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CS 133
Homework 3

1. Consider the basic matrix multiplication algorithm for two NxN matrices using KxK processors connected using a mesh network. Please derive the isoefficiency relation and the scalability function.

Isoefficiency relation:

$$n^2 \geq C * [(2t_s + t_{wnp})(\sqrt{p} - 1) + n^2/p]$$
$$n \geq C/n * [(2t_s + t_{wnk^2}(k-1) + n^2/k^2)]$$

Scalability function: $M(C/n * [(2t_s + t_{wnk^2}(k-1) + n^2/k^2)]/k^2$
 $= C^2 * [(2t_s + t_{wnk^2}(k-1) + n^2/k^2)]^2 / (nk)^2$

2. Please implement the scatter function (using basic Send/Receive functions) in two ways assuming the underlying communication topology (i) is a mesh, and (ii) is a 4-dimension hypercube.

Although the topologies are different, the actual implementations for these two ways are the same.

The runtime for these two methods are very close to the built in function, based on the time elapsed of calling these functions.

My code:

```
int MPI_Scatter_Mesh (float *sendbuf, float *recvbuf, int size){
    int pid, pnum, d, i,j;
    MPI_Status stat;
    MPI_Comm_size(MPI_COMM_WORLD, &pnum);
    MPI_Comm_rank(MPI_COMM_WORLD, &pid);
    if( pid != 0)
        sendbuf = (float*) malloc( sizeof(float) * size * pnum);
    d = pnum / 2;
    while(d > 0){
        if(pid % (d*2) == 0){
            MPI_Send(sendbuf + size * d,size * d, MPI_FLOAT,pid +
d,0,MPI_COMM_WORLD);
        }else if(pid % d == 0){
            MPI_Recv(sendbuf,size * d, MPI_FLOAT,pid -
d,0,MPI_COMM_WORLD, &stat);
        }
        d = d/2;
    }
    for(i = 0; i < size; i++)
        recvbuf[i] = sendbuf[i];
}
```