

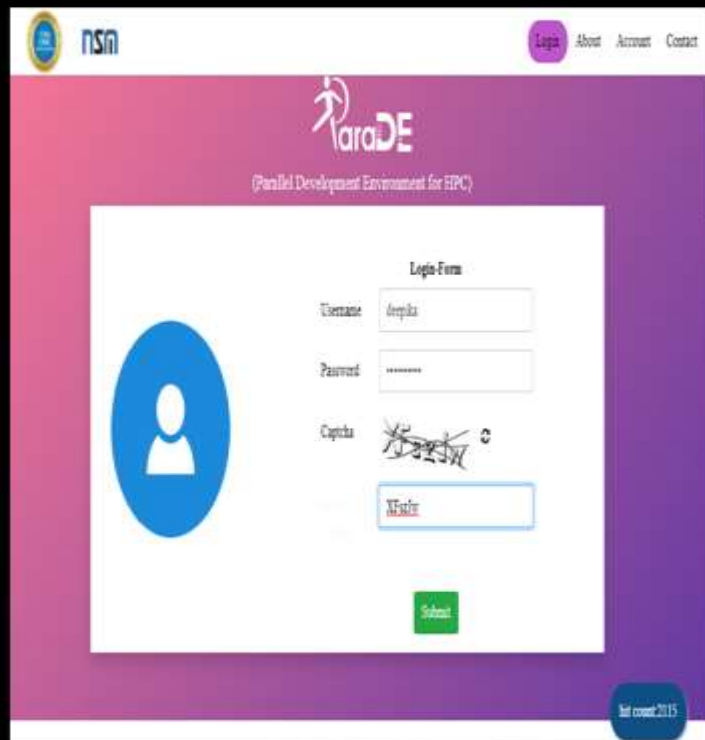


PARADE

Parallel Development Environment for HPC

PARADE

Integrated Development Environment for HPC



- Browser based IDE
- No installation required on the client machine
- Single interface for application development



WORKING ENVIRONMENT IN HPC

Using Command-line !!



```

[parade@login03 ~]$ module avail
----- /opt/ohpc/pub/modulefiles -----
EasyBuild/3.9.4
apps/mom/6/intel_18.2
apps/mpiblast/1.6.0/intel_18.2
apps/roms/3.6/intel_18
autotools
charliecloud/0.11
charliecloud/0.22
clustershell/1.8.2
cmake/3.15.4
compiler/hpc_sdk/nvhpc/21.7
compiler/intel/2017.7.259
compiler/intel/2018.4.057
compiler/intel/2019.5.281
compiler/intel/2020.4.304
cuda/7.5
cuda/8.0
cuda/9.0
cuda/9.2
cuda/10.0
cuda/10.1
cuda/10.2
cuda/11.2
gcc/8.2.0
gnu8/8.3.0
hwloc/2.1.0
intel/18.0.5.274
lib/netcdf_c/4.3.3.1/intel_18
lib/netcdf_fortran/4.4.0/intel_18
lib/parallel_hdf5/1.8.21/intel_18
oneapi/compiler32/2021.2.0
oneapi/dal/2021.2.0
oneapi/debugger/10.1.1
oneapi/dev-utilities/2021.2.0
oneapi/dnnl-cpu-gomp/2021.2.0
oneapi/dnnl-cpu-icomp/2021.2.0
oneapi/dnnl-cpu-tbb/2021.2.0
oneapi/dnnl/2021.2.0
oneapi/dpctl/2021.2.0
oneapi/dpl/2021.2.0
oneapi/init_openccl/2021.2.0
oneapi/inspector/2021.2.0
oneapi/intel_ipp_ia32/2021.2.0
oneapi/intel_ipp_intel64/2021.2.0
oneapi/intel_ippcp_ia32/2021.2.0
oneapi/intel_ippcp_intel64/2021.2.0
oneapi/itac/latest
oneapi/itac/2021.2.0
oneapi/mkl/latest
oneapi/mkl/2021.2.0
oneapi/mkl32/2021.2.0
oneapi/mpi/2021.2.0
oneapi/oclpga/2021.2.0
oneapi/tbb/2021.2.0
oneapi/tbb32/2021.2.0
oneapi/vpl/2021.2.2
oneapi/vtune/2021.2.0
openmpi/3.1.5
openmpi/4.0.5

