CS443
Distributed System and Algorithm

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Report on First Programming Assignment:

1-Source Code:

I include both source code and binary file inside the zip file.

2- Screen Shoots:

- Running on Microsoft Azure using UUID for electing the leader

```
makaraphav@MakaraUbuntuMasterMPI:~/cloud$ mpiexec -f hosts -n 1 ./ring_Microsoft_Azure
UUID: 4ce1233a-fb9f-a846-8068-08613bee4481
Hello world from process 0 of 1, priority 4ce1233a-fb9f-a846-8068-08613bee4481

Leader UUID: 4ce1233a-fb9f-a846-8068-08613bee4481
 Leader Node ID: -1 Node ID: 0 Computer Node Identity: MakaraUbuntsClient03
Number of message: 0
```

```
makaraphav@MakaraUbuntuMasterMPI:~/cloud$ mpiexec -f hosts -n 2 ./ring_Microsoft_Azure
UUID: UUID: 47c3e91a2f3437a3--f4b697fb--ab844463--8a0f6789--058f601037bdece54a488811

Hello world from process 0 of 2, priority 4ce1233a-fb9f-a846-8068-08613bee4481

Hello world from process 1 of 2, priority 739af473-467b-b443-af79-5f007dc5a881

Leader UUID: 739af473-467b-b443-af79-5f007dc5a881
 Leader Node ID: 1 Node ID: 1 Computer Node Identity: MakaraUbuntuClient01
Number of message: 3
Leader UUID: 739af473-467b-b443-af79-5f007dc5a881
 Leader Node ID: 1 Node ID: 0 Computer Node Identity: MakaraUbuntsClient03
Number of message: 4
makaraphav@MakaraUbuntuMasterMPI:~/cloud$
```

