Title: Automatic Verification of Message-Passing Concurrency

Speaker: Prof. Luke Ong  
Department of Computer Science  
University of Oxford

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Chaired by: Dr P.S. Thiagarajan, Professor, School of Computing  
(thiagu@comp.nus.edu.sg)

Abstract:

We study the reachability problem of concurrent pushdown systems that communicate via unbounded and unordered message buffers, a model of computation for concurrency-oriented programming languages such as Erlang and Go. Our goal is to relax the common restriction that messages can only be retrieved by a pushdown process when its call stack is empty. We introduce a new class of concurrent pushdown systems -- Asynchronously Communicating Pushdown Systems (ACPS) -- with a shape constraint for which the coverability problem is decidable, thus enabling a larger class of concurrent programs to be modelled. We then establish a close connection between ACPS with shaped stacks and a novel extension of Petri nets: Nets with Nested Coloured Tokens (NNCTs). We show that the coverability problem for NNCTs is Tower complete. To our knowledge, NNCT is the first extension of Petri nets (with an infinite set of token types) which have primitive recursive coverability. This result implies Tower completeness of coverability for ACPS with shaped stacks.

This talk will begin with a survey of a recent project [1], Soter, to verify safety properties of Erlang programs by abstract interpretation and infinite-state model checking, and a discussion of the lessons learn, which motivates the work described above.

This is joint work with Jonathan Kochems and Emanuele D'Osualdo.


Biodata:

Luke Ong is Professor of Computer Science at University of Oxford, and Fellow of Merton
College. He holds a BA in Mathematics (1984, Triple First) and a Postgraduate Diploma in Computer Science (1985, Distinction) from University of Cambridge, and PhD in Computer Science (1988) from Imperial College London. After a Lectureship at NUS (1991) and a Prize Research Fellowship at University of Cambridge (1992-1993), he was appointed to a University Lectureship at University of Oxford in 1994 and promoted to Professor in 2004.

Ong has worked in many areas in the semantics and logic of computation, programming languages, and algorithmic verification. He has played a leading role in the development of game semantics of programming languages: his solution (with Hyland) to the PCF Full Abstraction Problem has come to be known as the Hyland-Ong game. His LICS 2006 paper, "On model-checking trees generated by higher-order recursion schemes", has opened up Higher-Order Model Checking, a new branch of algorithmic verification.