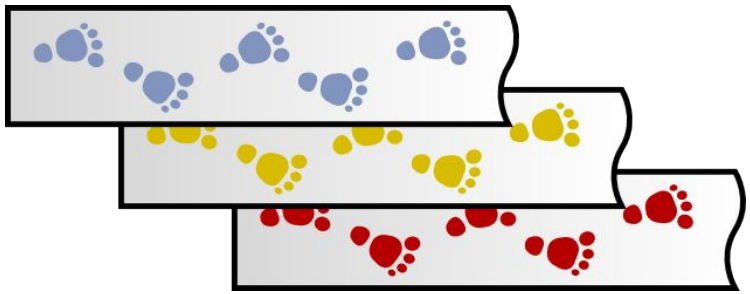
Trace-Based Reasoning

Combining Case-Based Reasoning and Traces to reason on experiences



Amélie Cordier

Octobre 2016

http://liris.cnrs.fr/amelie.cordier – amelie.cordier@liris.cnrs.fr

Case-Based Reasoning

Case-Based Reasoning

Reusing past experiences to solve new problems

Genesis

- Marvin Minsky [1975] a model of memory -> frames
- Robert Schank [1982], a dynamic memory -> scripts
- CBR cycle [1994], CBR step by step

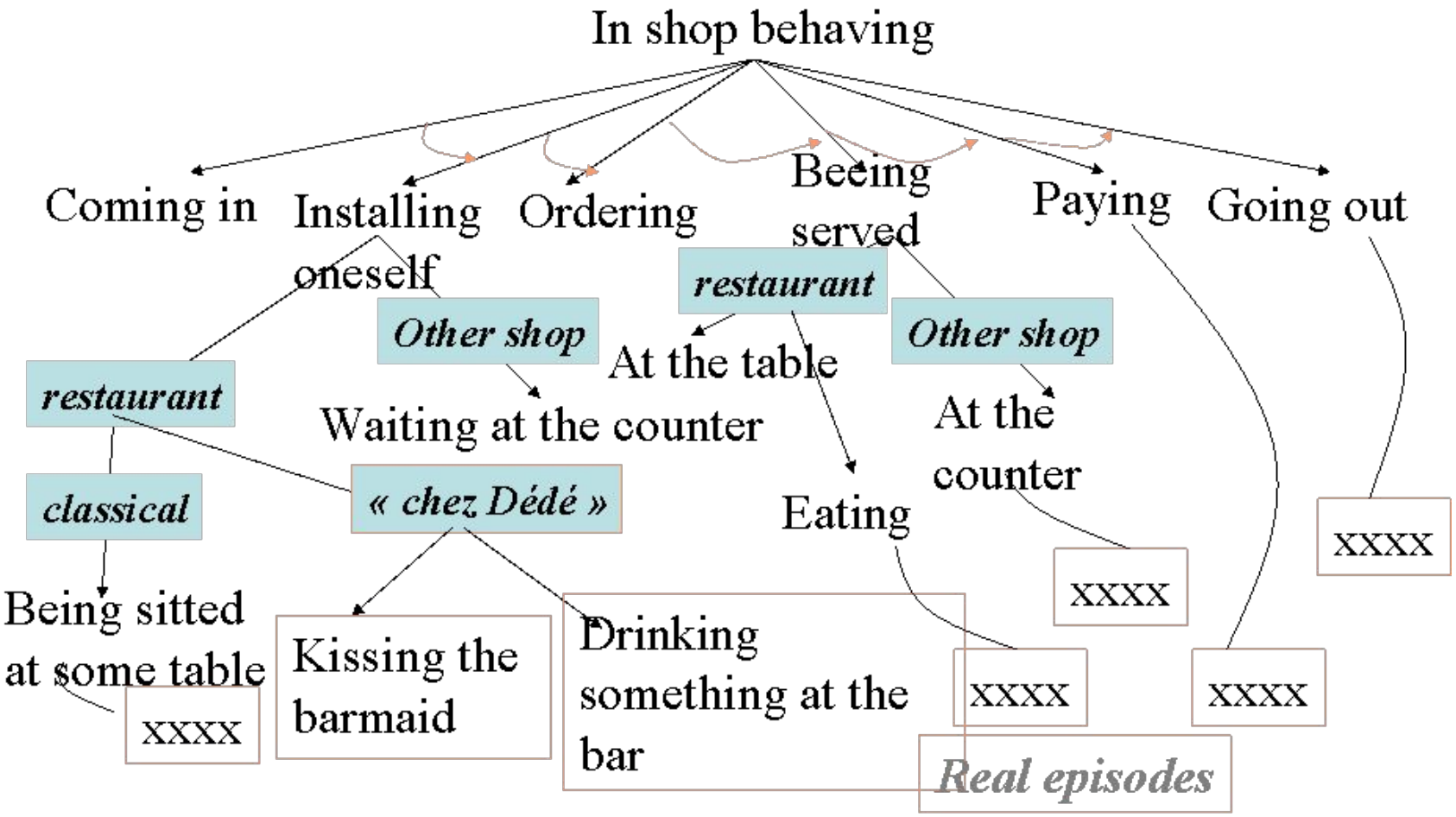
Minsky's theory

"Here is the essence of the theory: When one encounters a new situation (or makes a substantial change in one's view of the present problem) one selects from memory a structure called a Frame. This is a remembered framework to be adapted to fit reality by changing details as necessary."

Schank introduces dynamic memory

- Understanding ⇔ Explaining
  - Natural language understanding
  - Using scripts to describe propositions
  - Using concrete experience to build incrementally the scripts.

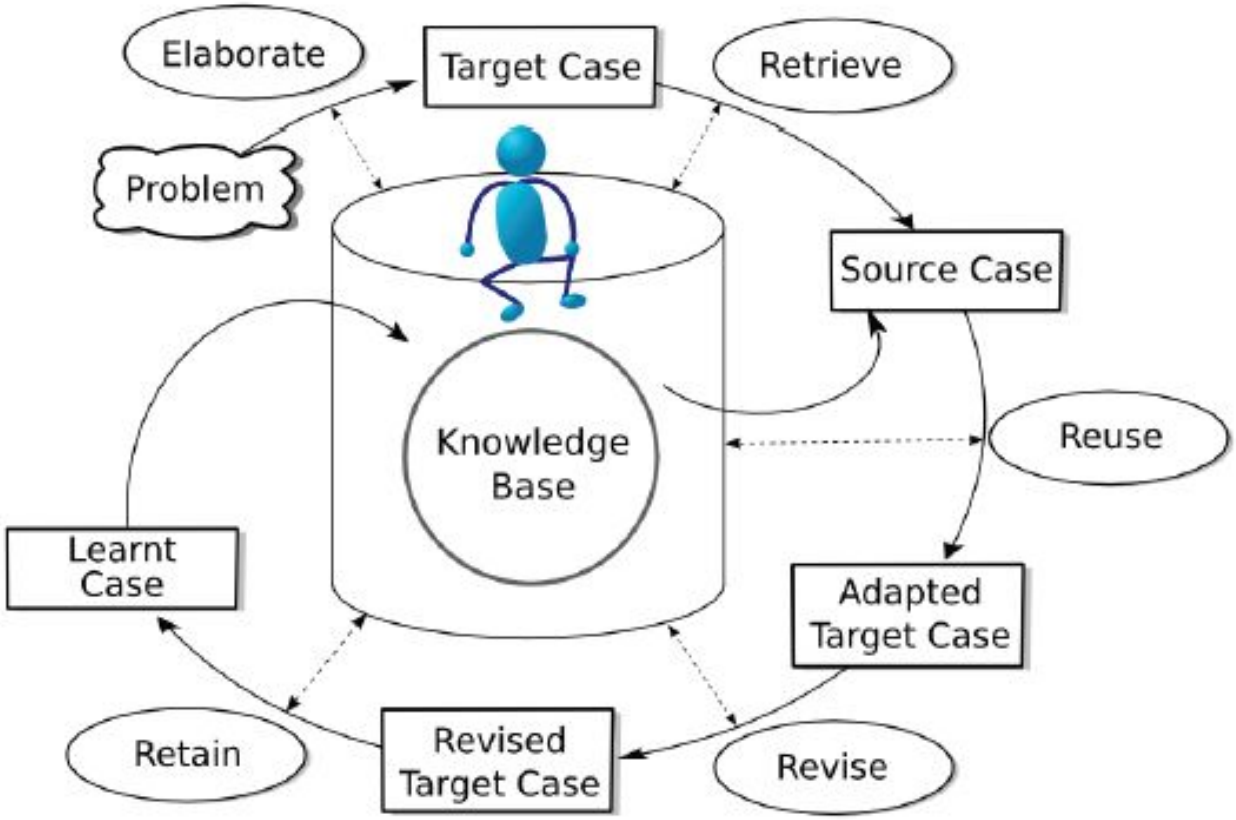
Script memory



Reasoning process according to Schank

- In a memory of concrete experiences (dynamically organized in a generalization hierarchy),
- One retrieves the « closest » experience to the current one,
- The corresponding script has to be generalized as less as possible to be re-specialized in the current context,
- Memory is re-organized if necessary according to what happens really.

Case-Based Reasoning



What is a case?

A case is the description of a

problem solving episode.

Its structure fits the situation of the task:
diagnostic, planning,

decision helping, design, etc.

Case descriptors

- A case is composed of a problem description and its corresponding solution description

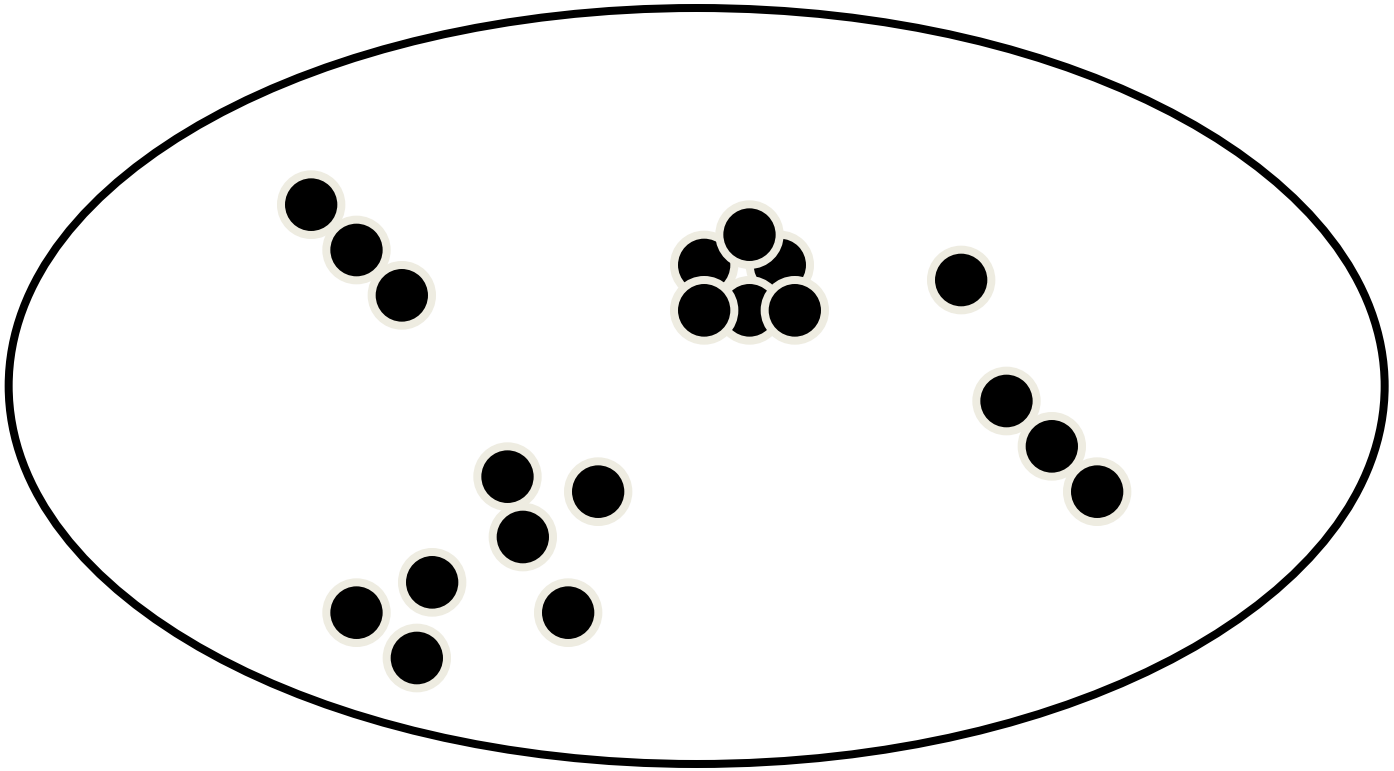
- A **source** case is a case whose solution will be adapted to find a solution for a new case, we call **target case.**

- A source case is formulated as:

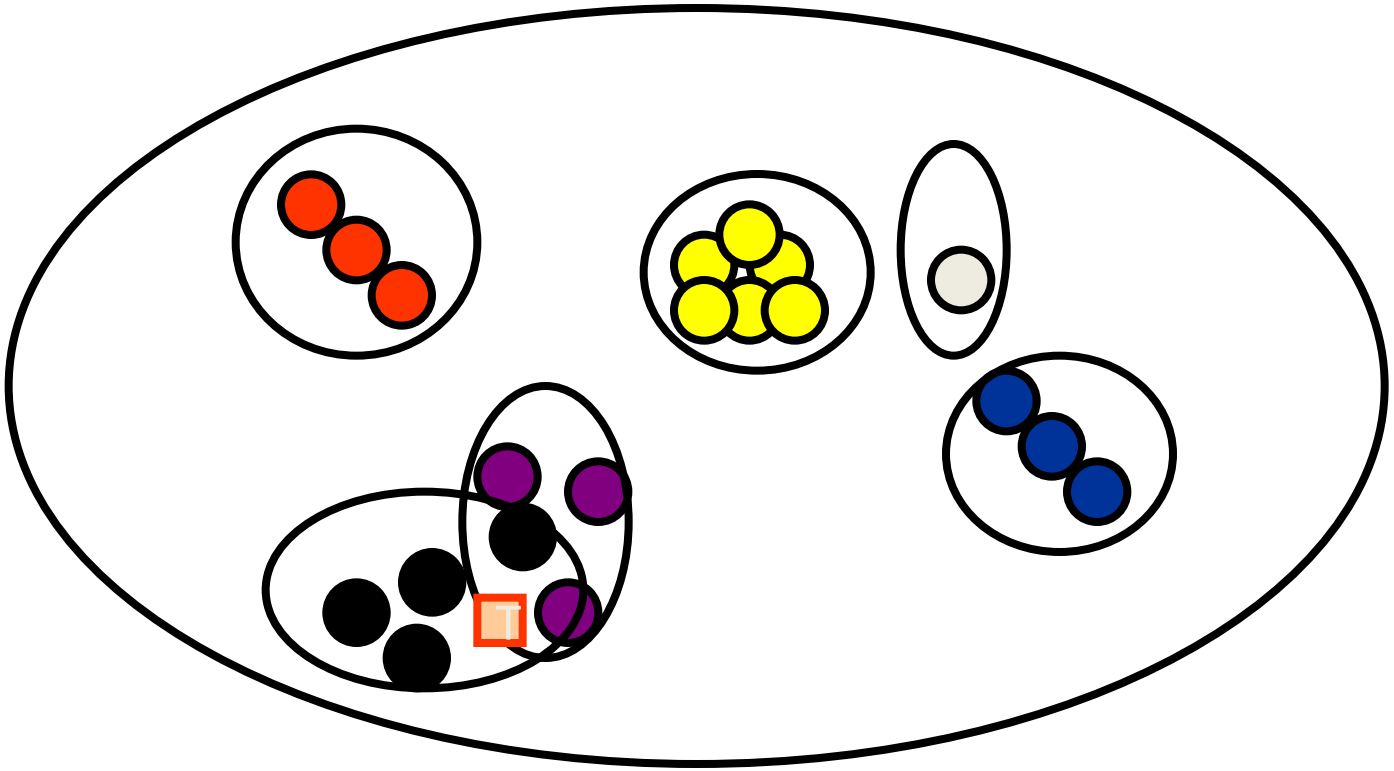
  Source_case=(source,Sol(source))
- And a target case:

