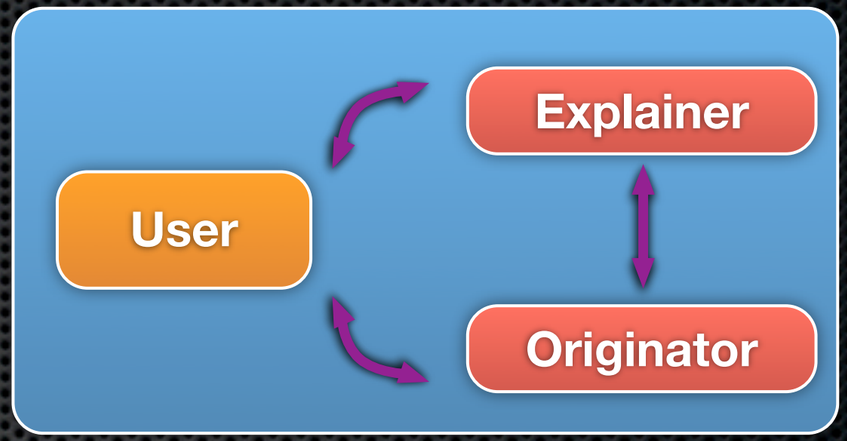


On Explanation

—Supporting the Use of Complex Information Systems—

Dr. Thomas Roth-Berghofer, Senior Researcher
German Research Center for Artificial Intelligence DFKI GmbH

Interner Workshop
November 23, 2007, Kaiserslautern, Germany

Current activities in several projects

myCBR

The Social Semantic Desktop
NEPOMUK

iDocument

DYNAQ

THESEUS
MEDICO

Quotes from the symposium

- „Knowledge is something that can be used for answering certain questions.“ (Prof. Yingxi Zhong)
- „Systems must adapt to us humans.“, „We have to learn more about human systems.“, „People have different background, different velocity of learning, different preferences …“ (Prof. Klaus Mainzer)
- „… human-computer interaction = human-human interaction …" (Prof. Elisabeth André)

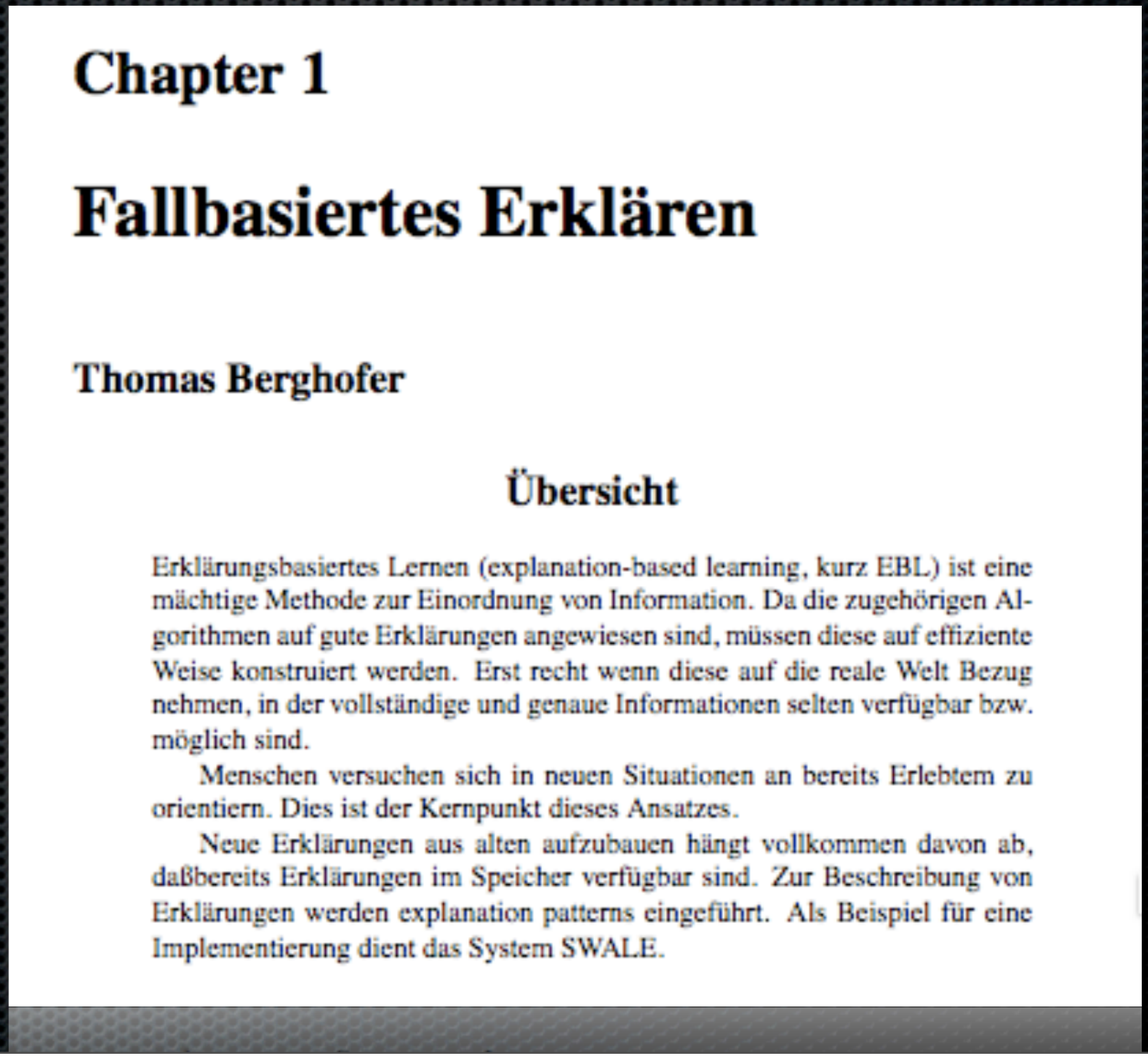
Quotes from Nepomuk prototype usability evaluation results

- …
- The users want to know **why** things happen; „Why does the computer show me this document?”
- They also want to **affect** what the computer does for them; „How can I tell the compute that I don't want …“
- People like to **be in control** of what happens.
- …

1991: Seminar on case-based reasoning

First contact with „Case-based explanations“ and David B. Leake‘s work

Co-Chair of Explanation-aware Computing workshops



Chapter 1

Fallbasiertes Erklären

Thomas Berghofer

Übersicht

Erklärungsbasiertes Lernen (explanation-based learning, kurz EBL) ist eine mächtige Methode zur Einordnung von Information. Da die zugehörigen Algorithmen auf gute Erklärungen angewiesen sind, müssen diese auf effiziente Weise konstruiert werden. Erst recht wenn diese auf die reale Welt Bezug nehmen, in der vollständige und genaue Informationen selten verfügbar bzw. möglich sind.

Menschen versuchen sich in neuen Situationen an bereits Erlebtem zu orientiern. Dies ist der Kernpunkt dieses Ansatzes.

Neue Erklärungen aus alten aufzubauen hängt vollkommen davon ab, daßbereits Erklärungen im Speicher verfügbar sind. Zur Beschreibung von Erklärungen werden explanation patterns eingeführt. Als Beispiel für eine Implementierung dient das System SWALE.

1997: Diploma thesis

„Explanation-based learning of control information from failures in (action) planning“

Diplomarbeit

Erklärungsbasiertes Lernen
von Kontrollinformationen
aus Fehlschlägen bei der Planung

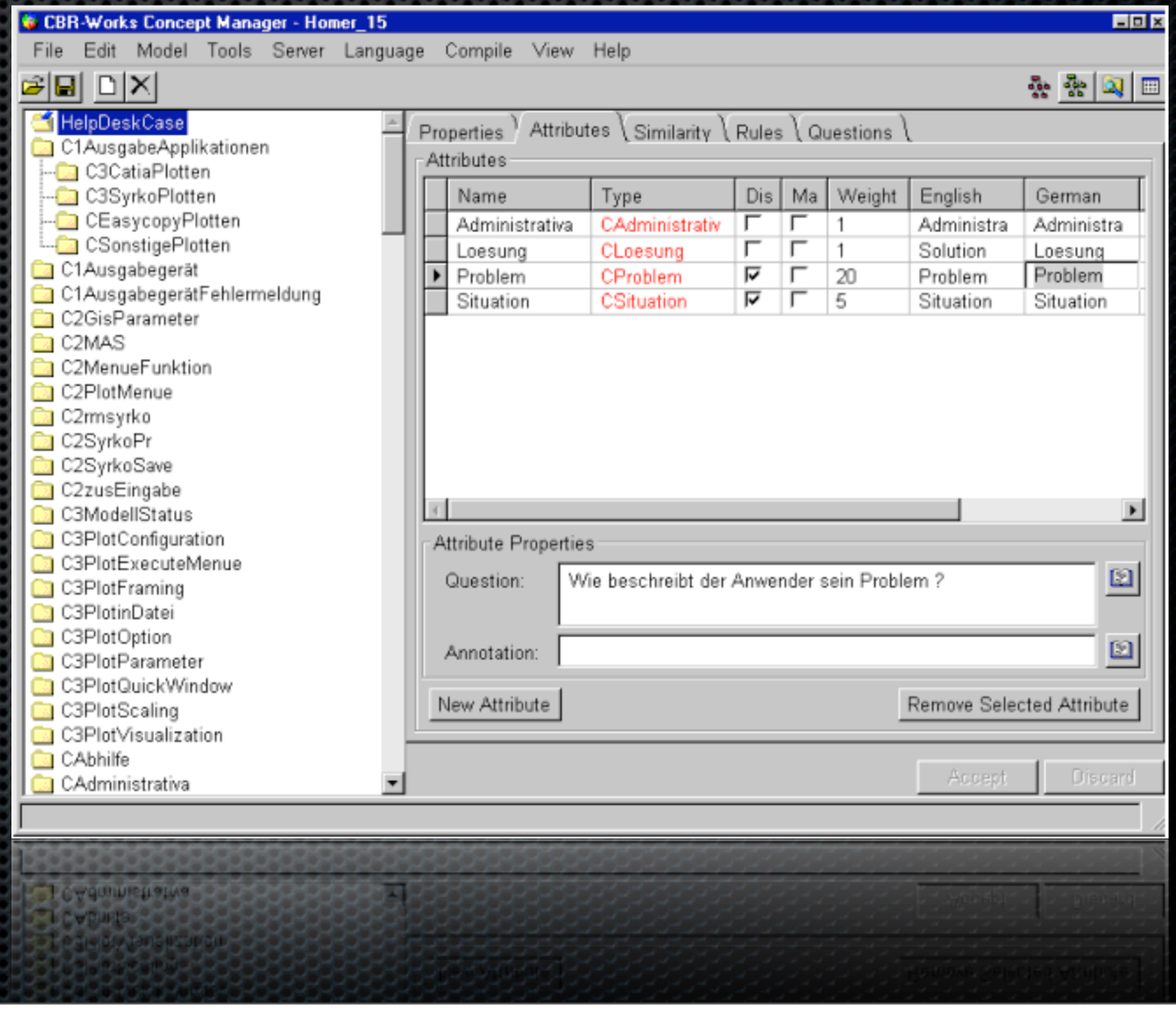
Thomas Roth-Berghofer

Juli 1996

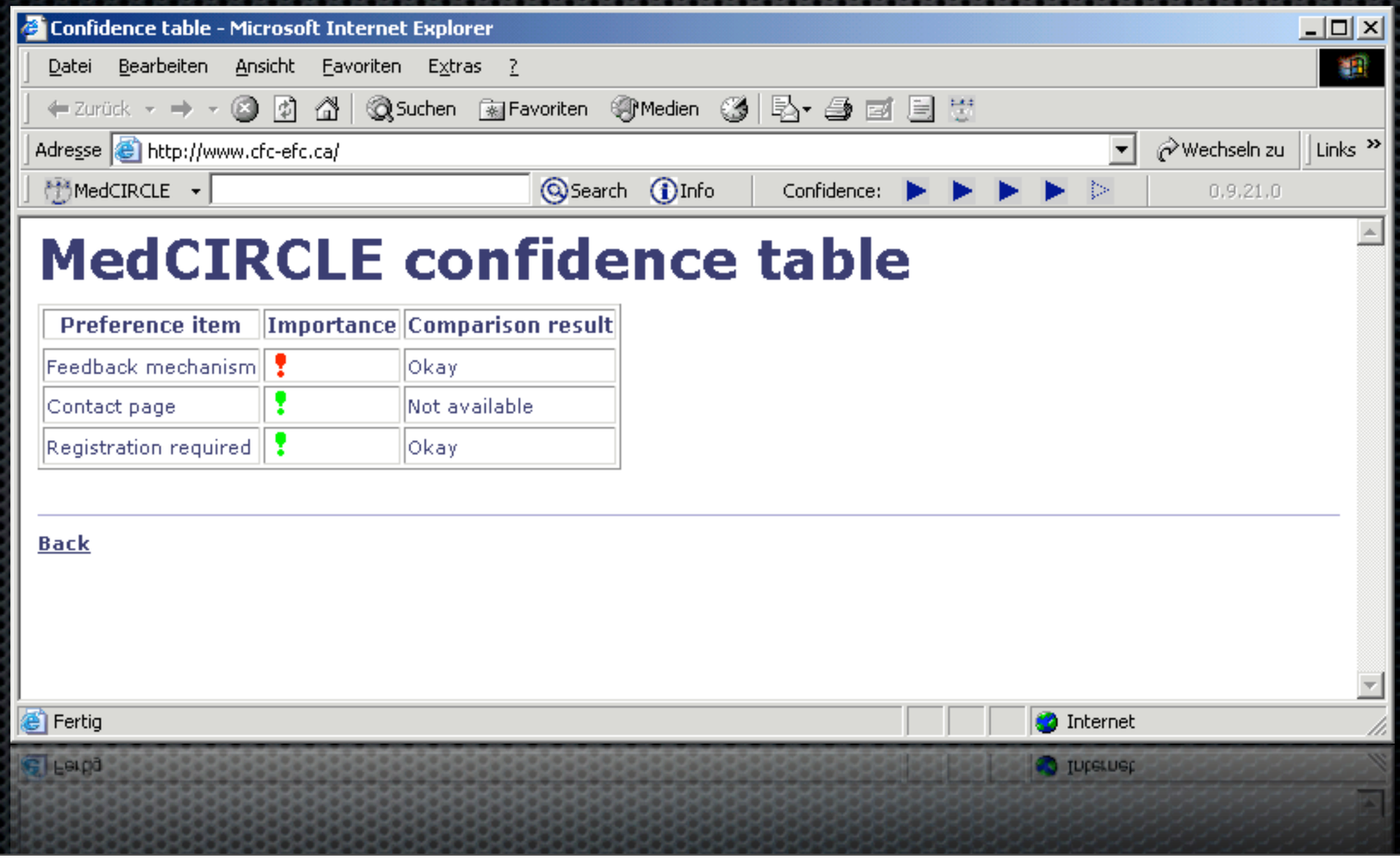
1997–2002: CBRWorks and orenge

Simple explanations of similarity calculations in *CBRWorks*

Explanation of recognized concepts in textual CBR part of *orenge*



2004: Explanation of confidence calculation



What do we do when we have problems following a conversation?

Then we …

- Ask about the concepts we do not understand
- Request justifications for some fact or line of argumentation
- Ask about functions or purposes of used concepts
- Ask about motivation of conversation partner or how a conclusion was reached
- Ask about our conversation partner‘s confidence in some fact or line of reasoning

When was the last time you „asked“ an information system such questions?

„Trust me. I know what I am doing!“

Sledge Hammer

„Trust me. I know what I am doing!“

Sledge Hammer

Explanation participants

Explanation participants

Explanation participants

myCBR

The Social Semantic Desktop
NEPOMUK

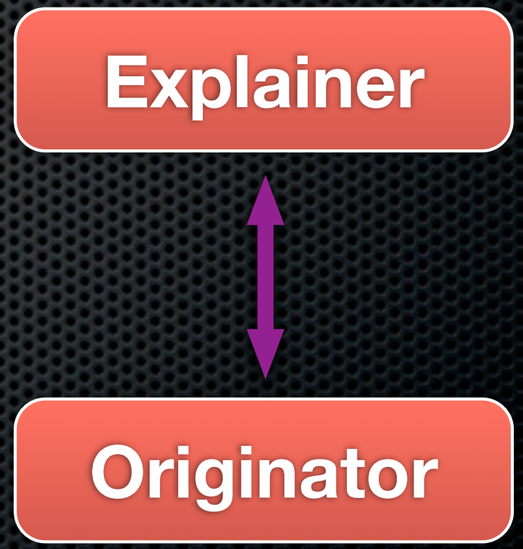
iDocument
...

Research questions

- Necessary knowledge

  What does the explainer need to know for generating explanations?

  What can and what does the orginator need to provide?



- Explanation-enabled/-aware architecture
- Methodology

  How to build an explanation-aware information system

Overview

- General explanation characteristics
- Explanations from an information point of view
- Example projects:

  Nepomuk – The Social Semantic Desktop

  myCBR

What are explanations?

What are explanations?

Explanations are answers to questions.

When are questions being asked?

When are questions being asked?

Whenever expectations are not met.

What must be explained?

Humans explain …

- The **physical world**, i.e., how things work
- The **social world**, i.e., how societies work
- **Individual patterns** of behaviour, i.e., how individuals work

R. C. Schank. Explanation Patterns: Understanding Mechanically and Creatively. Lawrence Erlbaum Associates, Hillsdale, NJ, 1986.

What are good explanations?

- Short and easy to overlook
- Innovative
- Relevant
- Convincing
- Different perspectives and follow-up questions
- Natural

W. R. Swartout and J. D. Moore. Explanation in second generation expert systems. In J. David, J. Krivine, and R. Simmons, editors, Second Generation Expert Systems, pages 543–585, Berlin, 1993. Springer Verlag.

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determined by context-dependent criteria

W. R. Swartout and J. D. Moore. Explanation in second generation expert systems. In J. David, J. Krivine, and R. Simmons, editors, Second Generation Expert Systems, pages 543–585, Berlin, 1993. Springer Verlag.

Explanations can be viewed as a kind of information.

Concepts connected with the notion of information

„The train to Kaiserslautern leaves Lugano at 13:55 h.“

Concepts connected with the notion of information

Concepts connected with the notion of information

„The train to Kaiserslautern leaves Lugano at 13:55 h.“

Truth

Understanding

Concepts connected with the notion of information

Truth

Understanding

„The train to Kaiserslautern leaves Lugano at 13:55 h.“

Utility

Concepts connected with the notion of information

„The train to Kaiserslautern leaves Lugano at 13:55 h.“

Truth

Understanding

Utility

Storage and retrieval

Concepts connected with the notion of information

„The train to Kaiserslautern leaves Lugano at 13:55 h.“

Truth

Understanding

Utility

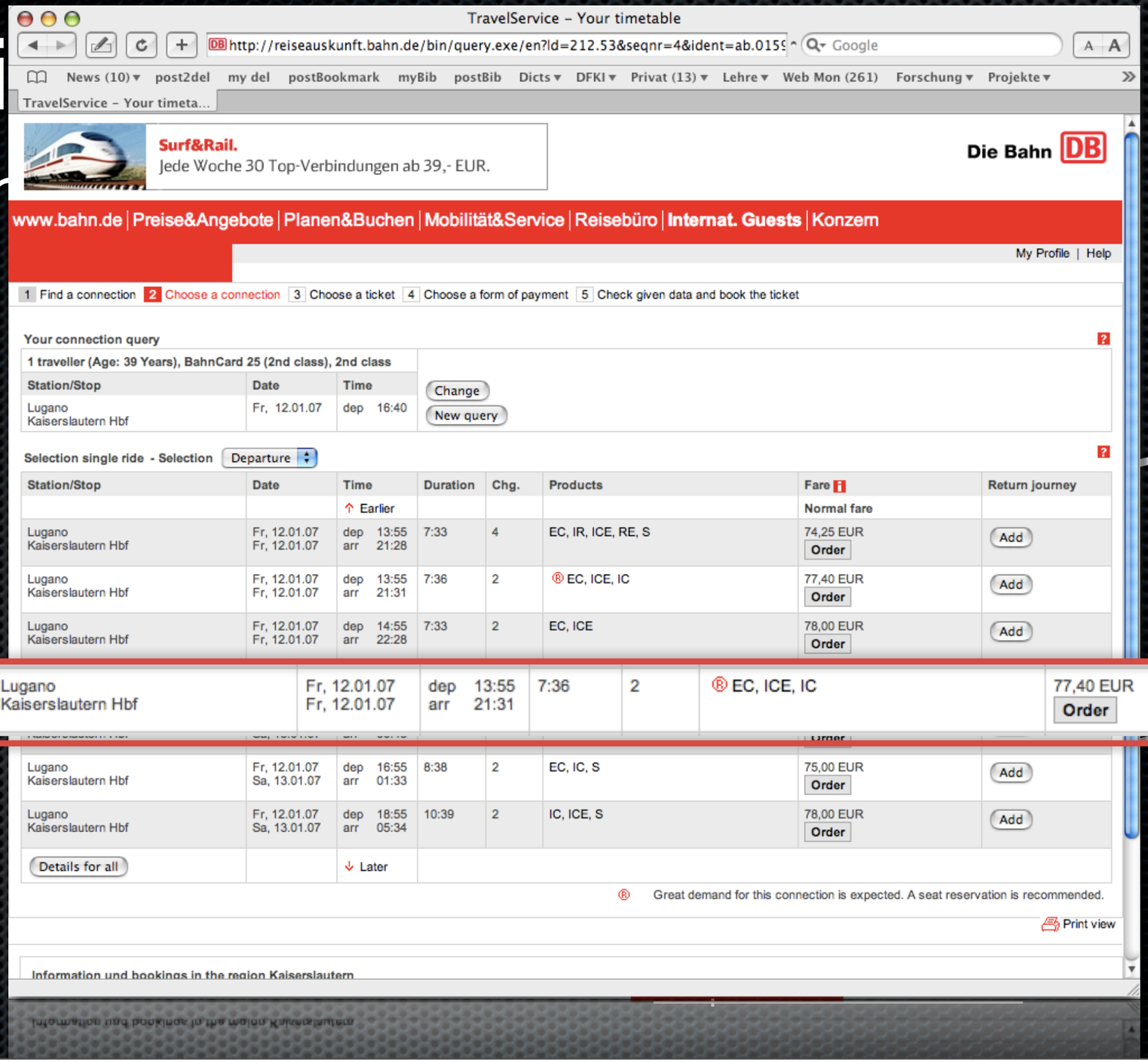
Storage and retrieval

Information generation

Participants in travel booking scenario

http://www.db.de

Partici
bookir



Explainer

Originator

Explanation dimensions

Cognitive aspects of explanations

- „Explanations are the most common method used by humans to support decision making.“ (Schank, 1986)
- Main purpose:
  - Explain a solution.
  - How was the solution derived?
  - How does a system work?
  - How to handle a system
  - Explain failures.

Cognitive aspects of explanations

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- …
- **Nepomuk evaluation results**
- The users want to know **why** things happen; „Why does the computer show me this document?”
- They also want to **affect** what the computer does for them; „How can I tell the compute that I don't want …“
- People like to **be in control** of what happens.
- …

Computational aspects

- Backward explanations:

  Explain the result and how it was obtained.

- Forward explanations:

  Explain (indirectly) by showing different ways to further optimize a given result.

  Open up possibilities for exploratory use.

