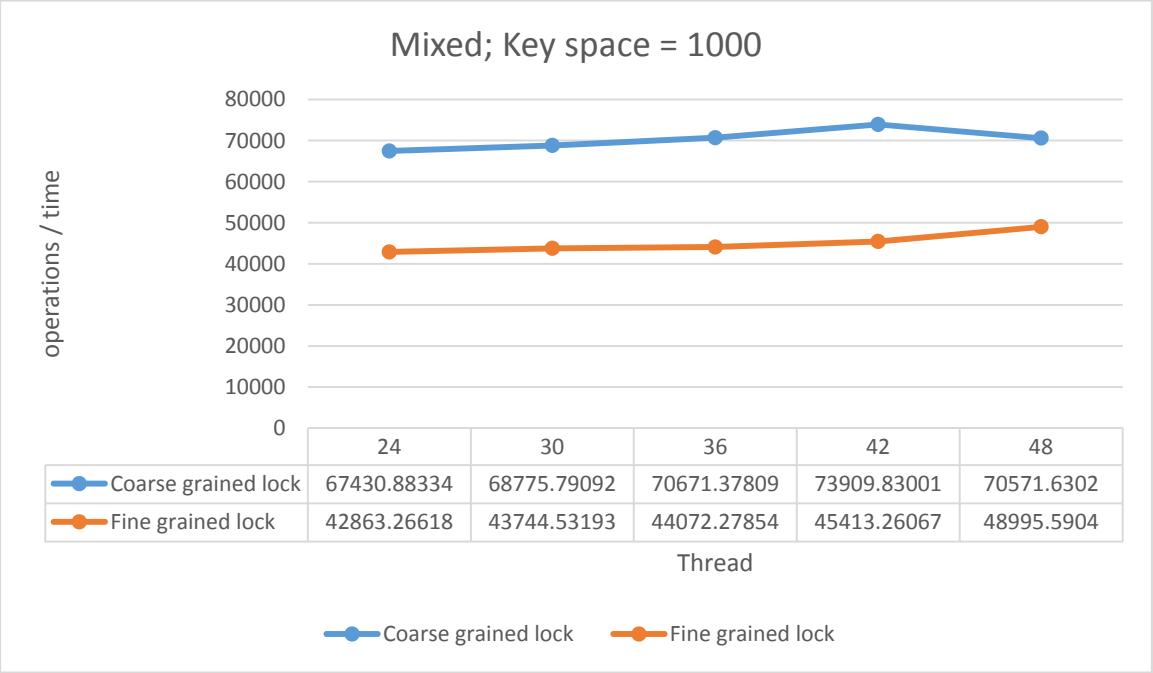


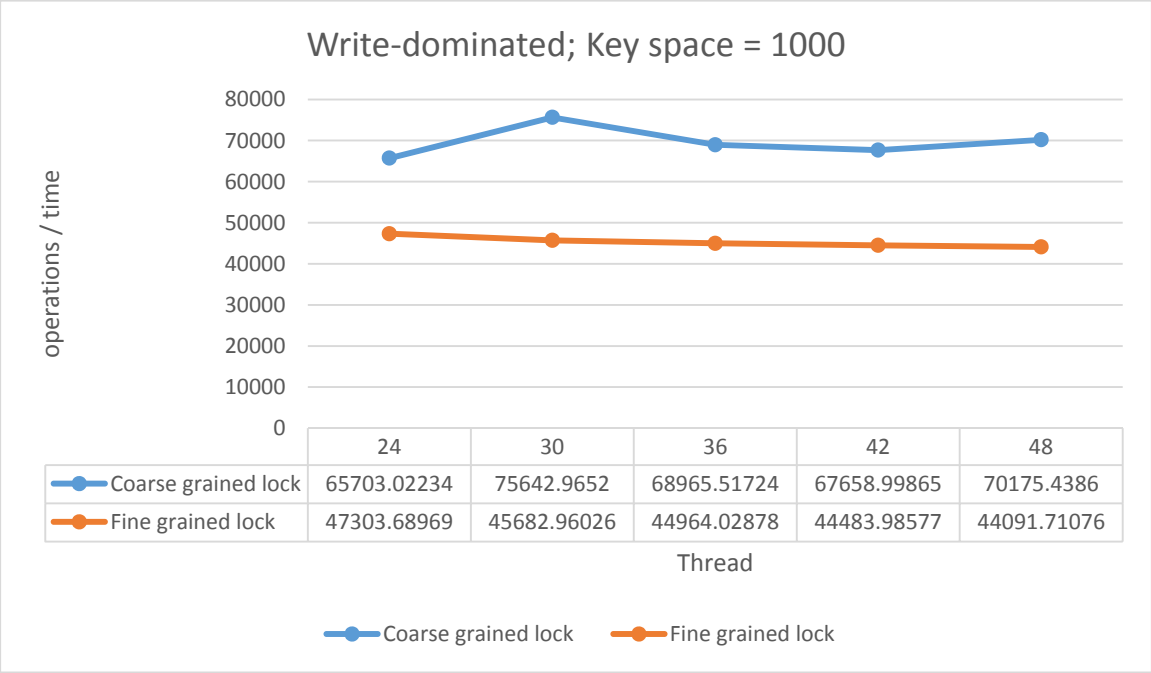
Thread	Coarse grained lock		Fine grained lock	
	Insert	Remove	Insert	Remove
24	380	26	2649	2005
30	261	23	2334	1681
36	191	1	2170	1473
42	149	2	1948	1295
48	145	1	1600	918

