



An Abduction Framework for Handling Incompleteness in First-Order Learning

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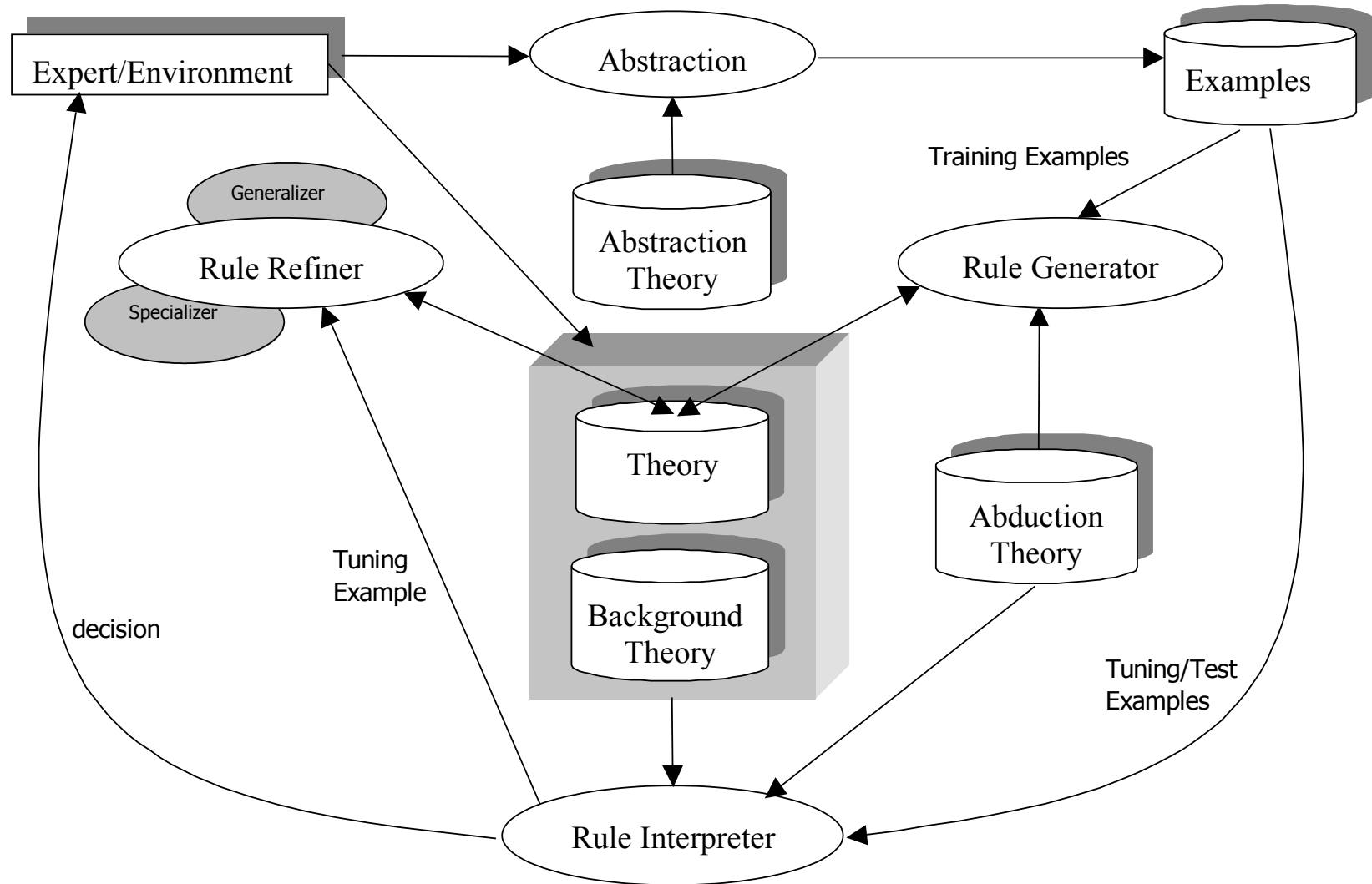
Overview

- INTHELEX
 - INcremental THEory Learner from EXamples
 - Features
 - Architecture
 - Multistrategy operators
- Experiments
- Connected Work

Features

- Multi-purpose
 - First-order logic hierarchical theories
- Object Identity assumption
- Fully incremental
 - Closed loop
- Multi-conceptual
 - Dependency graph
- Full memory storage
 - Historical memory of all positive/negative examples
- Multi-strategy
 - Induction
 - generalization, specialization
 - Abduction
 - Abstraction
 - Deduction

