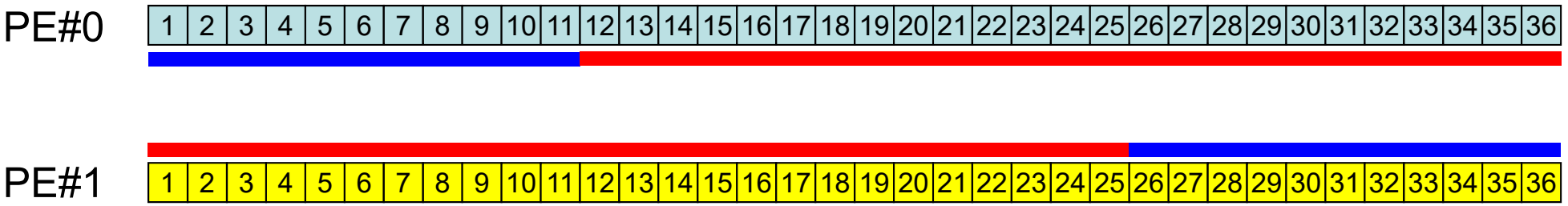
Ex.2: Send-Recv an Array (1/4)

- Exchange VEC (real, 8-byte) between PE#0 & PE#1
- PE#0 to PE#1
  - PE#0: send VEC(1)-VEC(11) (length=11)
  - PE#1: recv. as VEC(26)-VEC(36) (length=11)
- PE#1 to PE#0
  - PE#1: send VEC(1)-VEC(25) (length=25)
  - PE#0: recv. as VEC(12)-VEC(36) (length=25)



Practice: t1

- Initial status of VEC(:):
  - PE#0 VEC(1-36)= 101,102,103,~,135,136
  - PE#1 VEC(1-36)= 201,202,203,~,235,236

- Using following two functions:
  - MPI_Isend/Irecv/Waitall
  - MPI_Sendrecv

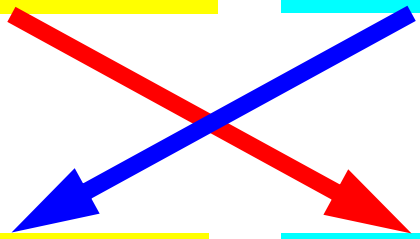
- Sample codes are in the following directory.
- Copy them to <$O-S2>.

```
/lustre/gt16/z30088/class_eps/answer/t1
```

Notice: Send/Recv Arrays

```
#PE0
  send:
    VEC(start_send)~
    VEC(start_send+length_send-1)
```

```
#PE1
  send:
    VEC(start_send)~
    VEC(start_send+length_send-1)
```



```
#PE0
  recv:
    VEC(start_recv)~
    VEC(start_recv+length_recv-1)
```

```
#PE1
  recv:
    VEC(start_recv)~
    VEC(start_recv+length_recv-1)
```

- “length_send” of sending process must be equal to “length_recv” of receiving process.
  - PE#0 to PE#1, PE#1 to PE#0
- “sendbuf” and “recvbuf”: different address

Example: Fortran (1/3)

Fortran

Isend/Irecv/Waitall

```
$> cd <$O-S2>
$> mpiifort -O3 ex2a.f
$> qsub go2.sh
```

```
      implicit REAL*8 (A-H,O-Z)
      include  'mpif.h'

      integer(kind=4) :: my_rank, PETOT, NEIB
      real   (kind=8) :: VEC(36)

      integer(kind=4), dimension(MPI_STATUS_SIZE,1) :: stat_send
      integer(kind=4), dimension(MPI_STATUS_SIZE,1) :: stat_recv
      integer(kind=4), dimension(1)    :: request_send
      integer(kind=4), dimension(1)    :: request_recv

      integer(kind=4) :: start_send, length_send
      integer(kind=4) :: start_recv, length_recv

      call MPI_INIT      (ierr)
      call MPI_COMM_SIZE (MPI_COMM_WORLD, PETOT, ierr )
      call MPI_COMM_RANK (MPI_COMM_WORLD, my_rank, ierr )
```

Example: Fortran (2/3)

Fortran

Isend/Irecv/Waitall

```
      if (my_rank.eq.0) then
        NEIB= 1
        start_send=   1
        length_send=  11
        start_recv=  length_send + 1
        length_recv=  25
        do i= 1, 36
          VEC(i)= 100 + i
        enddo
      endif

      if (my_rank.eq.1) then
        NEIB= 0
         start_send=  1
        length_send= 25
         start_recv= length_send + 1
        length_recv= 11
        do i= 1, 36
          VEC(i)= 200 + i
        enddo
      endif

      do i= 1, 36
        write (*,'(i1,a,i2,f10.0)') my_rank, ' #BEFORE# ', i,VEC(i)
      enddo
```

