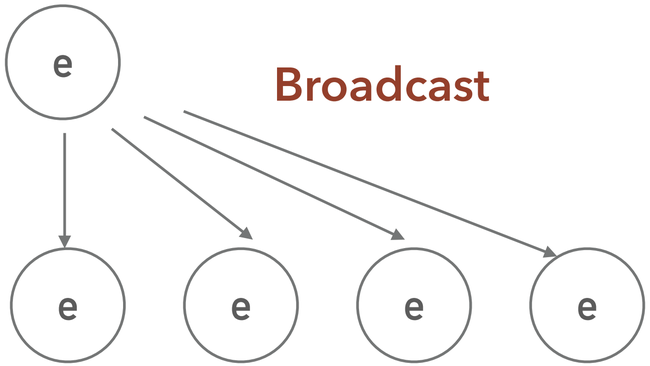
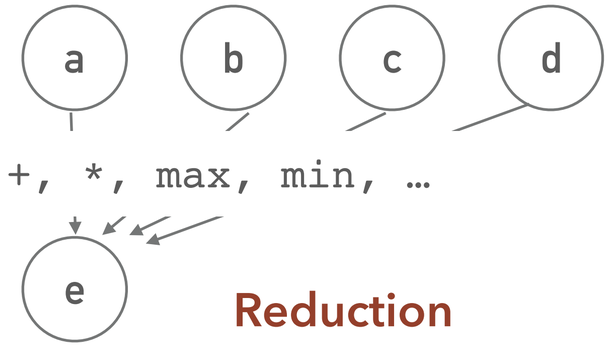
ME 471/571

