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Group of 2  
CS499  
HW2

**Timing Results:**

**MPI\_HEAT**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Procs\Width** | **6400** | **12800** | **25600** | **51200** | **102400** |
| **1** | 1.14 | 1.40 | 1.70 | 2.36 | 3.44 |
| **2** | 1.57 | 1.59 | 1.77 | 2.14 | 2.85 |
| **4** | 2.18 | 2.20 | 2.18 | 2.45 | 3.37 |
| **8** | 3.33 | 3.76 | 4.22 | 4.21 | 5.81 |
| **10** | 3.06 | 3.83 | 3.82 | 4.56 | 5.47 |
| **16** | 3.16 | 4.46 | 4.97 | 5.65 | 6.66 |

In the case when the matrix was of width 6400, 12800, 25600 no speed up was achieved by running the program on multiple processors. This is due to the simplicity of the calculations and additional overhead required to pass data between processors. For matrix of width 51200speedup was achieved in only one case when 2 processors were used. This is due to a comparably small communication cost between two processors. The communication cost between 2 processors was small when compared to a reasonably large number of calculations. Using more than 2 processors proved inefficient due to communication overhead. For matrix of width 102400 the speedup was achieved for 2 and 4 processors. When using more than 4 processors the communication overhead outweighed the speedup gained from performing calculations in parallel.

**MPI\_DENSE\_PAGERANK**

|  |  |  |
| --- | --- | --- |
| **Procs\Graph** | **8000** | **16000** |
| **1** | 16.59 | 69.86 |
| **2** | 11.08 | 45.72 |
| **3** | 13.48 | 12.56 |
| **4** | 13.64 | 15.78 |
| **5** | 11.79 | 40.88 |
| **6** | 11.39 | 38.62 |
| **7** | 11.80 | 16.01 |
| **8** | 11.79 | 16.07 |
| **9** | 10.42 | 34.58 |
| **10** | 9.98 | 16.15 |
| **11** | 10.75 | 15.78 |
| **12** | 10.35 | 16.55 |
| **13** | 9.51 | 13.74 |
| **14** | 10.48 | 13.63 |
| **15** | 10.36 | 14.20 |
| **16** | 9.79 | 13.90 |

For a matrix of size 8000 x 8000 the speedup over 1 processor was achieved in every case. Constantly increasing the number of processors proved inefficient. The speedup increased slowly when compared to the number of processes being added. Once the execution time of the program broke the 11 second mark with 9 processors adding more processors either increased the execution time or improved by at most 1 second.

When running the program with a 16000 x 1600 multiple processors speedup over running it with one processor was achieved every time. However there were anomalies when running it with 5, 6 and 9 processors. In these cases the execution time spiked to respectively 40.88, 38.62 and 34.58 seconds.

Overall parallelizing Page Rank program was more effective than the Heat program due to a much larger number of calculations performed and larger size of data sets. The communication overhead for Page Rank program was less significant than in the case of the Heat program.