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CS 5348.003-Operating Systems and Concepts - Design Document (Project 2)

Overview:

Implementation of the balanced sorting algorithm with log N stages, each of which consists of log N phases, to sort N items. During each phase, N/2 compare-exchange operations are made and these operations are performed in parallel by N/2 threads. The Threads are to be synchronized at a particular point required in each phase in order to sort correctly using the barrier synchronization where all threads must cross the same barrier at that point in each phase before continuing.

Critical Design Facts:

--->Three Semaphores were used to achieve Barrier Synchronization using a Reusable Barrier. The Semaphores are initialized with 1,0,1 Values Respectively.

---> The First Semaphore is used to increment and Decrement the value of the Counter which tracks the Number of Threads, and the other Two are used to realize a Two-Phase Barrier which is used here to force the threads to wait Twice to arrive first and then again to execute critical section i.e; Sorting Algorithm where only the last thread can lock or unlock which makes it impossible for a particular thread to move ahead of the remaining Threads.

--->When the Count is equal to the number of threads, Second Semaphore is Unlocked and the Third is locked so that all the threads stop at the end of Sorting operation till each thread completes the sorting and then proceed.

---> After Sorting is Done in parallel the Count is decremented by 1 by each thread, again when the count reaches 0 we lock the second semaphore and unlock the third, this will hold all the threads at that point before starting each phase till each and every thread have completed the earlier one.

Trivial Design Facts:

---> Tab Spaces (Although Not in consistent with the sample Invocations Given) is used in the printing of Thread completion statements so that the print is organized in case the Thread Count goes beyond a Single Digit incase of large List Sizes.

--->Only 8 Numbers were Printed in a single line and a Tab Space is used here as well during the print generally to be consistent with the print in the observation mode as specified above incase of large list size.

--->As specified in the project Document, Mode specifics were included to control the printing of outputs. The program also checks if the sorting is done after each stage and proceeds accordingly from thereon i.e, Exit and print the output after that stage if the sorting is done or proceed otherwise.