CS4230 Programming Assignment 5 Report

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December 10, 2022

1 Ping Pong

1.1 Communication Statistics

```
Message length: 1 , GBytes/sec: 0.037 , NIters: 990099 , Time taken
    per message (microsecs): 0.218 , Total time (secs): 0.865
Message length: 8 , GBytes/sec: 0.266 , NIters: 925925 , Time taken
    per message (microsecs): 0.240 , Total time (secs): 0.890
Message length: 64 , GBytes/sec: 1.019 , NIters: 609756 , Time
    taken per message (microsecs): 0.502 , Total time (secs): 1.226
Message length: 512 , GBytes/sec: 3.031 , NIters: 163398 , Time
    taken per message (microsecs): 1.351 , Total time (secs): 0.883
Message length: 4096 , GBytes/sec: 6.195 , NIters: 23832 , Time
    taken per message (microsecs): 5.290 , Total time (secs): 0.504
Message length: 32768 , GBytes/sec: 12.107 , NIters: 3042 , Time
    taken per message (microsecs): 21.652 , Total time (secs):
    0.263
Message length: 262144 , GBytes/sec: 10.401 , NIters: 381 , Time
    taken per message (microsecs): 201.639 , Total time (secs):
    0.307
Message length: 1048576 , GBytes/sec: 7.267 , NIters: 95 , Time
    taken per message (microsecs): 1154.386 , Total time (secs):
    0.439
```

1.2 alpha-beta model analysis

Let's take a look at the case when the message length = 1:

1. The alpha-beta model is as follows:

   $TotalTime = \alpha + n * \beta$

2. Beta values (nanoseconds per byte) are as follows:

   $msglength = 1 : \beta = 27.03(ns/byte)$

   $msglength = 8 : \beta = 3.76(ns/byte)$

   $msglength = 64 : \beta = 0.98(ns/byte)$

   $msglength = 512 : \beta = 0.32(ns/byte)$

   $msglength = 4096 : \beta = 0.16(ns/byte)$

$$msglength = 32768 : \beta = 0.082(ns/byte)$$
$$msglength = 262144 : \beta = 0.096(ns/byte)$$
$$msglength = 1048576 : \beta = 0.14(ns/byte)$$

3. We can tell from the data above, sending longer messages reduces the cost per word.

4. Therefore, this experiment roughly fits the alpha-beta model, where we concluded that sending longer messages is better than sending a lot of short messages.

2 Ring

2.1 Communication Statistics

2.1.1 nproc = 2

```
Ring Communication: Message Size = 1; 0.022 Gbytes/sec; Time =
    0.015 sec;
Ring Communication: Message Size = 8; 0.163 Gbytes/sec; Time =
    0.016 sec;
Ring Communication: Message Size = 64; 0.709 Gbytes/sec; Time =
    0.027 sec;
Ring Communication: Message Size = 512; 2.639 Gbytes/sec; Time =
    0.041 sec;
Ring Communication: Message Size = 4096; 3.146 Gbytes/sec; Time =
    0.082 sec;
Ring Communication: Message Size = 32768; 6.697 Gbytes/sec; Time =
    0.046 sec;
Ring Communication: Message Size = 262144; 6.910 Gbytes/sec; Time =
    0.046 sec;
Ring Communication: Message Size = 1048576; 5.192 Gbytes/sec; Time
    = 0.058 sec;
```

2.1.2 nproc = 4

```
Ring Communication: Message Size = 1; 0.020 Gbytes/sec; Time =
    0.032 sec;
Ring Communication: Message Size = 8; 0.106 Gbytes/sec; Time =
    0.048 sec;
Ring Communication: Message Size = 64; 0.401 Gbytes/sec; Time =
    0.096 sec;
Ring Communication: Message Size = 512; 1.183 Gbytes/sec; Time =
    0.183 sec;
Ring Communication: Message Size = 4096; 2.039 Gbytes/sec; Time =
    0.252 sec;
Ring Communication: Message Size = 32768; 3.373 Gbytes/sec; Time =
    0.184 sec;
Ring Communication: Message Size = 262144; 3.697 Gbytes/sec; Time =
    0.172 sec;
Ring Communication: Message Size = 1048576; 3.520 Gbytes/sec; Time
    = 0.172 sec;
```

2.1.3   nproc = 8

```
Ring Communication: Message Size = 1; 0.011 Gbytes/sec; Time =
    0.115 sec;
Ring Communication: Message Size = 8; 0.050 Gbytes/sec; Time =
    0.203 sec;
Ring Communication: Message Size = 64; 0.192 Gbytes/sec; Time =
    0.401 sec;
Ring Communication: Message Size = 512; 0.559 Gbytes/sec; Time =
    0.776 sec;
Ring Communication: Message Size = 4096; 0.935 Gbytes/sec; Time =
    1.100 sec;
Ring Communication: Message Size = 32768; 1.496 Gbytes/sec; Time =
    0.830 sec;
Ring Communication: Message Size = 262144; 1.484 Gbytes/sec; Time =
     0.859 sec;
Ring Communication: Message Size = 1048576; 1.481 Gbytes/sec; Time
    = 0.815 sec;
```

2.1.4   nproc = 16

```
Ring Communication: Message Size = 1; 0.004 Gbytes/sec; Time =
    0.582 sec;
Ring Communication: Message Size = 8; 0.023 Gbytes/sec; Time =
    0.890 sec;
Ring Communication: Message Size = 64; 0.086 Gbytes/sec; Time =
    1.800 sec;
Ring Communication: Message Size = 512; 0.192 Gbytes/sec; Time =
    4.505 sec;
Ring Communication: Message Size = 4096; 0.367 Gbytes/sec; Time =
    5.600 sec;
Ring Communication: Message Size = 32768; 0.451 Gbytes/sec; Time =
    5.510 sec;
Ring Communication: Message Size = 262144; 0.482 Gbytes/sec; Time =
     5.292 sec;
Ring Communication: Message Size = 1048576; 0.455 Gbytes/sec; Time
    = 5.310 sec;
```

3   Matrix Vector Multiplication

3.1   Performance

3.1.1   nproc = 2

```
Repeated MV: Sequential Version: Matrix Size = 8192; 1.29 GFLOPS;
    Time = 1.043 sec;
Repeated MV: Parallel Version: Matrix Size = 8192; 2.56 GFLOPS;
    Time = 0.525 sec;
No differences found between base and test versions
MinRef = 11.926562; MinPar = 11.926562; MaxRef = 12.632827; MaxPar
    = 12.632827
```

3.1.2   nproc = 4

```
Repeated MV: Sequential Version: Matrix Size = 8192; 1.29 GFLOPS;
    Time = 1.044 sec;
Repeated MV: Parallel Version: Matrix Size = 8192; 4.99 GFLOPS;
    Time = 0.269 sec;
No differences found between base and test versions
MinRef = 11.926562; MinPar = 11.926562; MaxRef = 12.632827; MaxPar
    = 12.632827
```

3.1.3   nproc = 8

```
Repeated MV: Sequential Version: Matrix Size = 8192; 0.63 GFLOPS;
    Time = 2.117 sec;
Repeated MV: Parallel Version: Matrix Size = 8192; 4.65 GFLOPS;
    Time = 0.288 sec;
No differences found between base and test versions
MinRef = 11.926562; MinPar = 11.926562; MaxRef = 12.632827; MaxPar
    = 12.632827
```

3.1.4   nproc = 16

```
Process killed. No report available.
```