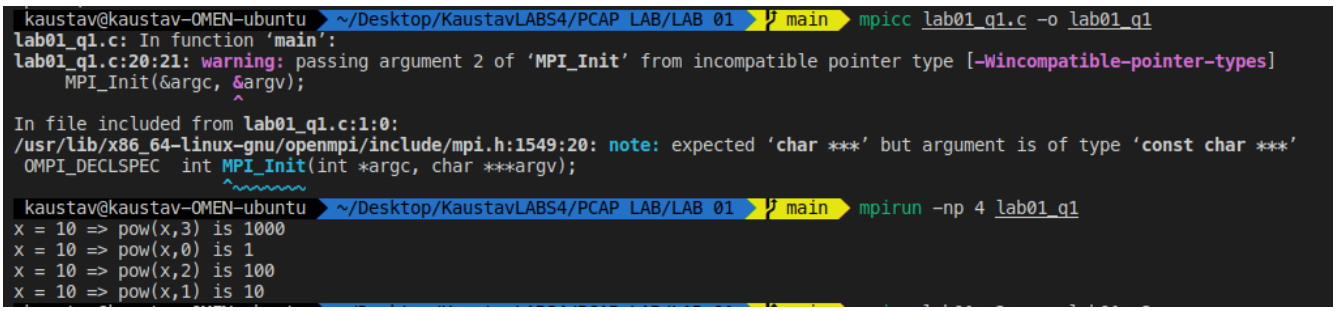
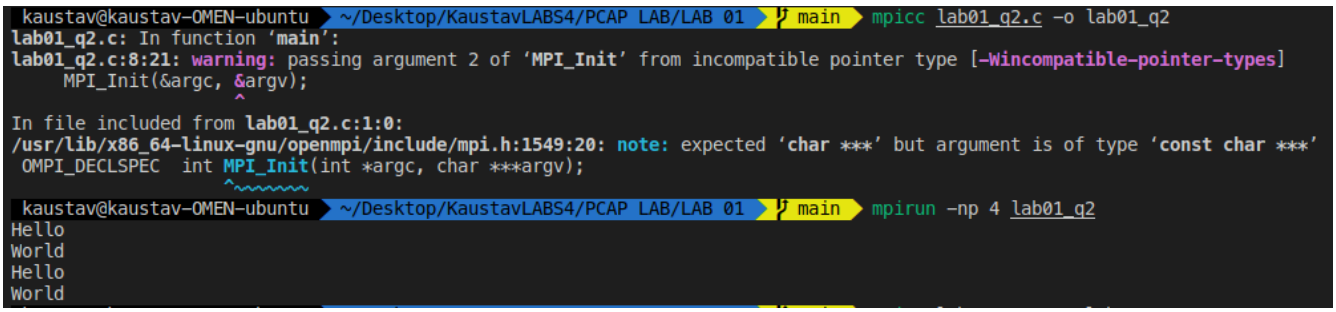
Q1

```
#include "mpi.h"
#include <stdio.h>

int power(int base, int exponent)
{
    if (base == 0 || base == 1)
        return base;
    else if (exponent == 0)
        return 1;
    else if (exponent == 1)
        return base;
    else
        return base * power(base, exponent - 1);
}

int main(int argc, char const *argv[])
{
    int rank, size;

    MPI_Init(&argc, &argv);
    MPI_Comm_rank(MPI_COMM_WORLD, &rank);
    MPI_Comm_size(MPI_COMM_WORLD, &size);

    int x = 10;
    printf("x = %d => pow(x,%d) is %d \n", x, rank, power(x, rank));

    MPI_Finalize();
    return 0;
}
```



Q2

```
#include "mpi.h"
#include <stdio.h>

int main(int argc, char const *argv[])
{
    int rank, size;

    MPI_Init(&argc, &argv);
    MPI_Comm_rank(MPI_COMM_WORLD, &rank);
    MPI_Comm_size(MPI_COMM_WORLD, &size);

    if (rank % 2 == 0)
        printf("Hello (Rank %d) \n", rank);
    else
        printf("World (Rank %d) \n", rank);

    MPI_Finalize();
    return 0;
}
```