```

- Write code on editor or import existing code to the cluster

- Search for compatible compilers and libraries to compile

- Now compile and create executable

- Understand the submission process on the cluster
- Create a LRM based script to execute the application

```
parade@login03:~  
[parade@login03 ~]$ sinfo  
PARTITION AVAIL  TIMELIMIT  NODES  STATE NODELIST  
standard*   up 3-00:00:00      10 drain* cn[030-031,067-069],gpu010,hm[017,026,038-039]  
standard*   up 3-00:00:00     106 alloc cn[001-028,033-060,070-072,074-101,105-110],hm[001  
,025,027-037]  
standard*   up 3-00:00:00      43  idle cn[029,032,061-066,073,102-104],gpu[001-009],hm[00  
2-016,018-024]  
gpu         up 3-00:00:00        1 drain* gpu010  
gpu         up 3-00:00:00        9  idle gpu[001-009]  
hm          up 3-00:00:00        4 drain* hm[017,026,038-039]  
hm          up 3-00:00:00       13 alloc hm[001,025,027-037]  
hm          up 3-00:00:00       22  idle hm[002-016,018-024]  
cpu         up 3-00:00:00        5 drain* cn[030-031,067-069]  
cpu         up 3-00:00:00      93 alloc cn[001-028,033-060,070-072,074-101,105-110]  
cpu         up 3-00:00:00      12  idle cn[029,032,061-066,073,102-104]  
[parade@login03 ~]$ vi slurm_script
```

View the result and optimize if required



```
parade@login03:/scratch/parade/ParaDE/ExecutionDirectory/PI_Calculation
[parade@login03 PI_Calculation]$ cat output_19074.out
=====
SLURM_CLUSTER_NAME = paramutkarsh
SLURM_ARRAY_JOB_ID =
SLURM_ARRAY_TASK_ID =
SLURM_ARRAY_TASK_COUNT =
SLURM_ARRAY_TASK_MAX =
SLURM_ARRAY_TASK_MIN =
SLURM_JOB_ACCOUNT = cdac
SLURM_JOB_ID = 19074
SLURM_JOB_NAME = PI_Calculation
SLURM_JOB_NODELIST = cn[064-065]
SLURM_JOB_USER = parade
SLURM_JOB_UID = 21040
SLURM_JOB_PARTITION = standard
SLURM_TASK_PID = 348
SLURM_SUBMIT_DIR = /scratch/parade/ParaDE/ExecutionDirectory/PI_Calculation
SLURM_CPUS_ON_NODE = 2
SLURM_NTASKS =
SLURM_TASK_PID = 348
=====
Number of processes 2
Number of Threads 2
Pi Is Approximately 3.1415926535898993
[parade@login03 PI_Calculation]$
```


Debug code in case of errors

```
parade@login03:~  
ib64/qt-3.3/bin:/usr/local/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/home/parade/.local/bin:/home/parade/bin  
[parade@login03 ~]$ module load compiler/intel/2020.4.304  
[parade@login03 ~]$ mpicc test_mpi.c -g -o test_mpi  
[parade@login03 ~]$ gdb ./test_mpi  
GNU gdb (GDB) Red Hat Enterprise Linux 7.6.1-120.el7  
Copyright (C) 2013 Free Software Foundation, Inc.  
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>  
This is free software: you are free to change and redistribute it.  
There is NO WARRANTY, to the extent permitted by law. Type "show copying"  
and "show warranty" for details.  
This GDB was configured as "x86_64-redhat-linux-gnu".  
For bug reporting instructions, please see:  
<http://www.gnu.org/software/gdb/bugs/>...  
Reading symbols from /home/parade/test_mpi...done.  
(gdb) b main  
Breakpoint 1 at 0x4008a5: file test_mpi.c, line 6.  
(gdb) r  
Starting program: /home/parade/./test_mpi  
[Thread debugging using libthread_db enabled]  
Using host libthread_db library "/lib64/libthread_db.so.1".  
  
Breakpoint 1, main (argc=1, argv=0x7fffffffcd18) at test_mpi.c:6  
6      MPI_Init(NULL, NULL);  
Missing separate debuginfos, use: debuginfo-install glibc-2.17-324.el7_9.x86_64 libgcc-4.8.5-44.el7.x86_64  
(gdb) n  
10      MPI_Comm_size(MPI_COMM_WORLD, &world_size);  
Missing separate debuginfos, use: debuginfo-install libibverbs-54mlnx1-1.54103.x86_64 libnl3-3.2.28-4.el7.x86_64 librdmacm-54mlnx1-1.54103.x86_64 numactl-libs-2.0.12-5.el7.x86_64 ucx-1.11.0-1.54103.x86_64 zlib-1.2.7-19.el7_9.x86_64  
(gdb)
```