  Target_case=(target,Sol(target))

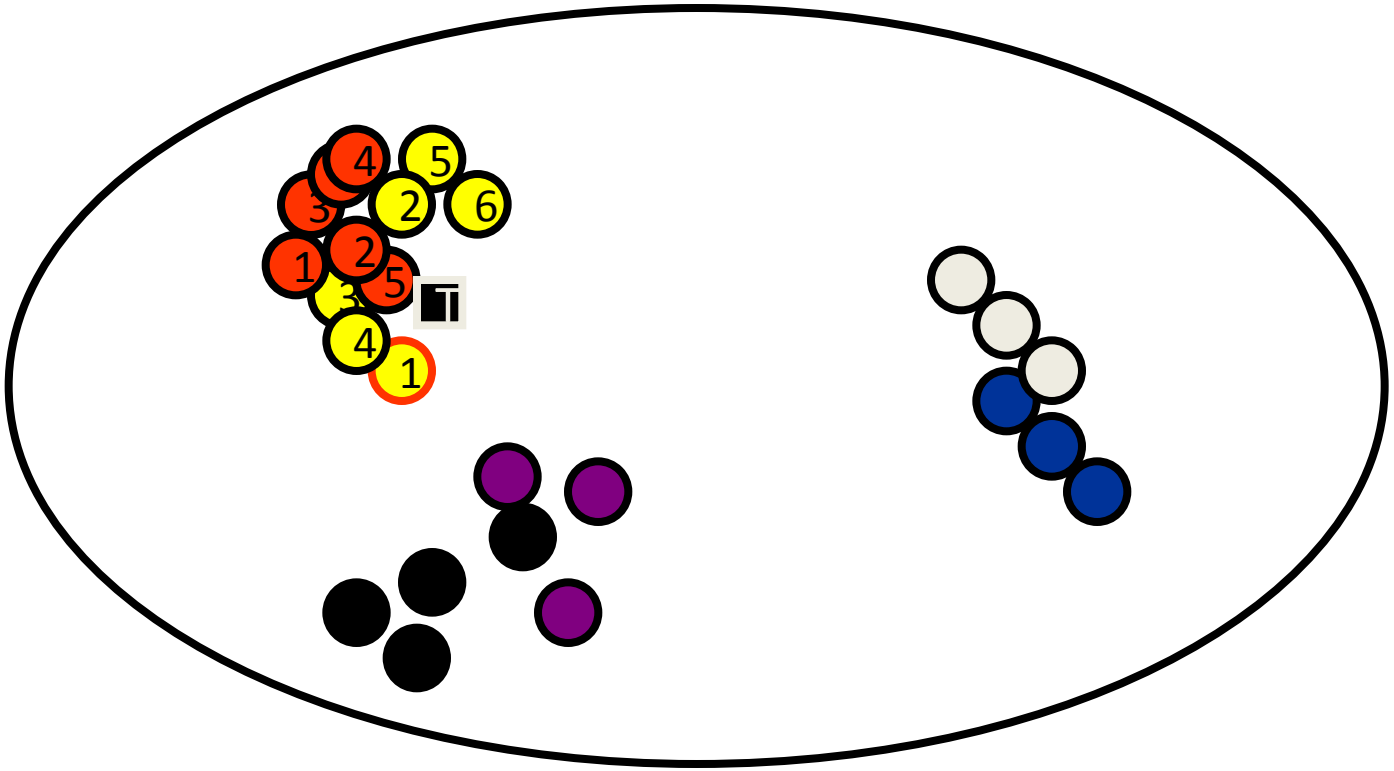
Cases in the solution space



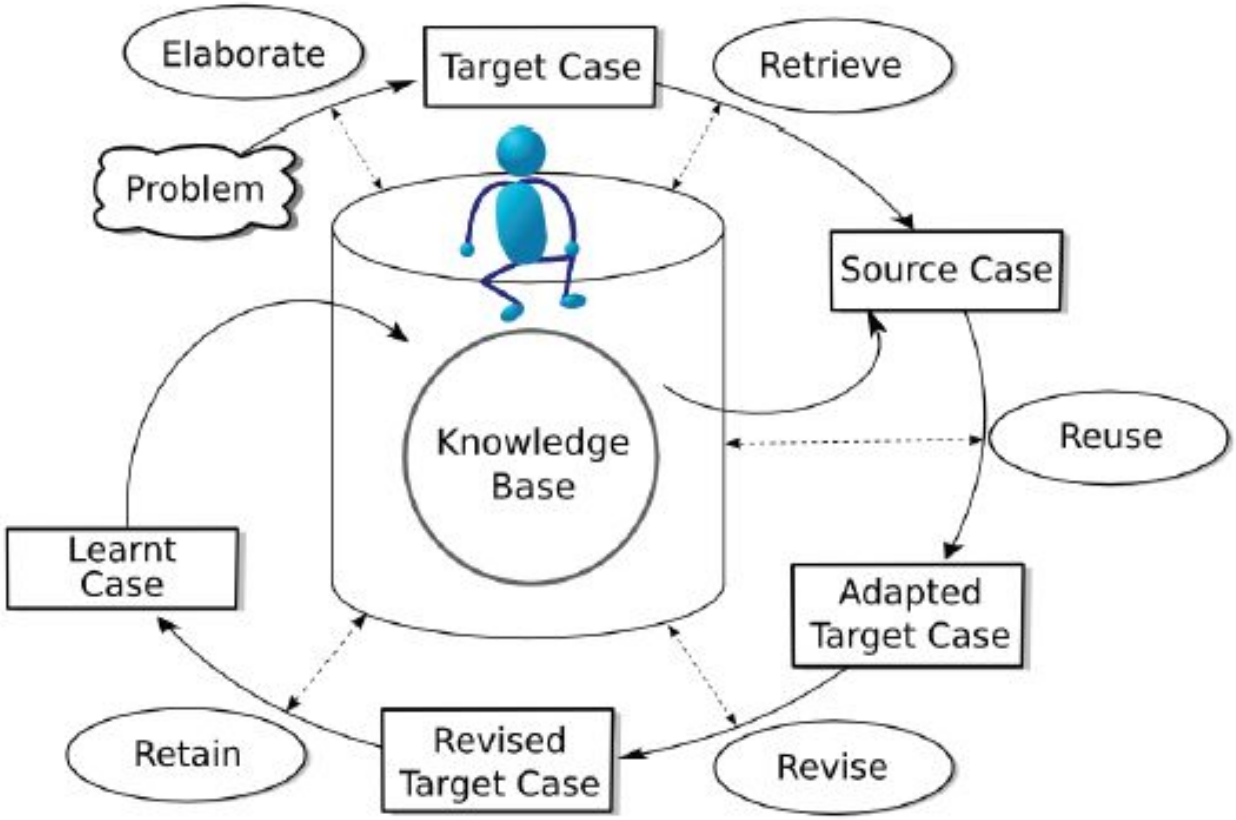
Different classes of solutions



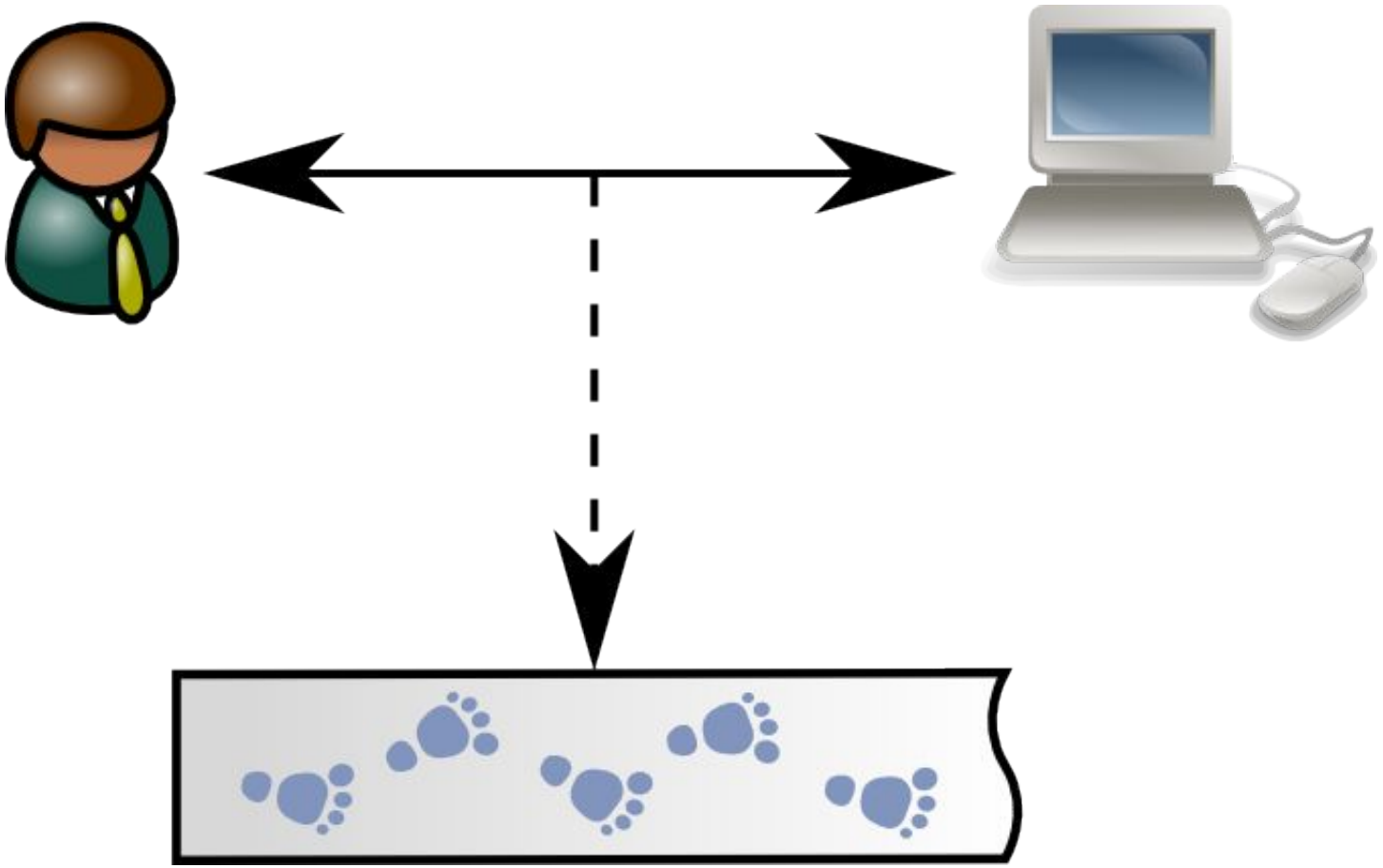
Choice of a source case



Case-Based Reasoning

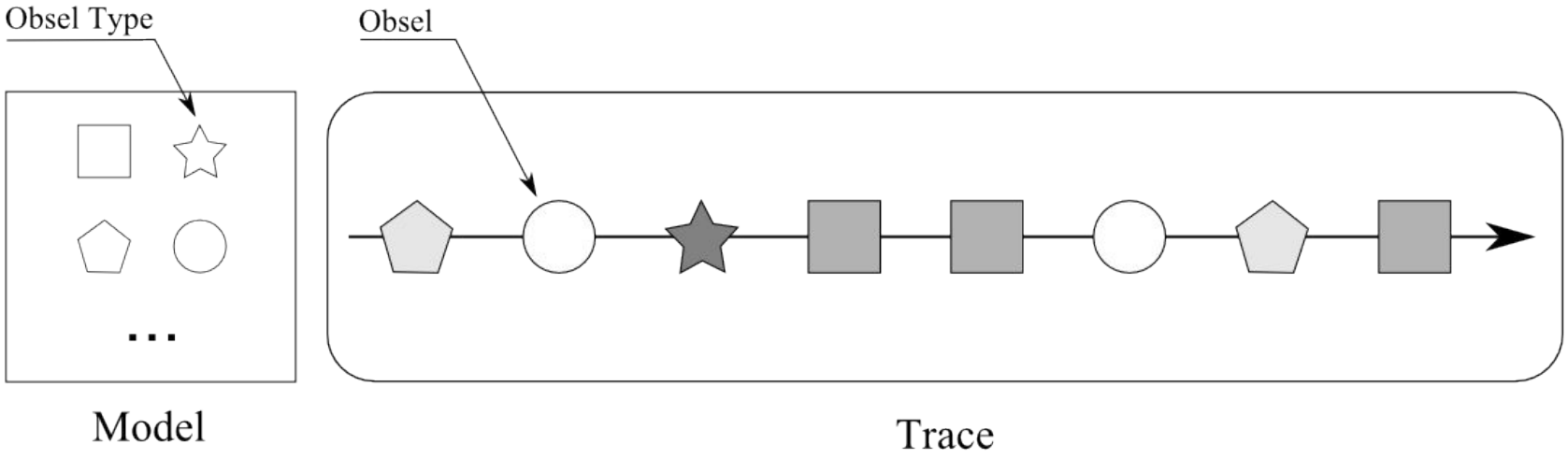


Trace-Based Reasoning

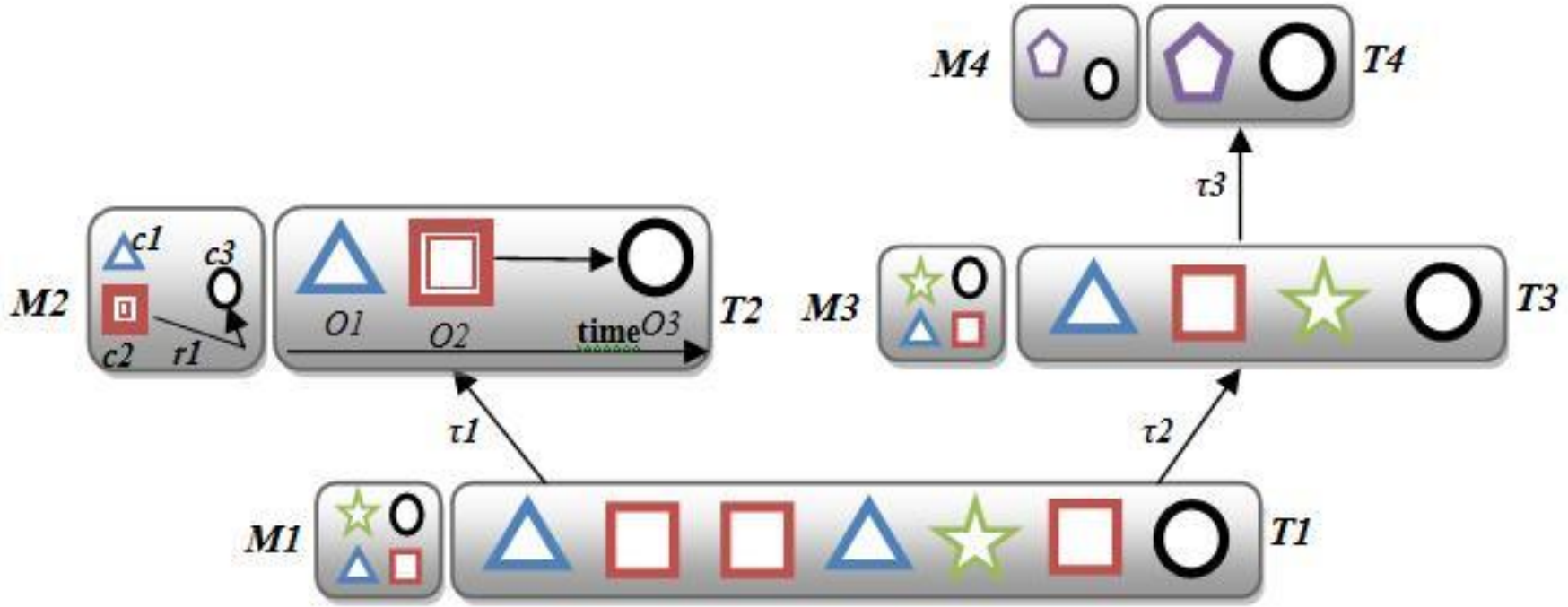


Trace

A trace is nothing without its model



Transformations



A trace is an experience container!

