

# **Web Services Interfaces**

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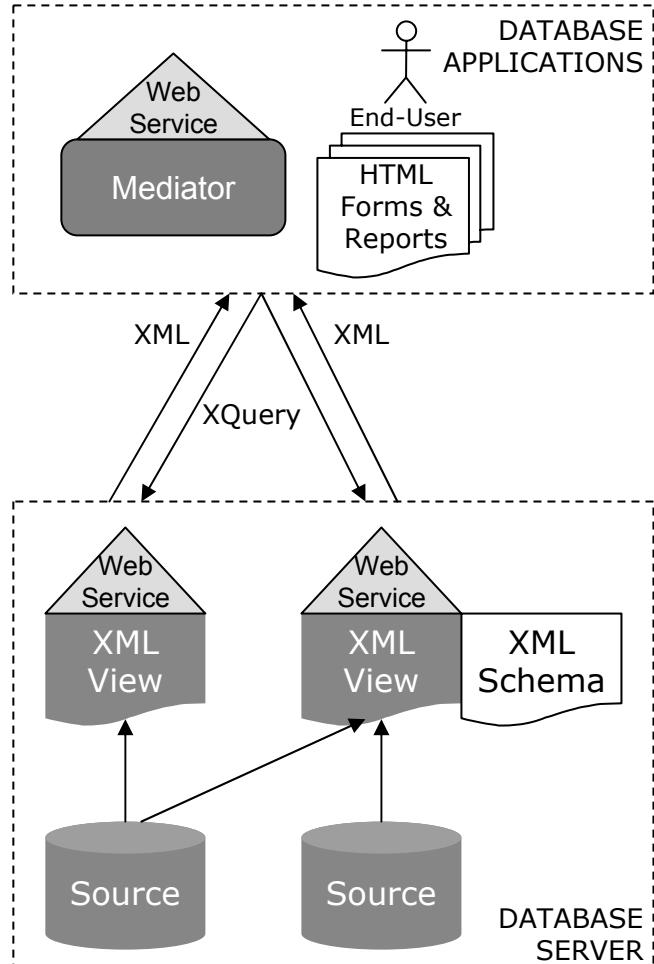
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**Microsoft Research, July 2003**

# Exporting DBMSs on the Web



- Exporting Query Capabilities on the Web
  - Web Services (Function Signatures)
- Integrating Web Applications
  - Use Web Services
  - Export Query Capabilities Themselves
- HTML Web Interfaces (Forms & Reports)

# Overview

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- Query Set Specification Language (QSSL)
  - Describes Parameterized Tree Pattern (TP) Queries
- Data Services
  - Web Services for Query Capabilities
- Forms & Reports for Semistructured Data
  - The QURSED system
- Authoring Interfaces

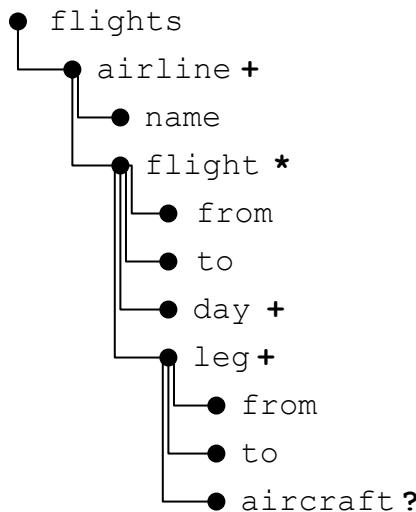
# Motivation for QSSL

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- Web Services published as function signatures:
  - Fixed number of input and output parameters
  - Do not capture the functionality of databases
  - Large number of web services needed
    - One function signature for every parameterized query
  - Do not capture the semantic connections the available functions have with each other and with the underlying databases
- JDBC Interfaces
  - All possible queries
  - Difficult to export schema information

# Query Set Specification Language

## Goals

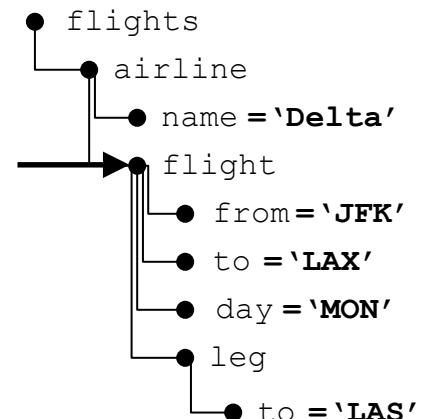


- Any combination of the following conditions on:
  - the name of the airline company
  - the origin and destination of one or more flights (optional)
  - a day of the week
  - the origin of zero or more legs (optional)
  - the destination of zero or more legs (optional)
  - the aircraft used for zero or more legs (optional)
- The queries may return “airline” or “flight” elements

