

ADVANCED OPERATING SYSTEMS

Project 2 – Quorum Based Mutual Exclusion Algorithm

By Akshath Salekoppal Ramesh – asr150330

Note- Algorithm mentioned in project document is prone to deadlock.*

Deadlock Explanation

At any given instant two clients can make request even if the delay between requests are taken care of. Two clients have the option to choose same quorum or different quorum.

1. Same Quorum

On choosing the same quorum the order in which server receives the request will be different there by the deadlock scenario.

Example

C1 – Chooses quorum <3,4,2,6> *Server ID starts with 0

C2 – Chooses quorum <3,4,2,6>

Server 3, 4 might receive the request from C1 first and then the one's from C2.

Server 2, 6 might receive the request from C2 first.

There by Server 3, 4 replies with grant to C1 and Server 2, 6 will reply grant to C2.

Ideally, if C1 generates the request prior to C2 all the request should reach all Server 3, 4, 2, 6 first for algorithm to work. This is not the case in real world scenario. Due to network delay.

2. Different Quorum

Same explanation as above except request reach the intersecting server ID's in different order.

Analysis

1. Changing time between a client exiting its critical section and issuing its next request

Below are the simulation data of multiple attempts by changing time between generating two requests. Increasing simulation count represents increasing time gap between two requests.

```
0 Client used critical section at timestamp -> 1554596294547 : Time elapsed: 103
1 Client used critical section at timestamp -> 1554596295038 : Time elapsed: 107
0 Client used critical section at timestamp -> 1554596295542 : Time elapsed: 95
2 Client used critical section at timestamp -> 1554596295717 : Time elapsed: 199
3 Client used critical section at timestamp -> 1554596295831 : Time elapsed: 37
```

4 Client used critical section at timestamp -> 1554596296389 : Time elapsed: 108
1 Client used critical section at timestamp -> 1554596296605 : Time elapsed: 134
0 Client used critical section at timestamp -> 1554596296648 : Time elapsed: 197
0 Client used critical section at timestamp -> 1554596297533 : Time elapsed: 80
2 Client used critical section at timestamp -> 1554596297713 : Time elapsed: 79
1 Client used critical section at timestamp -> 1554596298093 : Time elapsed: 81
3 Client used critical section at timestamp -> 1554596298249 : Time elapsed: 67
0 Client used critical section at timestamp -> 1554596298539 : Time elapsed: 78
4 Client used critical section at timestamp -> 1554596299202 : Time elapsed: 93
0 Client used critical section at timestamp -> 1554596299535 : Time elapsed: 71
1 Client used critical section at timestamp -> 1554596299676 : Time elapsed: 122
2 Client used critical section at timestamp -> 1554596299790 : Time elapsed: 42
0 Client used critical section at timestamp -> 1554596300557 : Time elapsed: 86
3 Client used critical section at timestamp -> 1554596300746 : Time elapsed: 180
1 Client used critical section at timestamp -> 1554596301155 : Time elapsed: 57
0 Client used critical section at timestamp -> 1554596301576 : Time elapsed: 102
2 Client used critical section at timestamp -> 1554596302060 : Time elapsed: 194
4 Client used critical section at timestamp -> 1554596302213 : Time elapsed: 286
0 Client used critical section at timestamp -> 1554596302565 : Time elapsed: 89
1 Client used critical section at timestamp -> 1554596302718 : Time elapsed: 74
3 Client used critical section at timestamp -> 1554596303008 : Time elapsed: 50
0 Client used critical section at timestamp -> 1554596303523 : Time elapsed: 40
2 Client used critical section at timestamp -> 1554596304072 : Time elapsed: 92
1 Client used critical section at timestamp -> 1554596304215 : Time elapsed: 32
0 Client used critical section at timestamp -> 1554596304567 : Time elapsed: 81
4 Client used critical section at timestamp -> 1554596304898 : Time elapsed: 152
3 Client used critical section at timestamp -> 1554596305444 : Time elapsed: 104
0 Client used critical section at timestamp -> 1554596305580 : Time elapsed: 86
1 Client used critical section at timestamp -> 1554596305804 : Time elapsed: 76
2 Client used critical section at timestamp -> 1554596306188 : Time elapsed: 84
0 Client used critical section at timestamp -> 1554596306611 : Time elapsed: 115
1 Client used critical section at timestamp -> 1554596307331 : Time elapsed: 64
0 Client used critical section at timestamp -> 1554596307584 : Time elapsed: 86
4 Client used critical section at timestamp -> 1554596307759 : Time elapsed: 54
3 Client used critical section at timestamp -> 1554596307891 : Time elapsed: 170
2 Client used critical section at timestamp -> 1554596308318 : Time elapsed: 94
0 Client used critical section at timestamp -> 1554596308604 : Time elapsed: 102
1 Client used critical section at timestamp -> 1554596308898 : Time elapsed: 84
0 Client used critical section at timestamp -> 1554596309576 : Time elapsed: 66
3 Client used critical section at timestamp -> 1554596310156 : Time elapsed: 53
2 Client used critical section at timestamp -> 1554596310414 : Time elapsed: 72
1 Client used critical section at timestamp -> 1554596310527 : Time elapsed: 175
4 Client used critical section at timestamp -> 1554596310647 : Time elapsed: 123
0 Client used critical section at timestamp -> 1554596310797 : Time elapsed: 280
0 Client used critical section at timestamp -> 1554596311602 : Time elapsed: 77
1 Client used critical section at timestamp -> 1554596311925 : Time elapsed: 31
3 Client used critical section at timestamp -> 1554596312528 : Time elapsed: 36