Objects

Obsel

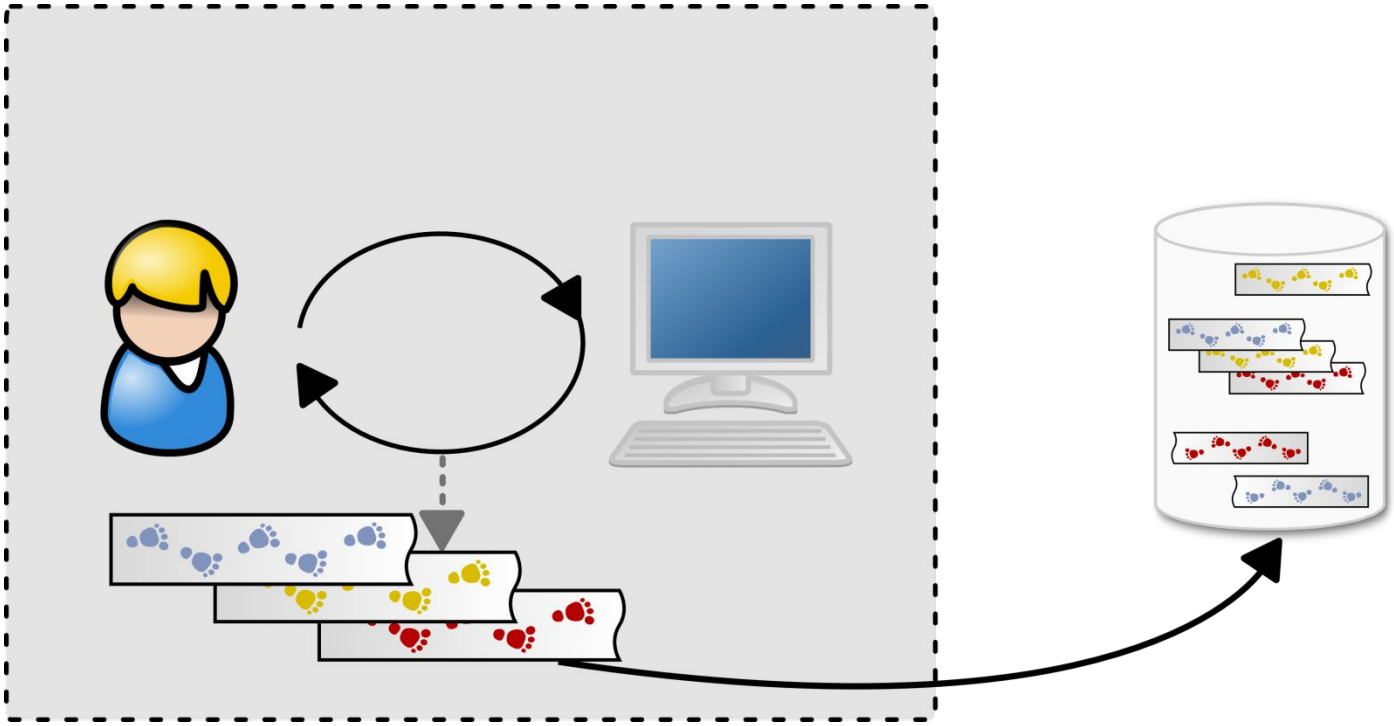
Model

KTBS

Processes

Collect

Transformation



KTBS: a Kernel for Trace-Based Systems

http://liris.cnrs.fr/sbt-dev/ktbs/

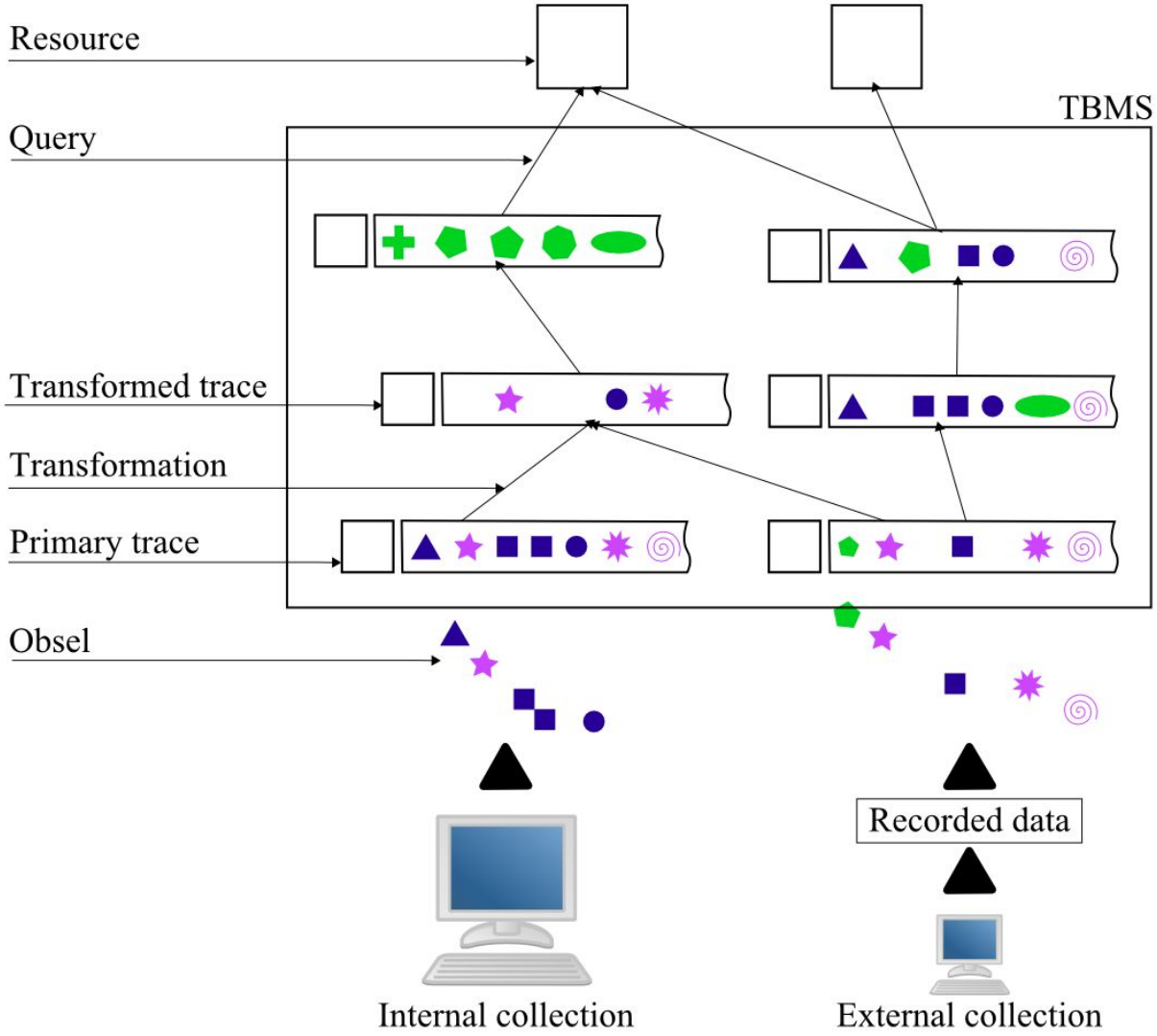
Properties

- Open source
- Simple data model
- Extensible

Technical details

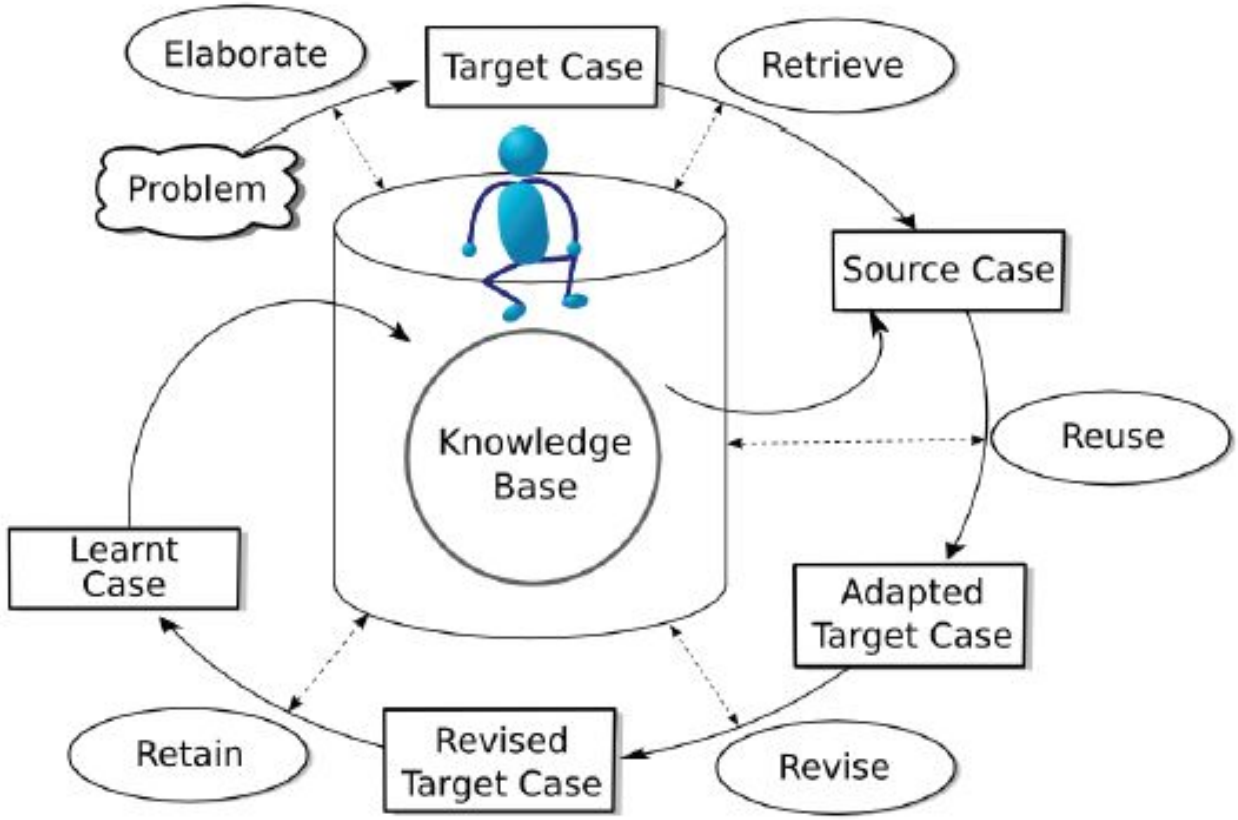
- RDF for representing its data
- RESTful HTTP for interaction
- Available in all programming languages
- Client API in Python, Java, ActionScript

kTBS in action!

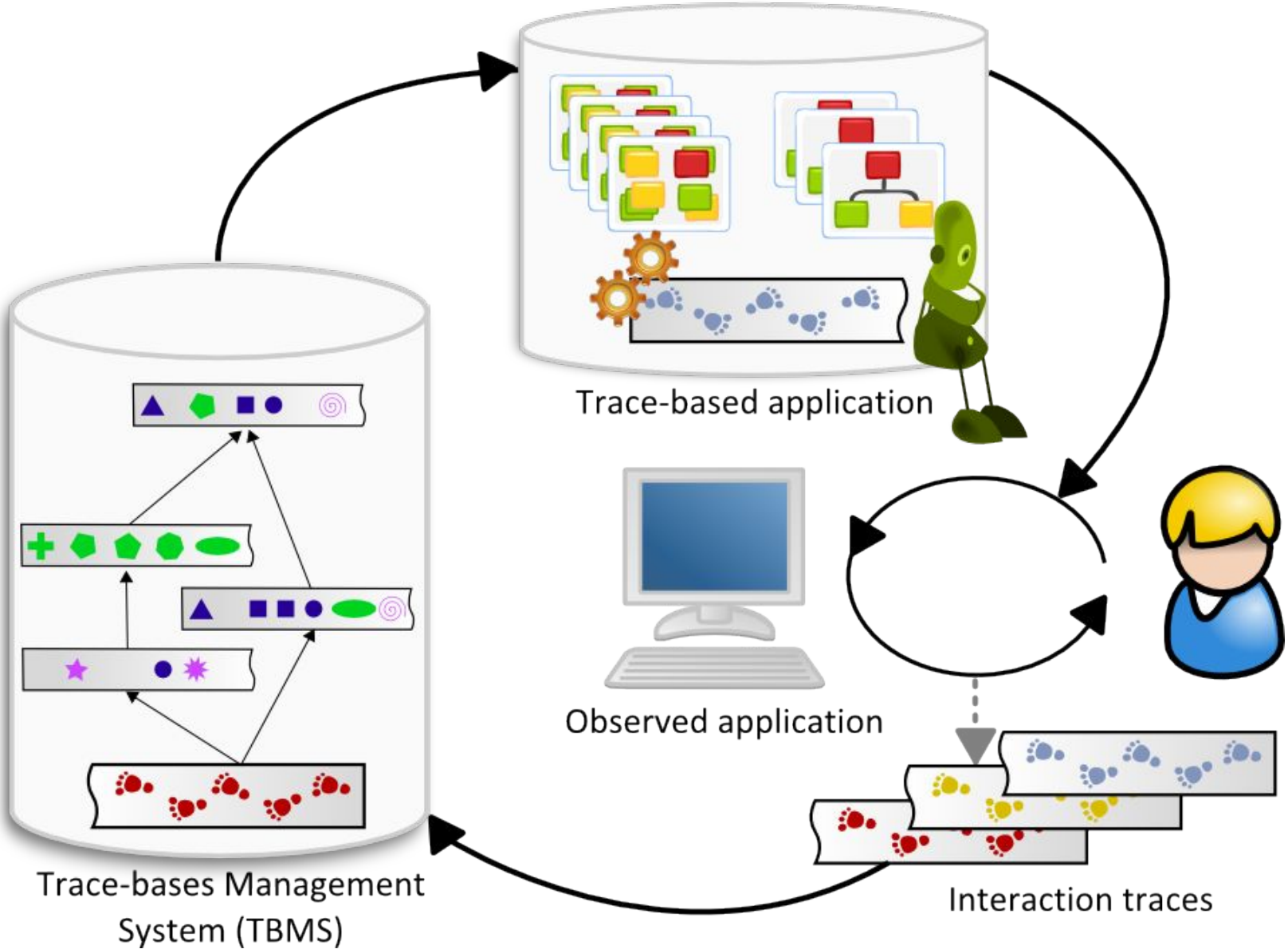


KTBS stores traces!

