

PGF transformer semantics

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You may have doubts

The theme: PGF transform semantics based equivalence checking of pGCL programs

Equivalence checking?

This work is about linearity no normalization is ever involved.

I heard the problem is undecidable!

We will focus on a restricted fragment of pGCL called ReDiP.

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Backgrounds

Motivation

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The research questions

Overview of our solution

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Syntax of pGCL

Semantics of pGCL

A fragement of pGCL: ReDiP

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Review on PGFs

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Fixed Point Induction

Linearity & Closed-form preservation

Summary

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Benchmark setup

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Conclusion

Limitations and future works

Questions are welcomed.

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7 references

- [1] Mingshuai Chen et al. Does a Program Yield the Right Distribution? Verifying Probabilistic Programs via Generating Functions. 2022. [arXiv: 2205.01449 \[cs.LG\]](#).
- [2] He Jifeng, K. Seidel, and A. McIver. “Probabilistic models for the guarded command language”. In: Science of Computer Programming 28.2 (1997). Formal Specifications: Foundations, Methods, Tools and Applications, pp. 171–192. ISSN: 0167-6423. DOI: [https://doi.org/10.1016/S0167-6423\(96\)00019-6](https://doi.org/10.1016/S0167-6423(96)00019-6). URL: <https://www.sciencedirect.com/science/article/pii/S0167642396000196>.
- [3] Lutz Klinkenberg et al. “Exact Bayesian Inference for Loopy Probabilistic Programs using Generating Functions”. In: Proc. ACM Program. Lang. 8.OOPSLA1 (2024).
- [4] Lutz Klinkenberg et al. “Exact Probabilistic Inference Using Generating Functions”. In: LAFI. [Extended Abstract]. 2023.
- [5] Aaron Meurer et al. “SymPy: symbolic computing in Python”. In: PeerJ Computer Science 3 (Jan. 2017), e103. ISSN: 2376-5992. DOI: 10.7717/peerj-cs.103. URL: <https://doi.org/10.7717/peerj-cs.103>.
- [6] Chen Mingshuai et al. “Does a program yield the right distribution? Verifying probabilistic programs via generating functions”. In: International Conference on Computer Aided Verification. Springer. 2022, pp. 79–101.
- [7] Philipp Schröer, Lutz Klinkenberg, and Leo Mommers. Probably. <https://github.com/Philipp15b/probably>. 2021.
- [8] Herbert S Wilf. generatingfunctionology. CRC press, 2005.