Restricted Chase Termination

You Want More than Fairness

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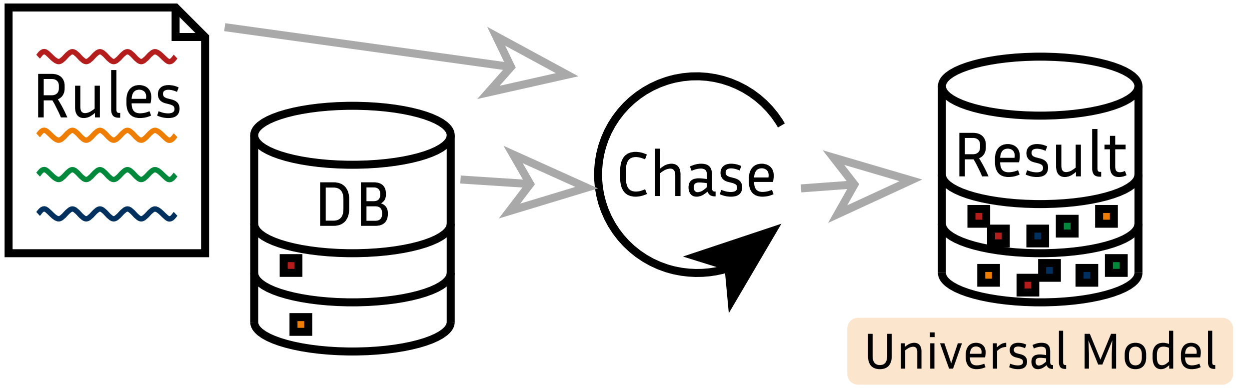
TECHNISCHE UNIVERSITÄT DRESDEN International Center for Computational Logic Inria

Chase Crash Course



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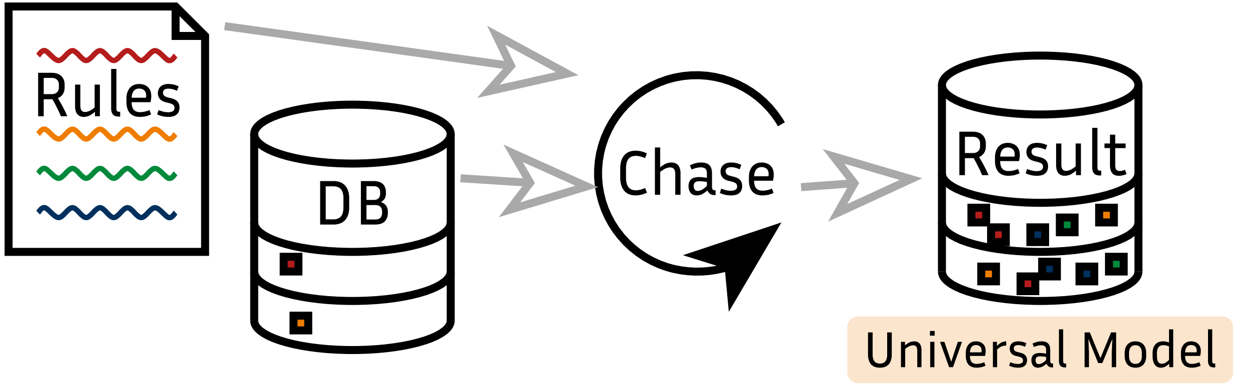

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$$R(x, y) \rightarrow R(y, x)$$

