Querying Relational Concept Lattices

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Introduction

Relational Concept Analysis (RCA) constructs conceptual abstractions from a relational context family (RCF). An RCF is sets of objects described by both own properties and inter-object links. It generates several lattices that are connected via relational attributes. Navigating such interrelated lattice family in order to find concepts of interest is not a trivial task due to the potentially large size of the lattices and the need to move the expert's focus from one lattice to another. We propose a query-based navigation approach that helps an expert to explore a concept lattice family, according to a navigation schema.

Definition: Relational Context Family

An RCF is a pair $(\mathbb{K}, R)$ where $\mathbb{K}$ is a set of formal (object-attribute) contexts $K_i = (O_i, A_i, I_i)$ and R is a set of relational (object-object) contexts $r_{ij} \subseteq O_i \times O_j$ where O_i (domain of r_{ij}) and O_j (range of r_{ij}) are the object sets of the contexts K_i and K_j, respectively.

Example: RCF

An RCF of countries, restaurants, mexican dishes, ingredients, and salsas, together with relations between them.
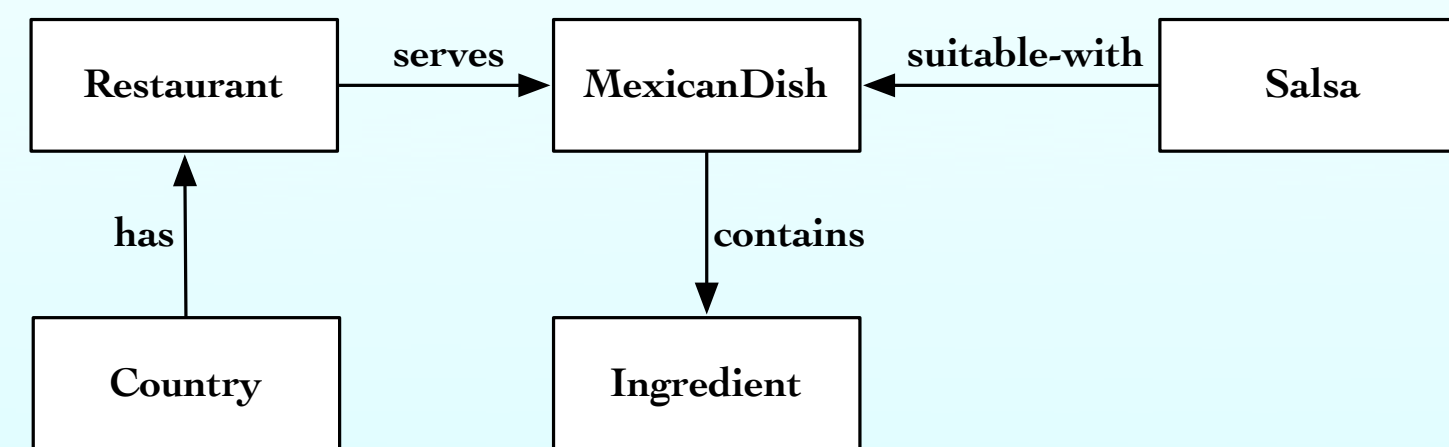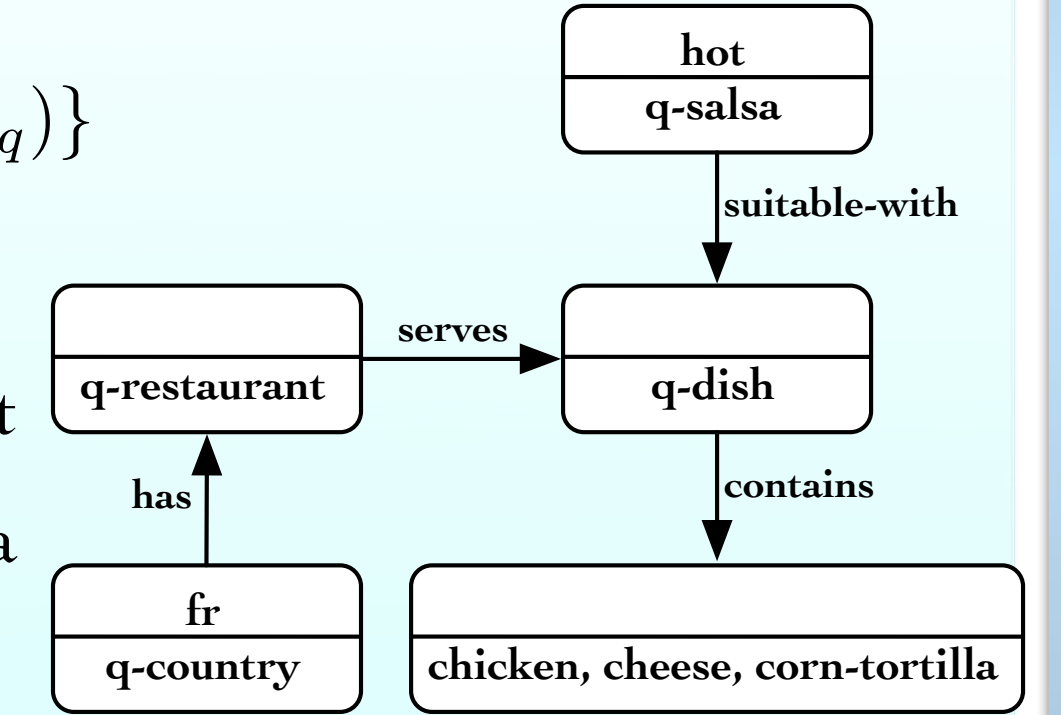
Definition: Relational Query

