
— Bachelor's or Master's Thesis —

Expressive Predicates for Sets of Distributions

What is it all about?

Distributions over a set S are mappings $\mu: S \rightarrow [0, 1]$ such that $\sum_{s \in S} \mu(s) = 1$. In our context, we usually deal with distributions over **program states**. To represent a set of distributions, we can establish a **predicate** describing this set. For example, $\Pr[x \leq 42] \geq 0.9$ describes the set of all distributions, for which the variable x has a value less or equal than 42 with probability at least 90 per cent. There is already literature about different syntactic approaches to establish predicates [dHdV02, BEG⁺18].

There is also the possibility to implement (an automatic evaluation of) the predicates, for more practically interested people!

What is to be done?

The goals of this project are:

1. **Syntactically define** multiple predicate languages (from the literature) and **compare** them
2. **Explore** the expressiveness of the languages, i.e., can **all** sets of distributions be represented by some predicate?

This list is of course non-exhaustive! The above suggestions may be changed, shortened and/or extended while we work on our project and gain more insights on how difficult the topic is.

What we expect:

- Solid background in theoretical computer science and maths – ideally you have already taken theoretical CS electives
- Passion and endurance for solving theoretical problems

What you can expect:

- Get a chance to work on relevant problems of both theoretical and practical nature
- You can work in the student room at our chair – we have a coffee machine, lots of tea and sometimes cookies :)

Apply

- Daniel Zilken (daniel.zilken@cs.rwth-aachen.de)
Please introduce yourself briefly and say why you're interested in this topic!

References

- [BEG⁺18] Gilles Barthe, Thomas Espitau, Marco Gaboardi, Benjamin Grégoire, Justin Hsu, and Pierre-Yves Strub. An Assertion-Based Program Logic for Probabilistic Programs. In *Programming Languages and Systems*, volume 10801 of *Lecture Notes in Computer Science*, pages 117–144. Springer, 2018.
- [dHdV02] Jerry den Hartog and Erik P. de Vink. Verifying Probabilistic Programs Using a Hoare Like Logic. *Int. J. Found. Comput. Sci.*, 13(3):315–340, 2002.