Architecture



Induction

- Generalization

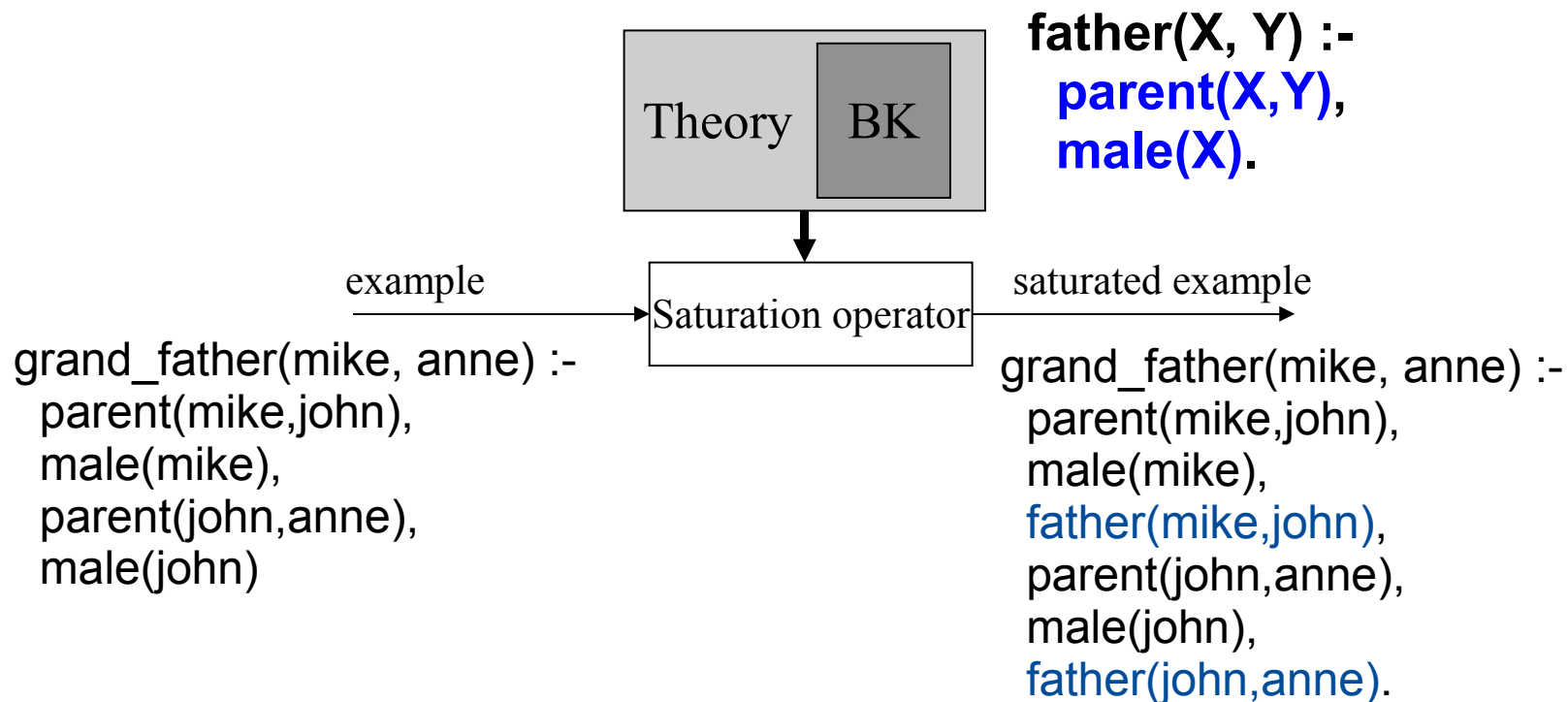
- (Least) General Generalization
 - under Object Identity
- Addition of new clause
- Exception

- Specialization

- Addition of positive literal(s)
 - Any clause in the derivation
- Addition of negative literal
 - Top-level clause
- Exception

Deduction

- Based on a saturation operator
 - Recognizes higher level concepts, deduced via subsumption and/or resolution, in the example descriptions