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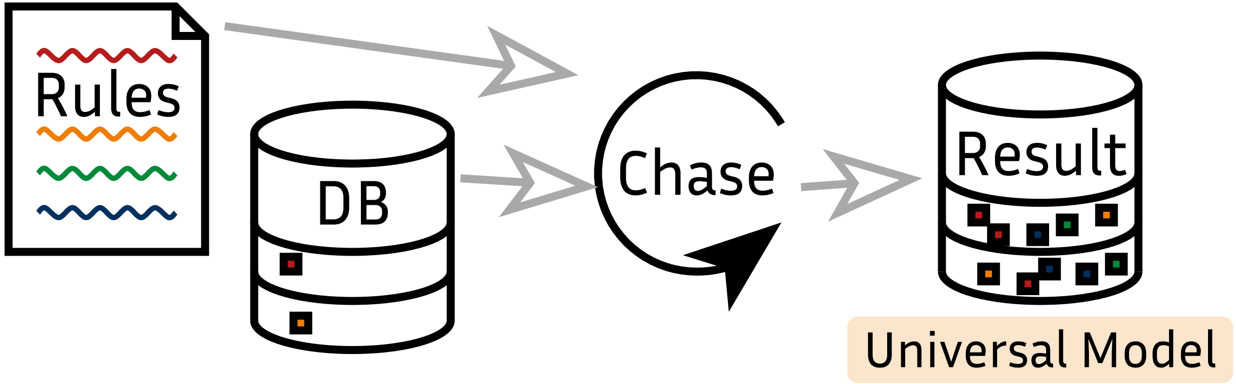

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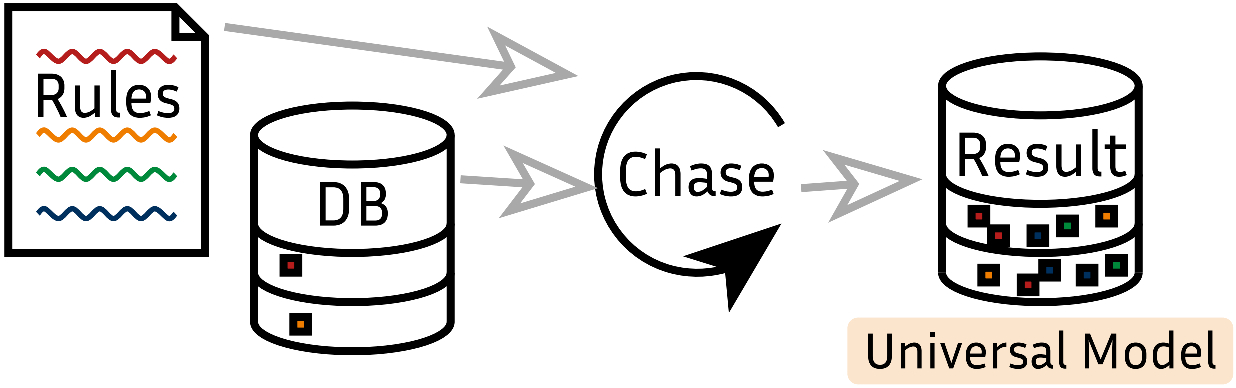

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Step 1: $R(c, n_1)$, $B(n_1)$

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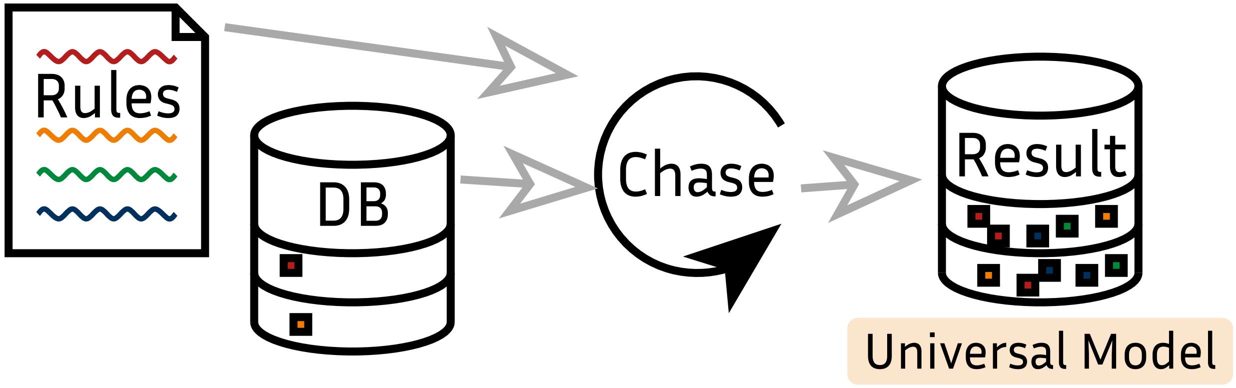

