HPC-As10

February 17, 2024

1 Assignment 10

Write a program to show collective communication by taking suitable example such that computing average of n numbers or computing sum or product of two matrices… :

- Bcast function
- Scatter function
- Gather function

[1]:
```
from mpi4py import MPI
import numpy as np
```

[2]:
```
comm = MPI.COMM_WORLD
rank = comm.Get_rank()
size = comm.Get_size()
```

[3]:
```
n = 10
local_sum = np.random.randint(0, 100, n)

local_sum_total = np.sum(local_sum)

global_sum = np.array(0, dtype='i')
comm.Reduce(local_sum_total, global_sum, op=MPI.SUM, root=0)

if rank == 0:
    print("Global sum:", global_sum)
```

```
Global sum: 533
```

[6]:
```
!mpiexec -n 10 python bcast.py
```

```
Rank 0 is broadcasting
Process :  0 received data :  66
Process :  8  , is waiting to receive data from Rank 0
Process :  8 received data :  66
Process :  9  , is waiting to receive data from Rank 0
Process :  9 received data :  66
Process :  1  , is waiting to receive data from Rank 0
Process :  1 received data :  66
Process :  2  , is waiting to receive data from Rank 0
```

```
Process :  2 received data :  66
Process :  3  , is waiting to receive data from Rank 0
Process :  3 received data :  66
Process :  4  , is waiting to receive data from Rank 0
Process :  4 received data :  66
Process :  5  , is waiting to receive data from Rank 0
Process :  5 received data :  66
Process :  6  , is waiting to receive data from Rank 0
Process :  6 received data :  66
Process :  7  , is waiting to receive data from Rank 0
Process :  7 received data :  66
```

[7]:
```
if rank == 0:
    print("Rank 0 is scattering")
else:
    print("Process : ", rank, " , is waiting to receive scattered data from␣
 ↪Rank 0")

if rank == 0:
    send_data = np.arange(size) * 10
else:
    send_data = None

recv_data = np.empty(1, dtype=int)
comm.Scatter(send_data, recv_data, root=0)

print("Process : ", rank, "received data : ", recv_data[0])
```

```
Rank 0 is scattering
Process :  0 received data :  0
```

[8]:
```
!mpiexec -n 10 python scatter.py
```

```
Process :  8  , is waiting to receive scattered data from Rank 0
Process :  8 received data :  80
Rank 0 is scattering
Process :  0 received data :  0
Process :  1  , is waiting to receive scattered data from Rank 0
Process :  1 received data :  10
Process :  4  , is waiting to receive scattered data from Rank 0
Process :  4 received data :  40
Process :  2  , is waiting to receive scattered data from Rank 0
Process :  2 received data :  20
Process :  5  , is waiting to receive scattered data from Rank 0
Process :  5 received data :  50
Process :  6  , is waiting to receive scattered data from Rank 0
Process :  6 received data :  60
Process :  3  , is waiting to receive scattered data from Rank 0
Process :  3 received data :  30
```

```
Process :  9  , is waiting to receive scattered data from Rank 0
Process :  9 received data :  90
Process :  7  , is waiting to receive scattered data from Rank 0
Process :  7 received data :  70
```

[9]:
```python
local_sum = np.random.randint(0, 100)

if rank == 0:
    print("Rank 0 is gathering")

global_sums = None
if rank == 0:
    global_sums = np.empty(size, dtype=int)
comm.Gather(np.array(local_sum, dtype=int), global_sums, root=0)

if rank == 0:
    print("Rank 0 gathered the following local sums : ", global_sums)
```

```
Rank 0 is gathering
Rank 0 gathered the following local sums :  [77]
```

[10]:
```
!mpiexec -n 10 python gather.py
```

```
Rank 0 is gathering
Rank 0 gathered the following local sums :  [25  4 22 96 94 95 54 17 40 76]
```