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jashan-jain@JashanLinux:~/Desktop/openmpi$ touch A1Q1.c
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A1Q1.c -o A1Q1
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A1Q1
Process 0 sending 42 to process 1
Process 1 received 42 from process 0
jashan-jain@JashanLinux:~/Desktop/openmpi$
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```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A1Q2.c -o A1Q2
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A1Q2
Process 0 sent two messages of different sizes.
Process 1 received 3 elements: 10 20 30
Process 1 received 5 elements: 100 200 300 400 500
jashan-jain@JashanLinux:~/Desktop/openmpi$
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```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A1Q3.c -o A1Q3
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A1Q3
Master starts walker at process 0
Walker at process 0, step 0
Walker at process 0, step 3
Walker at process 1, step 2
Walker at process 2, step 1
Walker at process 3, step 4
Walker at process 0, step 8
Walker at process 1, step 5
Walker at process 2, step 7
Walker at process 2, step 10
Walker stops at process 2 after 10 steps.
Walker at process 3, step 6
Walker at process 3, step 9
```

```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A2Q1.c -o A2Q1
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A2Q1
Estimated Pi value: 3.140606
jashan-jain@JashanLinux:~/Desktop/openmpi$
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```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc -fopenmp A2Q2.c -o A2Q2
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A2Q2
Serial Execution Time: 0.002005 seconds
Parallel Execution Time: 0.001582 seconds
jashan-jain@JashanLinux:~/Desktop/openmpi$
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```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A2Q3.c -o A2Q3
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A2Q3
Unsorted array:
66 19 67 66 81 85 12 25 11 65 33 10 10 20 45 44
Sorted array:
10 10 11 12 19 20 25 33 44 45 65 66 66 67 81 85
Execution Time: 0.000131 seconds
jashan-jain@JashanLinux:~/Desktop/openmpi$
```

```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A2Q4.c -o A2Q4
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A2Q4
Final Heat Distribution:
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
100.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 100.00
100.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 100.00
100.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 100.00
100.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 100.00
100.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 100.00
100.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 100.00
100.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 100.00
100.00 100.00 100.00 100.00 100.00 100.00 100.00 100.00 100.00 100.00
Execution Time: 0.003834 seconds
jashan-jain@JashanLinux:~/Desktop/openmpi$
```

```
Execution Time: 0.003834 seconds
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A2Q5.c -o A2Q5
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A2Q5
Sum of all ranks = 10
jashan-jain@JashanLinux:~/Desktop/openmpi$
```

```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A2Q6.c -o A2Q6
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A2Q6
Dot Product = 100.000000
jashan-jain@JashanLinux:~/Desktop/openmpi$
```

```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A2Q7.c -o A2Q7
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A2Q7
Rank 0: Prefix sum = 1
Rank 1: Prefix sum = 3
Rank 2: Prefix sum = 6
Rank 3: Prefix sum = 10
jashan-jain@JashanLinux:~/Desktop/openmpi$
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```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A2Q8.c -o A2Q8
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A2Q8
Original Matrix:
  0   1   2   3   4   5
  6   7   8   9  10  11
 12  13  14  15  16  17
 18  19  20  21  22  23
 24  25  26  27  28  29
 30  31  32  33  34  35

Transposed Matrix:
  0 16777216 32768   0   0   0
  6 16777216 32768   0   0   0
 12 16777216 32768   0   0   0
 18 16777216 32768   0   0   0
 32   0   25   0  16   0
 64   0   8   0 12582912   0
jashan-jain@JashanLinux:~/Desktop/openmpi$
```



```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A3Q1.c -o A3Q1
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A3Q1
DAXPY completed in 0.000058 seconds
jashan-jain@JashanLinux:~/Desktop/openmpi$
```

```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A3Q2.c -o A3Q2
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A3Q2
Calculated  $n \approx 3.141592653589875$ 
Execution Time: 0.002729 seconds
jashan-jain@JashanLinux:~/Desktop/openmpi$
```

```
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpicc A3Q3.c -o A3Q3
jashan-jain@JashanLinux:~/Desktop/openmpi$ mpirun -np 4 ./A3Q3
2 is prime
3 is prime
5 is prime
7 is prime
11 is prime
13 is prime
17 is prime
19 is prime
23 is prime
29 is prime
31 is prime
37 is prime
41 is prime
43 is prime
47 is prime
53 is prime
59 is prime
61 is prime
67 is prime
71 is prime
73 is prime
79 is prime
83 is prime
89 is prime
97 is prime
```