Example

The Social Semantic Desktop

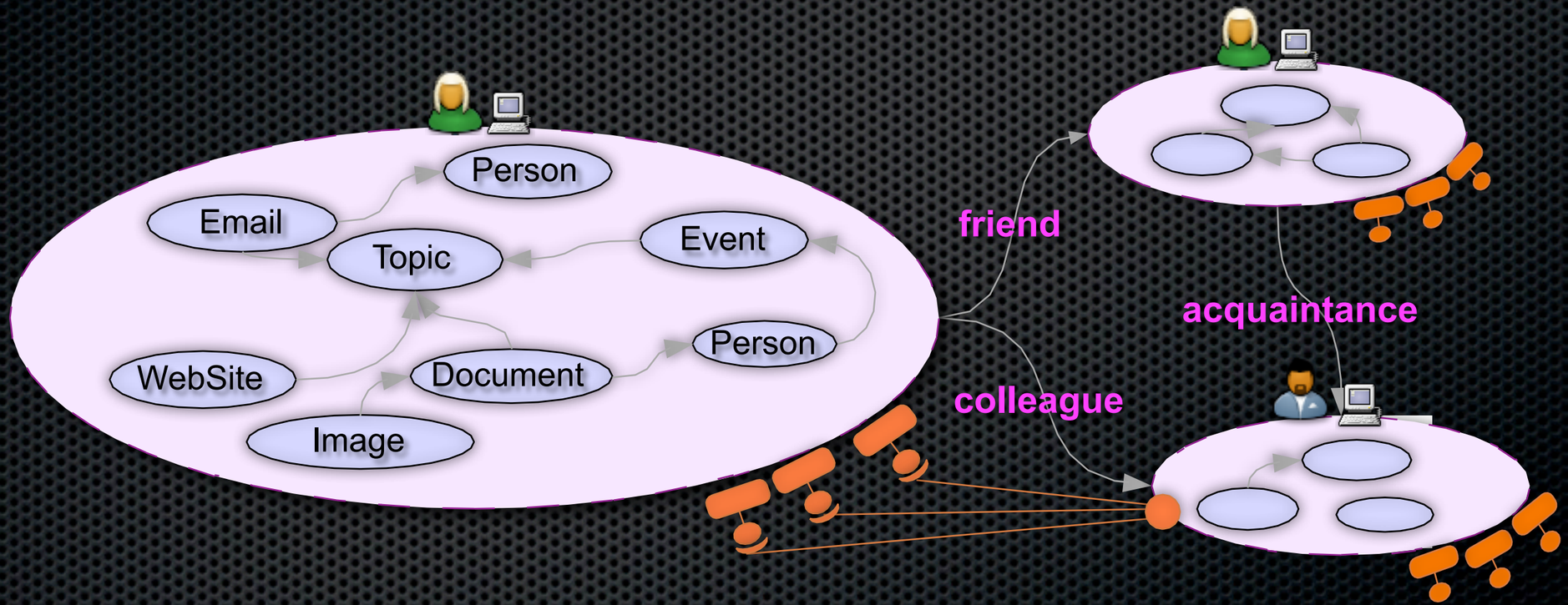
NEPOMUK

Backward explanations

myCBR

Forward and backward explanations

NEPOMUK Vision

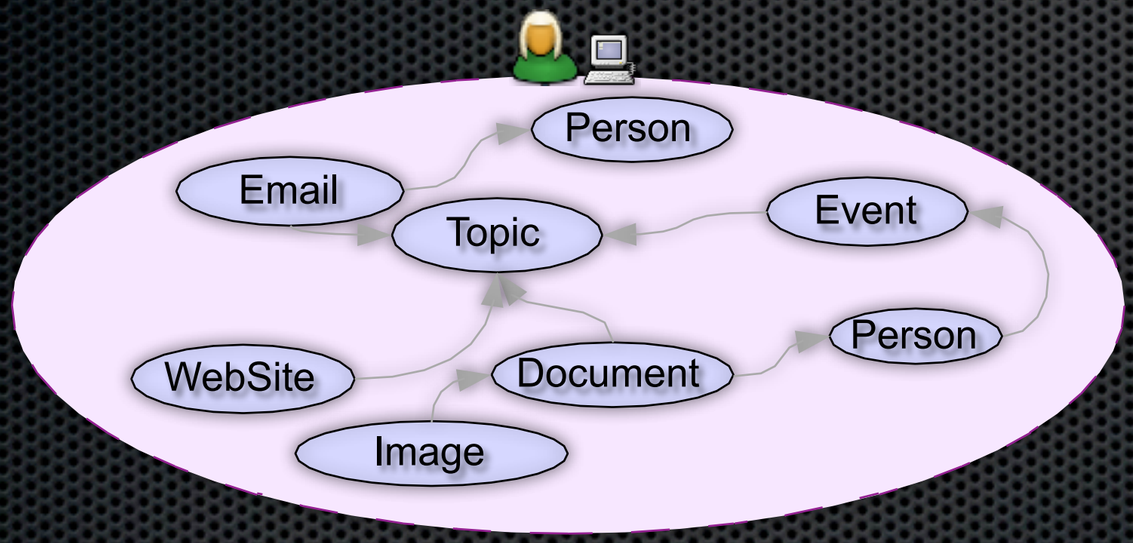


Personal Semantic Web: ***a semantically enlarged intimate supplement to memory***

Social protocols and distributed search

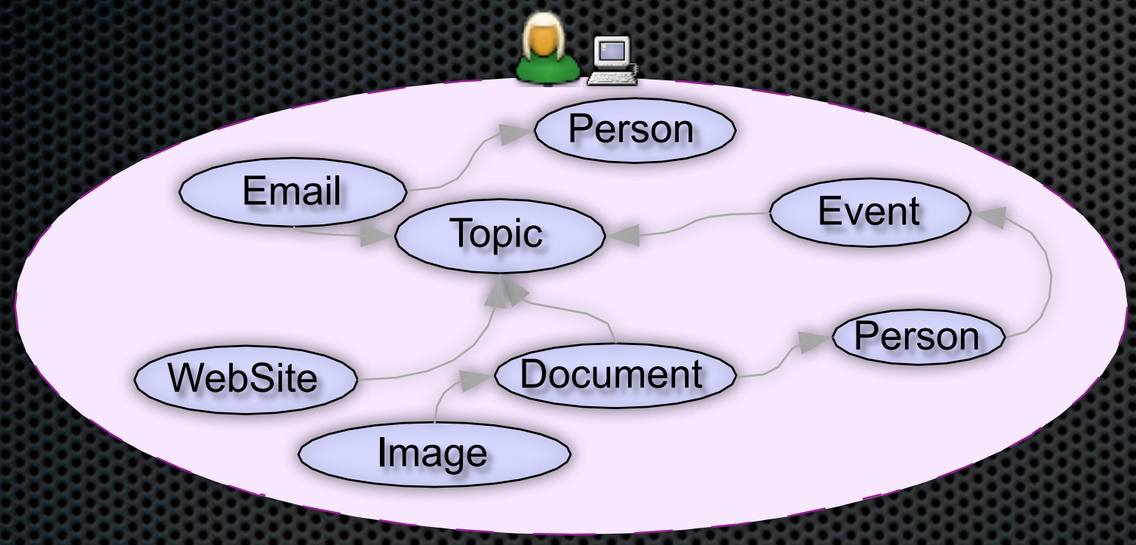
NEPOMUK enabled peers

Personal Information Model PIMO



Articulate and link concepts with relations

Personal Information Model PIMO



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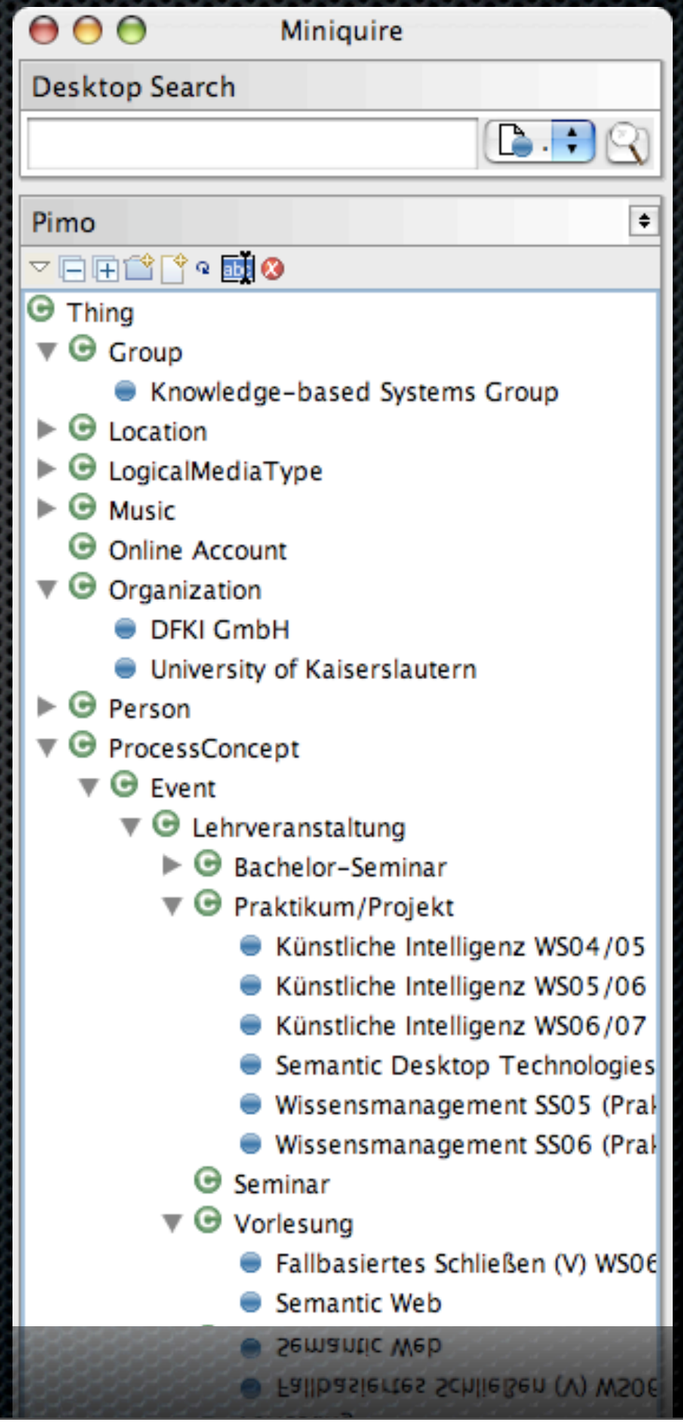
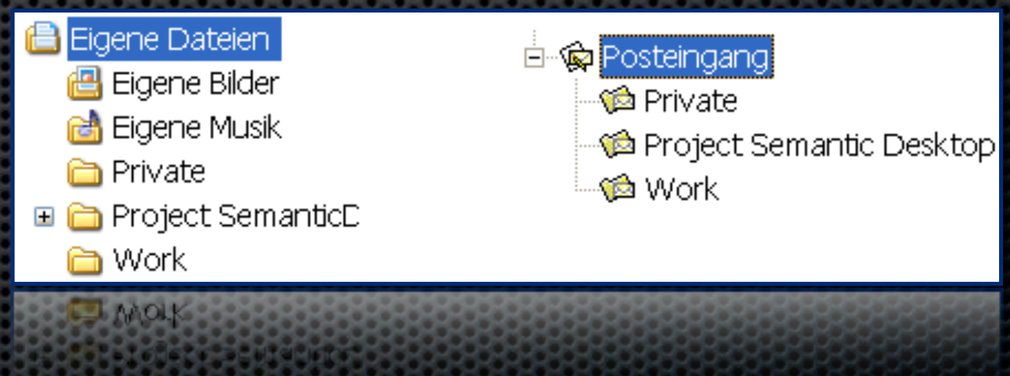


How can we support knowledge articulation?

Building your personal semantic web

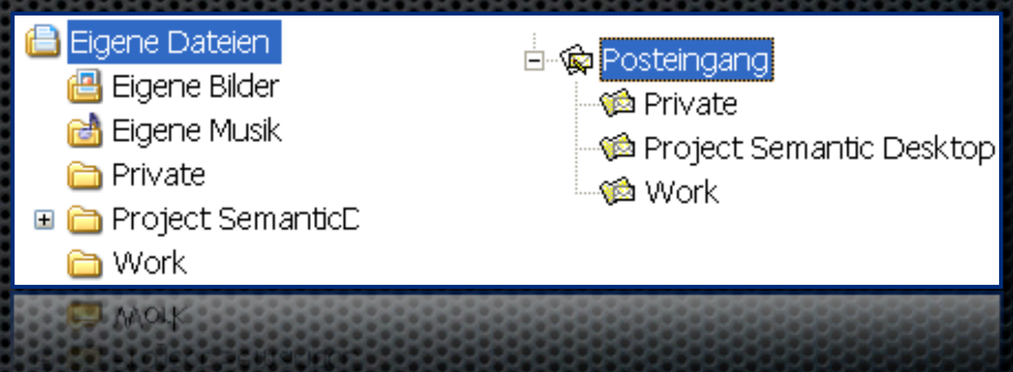
Existing structures



Building your personal semantic web

Semantic Desktop

Existing structures

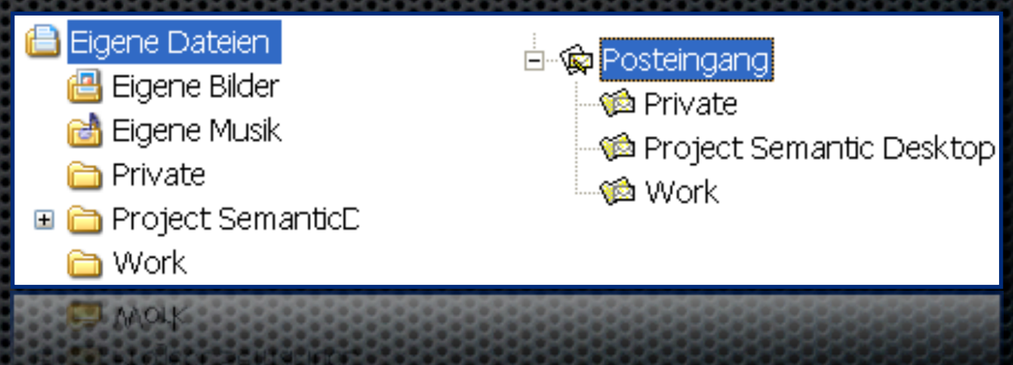


Building your personal semantic web

Semantic Desktop

„Rebirth“

Existing structures



Rebirth example: PIMO person

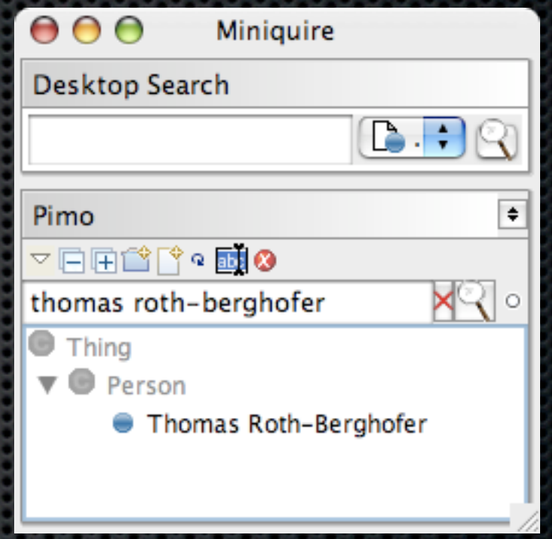
Semantic Desktop

„Rebirth“

Existing structures

Rebirth example: PIMO person

Semantic Desktop

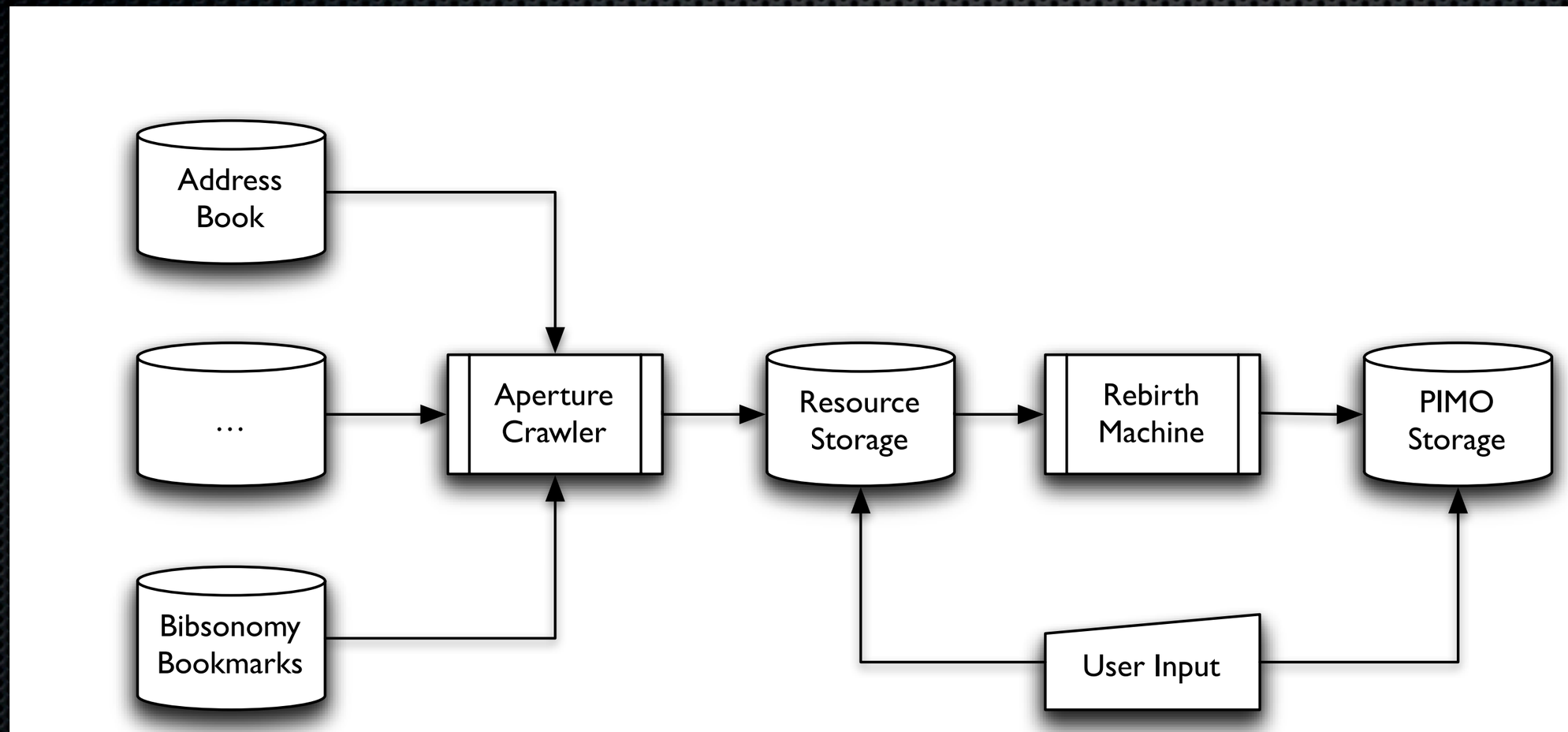


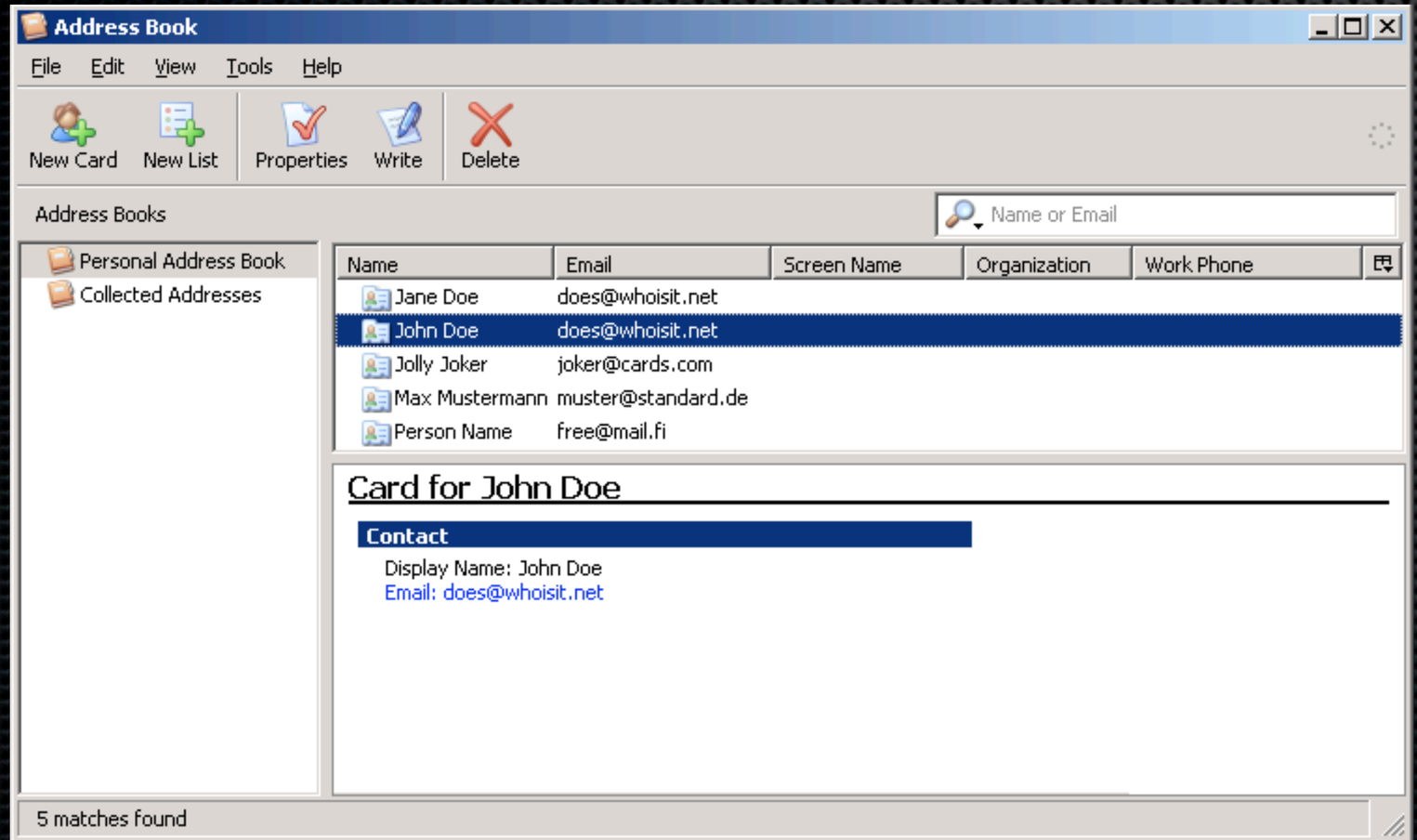
„Rebirth“

Existing structures

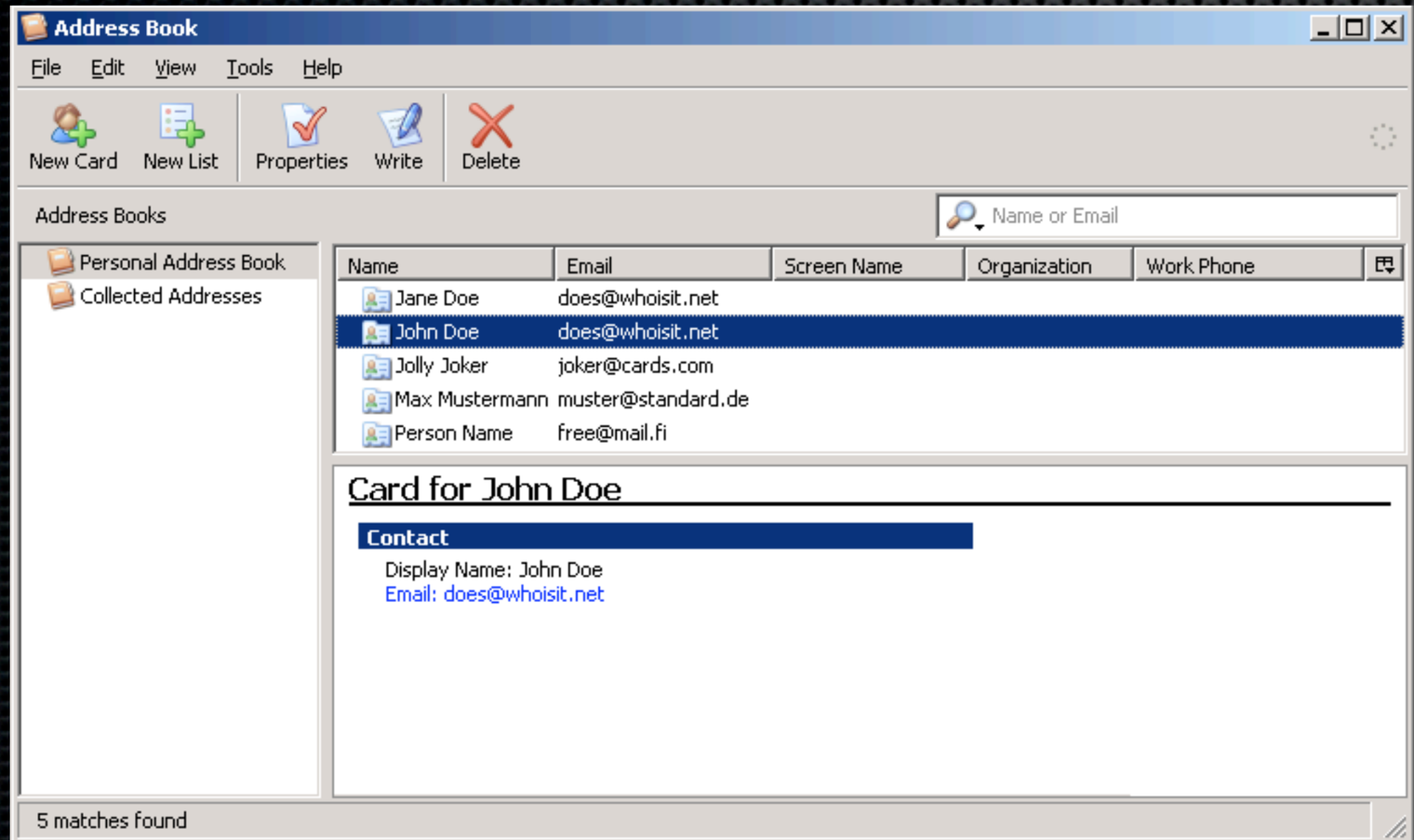
Apple Addressbook

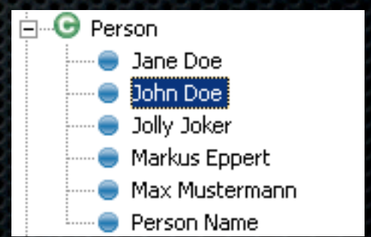
Import and rebirth process: Schematic overview