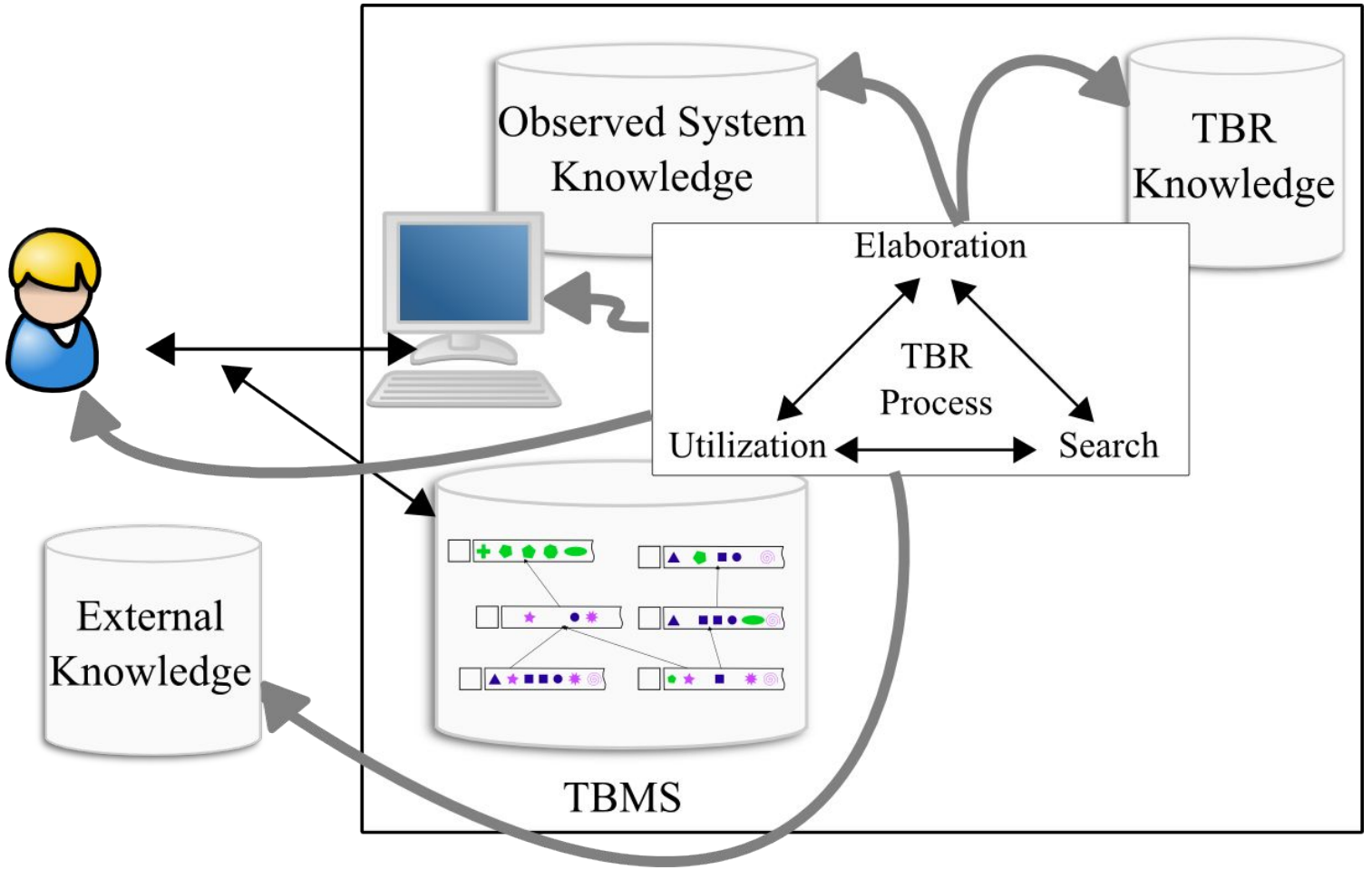
From Case-Based Reasoning to Trace-Based Reasoning?



Trace-Based Reasoning for user assistance



Trace-Based Reasoning for other purposes



What can we do with traces?

Knowledge acquisition

Replay

Visualisation

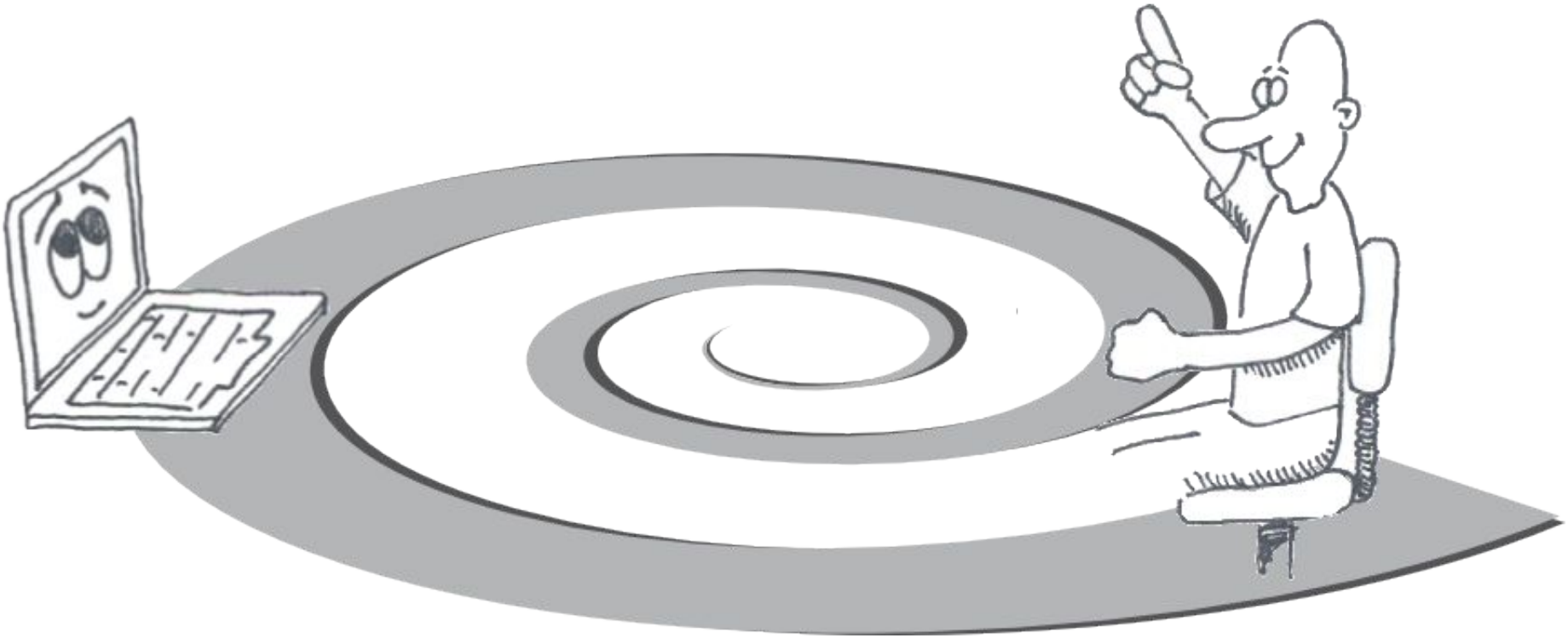
Learning

Assistance

Co-Construction

of knowledge

Interactive knowledge acquisition, both for humans and machines?



Why should we put the user back in the loop?

Applications

Name: **Abstract** and **Abstract Lite**

Author: Olivier Georgeon (et al.)

Project Type: PhD thesis (and more...)

Date: 2007-2011

Collaborations: INRETS

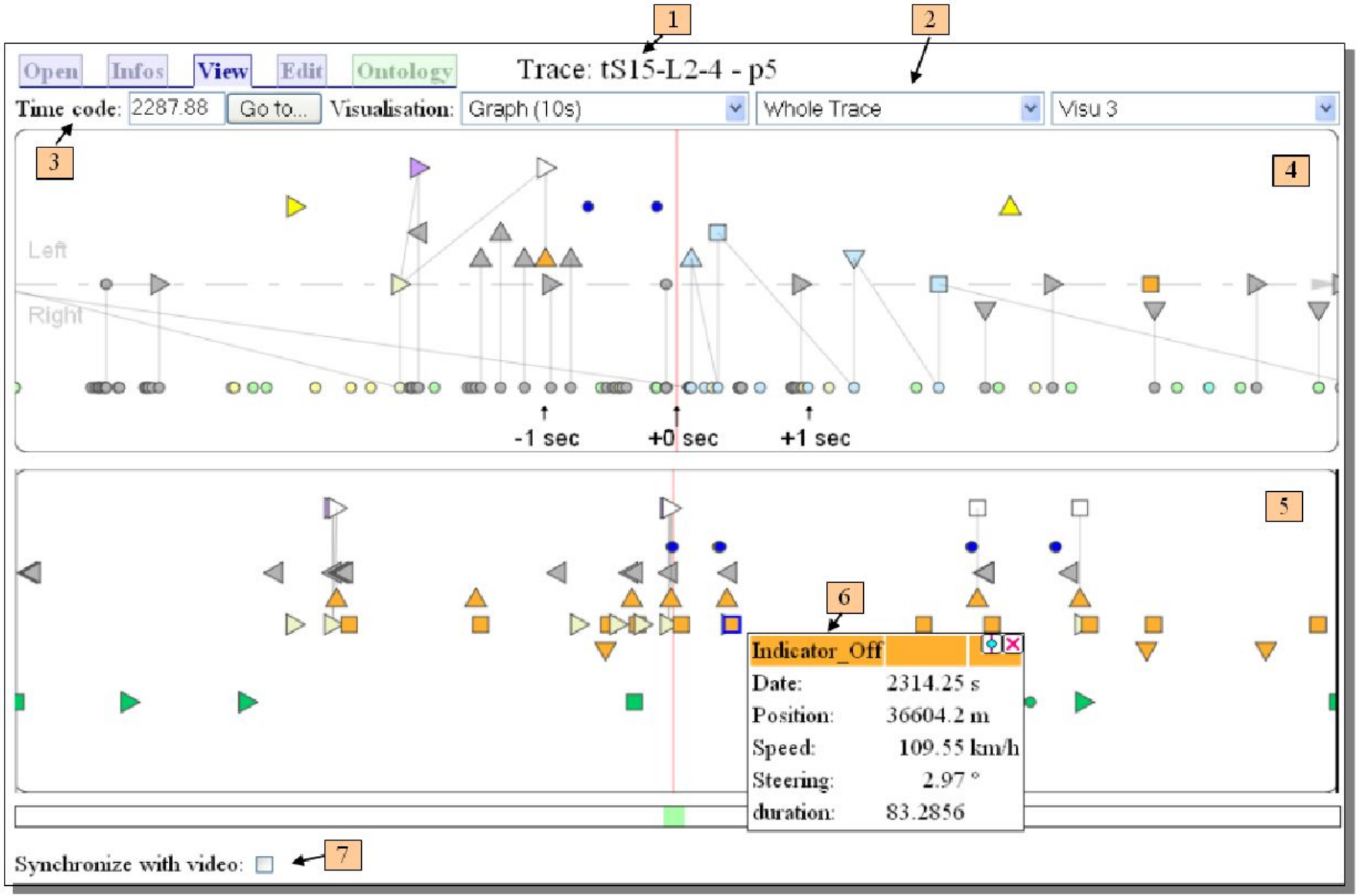
Research issues: Activity traces visualization
Tools for human activity analysis
Knowledge discovery
(a lot of application domains)

Websites: http://liris.cnrs.fr/abstract/
http://vm.liris.cnrs.fr:34080/abstract/lite

Case study: Analysis of drivers' behaviours

Abstract

A.B.S.T.R.A.C.T.



Abstract

A.B.S.T.R.A.C.T.

Disconnect Change password My cookie Help

Instantaneous symbol Not playing

(Fields are xpath expressions)

Condition:
Shape:
Color:
Vertical offset:
Image URL: (if shape evaluates to 'image')
X scale: (leave empty if none)
Y scale: (leave empty if none)
Rotation: (leave empty if none)
X skew: (leave empty if none)
Y skew: (leave empty if none)
Send

Interval symbol

(Fields are xpath expressions)

Begin condition:
Begin event properties
Shape:
Color:

Share customization

Share current customization publicly

Save customization as

Name: Save

Customization list

Trace list

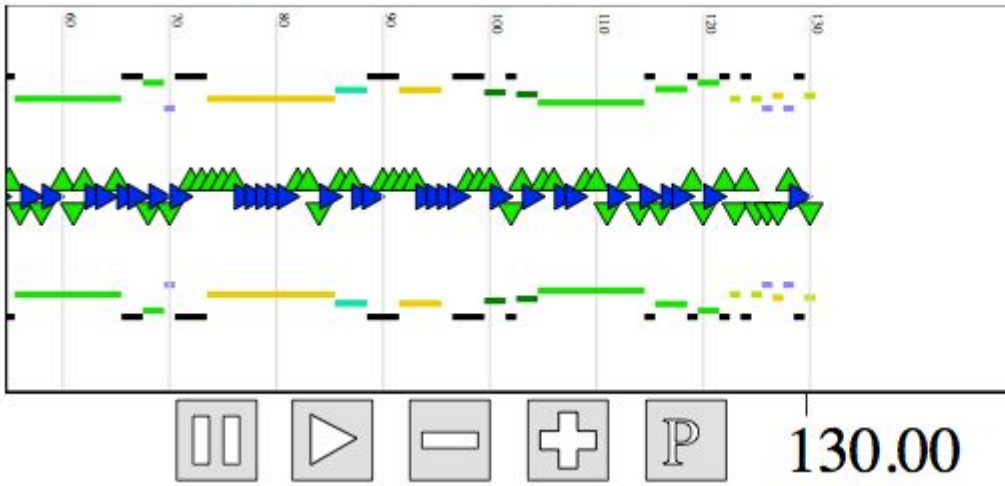
• ▶ 10 ✗ ⇩

Always play last

Upload a trace

Parcourir... Upload

Disconnect Change password My cookie Help



Abstract-lite

A.B.S.T.R.A.C.T.

