

EE5848 Topics in Information Theory & Coding (2020-21)

Programming Assignment - 2

Due on 6am, 26 Apr. 2021

Submission Instructions: (as usual) You may form teams of size 1-2 students (only among students crediting the course). Exactly one of the team members must upload **the simulation result and python script file** online. You must upload the simulation result as a figure in '.pdf' format. Other formats are not allowed).

You are allowed to discuss with other teams, but the program must be written on your own.

Programming Language: You must use python, numpy and mpi4py for this programming assignment.

The Problem: You must find $\mathbb{E}T_{\text{overall}}^{\text{uncoded}}$ the expected overall time taken by uncoded matrix-vector multiplication $\mathbf{y}^T = \mathbf{A}\mathbf{x}^T$ using numpy and mpi4py. The time taken (in milliseconds) must be plot against the number of workers for two sizes of \mathbf{A} : 9000×9000 and 9000×4500 , and for number of workers equal to 2, 4, 6. The two curves must be plot in a single figure. You must upload:

1. One figure file, in pdf format, and
2. your python script as a text file

The matrix \mathbf{A} must be generated randomly, and its partitions must be assigned to respective workers. The input to the system is \mathbf{x} and must be generated randomly at the master process. The time taken for the operation must include

1. broadcasting \mathbf{x} from master to all workers
2. computation at all workers
3. master receiving and collating the results from all workers into the output \mathbf{y} .

Do not include the time taken to generate \mathbf{A} and \mathbf{x} or the time required to place the partitions of \mathbf{A} in the workers to calculate $T_{\text{overall}}^{\text{uncoded}}$.

To estimate the expected value $\mathbb{E}T_{\text{overall}}^{\text{uncoded}}$, run the distributed algorithm 20 times, with 0.5 seconds intervals between each of these 20 iterations, and calculate the average of these 20 completion times.

Note:

1. Use the shared Google Sheet EE5848 Slots to Access Workstation to book your slots. Perform secure copy and ssh log-in only during your own time slot. Book your slot before using the machine.
2. Secure copy your python script into the workstation before logging in. You can use:

```
$ scp filename.py ee5848@192.168.83.20:~/
```

3. Log in to the workstation using ssh:

```
$ ssh ee5848@192.168.83.20
```

4. You can use vim, emacs or nano to edit your file within the workstation.

5. Run the following two commands once you log in

```
$ module load mpi/openmpi-x86_64
```

```
$ export OPENBLAS_NUM_THREADS=1
```

6. Use the workstation to record the average completion times. You can plot the figure in your own laptop or desktop using Matlab or Python.

7. Delete your files before logging out

```
$ rm filename.py
```

8. Log out of the machine using the following command

```
$ exit
```

9. The examples written during the tutorial session are available in the folder ~/Tutorial/