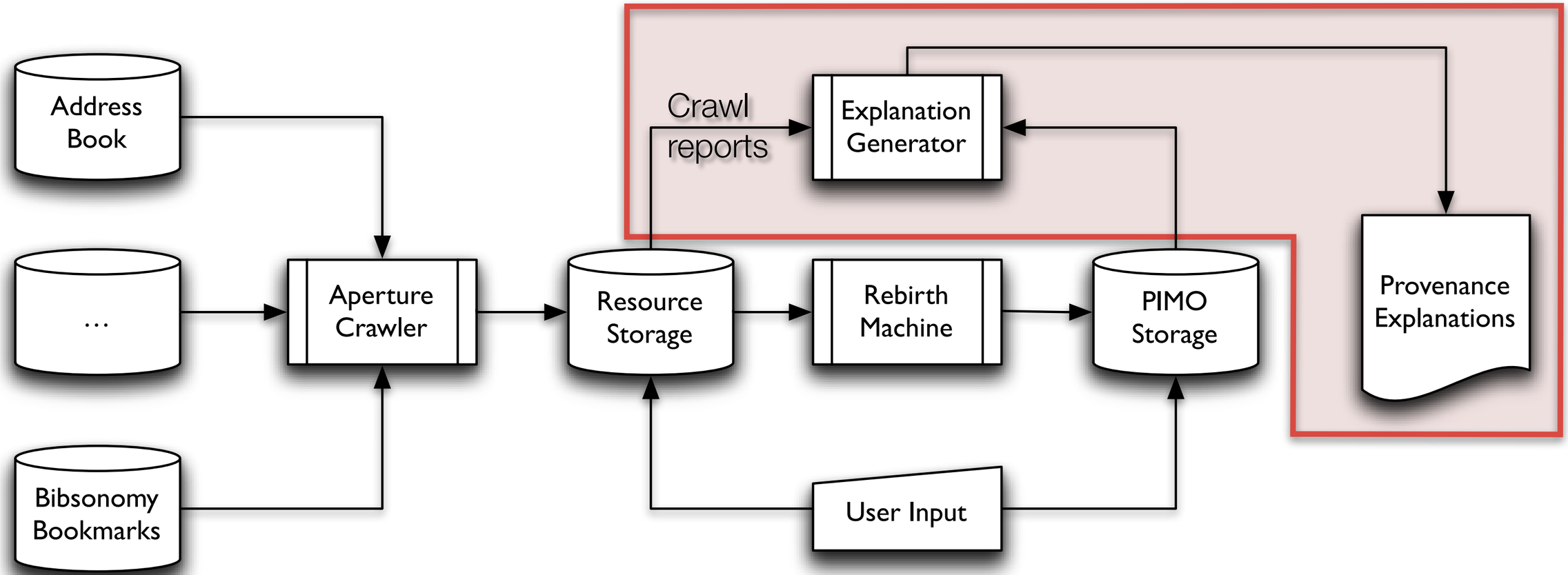

Address Book
File Edit View Tools Help
New Card
New List
Properties
Write
Delete
Address Books
Name or Email
Personal Address Book
Collected Addresses
Name
Email
Screen Name
Organization
Work Phone
Jane Doe does@whoisit.net
John Doe does@whoisit.net
Jolly Joker joker@cards.com
Max Mustermann muster@standard.de
Person Name free@mail.fi
Card for John Doe
Contact
Display Name: John Doe
Email: does@whoisit.net
5 matches found


Person
Jane Doe
John Doe
Jolly Joker
Markus Eppert
Max Mustermann
Person Name


Address Book
File Edit View Tools Help
New Card
New List
Properties
Write
Delete
Address Books
Name or Email
Personal Address Book
Collected Addresses
Name
Email
Screen Name
Organization
Work Phone
Jane Doe does@whoisit.net
John Doe does@whoisit.net
Jolly Joker joker@cards.com
Max Mustermann muster@standard.de
Person Name free@mail.fi
Card for John Doe
Contact
Display Name: John Doe
Email: does@whoisit.net
5 matches found


Person
Jane Doe
John Doe
Jolly Joker
Markus Eppert
Max Mustermann
Person Name

Provenance explanations from crawl reports



services

Version 0.9.0

Gnowsis | Ontologies | Crawl Report | Database | Admin | Debug | Sync

Provenance Explanations

This explanation describes the import/creation process of the PIMO item "JohnDoe".

"JohnDoe" is a Person in PIMO, because the data source it has been crawled from is an address book.

"JohnDoe" has been crawled from:

DataSource	Started	Finished	New Objects	Deleted Objects	Modified Objects	Not Modified Objects	
"Address Book" (http://aperture.semanticdesktop.org/ontology/source#AddressbookDataSource)	"2007-03-05T14:17:11"	"2007-03-05T14:17:11"	"3"	NULL	NULL	"1"	view details

An address book entry describes features of a person. Only the primary e-mail address is used at the moment to identify the person, other information is not used. An import of an address book entry is transformed into an instance of the PIMO class "Person".

services

Version 0.9.0

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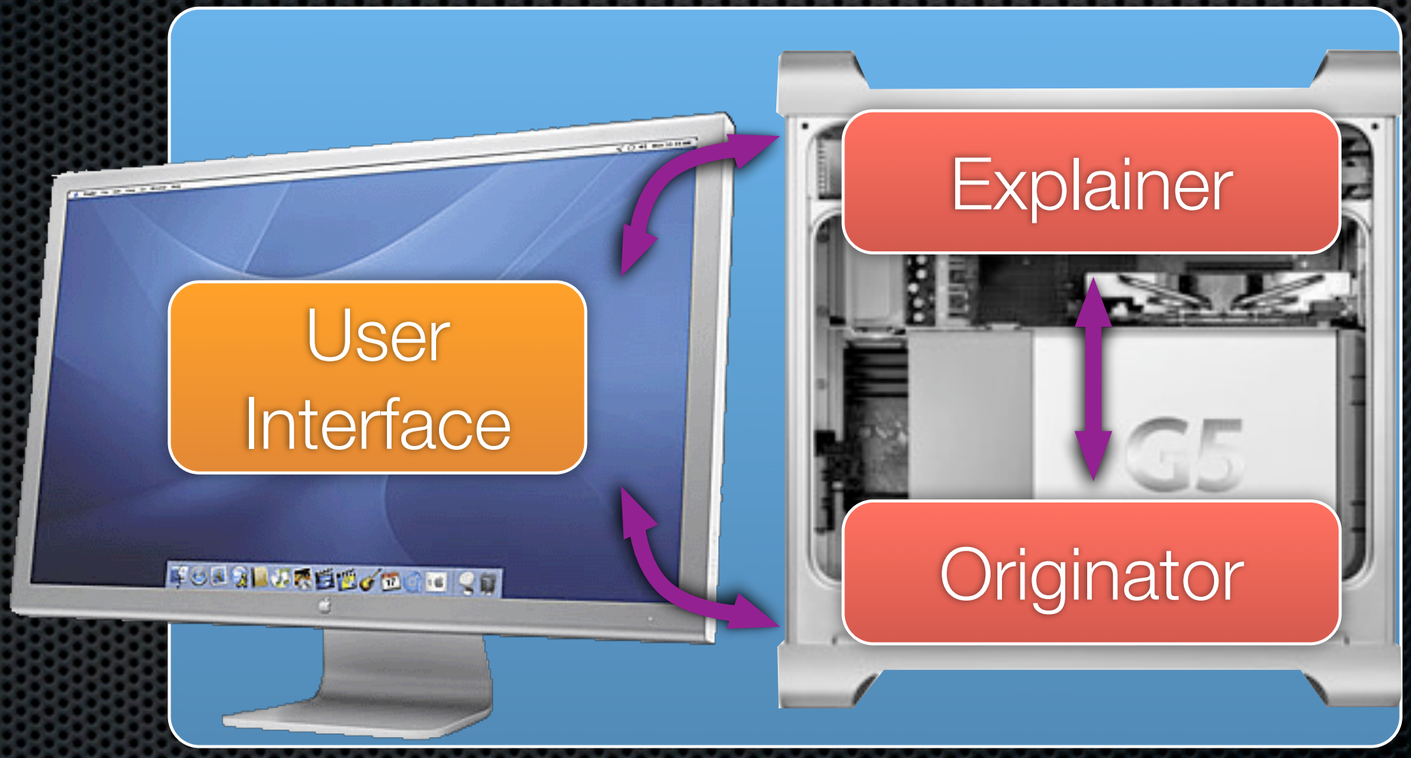
Status and plans

- Markus Eppert (graduate student) developed first prototype for basic provenance explanations of crawled and reborn addressbook entries.
- Follow-up diploma thesis: „Design and development of a generic explanation component for the rebirth machine“
- Florian Mittag (graduate student) develops a decision tracking component on top of a Justification-based Truth Maintenance system.

Explanations in myCBR



myCBR

Case-Based Reasoning (CBR) is ...

- A problem solving approach:

  New problems are solved based on the solutions of similar past problems.

- Basic assumption:

  Similar problems have similar solutions.

Typical examples

- An **auto mechanic** who fixes an engine by recalling another car that exhibited similar symptoms is using case-based reasoning.
- A **lawyer** who advocates a particular outcome in a trial based on legal precedents or a judge who creates case law is using case-based reasoning.
- In **e-commerce** scenarios: Similarity-based product retrieval and recommendation.

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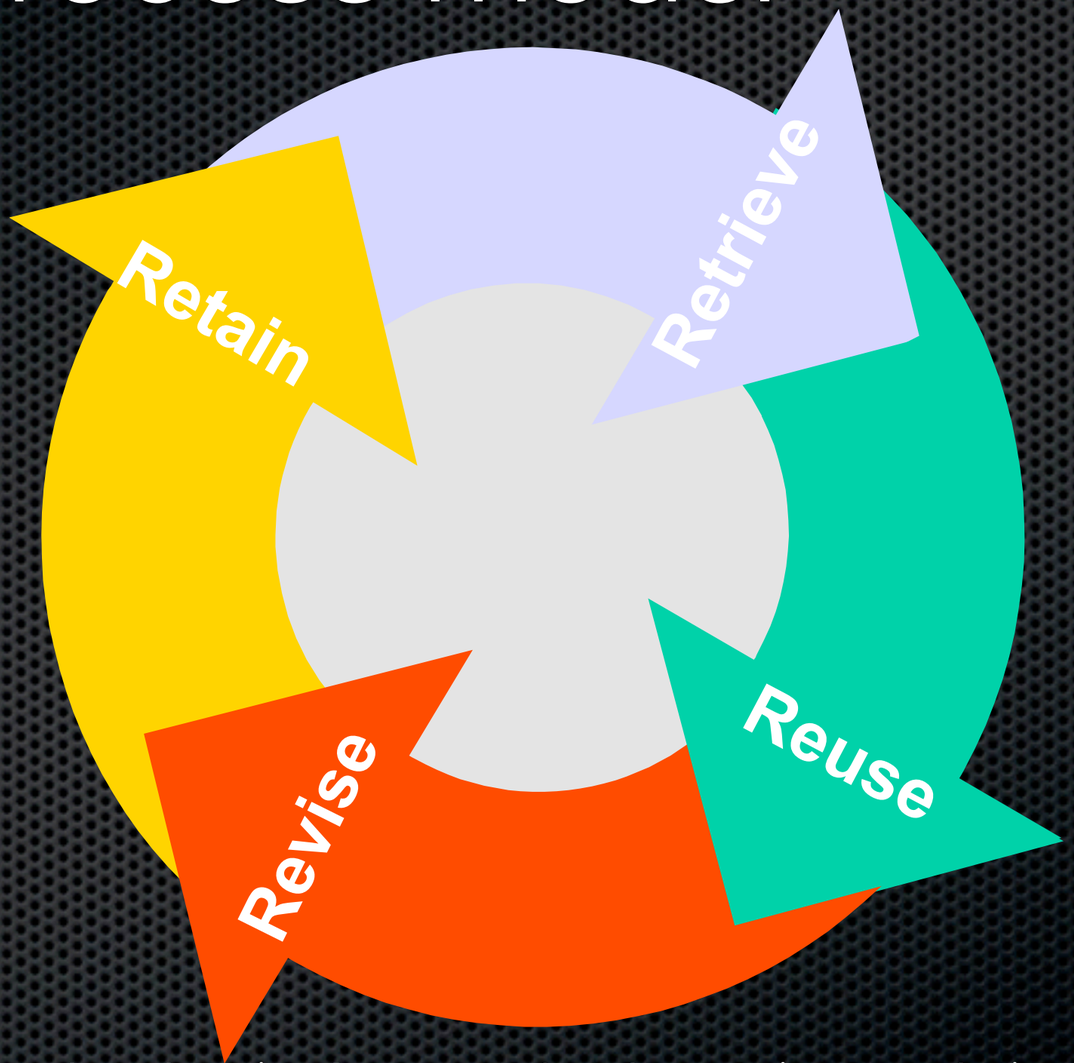
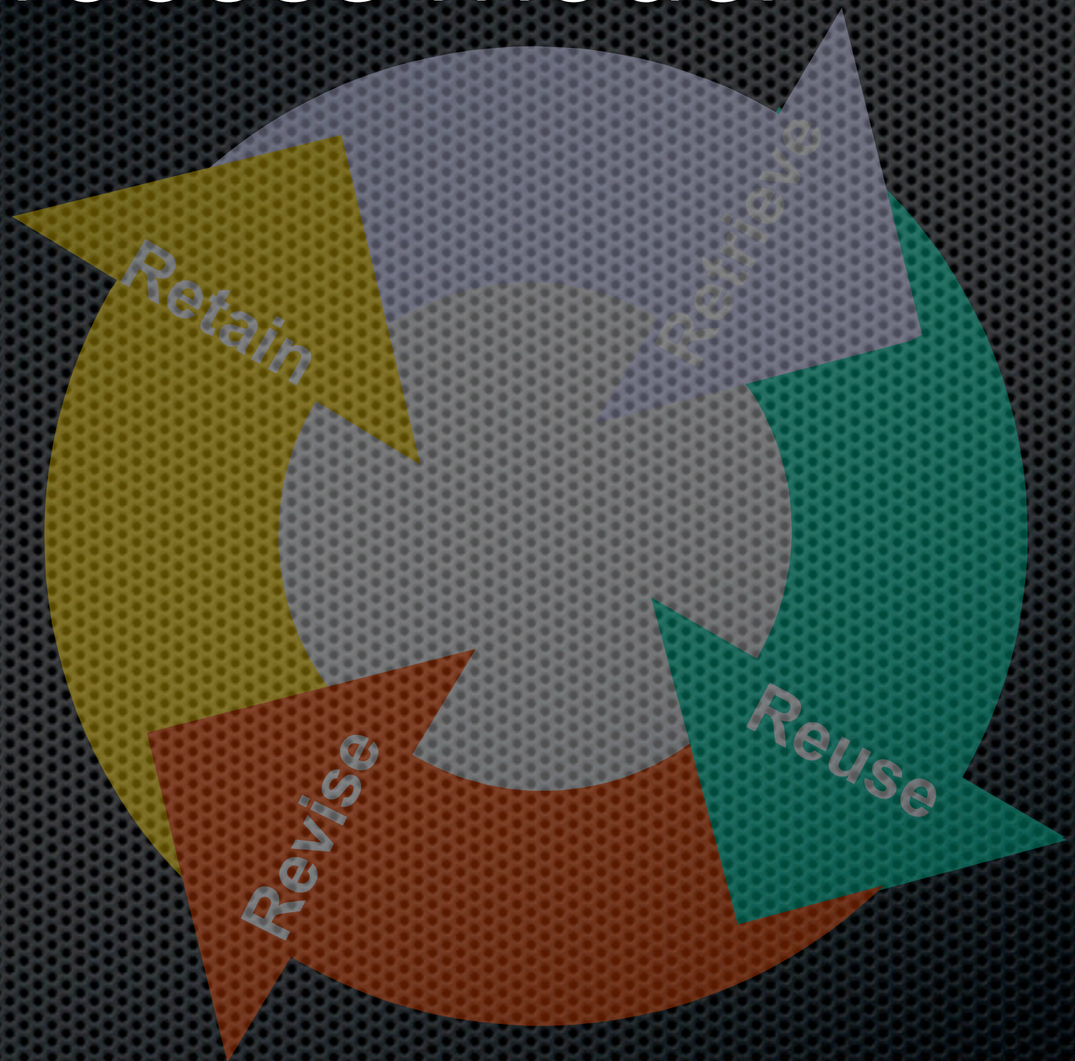
Traditional view

The CBR process model



Agnar Aamodt and Enric Plaza. Case-based reasoning: Foundational issues, methodological variations, and system approaches. AI Communications, 7(1):39–59, 1994.

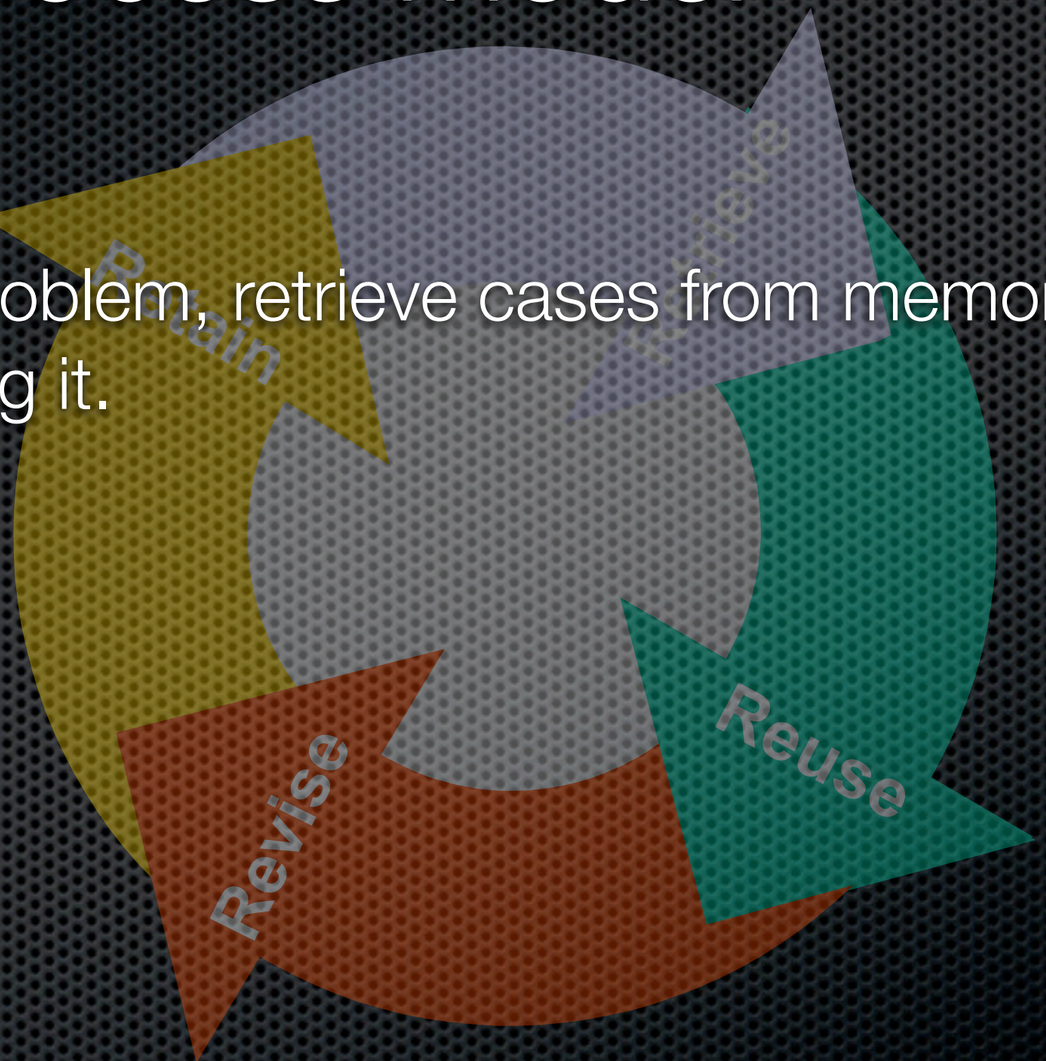
The CBR process model



The CBR process model

- Retrieve:

  Given a target problem, retrieve cases from memory that are relevant to solving it.



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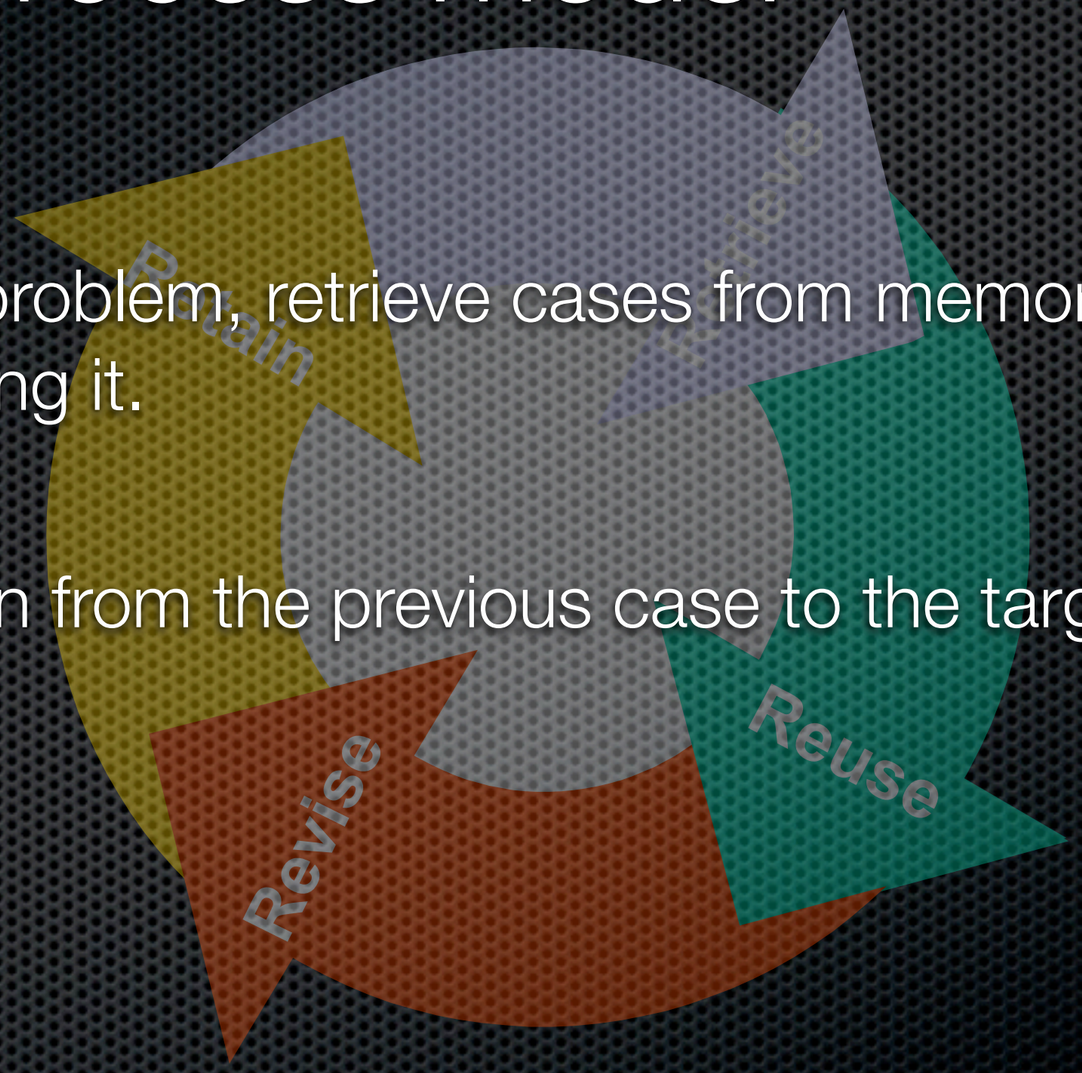
- Reuse:

  Map the solution from the previous case to the target problem.