Q3

```
#include "mpi.h"
#include <stdio.h>

int main(int argc, char const *argv[])
{
    int rank, size;

    const int num1 = 10;
    const int num2 = 20;

    MPI_Init(&argc, &argv);
    MPI_Comm_rank(MPI_COMM_WORLD, &rank);
    MPI_Comm_size(MPI_COMM_WORLD, &size);

    int result = 0;
    switch (rank)
    {
    case 0:
        result = num1 + num2;
        printf("%d + %d is %d (Rank %d) \n", num1, num2, (num1 +
num2), rank);
        break;
    case 1:
        result = num1 - num2;
        printf("%d - %d is %d (Rank %d) \n", num1, num2, (num1 -
num2), rank);
        break;
    case 2:
        result = num1 * num2;
        printf("%d * %d is %d (Rank %d) \n", num1, num2, (num1 *
num2), rank);
        break;
    case 3:
        result = num1 / num2;
        printf("%d / %d is %d (Rank %d) \n", num1, num2, (num1 /
num2), rank);
        break;
    }

    MPI_Finalize();
    return 0;
}
```

```
kaustav@kaustav-OMEN-ubuntu ~/Desktop/KaustavLABS4/PCAP LAB/LAB 01 main mpicc lab01_q3.c -o lab01_q3
lab01_q3.c: In function ‘main’:
lab01_q3.c:11:21: warning: passing argument 2 of ‘MPI_Init’ from incompatible pointer type [-Wincompatible-pointer-types]
    MPI_Init(&argc, &argv);
                    ^
In file included from lab01_q3.c:1:0:
/usr/lib/x86_64-linux-gnu/openmpi/include/mpi.h:1549:20: note: expected ‘char ***’ but argument is of type ‘const char ***’
 OMPI_DECLSPEC  int MPI_Init(int *argc, char ***argv);
                    ^~~~~~~~
kaustav@kaustav-OMEN-ubuntu ~/Desktop/KaustavLABS4/PCAP LAB/LAB 01 main mpirun -np 4 lab01_q3
10 + 20 is 30 (Rank 0)
10 - 20 is -10 (Rank 1)
10 / 20 is 0 (Rank 3)
10 * 20 is 200 (Rank 2)
```

Q4

```
#include "mpi.h"
#include <stdio.h>

int main(int argc, char const *argv[])
{
    int rank, size;

    char str[] = "HeLLO";

    MPI_Init(&argc, &argv);
    MPI_Comm_rank(MPI_COMM_WORLD, &rank);
    MPI_Comm_size(MPI_COMM_WORLD, &size);

    if (str[rank] >= 'a' && str[rank] <= 'z')
        str[rank] = str[rank] - 32;
    else if (str[rank] >= 'A' && str[rank] <= 'Z')
        str[rank] = str[rank] + 32;

    printf("My rank is %d and the modified string is %s \n", rank,
str);

    MPI_Finalize();
    return 0;
}
```

```
kaustav@kaustav-OMEN-ubuntu ~/Desktop/KaustavLABS4/PCAP LAB/LAB 01 main mpicc lab01_q4.c -o lab01_q4
lab01_q4.c: In function ‘main’:
lab01_q4.c:10:21: warning: passing argument 2 of ‘MPI_Init’ from incompatible pointer type [-Wincompatible-pointer-types]
    MPI_Init(&argc, &argv);
                    ^
In file included from lab01_q4.c:1:0:
/usr/lib/x86_64-linux-gnu/openmpi/include/mpi.h:1549:20: note: expected ‘char ***’ but argument is of type ‘const char ***’
 OMPI_DECLSPEC  int MPI_Init(int *argc, char ***argv);
                    ^~~~~~~~
kaustav@kaustav-OMEN-ubuntu ~/Desktop/KaustavLABS4/PCAP LAB/LAB 01 main mpirun -np 5 lab01_q4
My rank is 4 and the modified string is HeLLo
My rank is 1 and the modified string is HELLO
My rank is 2 and the modified string is HelLO
My rank is 3 and the modified string is HeLlO
My rank is 0 and the modified string is heLLO
```