0 Profile the code to analyze the program for decreasing the execution time

```

3. paramganga.iitr.ac.in
[parade@login04 ~]$ gcc -pg mg_serial.c -o mg_serial -lm
[parade@login04 ~]$ ./mg_serial ^C
[parade@login04 ~]$ gprof -b mg_serial gmon.out >profile.log
[parade@login04 ~]$ cat profile.log
Flat profile:

Each sample counts as 0.01 seconds.
 %   cumulative   self           self       total
time  seconds    seconds   calls   us/call   us/call   name
100.19    0.01    0.01        101     99.20     99.20   compute
 0.00     0.01    0.00    999900      0.00      0.00   dist
 0.00     0.01    0.00        100      0.00      0.00   update
 0.00     0.01    0.00         2      0.00      0.00   cpu_time
 0.00     0.01    0.00         2      0.00      0.00   timestamp
 0.00     0.01    0.00         1      0.00      0.00   initialize
 0.00     0.01    0.00         1      0.00      0.00   r8mat_uniform_ab

Call graph

granularity: each sample hit covers 2 byte(s) for 99.81% of 0.01 seconds

index % time    self  children    called      name
[1]    100.0     0.01    0.00    101/101      main [2]
      0.01    0.00     101      compute [1]
      0.00    0.00  999900/999900    dist [3]
-----
[2]    100.0     0.00    0.01    101/101      <spontaneous>
      0.01    0.00    101/101      main [2]
      0.00    0.00   100/100      compute [1]
      0.00    0.00    100/100      update [4]
      0.00    0.00      2/2      timestamp [6]
      0.00    0.00      2/2      cpu_time [5]
      0.00    0.00      1/1      initialize [7]
-----
[3]     0.0     0.00    0.00  999900/999900    compute [1]
      0.00    0.00    999900    dist [3]
-----