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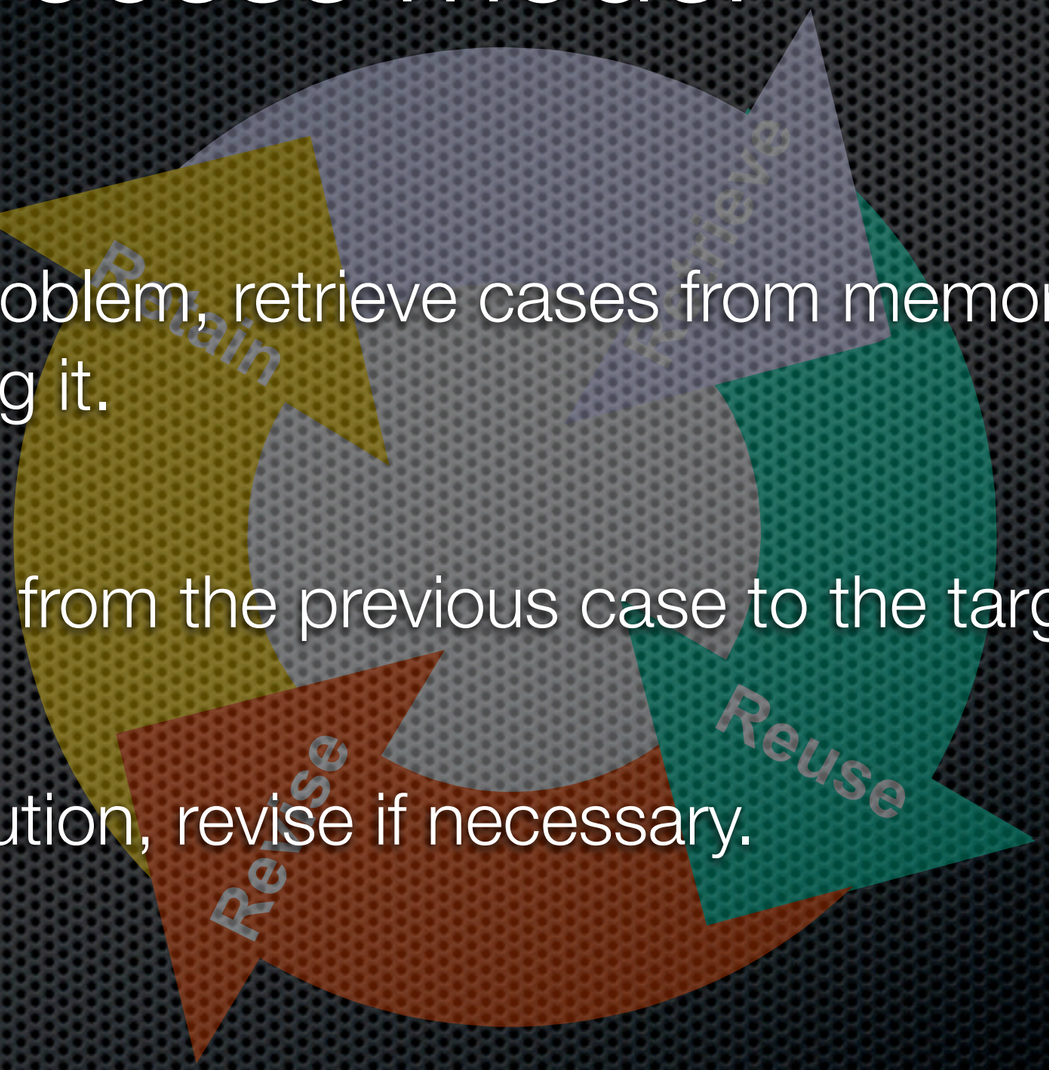

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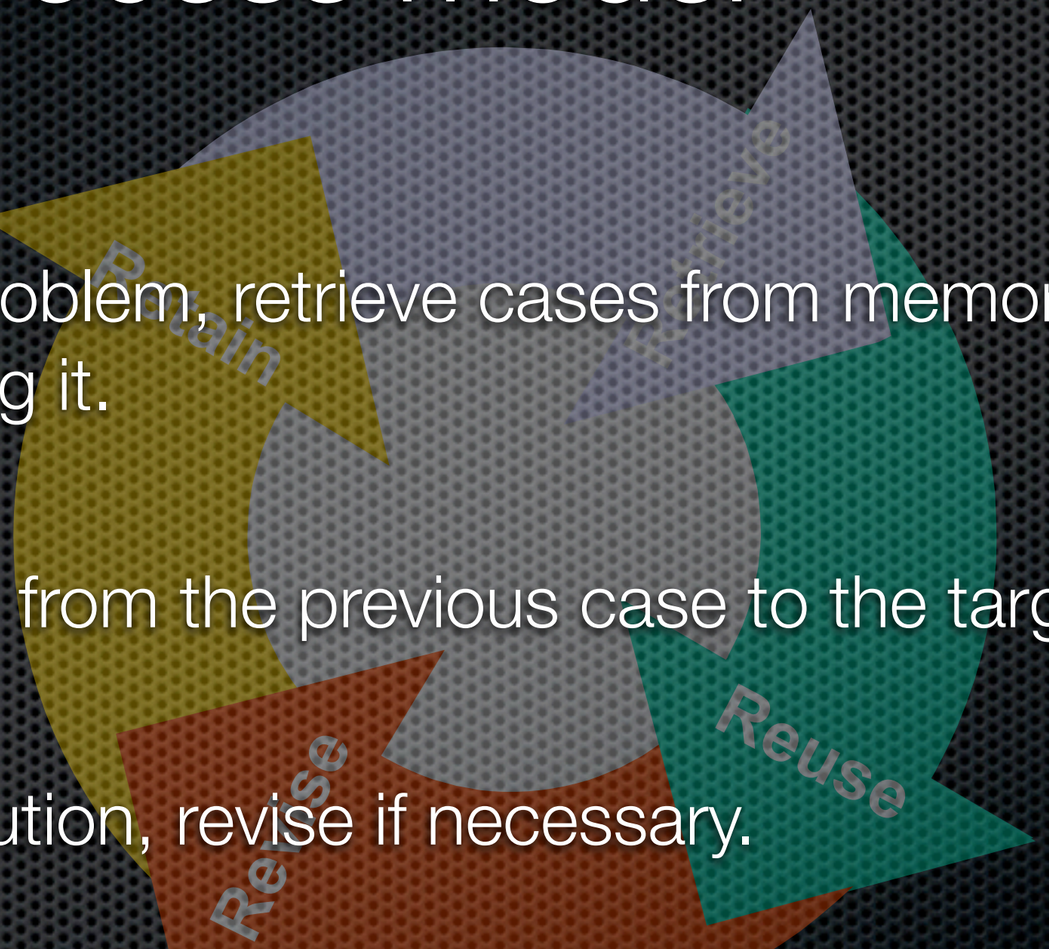

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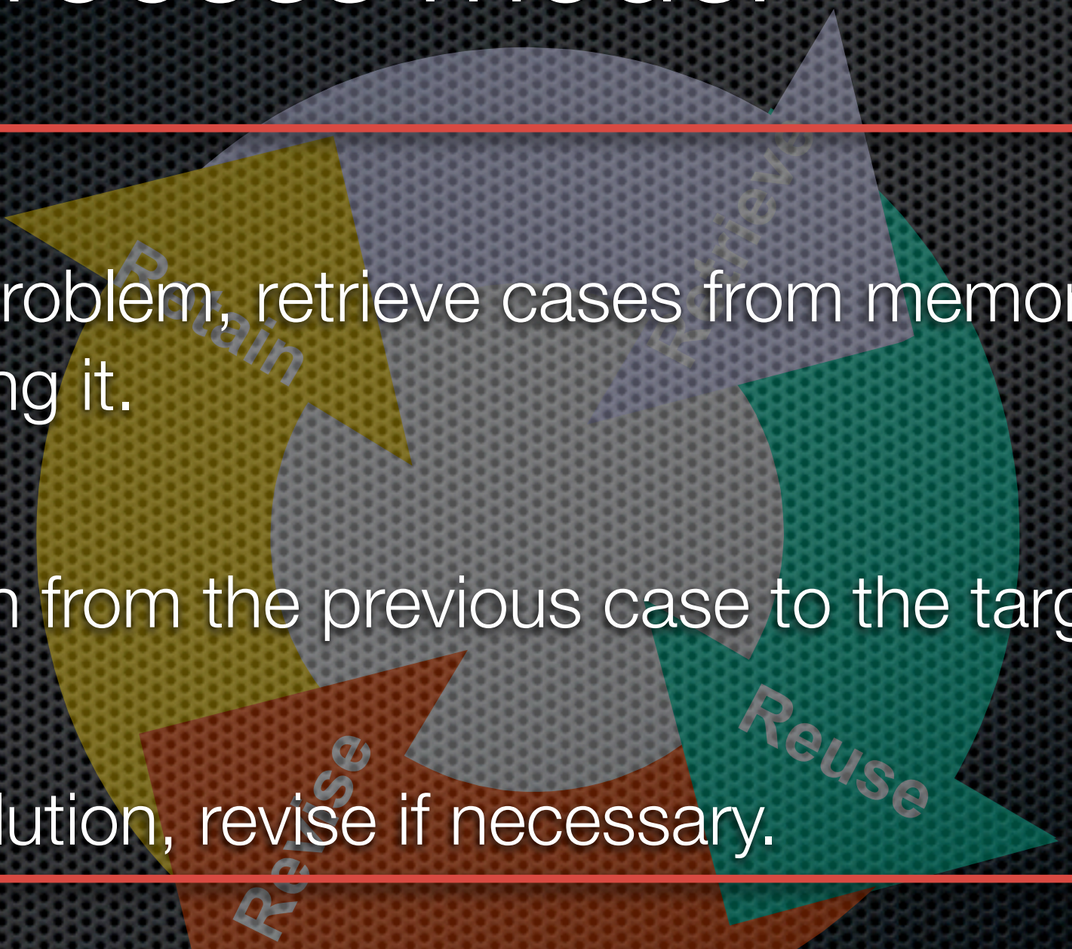

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Knowledge containers

- Concept introduced by M. M. Richter (in 1995)
- Contain and structure the knowledge of a CBR system
- Collection of knowledge that is relevant to many tasks
- Knowledge containers in rule-based systems:

  Facts

  Rules

M. Lenz, B. Bartsch-Spörl, H.-D. Burkhard, and S. Wess, editors.
Case-Based Reasoning Technology: From Foundations to Applications.
LNAI. Springer-Verlag, Berlin, 1998.

Knowledge Containers

- **Vocabulary**

  Structure of the domain schema, e.g., classes, attributes, allowed values

  Basis for the three other knowledge containers
- **Similarity measures**

  define how the most useful cases are retrieved

  define by what means the similarity is calculated
- **Solution transformation (or adaptation) knowledge**

  covers the knowledge for translating prior solutions to fit a given query
- **Case base**

  stores the experience of the CBR system in the form of cases

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(some) myCBR features

- Plugin for popular ontology editor Protégé (Version 3.x)
- Extensions provided by myCBR (current Version 2.0 *beta*):
  - Easy import of raw data (csv-files)
  - GUIs for modelling knowledge-intensive similarity measures
  - Similarity-based retrieval functionality
  - Export of domain model and similarity measures in XML format
- Stand-alone retrieval engine for separate use / integration

More information and download: http://mycbr-project.net

How do you compare used cars?

Comparing features

Body

Model

Color

Manufacturer

Mileage

Class „Car“

autos Protégé 3.1.1 (file:/Users/roth/Documents/workspace/mycbr/distribution/samples/auto_set/autos.pprj, Protégé Files (.pont and .pins))

protégé

Classes | Slots | Forms | Instances | Similarity Modeling | CBR Retrieval

CLASS BROWSER

For Project: autos

Class Hierarchy

- :THING
  - :SYSTEM-CLASS
    - Car
    - Soundsystem

Superclasses

- :THING

CLASS EDITOR

For Class: Car (instance of :STANDARD-CLASS)

Name: Car

Documentation

Constraints

Role: Concrete

Template Slots

Name	Cardinality	Type	Other Facets
Body	single	Symbol	allowed-values={convertible,coupe,fastback,roadster,sedan...
Car Code	single	Integer	minimum=0, maximum=10000000
CCM	single	Integer	minimum=1000, maximum=6000
Color	single	Symbol	allowed-values={anthracite,black,blue,dark_blue,dark_gray,...
Doors	single	Integer	minimum=2, maximum=7
Extras	multiple	Symbol	allowed-values={ABS,ESP,Navigation}
Gas	single	Symbol	allowed-values={diesel,gasoline}
Manufacturer	single	Symbol	allowed-values={audi,bmw,mercedes-benz,vw}
Miles	single	Integer	minimum=0, maximum=1000000
Model	single	Symbol	allowed-values={316i,318i,320i,323i,325td,325tds,328i,5...
Power	single	Integer	minimum=10, maximum=1000
Price	single	Integer	minimum=1, maximum=1000000
Sound	single	Instance of Soundsystem	
Speed	single	Integer	minimum=100, maximum=300
Year	single	Float	minimum=1950.0, maximum=2007.0
ZIP	single	Integer	minimum=0, maximum=9

Name

Car

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Power	single	Integer	minimum=10, maximum=1000
Price	single	Integer	minimum=1, maximum=1000000
Sound	single	Instance of Soundsystem	
Speed	single	Integer	minimum=100, maximum=300
Year	single	Float	minimum=1950.0, maximum=2007.0
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Speed	single	Integer	minimum=100, maximum=300
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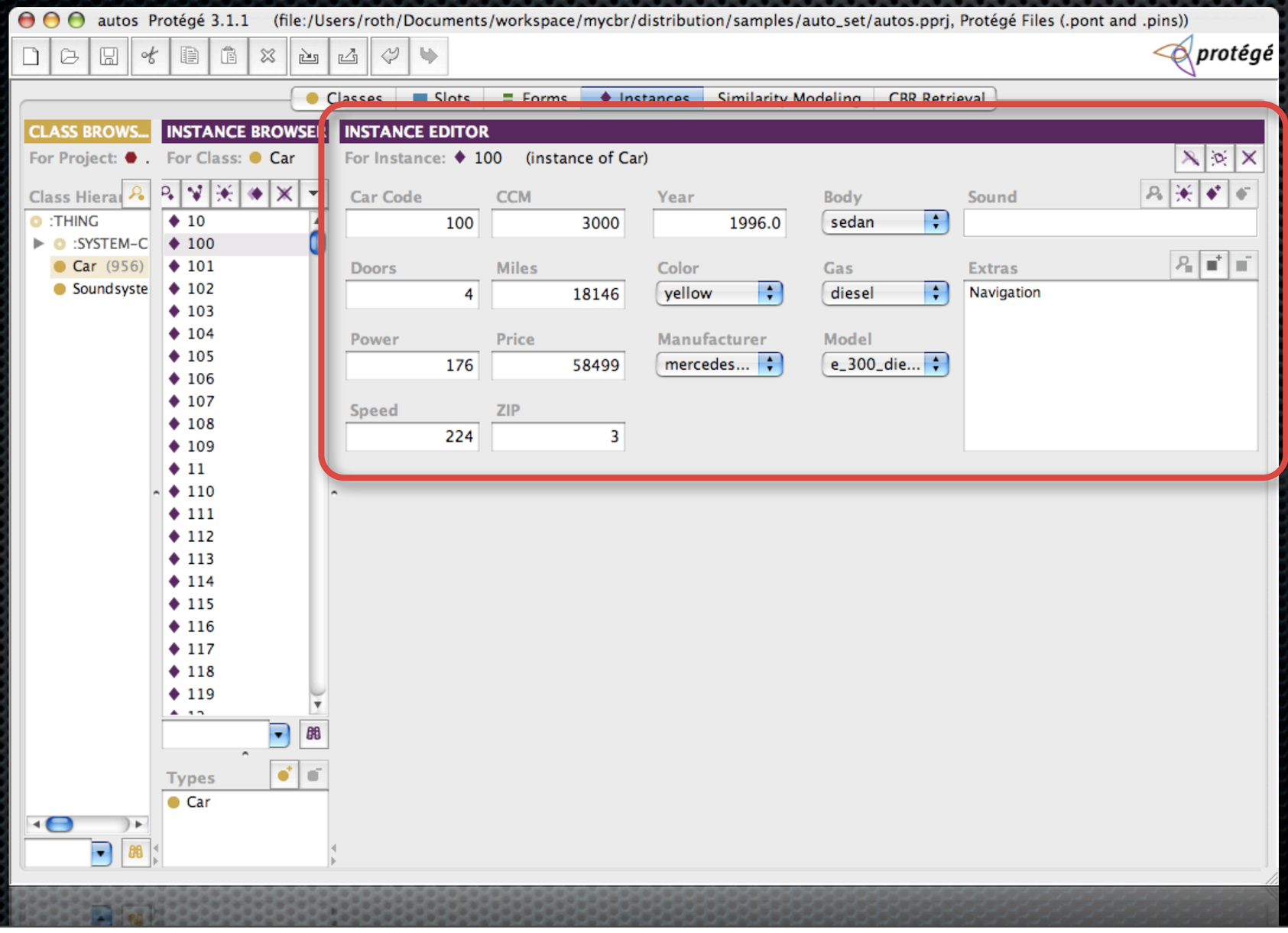
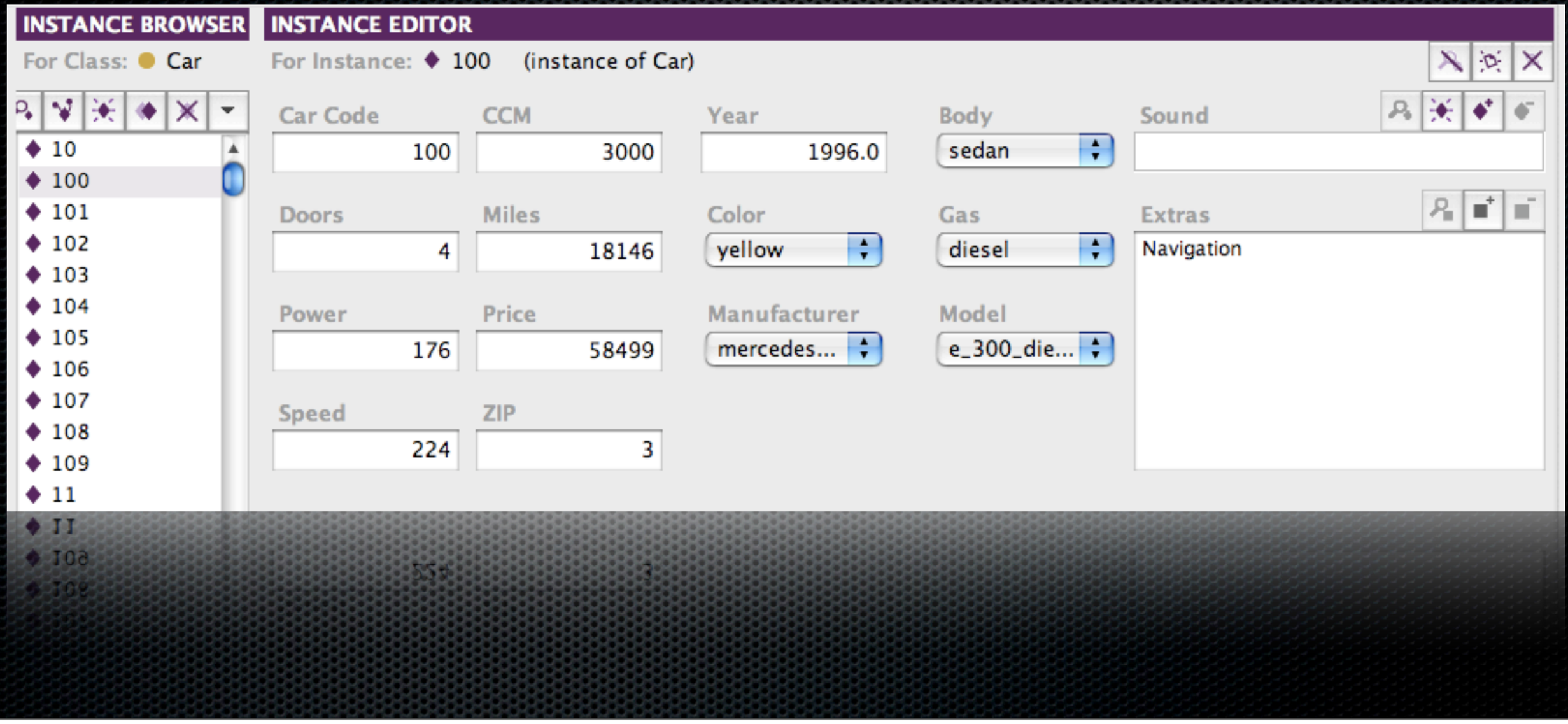
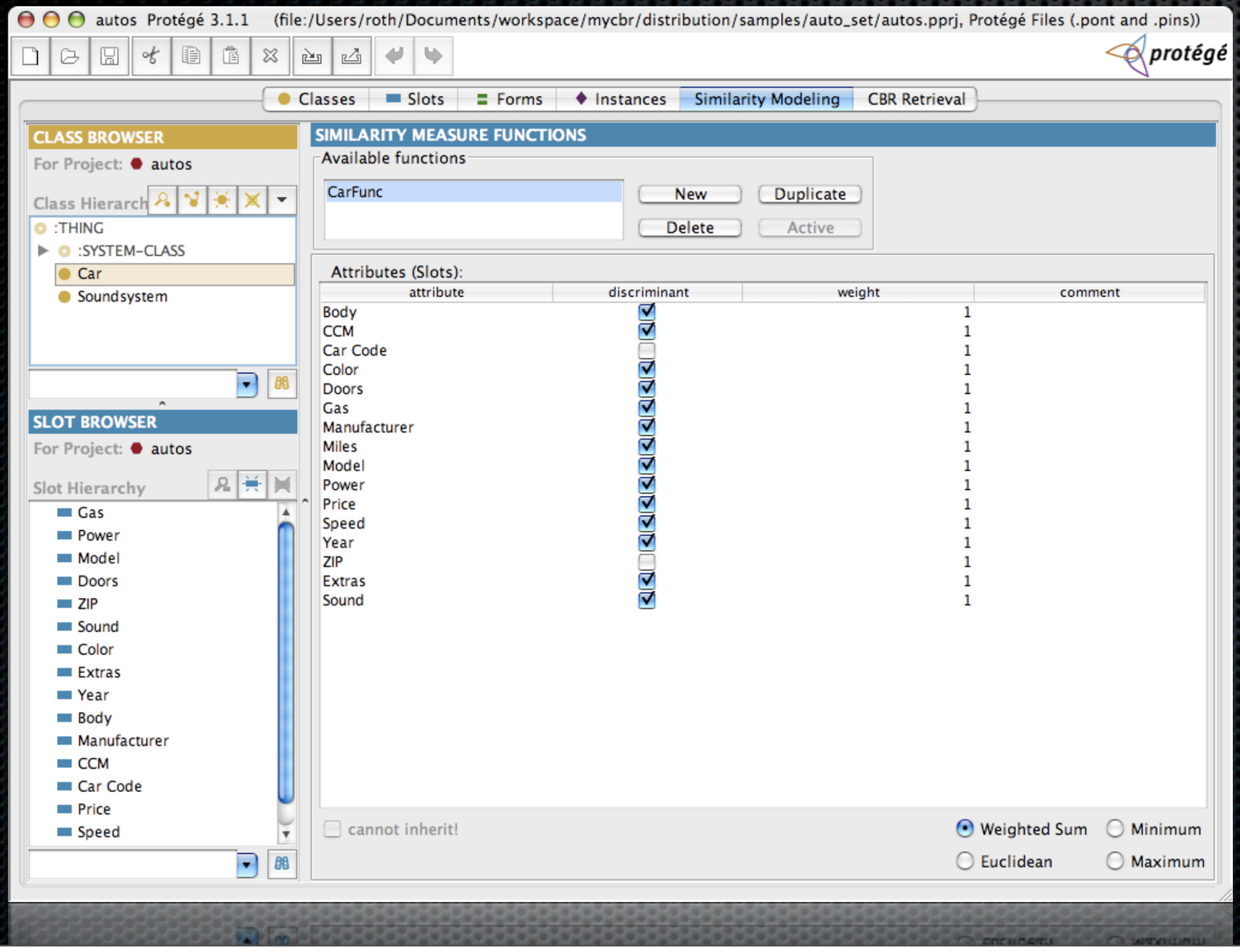
Car instances



Car instances

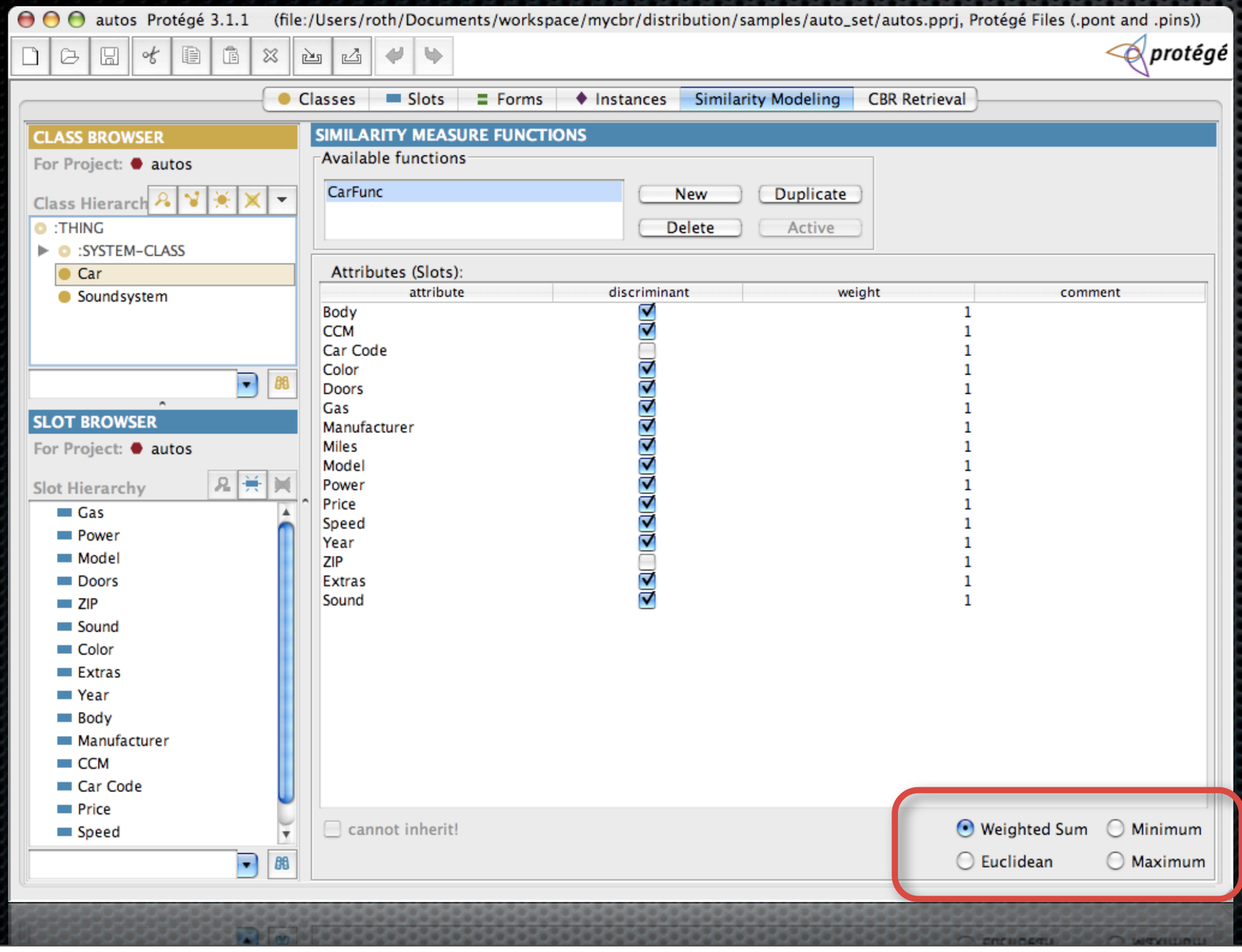


Global similarity measure



- Feature match: local similarity measures
- Class similarity: aggregate local similarities
  - Weighted sum
  - Maximum
  - Minimum
  - Euclidian distance