The table compares the successful operations performed for Insert and Delete on the Linked List using Coarse grained and Fine grained locks; a total of 100,000 operations were performed on the linked list.

Even though the coarse grained lock's execution time is less, the number of successful operations performed by fine grained lock are more than the coarse grained lock. This illustrates that more operations were performed by the search operation (without involving locks) in coarse grained lock.

Experiment:

- Linked List Key size = 1,000
- Write-dominated work load
    - 0% search, 50% insert and 50% delete
- Number of Threads: 24, 30, 36, 42, 48



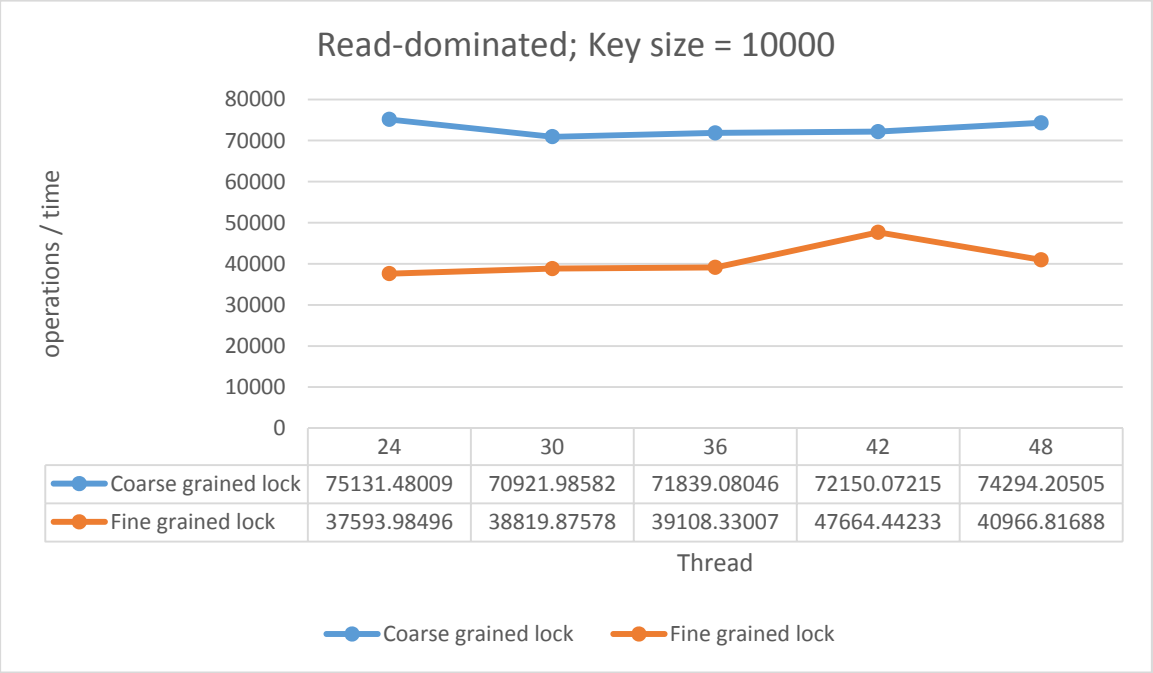
Thread	Coarse grained lock		Fine grained lock	
	Insert	Remove	Insert	Remove
24	2420	1432	25306	24799
30	3828	2881	25011	24518
36	3671	2689	25246	24753
42	4033	3055	25299	24806
48	2013	1037	25249	24751

