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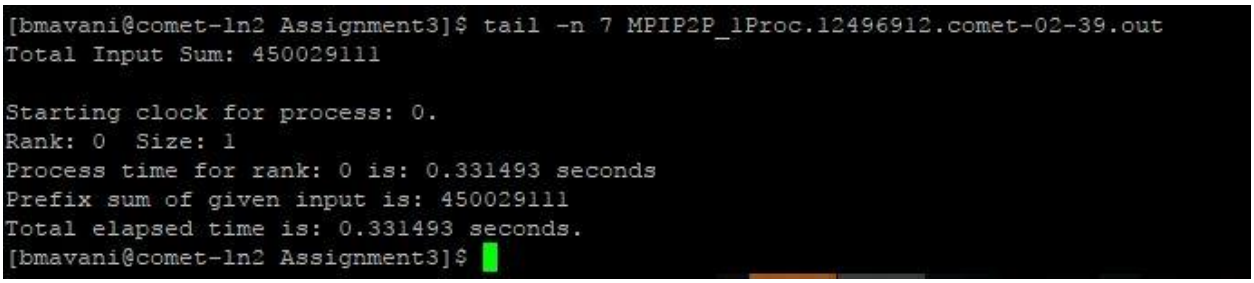
University: Illinois Institute of Technology
Course: Parallel and Distributed Processing
Assignment: 3 - Result Report

The results of the execution of the code are below. The speed up (Sp) can be calculated by Ts/Tp.

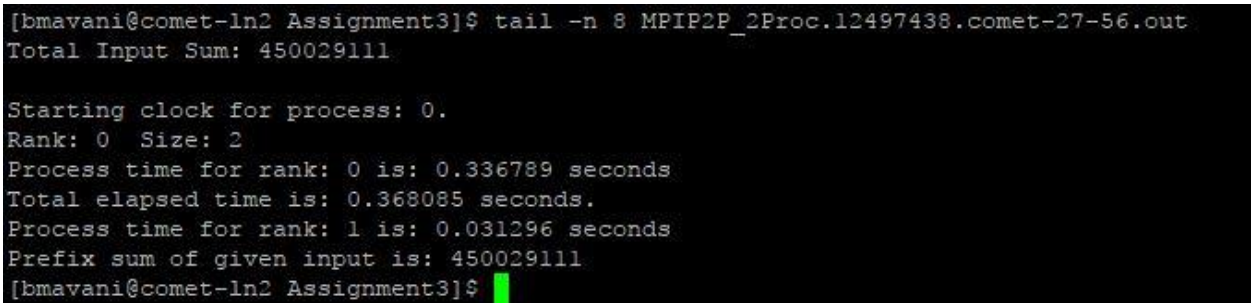
Efficiency (Ep) = Sp/P where P is the number of processors.

- Point to Point Communication: As this is not a final code, it is not executed for possible conditions.

1) 1 processor: As this is executed on a single processor, we can consider this as Ts. So, Ts= 0.331493.



2) 2 processors: The most time taken by processor will be considered as Tp. Tp = 0.336789.



Sp = 0.331493/0.336789 = 0.984275
Ep = 0.984275/2 = 0.49

3) 4 processors: The most time taken by processor will be considered as Tp. Tp = 0. 235477.

```
[bmavani@comet-ln2 Assignment3]$ tail -n 10 MPIP2P_4Proc.12497439.comet-27-30.out
Total Input Sum: 450029111

Starting clock for process: 0.
Rank: 0  Size: 4
Process time for rank: 0 is: 0.235477 seconds
Total elapsed time is: 0.316250 seconds.
Process time for rank: 1 is: 0.041533 seconds
Process time for rank: 3 is: 0.016477 seconds
Prefix sum of given input is: 450029111
Process time for rank: 2 is: 0.022763 seconds
[bmavani@comet-ln2 Assignment3]$
```

Sp = 0.331493/0.235477 = 1.407751
Ep = 1.407751 /4 = 0.36

4) 8 processors: The most time taken by processor will be considered as Tp. Tp = 0. 206947.

```
[bmavani@comet-ln2 Assignment3]$ tail -n 14 MPIP2P_8Proc.12497440.comet-25-58.out
Total Input Sum: 450029111

Starting clock for process: 0.
Rank: 0  Size: 8
Process time for rank: 0 is: 0.206947 seconds
Process time for rank: 4 is: 0.016115 seconds
Process time for rank: 1 is: 0.023424 seconds
Process time for rank: 5 is: 0.011884 seconds
Process time for rank: 3 is: 0.022615 seconds
Process time for rank: 7 is: 0.009040 seconds
Process time for rank: 6 is: 0.009925 seconds
Process time for rank: 2 is: 0.023383 seconds
Total elapsed time is: 0.323334 seconds.
Prefix sum of given input is: 450029111
[bmavani@comet-ln2 Assignment3]$
```