Global similarity measure



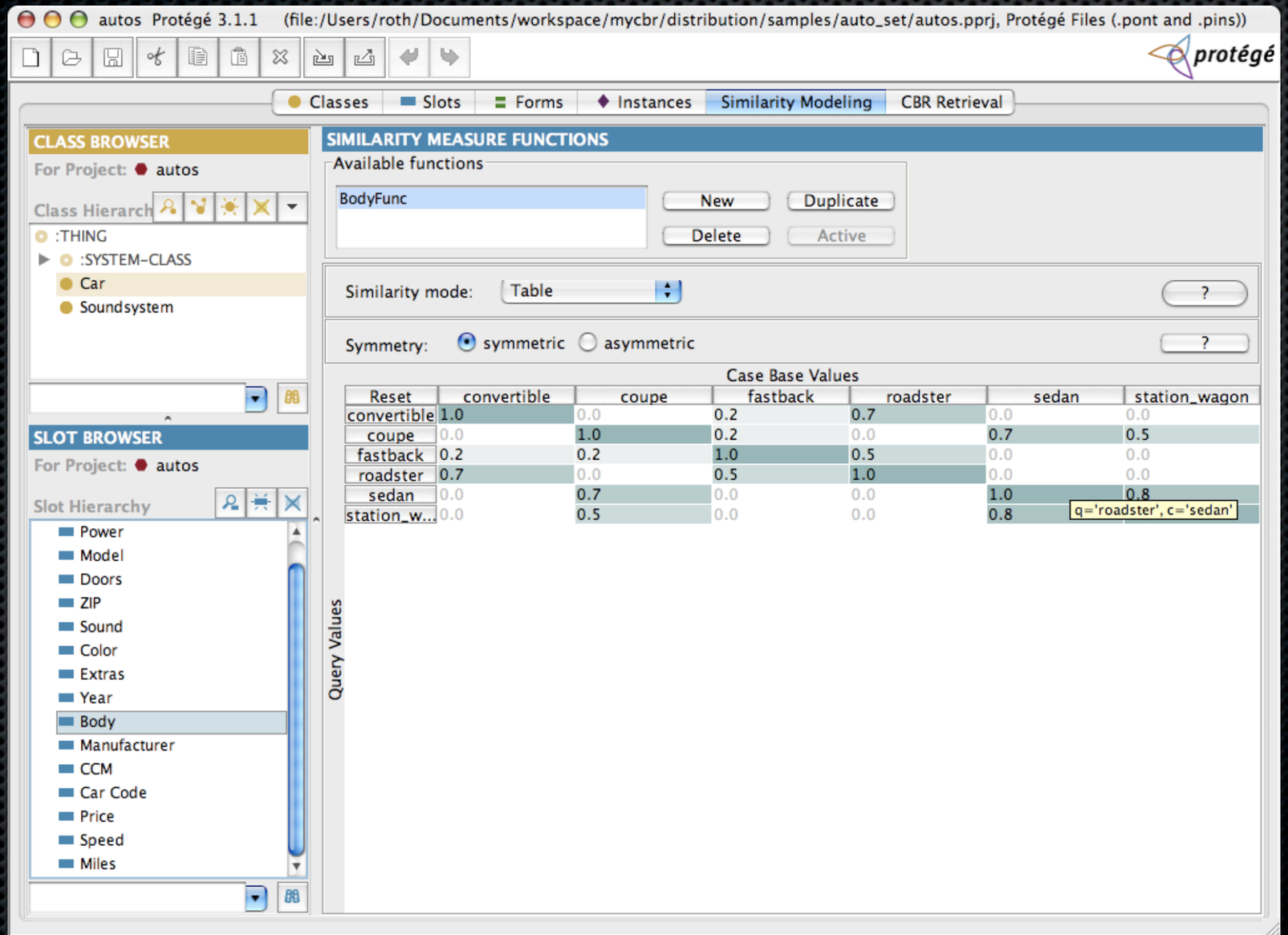
- Feature match: local similarity measures
- Class similarity: aggregate local similarities
  - Weighted sum
  - Maximum
  - Minimum
  - Euclidian distance

Important attributes

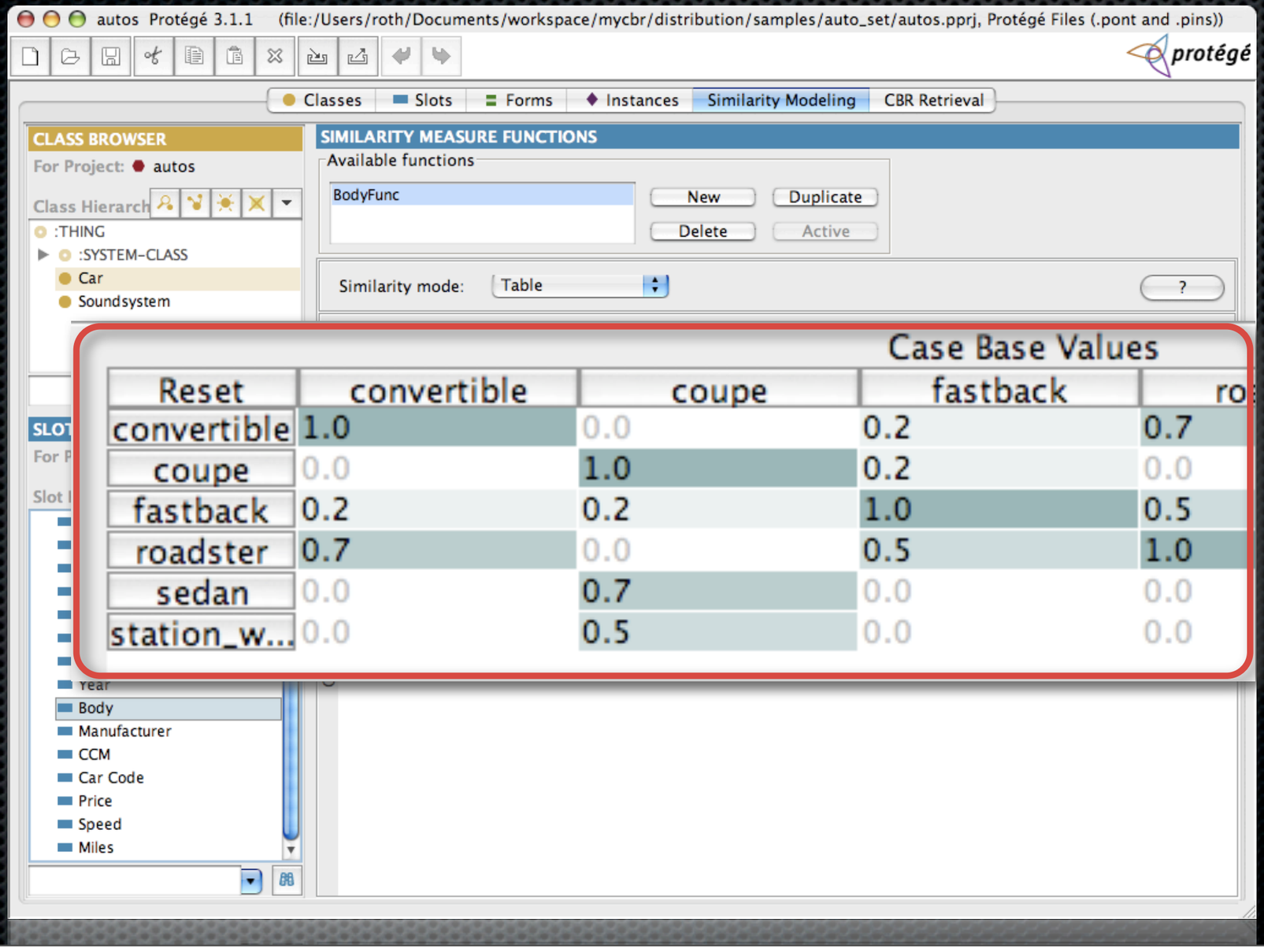
Attributes (Slots):

attribute	discriminant	wei...	...	comment
Manufacturer	☑	7	Activ...	Car manufacturer
Price	☑	7	Activ...	Basis for negotiation
Body	☑	5	Activ...	Car body
Color	☑	5	Activ...	Car color
Model	☑	5	Activ...	Car model
Miles	☑	3	Activ...	Mileage
Power	☑	3	Activ...	Horse power
Doors	☑	2	Activ...	Number of doors
CCM	☑	1	Activ...	Cylinder capacity
Car Code	☐	1	Activ...	Identifier; not used for retrieval
Gas	☑	1	Activ...	Type of fuel
Speed	☑	1	Activ...	Top speed
Year	☑	1	Activ...	Year of production
ZIP	☐	1	Activ...	Area of seller (first digit; Germany); not used for retrieval

