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Project #7: MPI

Key snippets of code

```
    if( me == THEBOSS )
    {
        for( int i = 0; i < PPSize+MAXSHIFTS; i++ )
        {
            PPSignal[i] = BigSignal[ THEBOSS*PPSize + i ];
        }
    }
```

THEBOSS will first assign itself its copy

```
    if( me == THEBOSS )
    {
        for( int dst = 0; dst < NumCpus; dst++ )
        {
            if( dst != THEBOSS )
            {
                MPI_Send( &BigSignal[dst*PPSize], PPSize, MPI_FLOAT, dst, TAG_SCATTER, MPI_COMM_WORLD );
            }
        }
    }
    else
    {
        MPI_Recv( PPSignal, PPSize, MPI_FLOAT, THEBOSS, TAG_SCATTER, MPI_COMM_WORLD, &status );
    }
```

THEBOSS will then sends everyone their copy while the rest will receive it.

```
    if( me == THEBOSS )
    {
        for( int s = 0; s < MAXSHIFTS; s++ )
        {
            BigSums[s] = PPSums[s];     // start the overall sums with the THEBOSS's sums
        }
    }
    else
    {
        MPI_Send( PPSums, MAXSHIFTS, MPI_FLOAT, THEBOSS, TAG_GATHER, MPI_COMM_WORLD );
    }
```

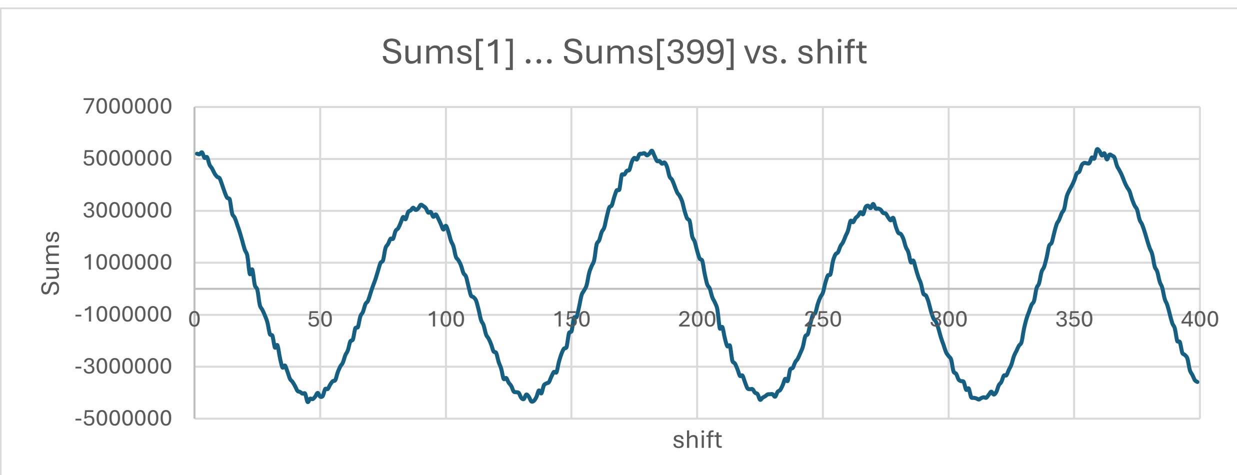
Once everyone does one local auto correlation, each partial sum is then summed together and we have the end result.

Tables of data

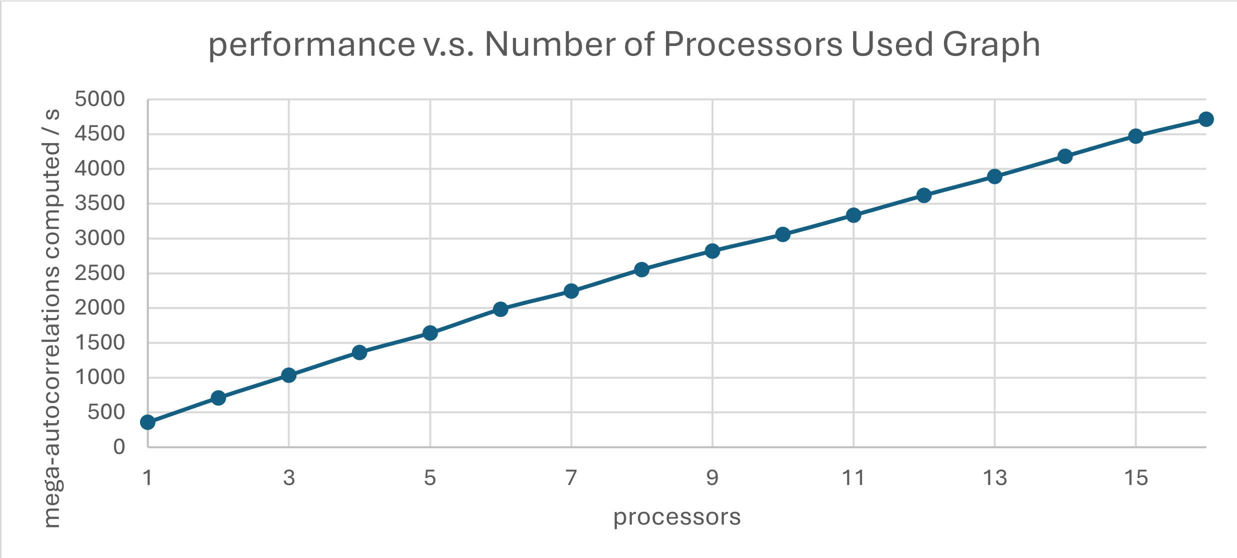
processors	elements	mega-autocorrelations computed / s
1	8388608	357.55
2	8388608	709.27
3	8388608	1034.07
4	8388608	1362.73
5	8388608	1641.66
6	8388608	1983.3
7	8388608	2243.51
8	8388608	2553.58
9	8388608	2820.27
10	8388608	3058.69
11	8388608	3334.42
12	8388608	3620.39
13	8388608	3890.32
14	8388608	4181.99
15	8388608	4471.63
16	8388608	4715.58

Graphs of data

Sums{1] ... Sums[399] vs. shift scatterplot



We observe that there are two secret sine waves in the shifted sums graph above. The low sine waves have crests at 3233366 and 3266846 at shifts 90 and 270; the first secret sine-wave period is 180 shifts. The high sine waves have crests at 5316159 and 5364590 at shifts 182 and 359; the second secret sine-wave period is 177 shifts. The two secret sine-wave periods are 180 and 177 shifts.



The performance is seen to be at 357.55 mega-autocorrelations computed/s per processor. When processors are above 8, we observe a slight slowdown in performance. This is because we are running 16 tasks and 8 nodes, splitting 2 task per node when it is above 8 nodes. The important take away here is that it is linear and performance does not reduce significantly as seen with techniques before MPI.

PDF Commentary

1. Show the Sums{1] ... Sums[399] vs. shift scatterplot.

Shown in **Graphs of data**

2. State what the two secret sine-wave periods are.

Discussed in **Graphs of data**; The two secret sine-wave periods are 180 and 177 shifts.

3. Show your graph of Performance vs. Number of Processors used.

Shown in **Graphs of data.**

4. What patterns are you seeing in the performance graph?

Discussed in Graphs of data.

5. Why do you think the performances work this way?

Discussed in Graphs of data. Also, there is an increased performance for 16 processors running on 8 nodes as expected, however we observe that the linear slope decreases passes 8 processors due to the increase overhead. We do still benefit from parallelism as more computational resources are being used with an increased contention on resources.