

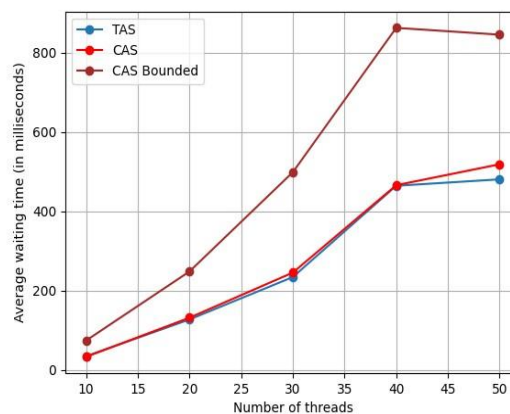
# OPERATING SYSTEMS II

## Synchronization Tools

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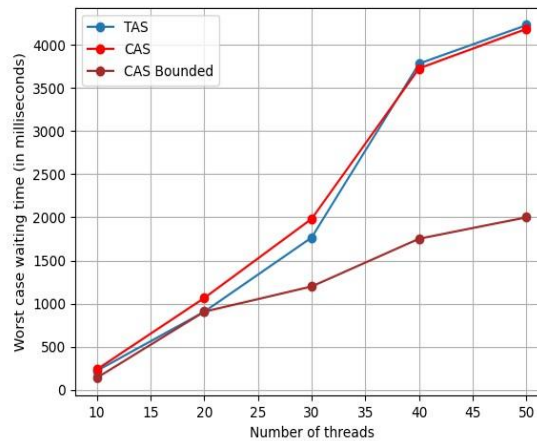
Following are the graphs related to the observations regarding the average and maximum waiting time of threads while executing a critical section program concurrently.

**Graph 1:**



Above graph is constructed with the X – axis as number of threads used at run time and with Y – axis as the average waiting time of each thread in each of the implementations as the legend denotes.

## Graph 2:



Above graph is constructed with X – axis as the number of threads used at run time and with Y – axis as maximum(worst case) waiting time of all the threads used in each of the implementations as the legend denotes.

## Observations and Analysis:

- We can see in the first graph that the TAS and CAS methods have lesser average waiting times than that of the CAS Bounded method. This is because the bounded CAS must ensure the bounded waiting time condition for which, it must be more complex than simpler TAS and CAS. Hence, we see more average waiting time for a given thread being implemented in CAS bounded method.
- While in the second graph, much to the contrary, we see that the maximum(worst case) waiting time of a thread executing in

CAS bounded method is much less than those of which implement in CAS or TAS methods. This also is an effect of the bounded waiting time for a given thread. This condition makes sure that waiting time of a given thread never crosses a threshold which is why we also see that the maximum waiting time and average waiting time for a thread executing in CAS bounded method are close and comparable, while for those executing in TAS or CAS methods, they are further apart.

- Another observation we can make is that the TAS and CAS methods have very similar trends in the graphs. It should be true because just the entry of critical section is different in the TAS and CAS implementation. None can be called better than the other in this situation.
- We can say, in TAS and CAS methods, the average waiting time is less, but the actual waiting time has huge fluctuations which explains the high worst case waiting time.
- But in the case of CAS bounded method, the average waiting time is higher than that of the prior but the worst-case waiting time is much lesser than them. This shows that the waiting times are closely distributed in this case.