159.735 Parallel and Distributed computing, Assignment 3, Heat Distribution.

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To implement this project in a parallel environment i started by firstly generating the data on the master node. The data is then converted into a 1d array then split. The information is then sent to each node based on how many are available using a MPI_Scatterv. Once each node has been given its required data it then creates two tables and recreates the data into a 2d array, the data is then worked on using the supplied formula. To calculate the top and bottom row of each bit of data a buffer is created which will be used to store the information of the row above and below each section. using MPI_Isend and MPI_Irecv we are able to create a non-blocking environment for which allows the processors to send data and then continue working on other parts reducing the amount of time taken waiting for a conformation of the recv. once the data has been updated a comparison is made between the current table and the previous one to check if any changes have been made and then inform the master node of the results. the master node will then check to make sure all nodes are no longer updating then will tell each node to stop. once each node has stopped the data is collected using MPI_Gatherv and join back at the master node, before been printed to the fits file.

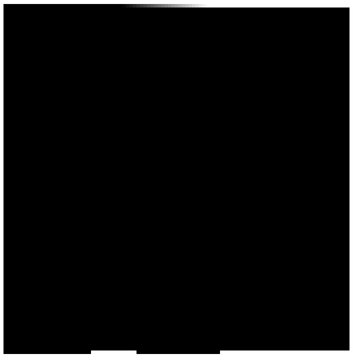
To avoid dead locking or working on incorrect data a MPI_WAIT is used to ensure that all sends and recvs have completed before moving onto the next iterations, although this creates a block it is required to avoid corrupting data as one node may send data while the previous data sent is yet to be received, causing it to be over written

to ensure that all process quit at the same point several variables were created to check if a change had occurred and if so tell the master node about it and this will then inform the other nodes to keep working

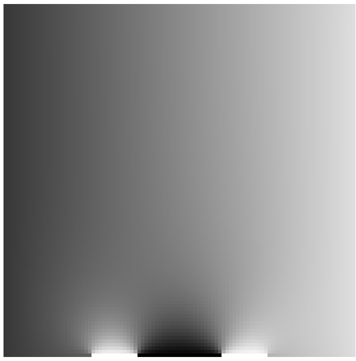
The time taken for this process to complete on Zaphod using 1 node and and X processors as shown by the results below there are considerable speed ups when introducing additional processors, yet this effect eventually levels out as the increased communication time causes the benefits to be reduced.

Processors	Time Taken
1	2.341322s
2	1.259686s
3	0.975821s
4	0.796879s
5	0.727313s
6	0.673613s
7	0.664622s
8	0.658147s

The results from this program.



The Original Fits file before any changes are made



The Updated Fits file once the heat has been distrabuted