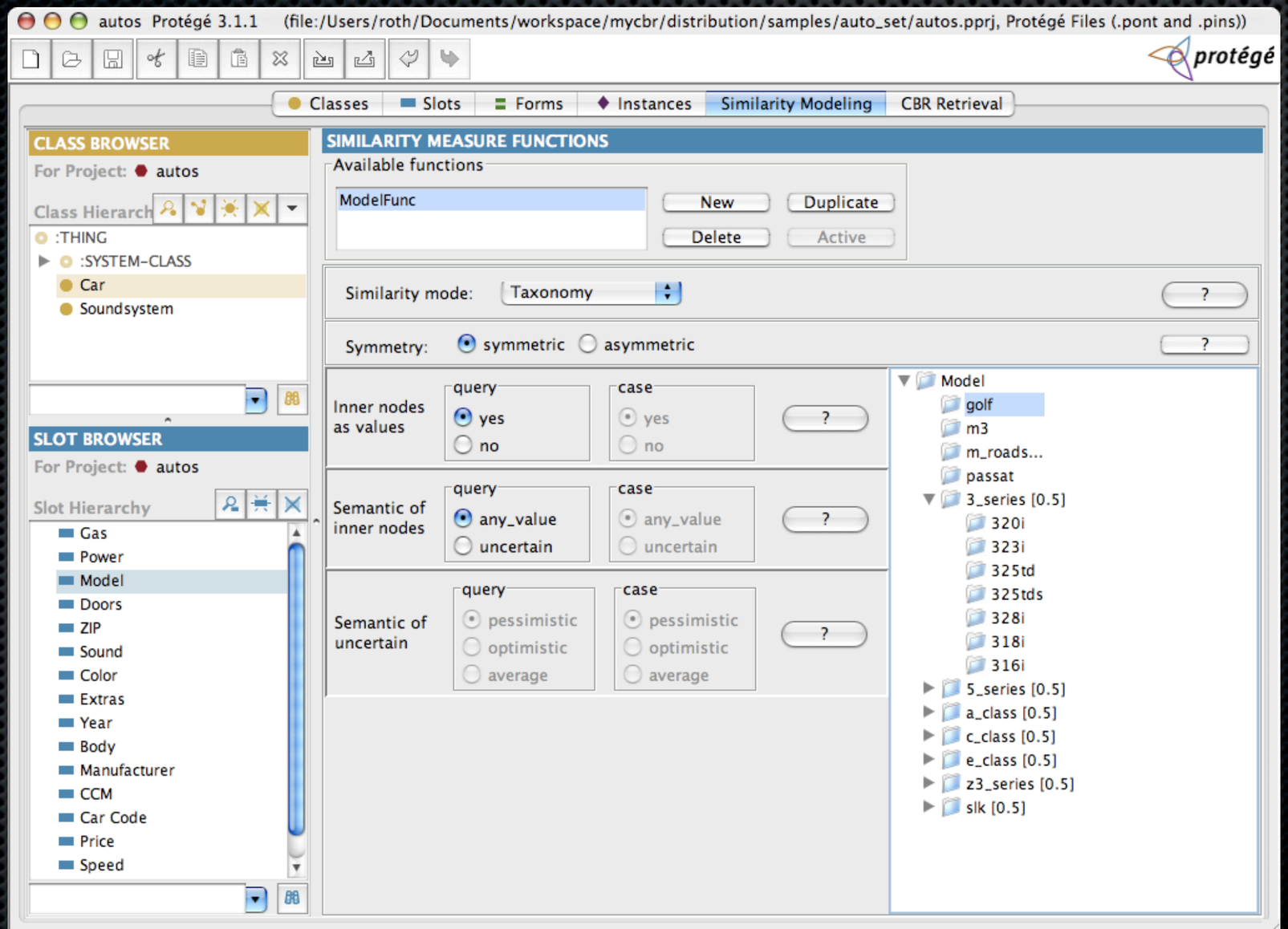
Local similarities: Car body



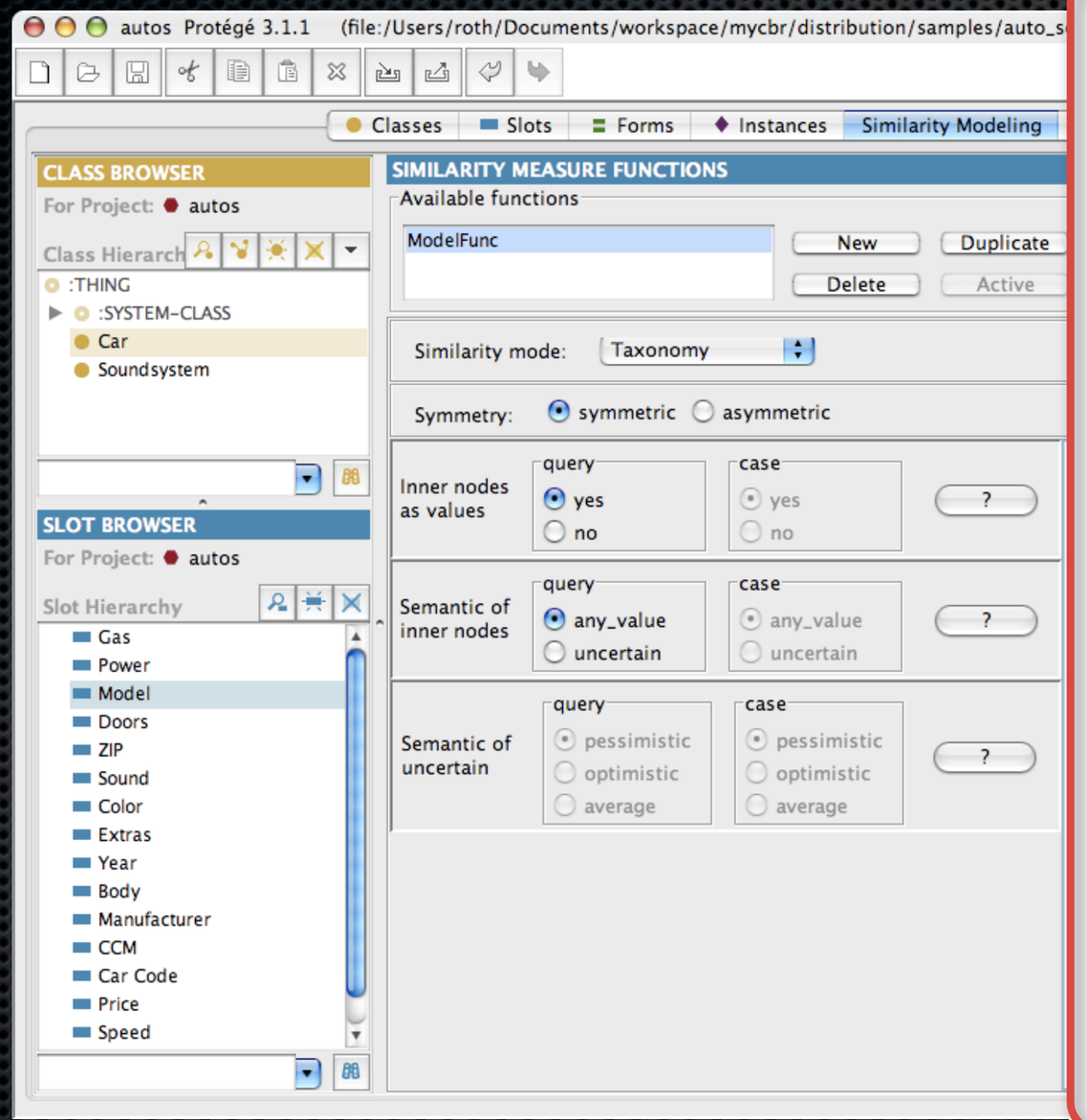
Local similarities: Car body

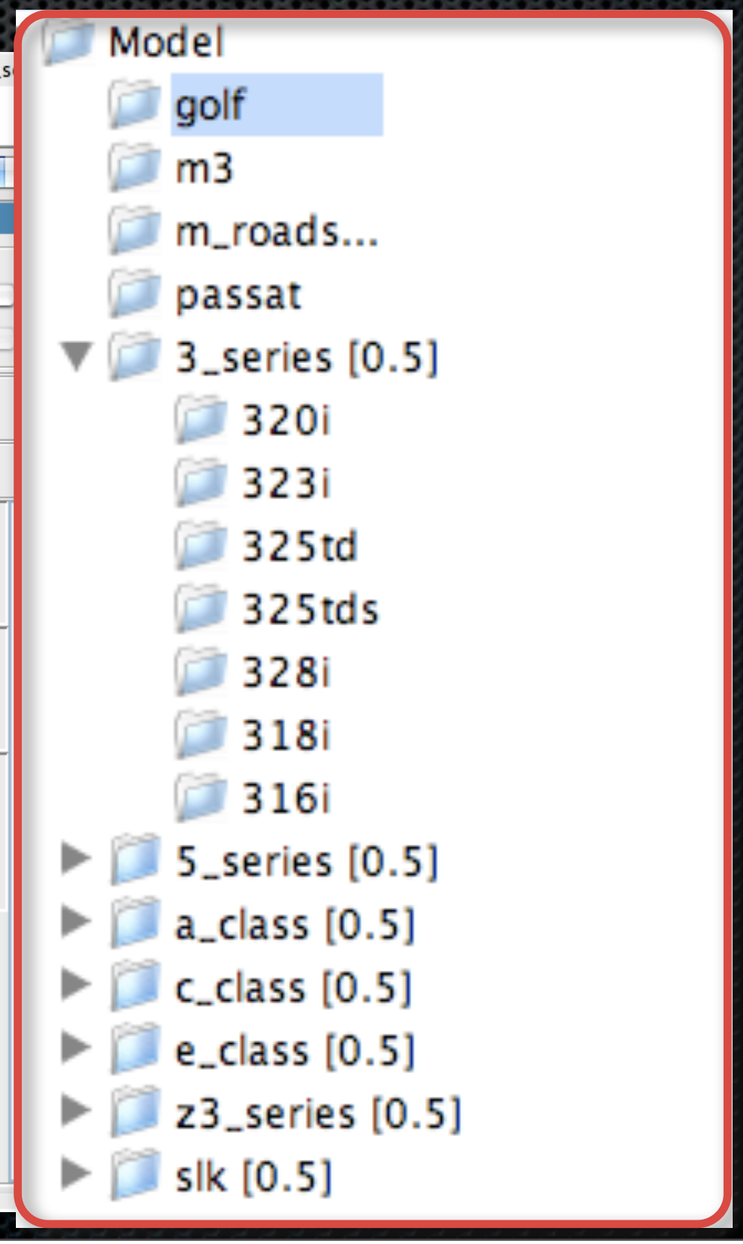


Local similarities: Car model

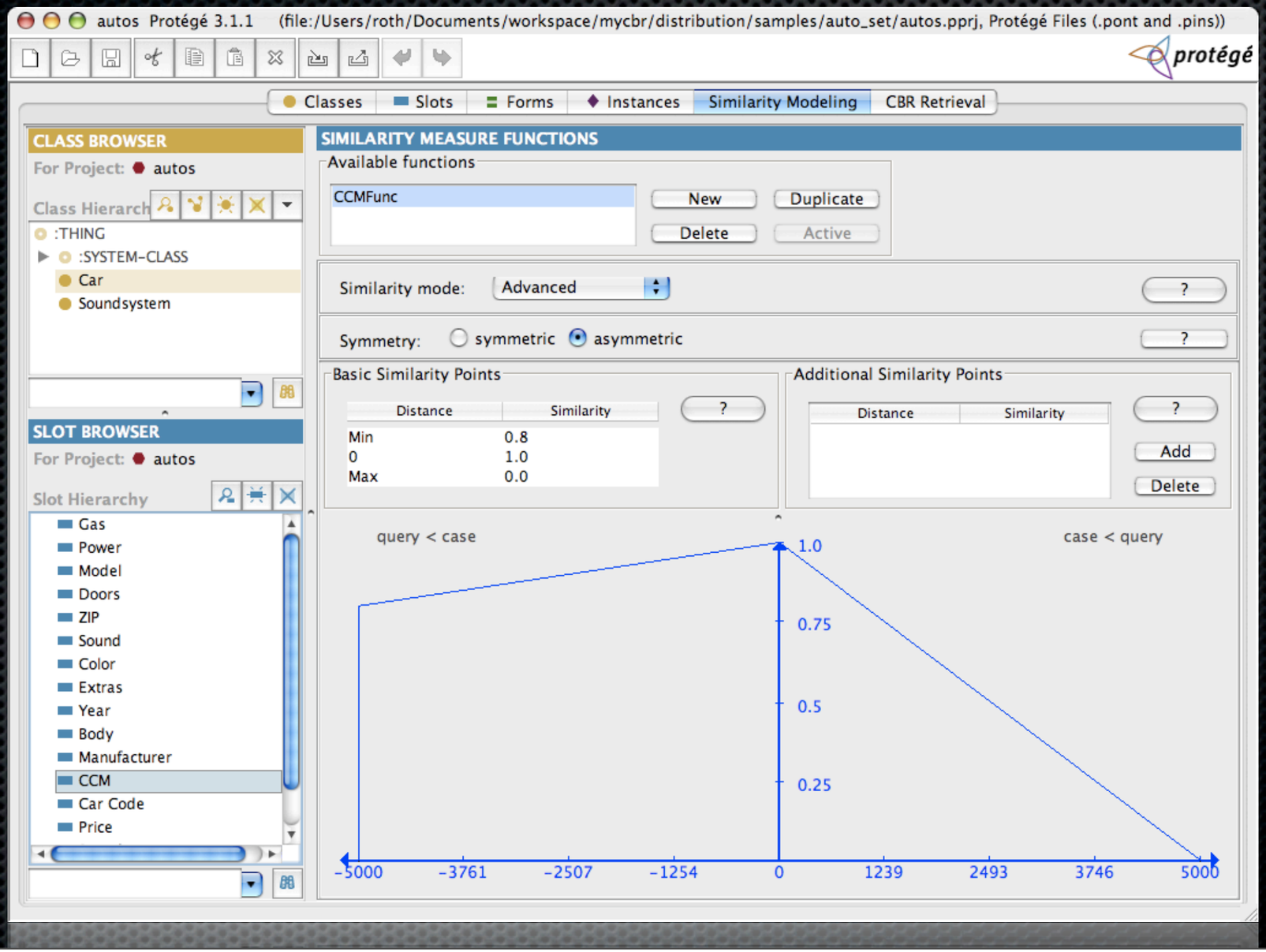


Local similarities: Car model

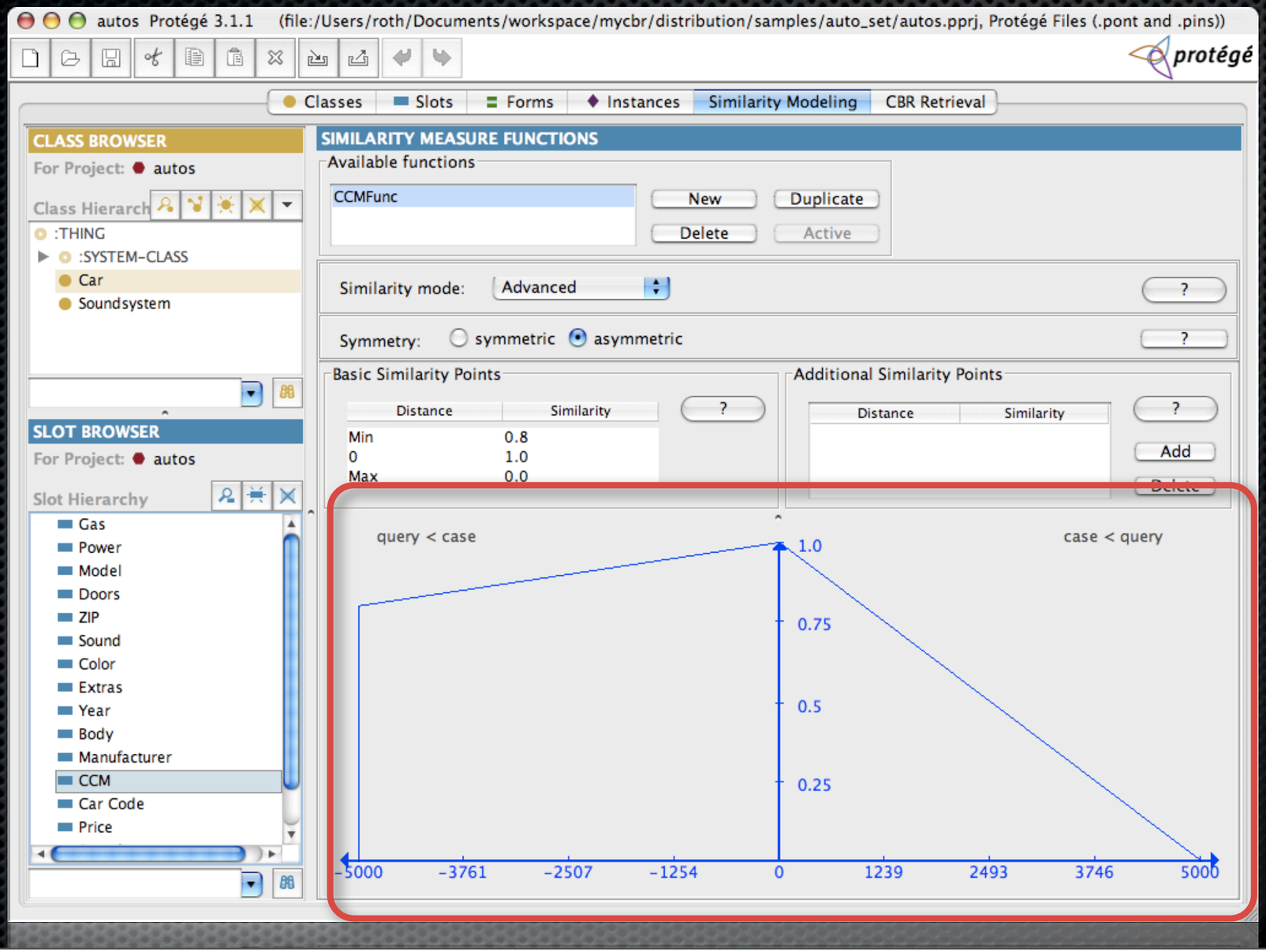




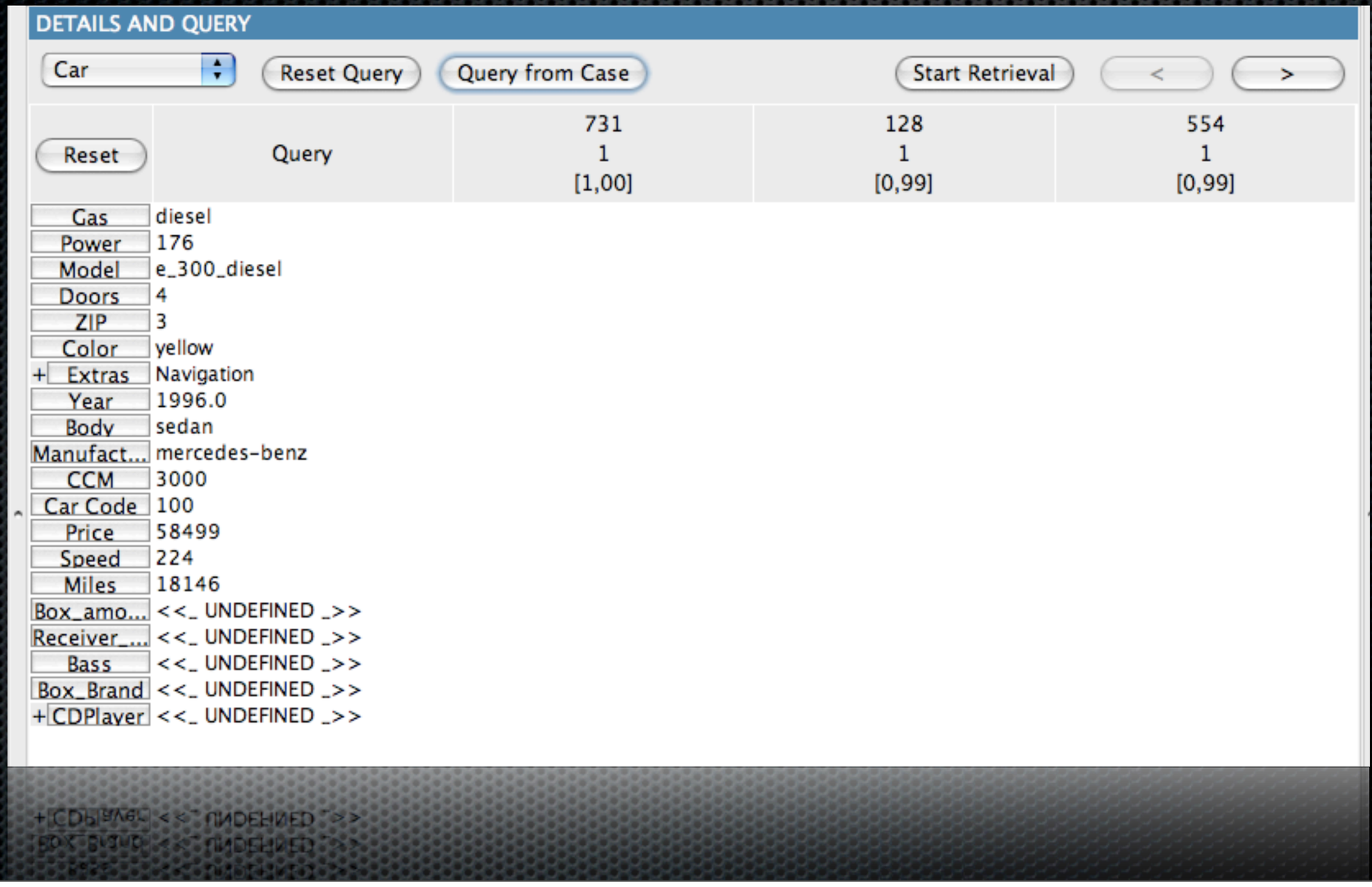
Local similarities: Cylinder capacity



Local similarities: Cylinder capacity



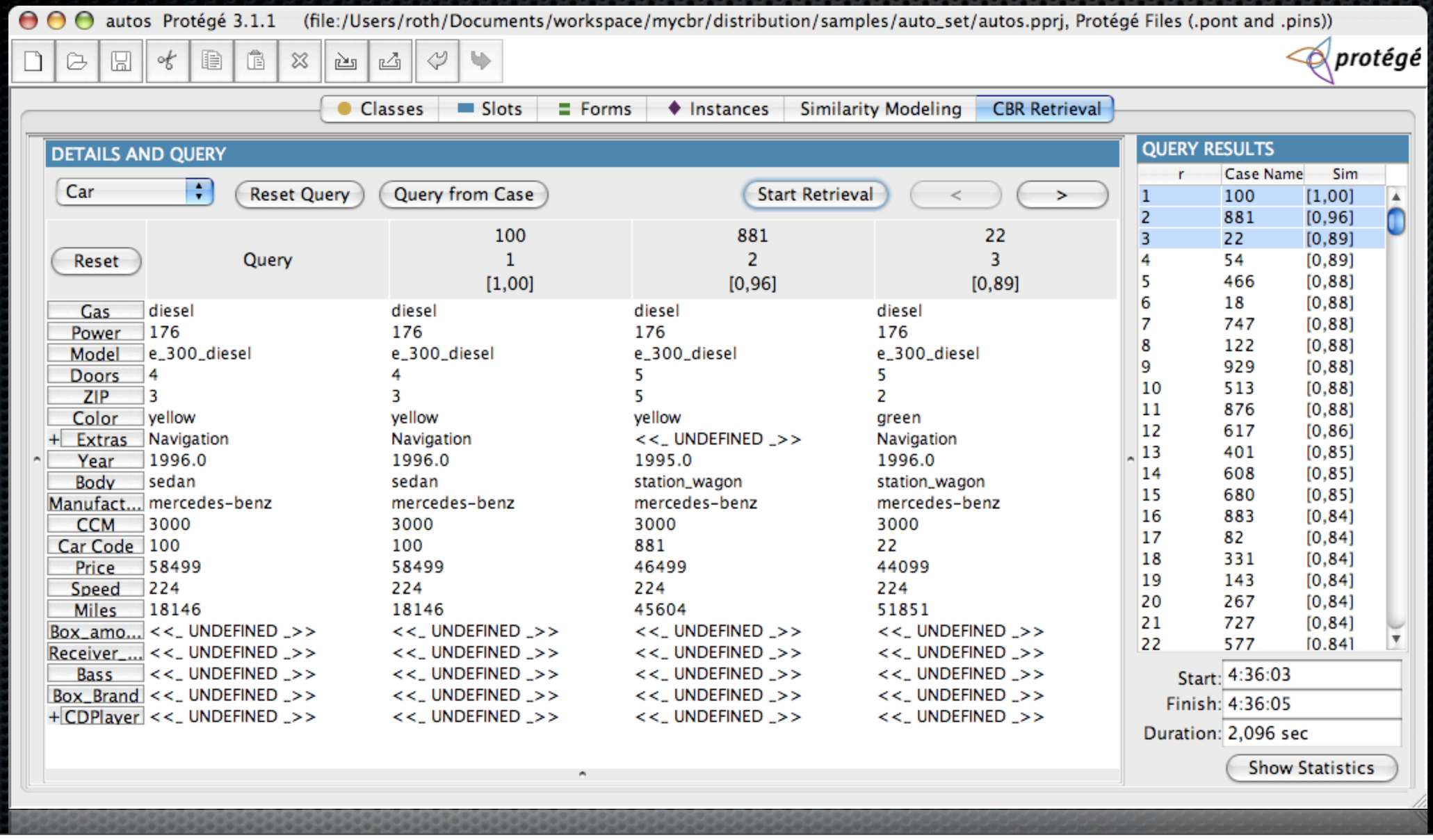
myCBR Retrieval Tab



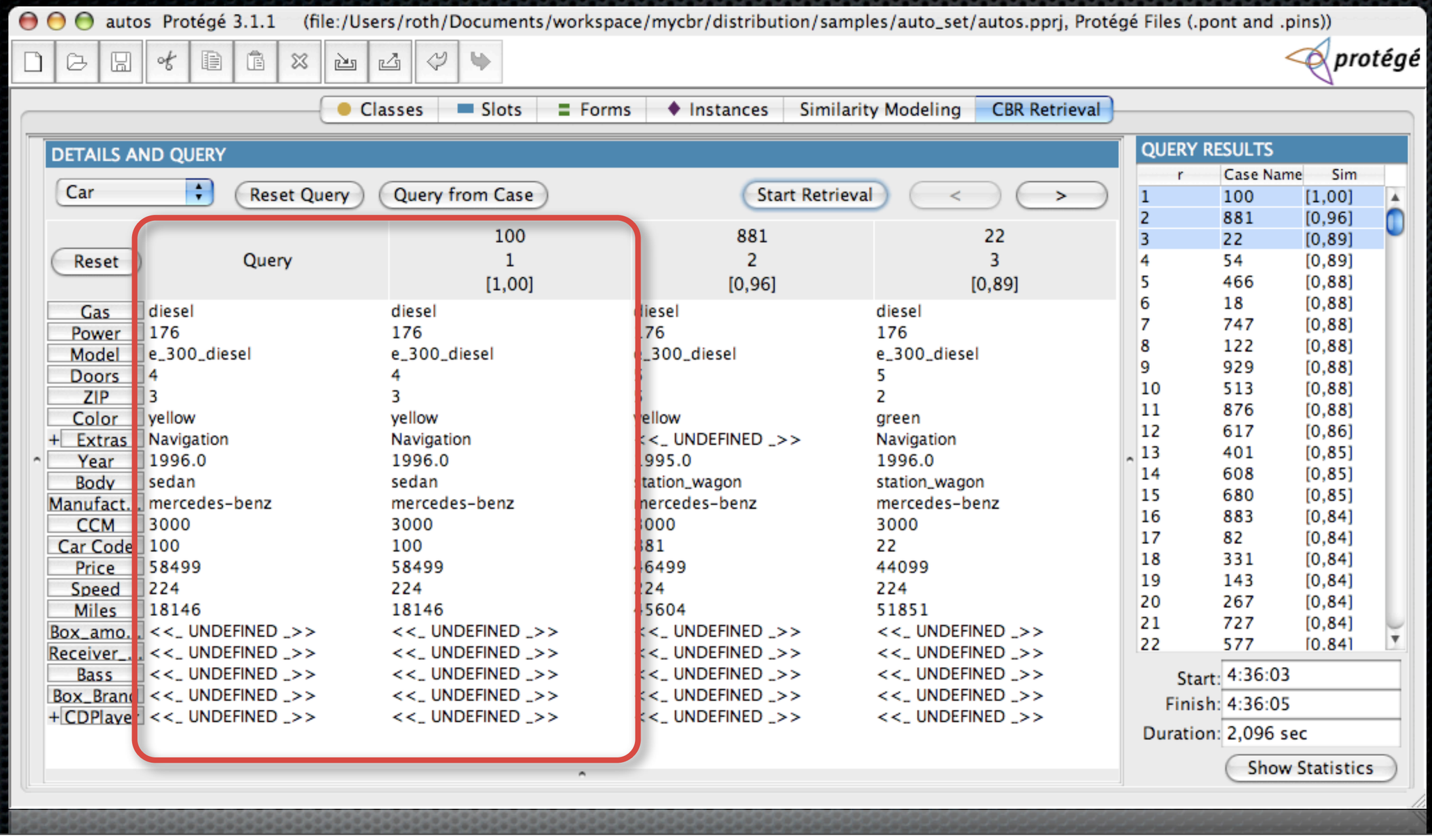
Query

Reset	Query
Gas	diesel
Power	176
Model	e_300_diesel
Doors	4
ZIP	3
Color	yellow
+ Extras	Navigation
Year	1996.0
Body	sedan
Manufact...	mercedes-benz
CCM	3000
Car Code	100
Price	58499
Speed	224
Miles	18146
Box_amo...	<<_ UNDEFINED _>>
Receiver_...	<<_ UNDEFINED _>>
Bass	<<_ UNDEFINED _>>
Box_Brand	<<_ UNDEFINED _>>
+ CDPlayer	<<_ UNDEFINED _>>

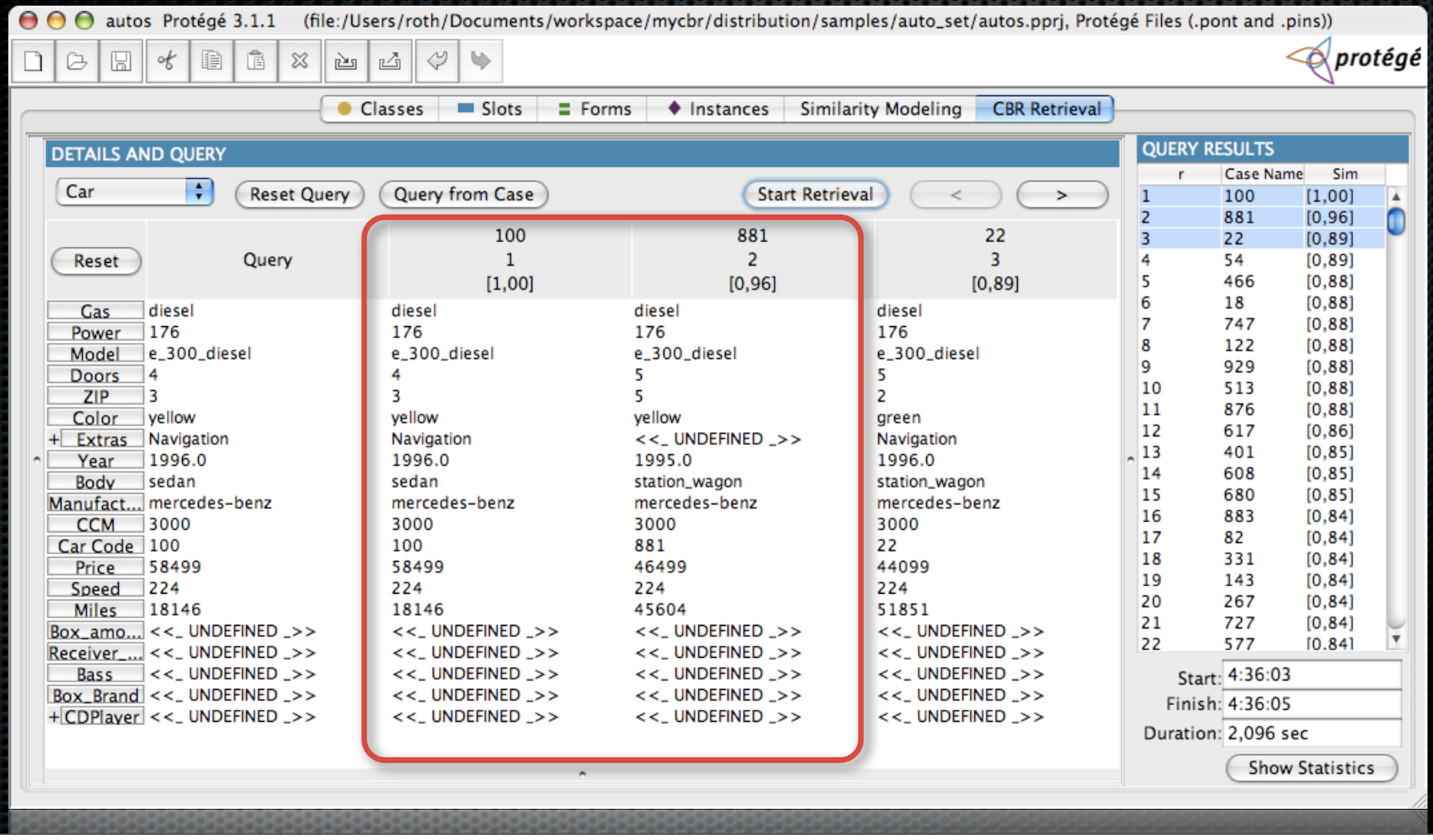
Retrieval results for case 100



Retrieval results for case 100



Retrieval results for case 100



Ranking of cases

QUERY RESULTS

r	Case Name	Sim
1	100	[1,00]
2	881	[0,96]
3	22	[0,89]
4	54	[0,89]
5	466	[0,88]
6	18	[0,88]
7	747	[0,88]
8	122	[0,88]
9	929	[0,88]
10	513	[0,88]
11	876	[0,88]
12	617	[0,86]
13	401	[0,85]
14	608	[0,85]
15	680	[0,85]
16	883	[0,84]
17	82	[0,84]
18	331	[0,84]
19	143	[0,84]
20	267	[0,84]
21	727	[0,84]
22	577	[0,84]

Retrieval results for case 100

Reset	Query	1 [1,00]	2 [0,96]	3 [0,89]
Gas	diesel	diesel	diesel	diesel
Power	176	176	176	176
Model	e_300_diesel	e_300_diesel	e_300_diesel	e_300_diesel
Doors	4	4	5	5
ZIP	3	3	5	2
Color	yellow	yellow	yellow	green
+ Extras	Navigation	Navigation	<<_ UNDEFINED _>>	Navigation
Year	1996.0	1996.0	1995.0	1996.0
Body	sedan	sedan	station_wagon	station_wagon
Manufact...	mercedes-benz	mercedes-benz	mercedes-benz	mercedes-benz
CCM	3000	3000	3000	3000
Car Code	100	100	881	22
Price	58499	58499	46499	44099
Speed	224	224	224	224
Miles	18146	18146	45604	51851
Box_amo...	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>
Receiver_...	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>
Bass	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>
Box_Brand	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>
+ CDPlayer	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>

Retrieval results for case 100

Reset	Query	1 [1,00]		
Gas	diesel	diesel	diesel	
Power	176	176	176	
Model	e_300_diesel	e_300_diesel	e_300	
Doors	4	4	5	
ZIP	3	3	5	
Color	yellow	yellow	yellow	
+ Extras	Navigation	Navigation	<<_	
Year	1996.0	1996.0	1995	
Body	sedan	sedan	statio	
Manufact...	mercedes-benz	mercedes-benz	merce	mercedes-benz
CCM	3000	3000	3000	3000
Car Code	100	100	881	22
Price	58499	58499	46499	44099
Speed	224	224	224	224
Miles	18146	18146	45604	51851
Box_amo...	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>
Receiver_...	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>
Bass	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>
Box_Brand	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>
+ CDPlayer	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>	<<_ UNDEFINED _>>

Backward explanations of retrieval results via tooltips, for example:

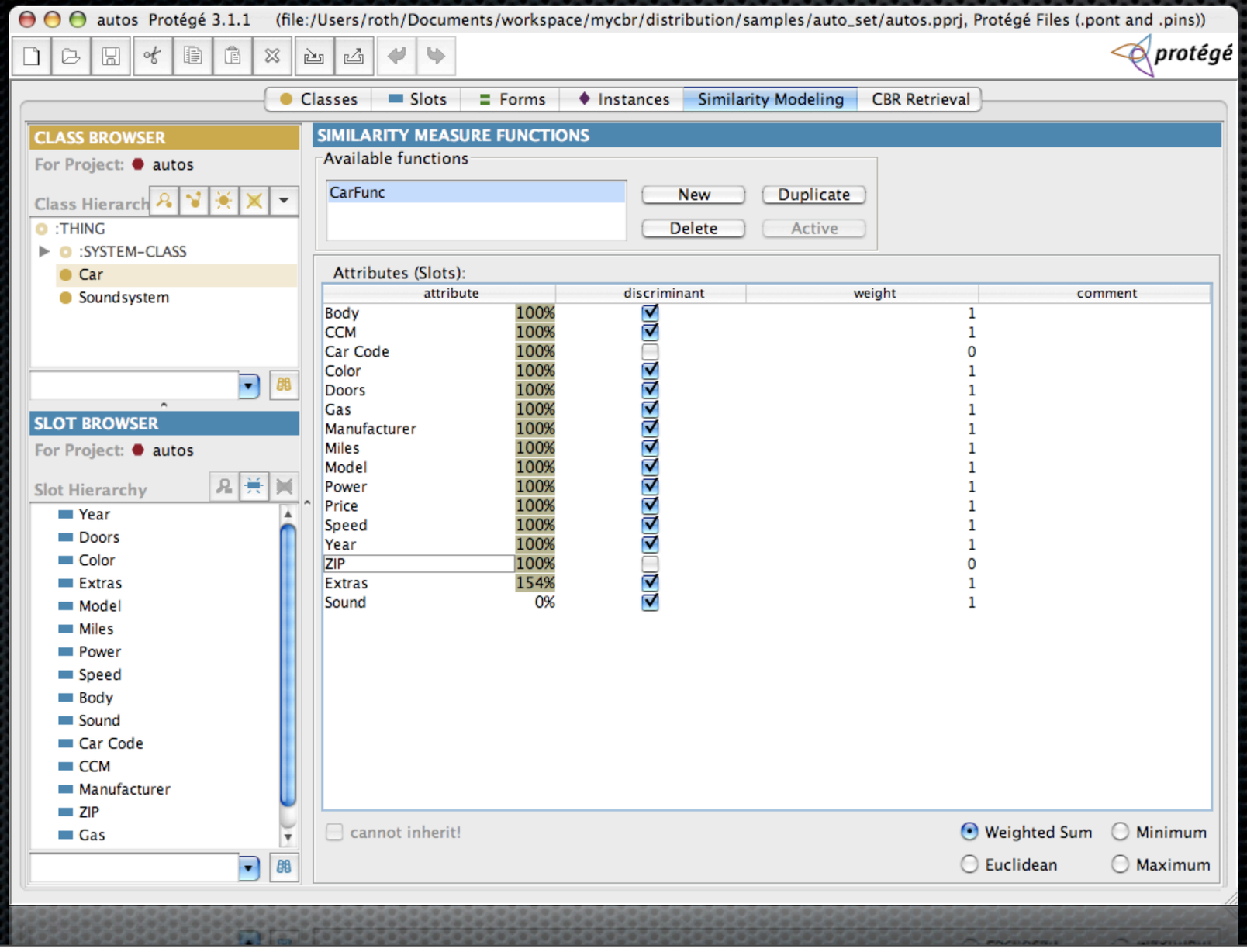
- local similarity values
- used amalgamation function
- information on structural similarity (class hierarchy)