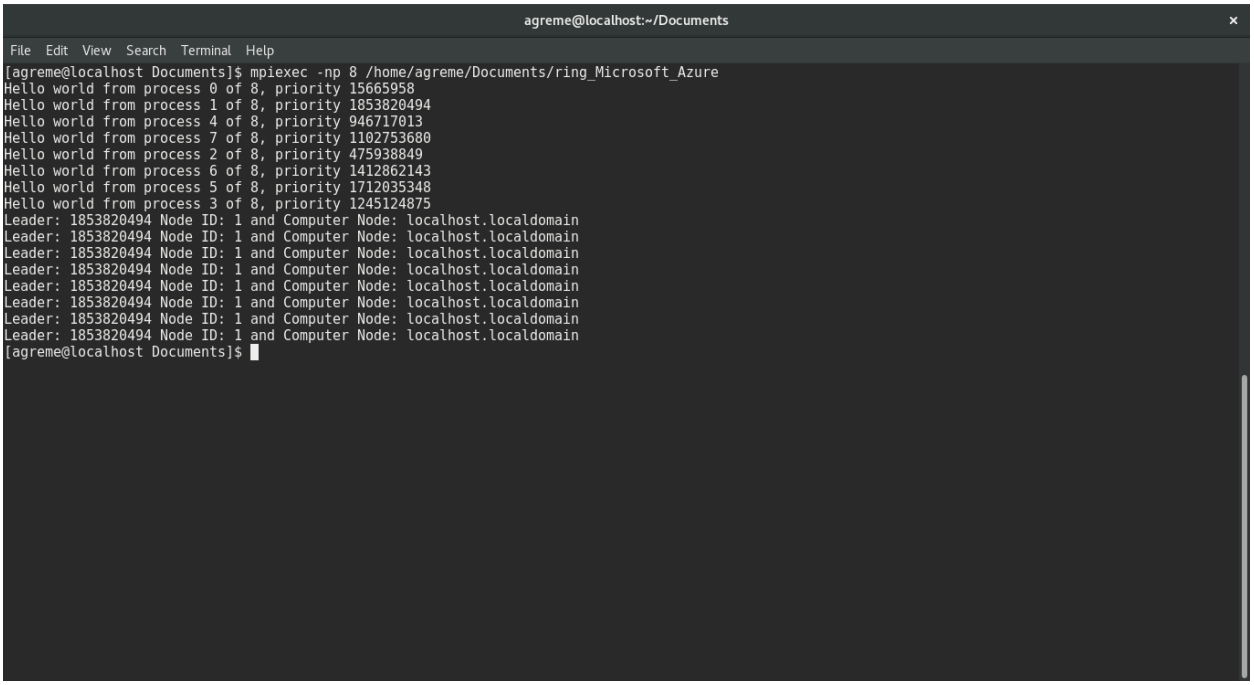
```
makaraphav@MakaraUbuntuMasterMPI:~/cloud$ mpiexec -f hosts -n 4 ./ring_Microsoft_Azure
UUID: 18930c14-6f73-9640-a739-3f494204a97c
Hello world from process 3 of 4, priority 18930c14-6f73-9640-a739-3f494204a97c

UUID: 4ce1233a-fb9f-a846-8068-08613bee4481
Hello world from process 0 of 4, priority 4ce1233a-fb9f-a846-8068-08613bee4481

UUID: UUID: 733d9da2f8487a3b--446f74b8--b14c443d--abf37395--5af7050877d4cb5bae828a12

Hello world from process 1 of 4, priority 739af473-467b-b443-af79-5f007dc5a881

Hello world from process 2 of 4, priority 3dd288ab-4f48-1c4d-b335-a75874bbe2a2

Leader UUID: 739af473-467b-b443-af79-5f007dc5a881
 Leader Node ID: 1 Node ID: 1 Computer Node Identity: MakaraUbuntuClient01
Number of message: 5
Leader UUID: 739af473-467b-b443-af79-5f007dc5a881
 Leader Node ID: 1 Node ID: 2 Computer Node Identity: MakaraUbuntuClient02
Number of message: 6
Leader UUID: 739af473-467b-b443-af79-5f007dc5a881
 Leader Node ID: 1 Node ID: 3 Computer Node Identity: MakaraUbuntuClient04
Number of message: 7
Leader UUID: 739af473-467b-b443-af79-5f007dc5a881
 Leader Node ID: 1 Node ID: 0 Computer Node Identity: MakaraUbuntsClient03
Number of message: 8
makaraphav@MakaraUbuntuMasterMPI:~/cloud$
```

```
makaraphav@MakaraUbuntuMasterMPI:~/cloud$ mpiexec -f hosts -n 8 ./ring_Microsoft_Azure
UUID: cUUID: 91f869f3a0cc81-46-066f97-3f-a946f4-08-8ab703-90-43ef1UUID: 4a79UUID: UUID: d3493d9UUID: UUID: 2ad0a4406dbfc8422f4e5ae847149d8532e73a
-3fcebHello world from process 6 of 8, priority c9f6fac8-6069-fa4f-88b0-04e1add0bf45

43e
--6a2Hello world from process 3 of 8, priority 18930c14-6f73-9640-a739-3f494204a97c

647--cfbf6c4-b1f8b96--4f7e14--2c3a944-81cda44--f6b8b7--c398883-0b65561--f84ca0--a7005d578b68d68e7c16e453a8bab5fb8ee7e8e33214cea
4ec2Hello world from process 1 of 8, priority 739af473-467b-b443-af79-5f007dc5a881

84

18Hello world from process 4 of 8, priority 9a62ed3e-6ccf-e24c-8c86-cad6ee8f73ec

Hello world from process 2 of 8, priority 3dd288ab-4f48-1c4d-b335-a75874bbe2a2



Hello world from process 0 of 8, priority 4ce1233a-fb9f-a846-8068-08613bee4481

Hello world from process 5 of 8, priority 4854efe2-6167-914b-8b14-5b86a5e3ce48

UUID: 0cd6078c-7d20-ff44-a580-7e87e89ec728
Hello world from process 7 of 8, priority 0cd6078c-7d20-ff44-a580-7e87e89ec728

Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 6 Computer Node Identity: MakaraUbuntuClient07
Number of message: 9
Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 7 Computer Node Identity: MakaraUbuntuMasterMPI
Number of message: 10
Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 0 Computer Node Identity: MakaraUbuntsClient03
```

```
Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 6 Computer Node Identity: MakaraUbuntuClient07
Number of message: 9
Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 7 Computer Node Identity: MakaraUbuntuMasterMPI
Number of message: 10
Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 0 Computer Node Identity: MakaraUbuntsClient03
Number of message: 11
Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 1 Computer Node Identity: MakaraUbuntuClient01
Number of message: 12
Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 2 Computer Node Identity: MakaraUbuntuClient02
Number of message: 13
Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 3 Computer Node Identity: MakaraUbuntuClient04
Number of message: 14
Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 4 Computer Node Identity: MakaraUbuntuClient05
Number of message: 15
Leader UUID: c9f6fac8-6069-fa4f-88b0-04e1add0bf45
 Leader Node ID: 6 Node ID: 5 Computer Node Identity: MakaraUbuntuClient06
Number of message: 16
makaraphav@MakaraUbuntuMasterMPI:~/cloud$
```