Point-to-point communication

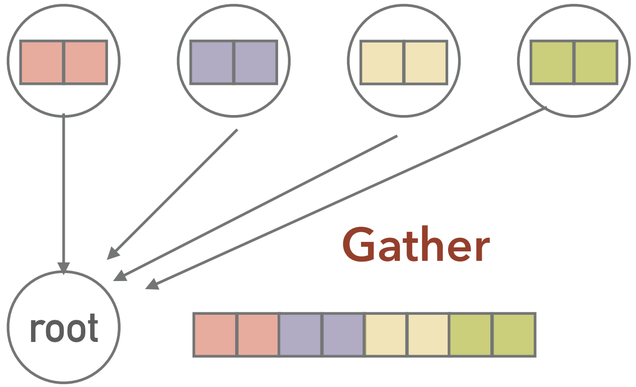
COLLECTIVE COMMUNICATION PATTERNS



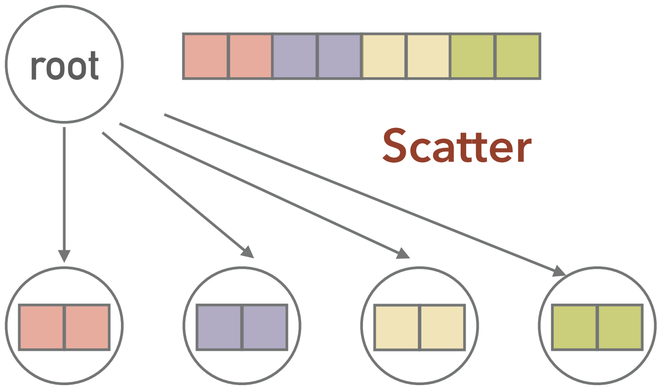
Broadcast



Reduction

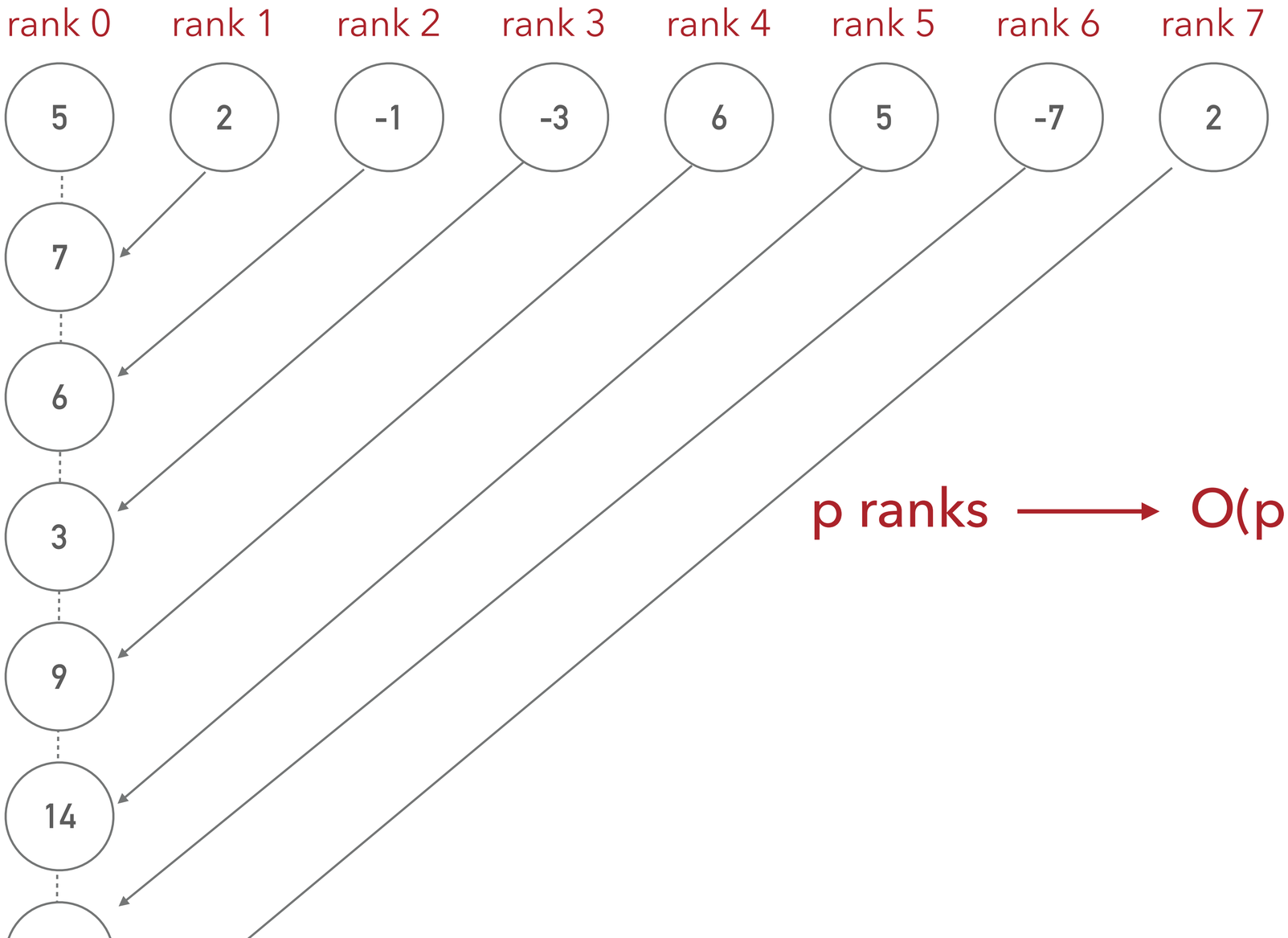


Gather

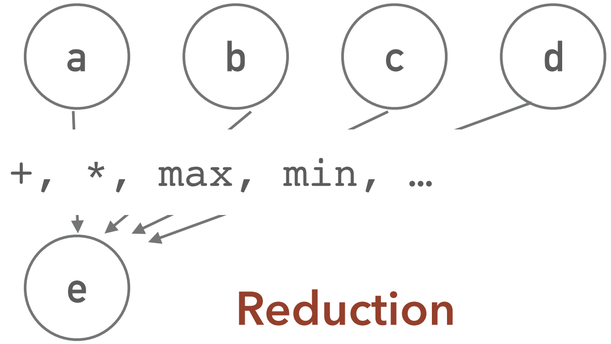


Scatter

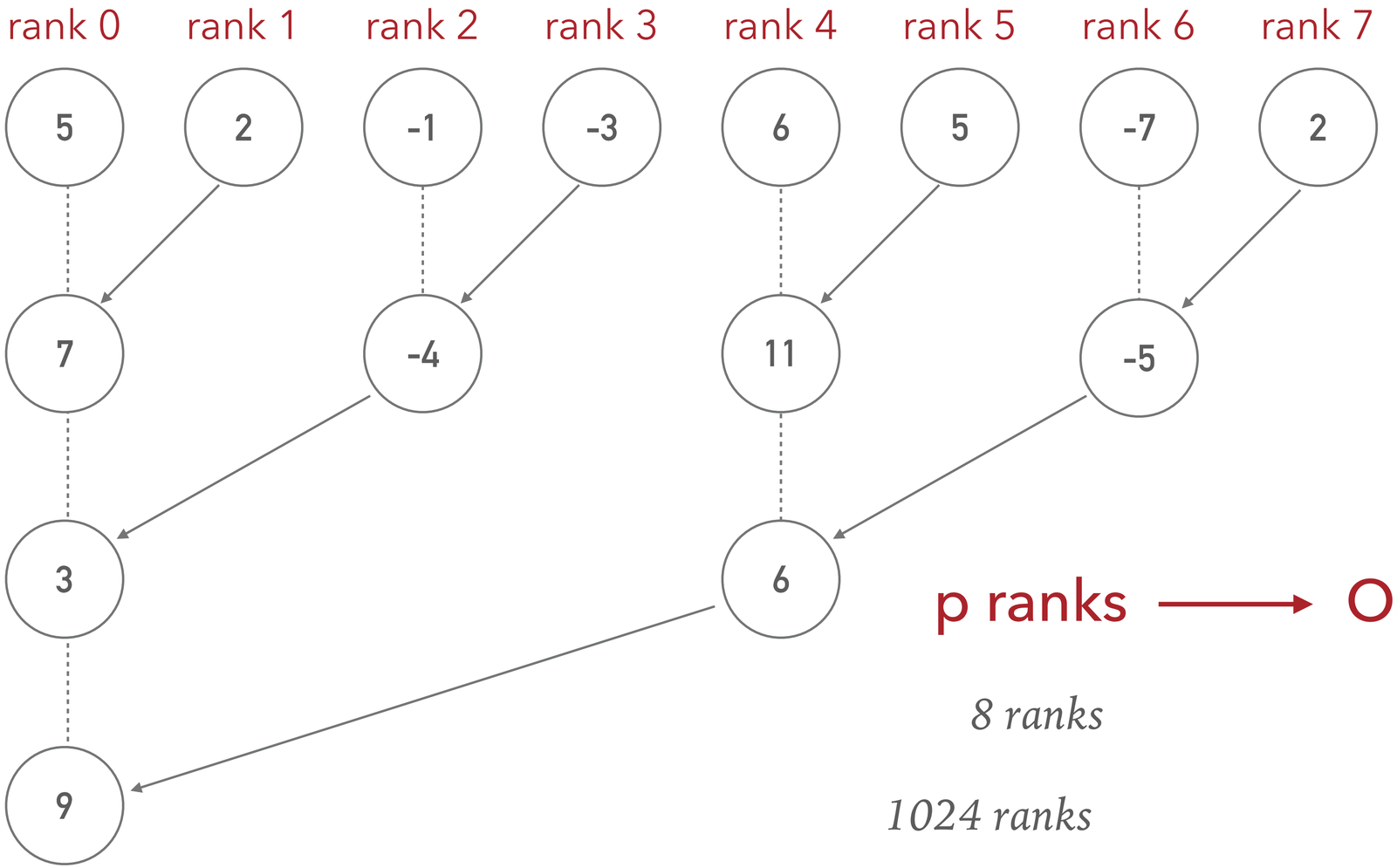
SUM REDUCTION



p ranks ⟶ O(p) messages



PARALLEL ADDITION IMPROVED



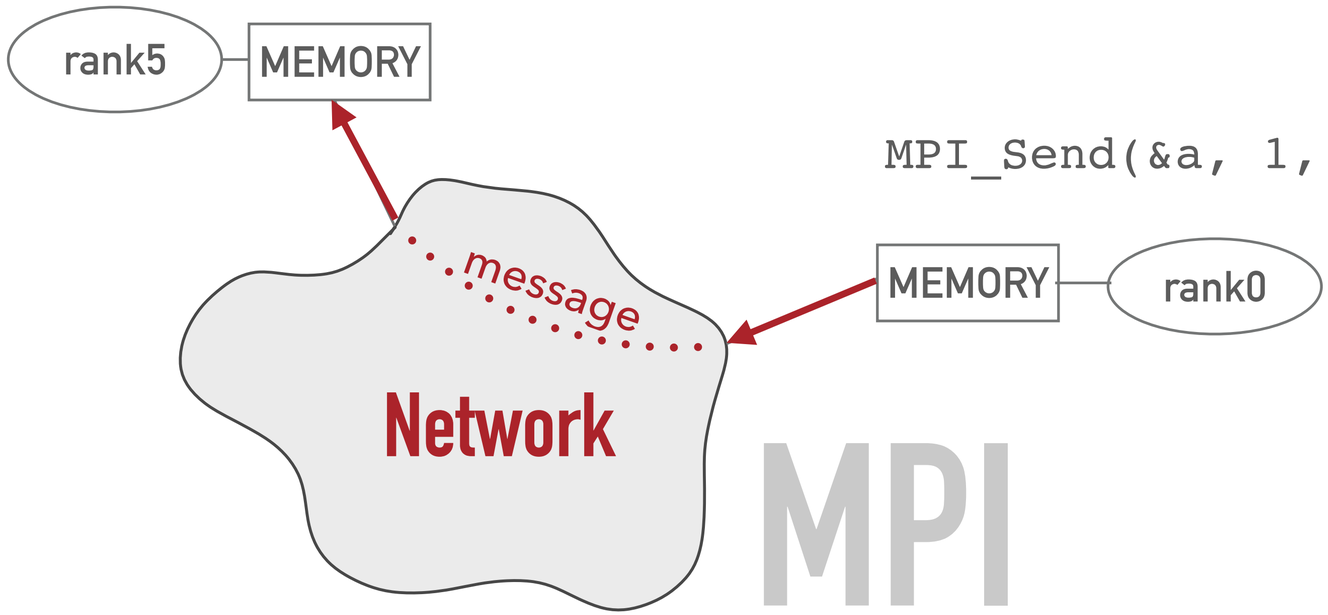
p ranks ⟶ O($\log_2(p)$) messages

8 ranks	*3 messages*
1024 ranks	*10 messages*
1,048,576 ranks	*20 messages*

MPI_SEND - SEND A MESSAGE

which data? *how much data?* *what kind of data?* *where?*

```
MPI_Send(void* data, int count, MPI_Datatype datatype, int destination,…
         int tag, MPI_Comm communicator)
```



