Part 1: Will you and why will you need HPC in your research?

In this era of accelerated change, overwhelming complexity, and tremendous competition, it is undeniable that breathtaking innovations are not solely focused upon experiment and theoretical background but required to be fast, stable, and efficient enough, by all means, all those algorithms based on parallel working procedures.

Let's look at my research which is based on tensor decomposition and networks for solving large-scale problems and where we can use HPC. The proliferation of high-dimensional data problems led us to discover the new solutions to figure out the complex large-scale issues. Tensor decomposition is a useful technique for capturing the high-order interactions in data analysis. Many problems solve using tensor decomposition such as analyzing high-dimensional data, e.g. Tucker decomposition, CANDECOMP/PARAFAC(CP) decomposition, and tensor singular value decomposition. Tensor networks decompose high-order tensors into sparsely interconnected small scale-factor matrices and/or low-order core tensors or it can be thought of as special graph structures that break down high-order core tensors into a set of sparsely interconnected low-order core tensors, many applications are in Healthcare Analytics, Quantum Chemistry, Data Mining, Signal Processing which are needed synchronization. As the predominant aim of my research is solving the large-scale problems while HPC now enters the era of extreme heterogeneity in which it aggregates computing power or the high-tech equivalent of a "divide and conquer" method or simply breaking up a single program into parts to run across multiple cores is a rather obvious way to increase speed for solving large-scale problems, it is natural to ask whether the critical sparse-tensor based algorithms can be efficiently executed on these HPC platforms, with their non-regular parallelism to be effectively exploited but as far as I know, there are algorithms called Parallel Sparse Tensor Algorithm benchmark a.k.a PASTA which supplies a fair baseline for evaluating performance improvement brought by new sparse tensor methods(Tensor decomposition and networks). The significant reinforcement by HPC can be implemented for solving, *the curse of dimensionality*, *mode orientation, tensor transformation(s), irregularity* while these challenges bring non-trivial computational and storage overheads, and some of them are even harder to overcome than their counterparts in classical linear algebra.

To summarize, I believe High-Performance Computing is desperately vital almost in all spheres and I would love to learn the best parallel algorithms during the course and have the profound experience to improve my research with capabilities of all HPC algorithms in the field of tensor decomposition and networks for solving large-scale problems.

Part 2: Find an interesting/fun application of HPC and supercomputers and briefly describe it

Nowadays several industries, governments, and academic sectors using HPC and supercomputers from Economics, Finance to weather forecasting, and motivations of using HPC are every governmental or not governmental organization wants to have fast, informed decisions, competitive products, and how those things can drive profits higher. In the field of HPC, there are applications in MPI, GPU, Phi, Hadoop, on one hand, the existing applications can be optimized to reduce the cost, and on the other hand, forthcoming innovations will be designed to take advantage of the parallel nature of high-performance computational computing systems.

I have read several HPC applications and the most interesting ones were always be in Economics such as in stock-market and fraud detection in credit cards like anomaly detection in Machine Learning tasks in which I have tried with credit card fraud detection in last term at ML class using csv dataset in python. I think high performance computing is crucial in banking and stocks otherwise the huge amount of financial circulation within one system will be extremely dangerous and will have vulnerabilities in information security and data protection.

By using the supercomputers The National Oceanic and Atmospheric Administration are now processing millions of observations and changes in the weather, moreover, it has several functions of assessing and predicting the changes in these systems over time, along with understanding and describing Earth systems through research and analysis of that data in which high performance/supercomputers make their job very efficient and more reliable than trivial applications existed in the bygone times.

In conclusion, all the supercomputers listed in top500.org are super vital for not only the existing applications but they will have indispensable impacts upon numerous undiscovered applications which are yet to come in the future.