Name:

Author: Raafat Zarka

Project Type: Master Research project

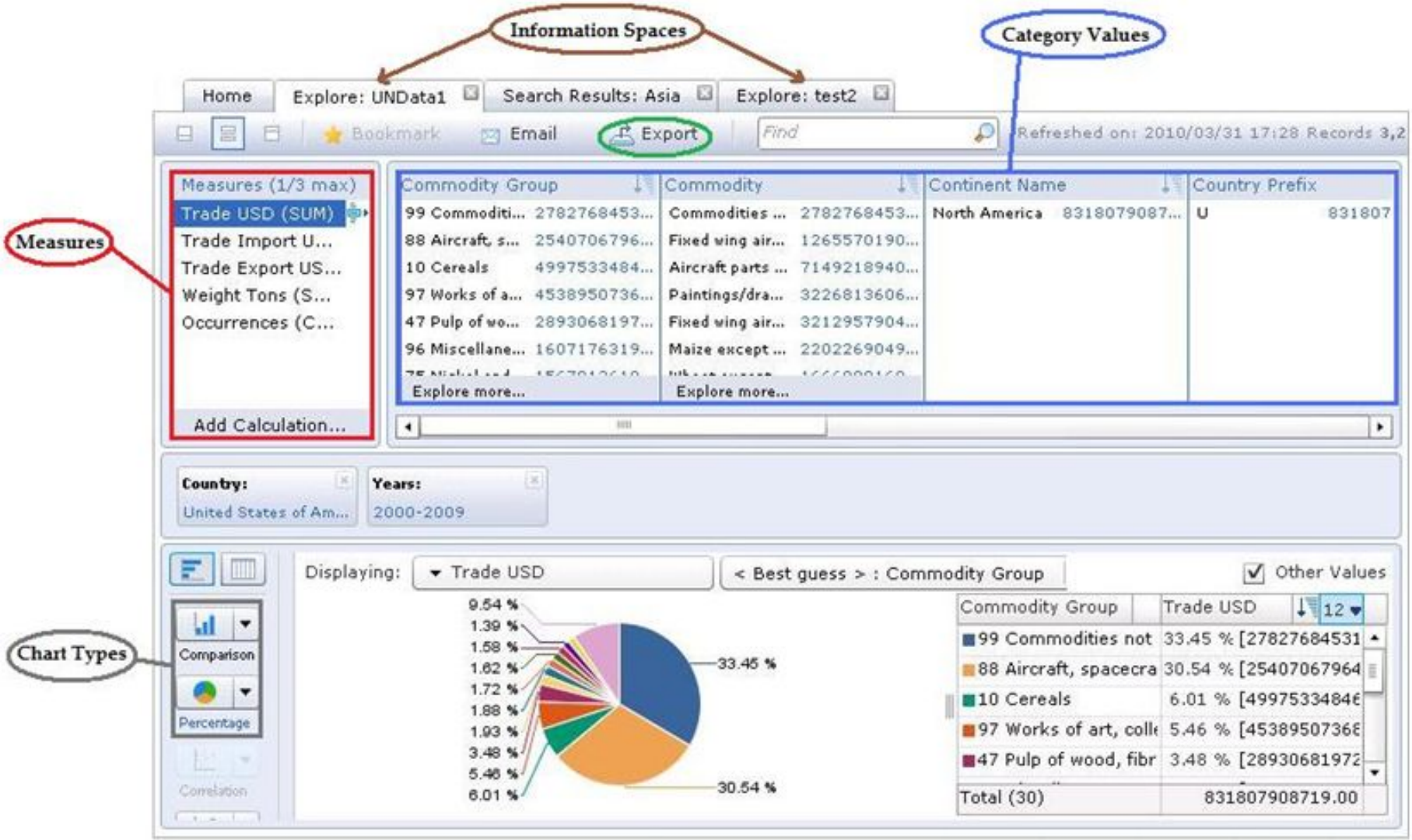
Date: 2010

Collaborations: SAP (Paris, France)

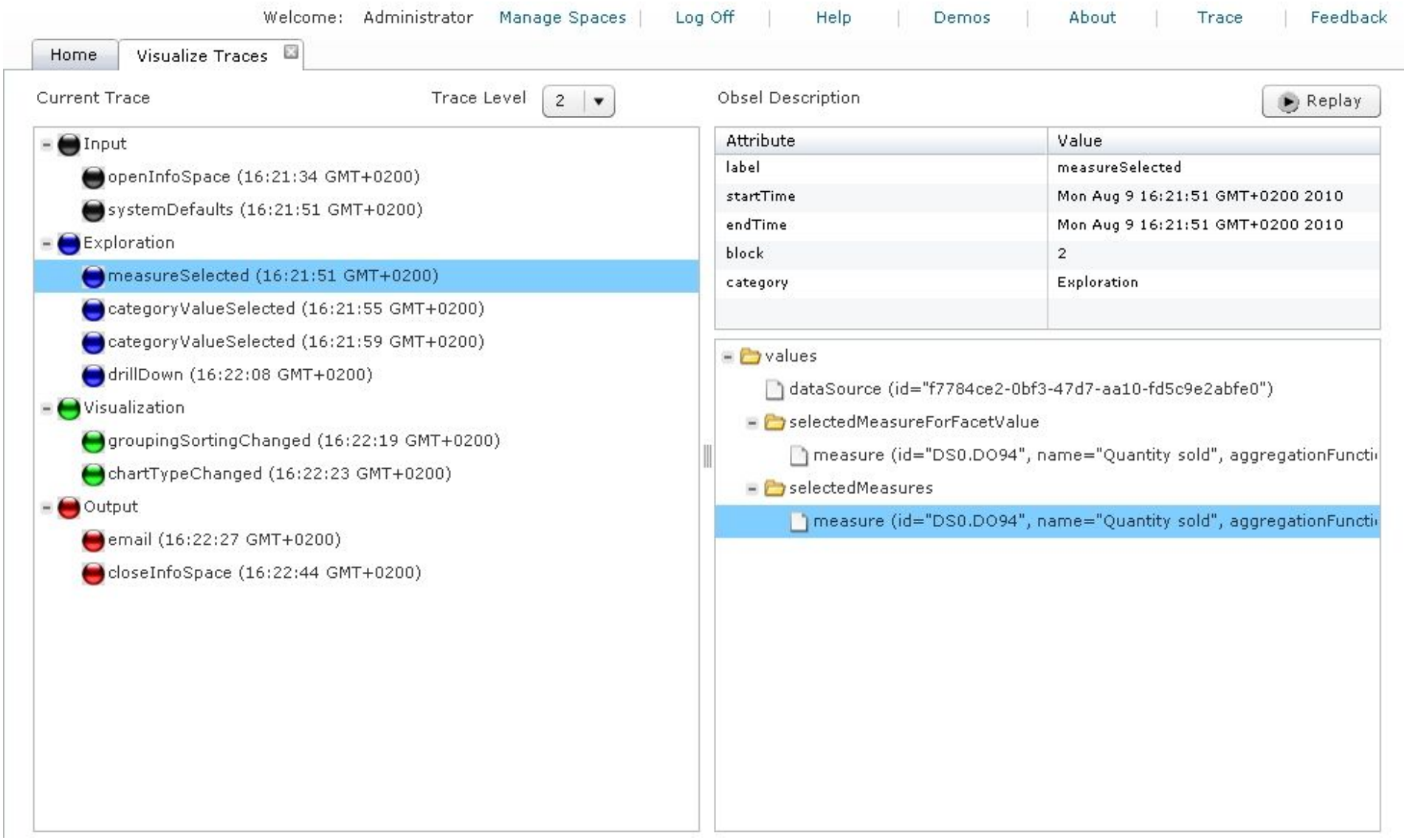
Research issues: Trace-based reasoning for user assistance

Collect of traces
Replay of traces
Impact propagation of changes

Website:
http://liris.cnrs.fr/raafat.zarka/ReplayTraceDemo/



SAP-BO Explorer



SAP-BO Explorer

Name: **Wanaclip**

Author: Raafat Zarka

Project Type: PhD (French National gran

Date: 2011

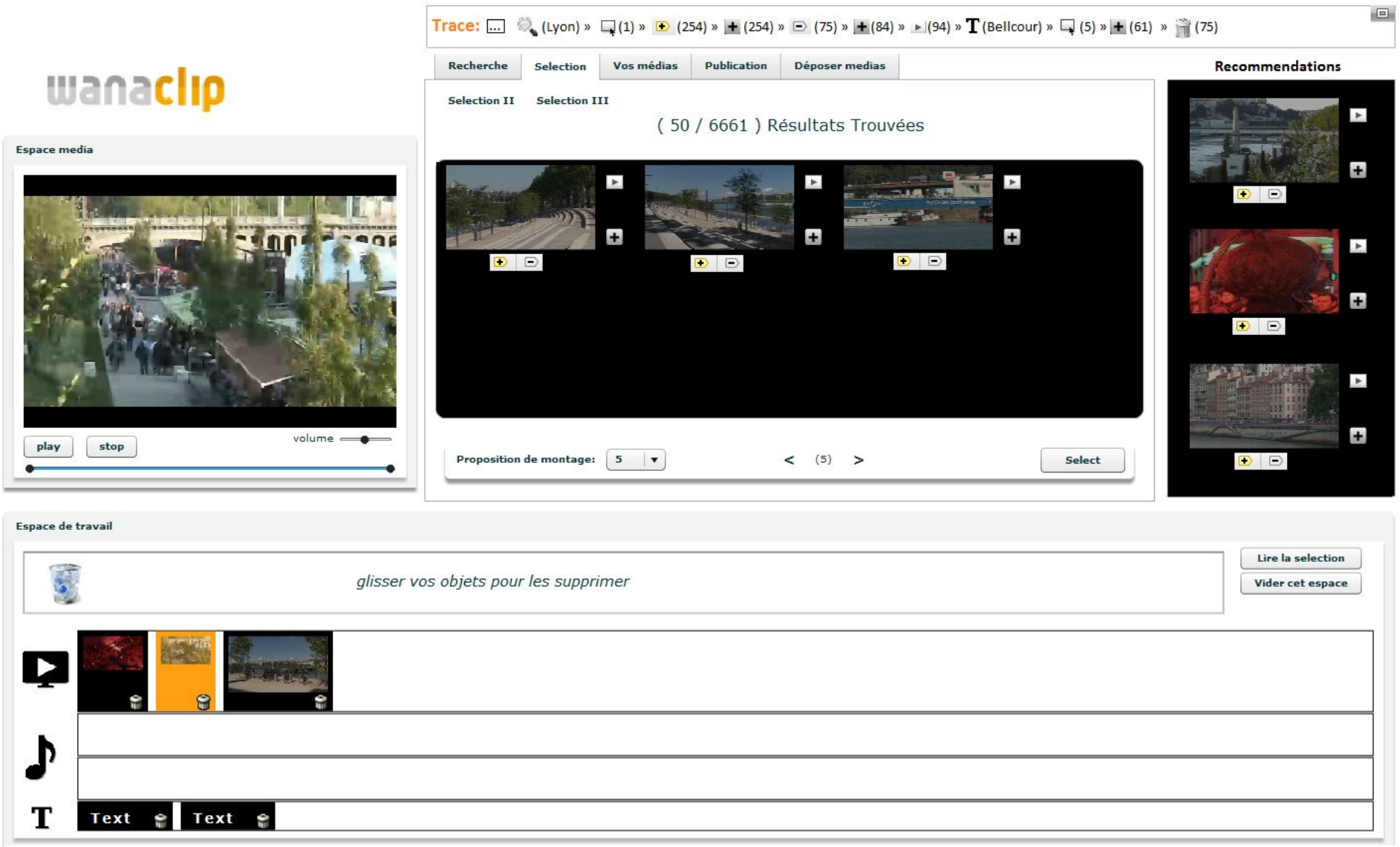
Collaborations: Webcastor (Lyon, France)

Research issues: Trace-based reasoning for user assistance

Collect

Trace-based recommendations

Website: http://liris.cnrs.fr/raafat.zarka/



Wanaclip

webcastor

Name: **Taaable**

Author: Amélie Cordier (et al.)

Project Type: Open project

Date: 2008-2011

Collaborations: LORIA, LINA, LIPN (French labs.)

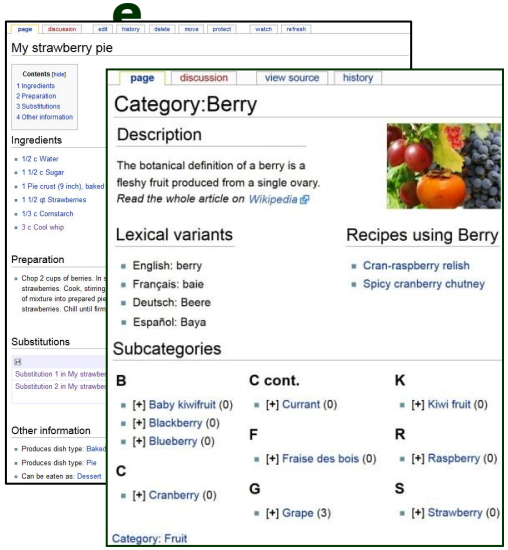
Research issues: Case-based Cooking
Knowledge representation
Collaborative work
Semantic wikis

Websites: http://taaable.fr/
http://computercookingcontest.net

ABOUT TAAABLE

Taaable components

WikiTaaable



Taaable (.fr)

Reasoning Process

Knowledge Discovery Process

Taaable CBR engine

- Adaptation of recipes
- Example

I want a dessert, with apples but no cinnamon

- Adaptation

Adapt "My Strawberry Pie", because I do not have strawberry

Taaable knowledge

- WikiTaaable
  - Semantic Wiki
  - Ontology

page | discussion | view source | history

Category:Berry

Description

The botanical definition of a berry is a fleshy fruit produced from a single ovary.
Read the whole article on Wikipedia

Lexical variants

- English: berry
- Français: baie
- Deutsch: Beere
- Español: Baya

Recipes using Berry

- Cran-raspberry relish
- Spicy cranberry chutney

Subcategories

B
- [+] Baby kiwifruit (0)
- [+] Blackberry (0)
- [+] Blueberry (0)

C
- [+] Cranberry (0)

C cont.
- [+] Currant (0)

F
- [+] Fraise des bois (0)

G
- [+] Grape (3)

K
- [+] Kiwi fruit (0)

R
- [+] Raspberry (0)

S
- [+] Strawberry (0)

Category: Fruit

And some recipes

page | discussion | edit | history | delete | move | protect | watch | refresh

My strawberry pie

Contents [hide]

1 Ingredients
2 Preparation
3 Substitutions
4 Other information

Ingredients [edit]

- 1/2 c Water
- 1 1/2 c Sugar
- 1 Pie crust (9 inch), baked
- 1 1/2 qt Strawberries
- 1/3 c Cornstarch
- 3 c Cool whip

Preparation [edit]

- Chop 2 cups of berries. In saucepan combine sugar and cornstarch. Slowly add water to combine smoothly. Add chopped strawberries. Cook, stirring constantly until mixture thickens and boils. Cool in refrigerator for about 1/2 hour. Pour about 3/4 of mixture into prepared pie crust. Stand up whole strawberries in syrup (to fill crust). Pour remaining syrup over strawberries. Chill until firm (about 3 hours). Spread cool whip over top of pie and serve.

