Actionable Guidance for Junior HPC Researchers

Hang Liu
Stevens Institute of Technology

Chuhua Liao
Lawrence Livermore National Laboratory

***Abstract*—High Performance Computing (HPC) and, in general, Parallel and Distributed Computing (PDC) has become pervasive, so does the pertinent research. While a collection of research advice write-ups has surged in the community, very few of them are *actionable* and *specific* for HPC researchers. This lightning talk aims to provide such guidelines. As an early success, we have posted these guidelines on GitHub (https://github.com/asherliu/researchHOWTO), which draws around 30 stars and positive feedbacks. In addition, our graduate and undergraduate students find the advice to be constructive.**

The need of this lightning talk starts from the fact that "we know more than we can tell" [4]. After surveying around several dozens of the undergraduate and graduate students who are doing HPC research at various universities, we have found that the majority of them regard how to express their ideas as the key hurdle that hampers their progress. This student body consists of both native and foreign students. Here, we use expressing to indicate either writing or presenting, or both.

The other fact that further strengthens our desire of providing this lightning talk is that a variety of existing research experience articles [2], [3], [1], [7], [5], [6] are more of helping researchers advance their expressing skills from a status that they already know how to express. In other words, they only cover discontinued bullets about principles. This lightning talk, in contrast, explains how to *step-by-step express a research mainly for HPC researchers*.

HPC research differs from other Computer and Information Science and Engineering (CISE) fields in three, if not more, ways. First, HPC research is inherently inter-disciplinary, that is, it often requires to build a fast computing system for important applications or algorithms. Second, HPC publications care more about the performance impacts of each proposed technique. Third, HPC research is more of accelerating existing functionalities, instead of inventing new ones. These rigid yet blurry features make expressing HPC research challenging. In light of fresh HPC researchers, this lightning talk will include the following three actionable pillars.

First, reading - writing - presentation should come together for expressing an HPC paper. Particularly, reading can help writing in the following ways: we should apply the positive writing skills from the paper we read to our own writing. Using the introduction of HPC papers as an example, you will find majority of the HPC papers start with describing the importance of the focused applications or algorithms, then the shortcomings of the existing work, followed by potentially some descriptions about the hardware systems, eventually the designed and implemented techniques, as well as their impacts. Consequently, we should write our HPC paper similarly. It is also worthy of mentioning that presentation helps write HPC papers significantly. For instance, if your writing contains mistakes, you will often notice them when speaking it out loud.

Second, "think like your audience" is the key to help write an HPC paper. Believe it or not, writing is the most important skill for a fresh researcher because publications are, unanimously, the most profound metric of success for a researcher. However, fresh researchers often fail at this task, regardless of native or foreign students. The root cause of this failure is the *gap between writers and readers*. Particularly, the writers (i.e., researchers) have months on a topic while the readers (or the reviewers) would only pay at most hours. This gap is further amplified for HPC papers which are inter-disciplinary in nature. This lightning talk will carefully develop examples to illustrate the importance of "think like your audience", as well as the means towards that.

Third, patience is the virtue - you cannot become a good researcher in one day, which is especially true for HPC research because it asks for the understanding of the background applications and the systems, as well as advancing the state-of-the-art. At the very beginning, we encourage the fresh HPC researchers to simply imitate the leading researchers about the expressing style (note, not copying the contents, but the style). After an array of styles is learnt, your will become a proficient researcher. A famous Chinese proverb once said that *once you read thousands of papers, god will help you write*. This underscores the significance of building background in research.

In summary, this lightning talk brings together two presenters of complementary experiences and backgrounds. With tremendous passion in promoting HPC research education, we are jointly hosting a forum about how to do research on GitHub (https://github.com/asherliu/researchHOWTO), hoping to benefit our community at large.

References

[1] André DeHon. How to be a winner. Retrived from https://www.seas.upenn.edu/~andre/general/student_research_advice.html. Accessed: 2019, July 6.

[2] Levin, R., and Redell, D. D. An evaluation of the ninth sosp submissions or: How (and how not) to write a good systems paper.

[3] Patterson, D. A. How to have a bad career in research/academia.

[4] Polanyi, M. *The tacit dimension*. University of Chicago press, 2009.

[5] Simon Peyton Jones. How to write a great research paper, proposal and give a great research talk. Retrived from https://www.microsoft.com/en-us/research/people/simonpj/. Accessed: 2019, July 6.

[6] Xie, Tao. How to write research papers. Retrived from http://taoxie.cs.illinois.edu/publications/writepapers.pdf. Accessed: 2019, July 6.

[7] Zhou, Hai and Dijkstra, Edsger. The Three Golden Rules for Successful Scientific Research. Retrived from https://www.cs.utexas.edu/users/EWD/transcriptions/EWD06xx/EWD637.html. Accessed: 2019, July 6.