Thesis Topic – A Tool for Regular Real Analysis

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1 Project Tasks

In recent work (`www.cs.rice.edu/~sc40/pubs/lics13.pdf`), a new approach was presented to encode functions on the real numbers using Büchi automata [CSV13]. Automata-based constructions are given for composing simple functions and for deciding properties of functions like continuity.

The goals of the thesis would be the following:

- Familiarize yourself with the literature and choose a suitable library for Büchi-Automata (e.g. http://spot.lip6.fr/wiki/).

- Implement the constructions from the paper, develop optimized variants, and produce a library to aid experimentation with regular real functions (e.g. enable easy construction of functions via several predefined primitive functions).

- Complete the missing proofs of constructions (e.g. automata constructions for linear combinations of functions, fixed-point computation of regular functions),.

- (Practice) Experiment with your tool and assess the practicality of the approach.

- (Practice) Investigate Applications [CGLN11, CGL10] (e.g. automatic stability analysis of controllers)

- (Theory) Try to lower the complexity of the problem of recognizing a regular function or prove PSPACE hardness.

- (Theory) Investigate how to check differentiability of certain regular functions. To this end, use your tool to identify a suitable subclass of functions since the general problem might be hard.

This topic can be pursued as a Bachelor's thesis, Master's thesis, or as a guided research project, depending on your interests and level of expertise.

2 Contact

If you are interested, please write an email to Maximilian Schlund (schlund@model.in.tum.de) or just drop by at my office (Room 03.11.055).

References

[CGL10]   Swarat Chaudhuri, Sumit Gulwani, and Roberto Lublinerman. Continuity analysis of programs. In *Proceedings of the 37th ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages, POPL 2010, Madrid, Spain, January 17-23, 2010*, pages 57–70, 2010.

[CGLN11] Swarat Chaudhuri, Sumit Gulwani, Roberto Lublinerman, and Sara NavidPour. Proving programs robust. In *SIGSOFT/FSE'11 19th ACM SIGSOFT Symposium on the Foundations of Software Engineering (FSE-19) and ESEC'11: 13rd European Software Engineering Conference (ESEC-13), Szeged, Hungary, September 5-9, 2011*, pages 102–112, 2011.

[CSV13]   Swarat Chaudhuri, Sriram Sankaranarayanan, and Moshe Y. Vardi. Regular real analysis. In *28th Annual ACM/IEEE Symposium on Logic in Computer Science, LICS 2013, New Orleans, LA, USA, June 25-28, 2013*, pages 509–518, 2013.