CPS 376: HW2 Notes

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serial.cpp—moodle

- General: for each step, for each particle, for each other particle apply the forces then move the particles

  - apply_force:
    - Calculate distance between self, neighbor
    - Calculate the force between self, neighbor (if close enough); update the movement needed.
  - move_particle:
    - Moves each particle based on the results of apply_force

serial.cpp—canvas

- General: uses a system of bins of size cutoff × cutoff, updates forces bin by bin
- Each bin is self-contained, only cares about the particles in itself.

openmp.cpp

- The same approach is used as in serial.cpp, but the loops to calculate force and update locations are run in parallel

mpi

- MPI commands

  - `MPI_request`: Data type used to determine if a non-blocking operation is finished
  - `MPI_Status`: Struct indicating the source and the tag of a message
  - `MPI_Type_contiguous`: Creates a new data type consisting of a bunch of copies of an old data type.
  - `MPI_Type_commit`: Adds a new data type to the system. Needs to be called for user types
  - `MPI_Scatter`: Sends data from one task to every other task in a group

  - `MPI_Irecv`: Creates a buffer in memory to receive messages, and continues without waiting for the buffer to receive anything
  - `MPI_Isend`: Creates a buffer in memory to send messages, and continues without waiting for the buffer to send anything.
  - `MPI_Wait`: Waits for a send or receive to complete
  - `MPI_Reduce`: Applies a reduction operation to every task in a group and puts the result in one task.
  - `MPI_SUM`: Reduction operation which produces a sum
  - `MPI_MIN`: Reduction operation which produces a minimum
  - `MPI_Barrier`: Blocks the caller and waits all other processes to reach the barrier before continuing

- My approach to particle simulation

  - Divide the overall bin structure into rows, and divide them (mostly) equally between the processes
  - Each process gets local bins: its own, and one row above and below to receive neighboring particles
  - Send top bottom row of each process' bins to the process below it while receiving from the process above it
  - Send the top row of each process' bins to the process above it while receiving from the process below it
  - Compute forces locally, and repeat

- **IMPORTANT:** My simulation runs with 1 thread, segfaults on 2, and hangs on more. I know the error is around line 233, in sending particle info up; however, I did not have time to fully track down this segfault. I suspect it has something to do with the indexing of the inBin and outBin.