Example: Fortran (3/3)

Fortran

Isend/Irecv/Waitall

```
 call MPI_ISEND (VEC(start_send), length_send,                    &
&                MPI_DOUBLE_PRECISION, NEIB, 0, MPI_COMM_WORLD,   &
&                request_send(1), ierr)
 call MPI_IRECV (VEC(start_recv), length_recv,                    &
&                MPI_DOUBLE_PRECISION, NEIB, 0, MPI_COMM_WORLD,   &
&                request_recv(1), ierr)

 call MPI_WAITALL (1, request_recv, stat_recv, ierr)
 call MPI_WAITALL (1, request_send, stat_send, ierr)

 do i= 1, 36
   write (*,'(i1,a,i2,f10.0)') my_rank, ' #AFTER # ', i,VEC(i)
 enddo

 call MPI_FINALIZE (ierr)

 end
```

- Portability !
- “Data (structure) is everything”... don’t you agree with that ?

Example: C (1/3)

C

Isend/Irecv/Waitall

```
$> cd <$O-S2>
$> mpicc –O3 ex2a.c
$> qsub go2.sh
```

```
#include <stdio.h>
#include <stdlib.h>
#include “mpi.h”

int main(int argc, char **argv){
        int i, neib;
        int MyRank, PeTot;
        double VEC[36];
        int Start_Send, Length_Send;
        int Start_Recv, Length_Recv;

        MPI_Status *StatSend, *StatRecv;
        MPI_Request *RequestSend, *RequestRecv;

        MPI_Init(&argc, &argv);
        MPI_Comm_size(MPI_COMM_WORLD, &PeTot);
        MPI_Comm_rank(MPI_COMM_WORLD, &MyRank);
```

Example: C (2/3)

C

Isend/Irecv/Waitall

```
      Start_Send= 1;

      if(MyRank == 0) {
        neib= 1;
        Length_Send= 11;
        Length_Recv= 25;
        for (i=0;i<36;i++){VEC[i]=100.0+i+1;}}

      if(MyRank == 1) {
        neib= 0;
        Length_Send= 25;
        Length_Recv= 11;
        for (i=0;i<36;i++){VEC[i]=200.0+i+1;}}

      Start_Recv= 1 + Length_Send;

      StatSend = malloc(sizeof(MPI_Status) * 1);
      StatRecv = malloc(sizeof(MPI_Status) * 1);
      RequestSend = malloc(sizeof(MPI_Request) * 1);
      RequestRecv = malloc(sizeof(MPI_Request) * 1);

      for (i=0;i<36;i++) {
        printf("%s%2d%5d%8.0f¥n", "### before", MyRank, i, VEC[i]);}
```

Example: C (3/3)

C

Isend/Irecv/Waitall

```
        MPI_Isend(&VEC[Start_Send-1], Length_Send, MPI_DOUBLE, neib, 0,
                  MPI_COMM_WORLD, &RequestSend[0]);

        MPI_Irecv(&VEC[Start_Recv-1], Length_Recv, MPI_DOUBLE, neib, 0,
                  MPI_COMM_WORLD, &RequestRecv[0]);

        MPI_Waitall(1, RequestRecv, StatRecv);

        MPI_Waitall(1, RequestSend, StatSend);

        for (i=0;i<36;i++) {
          printf("%s%2d%5d%8.0f¥n", "### after ", MyRank, i, VEC[i]);}

        MPI_Finalize();
        return 0;
}
```

- Portability !
- “Data (structure) is everything”... don’t you agree with that ?