# Query Set Specification Language

## Query Language

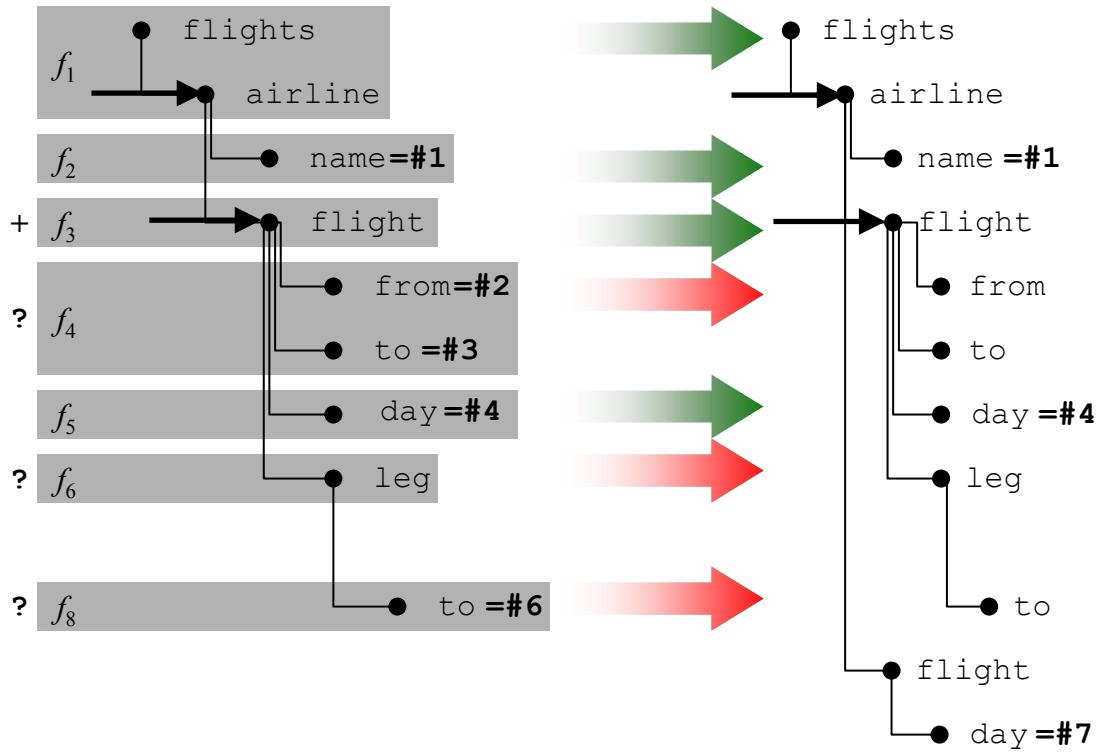
- Tree Pattern Queries:
  - Acyclic XPath expressions consisting of:
    - node tests
    - child axis ‘/’
    - descendant axis ‘//’
    - predicates ‘[]’
  - Widely used in current applications
  - Building blocks of XQuery
  - Excellent visual paradigm for GUIs



```
flights/airline[name='Delta']/flight[from='JFK' ][to='LAX' ][day='MON' ][leg[to='LAS' ]]
```

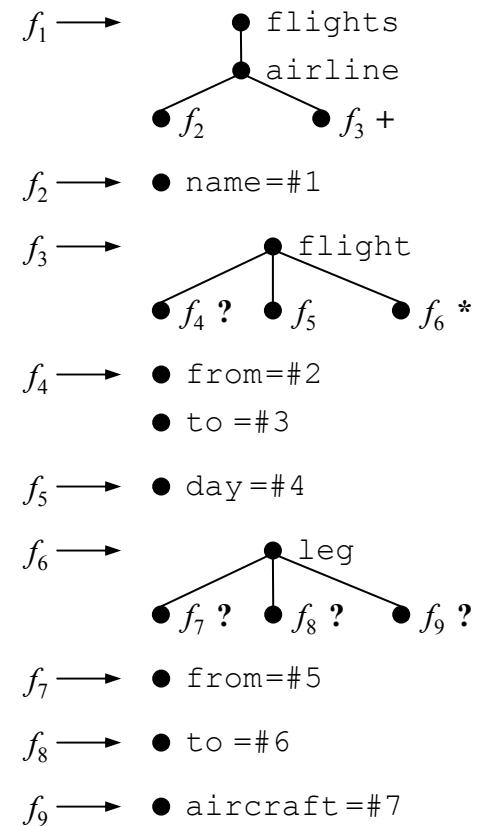
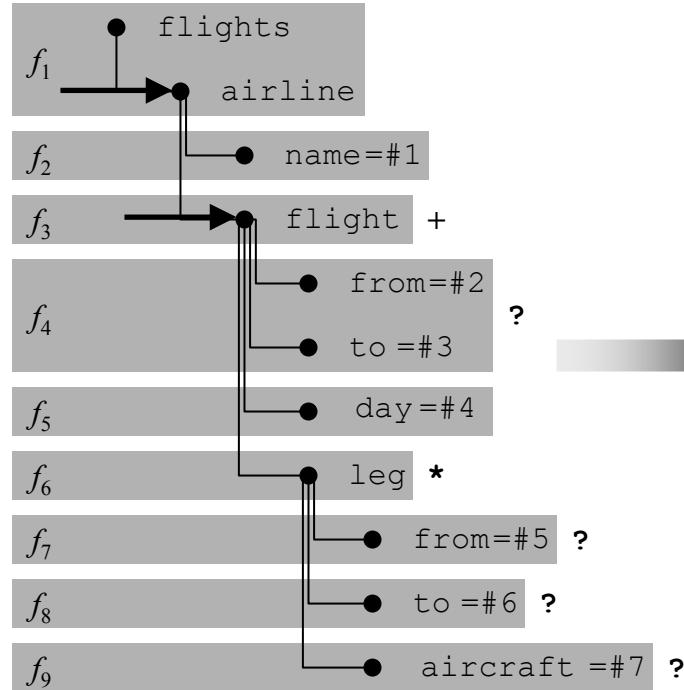
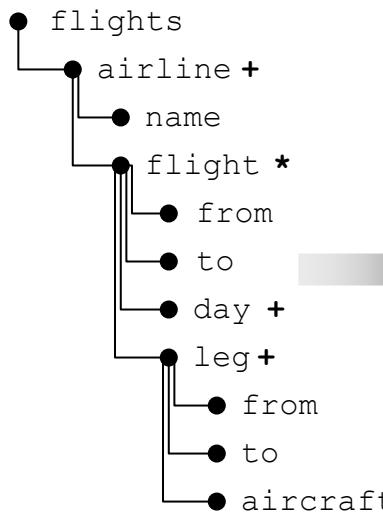
# Query Set Specification Language