The table compares the successful operations performed for Insert and Delete on the Linked List using Coarse grained and Fine grained locks; a total of 100,000 operations were performed on the linked list.

Even though the coarse grained lock has higher throughput, the number of successful operations performed by fine grained lock are more than the coarse grained lock.

Experiment:

- Linked List Key size = 10,000
- Read-dominated work load
    - 90% search, 9% insert and 1% delete
- Number of Threads: 24, 30, 36, 42, 48



Thread	Coarse grained lock		Fine grained lock	
	Insert	Remove	Insert	Remove
24	4	0	4217	0
30	180	0	3617	0
36	149	0	3872	0
42	120	0	2576	0
48	96	0	3378	0

The table compares the successful operations performed for Insert and Delete on the Linked List using Coarse grained and Fine grained locks; a total of 100,000 operations were performed on the linked list.

Most of the operations are performed by the search threads and very few operations are performed by the Insert and Remove threads together.

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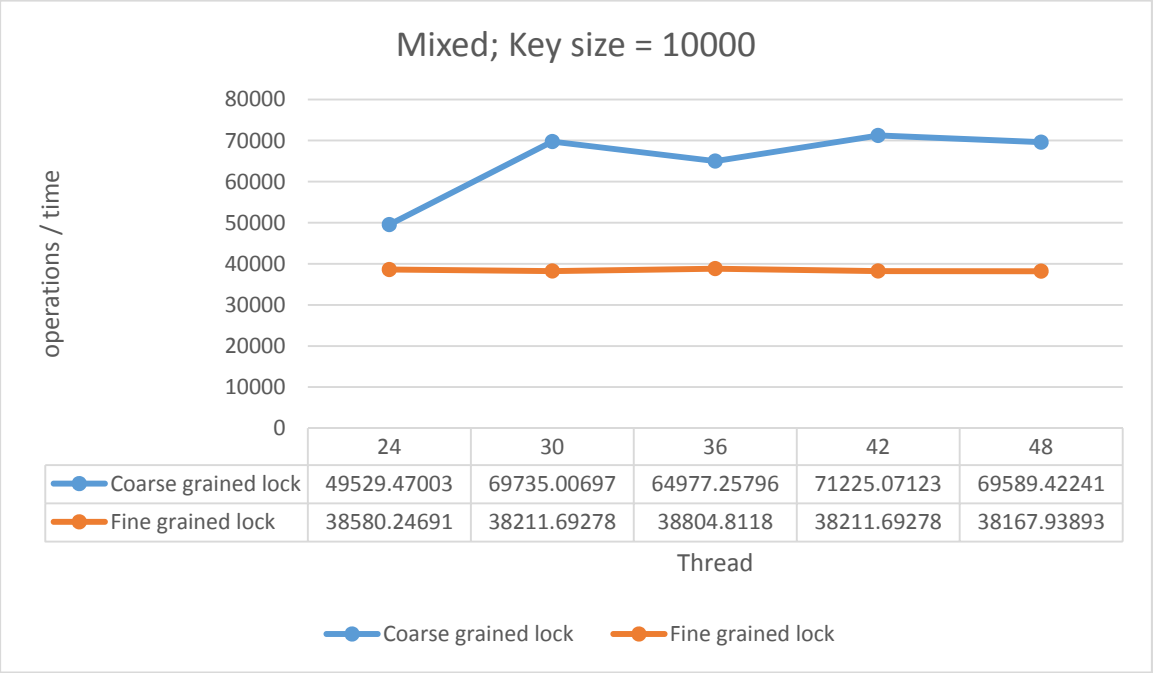
- Number of Threads: 24, 30, 36, 42, 48