Results

```
0 #BEFORE#  1      101.
0 #BEFORE#  2      102.
0 #BEFORE#  3      103.
0 #BEFORE#  4      104.
0 #BEFORE#  5      105.
0 #BEFORE#  6      106.
0 #BEFORE#  7      107.
0 #BEFORE#  8      108.
0 #BEFORE#  9      109.
0 #BEFORE# 10      110.
0 #BEFORE# 11      111.
0 #BEFORE# 12      112.
0 #BEFORE# 13      113.
0 #BEFORE# 14      114.
0 #BEFORE# 15      115.
0 #BEFORE# 16      116.
0 #BEFORE# 17      117.
0 #BEFORE# 18      118.
0 #BEFORE# 19      119.
0 #BEFORE# 20      120.
0 #BEFORE# 21      121.
0 #BEFORE# 22      122.
0 #BEFORE# 23      123.
0 #BEFORE# 24      124.
0 #BEFORE# 25      125.
0 #BEFORE# 26      126.
0 #BEFORE# 27      127.
0 #BEFORE# 28      128.
0 #BEFORE# 29      129.
0 #BEFORE# 30      130.
0 #BEFORE# 31      131.
0 #BEFORE# 32      132.
0 #BEFORE# 33      133.
0 #BEFORE# 34      134.
0 #BEFORE# 35      135.
0 #BEFORE# 36      136.
```

```
0 #AFTER #  1      101.
0 #AFTER #  2      102.
0 #AFTER #  3      103.
0 #AFTER #  4      104.
0 #AFTER #  5      105.
0 #AFTER #  6      106.
0 #AFTER #  7      107.
0 #AFTER #  8      108.
0 #AFTER #  9      109.
0 #AFTER # 10      110.
0 #AFTER # 11      111.
0 #AFTER # 12      201.
0 #AFTER # 13      202.
0 #AFTER # 14      203.
0 #AFTER # 15      204.
0 #AFTER # 16      205.
0 #AFTER # 17      206.
0 #AFTER # 18      207.
0 #AFTER # 19      208.
0 #AFTER # 20      209.
0 #AFTER # 21      210.
0 #AFTER # 22      211.
0 #AFTER # 23      212.
0 #AFTER # 24      213.
0 #AFTER # 25      214.
0 #AFTER # 26      215.
0 #AFTER # 27      216.
0 #AFTER # 28      217.
0 #AFTER # 29      218.
0 #AFTER # 30      219.
0 #AFTER # 31      220.
0 #AFTER # 32      221.
0 #AFTER # 33      222.
0 #AFTER # 34      223.
0 #AFTER # 35      224.
0 #AFTER # 36      225.
```

```
1 #BEFORE#  1      201.
1 #BEFORE#  2      202.
1 #BEFORE#  3      203.
1 #BEFORE#  4      204.
1 #BEFORE#  5      205.
1 #BEFORE#  6      206.
1 #BEFORE#  7      207.
1 #BEFORE#  8      208.
1 #BEFORE#  9      209.
1 #BEFORE# 10      210.
1 #BEFORE# 11      211.
1 #BEFORE# 12      212.
1 #BEFORE# 13      213.
1 #BEFORE# 14      214.
1 #BEFORE# 15      215.
1 #BEFORE# 16      216.
1 #BEFORE# 17      217.
1 #BEFORE# 18      218.
1 #BEFORE# 19      219.
1 #BEFORE# 20      220.
1 #BEFORE# 21      221.
1 #BEFORE# 22      222.
1 #BEFORE# 23      223.
1 #BEFORE# 24      224.
1 #BEFORE# 25      225.
1 #BEFORE# 26      226.
1 #BEFORE# 27      227.
1 #BEFORE# 28      228.
1 #BEFORE# 29      229.
1 #BEFORE# 30      230.
1 #BEFORE# 31      231.
1 #BEFORE# 32      232.
1 #BEFORE# 33      233.
1 #BEFORE# 34      234.
1 #BEFORE# 35      235.
1 #BEFORE# 36      236.
```

```
1 #AFTER #  1      201.
1 #AFTER #  2      202.
1 #AFTER #  3      203.
1 #AFTER #  4      204.
1 #AFTER #  5      205.
1 #AFTER #  6      206.
1 #AFTER #  7      207.
1 #AFTER #  8      208.
1 #AFTER #  9      209.
1 #AFTER # 10      210.
1 #AFTER # 11      211.
1 #AFTER # 12      212.
1 #AFTER # 13      213.
1 #AFTER # 14      214.
1 #AFTER # 15      215.
1 #AFTER # 16      216.
1 #AFTER # 17      217.
1 #AFTER # 18      218.
1 #AFTER # 19      219.
1 #AFTER # 20      220.
1 #AFTER # 21      221.
1 #AFTER # 22      222.
1 #AFTER # 23      223.
1 #AFTER # 24      224.
1 #AFTER # 25      225.
1 #AFTER # 26      101.
1 #AFTER # 27      102.
1 #AFTER # 28      103.
1 #AFTER # 29      104.
1 #AFTER # 30      105.
1 #AFTER # 31      106.
1 #AFTER # 32      107.
1 #AFTER # 33      108.
1 #AFTER # 34      109.
1 #AFTER # 35      110.
1 #AFTER # 36      111.
```