User interface

Taaable

dessert_dish rice fig

Find recipes! Clear

Dietary practices: Vegetarian Nut-free No alcohol Low cholesterol Gout Diet

Customize your dietary practices...

Adapt a specific recipe...

Example. *If you want an apple pie without cinnamon, enter "apple pie_dish -cinnamon".*

Learn more about advanced queries...

Your request is: dessert_dish fig rice

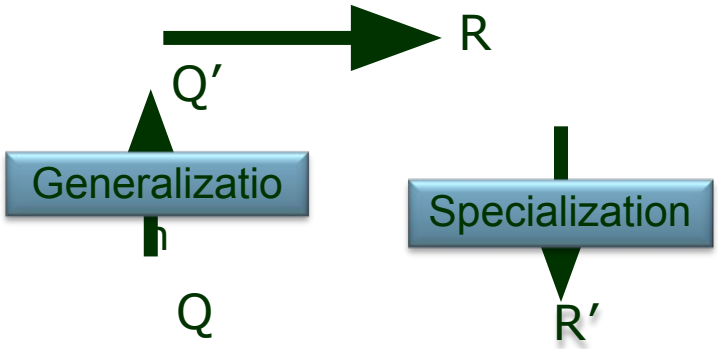
The request used for adaptation is: dessert_dish fig rice

#	Original recipe name (click to open recipe)	Adaptation overview (click to see the details)
1	Glutinous_rice_with_mangoes	Replace: Mango by Fig

Results 1 - 1 on 1 | Processing time: 0.6189 seconds

Reasoning process

- Adaptation
  - Retrieve similar recipes
  - Replace some ingredients by others



Examples of adaptation

Glutinous rice with mangoes

The ingredient substitutions OK not OK

1. Mango → Fig

Ingredient Quantities

Ingredient	Initial Quantity	New Quantity
Salt	=	1 tsp (7.0 grams)
Mango	6 whole (1242.0 grams)	0 whole (0.0 grams)
Coconut cream	=	2 cup (648.0 grams)
Glutinous rice	=	3 cup (522.0 grams)
Sesame seed	2 tbsp (16.0 grams)	1 tbsp (10.0 grams)
Fig	0 grams (0.0 grams)	1242 grams
Sugar	=	2 cup (625.0 grams)

Preparation Adaptation

Cut figs into wedges. SEASONINGS SAUCE GARNISH Soak the rice in cold water for 2 hours. Drain. Line a steamer with cheesecloth, heat steamer and lay rice on the cheesecloth. Steam for 30 minutes or until cooked through. The rice will become glossy. Mix the SEASONINGS_ingredients in a large bowl and gently mix in the hot steamed rice. Cover tightly and let soak for 30 minutes to absorb the coconut flavour. Blend the SAUCE_ingredients in a pot and heat until it just reaches the boiling point. Let cool. ~~Peel the mangoes, slice lengthwise and remove the pits.~~ Divide the rice among 6 plates. Place ~~mango~~ fig slices on top and cover with the sauce. Sprinkle with the sesame seeds and serve.

Show details

Adaptation Knowledge Acquisition

- Based on the extraction of closed itemsets on variations of ingredients in recipes

Adaptation knowledge in a semantic wiki

page | discussion | edit | history | delete | move | protect | watch

Substitution 1 in My strawberry pie

Contents [hide]

1 In Context
2 Replace
3 By
4 Origin

In Context [edit]

My strawberry pie

Replace [edit]

Ingredient : Strawberry

By [edit]

Ingredient : Raspberry

Origin [edit]

Adaptation source :Taaable

Category: Specific substitution

Adaptation knowledge

page | discussion | edit | history | delete | move | protect | watch | refresh

My strawberry pie

Contents [hide]

1 Ingredients
2 Preparation
3 Substitutions
4 Other information

Ingredients [edit]

- 1/2 c Water
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- 1/3 c Cornstarch
- 3 c Cool whip

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Substitutions [edit]

	Context	Replace	By	Origin
Substitution 1 in My strawberry pie	**My strawberry pie**	Strawberry	Raspberry	Taaable

Taaable writing bot

Glutinous rice with mangoes

The ingredient substitutions OK not OK

1. Mango → Fig

Recipe and substitution

page | discussion | edit | history | delete | move | protect | watch | refresh

My strawberry pie

Contents [hide]

1 Ingredients
2 Preparation
3 Substitutions
4 Other information

Ingredients [edit]

- 1/2 c Water
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Substitutions [edit]

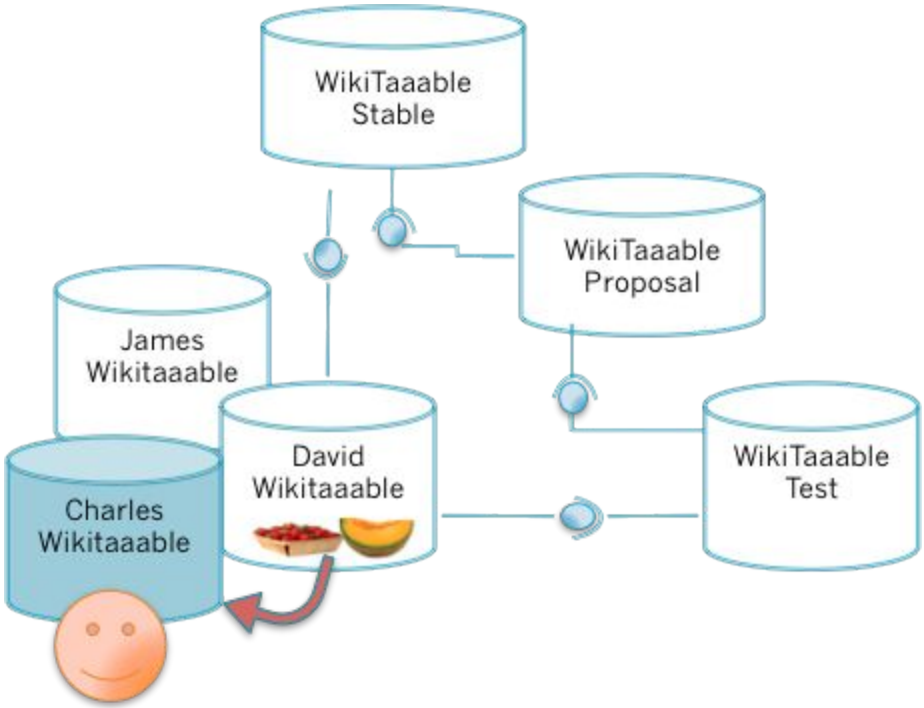
	Context	Replace	By	Origin
Substitution 1 in My strawberry pie	**My strawberry pie**	Strawberry	Raspberry	Taaable
Substitution 2 in My strawberry pie	**My strawberry pie**	Strawberry Cool whip	Raspberry Food color	AKExtractor

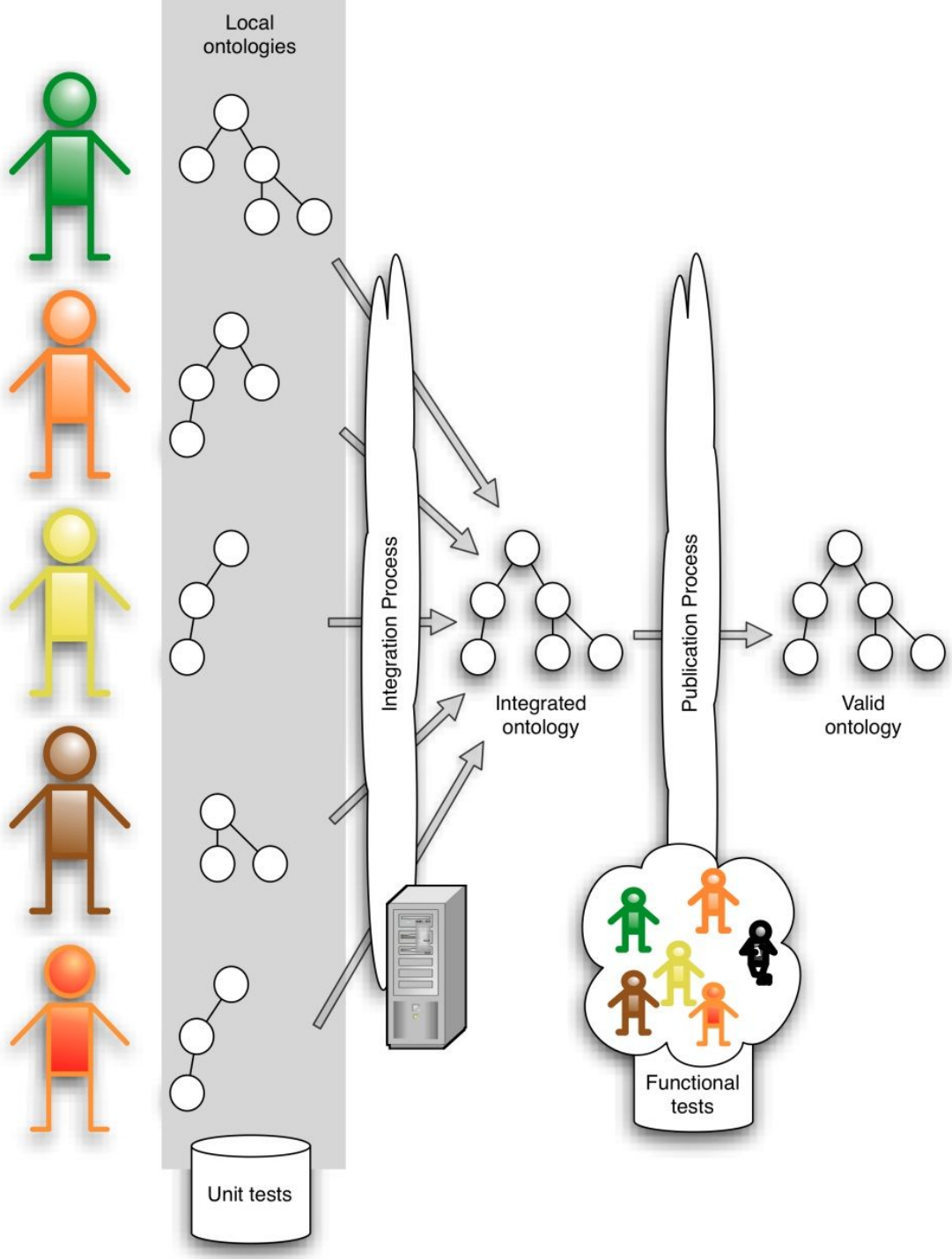
Other information [edit]

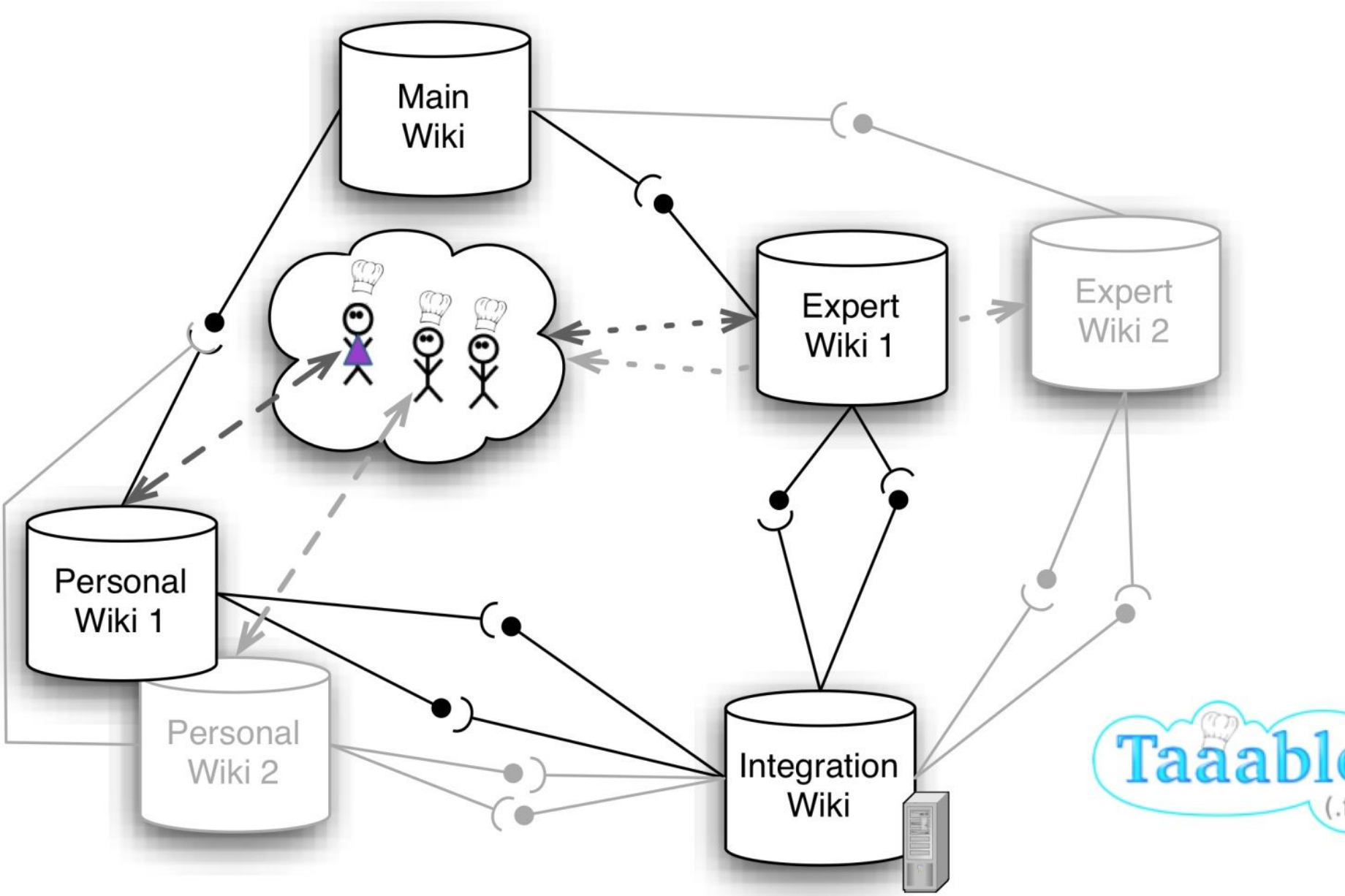
- Produces dish type: Baked good
- Produces dish type: Pie
- Can be eaten as: Dessert

AGENCE NATIONALE DE LA RECHERCHE
ANR
kOIflOw

Kolflow aims at building a **social semantic space** where **humans** collaborate with **smart agents** in order to produce **knowledge understandable** by humans and machines


WikiTaaable
Stable
WikiTaaable
Proposal
James
Wikitaaable
David
Wikitaaable
WikiTaaable
Test
Charles
Wikitaaable


Local
ontologies
Integration Process
Integrated
ontology
Publication Process
Valid
ontology
Functional
tests
Unit tests


Main
Wiki
Expert
Wiki 1
Expert
Wiki 2
Personal
Wiki 1
Personal
Wiki 2
Integration
Wiki
Taaable
(.fr)

Taaable

pear pie_dish

Find recipes! Clear

Dietary practices: Vegetarian Nut-free No alcohol

Low cholesterol Gout Diet

Customize your dietary practices...

