

# Getting Answers to Fuzzy and Flexible Searches by Easy Modelling of Real-World Knowledge

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# Overview

- Motivation
  - Crisp Databases
  - Fuzzy Databases
  - Real Databases
  - Expressive Queries
  - Limited Queries
- Goal
- Query Framework
  - Query Components
  - Query Structure
  - Basis
  - Semantics & Syntax
  - Syntactical Constructions
- Present work
- Conclusions

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# Crisp Databases

## Restaurants table

name	distance	price avg.	food type
Il_tempietto	100	30	italian
Tapasbar	300	20	spanish
Ni Hao	900	10	chinese
Kenzo	1200	40	japanese

# Fuzzy Databases

## Restaurants table

name	close	cheap	similar to mediterranean
Il_tempietto	1	0.5	0.8
Tapasbar	0.9	0.8	0.9
Ni Hao	0.4	1	0.1
Kenzo	0.1	0.2	0.2

# Real Databases

- Crisp values (traditional)
- Easy update values
- Fuzzy concept personalization
- Less number of fields
- Data objectivity

# Expressive Queries

I'm looking for a ...

- restaurant of mediterranean food or similar and not far from the city center
- cheap flat of two rooms very close to the beach

# Limited Queries

I'm looking for a restaurant or a flat

- mediterranean food
- 2 rooms
- cheaper than 30 euros menu



# Limited Queries

I'm looking for a restaurant

- food type = mediterranean
- number of rooms = 1
- price  $\leq$  30 euros

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# Goal

- Defining a flexible and expressive query structure
- Providing a sound framework with a search engine of these queries over traditional databases

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# Query Components

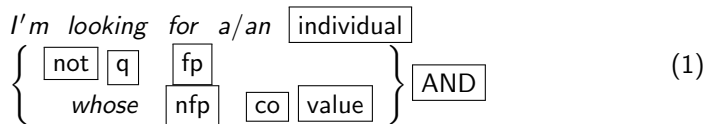
I'm looking for a ...

- restaurant of mediterranean food or similar and  
**individual**                      **value**      **nfp**              **co**  
not              far from the city center  
**negation**                      **fp**
- cheap      flat of      two rooms very close to the beach  
**fp**      **individual**      **value** **nfp**      **q**                      **fp**

# Query Components

- **individuals** (restaurant, film, house, ...)
- **comparison operands** co (equal, distinct, greater, less, similar, ...)
- **fuzzy concepts** fp (big, cheap, close to the beach, ...)
- **quantifiers** q (quite, rather, much, very, little, ...)
- **crisp concepts** nfp (prize, size, distance, food type, ...)
- **values** (30000, 3, mediterranean, comedy, ...)

# Query Structure



# Basis

RFuzzy (very expressive fusion information tool)

- Multi adjoint Logic
- Over Prolog (distributed computation, constraints, finite domains, ...)
- Sugar Syntax
- Similarity
- Types
- Combine crisp and fuzzy information
- Incomplete information (default values, conditioned)



# Semantics and Syntax

- Framework Semantics  $\leftarrow$  RFuzzy Semantics
- Framework Syntax  $\leftarrow$  defined using RFuzzy predicates
  - Fuzzy concepts  $\leftarrow$  fuzzyfication of crisp values of nfp
  - Similarity  $\leftarrow$  explicit or advance definition
  - Configuration file  $\leftarrow$  fp definition

# Syntactical constructions

## Database definition

*define\_database*( $pT/pA$ ,  $[(pN, pT')]$ ) (2)

*define\_database*(*restaurant/4*, [  
    (*id*, *string\_type*),  
    (*food\_type*, *enum\_type*),  
    (*years\_since\_opening*, *integer\_type*),  
    (*distance\_to\_the\_city\_center*, *integer\_type*)]). (3)

# Syntactical constructions

## Similarity Definition

$$\text{similarity\_between}(pT, pN(V1), pN(V2), TV) \quad (4)$$

$$\text{with\_credibility}(\text{credOp}, \text{credVal}) \quad (5)$$

$$\text{only\_for\_user 'UserName'} \quad (6)$$

$$\begin{aligned} &\text{similarity\_between}(\text{restaurant}, \\ &\quad \text{food\_type}(\text{mediterranean}), \\ &\quad \text{food\_type}(\text{spanish}), 0.8) \end{aligned} \quad (7)$$

$$\text{similarity}(pT(pN(V1, V2))) \xleftarrow{(p, v), \&_i} TV \quad \text{if } COND \quad (8)$$

# Syntactical constructions

## Truth value Definition

$$fPredName(pT) : \sim value(TV) \quad (9)$$

$$if(pN(pT) \text{ cond } value). \quad (10)$$

$$cheap(restaurant) : value(0.1) \\ if(id(restaurant) \text{ is\_equal\_to } zalacain). \quad (11)$$

$$fPredName \leftarrow \frac{(p, v), \&_i}{TV \text{ if } COND} \quad (12)$$

# Syntactical constructions

## Fuzzification Definition

$$fPredName(pT) : \sim function(pN(pT), [(valIn, valOut)]) \quad (13)$$

$$\begin{aligned} traditional(restaurant) : & function( \\ & years\_since\_opening(restaurant), \\ & [(0, 0), (5, 0.1), (10, 0.4), (15, 1), (100, 1)]). \end{aligned} \quad (14)$$

$$fPredName(valIn) \leftarrow \frac{(p, v), \&_i}{OP \text{ if } COND} \quad (15)$$

$$OP = valIn * \frac{(valOut2 - valIn1)}{(valIn2 - valIn1)} \quad (16)$$

$$COND' = (valIn1 < valIn < valIn2) \quad (17)$$

# Syntactical constructions

## RFuzzy Rule Definition

$$fPredName(pT) : \sim rule(aggr, complexBody) \quad (18)$$

$$fPredName(pT) : \sim rule(simpleBody) \quad (19)$$

$$fPredName \xleftarrow{(p, v), \&_i} aggr(complexBody) \text{ if } COND \quad (20)$$

$$fPredName \xleftarrow{(p, v), \&_i} simplexBody \text{ if } COND \quad (21)$$

# Syntactical constructions

## Default Values Definition

$$fPredName(pT) : \sim defaults\_to(TV) \quad (22)$$

$$near\_the\_city\_center(restaurant) : \sim defaults\_to(0). \quad (23)$$

$$fPredName \xleftarrow{(p, v), \&_i} TV \quad \text{if } COND \quad (24)$$

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# Present work

## Prototype

- Web Interface Application
- Parametric (databases)
- Personalized (fuzzy concepts)

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# Conclusions

- Useful, expressive query structure (friendly user interface)
- Flexible and fuzzy search included combination with crisp search and similarity
- Easily implemented over CLP
- Adequate for any kind of traditional database
- Multiple possibilities of personalization

Thank you

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