***** SIMULATION COUNT:2 *****

0 Client used critical section at timestamp -> 1554596339684 : Time elapsed: 55
1 Client used critical section at timestamp -> 1554596339817 : Time elapsed: 145
2 Client used critical section at timestamp -> 1554596340212 : Time elapsed: 63
0 Client used critical section at timestamp -> 1554596340732 : Time elapsed: 97
3 Client used critical section at timestamp -> 1554596341168 : Time elapsed: 42
1 Client used critical section at timestamp -> 1554596341316 : Time elapsed: 106
0 Client used critical section at timestamp -> 1554596341721 : Time elapsed: 85
4 Client used critical section at timestamp -> 1554596341963 : Time elapsed: 278
2 Client used critical section at timestamp -> 1554596342348 : Time elapsed: 80
0 Client used critical section at timestamp -> 1554596342675 : Time elapsed: 30
1 Client used critical section at timestamp -> 1554596342835 : Time elapsed: 84
3 Client used critical section at timestamp -> 1554596343590 : Time elapsed: 75
0 Client used critical section at timestamp -> 1554596343760 : Time elapsed: 113
1 Client used critical section at timestamp -> 1554596344342 : Time elapsed: 54
4 Client used critical section at timestamp -> 1554596344574 : Time elapsed: 67
2 Client used critical section at timestamp -> 1554596344662 : Time elapsed: 227
0 Client used critical section at timestamp -> 1554596344788 : Time elapsed: 140
0 Client used critical section at timestamp -> 1554596345745 : Time elapsed: 91
1 Client used critical section at timestamp -> 1554596345893 : Time elapsed: 67
3 Client used critical section at timestamp -> 1554596345968 : Time elapsed: 71

```

2 Client used critical section at timestamp -> 1554596346736 : Time elapsed: 87
0 Client used critical section at timestamp -> 1554596346830 : Time elapsed: 175
4 Client used critical section at timestamp -> 1554596347413 : Time elapsed: 82
1 Client used critical section at timestamp -> 1554596347604 : Time elapsed: 233
0 Client used critical section at timestamp -> 1554596347743 : Time elapsed: 78
3 Client used critical section at timestamp -> 1554596348355 : Time elapsed: 69
0 Client used critical section at timestamp -> 1554596348766 : Time elapsed: 98
2 Client used critical section at timestamp -> 1554596348878 : Time elapsed: 111
1 Client used critical section at timestamp -> 1554596349011 : Time elapsed: 101
0 Client used critical section at timestamp -> 1554596349764 : Time elapsed: 93
4 Client used critical section at timestamp -> 1554596350233 : Time elapsed: 83
1 Client used critical section at timestamp -> 1554596350586 : Time elapsed: 137
3 Client used critical section at timestamp -> 1554596350747 : Time elapsed: 79
0 Client used critical section at timestamp -> 1554596350847 : Time elapsed: 168
2 Client used critical section at timestamp -> 1554596350951 : Time elapsed: 67
0 Client used critical section at timestamp -> 1554596351772 : Time elapsed: 91
1 Client used critical section at timestamp -> 1554596352068 : Time elapsed: 78
0 Client used critical section at timestamp -> 1554596352830 : Time elapsed: 144
***** SIMULATION COUNT:3 *****
0 Client used critical section at timestamp -> 1554596487253 : Time elapsed: 74
0 Client used critical section at timestamp -> 1554596487378 : Time elapsed: 97
1 Client used critical section at timestamp -> 1554596487543 : Time elapsed: 164
0 Client used critical section at timestamp -> 1554596487641 : Time elapsed: 198
0 Client used critical section at timestamp -> 1554596487752 : Time elapsed: 86
0 Client used critical section at timestamp -> 1554596487894 : Time elapsed: 108
1 Client used critical section at timestamp -> 1554596488026 : Time elapsed: 83
0 Client used critical section at timestamp -> 1554596488150 : Time elapsed: 205
0 Client used critical section at timestamp -> 1554596488266 : Time elapsed: 95
0 Client used critical section at timestamp -> 1554596488414 : Time elapsed: 82
2 Client used critical section at timestamp -> 1554596488498 : Time elapsed: 132
1 Client used critical section at timestamp -> 1554596488605 : Time elapsed: 95
0 Client used critical section at timestamp -> 1554596488705 : Time elapsed: 269
0 Client used critical section at timestamp -> 1554596488848 : Time elapsed: 91
0 Client used critical section at timestamp -> 1554596488966 : Time elapsed: 43
0 Client used critical section at timestamp -> 1554596489100 : Time elapsed: 72
***** SIMULATION COUNT:4 *****
0 Client used critical section at timestamp -> 1554596516795 : Time elapsed: 97
0 Client used critical section at timestamp -> 1554596516936 : Time elapsed: 81
0 Client used critical section at timestamp -> 1554596517064 : Time elapsed: 53
0 Client used critical section at timestamp -> 1554596517219 : Time elapsed: 106
***** SIMULATION COUNT:5 *****
0 Client used critical section at timestamp -> 1554596557489 : Time elapsed: 44
0 Client used critical section at timestamp -> 1554596557629 : Time elapsed: 74
1 Client used critical section at timestamp -> 1554596557736 : Time elapsed: 121
0 Client used critical section at timestamp -> 1554596557798 : Time elapsed: 125
0 Client used critical section at timestamp -> 1554596558012 : Time elapsed: 179
0 Client used critical section at timestamp -> 1554596558135 : Time elapsed: 76
***** SIMULATION COUNT:6 *****
2 Client used critical section at timestamp -> 1554596666328 : Time elapsed: 57
4 Client used critical section at timestamp -> 1554596666711 : Time elapsed: 158
0 Client used critical section at timestamp -> 1554596666847 : Time elapsed: 271
3 Client used critical section at timestamp -> 1554596666947 : Time elapsed: 56
0 Client used critical section at timestamp -> 1554596667681 : Time elapsed: 88
1 Client used critical section at timestamp -> 1554596667812 : Time elapsed: 223
0 Client used critical section at timestamp -> 1554596668718 : Time elapsed: 98
1 Client used critical section at timestamp -> 1554596669678 : Time elapsed: 88
***** SIMULATION COUNT:7 *****
0 Client used critical section at timestamp -> 1554596706464 : Time elapsed: 41
2 Client used critical section at timestamp -> 1554596706672 : Time elapsed: 134
0 Client used critical section at timestamp -> 1554596707533 : Time elapsed: 86
1 Client used critical section at timestamp -> 1554596707766 : Time elapsed: 63
3 Client used critical section at timestamp -> 1554596708097 : Time elapsed: 55
0 Client used critical section at timestamp -> 1554596708553 : Time elapsed: 86
4 Client used critical section at timestamp -> 1554596709162 : Time elapsed: 78
0 Client used critical section at timestamp -> 1554596709567 : Time elapsed: 78
1 Client used critical section at timestamp -> 1554596709775 : Time elapsed: 65
2 Client used critical section at timestamp -> 1554596709948 : Time elapsed: 70
0 Client used critical section at timestamp -> 1554596710645 : Time elapsed: 137

