ANSWERING INTENSIONAL QUESTIONS (1)

Alternative query formulations and answers

- ***Which* managers at IBM earn more than 1,000,000 $?**

  Smith, Miller, and Jones.

- ***What* managers at IBM earn more than 1,000,000 $?**

  Managers of rank A.

Building intensional answers

- **Based on *deduction***

  Exploiting rule traces

- **Based on *induction (inductive logic programming)***

  Reasoning over commonalities of extensional sets

ANSWERING INTENSIONAL QUESTIONS (2)

Motivation

- **Checking consistency constraints (debugging a database)**
- **Producing informative descriptions rather than pure enumerations**

Techniques for building intensional answers – idea

- **Building a description of one item**
- **Successively adapting this description, such that**
  - **increasingly more items in the "solution set" are covered**
  - **no element outside the "solution set" is covered**
  - **performing simplifications/generalizations whenever appropriate**

This task is the same as building referring expressions identifying sets of objects!

ANSWERING INTENSIONAL QUESTIONS – EXAMPLES

Checking consistency

"Which states have a capital?" – "All states."

"Which cities have inhabitants?" – "All German cities."
(Swiss cities on the border not modeled)

Producing informative descriptions

"Which cities are in a state that borders Austria?" – "All cities located in Bayern."

"Which cities are bigger than München?" (Berlin, Hamburg)

"All cities located at highway A24 and which a river flows through."

Limitations

Commonalities must be "total" (no disjunctions, no exceptions)

No concept indicating what is "of interest"

Extensions - Limited Commonalities

Building *disjunctions of descriptors* if necessary
(similar to generating referring expressions)

- **Computationally very expensive**
- **Iteratively increasing disjunction combinations**
- **Very selective generation of combinations**
- **Near-misses (with few/one exception) may be suitable**

Comparison to generating referring expressions

- **Also iteratively increasing disjunction combinations**
- **Description building algorithm orthogonally organized**
- **Constraint-based or best-first searching promising**

Intensional descriptions - example (1)

Question:

“What are the neighboring states of California?”

Answer:

“All states that are located west and
through which road 95 passes through.“

Extensional Answers:

Oregon, Nevada, and Arizona.

LGG Clause:

{Roadname={Oregon=[U.S. 95], Nevada=[U.S. 95]},
Location={Oregon=[West], Nevada=[West]}}

Intensional descriptions - example (2)

Question:

“Which states does the Truckee river pass through?”

Answer:

“All states that are located to the West and through which lake Tahoe flows through.“

Extensional Answers:

California and Nevada.

Intensional descriptions + exceptions - example (1)

Question:

“What are the neighboring states of Texas?”

Answer:

“All the states that are located south and through which road 40 passes through except Louisiana.“

Extensional Answers:

Oklahoma, Arkansas, Louisiana, and New Mexico.

. **LGG Clause:**

{Roadname={New Mexico=[road 10, road 40, road 25, road 64], Oklahoma=[road 40, road 44, road 64], Louisiana=[road 10, road 20, road 55], Arkansas=[road 40, road 75, road 30, road 64]}, Location={New Mexico=[South], Oklahoma= [South], Louisiana=[South], Arkansas=[South]}}

Intensional descriptions + exceptions - example (2)

Question:

“Which states does Missouri river pass through?”

Answer:

“All the states that border South Dakota except Wyoming.“

Extensional Answers:

Montana. South Dakota. North Dakota, Nebraska, Iowa, Kansas, and Missouri.

LGG Clause:

RiverName from {Montana, South Dakota, North Dakota, Nebraska, Iowa, Kansas, Missouri} ,
BorderName from {Montana, South Dakota, North Dakota, Nebraska, Iowa, Kansas, Missouri}

Intensional descriptions + near miss - example (1)

Question:

“What states border with Arizona?”

Answer:

“Colorado and
all states that are located West and
through which Colorado r, Truckee rivers flow.“

Extensional Answers:

California, Colorado, Nevada, and Utah.

Intensional descriptions + near miss - example (2)

Question:

“Through which states does Tennessee river flow?”

Answer:

“Alabama and
all states that are located to the south and
have lowland as mississippi river.“

Extensional Answers:

Kentucky, Tennessee, and Alabama.

Assessment - Various Places of Roadwork

Technically-based issues

- **Occasionally several disjunction elements needed**
- **By far too many possible disjunction combinations**
- **Neither general nor domain-specific heuristics known**
- **Potential for new search and cut-off techniques**

Content-based issues

- **Conditions for benefit of intensional answers unclear**
- **Informativeness and user-interest needs to be identified**
- **Coherence of properties in response with query**