Ex7p03

For this exercise I wrote the program *p03.cpp*. In the program, process 0 reads the data from the file ex7p3.dat (number of lines can be specified as a command line argument) into a vector which is then distributed to all processes using MPI_Scatterv. All processes then sum up their share of the vector like so:

```
float sum = 0, sq_sum = 0;
for (float val : recvdata) {
    sum += val;
    sq_sum += val * val;
}
```

Where recvdata is the data each process received. Process 0 then uses MPI_Gather to collect the sums and calculate the average and variance.

The program can also handle cases where the number of data points is not divisible by the number of processes by assigning extra elements to processes where needed.

Results:

lines = 8000
```
Reading data points from "ex7p3.dat" into vector...
Number of data points to be read: 8000
Done.
Process 0 received 2000 points of data
Process 0 sum: 2006.46, var: 2091.91
Process 1 received 2000 points of data
Process 1 sum: 2017.12, var: 2112.53
Process 2 received 2000 points of data
Process 2 sum: 2007.94, var: 2096.99
Process 3 received 2000 points of data
Process 3 sum: 1996.52, var: 2073.86
Average: 1.0035, Variance: 0.0398896
```

lines = 8001
```
Reading data points from "ex7p3.dat" into vector...
Number of data points to be read: 8001
Done.
Process 0 received 2001 points of data
Process 0 sum: 2007.48, var: 2092.94
Process 1 received 2000 points of data
Process 1 sum: 2016.98, var: 2112.27
Process 2 received 2000 points of data
Process 2 sum: 2007.92, var: 2096.94
Process 3 received 2000 points of data
```

Process 3 sum: 1996.74, var: 2074.28
Average: 1.00351, Variance: 0.039885

No number of lines specified
Reading data points from "ex7p3.dat" into vector...
Number of data points not specified, reading the whole file.
Done.
Process 0 received 25000 points of data
Process 1 received 25000 points of data
Process 1 sum: 24946.5, var: 25897.3
Process 2 received 25000 points of data
Process 2 sum: 24952.2, var: 25892.7
Process 3 received 25000 points of data
Process 3 sum: 25013.8, var: 26015.5
Process 0 sum: 25019, var: 26030.9
Average: 0.999315, Variance: 0.0397343

lines = 9997
Reading data points from "ex7p3.dat" into vector...
Number of data points to be read: 9997
Done.
Process 0 received 2500 points of data
Process 0 sum: 2509.5, var: 2618.48
Process 3 received 2499 points of data
Process 3 sum: 2501.58, var: 2599.01
Process 1 received 2499 points of data
Process 1 sum: 2517.42, var: 2635.71
Process 2 received 2499 points of data
Process 2 sum: 2493.9, var: 2589.22
Average: 1.00254, Variance: 0.0394653