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Virtual Workshop

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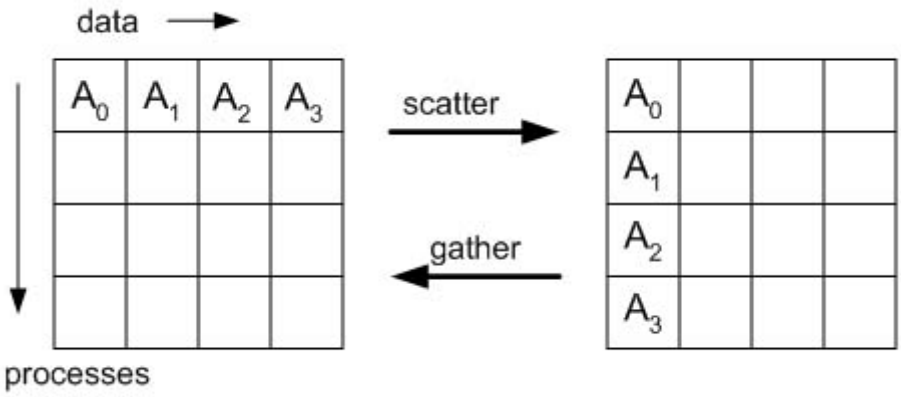
MPI Collective Communications: Gather/Scatter Effect

In order to illustrate the gather and scatter functions, we give a matrix-style depiction below:



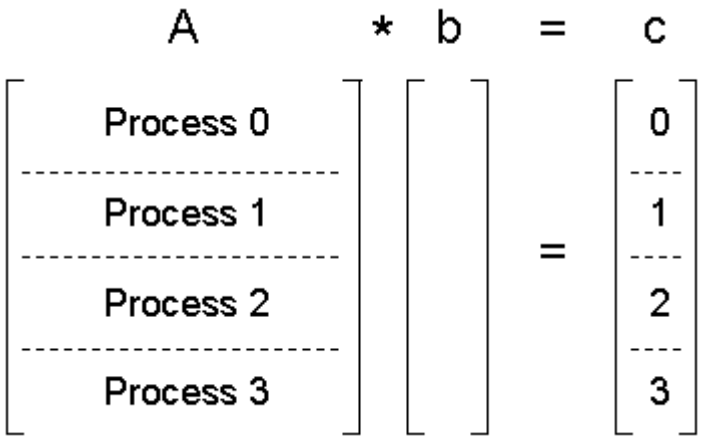
Let's consider in detail how MPI_Gather might be used to faciliate a distributed matrix computation.

Example: matrix-vector multiplication

- Matrix is distributed by rows (i.e. row-major order)
- Product vector is needed in entirety by one process
- MPI_Gather will be used to collect the product from processes

Description of Sample Code

The problem associated with the following sample code is the multiplication of a matrix A, size 100x100, by a vector b of length 100. The example uses four MPI processes, so each process will work on its own chunk of 25 rows of A. Since b is the same for each process, it will simply be replicated across processes. The vector c will therefore have 25 elements calculated by each process; these are stored in cpart. Here is a a picture of how the overall computation is distributed:



A: matrix distributed by rows
b: vector shared by all processes
c: vector updated by each process independently

The MPI_Gather routine will retrieve cpart from each process and store the result in ctotal, which is the complete vector c.

Sample Code in C

```
double a[25,100],b[100],cpart[25],ctotal[100];
int root;
root=0;
for(i=0;i<25;i++)
{
   cpart[i]=0;
   for(k=0;k<100;k++)
   {
      cpart[i]=cpart[i]+a[i,k]*b[k];
   }
}
MPI_Gather(cpart,25,MPI_REAL,ctotal,25,MPI_REAL,root,
     MPI_COMM_WORLD);
```

Sample Code in FORTRAN

```
! Fortran, unlike C, stores matrices in column-major order,
! so the A below is the transpose of the actual A matrix.
DIMENSION A(100,25), b(100), cpart(25), ctotal(100)
INTEGER root
DATA root/0/
DO I=1,25
     cpart(I) = 0.
     DO K=1,100
```

```
          cpart(I) = cpart(I) + A(K,I)*b(K)
      END DO
END DO
CALL MPI_GATHER(cpart, 25, MPI_REAL, ctotal, 25, MPI_REAL, &
      root, MPI_COMM_WORLD, ierr)
```

<= previous next =>

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