```

0 Client used critical section at timestamp -> 1554596711600 : Time elapsed: 72
1 Client used critical section at timestamp -> 1554596711830 : Time elapsed: 80
0 Client used critical section at timestamp -> 1554596712587 : Time elapsed: 35
3 Client used critical section at timestamp -> 1554596712730 : Time elapsed: 119
2 Client used critical section at timestamp -> 1554596713302 : Time elapsed: 90
0 Client used critical section at timestamp -> 1554596713994 : Time elapsed: 421
1 Client used critical section at timestamp -> 1554596714122 : Time elapsed: 370
4 Client used critical section at timestamp -> 1554596714469 : Time elapsed: 48
0 Client used critical section at timestamp -> 1554596714675 : Time elapsed: 81
0 Client used critical section at timestamp -> 1554596715685 : Time elapsed: 74
1 Client used critical section at timestamp -> 1554596715840 : Time elapsed: 84
2 Client used critical section at timestamp -> 1554596716631 : Time elapsed: 85
0 Client used critical section at timestamp -> 1554596716714 : Time elapsed: 79
3 Client used critical section at timestamp -> 1554596717212 : Time elapsed: 30
0 Client used critical section at timestamp -> 1554596717743 : Time elapsed: 88
1 Client used critical section at timestamp -> 1554596717881 : Time elapsed: 116
0 Client used critical section at timestamp -> 1554596718764 : Time elapsed: 91
0 Client used critical section at timestamp -> 1554596719762 : Time elapsed: 67

