

# Latticed $k$ -Induction with an Application to Probabilistic Programs

(Invited Talk)

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We revisit two well-established verification techniques,  $k$ -induction and bounded model checking (BMC), in the more general setting of fixed point theory over complete lattices. Our main theoretical contribution is latticed  $k$ -induction, which (i) generalizes classical  $k$ -induction for verifying transition systems, (ii) generalizes Park induction for bounding fixed points of monotonic maps on complete lattices, and (iii) extends from naturals  $k$  to transfinite ordinals  $\kappa$ , thus yielding  $\kappa$ -induction (pronounced “kappa induction”). The lattice-theoretic understanding of  $k$ -induction and BMC enables us to apply both techniques to the fully automatic verification of infinite-state probabilistic programs. Our prototypical implementation manages to automatically verify non-trivial specifications for probabilistic programs taken from the literature that — using existing techniques — cannot be proven without synthesizing a stronger inductive invariant first.