Adapt a specific recipe...

Example. If you want an apple pie without cinnamon, enter "apple pie_dish -cinnamon".

Learn more about advanced queries...

Your request is: pear pie_dish

The request used for adaptation is: pear pie_dish

#	Original recipe name (click to open recipe)	Adaptation overview (click to see the details)
1	La_tarte_tatin	Replace: Golden delicious apple by Pear
2	Custard_apple_tart	Replace: Apple by Pear
3	Individual_almond-cream_tarts	Replace: Apple by Pear

Results 1 - 3 on 3 | Processing time: 0.6166 seconds

Taaable

Help me! | Video tutorials | About Taaable | WikiTaaable | Administration

Taaable 3 - Copyleft Taaable Team 2010

Taaable

Taaable

Taaable

navigation

- Main page
- Community portal
- Current events
- Recent changes
- Random page
- Help

search

Go Search

toolbox

- What links here
- Related changes
- Special pages
- Printable version
- Permanent link
- Browse properties

Category:Food

Description

Food is any substance consumed to provide nutritional support for the body. It is usually of plant or animal origin, and contains essential nutrients, suc
vitamins, or minerals...

Read the whole article on Wikipedia

Lexical Variants

- English: Food *(Food)*
- Français: Aliment *(Aliments)*
- Deutsch: Lebensmittel *(Plural not available)*
- Español: Alimento *(Alimentos)*

Recipes using food

ForNavigationPurposeViewPoint

Subcategories

This category has the following 19 subcategories, out of 19 total.

A

- [+] Accompaniment (7)

B

- [+] Baking mix (5)

F cont.

- [+] Foodcomponent (4)
- [+] Fruit (10)

G

M

- [+] Meat (12)

O

- [+] Oil (18)

Taaable

Taaable

How to cook a perfect love story

Best Music Award at **IJCAI** 2009 Video Competition

http://www.youtube.com/watch?v=UMJyZnfqwYQ

Taaable

Name: **Kolflow**

Author: Kolflow team

Project Type: ANR Contint Project

Date: 2011-2014

Collaborations: LORIA, LINA, INRIA

Research issues: Co-Construction of knowledge
Trace-based user assistance
Semantic wikis

Websites: http://kolflow.univ-nantes.fr

page | discussion | view source | history | dsmw (/ patches)

DSMW

navigation
- Main Page
- Download/Install
- Licensing:
- Getting Started
- FAQ
- Team
- Recent changes

documentation
- DSMW User Manual
- Presentation and Papers

community
- Support
- Contributing
- Issue tracker
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- Roadmap

developpers
- Gforge Home
- Source documentation
- Source code

Home

DSMW is an extension of Semantic Mediawiki (SMW). It allows to create a network of SMW servers that share common semantic wiki pages. DSMW manages synchronisation of shared semantic pages and ensures CCI consistency as in Google Wave. CCI stands for Causality, Convergence, Intentions (see papers for more informations). DSMW provides to SMW nearly the same features as a Distributed Version Control systems:

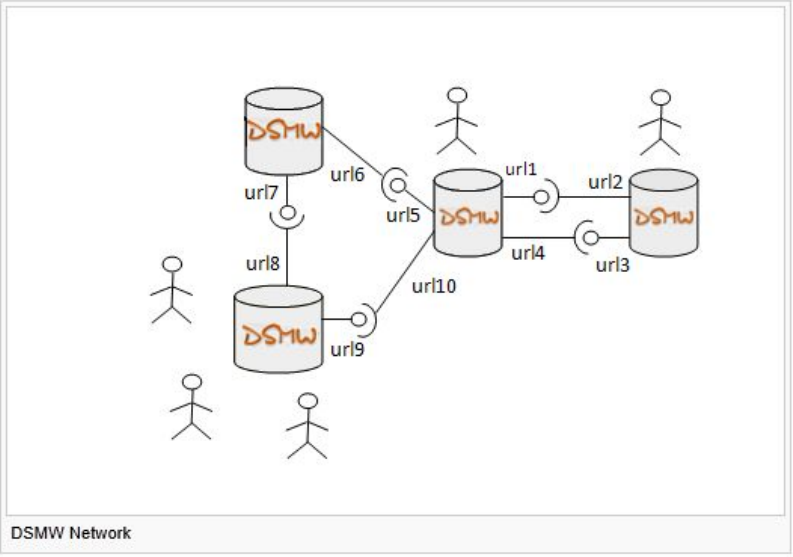
- you can work in isolation with your own server, test some stuff,
- publish changes to your own DSMW public feeds,
- you can also subscribe to any remote public DSMW feeds.

By this way, users can implements their own dataflows and represents any kind of dataflow oriented processes such as edit/review/publish.

DSMW is a network of a semantic wikis servers (DSMW peers). The number of peer is unknown. Semantic wiki pages can be replicated on several DSMW servers. A peer can replicate all or just some semantic wiki pages. The communication between DSMW peers is made through channels (feeds). This feeds are transporting operations that, when applied, modify local semantic wiki pages. If you are common to version control systems, a DSMW peer can be seen as a workspace, and a feed can be seen as a branch. DSMW works as follow:

- When a semantic wiki page is updated on a DSMW server, it generates a set of corresponding operations (Patch).
- The user can publish this patch into channels (PushFeed). The publication mechanism uses a semantic query. This query defines the pages' patches to be published (pushed).
- An authorized server can pull the patch(es) and integrated it (them) to the local replica of the pages. If needed, the integration process merges this modification with concurrent ones, generated either locally or received from a remote server. To do this, the user must create a PullFeed with the corresponding PushFeed features. For more information see (DSMW User Manual).

The system is correct if it ensure Causality, Convergence and Intention Preservations. Generation and integration is managed by the Logoot algorithm (see papers). DSMW allows users to build their own cooperative networks. The construction of the collaborative community is declarative, in the sense, every user declares explicitly with whom she would like to



DSMW Network

http://dsmw.loria.fr/

Kolflow

ANR kolflow

Name: **IIBM: Intelligent Interaction Based on Motion**

Author: Amélie Cordier (et al.)

Project Type: Internal Project

Date: 2009-2011

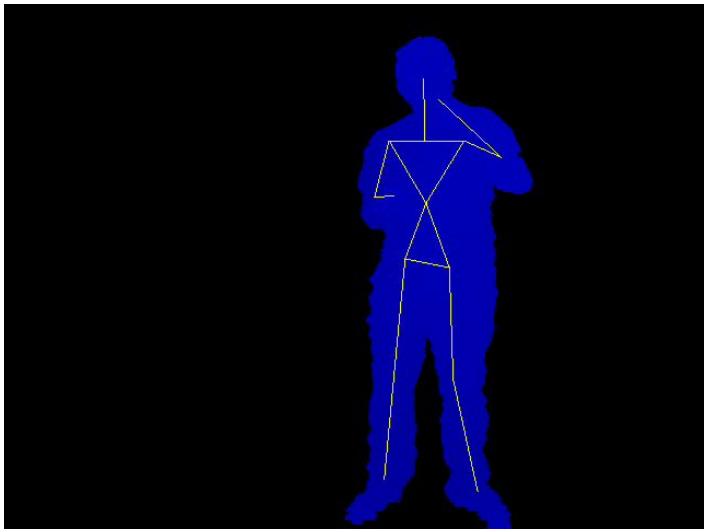
Collaborations: Multidisciplinary project

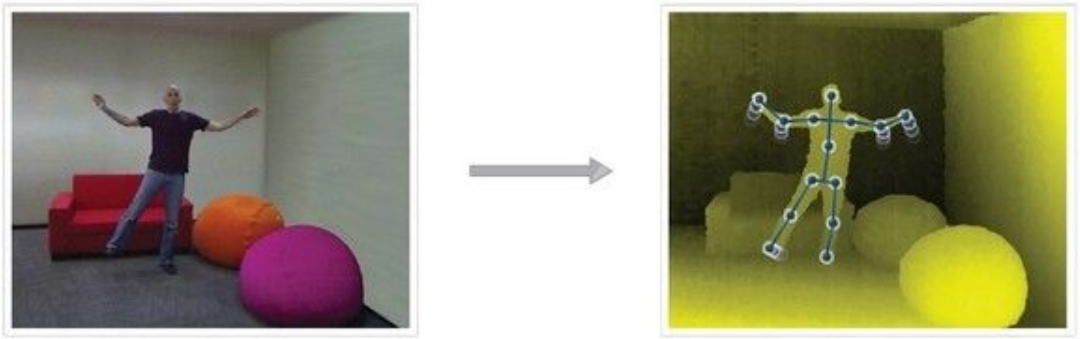
Research issues: Motion capture
Intelligent interactions
Trace-based user assistance

Website: http://liris.cnrs.fr/iibm

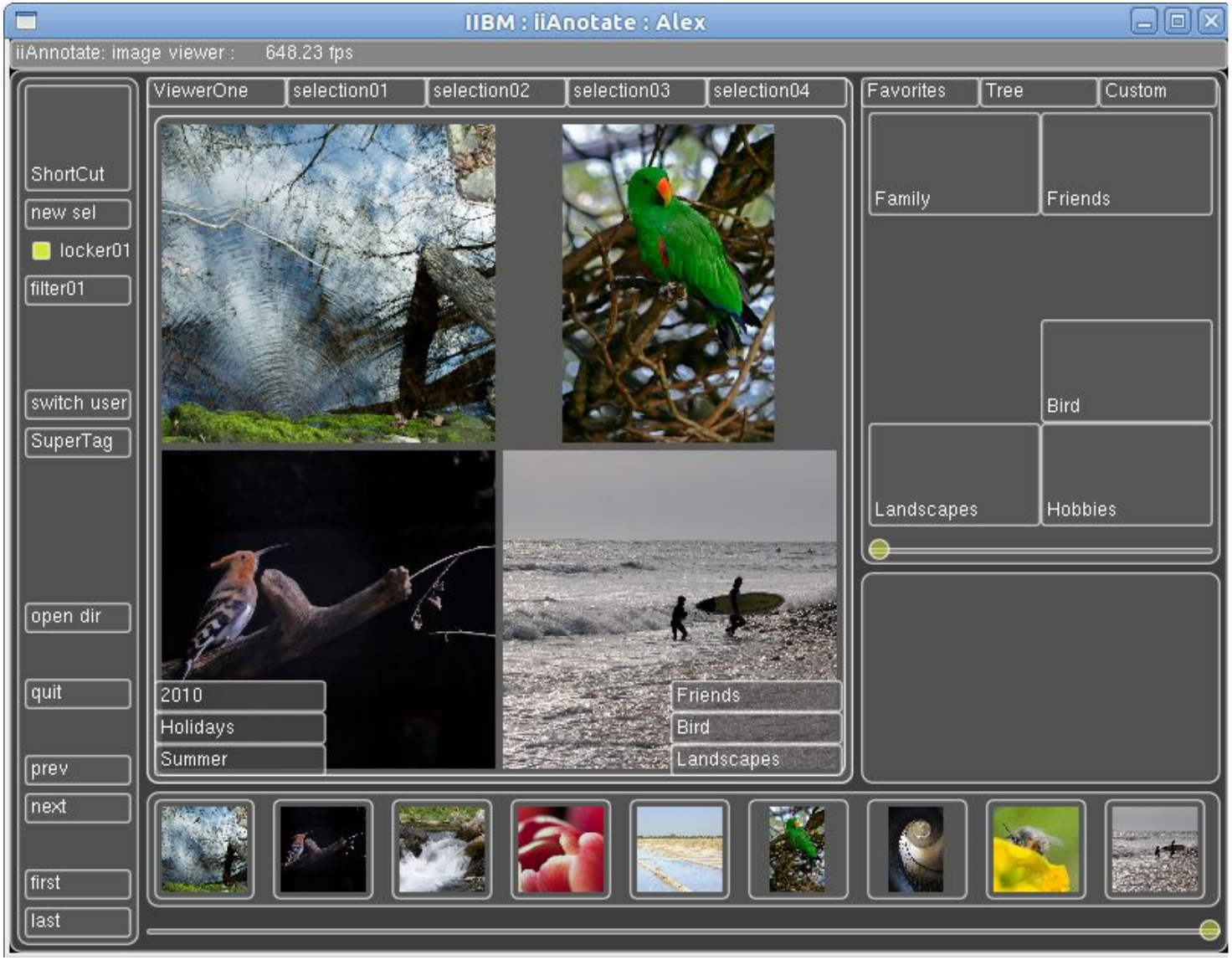
Kinect

OpenNI / NITE





IIBM


IIBM : iiAnotate : Alex
iiAnnotate: image viewer : 648.23 fps
ShortCut
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locker01
filter01
switch user
SuperTag
open dir
quit
prev
next
first
last
ViewerOne
selection01
selection02
selection03
selection04
2010
Holidays
Summer
Friends
Bird
Landscapes
Favorites
Tree
Custom
Family
Friends
Bird
Landscapes
Hobbies

