

Nominee:

Jeannette Wing
Director of Data Science Institute
Professor of Computer Science
Columbia University, NY, USA
wing@columbia.edu

Summary of achievements and evidence:

Prof. Jeannette Wing has been an outstanding contributor to both the theory and adoption of formal methods in industry for nearly 40 years.

Prof. Wing has made a number of long-lasting contributions to the theoretical foundations of formal software design. She is well-known for her seminal work with Maurice Herlihy on *linearizability*, a formal notion of correctness for concurrent programs that is now considered one of the fundamental models of consistency in distributed systems [3]. She is also recognized for her work with Barbara Liskov on a formal notion of behavioral subtyping [4], also famously known as the *Liskov substitution principle*. Her work on both linearizability and subtyping have also had significant impact on the industry; these concepts are regularly taught and included as part of standard curriculums for distributed systems and object-oriented programming, respectively. She was also one of the original contributors to Larch [2], an influential and one of the earliest examples of algebraic specification languages.

She has also made significant contributions to the use of formal methods in security. She created the concept of *attack graphs* as a formal representation of attacks on computer systems and developed techniques for automatically generating attack graphs from a formal system model [5]. She was also one of the first to propose a formal definition of an *attack surface* [7] and influenced the design of the Attack Surface Analyzer tool at Microsoft.

In addition to her theoretical contributions, she has been instrumental in raising awareness of formal methods and encouraging its adoption in industry. Her survey papers on formal methods [1,8] remain some of the most well-cited papers introducing the research field to a more general CS audience. As a Corporate Vice President of Microsoft Research between 2013 and 2017, she led the operations of its research labs worldwide, some of which have been at the forefront of the formal methods research in industry. While at Microsoft, she also led effort integrating research results into practice, including secure computation for cloud computing (now part of Azure Confidential Computing) and privacy-compliance checking tools [6].

Prior to Microsoft, she was an Assistant Director for Computer and Information Science and Engineering (CISE) at the National Science Foundation (NSF) in the US. In particular, she created the Expeditions in Computing program, which provided funding for large-scale, ambitious research projects. Noteworthy projects funded under this program that have contributed to the advancement of formal methods include the "Expeditions in Computer Augmented Program Engineering (ExCPAPE)", which has resulted in a number of major breakthroughs in program synthesis (<https://excape.cis.upenn.edu/>), and the "Science of Deep Specification", which has supported cutting-edge research into formal verification of whole system stacks (<https://deepspec.org/page/Research/>).

In summary, given her outstanding contributions to the theory, advancement, and adoption of formal methods, we give our strongest recommendation to Prof. Wing for an FME Fellowship Award.

[1] *Formal methods: State of the art and future directions*. E. M. Clarke, J. M. Wing. ACM Computing Surveys (CSUR) 28 (4), 626-643, 1996. (1982 citations on Google Scholar)

- [2] *The Larch Family of Specification Languages*. J. V. Guttag, J. J. Horning, J. M. Wing. IEEE Softw. 2 (5), 24-36, 1985. **(390 citations)**
- [3] *Linearizability: A correctness condition for concurrent objects*. M. P. Herlihy, J. M. Wing. ACM Transactions on Programming Languages and Systems (TOPLAS) 12 (3), 463-492, 1990. **(3502 citations)**
- [4] *A behavioral notion of subtyping*. B. H. Liskov, J. M. Wing. ACM Transactions on Programming Languages and Systems (TOPLAS) 16 (6), 1811-1841, 1994. **(1606 citations)**
- [5] *An attack surface metric*. P. K. Manadhata, J. M. Wing. IEEE Transactions on Software Engineering 37 (3), 371-386, 2010. **(685 citations)**
- [6] *Bootstrapping privacy compliance in big data systems*. S. Sen, S. Guha, A. Datta, S. K. Rajamani, J. Tsai, J. M. Wing. IEEE Symposium on Security and Privacy, 327-342, 2014.
- [7] *Automated generation and analysis of attack graphs*. O. Sheyner, J. Haines, S. Jha, R. Lippmann, J. M. Wing. IEEE Symposium on Security and Privacy, 273-284, 2020. **(1631 citations)**
- [8] *A specifier's introduction to formal methods*. J. M. Wing. Computer 23 (9), 8-22, 1990. **(1126 citations)**

Nominators:

Eunsuk Kang
Assistant Professor of Computer Science
Carnegie Mellon University, PA, USA
eunsukk@andrew.cmu.edu

David Garlan
Professor of Computer Science
Carnegie Mellon University, PA, USA
garlan@cs.cmu.edu