- Running on Local machine using random priority to choose leader

```
[agreme@localhost Documents]$ mpiexec -np 1 /home/agreme/Documents/ring_local_machine
Hello world from process 0 of 1, priority 1237840900
Leader Priority: 1237840900 Leader Node ID: -1 Node ID: 0 Computer Node Identity: localhost.localdomain
Number of message: 0
[agreme@localhost Documents]$

[agreme@localhost Documents]$ mpiexec -np 2 /home/agreme/Documents/ring_local_machine
Hello world from process 0 of 2, priority 939288877
Hello world from process 1 of 2, priority 1719024448
Leader Priority: 1719024448 Leader Node ID: 1 Node ID: 1 Computer Node Identity: localhost.localdomain
Number of message: 3
Leader Priority: 1719024448 Leader Node ID: 1 Node ID: 0 Computer Node Identity: localhost.localdomain
Number of message: 4
[agreme@localhost Documents]$ mpiexec -np 4 /home/agreme/Documents/ring_local_machine
Hello world from process 0 of 4, priority 1923703370
Hello world from process 1 of 4, priority 1607361587
Hello world from process 2 of 4, priority 1306061638
Hello world from process 3 of 4, priority 993902283
Leader Priority: 1923703370 Leader Node ID: 0 Node ID: 0 Computer Node Identity: localhost.localdomain
Number of message: 5
Leader Priority: 1923703370 Leader Node ID: 0 Node ID: 1 Computer Node Identity: localhost.localdomain
Number of message: 6
Leader Priority: 1923703370 Leader Node ID: 0 Node ID: 2 Computer Node Identity: localhost.localdomain
Number of message: 7
Leader Priority: 1923703370 Leader Node ID: 0 Node ID: 3 Computer Node Identity: localhost.localdomain
Number of message: 8
[agreme@localhost Documents]$
```



3- Number of Message Passing

Number of Processor	Best case	Worst case	Average case
1	0	0	0
2	7	7	7
4	26	26	26
8	100	100	100

4- Algorithm Implementation:
As it is described in the programming assignment document that we only send the message from node with index i to node with index (i+1) % size. So, I design a really basic leader election algorithm as follow. I will described my algorithm with pseudo code first:

```
while(!terminated){

    if (ring_size == 1){

        my_leader = my_rank;
        terminated = true;
        break;

    }
```

```
            if (message_terminated ){

                    terminated  = true
                    my_leader  = message_leader
                    My_max = message_max;

            }
            Else if (my_max > message_max){

                    my_max  = message_max;
                    my_leader  = message_leader;
                    terminated = false;

            }
            Else if (my_max == message_max){

                    if (message_ leader == my_leader)
                            terminated = true;
                    Else
                            my_leader  = my_rank;
                            terminated = false;

            }
            send (my_message, destination);
            receive (message);
    }
```

[Noted]:

1 - Assuming that my_max, my leader and terminated are variable belong to computer node
2 - Assuming that message_max, message_terminated, message_leader belong to incoming message
3- Message is already pack with message_max, message_terminated and message_leader

Firstly, all of the node will send out the massage until the maximum max_value is found. So, at least, it needs around n message to pass to get it for each node. However, the first node who receives the maximum max id is not break the loop yet it will need to send the message to person to the right that it already receive the max value. I modify the algorithm to send more message to ensure the true leader was elected when a node has the same max priority, it once again need to send our message with terminated state to the other nodes. So, the rest of the node will end up send one more message than the previous one because the rest of the nodes is waiting for the terminated state with true leader priority. As a result, the reason that my algorithm always send out the same amount of messages despite the case of the arrangement of the priority in each machine node. Therefore, in big o notation we, can get the following performance from the above algorithm:

Number of Processors	Best	Average	Worst
N	O(N^2)	O(N^2)	O(N^2)