

# Fixpoints vs Moore Families

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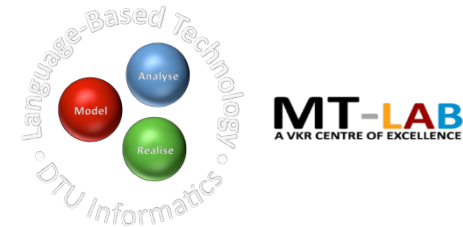
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**MT-LAB**  
A VKR CENTRE OF EXCELLENCE

# Background

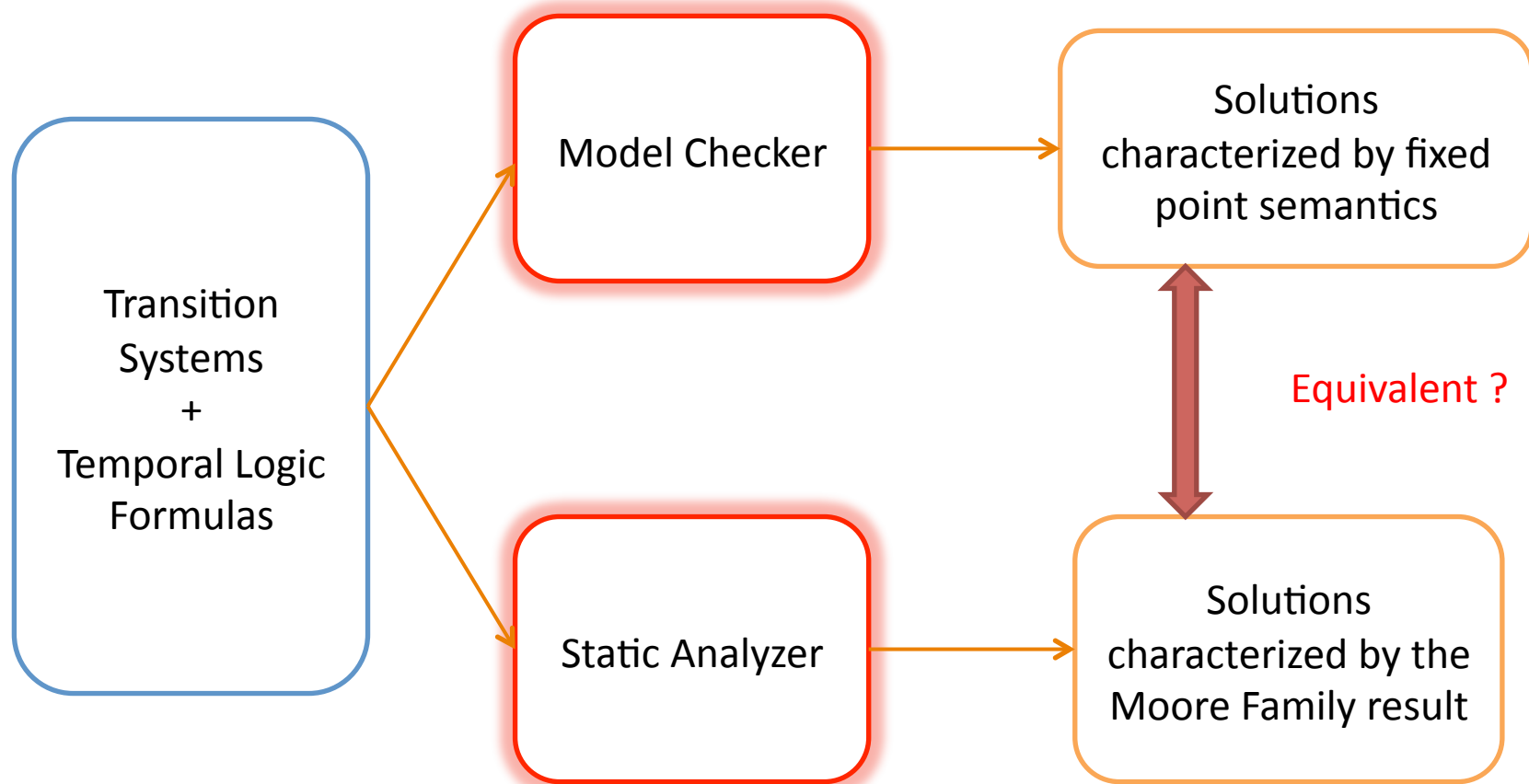
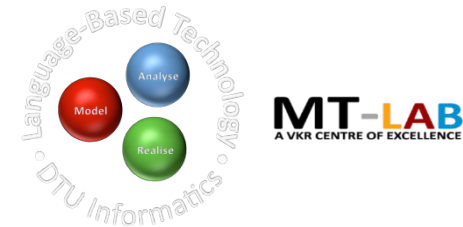
## Model Checking vs Static Analysis



- Static analysis problems can be reduced to model checking.
  - Bernhard Steffen: Data Flow Analysis as Model Checking. *TACS 1991* : 346-365
  - Bernhard Steffen: Generating Data Flow Analysis Algorithms from Modal Specifications. *Sci. Comput. Program.* 21 (2): 115-139 (1993)
  - David A. Schmidt, Bernhard Steffen: Program Analysis as Model Checking of Abstract Interpretations. *SAS 1998* : 351-380
  - David A. Schmidt: Data Flow Analysis is Model Checking of Abstract Interpretations. *POPL 1998* : 38-48
- Model checking can be encoded in static analysis.
  - Flemming Nielson, Hanne Riis Nielson: Model Checking Is Static Analysis of Modal Logic. *FOSSACS 2010* : 191-205

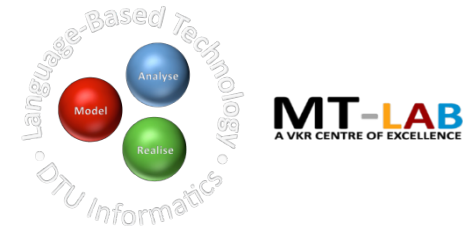
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## Setting the Scene

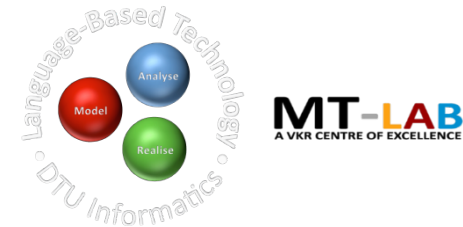
# Model Checking vs Static Analysis



- Model checking for the  $\mu$ -calculus:
  - The alternation-free fragment of the  $\mu$ -calculus
  - The  $\mu$ -calculus formulas of alternation depth  $n$  ( $n > 1$ )
- Alternation-Free Least Fixed Point logic (a logic approach to static analysis)
  - We use *stratification* to deal with negative uses of relations.
  - The Moore Family result: the set of solutions to an ALFP clause constitutes a Moore Family

## Research Results

# Model Checking vs Static Analysis



- The alternation-free fragment of the  $\mu$ -calculus can be encoded in ALFP.
  - The Moore family result makes use of a lexicographic ordering imposed by a suitable choice of ranking of the relations in the ALFP formula.
  - The set of states of a formula that make it true over a given Kripke structure is described as the least element in a Moore family of acceptable sets of states for the static analysis.
- It's not feasible to encode the  $\mu$ -calculus formulas of alternation depth  $n$  ( $n > 1$ ) into ALFP in a similar way.
  - It's interesting to identify fragments of the  $\mu$ -calculus that reside properly between alternation depth 2 and alternation free for which the ALFP-based development might still work.