Installing OpenMPI

apt-get install libopenmpi-dev openmpi-bin openmpi-doc openmpi-common

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Compiling and running MPI programs

mpicc test.c

mpirun –np **4** a.out

mpirun –np **3** date

Starts 4 processes.
Possibly on different machines.
They are identical but have different ids.
Works with non-MPI programs.

./a.out

Works but starts only **one** process.

MPI example

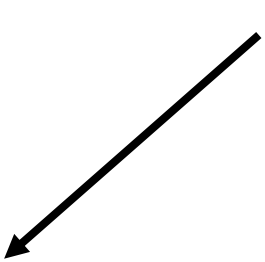
```
#include<mpi.h>
#include<stdio.h>

int main(int argc, char * argv[])
{
        int rank;
        int nProcesses;
        MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &rank);
        MPI_Comm_size(MPI_COMM_WORLD, &nProcesses);
        printf("Hello from %i/%i\n", rank, nProcesses);
        MPI_Finalize();
        return 0;
}
```

MPI example

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

int main(int argc, char * argv[])
{
        int rank;
        int nProcesses;
        MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &rank);
        MPI_Comm_size(MPI_COMM_WORLD, &nProcesses);
        printf("Hello from %i/%i\n", rank, nProcesses);
        MPI_Finalize();
        return 0;
}
```

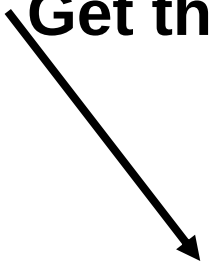


MPI example

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

int main(int argc, char * argv[])
{
        int rank;
        int nProcesses;
        MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &rank);
        MPI_Comm_size(MPI_COMM_WORLD, &nProcesses);
        printf("Hello from %i/%i\n", rank, nProcesses);
        MPI_Finalize();
        return 0;
}
```

Get the id (rank)



MPI example

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

int main(int argc, char * argv[])
{
        int rank;
        int nProcesses;
        MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &rank);
        MPI_Comm_size(MPI_COMM_WORLD, &nProcesses);
        printf("Hello from %i/%i\n", rank, nProcesses);
        MPI_Finalize();
        return 0;
}
```

Get the total number of processed

MPI example

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

int main(int argc, char * argv[])
{
        int rank;
        int nProcesses;
        MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &rank);
        MPI_Comm_size(MPI_COMM_WORLD, &nProcesses);
        printf("Hello from %i/%i\n", rank, nProcesses);
        MPI_Finalize();
        return 0;
}
```

Print hello from all processes.

MPI example

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

int main(int argc, char * argv[])
{
        int rank;
        int nProcesses;
        MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &rank);
        MPI_Comm_size(MPI_COMM_WORLD, &nProcesses);
        printf("Hello from %i/%i\n", rank, nProcesses);
        MPI_Finalize();
        return 0;
}
```

Stop the MPI environment.

MPI example executed

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

int main(int argc, char * argv[])
{
        int rank;
        int nProcesses;
        MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &rank);
        MPI_Comm_size(MPI_COMM_WORLD, &nProcesses);
        printf("Hello from %i/%i\n", rank, nProcesses);
        MPI_Finalize();
        return 0;
}
```

Hello from 0/4

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

int main(int argc, char * argv[])
{
        int rank;
        int nProcesses;
        MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &rank);
        MPI_Comm_size(MPI_COMM_WORLD, &nProcesses);
        printf("Hello from %i/%i\n", rank, nProcesses);
        MPI_Finalize();
        return 0;
}
```

Hello from 3/4

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

int main(int argc, char * argv[])
{
        int rank;
        int nProcesses;
        MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &rank);
        MPI_Comm_size(MPI_COMM_WORLD, &nProcesses);
        printf("Hello from %i/%i\n", rank, nProcesses);
        MPI_Finalize();
        return 0;
}
```

Hello from 2/4

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

int main(int argc, char * argv[])
{
        int rank;
        int nProcesses;
        MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &rank);
        MPI_Comm_size(MPI_COMM_WORLD, &nProcesses);
        printf("Hello from %i/%i\n", rank, nProcesses);
        MPI_Finalize();
        return 0;
}
```

Hello from 1/4

MPI memory

- There is no such thing as shared memory in MPI
- All variables are local per process (equivalent to private in OpenMP)
- To get information from one process to the other you have to use explicit communication
  - Send/Recv
  - Broadcast
  - Scatter
  - Gather