Sp = 0.331493/0.206947 = 1.601826
Ep = 1.601826 /8 = 0.20

5) 16 processors: The most time taken by processor will be considered as Tp. Tp = 0. 168092.

```
[bmavani@comet-ln2 Assignment3]$ tail -n 22 MPIP2P_16Proc.12496913.comet-02-03.out
Total Input Sum: 450029111

Starting clock for process: 0.
Rank: 0  Size: 16
Process time for rank: 0 is: 0.168092 seconds
Total elapsed time is: 0.507782 seconds.
Process time for rank: 14 is: 0.005458 seconds
Process time for rank: 11 is: 0.007296 seconds
Process time for rank: 10 is: 0.007423 seconds
Process time for rank: 3 is: 0.011783 seconds
Process time for rank: 13 is: 0.005937 seconds
Process time for rank: 2 is: 0.113474 seconds
Process time for rank: 5 is: 0.009131 seconds
Process time for rank: 1 is: 0.123679 seconds
Process time for rank: 7 is: 0.008580 seconds
Process time for rank: 9 is: 0.007829 seconds
Process time for rank: 6 is: 0.009105 seconds
Process time for rank: 12 is: 0.006664 seconds
Process time for rank: 8 is: 0.007940 seconds
Process time for rank: 4 is: 0.010043 seconds
Process time for rank: 15 is: 0.005349 seconds
Prefix sum of given input is: 450029111
```

Sp = 0.331493/0.168092 = 1.97209
Ep = 1.97209/16 = 0.12

- Collective Communication:

1) 1 processor: As this is executed on the single processor, we can consider this as Ts. So, Ts= 0.634280.

```
Total Input Sum: 450029111

Starting clock for process: 0.

Sum at process 0 is : 450029111.
Prefix sum at each process:  450029111
Prefix sum 450029111 equals to total input sum 450029111. Hence, it is correct.
Process time for rank: 0 is: 0.634280 seconds
Total elapsed time is: 0.634280 seconds.
[bmavani@comet-ln3 Assignment3]$
```

2) 2 processors: The most time taken by processor will be considered as Tp. Tp = 0.519825.

```
Total Input Sum: 450029111

Starting clock for process: 0.

Sum at process 1 is : 225003929.
Sum at process 0 is : 225025182.
Prefix sum at each process:  225025182 450029111
Prefix sum 450029111 equals to total input sum 450029111. Hence, it is correct.
Process time for rank: 1 is: 0.033895 seconds
Process time for rank: 0 is: 0.519825 seconds
Total elapsed time is: 0.553720 seconds.
[bmavani@comet-ln3 Assignment3]$
```

Sp = 0.634280 /0.519825 = 1.2201798
Ep = 1.2201798/2 = 0.61

3) 4 processors: The most time taken by processor will be considered as Tp. Tp = 0.296025.

```
Total Input Sum: 450029111

Starting clock for process: 0.

Sum at process 1 is : 112514874.
Sum at process 3 is : 112506522.
Sum at process 0 is : 112510308.
Sum at process 2 is : 112497407.
Prefix sum at each process:  112510308 225025182 337522589 450029111
Prefix sum 450029111 equals to total input sum 450029111. Hence, it is correct.Process time for rank: 1 is: 0.053518 seconds
Process time for rank: 2 is: 0.047987 seconds
Process time for rank: 3 is: 0.048190 seconds

Process time for rank: 0 is: 0.296025 seconds
Total elapsed time is: 0.445720 seconds.
[bmavani@comet-ln3 Assignment3]$
```

Sp = 0.634280 / 0.296025 = 2.1426568
Ep = 2.1426568/4 = 0.54

4) 8 processors: The most time taken by processor will be considered as Tp. Tp = 0.192833.

```
Total Input Sum: 450029111

Starting clock for process: 0.

Sum at process 3 is : 56259373.
Sum at process 4 is : 56260483.
Sum at process 1 is : 56251071.
Sum at process 6 is : 56242805.
Sum at process 7 is : 56263717.
Sum at process 5 is : 56236924.
Sum at process 2 is : 56255501.
Sum at process 0 is : 56259237.Process time for rank: 1 is: 0.018903 seconds
Process time for rank: 2 is: 0.017991 seconds
Process time for rank: 3 is: 0.019112 seconds
Process time for rank: 4 is: 0.019131 seconds
Process time for rank: 5 is: 0.018103 seconds
Process time for rank: 6 is: 0.018344 seconds
Process time for rank: 7 is: 0.017927 seconds

Prefix sum at each process:  56259237 112510308 168765809 225025182 281285665 337522589 393765394 450029111
Prefix sum 450029111 equals to total input sum 450029111. Hence, it is correct.
Process time for rank: 0 is: 0.192833 seconds
Total elapsed time is: 0.322344 seconds.
[bmavani@comet-ln3 Assignment3]$
```

Sp = 0.634280 /0.192833 = 3.2892710
Ep = 3.2892710/8 = 0.41

5) 12 processors: The most time taken by processor will be considered as Tp. Tp = 0.165520.

