MPI\_Gather(

void\* send\_data,

int send\_count,

MPI\_Datatype send\_datatype,

void\* recv\_data,

int recv\_count,

MPI\_Datatype recv\_datatype,

int root,

MPI\_Comm communicator)

MPI\_Scatter(

void\* send\_data,

int send\_count,

MPI\_Datatype send\_datatype,

void\* recv\_data,

int recv\_count,

MPI\_Datatype recv\_datatype,

int root,

MPI\_Comm communicator)

MPI\_Allgather(

void\* send\_data,

int send\_count,

MPI\_Datatype send\_datatype,

void\* recv\_data,

int recv\_count,

MPI\_Datatype recv\_datatype,

MPI\_Comm communicator)

## **Computing average of numbers with MPI\_Scatter and MPI\_Gather**

1. Generate a random array of numbers on the root process (process 0).
2. Scatter the numbers to all processes, giving each process an equal amount of numbers.
3. Each process computes the average of their subset of the numbers.
4. Gather all averages to the root process. The root process then computes the average of these numbers to get the final average.

The main part of the code with the MPI calls looks like this:

if (world\_rank == 0) {

rand\_nums = create\_rand\_nums(elements\_per\_proc \* world\_size);}

// Create a buffer that will hold a subset of the random numbersfloat \*sub\_rand\_nums = malloc(sizeof(float) \* elements\_per\_proc);

// Scatter the random numbers to all processesMPI\_Scatter(rand\_nums, elements\_per\_proc, MPI\_FLOAT, sub\_rand\_nums,

elements\_per\_proc, MPI\_FLOAT, 0, MPI\_COMM\_WORLD);

// Compute the average of your subsetfloat sub\_avg = compute\_avg(sub\_rand\_nums, elements\_per\_proc);// Gather all partial averages down to the root processfloat \*sub\_avgs = NULL;if (world\_rank == 0) {

sub\_avgs = malloc(sizeof(float) \* world\_size);}MPI\_Gather(&sub\_avg, 1, MPI\_FLOAT, sub\_avgs, 1, MPI\_FLOAT, 0,

MPI\_COMM\_WORLD);

// Compute the total average of all numbers.if (world\_rank == 0) {

float avg = compute\_avg(sub\_avgs, world\_size);}

I have modified the average computation code to use MPI\_Allgather. You can view the source in [all\_avg.c](https://github.com/mpitutorial/mpitutorial/tree/gh-pages/tutorials/mpi-scatter-gather-and-allgather/code/all_avg.c) from the [code for this lesson](https://github.com/mpitutorial/mpitutorial/tree/gh-pages/tutorials/mpi-scatter-gather-and-allgather/code). The main difference in the code is shown below.

// Gather all partial averages down to all the processesfloat \*sub\_avgs = (float \*)malloc(sizeof(float) \* world\_size);MPI\_Allgather(&sub\_avg, 1, MPI\_FLOAT, sub\_avgs, 1, MPI\_FLOAT,

MPI\_COMM\_WORLD);

// Compute the total average of all numbers.float avg = compute\_avg(sub\_avgs, world\_size);

MPI\_Bcast(

void\* data,

int count,

MPI\_Datatype datatype,

int root,

MPI\_Comm communicator)

MPI\_Send(

void\* data,

int count,

MPI\_Datatype datatype,

int destination,

int tag,

MPI\_Comm communicator)

MPI\_Recv(

void\* data,

int count,

MPI\_Datatype datatype,

int source,

int tag,

MPI\_Comm communicator,

MPI\_Status\* status)