

Q1

1. We initialized 32 processes in the SBATCH scripts or the command line options. What we need to do in the code is to check the world_rank of each MPI process and use MPI_Send and MPI_Recv for messaging. Specifically, we do not receive messages on the number 0 process because we start from it and we do not send messages on the last process because we end at it. For the rest of the processes, they first receive and then increase the value by 1 and send the value finally.
2. For backward message sending, specifically we do not receive messages on the last process because we start from it and do not send messages on the number 0 process because we end at it.

```
Process 23 has got pass_value 23
Process 23 has incremented pass_value to 24 and is now sending...
Process 24 has got pass_value 24
Process 24 has incremented pass_value to 25 and is now sending...
Process 25 has got pass_value 25
Process 25 has incremented pass_value to 26 and is now sending...
Process 26 has got pass_value 26
Process 26 has incremented pass_value to 27 and is now sending...
Process 27 has got pass_value 27
Process 27 has incremented pass_value to 28 and is now sending...
Process 28 has got pass_value 28
Process 28 has incremented pass_value to 29 and is now sending...
Process 29 has got pass_value 29
Process 29 has incremented pass_value to 30 and is now sending...
Process 30 has got pass_value 30
Process 30 has incremented pass_value to 31 and is now sending...
Process 31 has got pass_value 31
Process 31 has decremented pass_value to 30 and is now sending...
Process 30 has got pass_value 30
Process 30 has decremented pass_value to 29 and is now sending...
Process 29 has got pass_value 29
Process 29 has decremented pass_value to 28 and is now sending...
Process 28 has got pass_value 28
Process 28 has decremented pass_value to 27 and is now sending...
Process 27 has got pass_value 27
Process 27 has decremented pass_value to 26 and is now sending...
Process 26 has got pass_value 26
Process 26 has decremented pass_value to 25 and is now sending...
Process 25 has got pass_value 25
Process 25 has decremented pass_value to 24 and is now sending...
Process 24 has got pass_value 24
Process 24 has decremented pass_value to 23 and is now sending...
Process 23 has got pass_value 23
Process 23 has decremented pass_value to 22 and is now sending...
```