

NITheCS

National Institute for
Theoretical and
Computational Sciences

NITheCS Colloquium

Monday, 2 August 2021, 16h00

Prof Ina Schaefer (Technical University of Braunschweig), Prof Bruce Watson (SU) & Tobias Runge (Technical University of Braunschweig)

“Designing Correct Algorithms”



ABSTRACT

This talk gives a short introduction to Correctness-by-Construction (CbC) as applied to inventing new algorithms. Algorithms serve as the cornerstone of *Computational Thinking* and are by far the single most impactful invention. Traditionally, new algorithms have been designed by evolving and testing/debugging existing ones – though very occasionally through deep insights into the application domain. Testing only shows the presence (and never the absence) of errors and the resulting algorithms have often required correction through publication or code patches. That was bad enough with the small number of life-critical algorithms in autopilots and autonomous vehicles, but we are now in the era of widespread AI/Machine Learning in which highly influential algorithms are created by *algorithms/data*, and such debugging-oriented algorithm invention should be deeply worrying.

CbC is a methodology for inventing traditional algorithms that are guaranteed to be error-free – through a sequence of small refinement steps, starting from the specification and ending with an implicit correctness proof as well as the algorithm. CbC is relatively underused despite the error-free guarantees and some researchers being awarded the Turing for their involvement. Our group has used CbC to invent some of the best-performing algorithms, for example in pattern recognition (for network security) and lattice construction (for big data, cyberwarfare, and wine-science). This talk will additionally provide an overview and demo of a recently-developed tool supporting CbC.

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BIOGRAPHIES

Prof Ina Schaefer

Ina Schaefer is Full Professor and Head of the Institute of Software Engineering and Automotive Informatics at the Technical University of Braunschweig, Germany. Her research focus is quality assurance and correctness-by-construction engineering, particularly for variant-rich and evolving software systems. She received her PhD from the TU Kaiserslautern in 2008 and been a postdoc at Chalmers University, Gothenburg.

Prof Bruce Watson

As a member of the Centre for AI Research and the School for Data-Science & Computational Thinking, Bruce is involved in research that includes algorithm design, programming language and compiler implementation, and machine learning and knowledge representation. The resulting techniques are applied in areas as diverse as cyberthreat intelligence, social network analysis, natural language processing and wine science.

Watson's first PhD is in computing science/engineering from Eindhoven, after studying discrete mathematics and computer science in Waterloo (Canada). He later returned to Eindhoven as chair of Software Construction and subsequently completed his second PhD at the University of Pretoria. Parallel to his academic career, he worked on compilers (Microsoft and Ribbit), network security (Cisco and Netronome), nanolithography and simulation (Brion and ASML), and has been involved in several high-tech start-ups.

Tobias Runge

Tobias Runge is a PhD student since 2017 at the Technical University of Braunschweig, Germany. He is interested in formal methods, especially the correctness-by-construction approach, for which he and his colleagues have developed tool support.

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