2. Datalog Queries

1. Datalog Queries over Graphs

We are given two directed graphs G_{black} and G_{white} over the same set V of vertices, represented as binary relations. Write datalog programs that compute

1. the set of pairs $\langle a, b \rangle$ of vertices such that there exists a path from a to b,

2. the set of pairs $\langle a, b \rangle$ of vertices such that there exists a path from a to b, where black and white edges alternate, starting with a white edge.

2. Datalog Queries over a Flight Database

Suppose in a travel agency database there is a table with the schema

$$\texttt{flight(from, to, airline)},$$

where an entry $(c1,\ c2,\ l)$ means that it is possible to fly from city $c1$ to city $c2$ with the airline l.
Consider the following two queries:

1. Return all pairs of cities (x, y) such that is possible to travel from x to y using flights of a *single* airline.

2. Return all pairs of cities (x, y) such that is possible to travel from x to y using flights of *no more than two* airlines.

Which of these queries can you express in datalog?