A relational query Q on a relational context family $(\mathbb{K}, R)$ is a pair $Q = (A_q, O_{vq}, R_q)$,

where: $A_q = \{q_{|K_i} \mid q_{|K_i}$ is a simple query on $K_i \in \mathbb{K}$ composed of a set of attributes from $A_i\}$

O_{vq} is the set of query objects

R_q is a set of relational constraints $R_q = \{(o_{vq|K_i}, r_{ij}, O_q)\}$
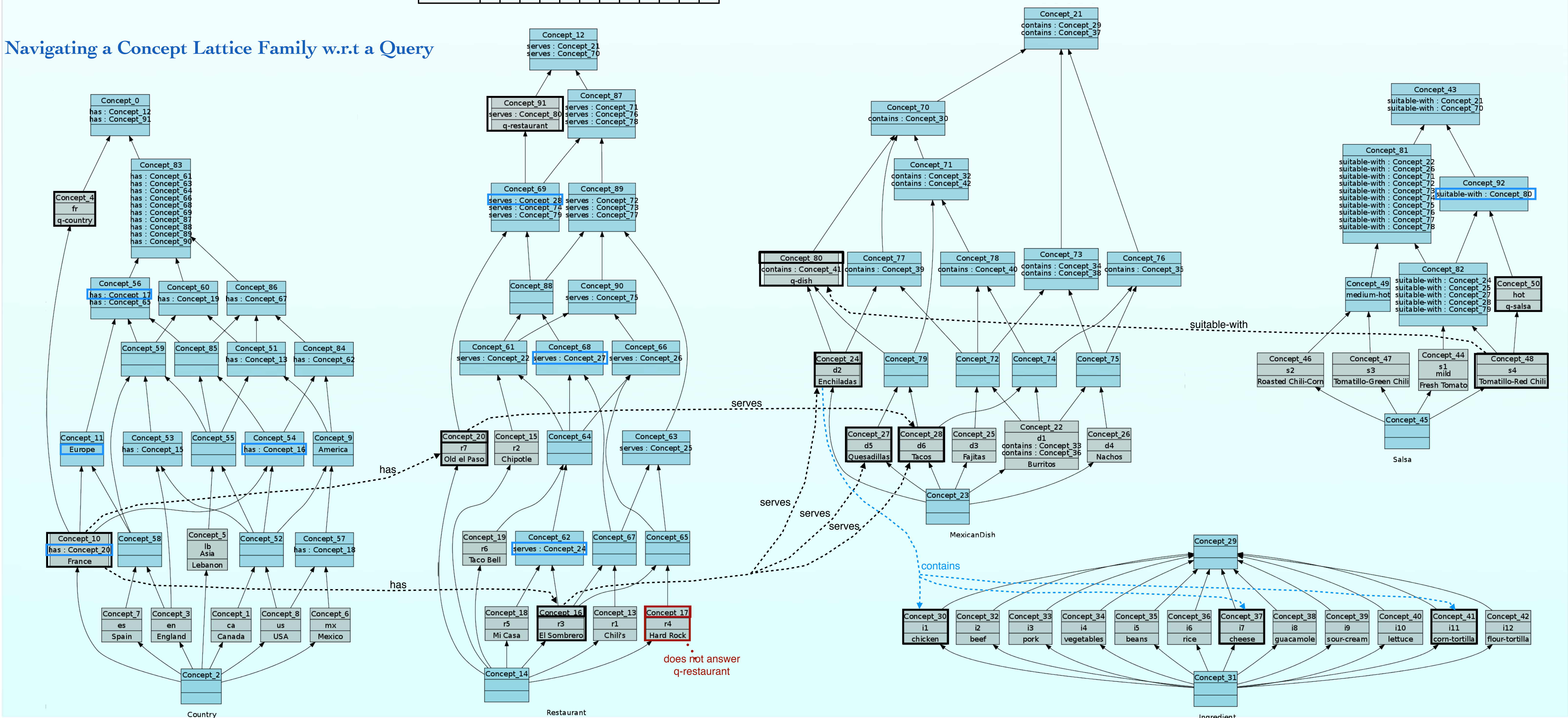
Example: Query

