8.1 Bridge Section:

- The lecture “Database Theory” or “Deductive Databases” (MSc or advanced BSc) builds upon the “Introduction to Databases” lecture and requires knowledge about First-Order Logic (e.g., courses “Formal Systems” or “Artificial Intelligence”)
- This section summarizes that knowledge and motivates the main idea of the lecture.
- a database can be seen as a purely relational FOL structure
  - predicate symbols of different arities,
  - only 0-ary functions = constants
    - in relational DB: these are the literals (numbers, strings, dates ...)
    - in object-relational DB: also object identifiers
    - in RDF: also URIs, which basically serve as object identifiers

SOME CONTENTS STILL MISSING

TYPES OF KNOWLEDGE

- (positive) atomic facts:
  - DB: tuples in an n-column table of the database
  - FOL: $\mathcal{S} = (\mathcal{I}, \mathcal{D})$: for an n-ary predicate, $\mathcal{I}(p) \subset \mathcal{D}^n$
  - atoms in a formula

  $\Rightarrow$ conjunctions/sets of atomic facts
- negative atomic facts/knowledge:
  - rather "implicit": the n-tuples "not there" in a DB or not in $\mathcal{I}(p)$.

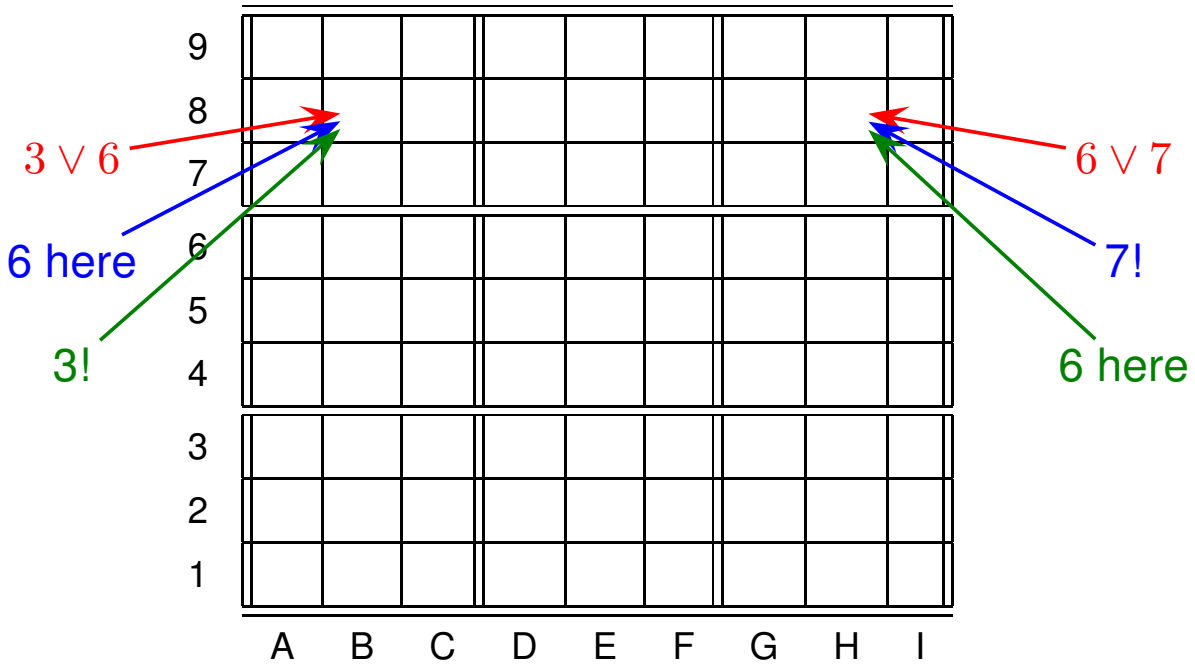
  $\Rightarrow$ queries under CWA and $\mathcal{S} \models \phi$.
- atomic positive conclusions: INSERT into DB, Views
- atomic negative conclusions: DELETE, or inconsistencies

Disjunctive Knowledge

- "$p(x)$ or $q(y)$ does hold"
- cannot be represented by a database or a single FOL interpretation, only by formulas

$\Rightarrow$ conclusions in "knowledge base"

Disjunctive Knowledge in Human Reasoning: Sudoku



B2:6 ∨ H2:6

$\Rightarrow$ B2:3 ∨ H2:7

Existential Knowledge

- "every country has some city that is its capital (and which is located in this country)"
  country(x)$\rightarrow \exists y$: (city(y) $\wedge$ located_in(y, x))
  - Mondial SQL: not null and foreign key to primary key reference:
    country.(code, capital, capprov) references city.(country, capital, province)
- "everything which is a parent has *some* child (which is a person)"
  ER model: Parent is a subclass of Person, minCardinality of "hasChild" is 1
  OWL/Semantic Web: Parent $\equiv \exists$child.Person
  $\Leftarrow$: SQL: view
  $\Rightarrow$: SQL: not possible
  FOL, e.g. tableau calculus: skolem function hasChild($alice$, $f_{\mathsf{child}}(alice)$)
- "every person has a parent (which is a person)"