

## 2. Properties of Relational Queries (1)

### 1. Satisfiability of Conjunctive Queries with Equalities and Comparisons

We consider conjunctive queries that in their body may contain comparisons, that is, atoms with the predicates “=”, “≠”, “≤”, and “<” and we are interested in finding out how difficult it is to decide whether a conjunctive query with comparisons is satisfiable.

(Of course, for queries with the predicates “≤” and “<” we have to specify which is the ordered domain over which those comparisons range. We will distinguish the two cases that they range over the rational numbers or over the integers.)

For each of the following classes of queries, describe a method by which one can check satisfiability: Conjunctive queries with

1. “=”
2. “=” and “≠”
3. “≤”, ranging over the rational numbers
4. “≤”, ranging over the integers
5. “≤” and “≠”, ranging over the rational numbers
6. “≤” and “<”, ranging over the rational numbers
7. “≤” and “<”, ranging over the integers.

### 2. Safety of Relational Queries

A query written in logical notation is safe if it returns finite results over all (finite) databases.

**Task:** Show that safety is not a recursive property.

**Hint 1:** You can take for granted that Trakhtenbrot’s Theorem holds:

Finite satisfiability of first order logic formulas is not a recursive property.

**Hint 2:** Application of this theorem needs a bit of care because the domain of our interpretations is not finite.

### 3. Evaluation of Conjunctive Queries

How difficult is it to decide the following problem:

**Given:** A conjunctive query  $q$  and a (finite) database instance  $\mathbf{I}$

**Question:** Is  $q(\mathbf{I}) \neq \emptyset$ ?