
HPC for novices through a course in parallel programming

EDUHIPC-18, In conjunction with HiPC conference, Bengaluru, India
December 17, 2018

V. Venkatesh Shenoi

Center for Development of Advanced Computing (C-DAC), Pune

Co-authors:

Vaishali Shah [Interdisciplinary School of Scientific Computing, Savitribai Phule Pune University]

Sandeep K. Joshi [C-DAC, Pune]

Parallel Computing course for M.Sc (Scientific Computing) students

Learnings/Observation

- Students who have done courses like Computational Physics/Biology prior to this course could appreciate the spirit of the exercises discussed, owing to a better exposure gained in mathematical modelling in sciences.
 - The applications of linear system of equations, iterative solver and hence iteration based numerical algorithms are appealing to these students, whereas, others get withdrawn.
- Algorithmic approach to numerical methods intimidates some of the students who are diffident about their mathematical background, leading to lack of interest in parallel computing in spite of their having better programming skills.
 - For e.g. difficulty in motivating matrix operations despite their understanding of the 2D array (matrix/table) as data structure.
- A composite class of postgraduates, research students, students with industry experience enriched the nature of interactions among peers with different levels of training, which, effectively raises the average reception level of the course material.

Challenges & our approach to overcome some of them

- To motivate the need for parallel computing and the notion of parallel algorithm, because students learn inherently sequential algorithms in their prior training.
- Subtlety that explicit message passing is needed to access data local to different processes in the single program multiple data (SPMD) approach for parallel algorithm design.
- Emphasizing the importance of floating point arithmetic for numerical computation for students with a computer science background.
- Unravelling of the hidden parallelism in many sequential algorithms and limited realization of parallel computing due to inexperience with real world need of solving larger problems.

Lab sessions: **Hand holding method** to ensure the learning outcomes of the course are met effectively.

- The students are assisted by tutors to motivate the parallel algorithm implementation, debugging and help with the completion of the hands-on exercises.
- The emphasis on “think parallel” for the exercises are done through black board discussions and handouts.

HPC work force building: challenges

Internship at C-DAC

- M.Sc (Scientific Computing): **one semester long dissertation projects**
 - *These students would require further training on parallel numerical algorithms to work with legacy codes in order to contribute to parallel application development.*
- Pre-final year of B.Tech programme: **summer internship for two months**
 - *This programme has its limitation due to short period of interns' stay at C-DAC*

Lack of reward owing to extremely limited job opportunities for students with HPC skills in the Indian job market (until recently when data science opened up more avenues) poses a serious challenging.