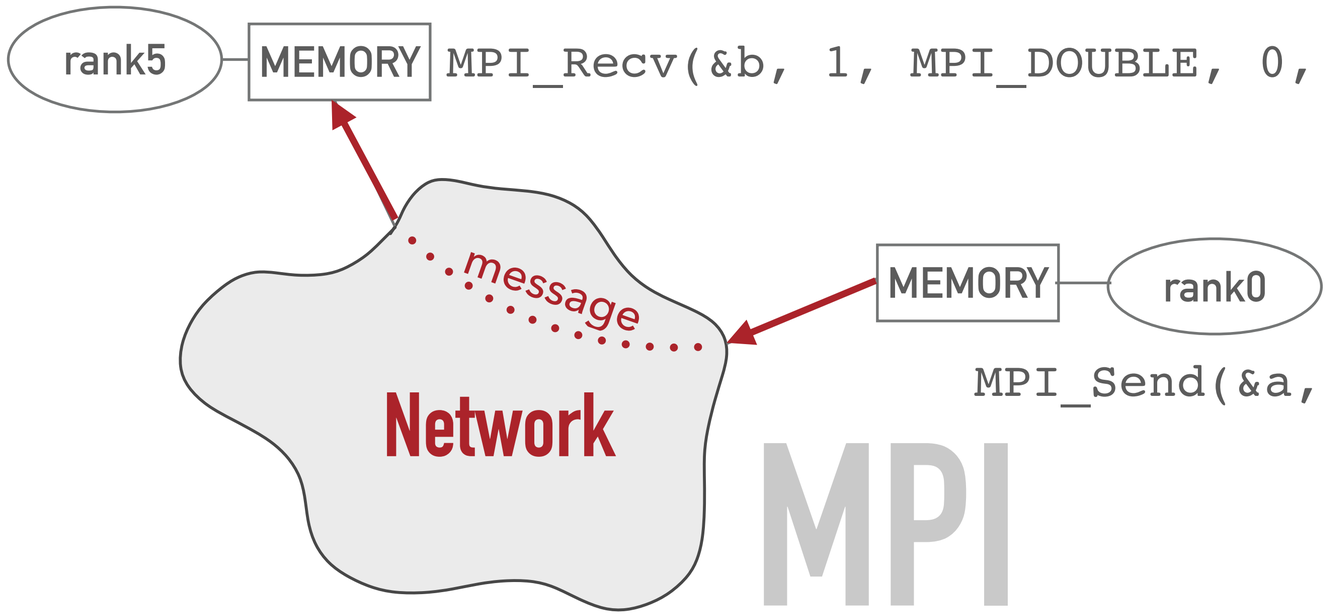

```
MPI_Send(&a, 1, MPI_DOUBLE, 5, 101, MPI_COMM_WORLD);
```

MPI

MPI_RECV - RECEIVE A MESSAGE

where to put it? *how much data?* *what kind of data?* *where from?*

```
MPI_Recv(void* data, int count, MPI_Datatype datatype, int source,…
         int tag, MPI_Comm communicator, MPI_Status status)
```

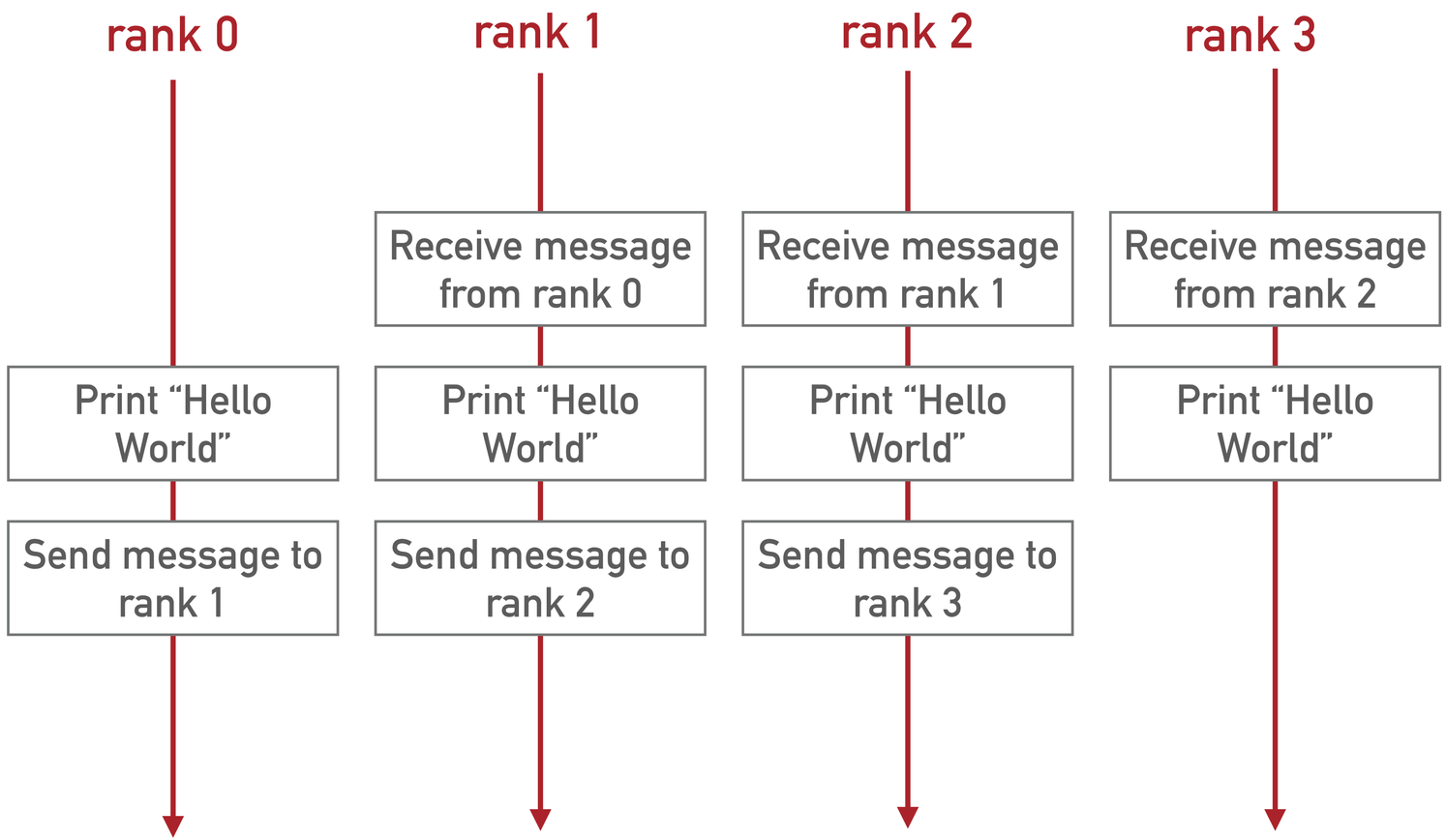



```
MPI_Recv(&b, 1, MPI_DOUBLE, 0, 101, MPI_COMM_WORLD, MPI_STATUS_IGNORE);
```

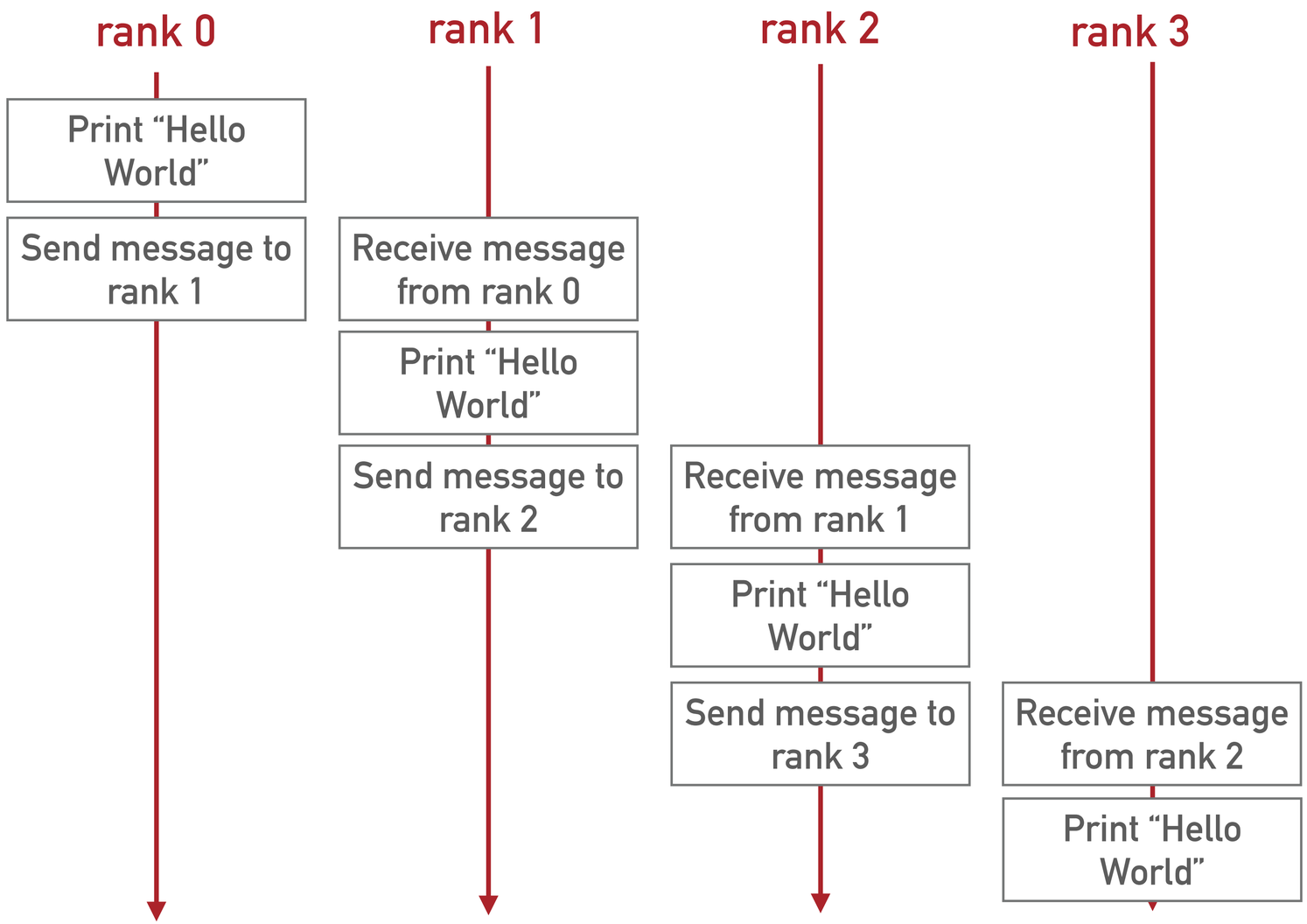
```
MPI_Send(&a, 1, MPI_DOUBLE, 5, 101, MPI_COMM_WORLD);
```

