Project 3

• Using Message Passing Interface (MPI) to apply the K-Means algorithm

• Due date: November 14th
  • You should be starting with the analysis phase now! 😊
Agenda

• Today, we’ll be re-implementing the **Parallel Sum** program from last week

• We’ll use **collective routines** to do so
Collective Communication

- Collective communication allows you to exchange data among a group of processes.
- It must involve all processes in the scope of a communicator.
- The communicator argument in a collective communication routine should specify which processes are involved in the communication.
- Hence, it is the programmer's responsibility to ensure that all processes within a communicator participate in any collective operation.
Patterns of Collective Communication

• There are several patterns of collective communication:

1. Broadcast
2. Scatter
3. Gather
4. Allgather
5. Alltoall
6. Reduce
7. Allreduce
8. Scan
9. Reducescatter
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Scatter and Gather

- **Scatter** distributes distinct messages from a single source task to each task in the group.
- **Gather** gathers distinct messages from each task in the group to a single destination task.

```c
int MPI_Scatter ( void *sendbuf, int sendcnt, MPI_Datatype sendtype, void *recvbuf, int recvcnt,
                  MPI_Datatype recvtype, int root, MPI_Comm comm )
```

```c
int MPI_Gather ( void *sendbuf, int sendcnt, MPI_Datatype sendtype, void *recvbuf, int recvcount,
                 MPI_Datatype recvtype, int root, MPI_Comm comm )
```
Reduce and All Reduce

- **Reduce** applies a reduction operation on all tasks in the group and places the result in one task.

- **Allreduce** applies a reduction operation and places the result in all tasks in the group. This is equivalent to an MPI_Reduce followed by an MPI_Bcast.

```
int MPI_Reduce ( void *sendbuf, void *recvbuf, int count, MPI_Datatype datatype, MPI_Op op, int root, MPI_Comm comm )
```

```
int MPI_Allreduce ( void *sendbuf, void *recvbuf, int count, MPI_Datatype datatype, MPI_Op op, MPI_Comm comm )
```