

C hello.c

```
1  #include <mpi.h>
2  #include <stdio.h>
3
4  int main(int argc, char *argv[])
5  {
6      int rank, size;
7
8
9      MPI_Init(&argc, &argv);
10
11     |
12     MPI_Comm_size(MPI_COMM_WORLD, &size);
13
14
15     MPI_Comm_rank(MPI_COMM_WORLD, &rank);
16
17
18     printf("Hello World from process %d out of %d processes\n", rank, size);
19
20     if(rank == 0) printf("Q0, Adarsh Ranjan 230962278");
21
22
23     MPI_Finalize();
24
25     return 0;
26 }
27
```

```
(base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$ mpicc hello.c -o hello
(base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$ mpirun -np 4 ./hello
hwloc/linux: Ignoring PCI device with non-16bit domain.
Pass --enable-32bits-pci-domain to configure to support such devices
(warning: it would break the library ABI, don't enable unless really needed).
Hello World from process 0 out of 4 processes
Hello World from process 1 out of 4 processes
Hello World from process 2 out of 4 processes
Hello World from process 3 out of 4 processes
Q0, Adarsh Ranjan 230962278(base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$
```

C q1.c

```
1  #include <mpi.h>
2  #include <stdio.h>
3
4  long power(int base, int exp) {
5      long res = 1;
6      for (int i = 0; i < exp; i++) {
7          res *= base;
8      }
9      return res;
10 }
11
12 int main(int argc, char *argv[])
13 {
14     int rank, size;
15     int x = 2;
16
17     MPI_Init(&argc, &argv);
18
19     MPI_Comm_rank(MPI_COMM_WORLD, &rank);
20     MPI_Comm_size(MPI_COMM_WORLD, &size);
21
22     long result = power(x, rank);
23
24     printf("Process %d: %d^%d = %ld\n", rank, x, rank, result);
25
26     if (rank % 2 == 0)
27         printf("Process %d says: Hello\n", rank);
28     else
29         printf("Process %d says: World\n", rank);
30
31
32     if(rank == 0) {
33         printf("Q1, Adarsh Ranjan 230962278\n");
34     }
35
36     MPI_Finalize();
37
38     return 0;
39 }
```

```
(base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$ mpirun -np 4 ./q1
hwloc/linux: Ignoring PCI device with non-16bit domain.
Pass --enable-32bits-pci-domain to configure to support such devices
(warning: it would break the library ABI, don't enable unless really needed).
Process 0:  $2^0 = 1$ 
Process 0 says: Hello
Q1, Adarsh Ranjan 230962278
Process 3:  $2^3 = 8$ 
Process 3 says: World
Process 1:  $2^1 = 2$ 
Process 1 says: World
Process 2:  $2^2 = 4$ 
Process 2 says: Hello
```

C q2.c

```
1  #include <mpi.h>
2  #include <stdio.h>
3
4  int main(int argc, char *argv[])
5  {
6      int rank, size;
7      int a = 20, b = 10;
8
9      MPI_Init(&argc, &argv);
10
11     MPI_Comm_rank(MPI_COMM_WORLD, &rank);
12     MPI_Comm_size(MPI_COMM_WORLD, &size);
13
14     if (size < 4)
15     {
16         if (rank == 0)
17             printf("Please run with at least 4 processes\n");
18         MPI_Finalize();
19         return 0;
20     }
21
22     if (rank == 0)
23         printf("Addition: %d + %d = %d\n", a, b, a + b);
24     else if (rank == 1)
25         printf("Subtraction: %d - %d = %d\n", a, b, a - b);
26     else if (rank == 2)
27         printf("Multiplication: %d * %d = %d\n", a, b, a * b);
28     else if (rank == 3)
29         printf("Division: %d / %d = %d\n", a, b, a / b);
30
31     if(rank == 0) printf("Q2,Adarsh Ranjan 230962278");
32
33
34     MPI_Finalize();
35     return 0;
36 }
37
```



```
• (base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$ mpicc q2.c -o q2
• (base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$ mpirun -np 4 ./q2
hwloc/linux: Ignoring PCI device with non-16bit domain.
Pass --enable-32bits-pci-domain to configure to support such devices
(warning: it would break the library ABI, don't enable unless really needed).
Subtraction:  $20 - 10 = 10$ 
Multiplication:  $20 * 10 = 200$ 
Division:  $20 / 10 = 2$ 
Addition:  $20 + 10 = 30$ 
○ Q2, Adarsh Ranjan 230962278 (base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$
```