***** SIMULATION COUNT:8 *****

0 Client used critical section at timestamp -> 1554596756652 : Time elapsed: 210
2 Client used critical section at timestamp -> 1554596756733 : Time elapsed: 63
4 Client used critical section at timestamp -> 1554596757053 : Time elapsed: 102
0 Client used critical section at timestamp -> 1554596757546 : Time elapsed: 84
1 Client used critical section at timestamp -> 1554596757916 : Time elapsed: 98
3 Client used critical section at timestamp -> 1554596758408 : Time elapsed: 89
0 Client used critical section at timestamp -> 1554596758561 : Time elapsed: 81
0 Client used critical section at timestamp -> 1554596759580 : Time elapsed: 78
1 Client used critical section at timestamp -> 1554596759877 : Time elapsed: 50
2 Client used critical section at timestamp -> 1554596760224 : Time elapsed: 97
0 Client used critical section at timestamp -> 1554596760630 : Time elapsed: 109
0 Client used critical section at timestamp -> 1554596761630 : Time elapsed: 89
1 Client used critical section at timestamp -> 1554596761902 : Time elapsed: 68
4 Client used critical section at timestamp -> 1554596762363 : Time elapsed: 99
0 Client used critical section at timestamp -> 1554596762651 : Time elapsed: 89
3 Client used critical section at timestamp -> 1554596762950 : Time elapsed: 60
2 Client used critical section at timestamp -> 1554596763528 : Time elapsed: 60
0 Client used critical section at timestamp -> 1554596763652 : Time elapsed: 71
1 Client used critical section at timestamp -> 1554596763880 : Time elapsed: 44
0 Client used critical section at timestamp -> 1554596764636 : Time elapsed: 37
0 Client used critical section at timestamp -> 1554596765713 : Time elapsed: 92
1 Client used critical section at timestamp -> 1554596765907 : Time elapsed: 63
0 Client used critical section at timestamp -> 1554596766738 : Time elapsed: 93
2 Client used critical section at timestamp -> 1554596766879 : Time elapsed: 73
3 Client used critical section at timestamp -> 1554596767552 : Time elapsed: 93
4 Client used critical section at timestamp -> 1554596767689 : Time elapsed: 111
0 Client used critical section at timestamp -> 1554596767794 : Time elapsed: 124
1 Client used critical section at timestamp -> 1554596767923 : Time elapsed: 78
0 Client used critical section at timestamp -> 1554596768762 : Time elapsed: 73
0 Client used critical section at timestamp -> 1554596769882 : Time elapsed: 169
1 Client used critical section at timestamp -> 1554596770043 : Time elapsed: 187
2 Client used critical section at timestamp -> 1554596770221 : Time elapsed: 75
0 Client used critical section at timestamp -> 1554596770801 : Time elapsed: 69
0 Client used critical section at timestamp -> 1554596771827 : Time elapsed: 77
1 Client used critical section at timestamp -> 1554596771961 : Time elapsed: 102
3 Client used critical section at timestamp -> 1554596772063 : Time elapsed: 36
0 Client used critical section at timestamp -> 1554596772863 : Time elapsed: 90
4 Client used critical section at timestamp -> 1554596773042 : Time elapsed: 145
2 Client used critical section at timestamp -> 1554596773559 : Time elapsed: 47
0 Client used critical section at timestamp -> 1554596773895 : Time elapsed: 99
1 Client used critical section at timestamp -> 1554596774049 : Time elapsed: 181
0 Client used critical section at timestamp -> 1554596774909 : Time elapsed: 89
0 Client used critical section at timestamp -> 1554596775895 : Time elapsed: 52
1 Client used critical section at timestamp -> 1554596776009 : Time elapsed: 139
3 Client used critical section at timestamp -> 1554596776650 : Time elapsed: 54
2 Client used critical section at timestamp -> 1554596776966 : Time elapsed: 110
1 Client used critical section at timestamp -> 1554596777901 : Time elapsed: 29
4 Client used critical section at timestamp -> 1554596778314 : Time elapsed: 103
1 Client used critical section at timestamp -> 1554596779943 : Time elapsed: 68

```

2 Client used critical section at timestamp -> 1554596780289 : Time elapsed: 100
