Lab 4 - Parallelism Synchronization - Part 2

Team Information

Section: PRA0102

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4.2.1-Coarse-grained and Fine-grained Locking

Logs

```
Coarse-grained lock
List: 40 50 100 120 160 180
List locked (coarse) for node with value 65
List locked (coarse) for node with value 77
Coarse-grained locking time: 119 us
List: 40 50 65 77 100 120 160 180
------------------
List: 40 50 100 120 160 180
List locked (coarse) for node with value 65
List locked (coarse) for node with value 77
Coarse-grained locking time: 136 us
List: 40 50 65 77 100 120 160 180
------------------
List: 40 50 100 120 160 180
List locked (coarse) for node with value 77
List locked (coarse) for node with value 65
Coarse-grained locking time: 103 us
List: 40 50 65 77 100 120 160 180
------------------
List: 40 50 100 120 160 180
List locked (coarse) for node with value 65
List locked (coarse) for node with value 77
Coarse-grained locking time: 82 us
List: 40 50 65 77 100 120 160 180
------------------
List: 40 50 100 120 160 180
List locked (coarse) for node with value 65
List locked (coarse) for node with value 77
Coarse-grained locking time: 71 us
List: 40 50 65 77 100 120 160 180
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Fine-grained lock
List: 40 50 100 120 160 180
Node 65 locked (fine)
Node 77 locked (fine)
Fine-grained locking time: 74 us
List: 40 50 65 77 100 120 160 180
------------------
List: 40 50 100 120 160 180
Node 65 locked (fine)
```

```
Node 77 locked (fine)
Fine-grained locking time: 67 us
List: 40 50 65 77 100 120 160 180
------------------
List: 40 50 100 120 160 180
Node 65 locked (fine)
Node 77 locked (fine)
Fine-grained locking time: 82 us
List: 40 50 65 77 100 120 160 180
------------------
List: 40 50 100 120 160 180
Node 65 locked (fine)
Node 77 locked (fine)
Fine-grained locking time: 52 us
List: 40 50 65 77 100 120 160 180
------------------
List: 40 50 100 120 160 180
Node 65 locked (fine)
Node 77 locked (fine)
Fine-grained locking time: 74 us
List: 40 50 65 77 100 120 160 180
------------------
```

Table

Time (us)	Run #1	Run #2	Run #3	Run #4	Run #5	Average
Coarse-grained lock	119	136	103	82	71	102.2
Fine-grained lock	74	67	82	52	74	69.8

Compare the processes in (a) and (b)

Coarse-Grained Locking: If there is one Mutex protecting an entire program, then it is coarse-grained locking

Put each of the processes entirely in its own critical section

So one process runs into completion before other one starts

Fine-Grained Locking: If there are many Mutex, like one per integer in the program that are need to read or write, then it is Fine-Grained Locking

advantages and disadvantage

Advantage of coarse-grained locks / Disadvantage of fine-grained locks

Correctness is easier with only one lock (less chance of taking the wrong lock)

Less overhead of creating locks

Less risk of deadlock

Advantage of fine-grained locks / Disadvantage of coarse-grained locks:

Performance is better as there are more concurrency and parallelism

4.2.2-Spin-Lock vs other Locks

Log

```
Thread 0 - Spin Time: 0.000176ms, Total Time: 5.08781ms
Thread 1 - Spin Time: 15.2247ms, Total Time: 20.3228ms
Thread 2 - Spin Time: 10.1324ms, Total Time: 15.2014ms
Thread 3 - Spin Time: 20.2811ms, Total Time: 25.3599ms
Thread 4 - Spin Time: 5.03571ms, Total Time: 10.1052ms
-------------------
Thread 0 - Spin Time: 0.000111ms, Total Time: 5.09017ms
Thread 1 - Spin Time: 20.2789ms, Total Time: 25.3671ms
Thread 2 - Spin Time: 10.1165ms, Total Time: 15.1724ms
Thread 3 - Spin Time: 5.08338ms, Total Time: 10.158ms
Thread 4 - Spin Time: 15.1548ms, Total Time: 20.2244ms
-------------------
Thread 0 - Spin Time: 0.000369ms, Total Time: 5.05886ms
Thread 1 - Spin Time: 10.0803ms, Total Time: 15.191ms
Thread 2 - Spin Time: 20.2365ms, Total Time: 25.3344ms
Thread 3 - Spin Time: 5.03111ms, Total Time: 10.0979ms
Thread 4 - Spin Time: 15.181ms, Total Time: 20.27ms
-------------------
Thread 0 - Spin Time: 10.1228ms, Total Time: 15.212ms
Thread 1 - Spin Time: 20.2531ms, Total Time: 25.3432ms
Thread 2 - Spin Time: 0.000103ms, Total Time: 5.06549ms
Thread 3 - Spin Time: 15.2252ms, Total Time: 20.303ms
Thread 4 - Spin Time: 5.03069ms, Total Time: 10.1122ms
-------------------
Thread 0 - Spin Time: 0.000106ms, Total Time: 5.05971ms
Thread 1 - Spin Time: 15.1267ms, Total Time: 20.2154ms
Thread 2 - Spin Time: 20.2152ms, Total Time: 25.3139ms
Thread 3 - Spin Time: 10.1127ms, Total Time: 15.1701ms
Thread 4 - Spin Time: 4.9903ms, Total Time: 10.0501ms
-------------------
Thread 0 - Average Spin Time: 2.02471ms, Average Total Time: 7.10171ms
Thread 1 - Average Spin Time: 16.1927ms, Average Total Time: 21.2879ms
Thread 2 - Average Spin Time: 12.1401ms, Average Total Time: 17.2175ms
Thread 3 - Average Spin Time: 11.1467ms, Average Total Time: 16.2178ms
Thread 4 - Average Spin Time: 9.0785ms, Average Total Time: 14.1524ms
```

Spin Time (ms)

Thread	Run 1	Run 2	Run 3	Run 4	Run 5
0	0.000176	0.000111	0.000369	10.1228	0.000106
1	15.2247	20.2789	10.0803	20.2531	15.1267
2	10.1324	10.1165	20.2365	0.000103	20.2152
3	20.2811	5.08338	5.03111	15.2252	10.1127
4	5.03571	15.1548	15.181	5.03069	4.9903

Total Time (ms)

Thread	Run 1	Run 2	Run 3	Run 4	Run 5
0	5.08781	5.09017	5.05886	15.212	5.05971
1	20.3228	25.3671	15.191	25.3432	20.2154
2	15.2014	15.1724	25.3344	5.06549	25.3139
3	25.3599	10.158	10.0979	20.303	15.1701
4	10.1052	20.2244	20.27	10.1122	10.0501

Average Times (ms)

Thread	Average Spin Time	Average Total Time
0	2.02471	7.10171
1	16.1927	21.2879
2	12.1401	17.2175
3	11.1467	16.2178
4	9.0785	14.1524