MPI

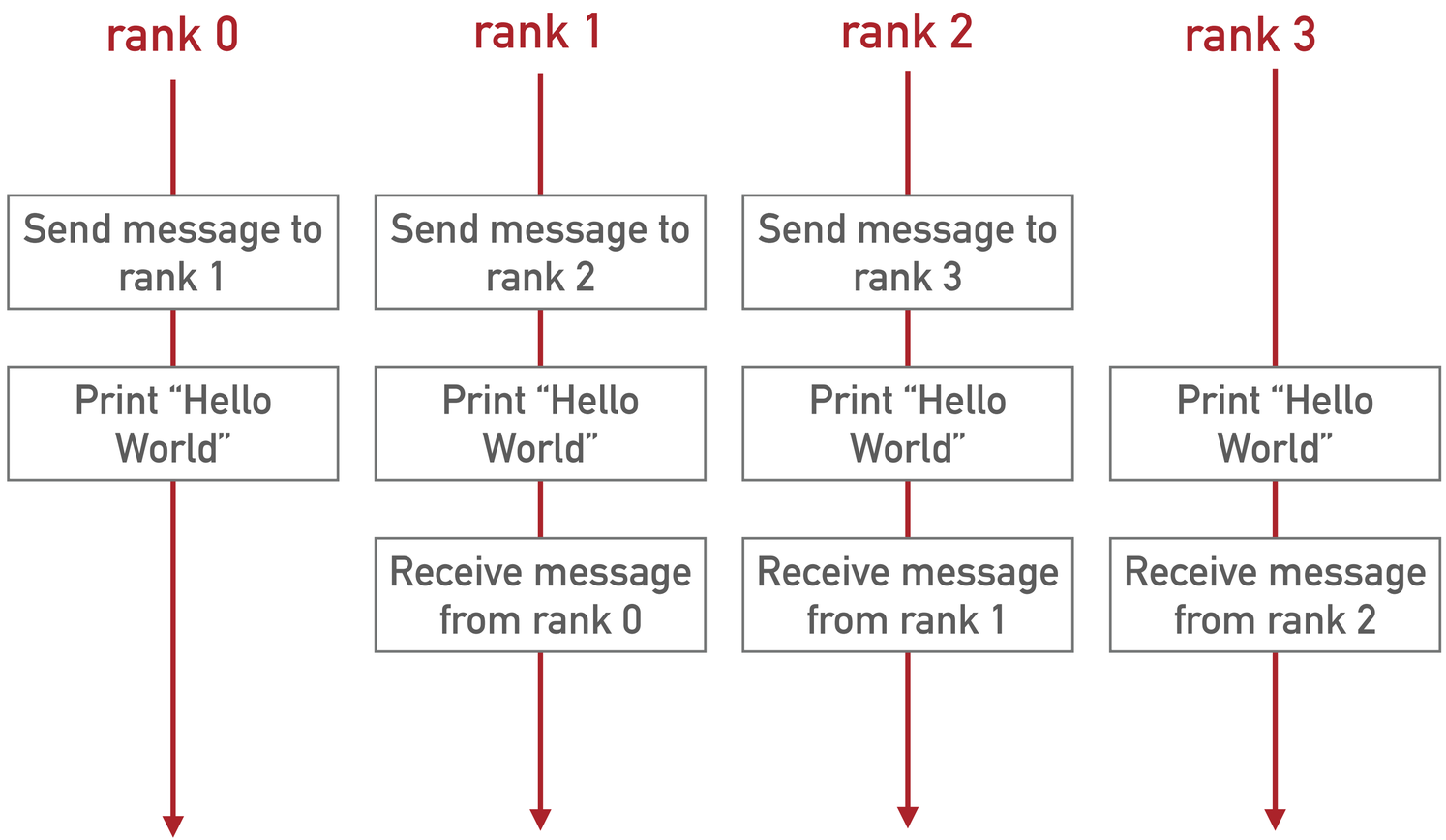
POINT-TO-POINT HELLO WORLD



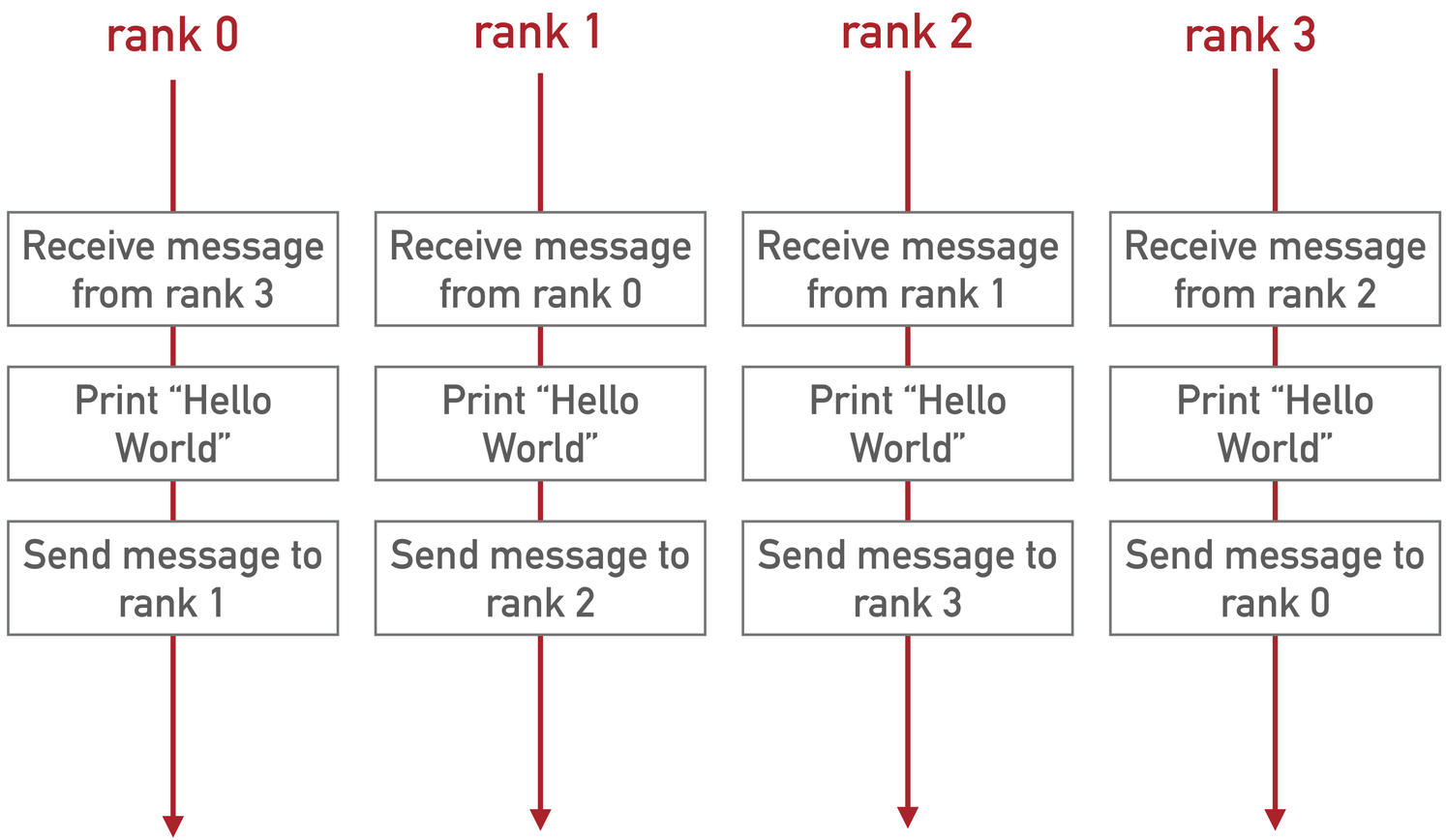
POINT-TO-POINT HELLO WORLD



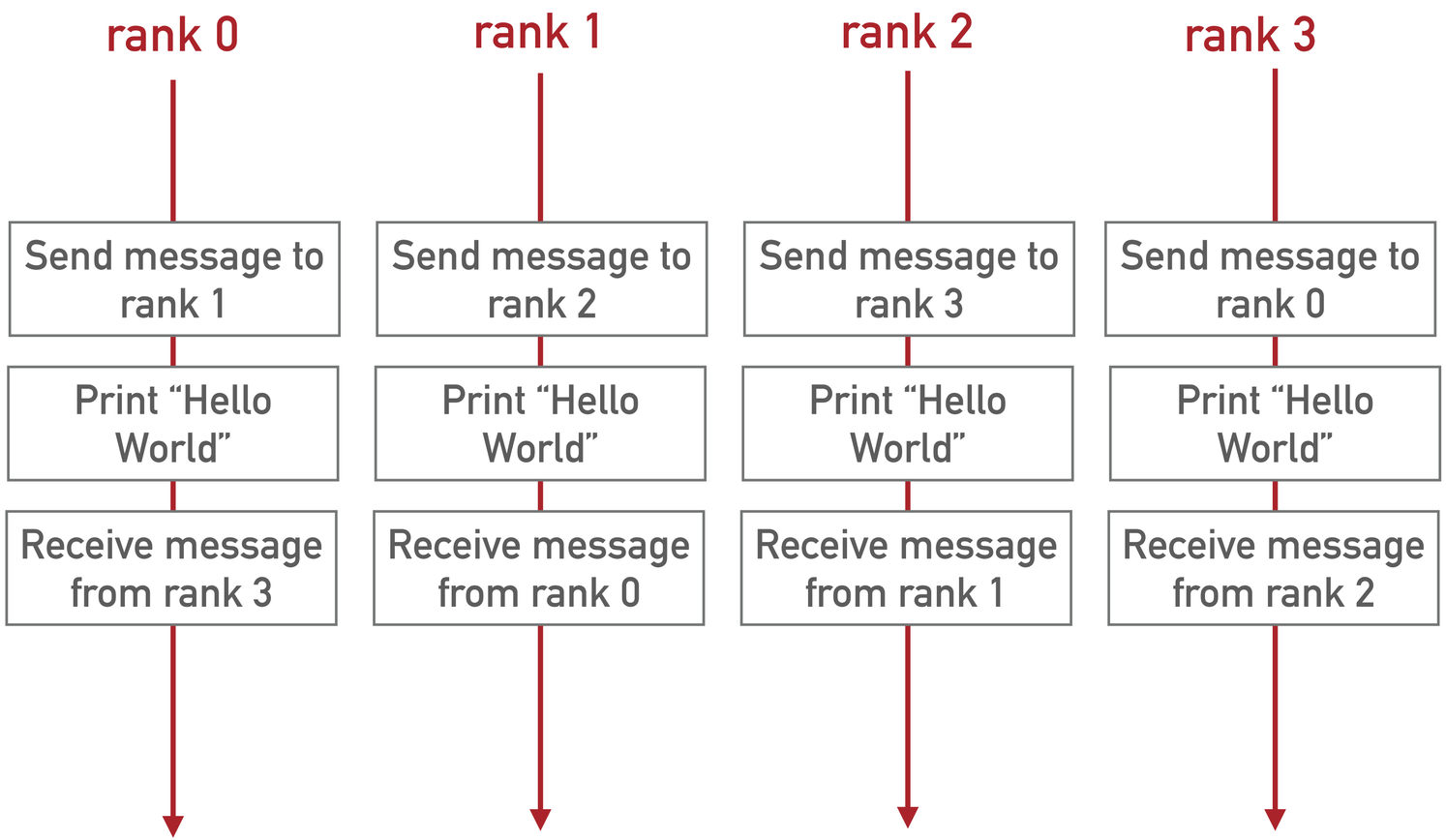
POINT-TO-POINT HELLO WORLD



POINT-TO-POINT HELLO WORLD



POINT-TO-POINT HELLO WORLD

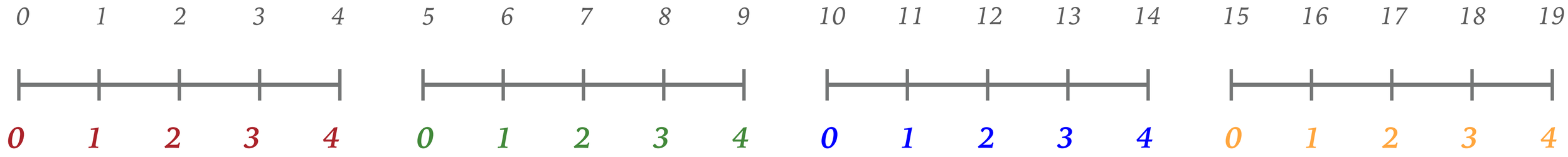