Thread	Coarse grained lock		Fine grained lock	
	Insert	Remove	Insert	Remove
24	2030	37	5868	1191
30	373	0	5693	1110
36	491	0	5306	766
42	177	0	5093	837
48	195	0	4741	667

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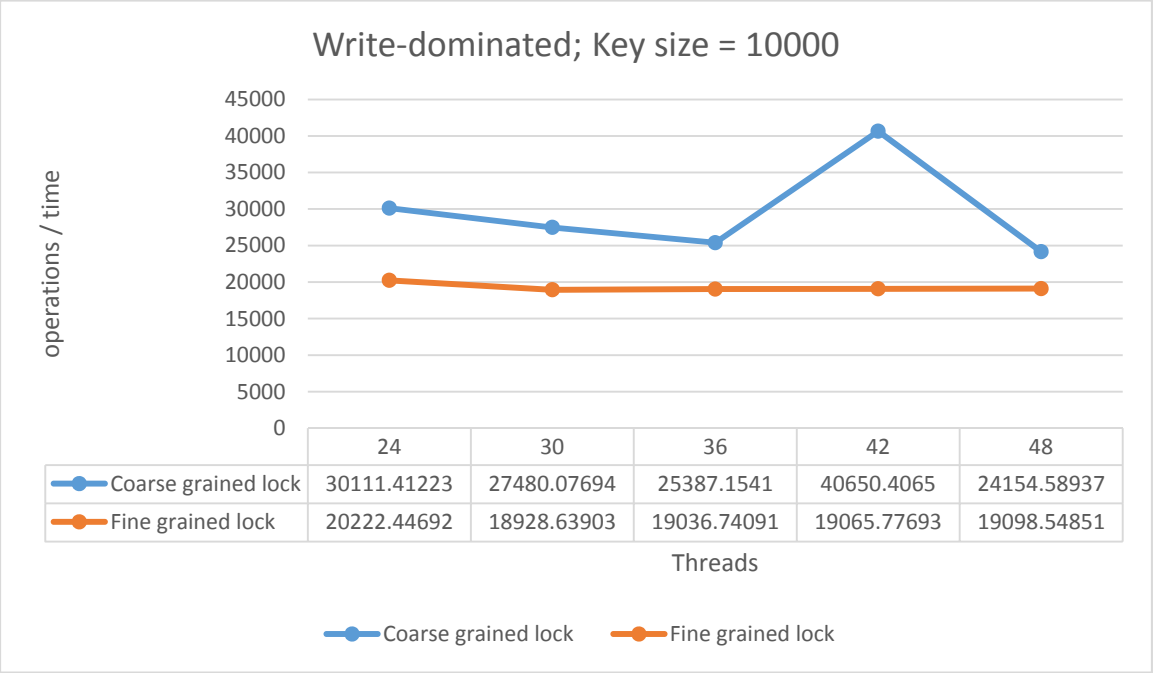

Thread	Coarse grained lock		Fine grained lock	
	Insert	Remove	Insert	Remove
24	20211	10543	27480	22522
30	15442	15210	27556	22586
36	17127	16079	27595	22592
42	18782	14641	27543	22570
48	18020	15117	27563	22590

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Even though the coarse grained lock has higher throughput, the number of successful operations performed by fine grained lock are more than the coarse grained lock.

Conclusion

The coarse grain locks have a better throughput performing more non-lock / few lock related operations compared to the fine grain locks; which perform more lock operations efficiently in a given time due to the hand-over locking mechanism.

All the experiments were tested for performing 100,000 operations by varying threads ranging from 24 to 48 (equivalent to the processing cores of the system) with varying linked list key sizes of 100, 1000, 10000 each.

Note: The results for running time may vary depending on the system configuration: processing cores / RAM available / on-going operations on the same machine.