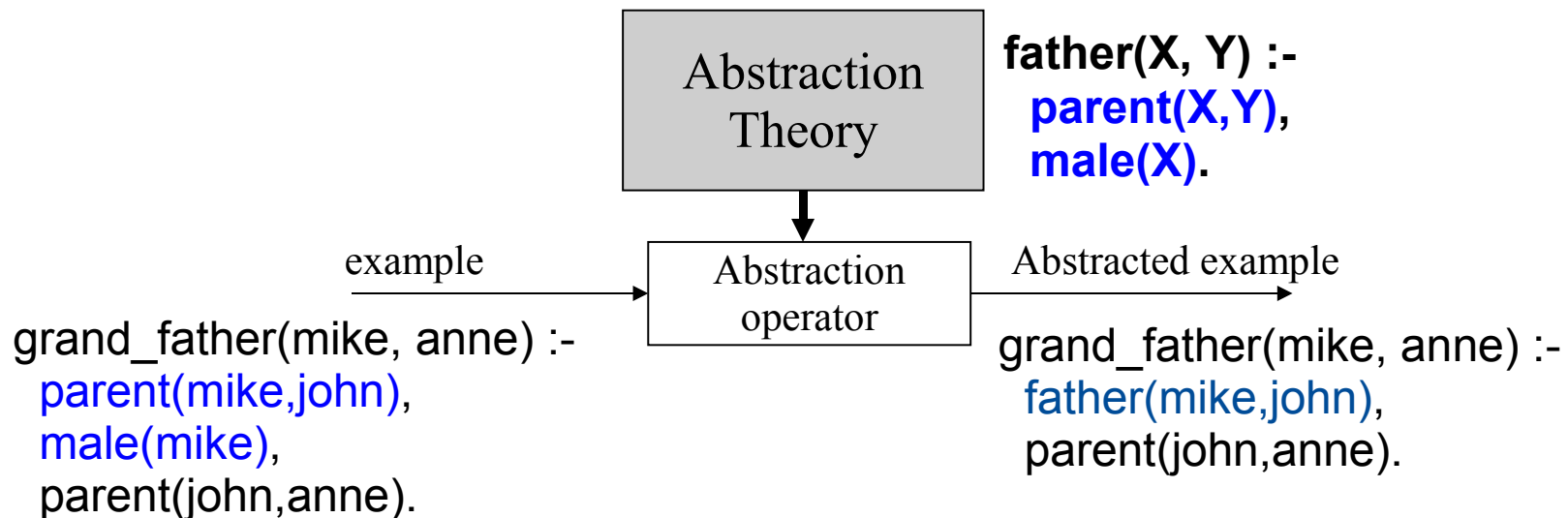
Abstraction

- Shift of representation language

- Abstraction Theory

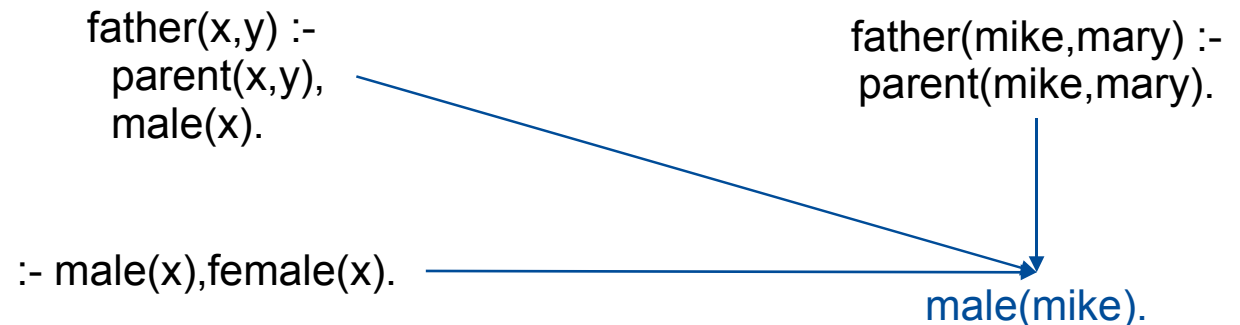
- Set of operators

- Replacing a number of components by a compound object
 - Decreasing the grain-size of a set of values
 - Ignoring whole objects or just part of their features
 - Neglecting the number of occurrences of some kind of object



Abduction

- Abductive logic theory
 - Intertwined abductive and consistency derivations
 - Abducibles
 - Predicates on which abductions can be made
 - Integrity Constraints
 - Indirect information about abducibles
 - Given a goal and a set of initial assumptions
Find a set of consistency hypotheses



Experiments

- Multiplexer
 - 64 possible configurations
 - 25% examples corrupted by 50% of description
 - Better behaviour and theories
 - Same time and accuracy
- Congressional Voting Records
 - Better behaviour, theories and accuracy
 - 33% worse runtime

Experiments

- Family Relationships
 - 36+, 200– examples, 742 literals description
 - Progressive Corruption (100% .. 40%)
 - Better behaviour, theories, runtime and accuracy
- Scientific Paper Classification
 - 4 classes, 112 literals description on average
 - 8% corruption of each example
 - Better behaviour, theories and accuracy
 - Worse runtime

Connected Work

- Automatic induction of integrity constraints
 - Providing correct abstraction theories can be difficult even for human experts
 - See above experiments for performance
- Induction of type constraints
 - Groups of unary predicates that represent different values of the same property
 - At most one literal in each group can be true for any given term
 - Speeds up the abductive proof