3 Client used critical section at timestamp -> 1554596781287 : Time elapsed: 123
1 Client used critical section at timestamp -> 1554596781936 : Time elapsed: 56
4 Client used critical section at timestamp -> 1554596783657 : Time elapsed: 130
2 Client used critical section at timestamp -> 1554596783766 : Time elapsed: 188
1 Client used critical section at timestamp -> 1554596783943 : Time elapsed: 55
3 Client used critical section at timestamp -> 1554596785832 : Time elapsed: 92
1 Client used critical section at timestamp -> 1554596785995 : Time elapsed: 104
2 Client used critical section at timestamp -> 1554596787015 : Time elapsed: 95
1 Client used critical section at timestamp -> 1554596788064 : Time elapsed: 169
4 Client used critical section at timestamp -> 1554596788913 : Time elapsed: 70
1 Client used critical section at timestamp -> 1554596789925 : Time elapsed: 28
2 Client used critical section at timestamp -> 1554596790307 : Time elapsed: 43
3 Client used critical section at timestamp -> 1554596790446 : Time elapsed: 132
1 Client used critical section at timestamp -> 1554596791988 : Time elapsed: 90
2 Client used critical section at timestamp -> 1554596793677 : Time elapsed: 77
1 Client used critical section at timestamp -> 1554596793984 : Time elapsed: 76
4 Client used critical section at timestamp -> 1554596794219 : Time elapsed: 57
3 Client used critical section at timestamp -> 1554596794985 : Time elapsed: 99
1 Client used critical section at timestamp -> 1554596795984 : Time elapsed: 65
2 Client used critical section at timestamp -> 1554596797016 : Time elapsed: 78
3 Client used critical section at timestamp -> 1554596799497 : Time elapsed: 38
4 Client used critical section at timestamp -> 1554596799599 : Time elapsed: 123
2 Client used critical section at timestamp -> 1554596800394 : Time elapsed: 115
2 Client used critical section at timestamp -> 1554596803661 : Time elapsed: 45
3 Client used critical section at timestamp -> 1554596804246 : Time elapsed: 214
4 Client used critical section at timestamp -> 1554596804862 : Time elapsed: 73
2 Client used critical section at timestamp -> 1554596807018 : Time elapsed: 60
3 Client used critical section at timestamp -> 1554596808798 : Time elapsed: 71
4 Client used critical section at timestamp -> 1554596810289 : Time elapsed: 186
2 Client used critical section at timestamp -> 1554596810421 : Time elapsed: 126
3 Client used critical section at timestamp -> 1554596813470 : Time elapsed: 174
2 Client used critical section at timestamp -> 1554596813736 : Time elapsed: 97
4 Client used critical section at timestamp -> 1554596815507 : Time elapsed: 83
2 Client used critical section at timestamp -> 1554596817041 : Time elapsed: 68
3 Client used critical section at timestamp -> 1554596817932 : Time elapsed: 59
2 Client used critical section at timestamp -> 1554596820454 : Time elapsed: 89
4 Client used critical section at timestamp -> 1554596820829 : Time elapsed: 91
3 Client used critical section at timestamp -> 1554596822531 : Time elapsed: 82
4 Client used critical section at timestamp -> 1554596826172 : Time elapsed: 122
3 Client used critical section at timestamp -> 1554596827066 : Time elapsed: 44
4 Client used critical section at timestamp -> 1554596831708 : Time elapsed: 233
3 Client used critical section at timestamp -> 1554596831867 : Time elapsed: 272
3 Client used critical section at timestamp -> 1554596836357 : Time elapsed: 187
4 Client used critical section at timestamp -> 1554596836850 : Time elapsed: 53
3 Client used critical section at timestamp -> 1554596840798 : Time elapsed: 55
4 Client used critical section at timestamp -> 1554596842207 : Time elapsed: 78
3 Client used critical section at timestamp -> 1554596845368 : Time elapsed: 54
4 Client used critical section at timestamp -> 1554596847518 : Time elapsed: 66
4 Client used critical section at timestamp -> 1554596852823 : Time elapsed: 51
4 Client used critical section at timestamp -> 1554596858190 : Time elapsed: 99

```

Observation for parameter changes as mentioned in point 1.

