CSCI5451 Lab3 Report Ruoyan Kong, kong0135

(a) Any specific comments you have on your implementation. For example: Any comments on things you did to reduce idle time the impact of communication? Did you have to use any communication commands other than sends and receives (and one broadast in back solve) in your two functions?

I use if (South!=(k % nprocs)&&((k/nprocs<n/nprocs-1)||(k%nprocs<South))) MPI_Send(a_k, n+1, MPI_DOUBLE, South, k, comm); So I check South!=(k % nprocs) first, if South already include row k, then we don't need to send row k to it. This can save the time for communication.

I use a barrier in back_solve.c:

```
// barrier until all process updated and t does no change.
MPI_Barrier(MPI_COMM_WORLD);
// sent t to all the processes.
MPI_Bcast(&t, 1, MPI_DOUBLE, id, comm);
```

I do this to make sure other process does not change t's value by broadcast it.

(b) Comments on the statistics you see. Timing, efficiency, etc.

nprocs		Efficiency
1	Err in solution = 1.250e-10 nprocs = 1, size = 2048, Gaussian elimination time = 2.274084e+01, triangular solve time = 1.168702e-01.	E_ge = 1 E_bs = 1
2	Err in solution = 1.250e-10 nprocs = 2, size = 2048, Gaussian elimination time = 1.415497e+01, triangular solve time = 6.216097e-02.	E_ge = 2.274084e+01/(2*1.415497e+01)=0.80 E_bs = 1.168702e-01/(2* 6.216097e-02)=0.94
4	Err in solution = 1.250e-10 nprocs = 4, size = 2048, Gaussian elimination time = 6.068016e+00, triangular solve time = 3.598189e-02.	E_ge = 2.274084e+01/(4* 6.068016e+00)=0.94 E_bs = 1.168702e-01/(4*3.598189e-02)=0.81
8	Err in solution = 1.250e-10 nprocs = 8, size = 2048, Gaussian elimination time = 3.149507e+00, triangular solve time = 1.738191e-02.	E_ge = 2.274084e+01/(8*3.149507e+00)=0.90 E_bs = 1.168702e-01/(8*1.738191e-02)=0.84
16	Err in solution = 1.250e-10 nprocs = 16, size = 2048, Gaussian elimination time = 2.399486e+00, triangular solve time = 1.340818e-02.	E_ge = 2.274084e+01/(16*2.399486e+00)=0.59 E_bs = 1.168702e-01/(16*1.340818e-02)=0.54
32	Err in solution = 1.250e-10 nprocs = 32, size = 2048, Gaussian	E_ge = 2.274084e+01/(32*1.710293e+00)=0.42 E_bs = 1.168702e-01/(32*3.635030e-01)=0.01

	elimination time = 1.710293e+00, triangular solve time = 3.635030e-01.	

When the nprocs increase, the time for Gaussian elimination and triangular solve both decrease. But the efficiency for Gaussian elimination reached highest when nprocs = 4, then decrease. And the efficiency for triangular solve reached highest when nprocs = 2. The decrease of efficiency might be caused by longer idle time and more communications demand between processes.