TOWARD SOLVING PDE'S

Consider the finite difference scheme we discussed at the beginning of the course:

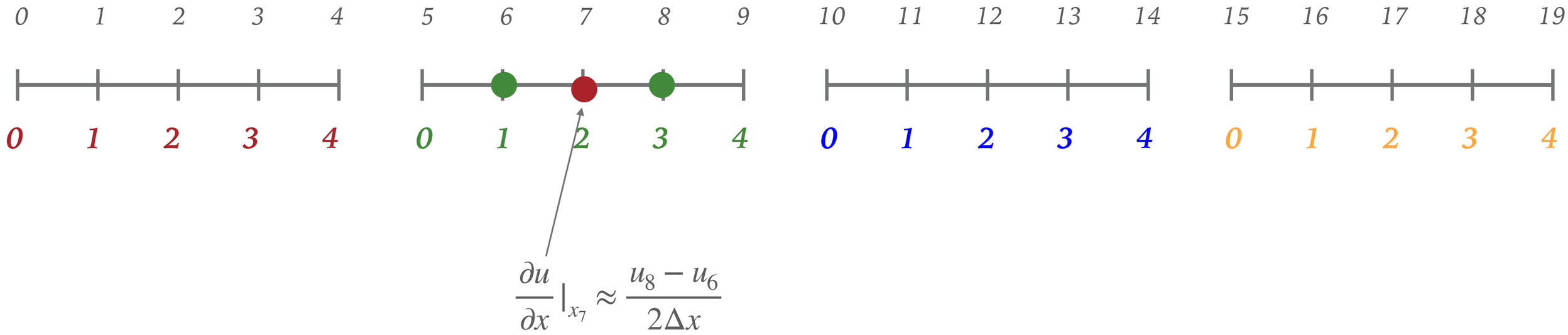
$$\frac{\partial u}{\partial x} \approx \frac{u_{i+1} - u_{i-1}}{2\Delta x}$$

Let's say we have data u which is distributed across processes:



TOWARD SOLVING PDE'S

$$\frac{\partial u}{\partial x} \approx \frac{u_{i+1} - u_{i-1}}{2\Delta x}$$



TOWARD SOLVING PDE'S

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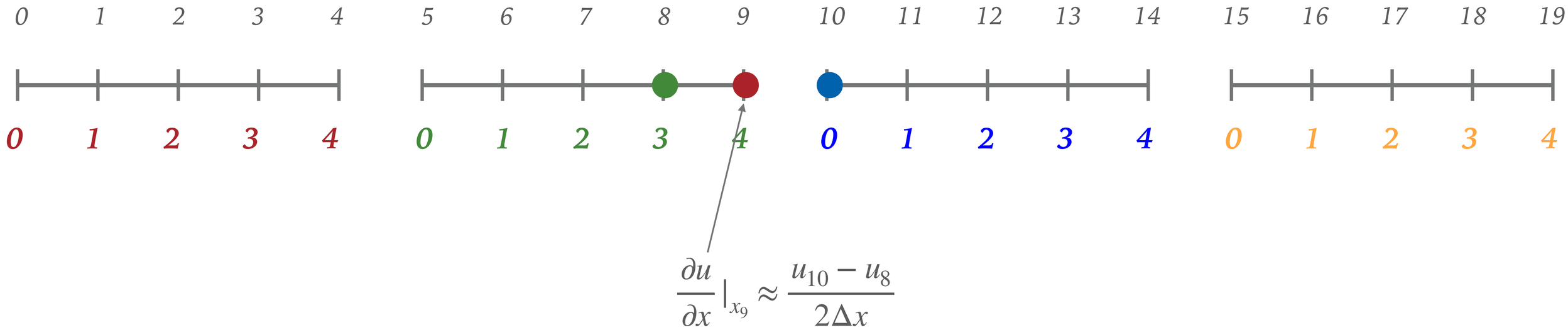
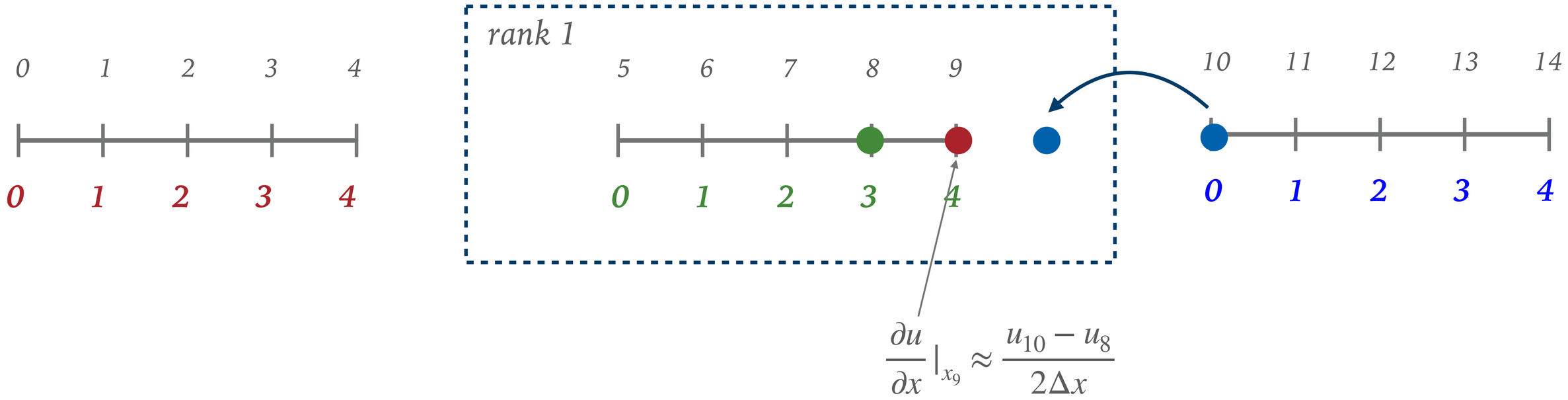


