1. Relational Queries

1. Queries in Calculus, Algebra and SQL

Suppose there is a database with the Signature $\Sigma = \{\texttt{Movie}, \texttt{Schedule}\}$, which contains the relations

$\texttt{Movie}(\texttt{title}, \texttt{director}, \texttt{actor})$ $\texttt{Schedule}(\texttt{theater}, \texttt{mtitle})$

Both attributes, `title` and `mtitle`, refer to the title of a movie.

Consider the following queries:

1. Which theaters show some movies directed by Spielberg?
2. Which theaters do not show any movies directed by Spielberg?
3. Which theaters show only movies directed by Spielberg?
4. Which theaters show all movies directed by Spielberg?

Express each of the queries above in the three query languages of Relational Algebra, Relational Calculus, and SQL.

2. Positive Queries

A predicate logic formula is *positive* if it contains only the logical symbols "$\wedge$", "$\vee$", and "$\exists$". A relational calculus query Q_φ is *positive* if the defining formula φ is positive.

1. Is satisfiability of positive queries decidable? If yes, what does an algorithm look like? If no, how can one prove undecidability?
2. Are positive queries safe? Are they domain independent? Can one represent every positive query in relational algebra?