## Query Set Specification



# Query Set Specification Language

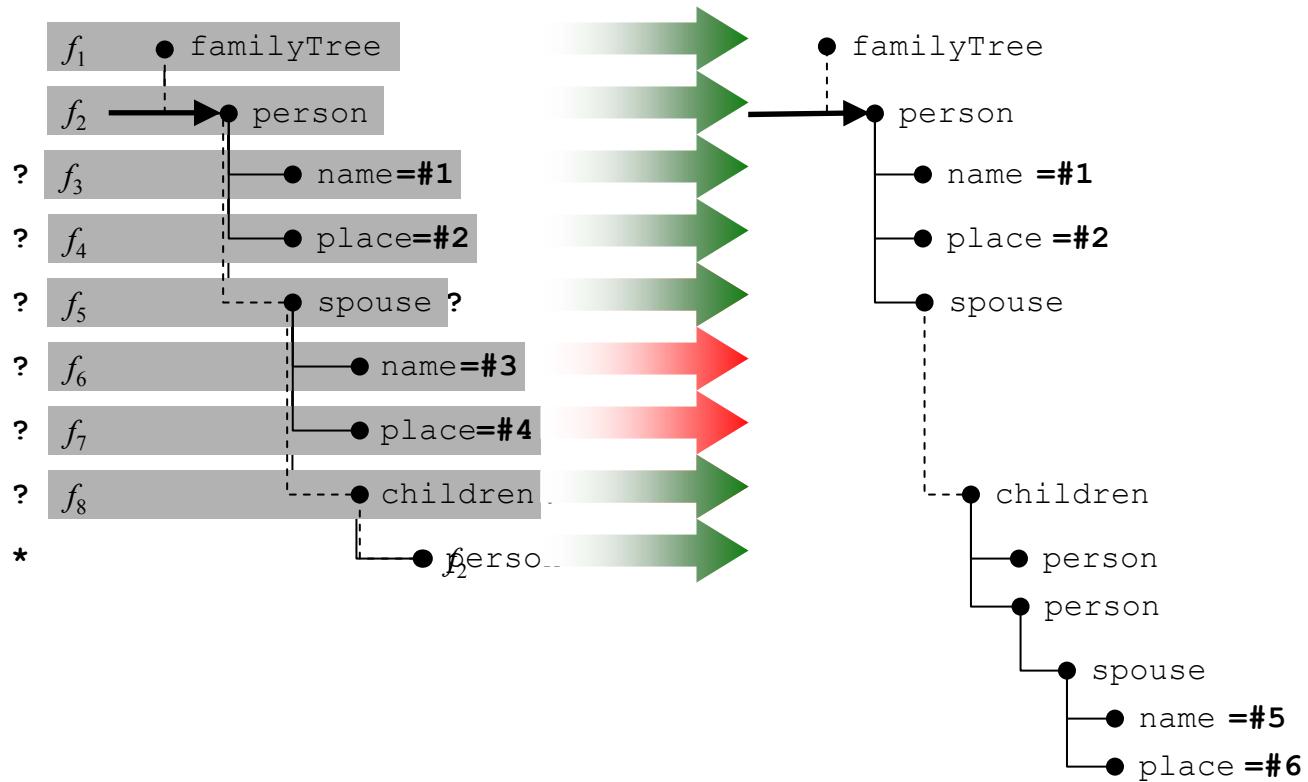
## Query Set Specification



- Similar to extended context-free grammars

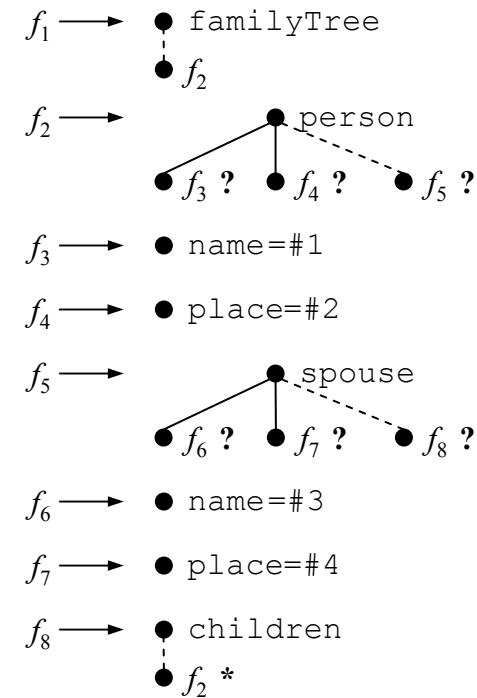
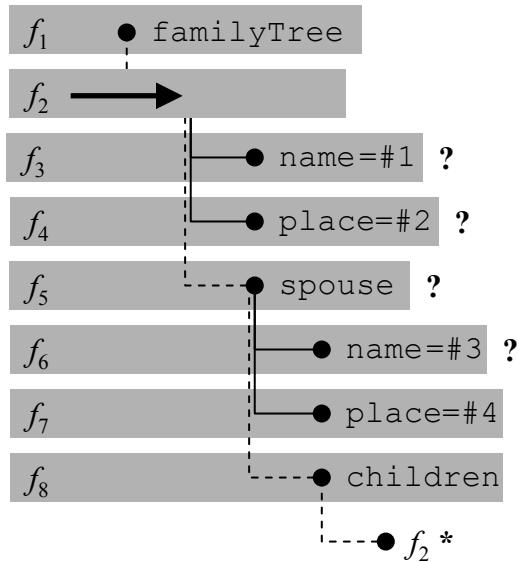
# Query Set Specification Language