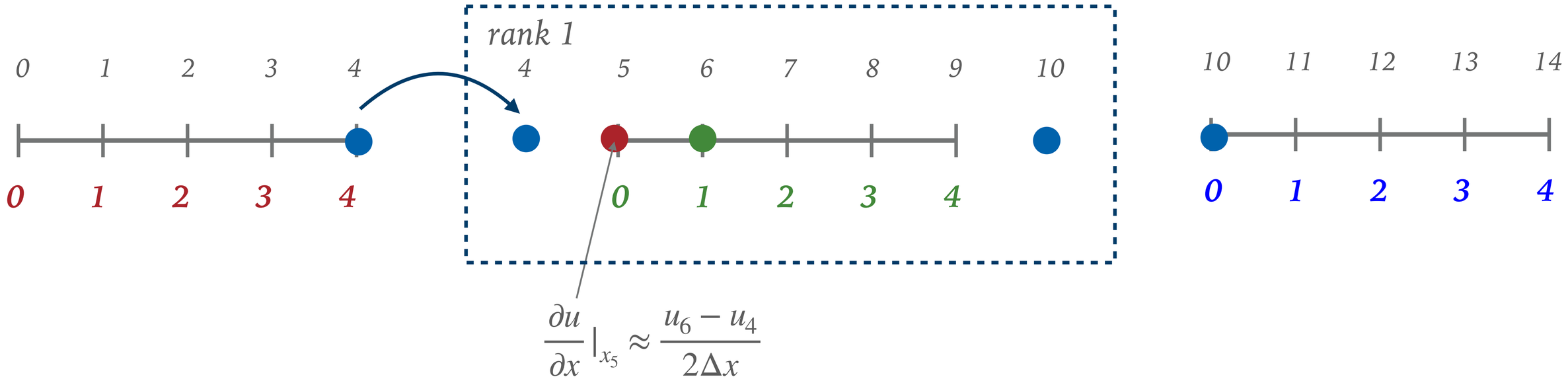
TOWARD SOLVING PDE'S

$$\frac{\partial u}{\partial x} \approx \frac{u_{i+1} - u_{i-1}}{2\Delta x}$$

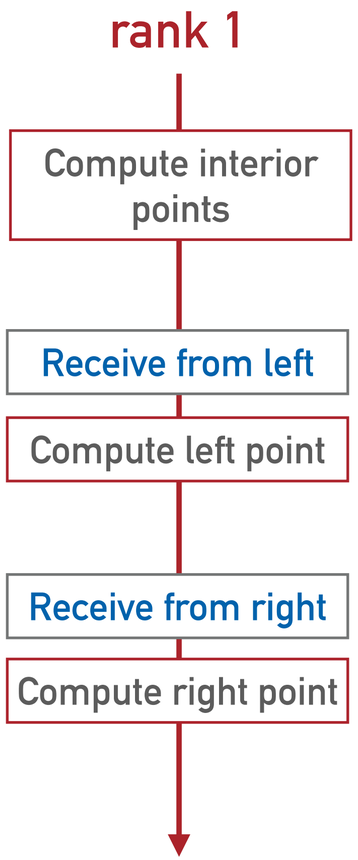


TOWARD SOLVING PDE'S

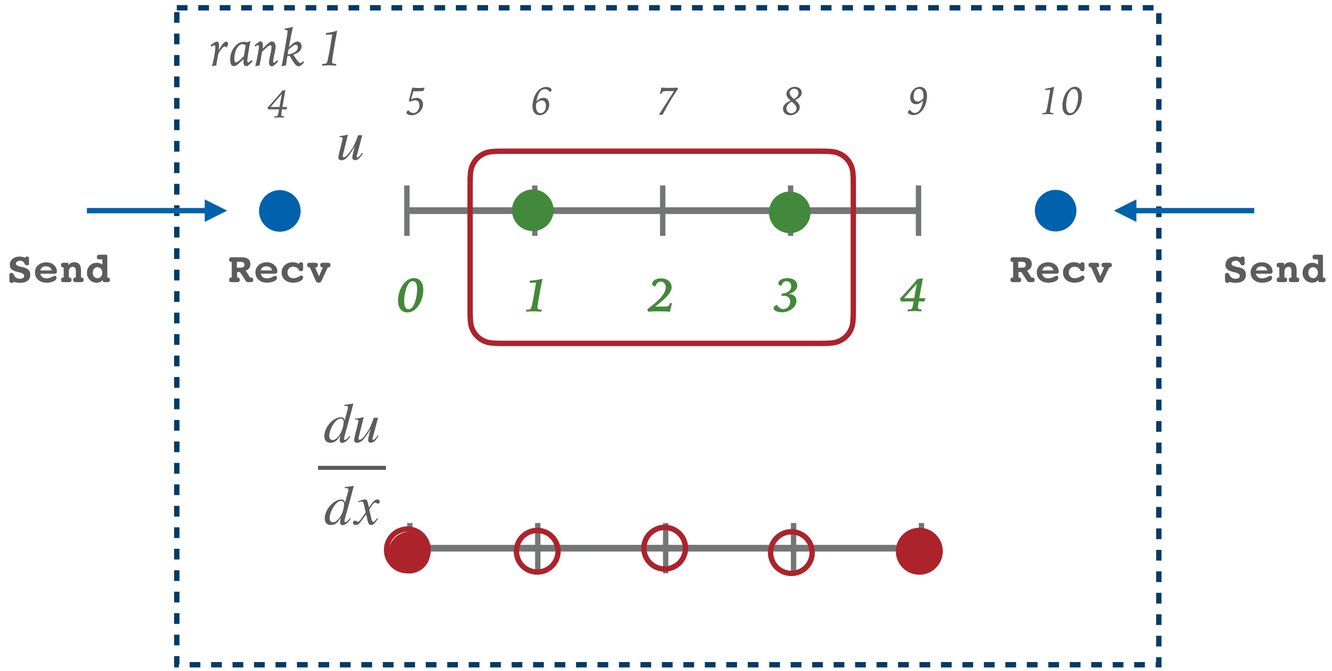
$$\frac{\partial u}{\partial x} \approx \frac{u_{i+1} - u_{i-1}}{2\Delta x}$$



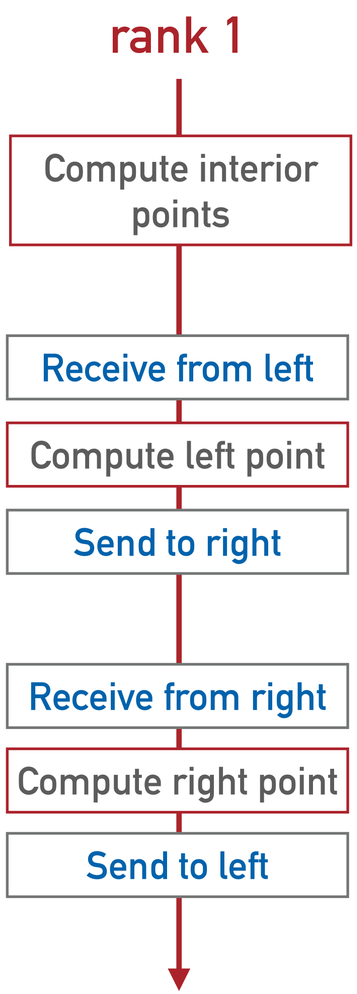
TOWARD SOLVING PDE'S



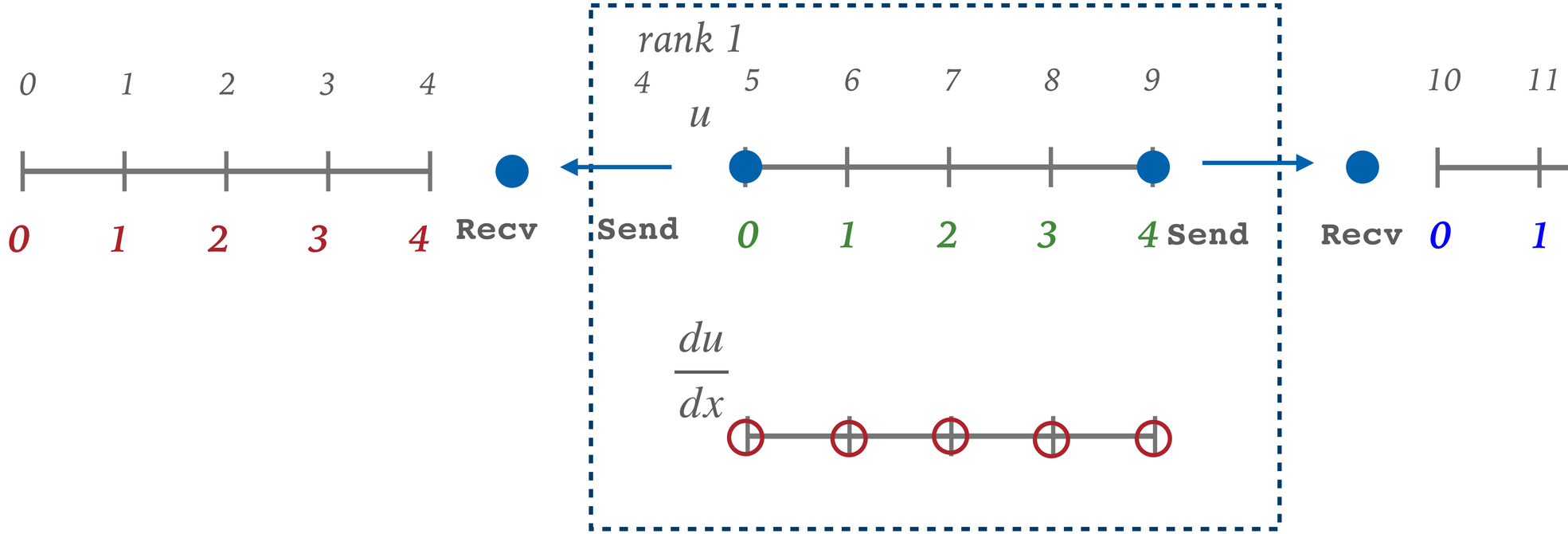
$$\frac{\partial u}{\partial x} \approx \frac{u_{i+1} - u_{i-1}}{2\Delta x}$$



