Topic: MPI Programming

Objective

- MPI point-to-point communication
- Important points to remember while implementing MPI
- Hands-on

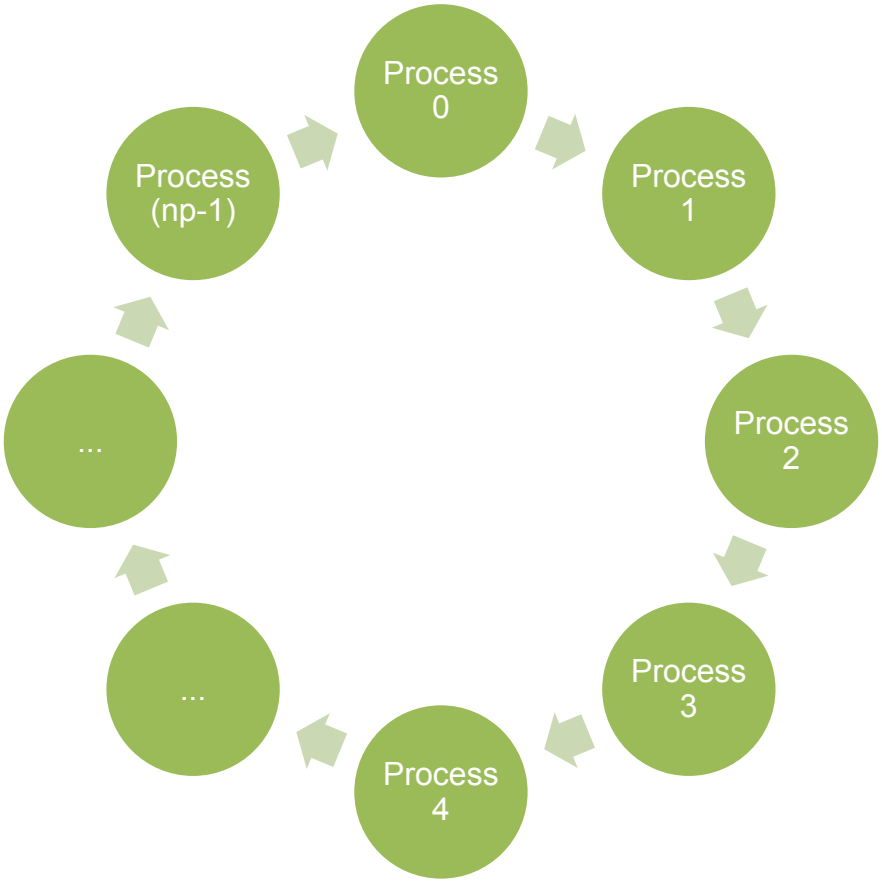
Blocking and non-blocking

Blocking	Non-blocking
MPI_Send	MPI_Isend
MPI_Recv	MPI_Irecv

Blocking: the process does not return until data transmitted is started from the buffer

Non-blocking: the process return immediately after the op

Sending data in a ring-like pattern/topology



MPI_ISend/MPI_IRecv

```
program test
 implicit none
 include 'mpif.h'

 integer :: p, id,err,root,msg,tag,request(MPI_Status_Size)

 call MPI_Init(err)
 call MPI_Comm_Size(MPI_Comm_World, p, err)
 call MPI_Comm_Rank(MPI_Comm_World, id, err)

 root=0 ; tag=0
 if(id==root) then
   msg=10
   call MPI_ISend(msg,1,MPI_Int,1,tag,MPI_Comm_World,request,err)
  else
   call MPI_IRecv(msg,1,MPI_Int,id-1,MPI_Any_Tag,MPI_Comm_World,request,err)
   write(*,*) id,'received from process:',id-1,'msg: ',msg
   call MPI_ISend(msg,1,MPI_Int,mod(id+1,p),tag,MPI_Comm_World,request,err)
 endif


 if(id==root) then
   call MPI_IRecv(msg,1,MPI_Int,p-1,MPI_Any_Tag,MPI_Comm_World,request,err)
   write(*,*) id,'received from process:',p-1,'msg: ',msg
 endif

 call MPI_Finalize(err)
end program test
```

Output

```
mpirun -np 4 ./mpifring.x
0 received from process:          3 msg:          10
2 received from process:          1 msg:           0
1 received from process:          0 msg:           0
3 received from process:          2 msg:           0
```

Correct – MPI_ISend/MPI_IRecv

```
program test
 implicit none
 include 'mpif.h'

 integer :: p, id,err,root,msg,tag,request(MPI_Status_Size),status(MPI_Status_Size),msg1

 call MPI_Init(err)
 call MPI_Comm_Size(MPI_Comm_World, p, err)
 call MPI_Comm_Rank(MPI_Comm_World, id, err)

 root=0 ; tag=0
 if(id==root) then
   msg=10
   call MPI_ISend(msg,1,MPI_Int,1,tag,MPI_Comm_World,request,err)
  else
   call MPI_IRecv(msg1,1,MPI_Int,id-1,MPI_Any_Tag,MPI_Comm_World,request,err)
   call MPI_Wait(request,status)
   write(*,*) id,'received from process:',id-1,'msg: ',msg1
   call MPI_ISend(msg1,1,MPI_Int,mod(id+1,p),tag,MPI_Comm_World,request,err)
 endif


 if(id==root) then
   call MPI_IRecv(msg1,1,MPI_Int,p-1,MPI_Any_Tag,MPI_Comm_World,request,err)
   call MPI_Wait(request,status)
   write(*,*) id,'received from process:',p-1,'msg: ',msg1
 endif

 call MPI_Finalize(err)
end program test
```

Topic: MPI Programming

Can we parallelize all parts of the programs?

- Fibonacci series: Generate ‘N’ Fibonacci numbers and calculate their average (can we implement MPI, here?)

  (

  Sum of previous two numbers gives the number

  $x_i = x_{(i-1)} + x_{(i-2)}$

)

https://en.wikipedia.org/wiki/Fibonacci_number

Can we parallelize all part of the programs? NO

```
!Fibonacci series:  each number will be the sum of the two preceding num
bers

program fibo_series
 implicit none

 integer(kind=16) :: sum,i,first,second,third,N


 write(*,*) 'enter N value'
 read(*,*) N

 first=1 ; second=1

 do i=1,N
   third=first+second
   sum=sum+third

   first=second
   second=third
   write(*,*) third
 enddo


end program fibo_series
```

When the current process depends on the data in other processes, synchronization needs to be established among processes, hence the communication time may dominate.

Hands on

- Using the above data ‘random_numbers.dat’, write a program to calculate the average value of N numbers. a) Implement MPI using point-to-point blocking communication protocols b) Implement MPI using point-to-point non-blocking communication protocols. Show that the result in both cases is the same.