# Practical Course - Recent Advances in Model Checking

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# Introduction

- Correct Probabilistic Model Checking with Floating-Point Arithmetic, by Arnd Hartmanns.

- Probabilistic model checkers can return erroneous results.

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- Computing reachability probabilities using numerical approximate methods (e.g., Value Iteration).

## Value Iteration

- Initialize solution vector $x$.
- Iterate:
- $x_{n+1}(s) = \max_{a \in A(s)} \sum_{s' \in S} \delta(s, a, s') \cdot x_n(s')$.
  until convergence.

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- **Main claim of the paper:** *"Using a sound algorithm does not guarantee correct results."*

## Rounding modes and proposed solution

- IEEE 754 standard defines three directed rounding modes: round towards zero (i.e. truncation), round towards $+\infty$ (i.e., always round up), and round towards $-\infty$ (i.e. always round down).

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- For example, when checking whether the relative error $> \epsilon$, round towards $+\infty$, etc.

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- You will learn a lot about the state of the art algorithms used in probabilistic verification.

- Control of the floating-point rounding mode however appears to be a rarely-used feature of IEEE 754 implementations.