Automatic Generation of High Quality Assertions

Assertions are ubiquitous in the design of today’s systems due to their versatile roles in verification, reliability and analysis. The effectiveness of assertion based methodologies is highly contingent on the type, number and quality of assertions that are written. Knowing what assertions to write is a manual, time-intensive, ad-hoc, subjective process. In this talk, I will present methods for automatic assertion generation that rely on statistical as well as static analyses of the system. GoldMine, our assertion generation software, uses algorithms that combine data mining and control flow graph analysis to provide high quality assertions. I will present real case studies in hardware and systems-on-a-chip where GoldMine has been successfully applied. I will also present algorithms that make GoldMine’s assertions concise, precise and expressive.

I will also present a methodology for generating test inputs iteratively using GoldMine. The methodology generates a test set with monotonically increasing coverage, and achieves test coverage closure within a few iterations.

I will finally discuss what a "good assertion" means—can we come up with a figure of merit for system properties? Is there an underlying principle of quality in the properties we express as humans? Can we objectify these notions for system properties?