## Recursive XML Schemas



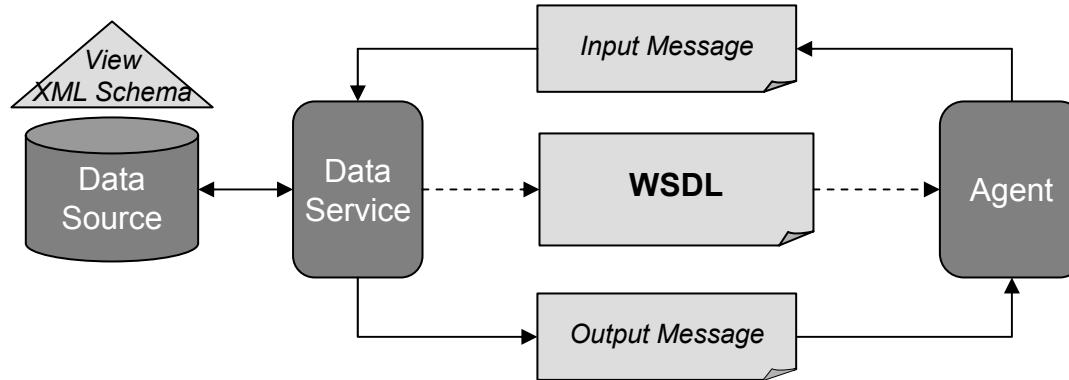
# Query Set Specification Language

## Recursive XML Schemas



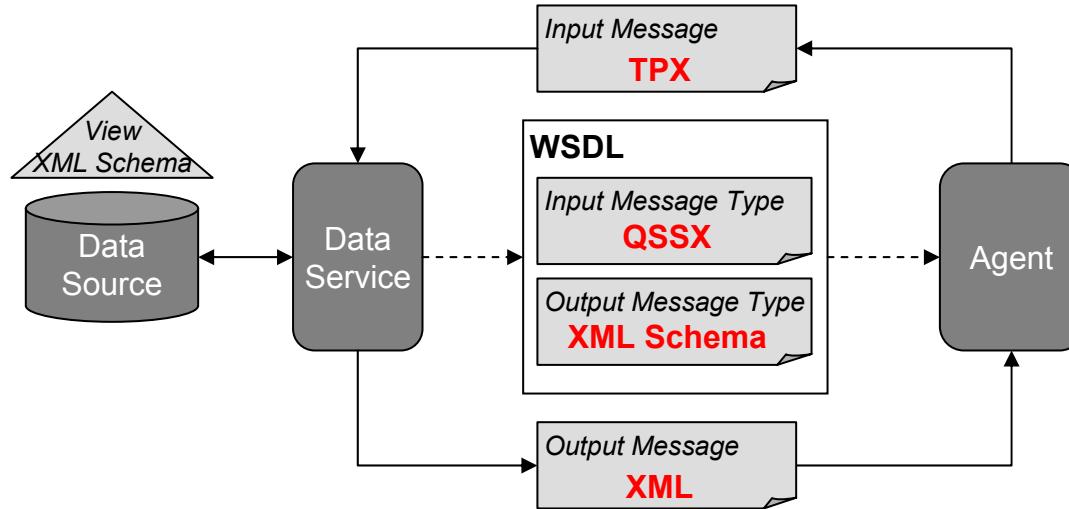
- QSS of fixed size

# Data Services



- **Data Service** = WSDL + QSS
- A QSS deployed as a web service
- Exports the XML Schema of an XML view
- Connects the WSDL calls with the underlying database
- Receives queries that are encoded by QSS
- Explicit relationship between input and output

# Data Services



- QSS is translated to XML Schema (QSSX)
- TP queries that are encoded as XML (TPX)
- Query result is described by an XML Schema

# Data Services

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## Reasoning

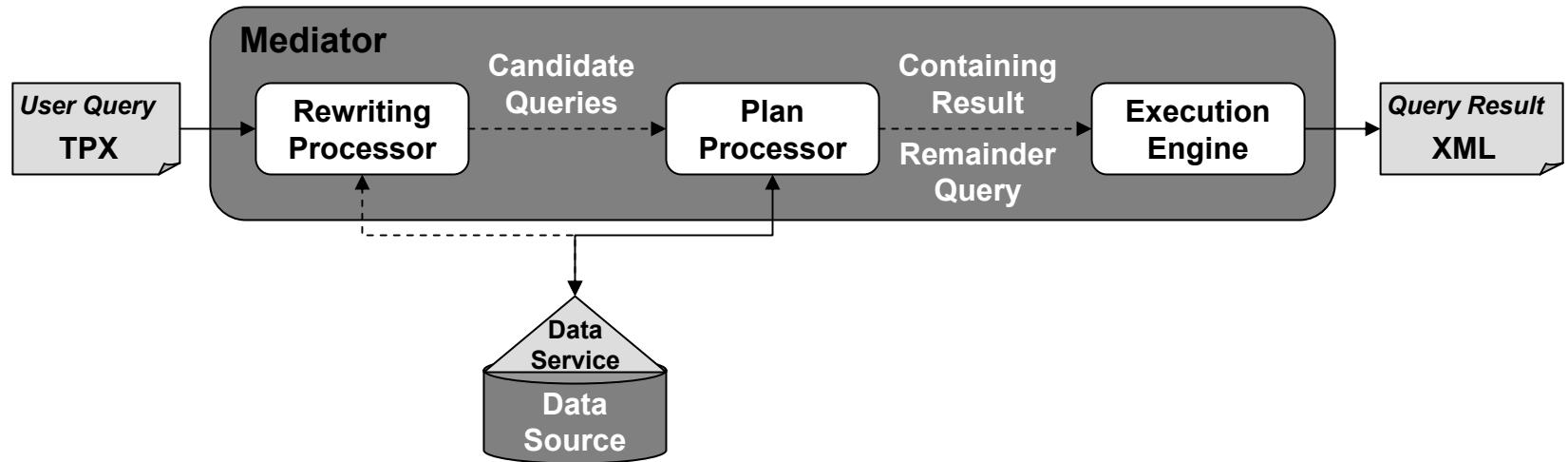
1. Membership of a query in a data service
2. Subsumption of data services
3. Totality of a data service
4. Overlap of data services

- These problems (except 1) are undecidable for context-free grammars
- QSS can be translated to an equivalent top-down nondeterministic unranked tree automaton
- Problems become decidable

# Future Work

## Capability-Based Rewriting



- Capability-based rewriting problem
  - Partial rewritings

# Data Services

## Authoring Interface

QSSX Editor - (flights.qxl)

File Action

EST Root

flights

airline

name = #0

flight

to = #1

from = #2

day = #3

leg

to = #4

from = #5

aircraft = #6

Selected Element Information:

Name:

Occ:

Type:

Fragments:

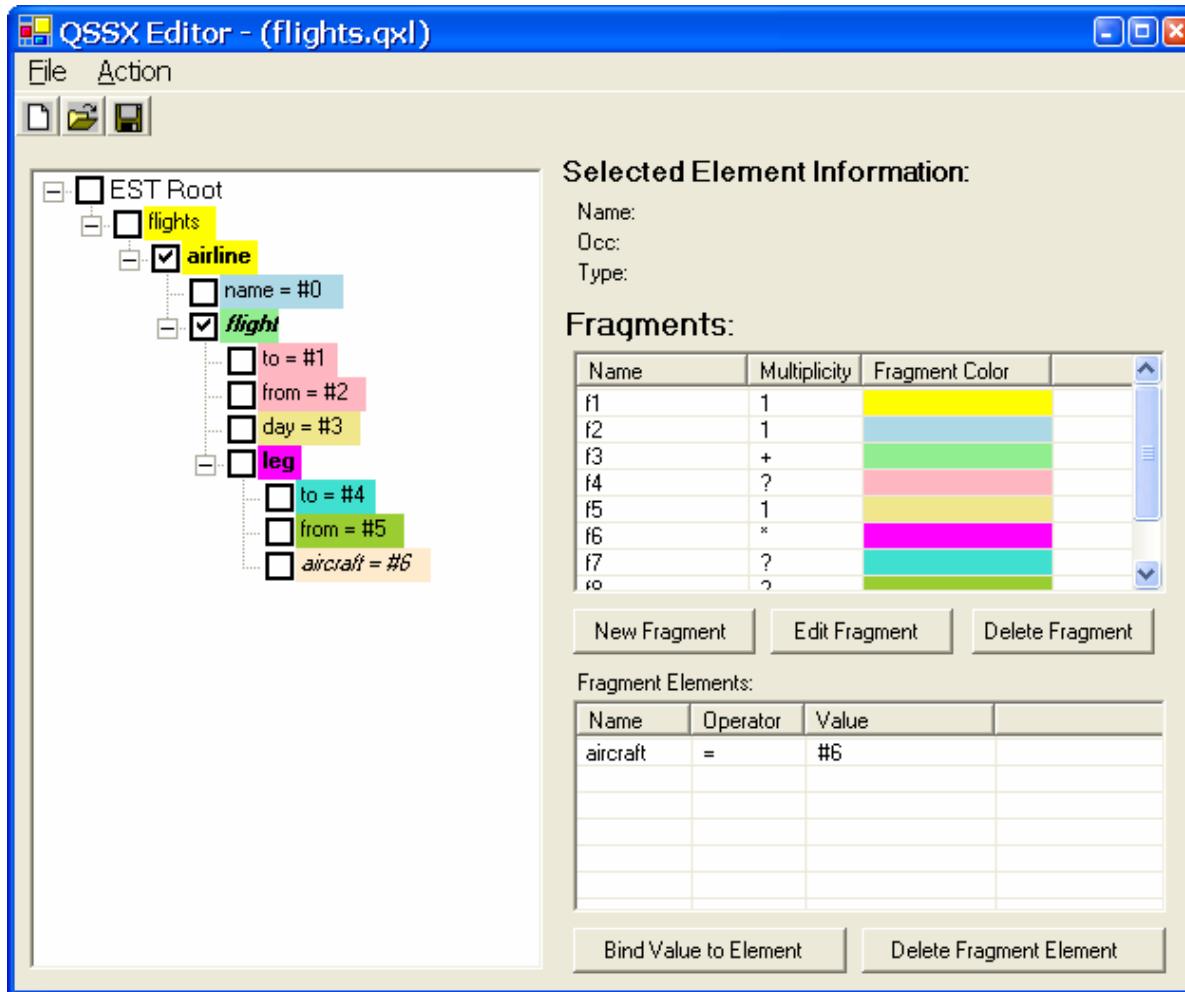
Name	Multiplicity	Fragment Color
f1	1	Yellow
f2	1	Light Blue
f3	+	Light Green
f4	?	Light Red
f5	1	Light Orange
f6	*	Magenta
f7	?	Cyan
o0	?	Light Green

New Fragment Edit Fragment Delete Fragment

Fragment Elements:

Name	Operator	Value
aircraft	=	#6

Bind Value to Element Delete Fragment Element



# Query Forms and Reports

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## Requirements

- Handle semistructureness
  - Powerful query forms and reports
- Be declarative
  - Separate logic from presentation
- Visual interface for the developer
  - Programming should NOT be a requirement

# Query Forms and Reports

Query Form and Report Pages - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Sensors

General

Manufacturer: No preference, Balluff, Baumer, Turck

Sensing Distance: 6 mm

Protection Rating 1: No preference

Protection Rating 2: No preference

Operating Temperature: to °C

Mechanical

Body Type: No preference

Dimension X: 20 mm

Dimension Y: 40 mm

Results

Results/page: 10

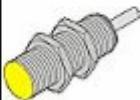
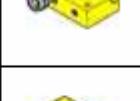
Sort By Options

