

CS3211 Parallel and Concurrent Programming – Guidelines for tutorial (29 March – 2 April 2010)

Sample Exercises:

[Please conduct these as an interactive discussion, rather than an evaluation. Please also make it clear to the students that they are not being evaluated for their performance in these exercises, so that they are not afraid to make mistakes while answering.]

MPI usage instructions <https://www.comp.nus.edu.sg/cf/tembusu/mpi.html>

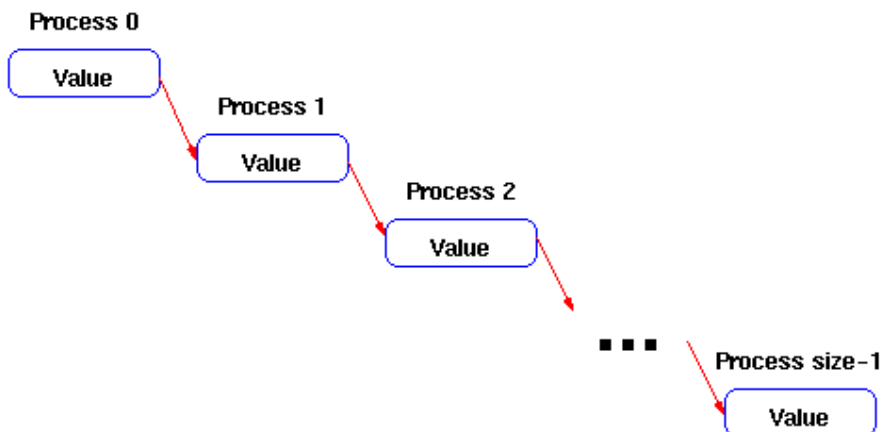
1. Hello world program – discussed in class.

```
#include "mpi.h"
#include <stdio.h>

int main(int argc, char *argv[])
{
    int rank, size;

    MPI_Init(&argc, &argv);
    MPI_Comm_rank(MPI_COMM_WORLD, &rank);
    MPI_Comm_size(MPI_COMM_WORLD, &size);
    printf("Hello world from processor %d of %d\n", rank, size);
    printf("Hello world\n");
    MPI_Finalize();
    return 0;
}
```

2. Write a program that takes data from process zero and sends it to all of the other processes by sending it in sequence. That is, process i should receive the data and send it to process $i+1$, until the last process is reached.



```

#include <stdio.h>
#include "mpi.h"

int main( argc, argv )
int argc;
char **argv;
{
    int rank, value, size;
    MPI_Status status;

    MPI\_Init( &argc, &argv );

    MPI\_Comm\_rank( MPI_COMM_WORLD, &rank );
    MPI\_Comm\_size( MPI_COMM_WORLD, &size );
    do {
        if (rank == 0) {
            scanf( "%d", &value );
            MPI\_Send( &value, 1, MPI_INT, rank + 1, 0, MPI_COMM_WORLD );
        }
        else {
            MPI\_Recv( &value, 1, MPI_INT, rank - 1, 0, MPI_COMM_WORLD,
                &status );
            if (rank < size - 1)
                MPI\_Send( &value, 1, MPI_INT, rank + 1, 0, MPI_COMM_WORLD );
        }
        printf( "Process %d got %d\n", rank, value );
        fflush(stdout);
    } while (value >= 0);

    MPI\_Finalize( );
    return 0;
}

```

Sample output

```

% mpicc -o ring ring.c
% mpirun -np 4 ring
10
Process 0 got 10
22
Process 0 got 22
-1
Process 0 got -1
Process 3 got 10
Process 3 got 22
Process 3 got -1
Process 2 got 10
Process 2 got 22
Process 2 got -1
Process 1 got 10
Process 1 got 22
Process 1 got -1
%

```

3. Write a program to test how fair the message passing implementation is. To do this, have all processes except process 0 send 100 messages to process 0. Have process 0 print out the messages as it receives them, using `MPI_ANY_SOURCE` and `MPI_ANY_TAG` in `MPI_Recv`. Is the MPI implementation fair?

Answer:

```
#include "mpi.h"
#include <stdio.h>
int main(argc, argv)
int argc;
char **argv;
{
    int rank, size, i, buf[1];
    MPI_Status status;

    MPI_Init( &argc, &argv );
    MPI_Comm_rank( MPI_COMM_WORLD, &rank );
    MPI_Comm_size( MPI_COMM_WORLD, &size );
    if (rank == 0) {
        for (i=0; i<100*(size-1); i++) {
            MPI_Recv( buf, 1, MPI_INT, MPI_ANY_SOURCE,
                    MPI_ANY_TAG, MPI_COMM_WORLD, &status );
            printf( "Msg from %d with tag %d\n",
                    status.MPI_SOURCE, status.MPI_TAG );
        }
    }
    else {
        for (i=0; i<100; i++)
            MPI_Send( buf, 1, MPI_INT, 0, i, MPI_COMM_WORLD );
    }
    MPI_Finalize();
    return 0;
}
```

Sample output:

```
Msg from 1 with tag 0
Msg from 1 with tag 1
Msg from 1 with tag 2
Msg from 1 with tag 3
Msg from 1 with tag 4
Msg from 1 with tag 5
Msg from 1 with tag 6
Msg from 1 with tag 7
Msg from 1 with tag 8
Msg from 1 with tag 9
Msg from 1 with tag 10
Msg from 1 with tag 11
Msg from 1 with tag 12
Msg from 1 with tag 13
Msg from 1 with tag 14
Msg from 1 with tag 15
Msg from 1 with tag 16
Msg from 1 with tag 17
Msg from 1 with tag 18
Msg from 1 with tag 19
Msg from 1 with tag 20
Msg from 1 with tag 21
```

Msg from 1 with tag 22
Msg from 1 with tag 23
Msg from 1 with tag 24
Msg from 1 with tag 25
Msg from 1 with tag 26
Msg from 1 with tag 27
Msg from 1 with tag 28
Msg from 1 with tag 29
Msg from 1 with tag 30
Msg from 1 with tag 31
Msg from 1 with tag 32
Msg from 1 with tag 33
Msg from 1 with tag 34
Msg from 1 with tag 35
Msg from 1 with tag 36
Msg from 1 with tag 37
Msg from 1 with tag 38
Msg from 1 with tag 39
Msg from 1 with tag 40
Msg from 1 with tag 41
Msg from 1 with tag 42
Msg from 1 with tag 43
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Msg from 1 with tag 69
Msg from 1 with tag 70
Msg from 1 with tag 71
Msg from 1 with tag 72
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