C q3.c

```
1  #include <mpi.h>
2  #include <stdio.h>
3  #include <string.h>
4  #include <ctype.h>
5
6  int main(int argc, char *argv[])
7  {
8      int rank, size;
9      char str[] = "HELLO";
10     int len = strlen(str);
11     char ch;
12
13     MPI_Init(&argc, &argv);
14
15     MPI_Comm_rank(MPI_COMM_WORLD, &rank);
16     MPI_Comm_size(MPI_COMM_WORLD, &size);
17
18     if (rank < len)
19     {
20         ch = str[rank];
21
22         if (islower(ch))
23             ch = toupper(ch);
24         else
25             ch = tolower(ch);
26     }
27
28     MPI_Gather(&ch, 1, MPI_CHAR,
29              str, 1, MPI_CHAR,
30              0, MPI_COMM_WORLD);
31
32     if (rank == 0)
33         printf("Toggled String: %s\n", str);
34
35     if(rank == 0) printf("Q3, Adarsh Ranjan 230962278");
36
37
38     MPI_Finalize();
39     return 0;
40 }
```

```
• (base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$ mpicc q3.c -o q3
• (base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$ mpirun -np 5 ./q3
hwloc/linux: Ignoring PCI device with non-16bit domain.
Pass --enable-32bits-pci-domain to configure to support such devices
(warning: it would break the library ABI, don't enable unless really needed).
Toggled String: hello
Q3, Adarsh Ranjan 230962278(base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$
```


C q4.c

```
1  #include <mpi.h>
2  #include <stdio.h>
3
4  long long factorial(int n)
5  {
6      long long fact = 1;
7      for (int i = 1; i <= n; i++)
8          fact *= i;
9      return fact;
10 }
11
12 long long fibonacci(int n)
13 {
14     long long a = 0, b = 1, c;
15     if (n == 0)
16         return 0;
17     for (int i = 2; i <= n; i++)
18     {
19         c = a + b;
20         a = b;
21         b = c;
22     }
23     return b;
24 }
25
26 int main(int argc, char *argv[])
27 {
28     int rank;
29
30     MPI_Init(&argc, &argv);
31     MPI_Comm_rank(MPI_COMM_WORLD, &rank);
32
33     if (rank % 2 == 0)
34         printf("Process %d (Even): Factorial = %lld\n", rank, factorial(rank));
35     else
36         printf("Process %d (Odd): Fibonacci = %lld\n", rank, fibonacci(rank));
37
38     if(rank == 0) printf("Q4, Adarsh Ranjan 230962278");
39
40
41     MPI_Finalize();
42     return 0;
43 }
44
```

```
(base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$ mpicc q4.c -o q4
(base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$ mpirun -np 6 ./q4
hwloc/linux: Ignoring PCI device with non-16bit domain.
Pass --enable-32bits-pci-domain to configure to support such devices
(warning: it would break the library ABI, don't enable unless really needed).
Process 4 (Even): Factorial = 24
Process 2 (Even): Factorial = 2
Process 3 (Odd): Fibonacci = 2
Process 1 (Odd): Fibonacci = 1
Process 5 (Odd): Fibonacci = 5
Process 0 (Even): Factorial = 1
Q4, Adarsh Ranjan 230962278(base) mca@computinglab25-22:~/Desktop/PPL_230962278/Week1$
```