Sensing Distance: DESC

DESC-Manufacturer: up, dn

Reset  Execute 

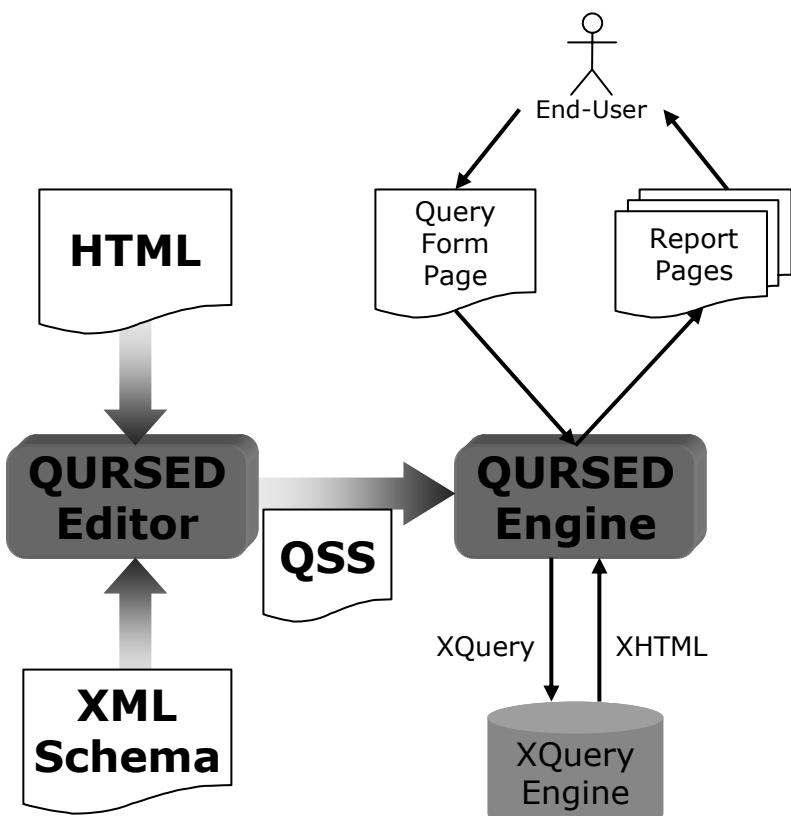
Next 10  Previous 10 

Image	Manufacturer	Part Number	Protection Ratings	Sensing Distance mm	Body Type	
	All		All	All		
	All	BC 3-M12-AN6X	NEMA1	6.0	Cylindrical	
	Balluff		NEMA3		Diameter mm	Barrel Style
	Turck		NEMA4		15	Smooth
	Turck	BC 3-M12-AP6X	NEMA3	6.0	Cylindrical	
					Diameter mm	Barrel Style
					19	Smooth
	Turck	BC 5-Q08-AN6X2	NEMA3	7.0	Rectangular	
					Height mm	Width mm
					14	9
	Turck	BC 5-Q08-AP6X2	NEMA3	7.5	Rectangular	
					Height mm	Width mm
					10	35
	Turck	BC 5-S18-AN4X	NEMA1	10.0	Rectangular	
					Height mm	Width mm
					15	10
	Turck	BC 5-S18-AP4X	NEMA1	10.6	Rectangular	
					Height mm	Width mm

 My Computer

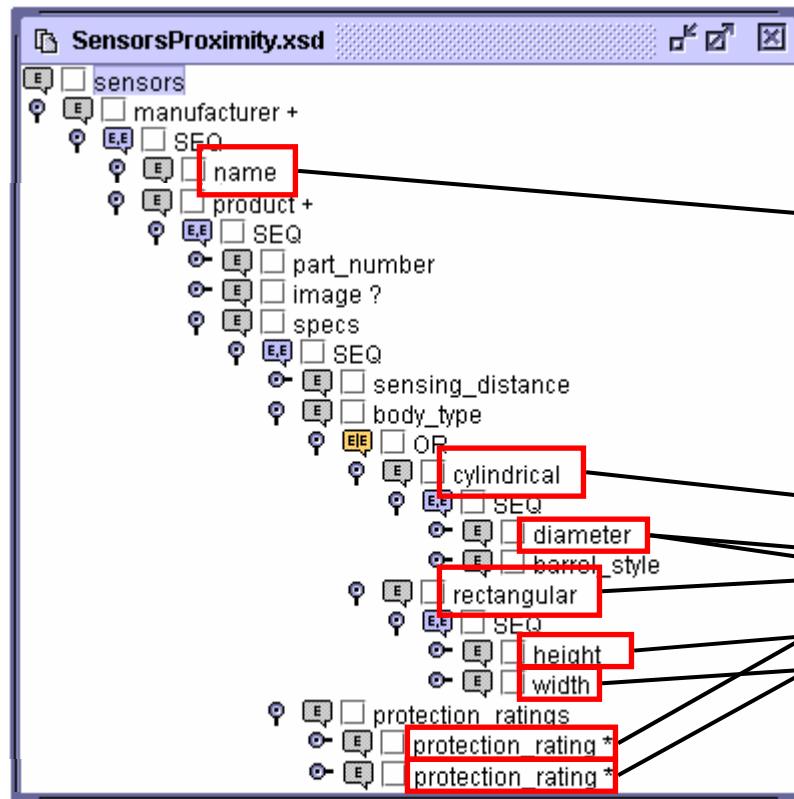
# Query Forms and Reports

## QURSED Approach



- XML Schema-driven
- Declarative!
  - Separation of content & presentation
- Editor
  - Visual actions to declarative specifications
  - Automatic construction of report pages
- Query Set Specification (QSS)
  - Large set of parameterized queries
  - Compact representation
- Engine
  - Automatic query formulation
  - Direct result construction

# Developing Query Forms from the XML Schema



Query Form and Report Pages ...

Sensors

General

Manufacturer: Turck

Sensing Distance: 6 mm

Protection Rating: No preference

Protection Rating: No preference

Operating Temperature: to °C

Mechanical

Body Type: Rectangular

Height: mm

Width: mm

Results

Results/page: 10

Sort By Options: Sensing Distance DESC

DESC-Manufacturer: up dn

Reset → Execute →

My Computer

# Developing Reports from the XML Schema

Diagram illustrating the development of reports from an XML Schema (SensorsProximity.xsd) using a database interface.

**XML Schema (SensorsProximity.xsd):**

- sensors**
  - manufacturer** (with **name** and **\***)
  - product** (with **part\_number**, **image?**, **specs** (containing **SEQ** for **cylindrical** and **rectangular**), and **protection\_ratings** (containing **SEQ** for **NEMA1**, **NEMA3**, and **NEMA4**))