Explanation-based similarity measure modelling support

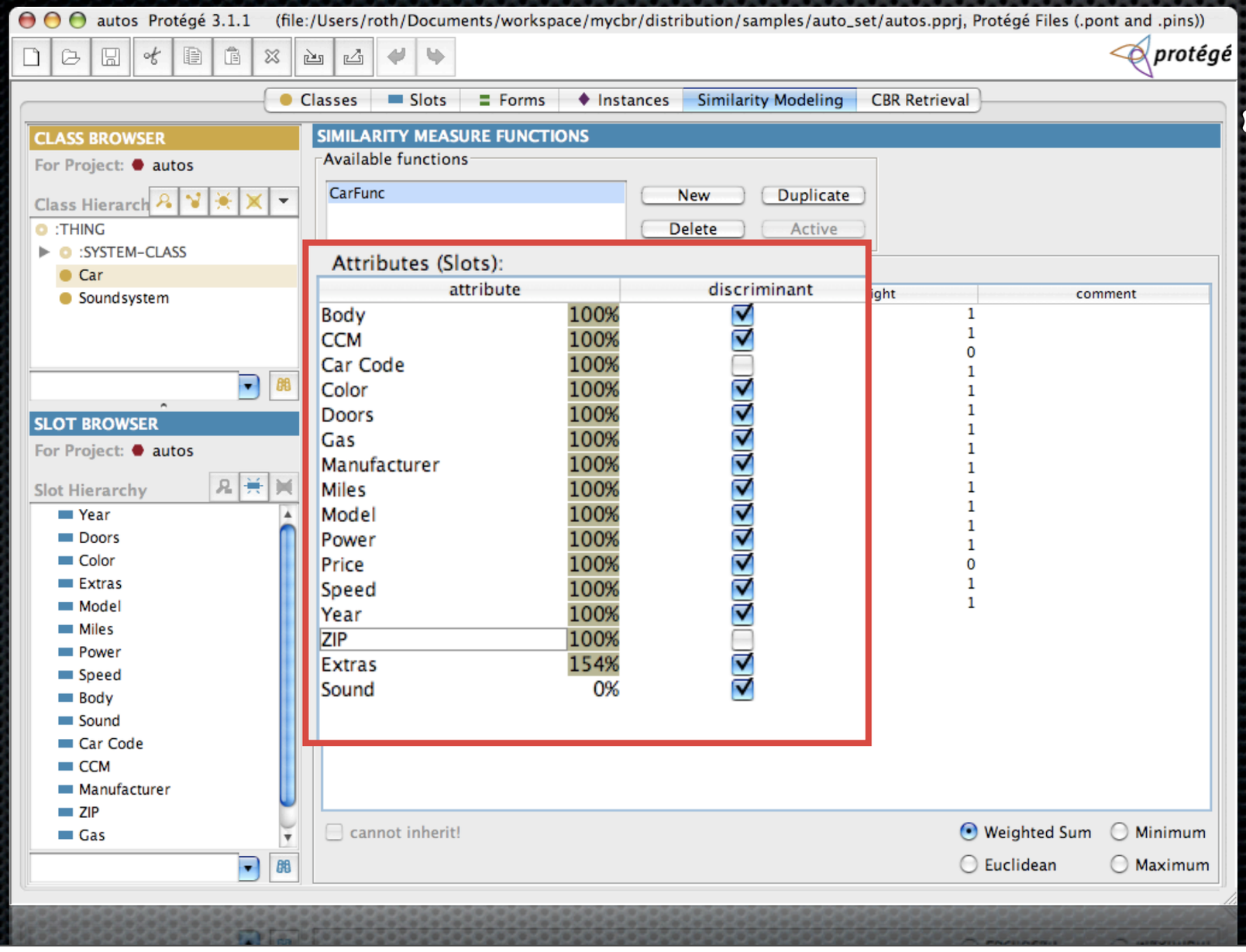
Goals

- Address questions of knowledge modeling from an explanation point of view
- Provide forward explanations for different slot types
- Give feedback on cases

Feedback from cases

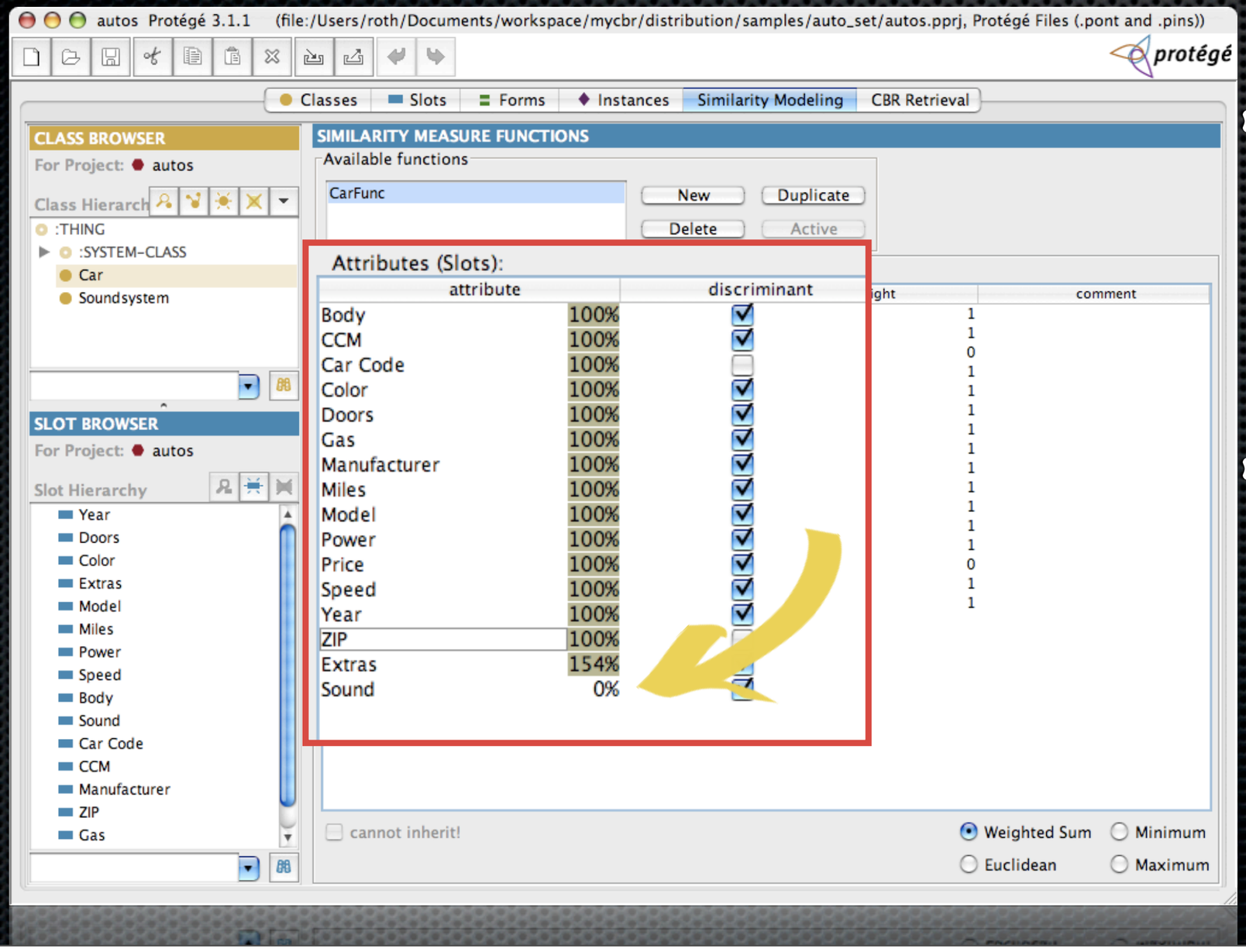


Feedback from cases



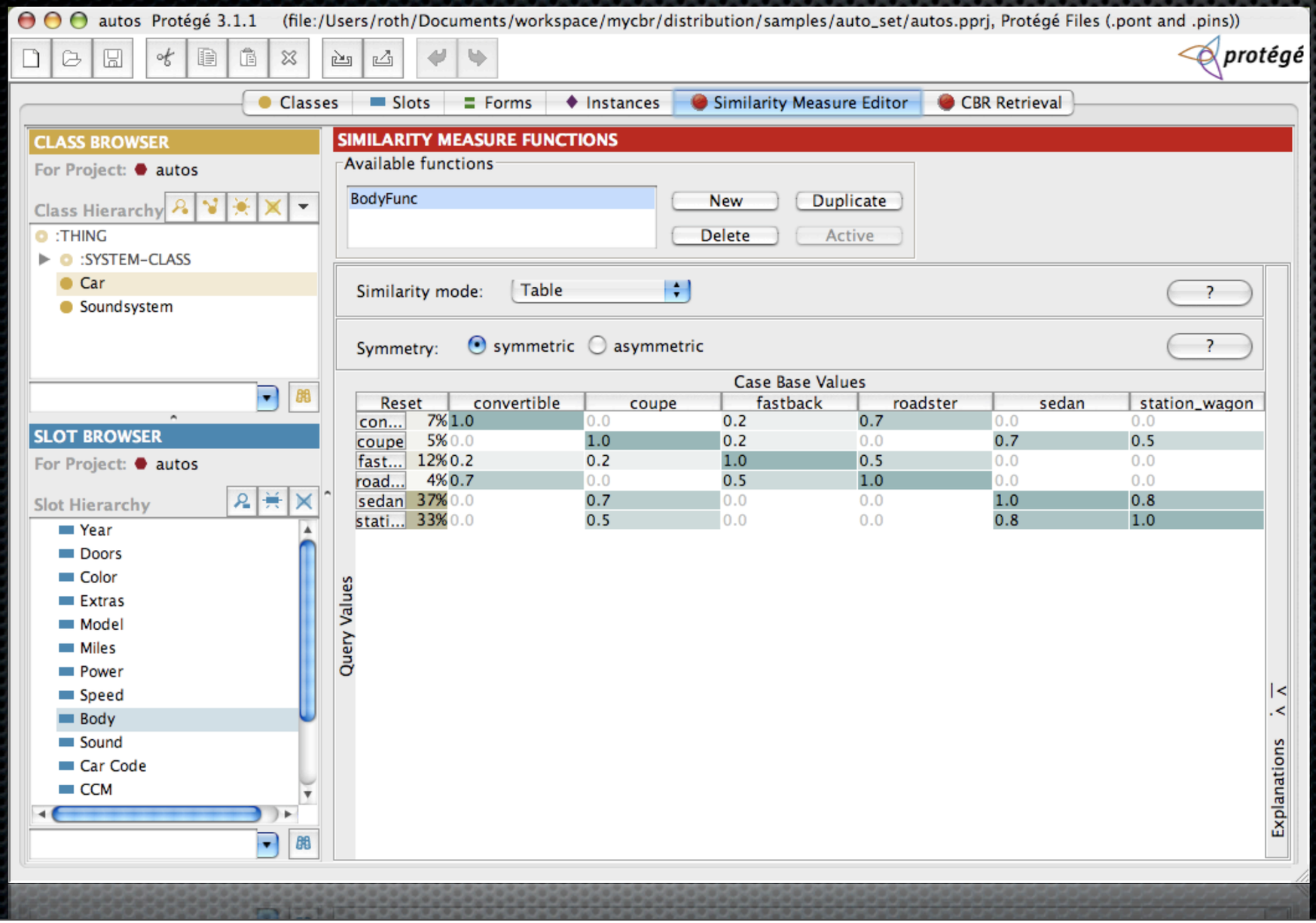
- How many cases have values for the given slot?

Feedback from cases



- How many cases have values for the given slot?
- No use in spending time on a similarity function for slot „Sound“!

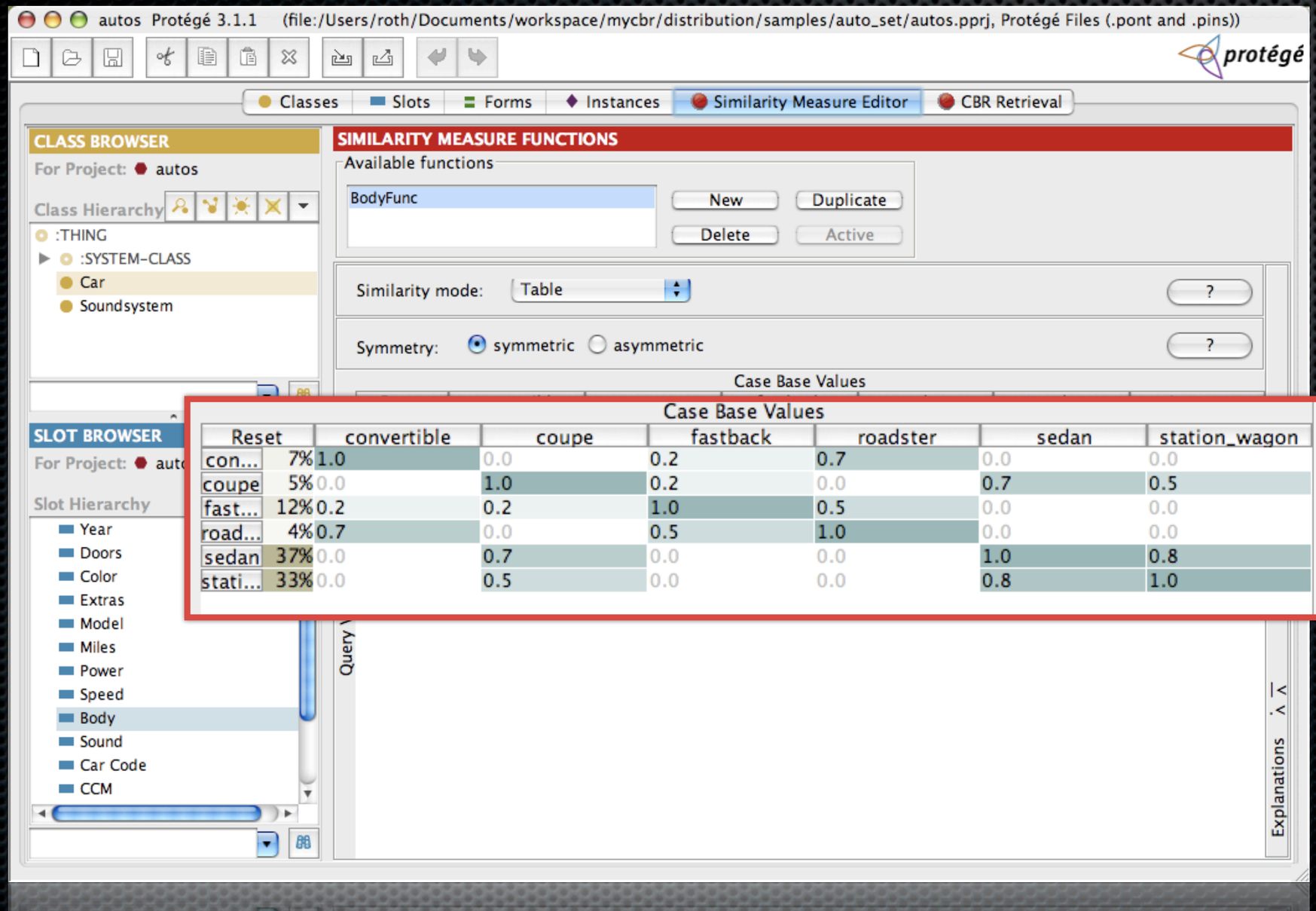
Distribution of values



Reset		convertible	coupe	fastback	roadster	sedan	station_wagon
con...	7%	1.0	0.0	0.2	0.7	0.0	0.0
coupe	5%	0.0	1.0	0.2	0.0	0.7	0.5
fast...	12%	0.2	0.2	1.0	0.5	0.0	0.0
road...	4%	0.7	0.0	0.5	1.0	0.0	0.0
sedan	37%	0.0	0.7	0.0	0.0	1.0	0.8
stati...	33%	0.0	0.5	0.0	0.0	0.8	1.0

- How often is the respective symbol used in the case base?

Distribution of values



- How often is the respective symbol used in the case base?

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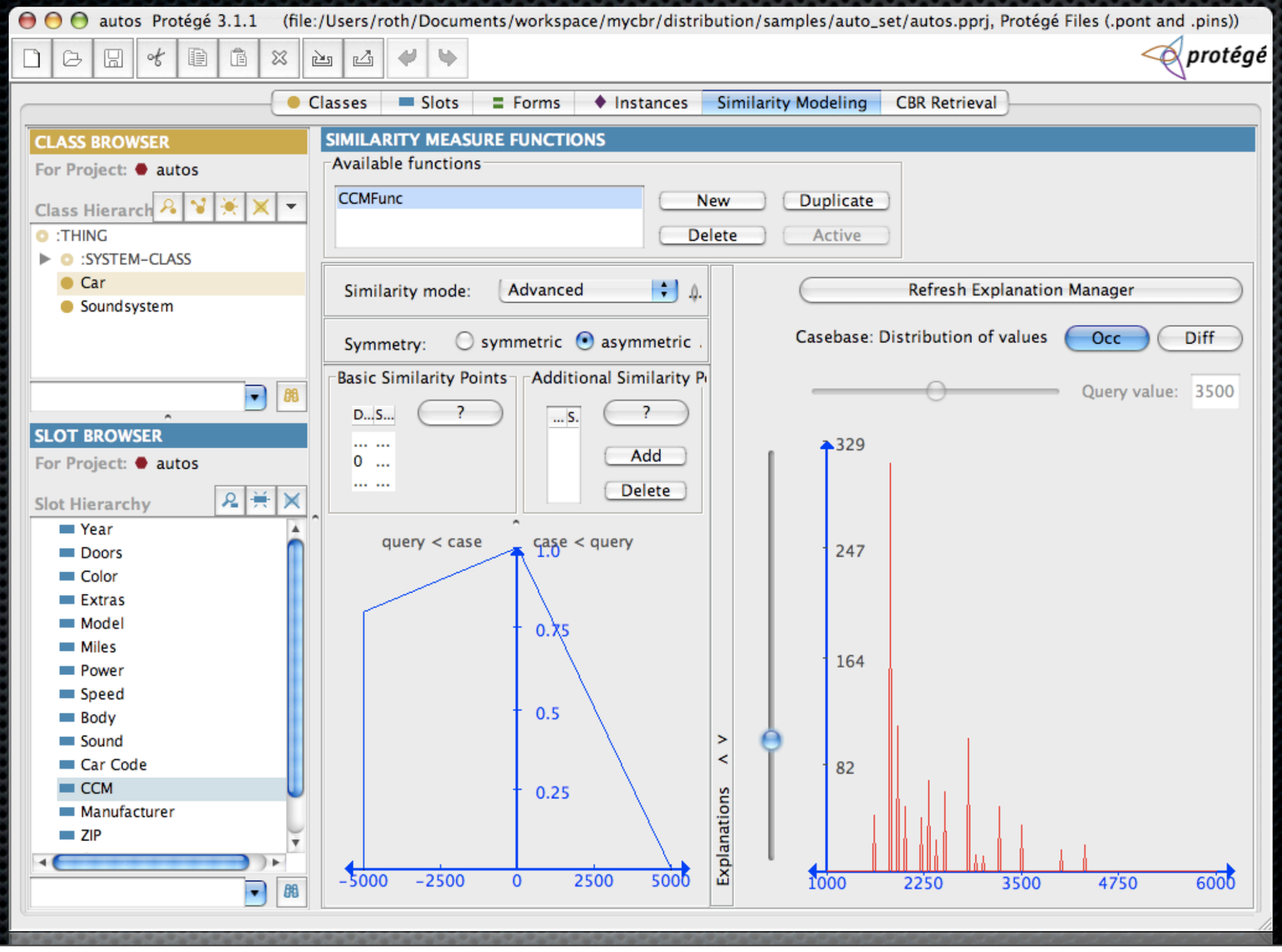

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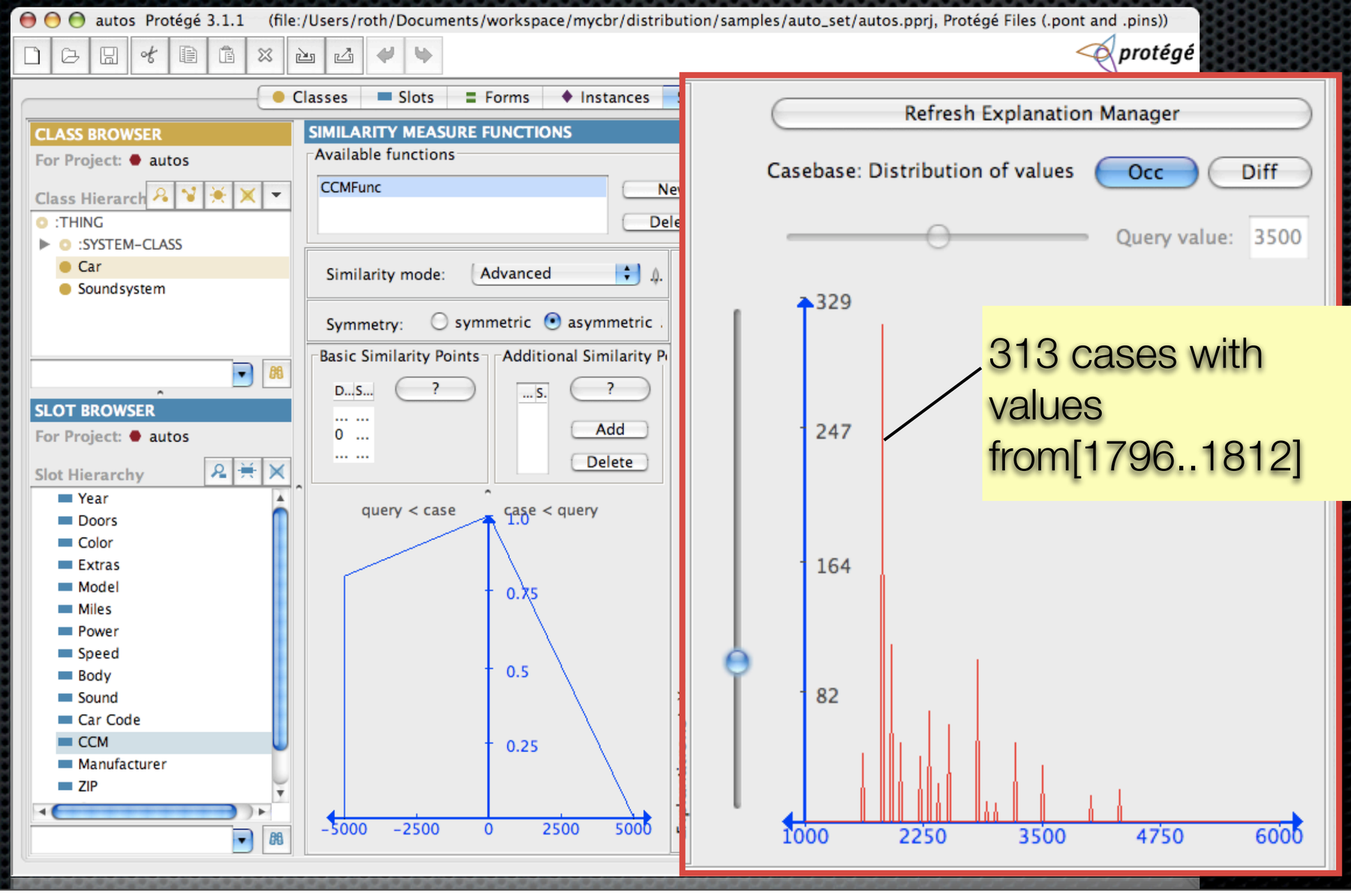
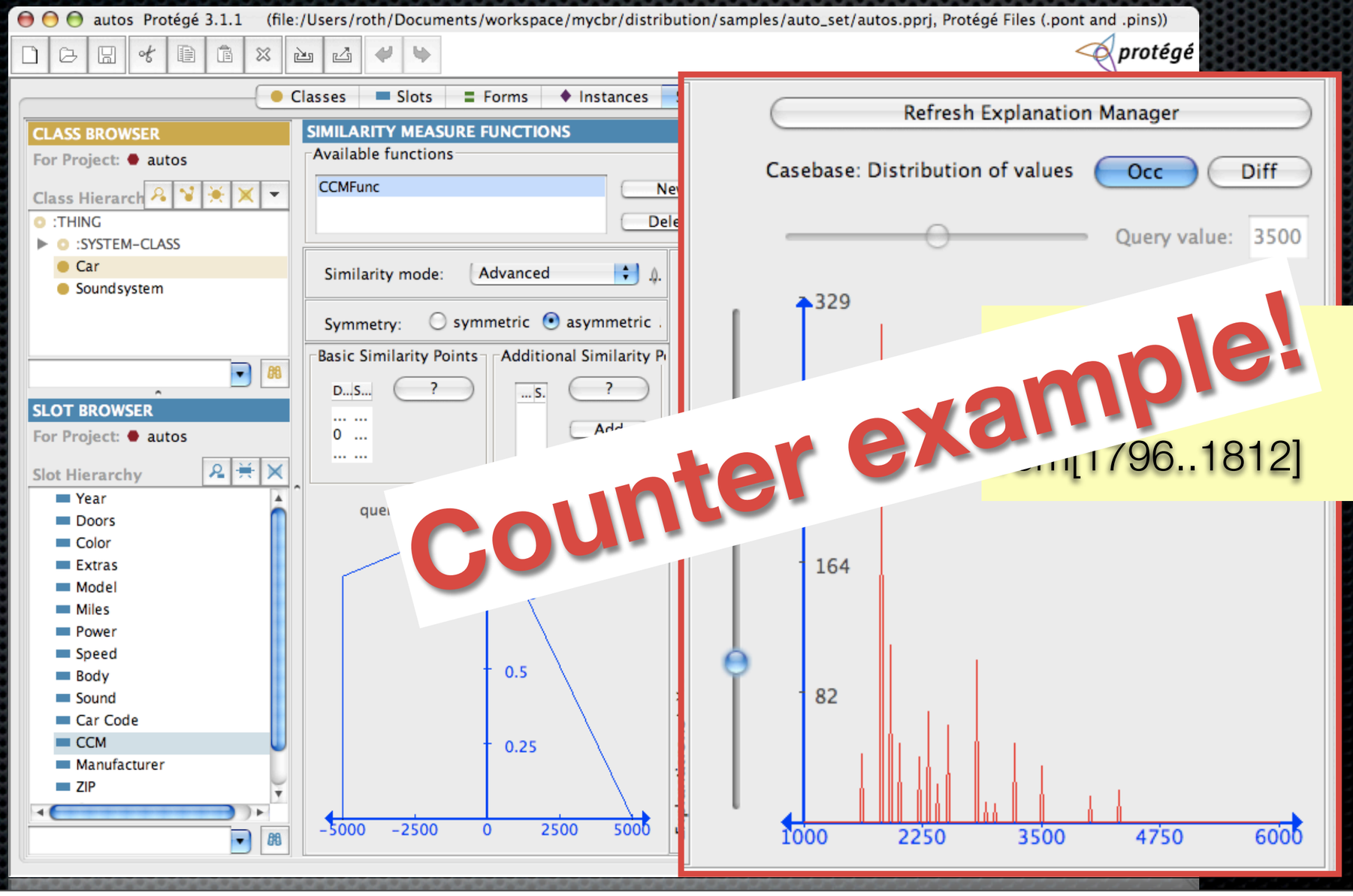


Distribution of case values



Status and plans

- Daniel Bahls (graduate student) programmed most of *myCBR*.
  works on a first prototype for basic similarity measure modeling support (project thesis)
  presented a student poster on myCBR and explanations at AAAI-07 in Vancouver, Canada
- Follow-up diploma thesis: Design and development of a generic (forward) explanation component.

