HPC Assignment 1

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In this workshop we parallelise a serial code for the numerical solution of the 1D heat equation and compare the results to the exact solution.

In Figure 1 we present the result of running both the serial and parallel code, along with the true solution. We observe that both of the numerical schemes appear to be performing well with little discernable difference between the numerical and true solutions. It is useful, as a check on the parallelisation, to note that because the only real

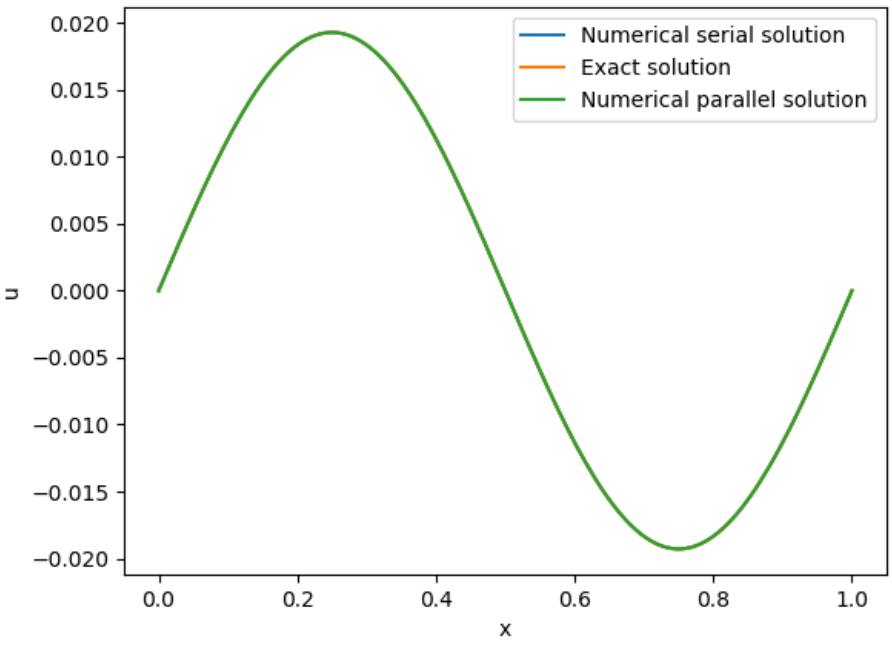

Figure 1: A plot of the serial and parallel numerical solutions, along with the true solution obtained for $(T, M, N) = (0.1, 152, 10000)$.

parallel computing technique used here is that of halo swapping. Thus, we use exactly the same computation to obtain the numerical solution at each point in the parallel code as we do with the serial code. We should then expect that if the parallelisation has been done correctly then the serial and parallel code should, in this case, provide exactly the same result (provided that the same parameters are used for both runs.). We show that this is indeed the case in Figure 2, where we plot the difference between the two numerical schemes at each spatial point. Note that this is zero for all points, as expected from a functioning parallelisation.

We also note a possible improvement to our code for the future. We have currently implemented the halo swapping in quite a naive fashion by looping individually over each overlap (of which there are $nproc - 1$) and using a pair of send/receive commands to swap the values. This has the advantage of being quite readable and easy to implement but it does leave most of the processes idle while each overlap is being resolved. It is probably quite possible to speed up this step by having multiple overlaps be resolved at each step of the loop.

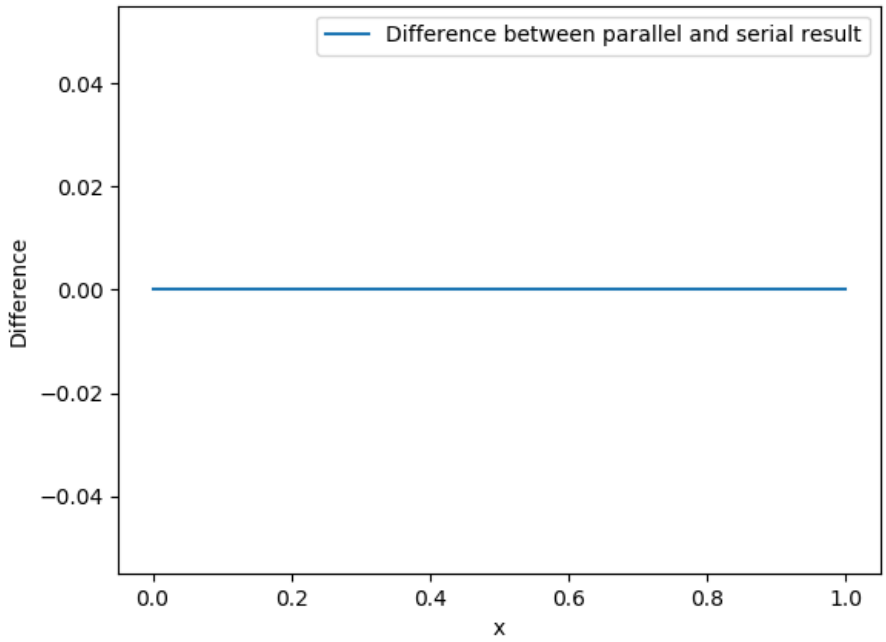

Figure 2: A plot of the difference between the serial and parallel solutions obtained for $(T, M, N) = (0.1, 152, 10000)$.