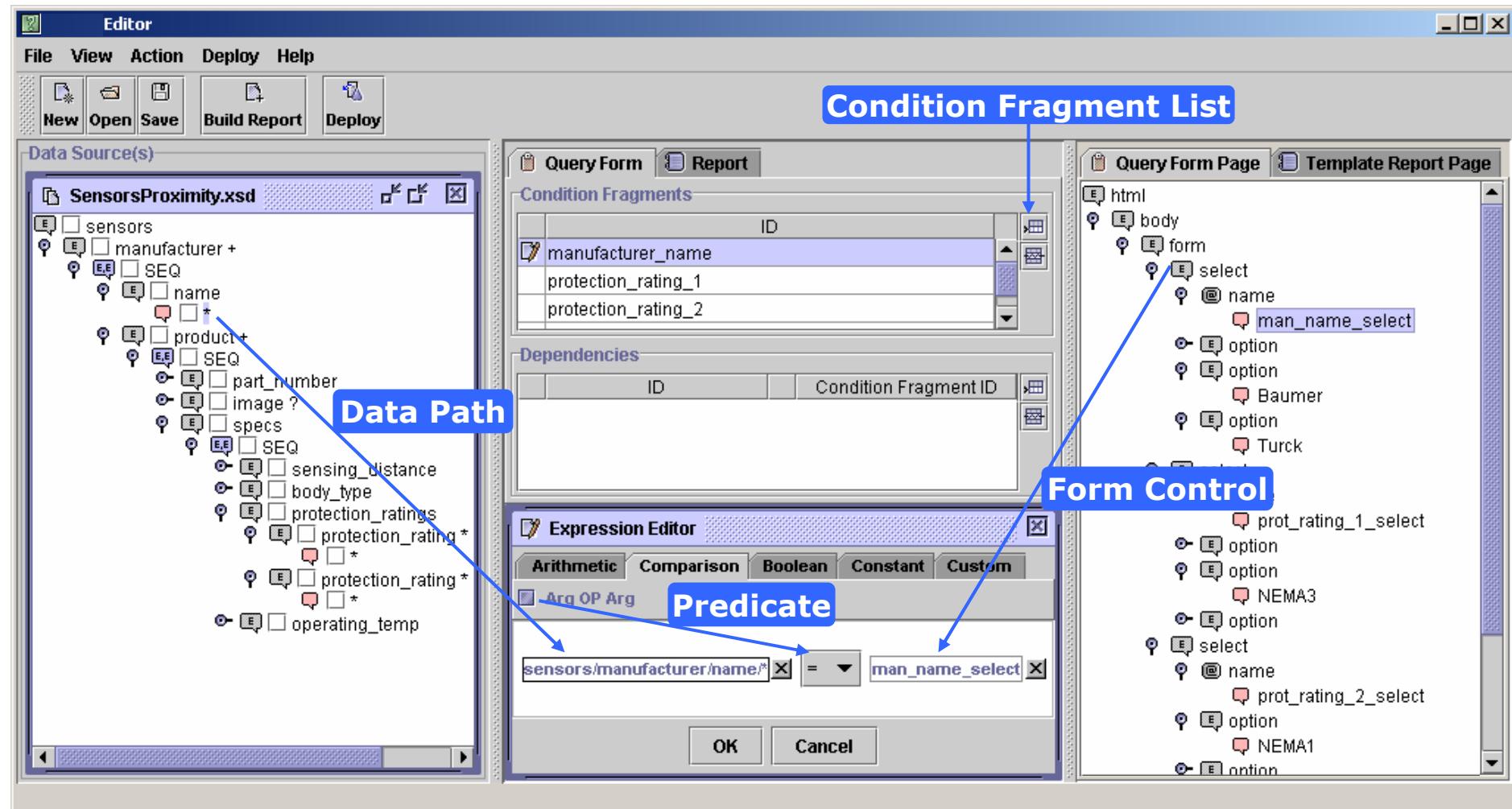
**Report Generation:**

The XML Schema is used to generate a report table showing sensor details. The table includes columns for Image, Manufacturer, Part Number, Protection Ratings, Sensing Distance mm, and Body Type.

Image	Manufacturer	Part Number	Protection Ratings	Sensing Distance mm	Body Type
	Turck	<a href="#">BC 3-M12-AN6X</a>	NEMA1 NEMA3 NEMA4	6.0	Cylindrical Diameter mm: 15 Barrel Style: Smooth
	Turck	<a href="#">BC 3-M12-AP6X</a>	NEMA3	6.0	Cylindrical Diameter mm: 19 Barrel Style: Smooth
	Turck	<a href="#">BC 5-Q08-AN6X2</a>	NEMA3 NEMA4	7.0	Rectangular Height mm: 14 Width mm: 9
	Turck	<a href="#">BC 5-Q08-AP6X2</a>	NEMA3 NEMA6 NEMA11	7.5	Rectangular Height mm: 10 Width mm: 35
	Turck	<a href="#">BC 5-S18-AN4X</a>		10.0	Rectangular Height mm: 15 Width mm: 10

# QURSED Editor

## Building Query/Visual Association



# QURSED Editor

## Building Reports

Editor

File View Action Deploy Help

New Open Save Build Report Deploy

Data Source(s)

SensorsProximity.xsd

Elements to Appear on Report

Query Form Report

Element Mappings

Source	Target
./manufacturer/*	table_cell_1
./part_number/*	td
./product/*	img_1
./sensing_distance/*	table_cell_3
./diameter/*	table_cell_4

Group By Mapping

Element Mapping

GroupBy Mappings

Source	Target
sensors/manufacturer	table_row_1
./manufacturer/prod...	table_row_2
./product/*	img_1
./body_type/cylindrical	table_row_3
./body_type/rectangular	table_row_4

SortBy Mappings

Source	Target
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Query Form Page Template Report Page

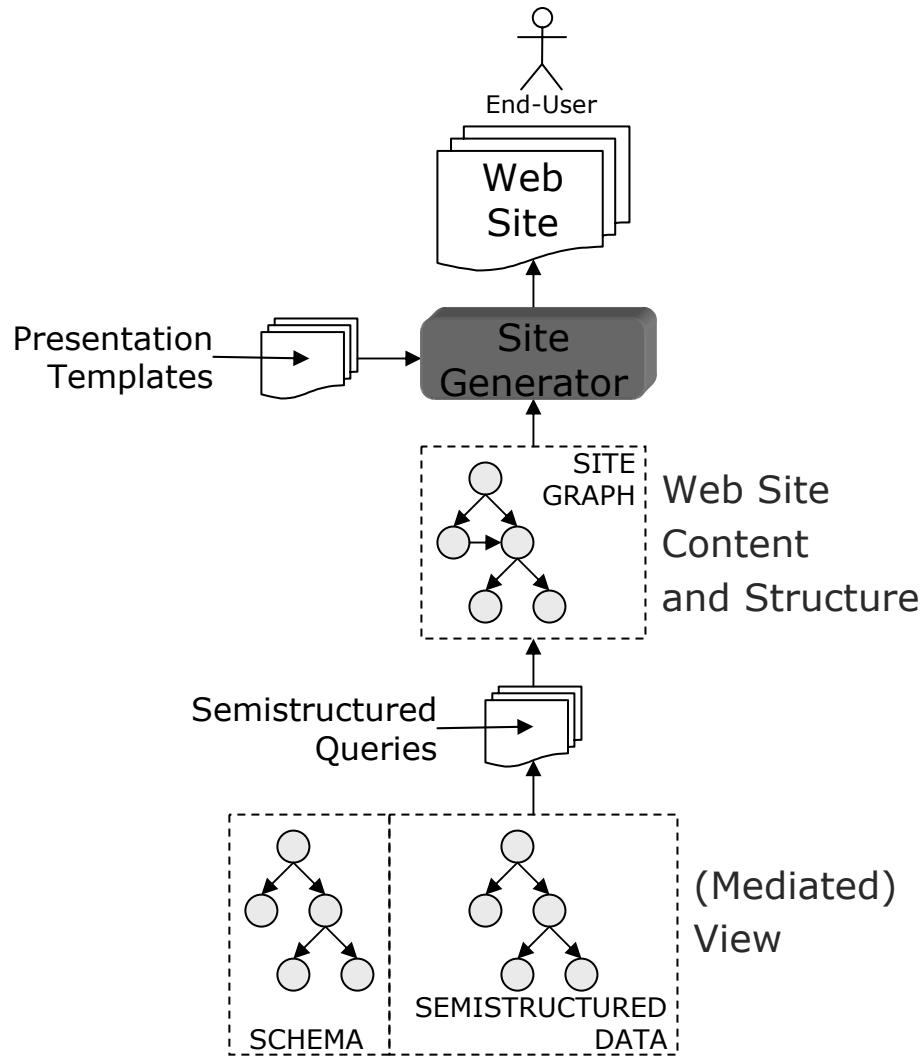
html body table tr td table\_row\_1 table\_row\_2 table\_row\_3 table\_row\_4 table\_cell\_1 table\_cell\_2 img img\_1