1. Clearly having greater difference between does not guarantee deadlock free execution. Also, it is reaffirmed by Simulation count 1 and Simulation count 4. Simulation count 1 had the least delay.
2. If we observe the latency of request, which is number at end of line. Changing time between two requests generated will not have any impact on the latency.
3. Change in latency we see between the requests from same client can be explained by two reason.
 - a. Quorum size is not constant. We can see the same is stats as message counter to complete 20 critical section differs.

```

0 Client -> Request Message Counter: 75 Release Message Counter: 75 Grant Message Counter: 75
1 Client -> Request Message Counter: 75 Release Message Counter: 75 Grant Message Counter: 75
2 Client -> Request Message Counter: 71 Release Message Counter: 71 Grant Message Counter: 71
3 Client -> Request Message Counter: 72 Release Message Counter: 72 Grant Message Counter: 72
4 Client -> Request Message Counter: 74 Release Message Counter: 74 Grant Message Counter: 74

```

- b. Chosen quorum member might have been locked by another client.

2. Changing amount of time spent in Critical Section

Below are the data collected for 3 ms is critical section delay, 300 ms in critical section delay and 3000 ms delay in critical section.

Assuming the simulation would have completed without deadlock.

3 ms data log

```

0 Client used critical section at timestamp -> 1554596756652 : Time elapsed: 210
2 Client used critical section at timestamp -> 1554596756733 : Time elapsed: 63
4 Client used critical section at timestamp -> 1554596757053 : Time elapsed: 102
0 Client used critical section at timestamp -> 1554596757546 : Time elapsed: 84
1 Client used critical section at timestamp -> 1554596757916 : Time elapsed: 98
3 Client used critical section at timestamp -> 1554596758408 : Time elapsed: 89
0 Client used critical section at timestamp -> 1554596758561 : Time elapsed: 81

```

300 ms data log < ensuring deadlock free operation with more delay between request>

```

0 Client used critical section at timestamp -> 1554601293182 : Time elapsed: 100
1 Client used critical section at timestamp -> 1554601293798 : Time elapsed: 78
1 Client used critical section at timestamp -> 1554601296001 : Time elapsed: 60
0 Client used critical section at timestamp -> 1554601296467 : Time elapsed: 47
4 Client used critical section at timestamp -> 1554601297321 : Time elapsed: 130
2 Client used critical section at timestamp -> 1554601297749 : Time elapsed: 195
1 Client used critical section at timestamp -> 1554601298217 : Time elapsed: 52

```

3000 ms data log < ensuring deadlock free operation with more delay between request>

```

***** SIMULATION COUNT:2 *****
3 Client used critical section at timestamp -> 1554601926239 : Time elapsed: 114
0 Client used critical section at timestamp -> 1554601929373 : Time elapsed: 1858
2 Client used critical section at timestamp -> 1554601932501 : Time elapsed: 1766
***** SIMULATION COUNT:3 *****
2 Client used critical section at timestamp -> 1554601967729 : Time elapsed: 77
0 Client used critical section at timestamp -> 1554601970824 : Time elapsed: 1276
***** SIMULATION COUNT:4 *****
0 Client used critical section at timestamp -> 1554601999625 : Time elapsed: 55
1 Client used critical section at timestamp -> 1554602003693 : Time elapsed: 85

```

Observation for parameter changes as mentioned in point 2.

1. Clearly from the above example. Increasing time spent in critical section should not change the latency. Comparing 3ms data log and 300ms data log.
2. However, here is an example from 3000 ms log justifying increased latency.
 - a. Simulation count 4 is ideal scenario.
 - b. Simulation count 3.
 - i. C1 – generating request every 4 second
 - ii. C2 – generating request every 7 second.

- iii. Time in critical section 3 second.
- iv. For first request of C1 and C2 there is enough time to access CS and latency will be minimum.
- v. For the consecutive request
 - 1. C1 – puts second request at 8th second
 - 2. C2 will be executing first request.
 - 3. C1 grant will be delayed till C2 finishes.
- 3. Two deductions from above observation stated in point 4 and 5.
- 4. If the consecutive delay between all 100 requests from all clients is made sure to have more than critical section delay, then the latency will remain same.
- 5. However, current code support generating in multiples of time unit number. There by generalising increasing the time spent in critical section increases the latency.