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Step 2: $\mathrm{A}(n_1)$; Step 3: $\mathrm{R}(n_1, c)$

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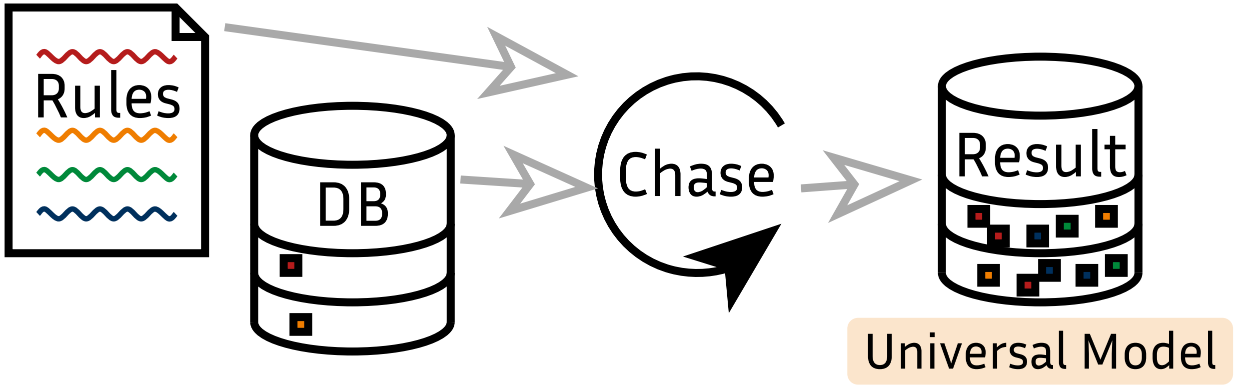

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Universal Models are "most general" and can answer conjunctive queries.

Chase Termination is Undecidable

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Step 1-2: $\mathrm{R}(c, n_1)$, $\mathrm{B}(n_1)$, $\mathrm{A}(n_1)$

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Step N: $\mathrm{R}(n_1, c)$ (due to Fairness)

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$\mathrm{CTR}^r_\forall$ is analogous for rule sets by $\forall$-quantifying over all databases.

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Σ_1^0 - Semi-Decidable Languages (e.g. Halting Problem)

Π_2^0 - Co-Semi-Decidable with Semi-Decision Oracle (e.g. Universal Halting Problem)

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Membership: Run all Chase Sequences in Parallel

Hardness: TM can be simulated with Existential Rules

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Membership: Use $\mathrm{CTK}_{\exists}^{r}$ oracle.

Hardness: (more involved)
see (Grahne and Onet 2018)

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This does not work because of *fairness*!

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The upper bound was still unknown! (Until slide 6)

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Possible Fix: We could demand something stronger, e.g. “breadth-first”.

Fairness for NTMs - based on (Harel 1986)

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This problem is Σ_1^1-complete - first analytical hierarchy level - beyond infinitely many Turing jumps. (Harel 1986)

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Run visiting the desig. state infinitely often **iff** infinite fair chase sequence.
Hence: Complement of $\mathrm{CTK}_\forall^r$ is in Σ_1^1; therefore $\mathrm{CTK}_\forall^r$ is in Π_1^1.

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Idea: With emergency brakes, we can force the chase to terminate after finitely many steps. If the designated state is visited, we create a new brake.

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Membership: Similar to $\mathrm{CTK}^r_\forall$ case using universal non-recurrence.

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Summing up...

Fairness makes Chase Termination highly Undecidable.

Stricter, finitely verifiable conditions could solve this (e.g. breadth-first).

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📢 *Talk to me about Lean and Typst* 🤓

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