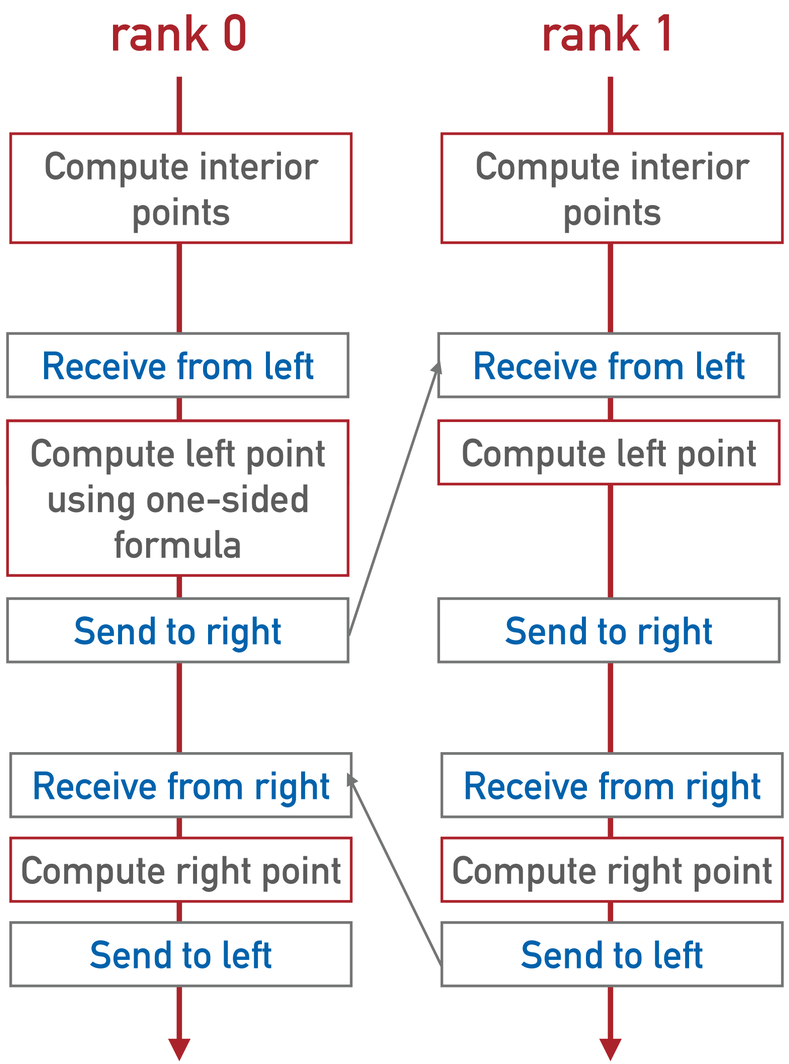
TOWARD SOLVING PDE'S



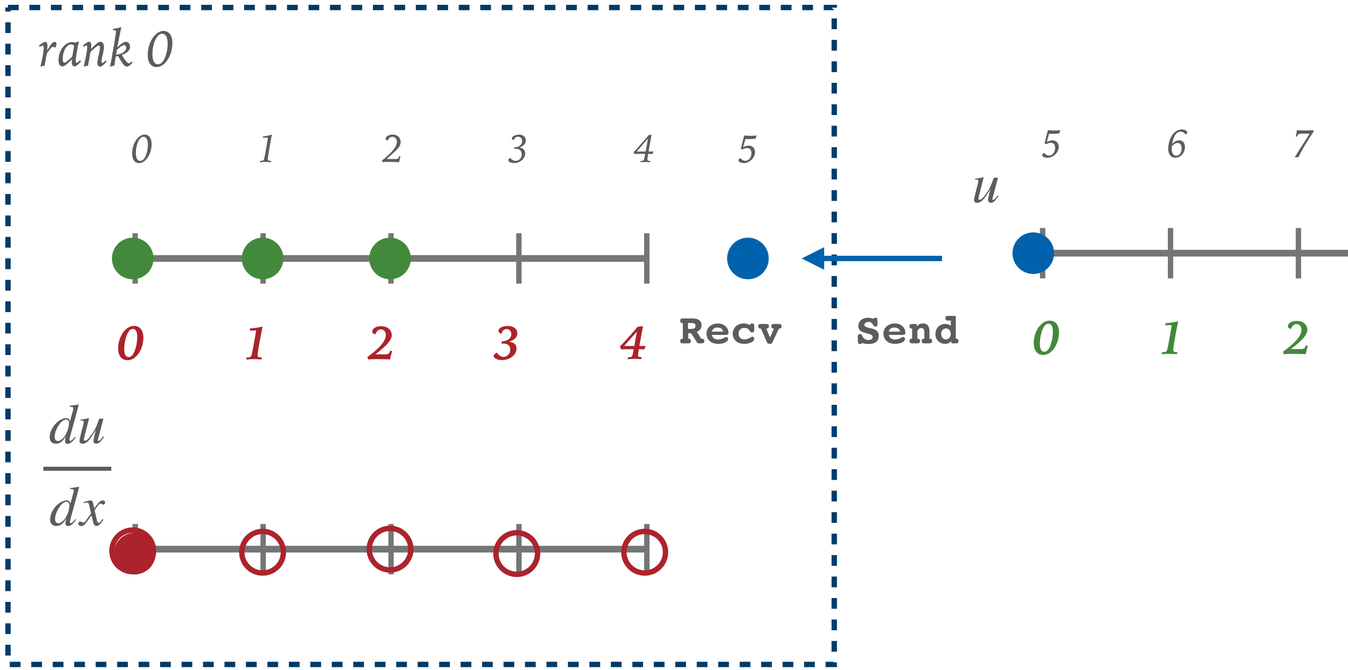
$$\frac{\partial u}{\partial x} \approx \frac{u_{i+1} - u_{i-1}}{2\Delta x}$$



TOWARD SOLVING PDE'S

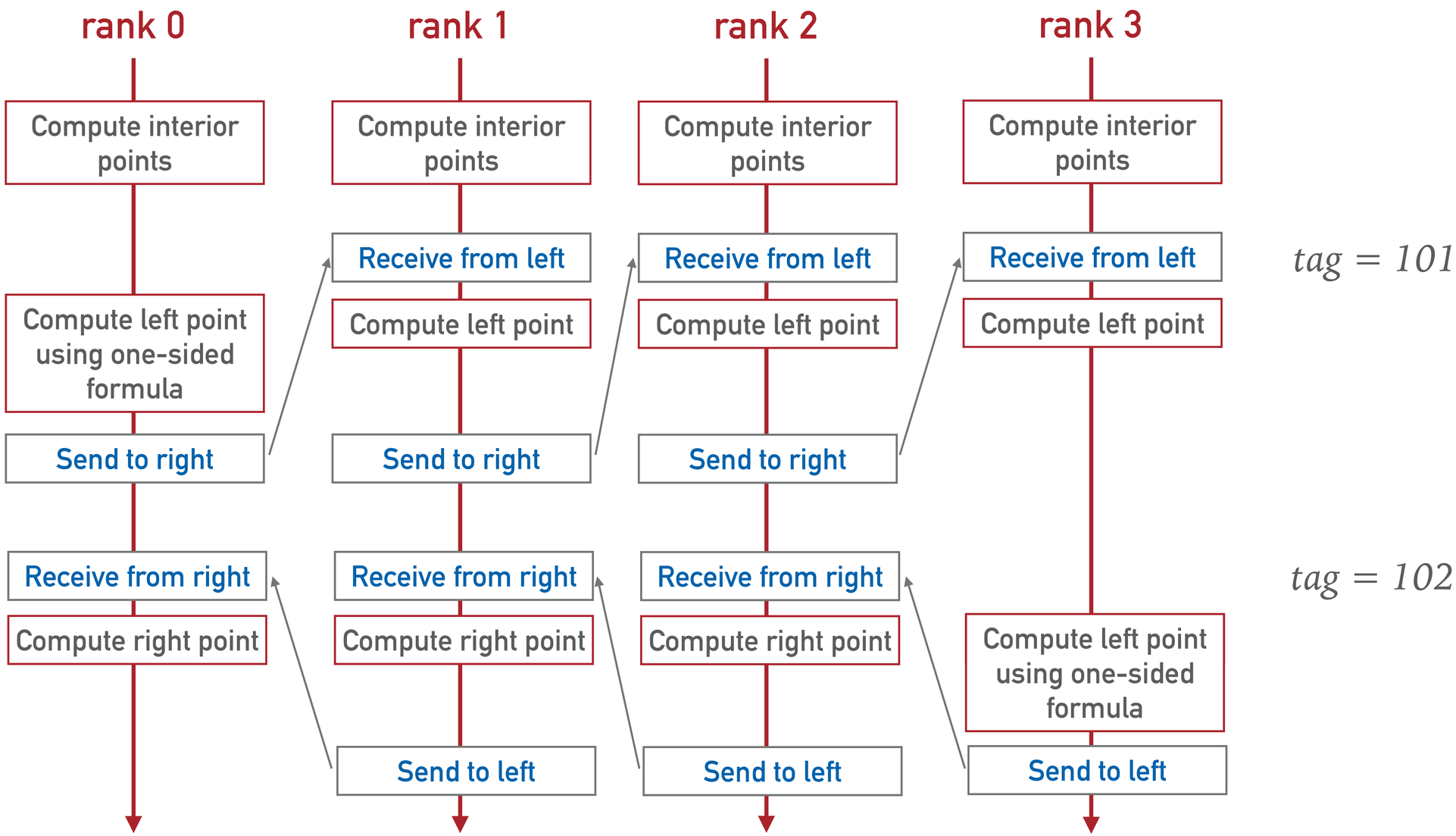


$$\frac{\partial u}{\partial x} \approx \frac{u_{i+1} - u_{i-1}}{2\Delta x}$$



$$\frac{\partial u}{\partial x}\Big|_{x_0} \approx \frac{-3u_0 + 4u_1 - u_2}{2\Delta x}$$

TOWARD SOLVING PDE'S



TOWARD SOLVING PDE'S