```
#include <mpi.h>
#include <stdlib.h>
#include <stdio.h>
void ringio(int p,int id);
int main(int ac,char *av){
    int ea,id,p;
    MPI_Init(&ac,&av);
    MPI_Comm_size(MPI_COMM_WORLD,&p);
    MPI_Comm_Rank(MPI_COMM_WORLD,&id);
    if(id==0){
    printf("\n RING_MPI : \n"C/MPI Version \n Measure time to pass a
    double Array around a process ring of %d in processes \n",p);
    }
    ringio(p,id);
    MPI_Finalize();
    if(id==0)
    printf("\n RING-MPI : \n Normal End of Execution \n");
}
void ringio(int p,int id){
int dest,i,n,j,n_test[5]={100,1000,10000,100000,1000000},n_test_num=5;
source,test,test_num=10;
double tave,tmax,tmin,wtime,*x;
MPIStatus status;
if(id==0)
printf(" \n Time based on %d experiments\n N double precision values sent in
    a ring transmission, starting & ending at process 0 in using %d processes \n
    N \t\t Tmin \t\t Tave \t\t Tmax \n");
for(i=0;i<n_test_num;i++){
    n=n_test[i];
    x=(double)malloc(n*sizeof(double));
    if(id==0){
        dest=1;
```

```
        source = p-1;
        tave=0; tmin = 1E+30; tmax = 0;
        for (test=1; test<=test_num; test++){
          for(j=0; j<n; j++)
              x[j] = (double)(test+j);
          wtime = MPI_Wtime();
          MPI_Send(x, n, MPI_DOUBLE, dest, 0, MPI_COMM_WORLD);
          MPI_Recv(x, n, MPI_DOUBLE, source, 0, MPI_COMM_WORLD, &status);
          wtime = MPI_Wtime() - wtime;
          tave += wtime;
          if(wtime < tmin) tmin = wtime;
          if(tmax < wtime) tmax = wtime;
        }
        tave /= (double)(test_num);
        printf("%8d %14.6g %14.6g %14.6g\n", n, tmin, tave, tmax);
      }
      else{
        source = id-1;
        dest = (id+1)%p;
        for(test=1; test<=test_num; test++){
          MPI_Recv(x, n, MPI_DOUBLE, source, 0, MPI_COMM_WORLD, &status);
          MPI_Send(x, n, MPI_DOUBLE, dest, 0, MPI_COMM_WORLD);
        }
      }
    }
    free(x);
  }
}
```

Output:

RING MPI :

C/MPI version

Measure time to pass a double Array around a process ring of 4 processes.

Time based on 10 experiments.

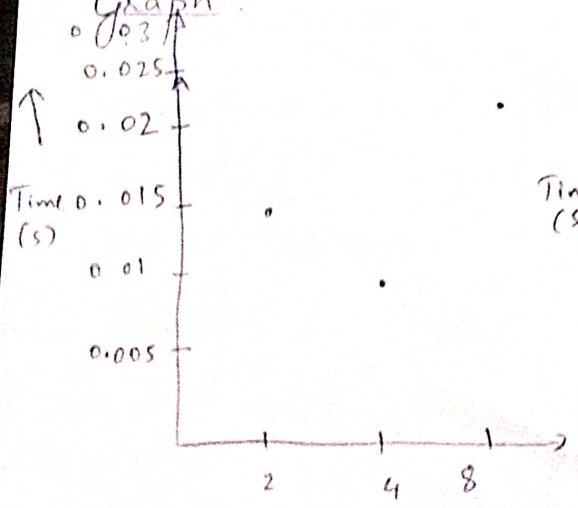
N double precision values sent in a ring transmission starting and ending at process 0 using 4 processes.

N	Tmin	Tave	Tmax
100	0.0037	0.0132	0.0262
1000	0.0017	0.0098	0.0269
10000	0.0067	0.0147	0.0226
100000	0.0073	0.0324	0.0920
1000000	0.0296	0.0640	0.1690

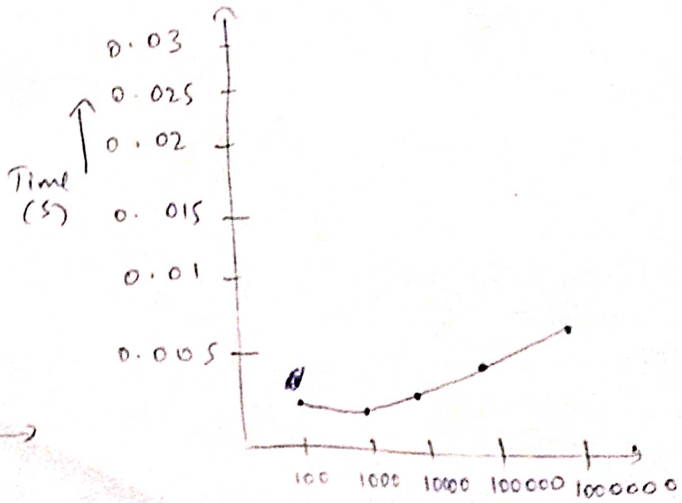
RING MPI:

Normal End of Execution

Graph



No of Threads vs Time



No of Iterations vs Time