Summary: Program equivalence in linear contexts, where programs are used or executed exactly once, is an important issue in programming languages. However, existing techniques like those based on bisimulations and logical relations only target at contextual equivalence in the usual (non-linear) functional languages, and fail in capturing non-trivial equivalent programs in linear contexts, particularly when non-determinism is present. We propose the notion of linear contextual equivalence to formally characterize such program equivalence, as well as a novel and general approach to studying it in higher-order languages, based on labeled transition systems specifically designed for functional languages. We show that linear contextual equivalence indeed coincides with trace equivalence. We illustrate our technique in both deterministic (a linear version of PCF) and non-deterministic (linear PCF in Moggi’s framework) functional languages.

Keywords: linear PCF; contextual equivalence; trace equivalence; non-determinism
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