Generating model from CSV file

cars_casebase.csv

	A	B	C	D	E	F	G	H	I
1	Car Code	Manufacturer	Model	Body	Price	Color	Year	Miles	Doors
2	2	bmw	325td	sedan	28699	dark_red	1995	66474	
3	3	bmw	320i	coupe	33299	dark_red	1995	31802	
4	4	bmw	540i	station_wago	87499	dark_green	1997	9874	
5	5	bmw	520i	station_wago	43599	black	1996	32292	
6	6	bmw	316i	fastback	25599	dark_red	1995	53714	
7	7	bmw	523i	station_wago	55599	gray	1997	11230	
8	8	bmw	318i	coupe	39099	light_gray	1996	12428	
9	9	bmw	318i	sedan	30399	dark_gray	1995	43979	
10	10	bmw	318i	sedan	16499	light_gray	1995	120039	
11	11	mercedes-be	e_280	station_wago	58699	yellow	1997	17742	
12	12	audi	a4_1.9_tdi	station_wago	31899	dark_green	1994	36304	
13	13	bmw	525tds	station_wago	34899	white	1995	65071	
14	14	mercedes-be	c_200	station_wago	14599	violet	1995	148011	
15	15	mercedes-be	e_430	sedan	41499	blue	1994	105427	
16	16	bmw	325tds	sedan	41899	turquoise	1996	25976	

- Columns become attributes
- Based on column content myCBR choses attribute type
  - Explanations required!

Generating model from CSV file

cars_casebase.csv

	A	B	C	D	E	F	G	H	I
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3	3	bmw	320i	coupe	33299	dark_red	1995	31802	
4	4	bmw	540i	station_wago	87499	dark_green	1997	9874	
5	5	bmw	520i	station_wago	43599	black	1996	32292	
6	6	bmw	316i	fastback	25599	dark_red	1995	53714	
7	7	bmw	523i	station_wago	55599	gray	1997	11230	
8	8	bmw	318i	coupe	39099	light_gray	1996	12428	
9	9	bmw	318i	sedan	30399	dark_gray	1995	43979	
10	10	bmw	318i	sedan	16499	light_gray	1995	120039	
11	11	mercedes-be	e_280	station_wago	58699	yellow	1997	17742	
12	12	audi	a4_1.9_tdi	station_wago	31899	dark_green	1994	36304	
13	13	bmw	525tds	station_wago	34899	white	1995	65071	
14	14	mercedes-be	c_200	station_wago	14599	violet	1995	148011	
15	15	mercedes-be	e_430	sedan	41499	blue	1994	105427	
16	16	bmw	325tds	sedan	41899	turquoise	1996	25976	

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  myCBR choses attribute type

  Explanations required!

cars_casebase.csv

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3	3	bmw	320i	coupe	33299	dark_red	1995	31802	
4	4	bmw	540i	station_wago	87499	dark_green	1997	9874	
5	5	bmw	520i	station_wago	43599	black	1996	32292	
6	6	bmw	316i	fastback	25599	dark_red	1995	53714	
7	7	bmw	523i	station_wago	55599	gray	1997	11230	
8	8	bmw	318i	coupe	39099	light_gray	1996	12428	
9	9	bmw	318i	sedan	30399	dark_gray	1995	43979	
10	10	bmw	318i	sedan	16499	light_gray	1995	120039	
11	11	mercedes-be	e_280	station_wago	58699	yellow	1997	17742	
12	12	audi	a4_1.9_tdi	station_wago	31899	dark_green	1994	36304	
13	13	bmw	525tds	station_wago	34899	white	1995	65071	
14	14	mercedes-be	c_200	station_wago	14599	violet	1995	148011	
15	15	mercedes-be	e_430	sedan	41499	blue	1994	105427	
16	16	bmw	325tds	sedan	41899	turquoise	1996	25976	

Name: Car

Documentation

Constraints

Role: Concrete

Template Slots

Name	Cardinality	Type	Other Facets
Body	single	Symbol	allowed-values={convertible,coupe,fastback,roadster,sedan...
Car Code	single	Integer	minimum=0, maximum=10000000
CCM	single	Integer	minimum=1000, maximum=6000
Color	single	Symbol	allowed-values={anthracite,black,blue,dark_blue,dark_gray,...
Doors	single	Integer	minimum=2, maximum=7
Extras	multiple	Symbol	allowed-values={ABS,ESP,Navigation}
Gas	single	Symbol	allowed-values={diesel,gasoline}
Manufacturer	single	Symbol	allowed-values={audi,bmw,mercedes-benz,vw}
Miles	single	Integer	minimum=0, maximum=1000000
Model	single	Symbol	allowed-values={316i,318i,320i,323i,325td,325tds,328i,5...
Power	single	Integer	minimum=10, maximum=1000
Price	single	Integer	minimum=1, maximum=1000000
Sound	single	Instance of Soundsystem	
Speed	single	Integer	minimum=100, maximum=300
Year	single	Float	minimum=1950.0, maximum=2007.0
ZIP	single	Integer	minimum=0, maximum=9

Kinds of explanations

Conceptual Explanations

- The goal of conceptual explanations is to build links between unknown and known concepts.
- Variations:

  Definition: “What is a bicycle?” – “A bicycle is a land vehicle with two wheels in line. Pedal cycles are powered by a seated human rider and are a form of human powered vehicle.”

  Theoretical proposition: “What is force?” – “Force is Mass times Acceleration.”

  Prototypical usage of individual things or actions: “What is a bicycle?” – “The thing, this man crashed with.”

  Functional mapping: “What is a bicycle?” – “A bicycle serves as a means of transport.”

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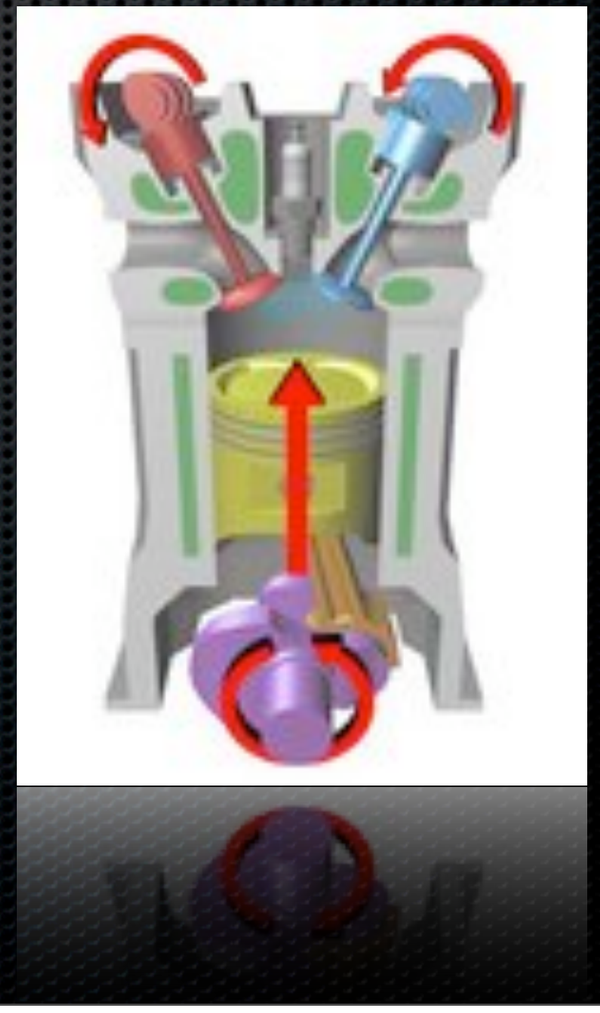
How-explanations

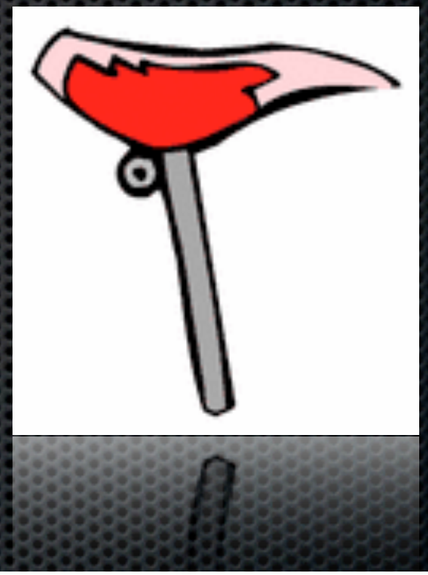
- The goal of how-explanations is to help the questioner understand the functionality of an object.
- Example:

  “How does a combustion engine work?”
  – “A combustion engine is an engine that operates by burning its fuel.”



Cognitive explanations

- Cognitive explanations explain the activities of the system.



- Examples:

  Action explanations: “Why was this seat post selected?” – “For the given price, only one other seat post was available. But this was too short.”

  Negative explanations: “Why was no carrier chosen?” – “A carrier is only available for touring bikes. The user did not choose a touring bike.”

Explanation goals

Sørmo, F., Cassens, J., Aamodt, A.: Explanation in Case-Based Reasoning – Perspectives and Goals, 2005.

Explanation goals

- Transparency
- Justification
- Relevance
- Conceptualization
- Learning

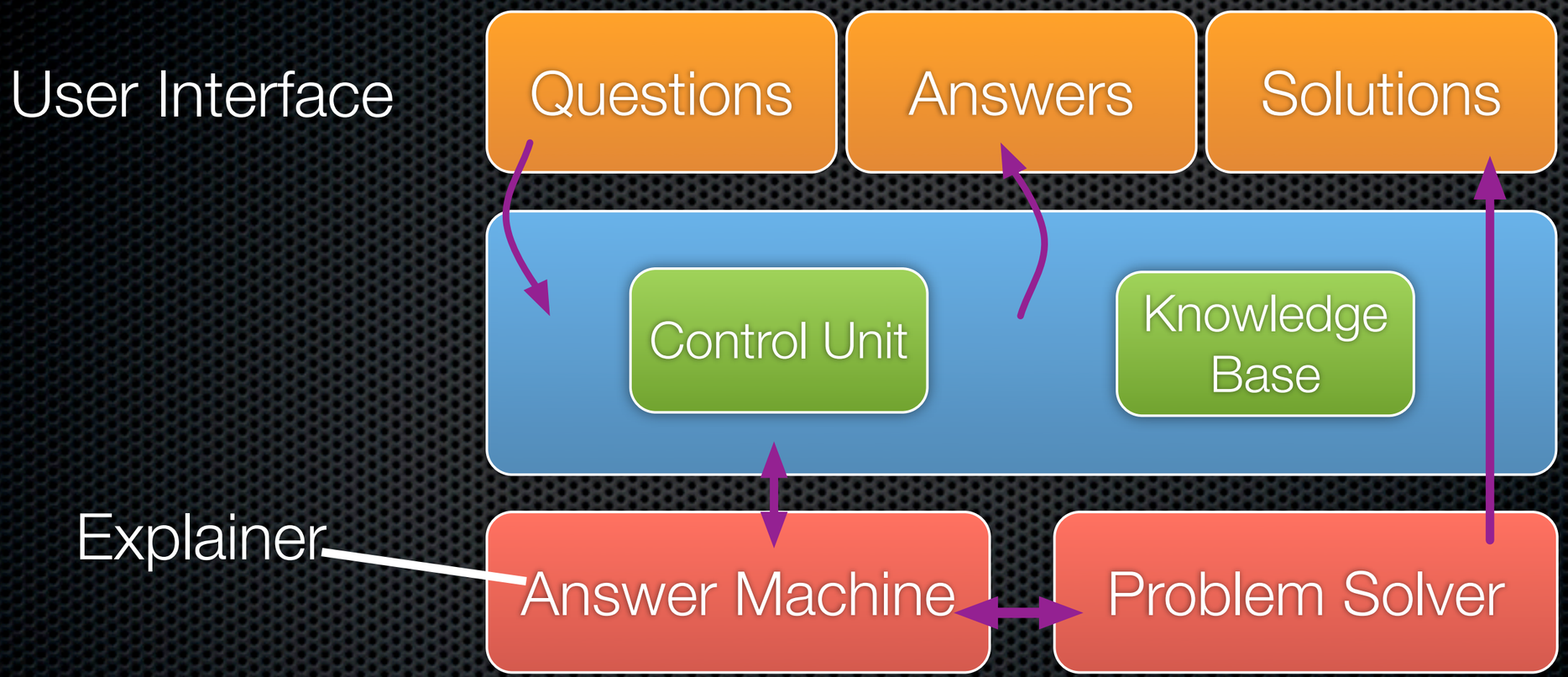
Sørmo, F., Cassens, J., Aamodt, A.: Explanation in Case-Based Reasoning – Perspectives and Goals, 2005.

Explanation architecture

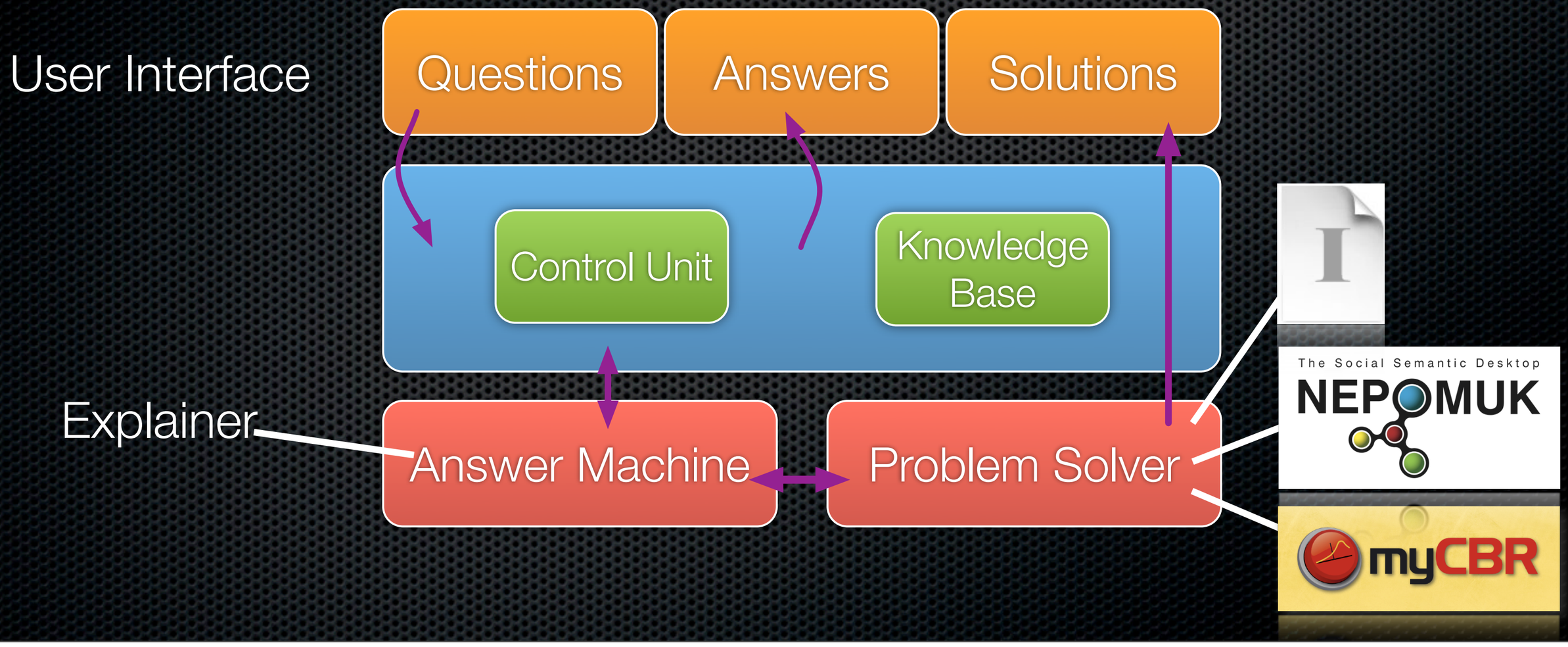
An explanation-enabled architecture needs to consider the …

- Explanation scenario
- Problem and problem solver in question
- User and user model
- Background knowledge for explanation

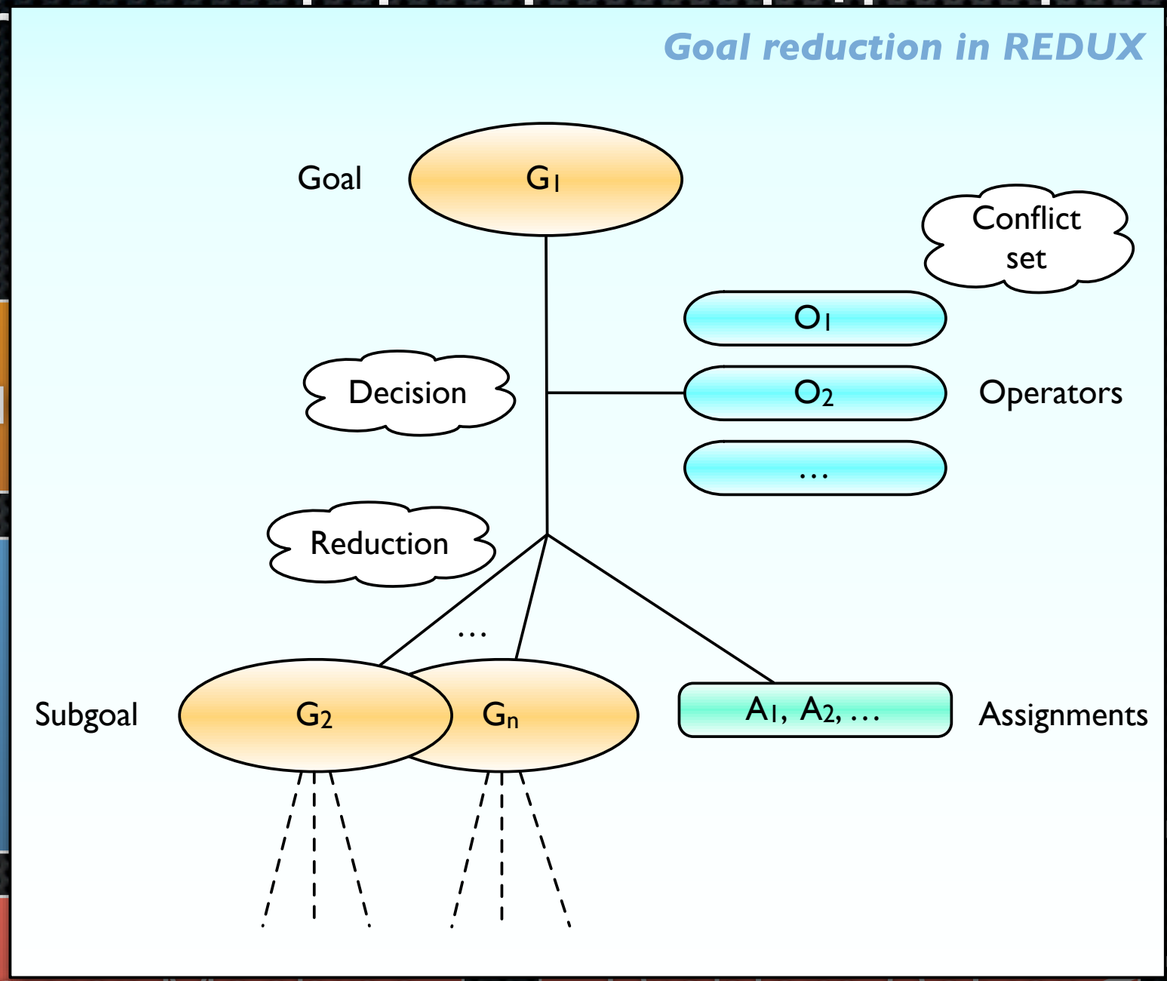
Explanation-enabled architecture



Explanation-enabled architecture



Explanation



User Interface

Qu

Explainer

Answer Machine

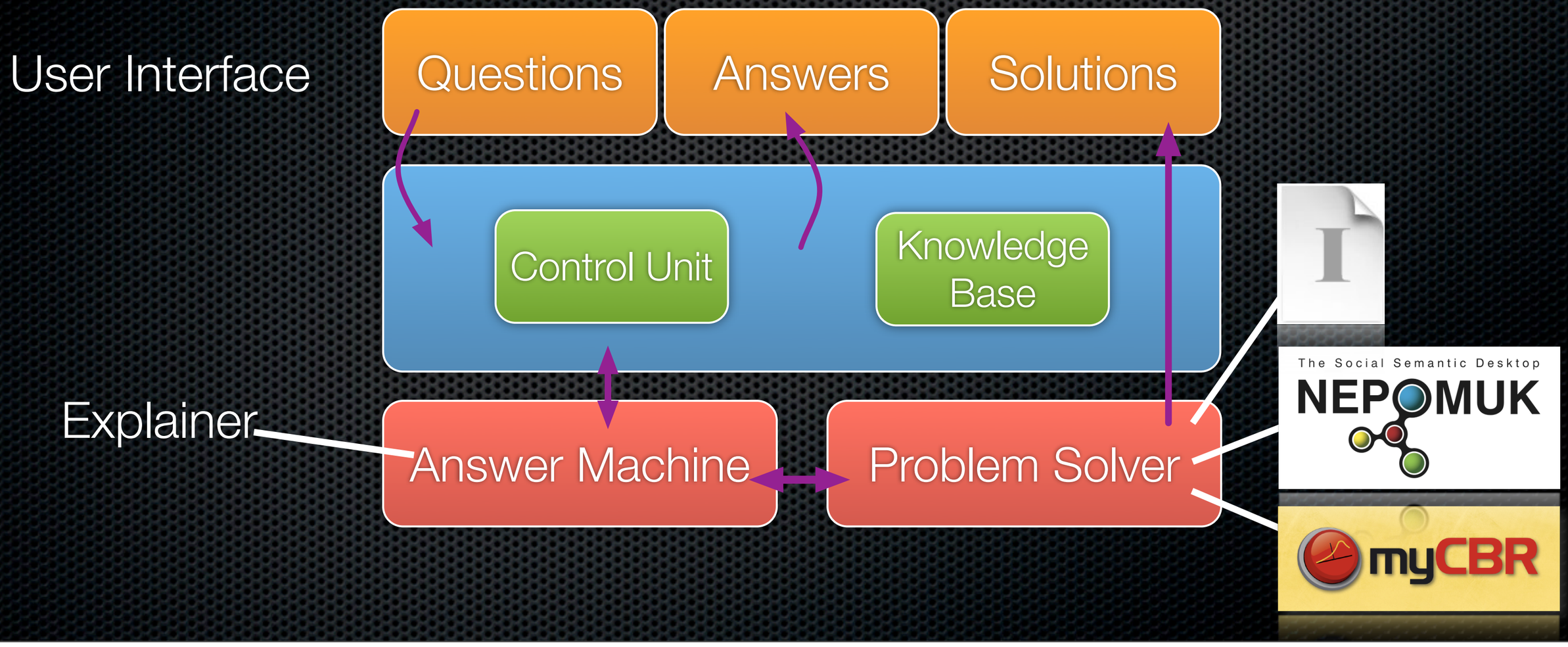
Problem Solver

The Social Semantic Desktop

NEPOMUK

myCBR

Explanation-enabled architecture



Summary

- Basic explanation scenario: user (interface), originator, and explainer
- Explanations are a special kind of information with cognitive and computational aspects.
- Examples:
  - Backward explanations in Nepomuk
  - Forward explanations in myCBR
- Outlook / Goal: Explanation-enabled architecture

On Explanation

—Supporting the Use of
Complex Information Systems—

Thank you!

Thomas Roth-Berghofer
Trippstadter Straße 122
67663 Kaiserslautern, Germany
trb@dfki.de
http://www.dfki.uni-kl.de/~roth