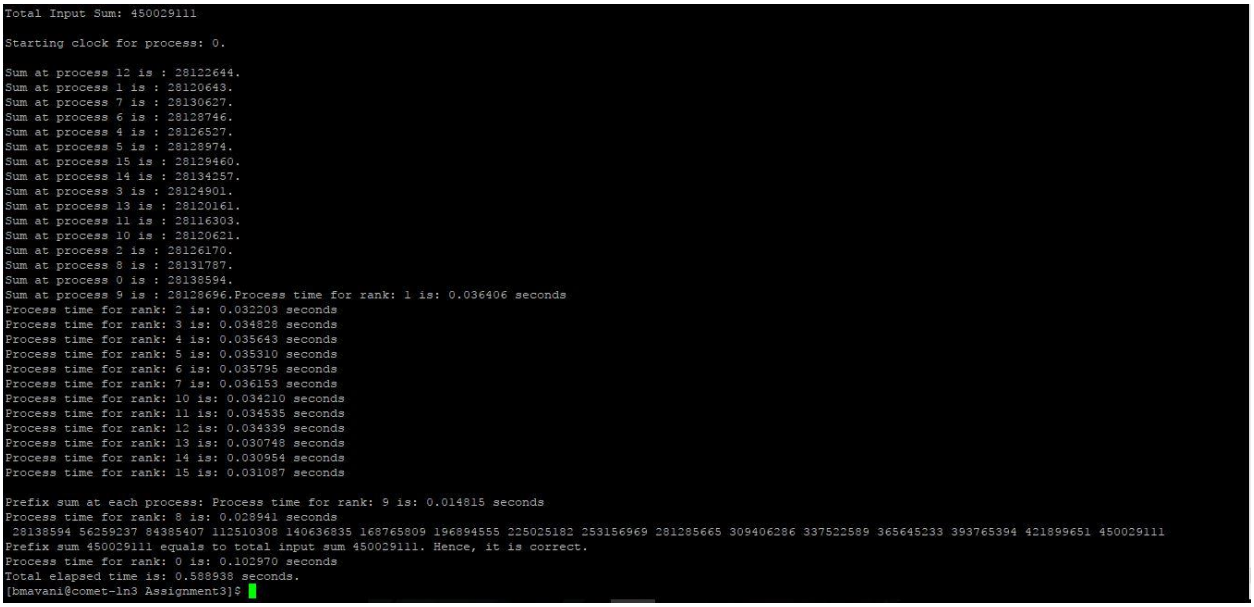
```
Total Input Sum: 450029083

Starting clock for process: 0.

Sum at process 1 is : 37498609.
Sum at process 4 is : 37507210.
Sum at process 6 is : 37502086.
Sum at process 7 is : 37505392.
Sum at process 5 is : 37504951.
Sum at process 9 is : 37499877.
Sum at process 10 is : 37496525.
Sum at process 3 is : 37502707.
Sum at process 11 is : 37510105.
Sum at process 2 is : 37498442.
Sum at process 8 is : 37489929.
Sum at process 0 is : 37513250.
Prefix sum at each process:  37513250 75011859 112510301 150013008 187520218 225025169Process time for rank: 1 is: 0.041064 seconds
Process time for rank: 2 is: 0.034063 seconds
Process time for rank: 3 is: 0.039155 seconds
Process time for rank: 4 is: 0.040971 seconds
Process time for rank: 5 is: 0.040248 seconds
Process time for rank: 6 is: 0.040893 seconds
Process time for rank: 7 is: 0.040749 seconds
Process time for rank: 8 is: 0.017654 seconds
Process time for rank: 9 is: 0.039792 seconds
Process time for rank: 10 is: 0.039775 seconds
Process time for rank: 11 is: 0.038079 seconds
 262527255 300032647 337522576 375022453 412518978 450029083
Prefix sum 450029083 equals to total input sum 450029083. Hence, it is correct.
Process time for rank: 0 is: 0.165520 seconds
Total elapsed time is: 0.577963 seconds.
[bmavani@comet-ln3 Assignment3]$
```

Sp = 0.634280 /0.165520 = 3.8320444
Ep = 3.8320444/12 = 0.32

6) 16 processors: The most time taken by processor will be considered as Tp. Tp = 0. 102970



Sp = 0. 634280 /0.102970 = 6.159852
Ep = 6.159852 /16 = 0.38

The collective implementation is more efficient and provides more speed up as it reduces to the inter-process communications.

- Efficiency at 16 processes:
  - ✓ Collective Communication: 0.38
  - ✓ Point to Point communication: 0.12

- Speed up at 16 processes:
  - ✓ Collective Communication: 6.159852
  - ✓ Point to Point communication: 1.97209