# More Features

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- Structural disjunction
- Dependencies
- Sort-by options
- Template-driven construction of report pages
- Report customization
- Dynamic projection
- Online demo:  
<http://www.db.ucsd.edu/qarsed/>

# Related work



- Data intensive Web site generators
  - Strudel
    - Forms as functions on edges/links
  - Araneus
  - Autoweb
- Declarative
- Separation of content, structure and presentation

# Related work

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- Web-based Form and Report Generators
  - Macromedia Ultradev, Coldfusion, Microsoft Visual InterDev
  - Excellent for flat uniform relational tables
  - Visual query formulation paradigm allows the specification of projections, sort-bys, simple conditions
  - However, the development of form and report pages for semistructured data requires substantial programming effort
- Visual Querying Interfaces
  - EquiX, BBQ, VQBD, Lorel's DataGuide-driven GUI, PESTO
  - Excellent visual paradigm for the formulation of fairly complex queries
  - The goal is the development of a query or a query template
  - User needs to be familiar with database models and schemas

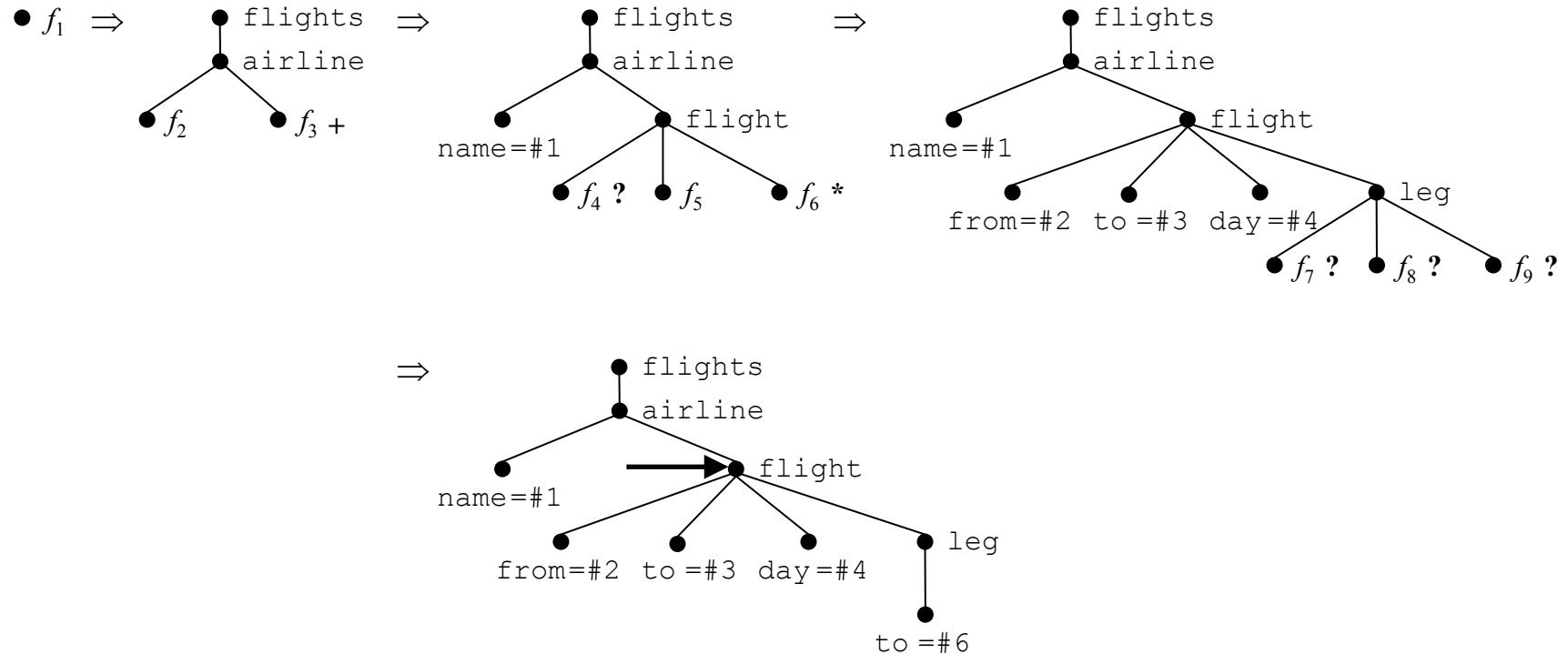
# Questions and Answers

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# Query Set Specification Language

## Example Derivation



# Related Work

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## Capability-Based Rewriting

- Capabilities described as binding patterns
  - Adornments on view attributes
  - Negative approach
- Expansions of Datalog programs
  - Recursive programs → Infinite queries
  - Positive approach
- Capability-based rewriting problem
  - Total rewritings only

# QURSED System Architecture

