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# Parallel Programming with OpenMP and MPI

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## Assignment 10 discussion



High Performance  
Computing

# Assignment 10, Task 1 – ray tracer w/ parallel I/O

Set up file views for master and workers:

```
MPI_File_open(MPI_COMM_WORLD, "ray_pio.pnm",
              MPI_MODE_CREATE | MPI_MODE_RDWR, MPI_INFO_NULL,
              &fh);

fs = size*size+19; // 19 bytes of header in PNM
MPI_File_set_size(fh, fs);

if(0==my_rank) {
    MPI_Offset ofs = 0;
    MPI_File_set_view(fh, ofs, MPI_CHAR, MPI_CHAR, "native",
                     MPI_INFO_NULL);
} else {
    MPI_Offset ofs = 19;
    MPI_File_set_view(fh, ofs, MPI_CHAR, MPI_CHAR, "native",
                     MPI_INFO_NULL);
}
```

# Assignment 10, Task 1 – ray tracer w/ parallel I/O

Writing header data (first 19 bytes) from master:

```
char headerbuf[1000];
sprintf(headerbuf, "P5\n%5d %5d\n255\n", size, size);
fs=0;
MPI_File_write_at(fh, fs, headerbuf,
                  strlen(headerbuf), MPI_CHAR,
                  &status );
```

Writing tile data from worker:

```
for(i=0; i<tilesizes; i++) {
    MPI_Offset ofs = (rtiledatas[2]+i)*(tilesizes*xtiles)+rtiledatas[1];
    MPI_File_write_at(fh, ofs, tile+i*tilesizes, tilesizes,
                      MPI_CHAR, &status);
}
```

# Assignment 10, Task 2 – hybrid dense MVM

OpenMP parallelization of dMVM kernel is trivial:

```
#pragma omp for
  for(int m=0; m<my_size; m++){
    for(int n=n_start; n<n_start+cur_size; n++){
      y[m]+=a[m*size+n]*x[n-n_start];
    }
  }
```

Run (example 5 threads per process / 4 processes per node):

```
$ mpirun_ruze -np 16 \  
  -pin 0,1,2,3,4_5,6,7,8,9_10,11,12,13,14_15,16,17,18,19 \  
  ./a.out 4000 4000
```

# Assignment 10, Task 2 – hybrid dense MVM

“It’s complicated” – data on Emmy with up to 80 cores (4 nodes)