Find a country described by "*fr*", a restaurant of this country that serves a dish containing "*chicken*", "*cheese*", and "*corn-tortilla*", and a salsa that is "*hot*" and suitable with this dish.

Relational Context Family with a Relational Query
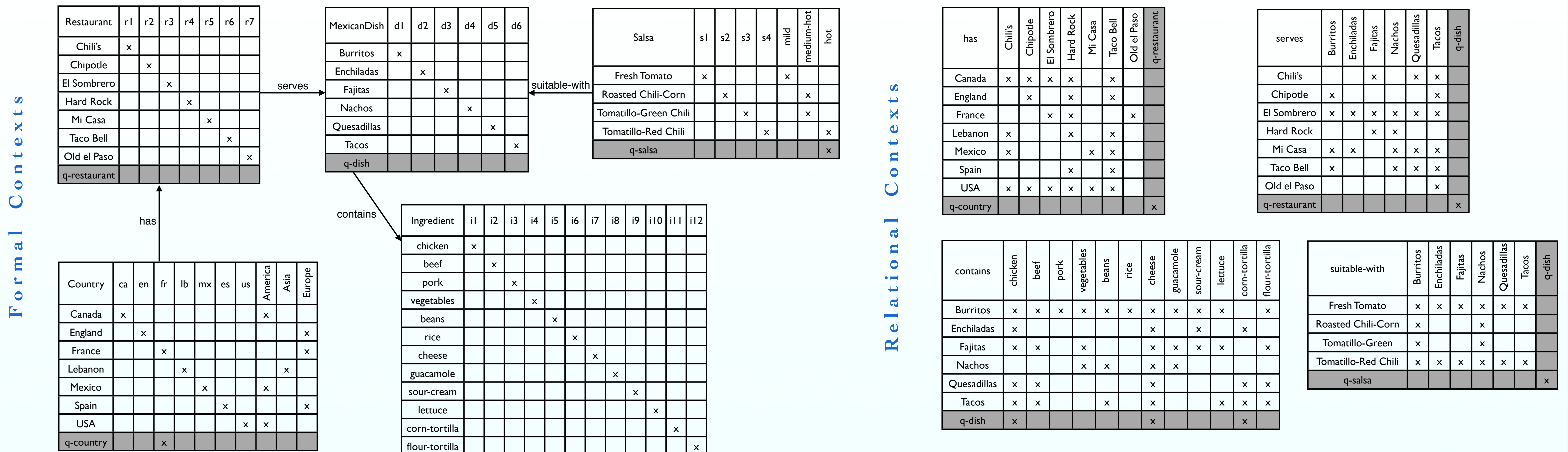
Navigating a Concept Lattice Family w.r.t a Query

Relational Query Answer

A human expert query defines a natural path (that guides an algorithm) for navigating a lattice family. Starting from country lattice, we can located "France" as the answer for "q-country". We extract its relational attributes {has:Concept_16, has:Concept_17, has:Concept_20}. In restaurant lattice, "Hard Rock" in Concept_17 can not be an answer to "q-restaurant". Like this for "q-restaurant", we have two restaurants {Old el Paso, El Sombrero}. They serve at least a dish answering "q-dish" and "q-salsa".

Conclusion

The query approach is a guiding method that enables a human expert to navigating a lattice family to locate interesting solutions. Each selected object is a departure point for inspecting the objects of the selected concept, exploring the neighborhood, going up by relaxing constraints or going down by adding constraints.