```


PROGRAMMING ON A SUPERCOMPUTER



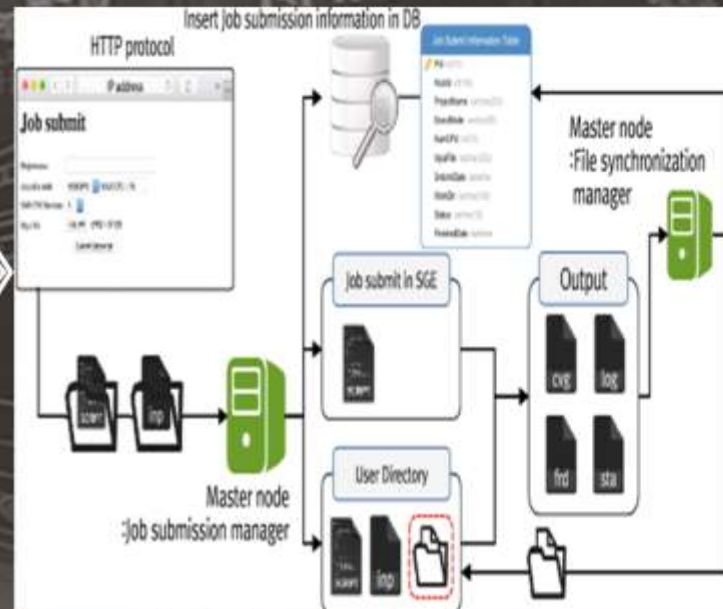
Compiler



DLL

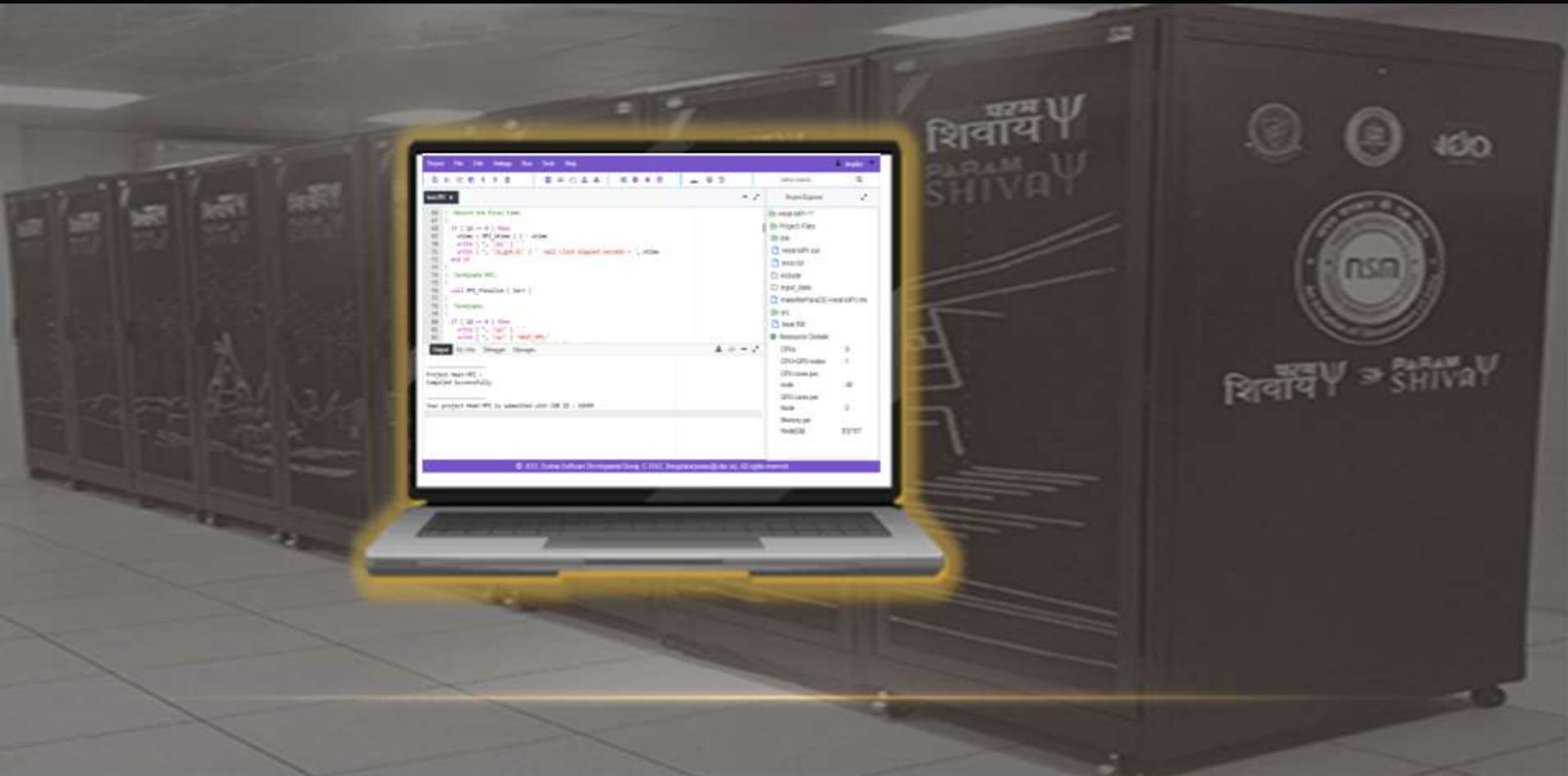


Programming environment





PROGRAMMING ON A SUPERCOMPUTER USING PARADE





NSM

Login

About

Account

Contact



(Parallel Development Environment for HPC)



Login-Form

Username

deepika

Password

Captcha



Enter

XFszJw

captcha

Submit

hit count:2115

Editor

Auto
Compile

HPC Job
Submission

Debug

View Output



Project File Edit Settings Run Tools Help

editor search...

PLc x

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <math.h>
4 #include <mpi.h>
5 #include <omp.h>
6
7 #define NUMINTERVALS 1000000
8
9 double
10 func(double x)
11 {
12     return (4.0 / (1.0 + x * x));
13 }
14
15 /* Main Program */
16
17 int
18 main(int argc, char *argv[])
19 {
20     // ...
21 }
```

Project Explorer

- PI_Calculation-OpenMPwithMPI [HC]
- Project Files
- bin
- PI_Calculation-OpenMPwithMPI.out
- error.txt
- include
- input_data
- lib
- makefileParaDE-PI_Calculation-OpenMPwithMPI.mk
- makefileParaDE-PI_Calculation.mk
- src
- PI.c
- Resource Details
 - CPU Core : 9
 - CPU+GPU nodes : 1

Output My Jobs Debugger Messages

Compiled Successfully with warnings

Your project PI_Calculation-OpenMPwithMPI is submitted with JOB ID : 18538

[Job ID : 18538 Name : PI_Calculation-OpenMPwithMPI] :

Note : If project is generating any output files, to check that files go to cluster head node (/scratch_ib/)

Number of processes 2
Number of Threads 8
Pi Is Approximately 3.1415926535899001



DEMO

ParaDE URL :: <https://paramuthkarsh.cdacb.in:8447/parade>

IDE FOR HPC

- Anytime
- Anywhere
- Single interface for HPC programming