IIBM

Name: **Scheme Emerger**
Author: Damien Cram

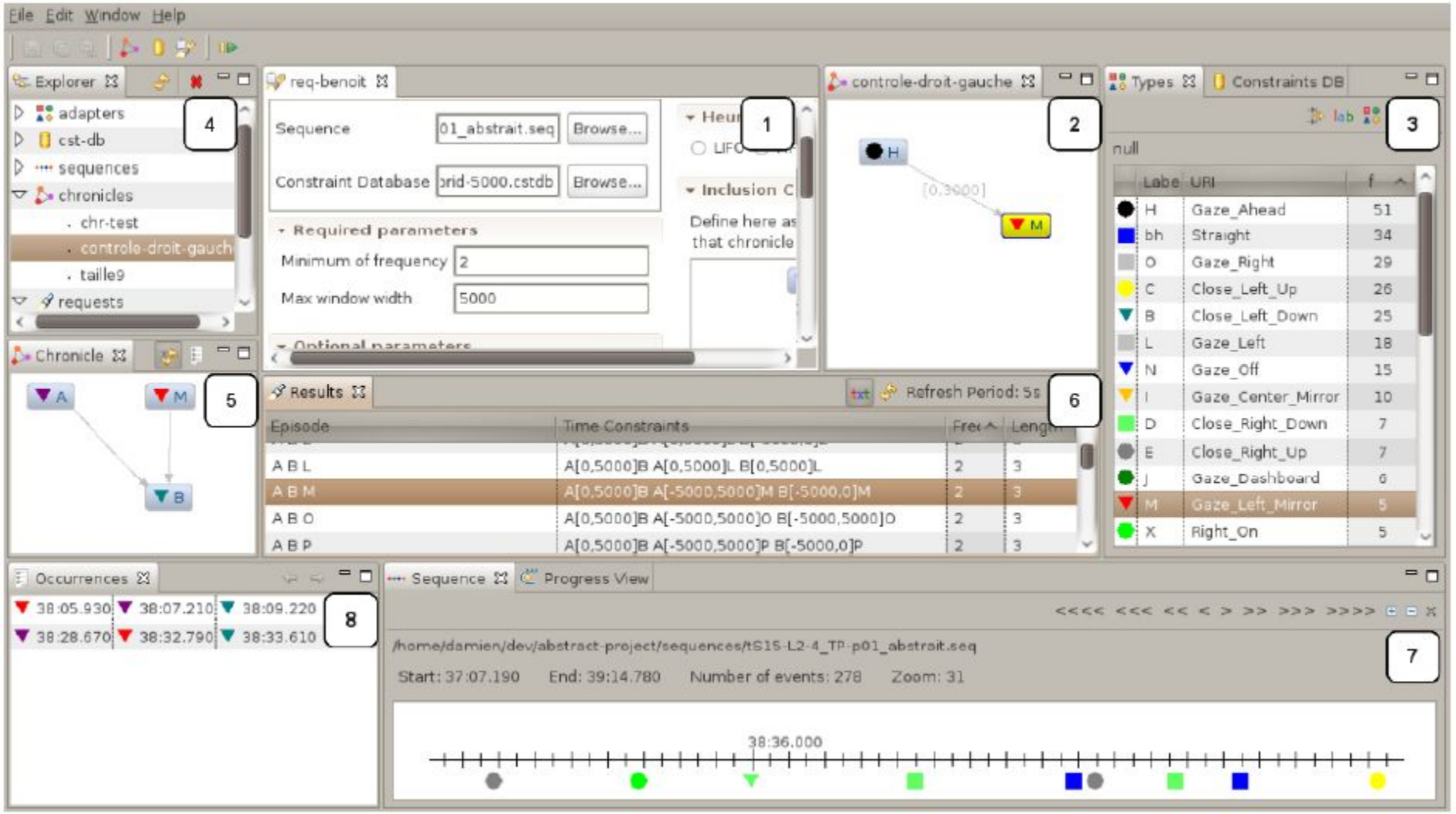
Project Type: PhD, ANR Procogec

Date: 2010

Collaborations: Knowings, DFKI
Research issues: Sequence Mining

Chronicle discovery
Trace analysis

Website: http://sourceforge.net/projects/schemerger/



Scheme Emerger

Name: **IDEAL: Implementation of DEvelopmentAl Learning**

Author: Olivier Georgeon

Project Type: ANR RPDoc

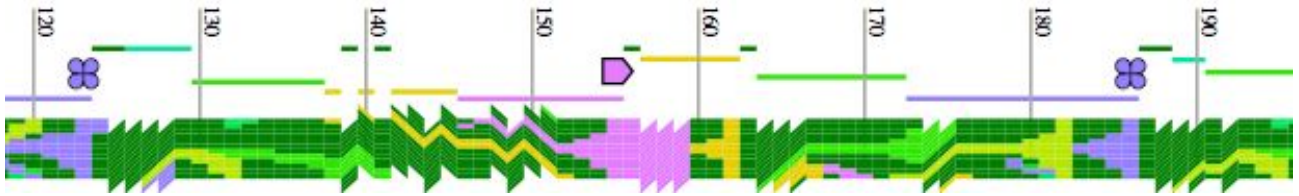
Date: 2010-2013

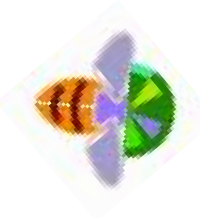
Collaborations: Pennsylvania State University, Sarah Lawrence College (NY)

Research issues: Early-stage cognitive development

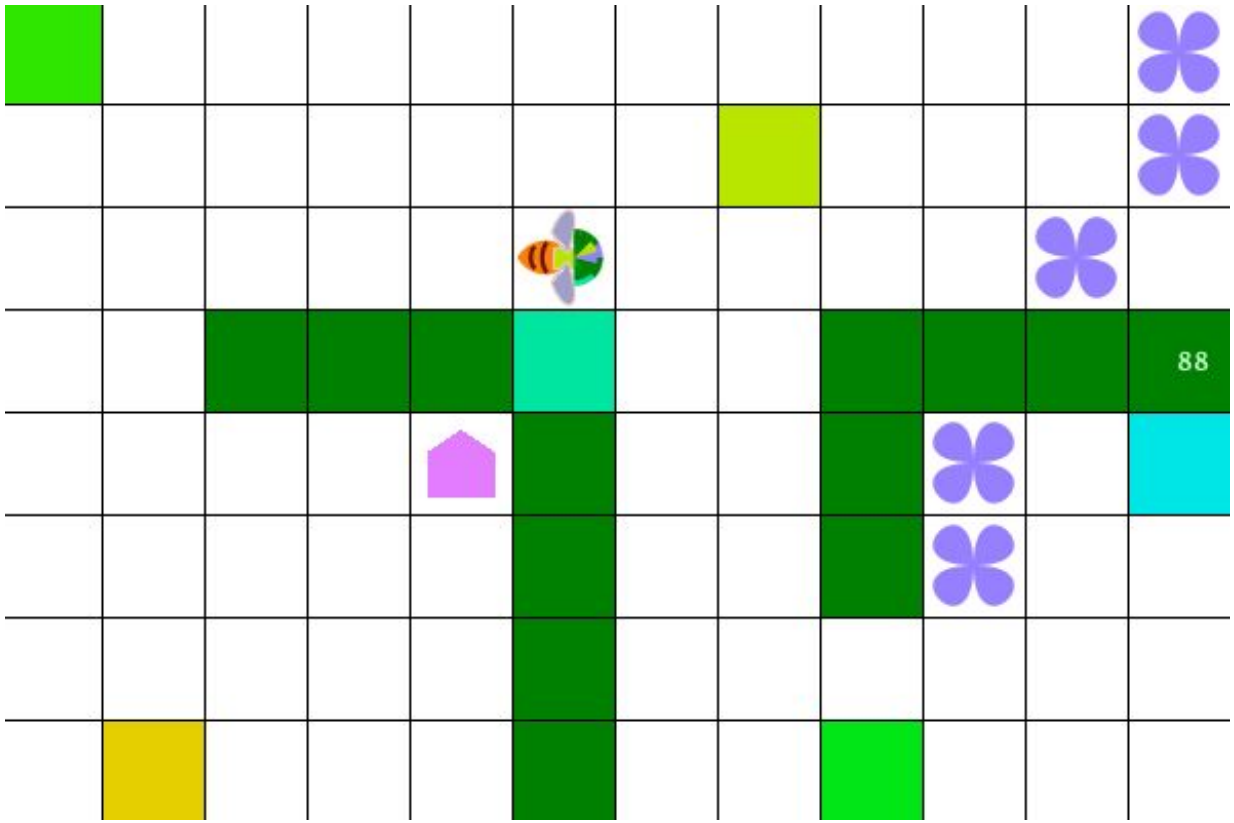
Intrisic motivation
Emergent situation awareness
Autonomous hierarchical skill learning

Websites: http://e-ernest.blogspot.com/
http://liris.cnrs.fr/ideal/demo/

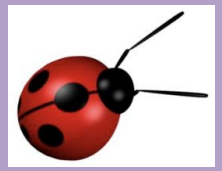




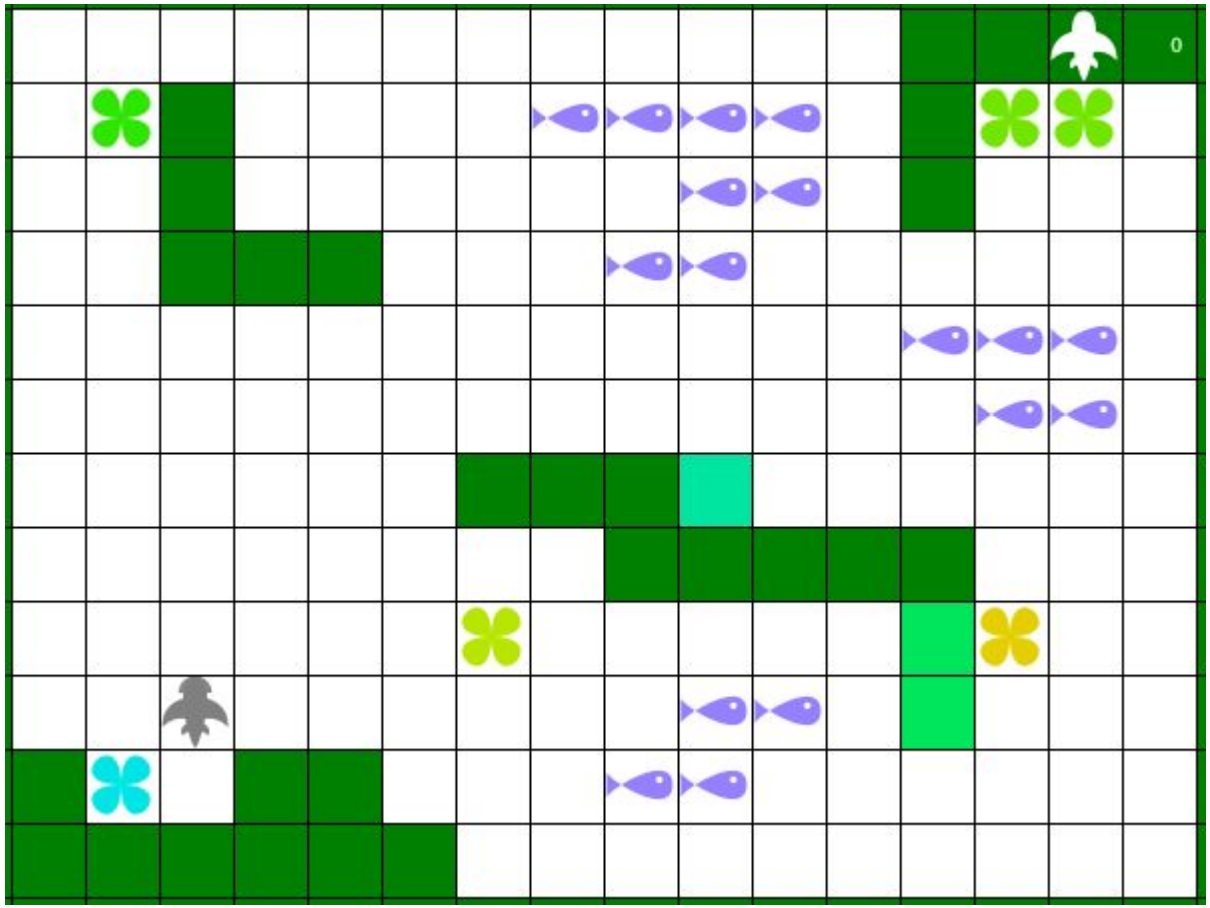
Ernest leaves traces!



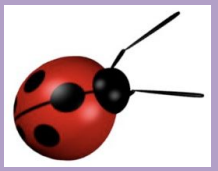
IDEAL

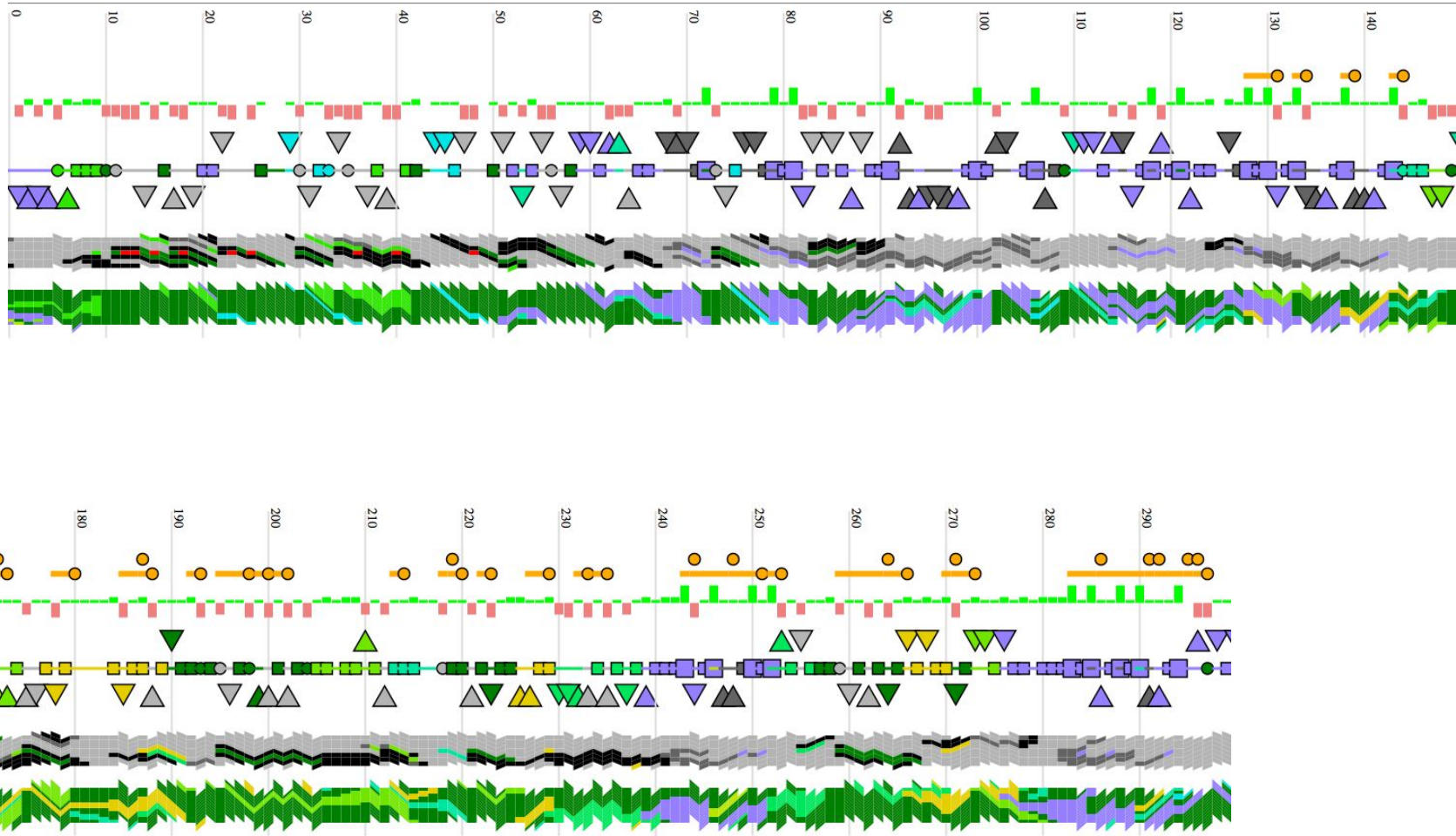


An evolution of Ernest



IDEAL

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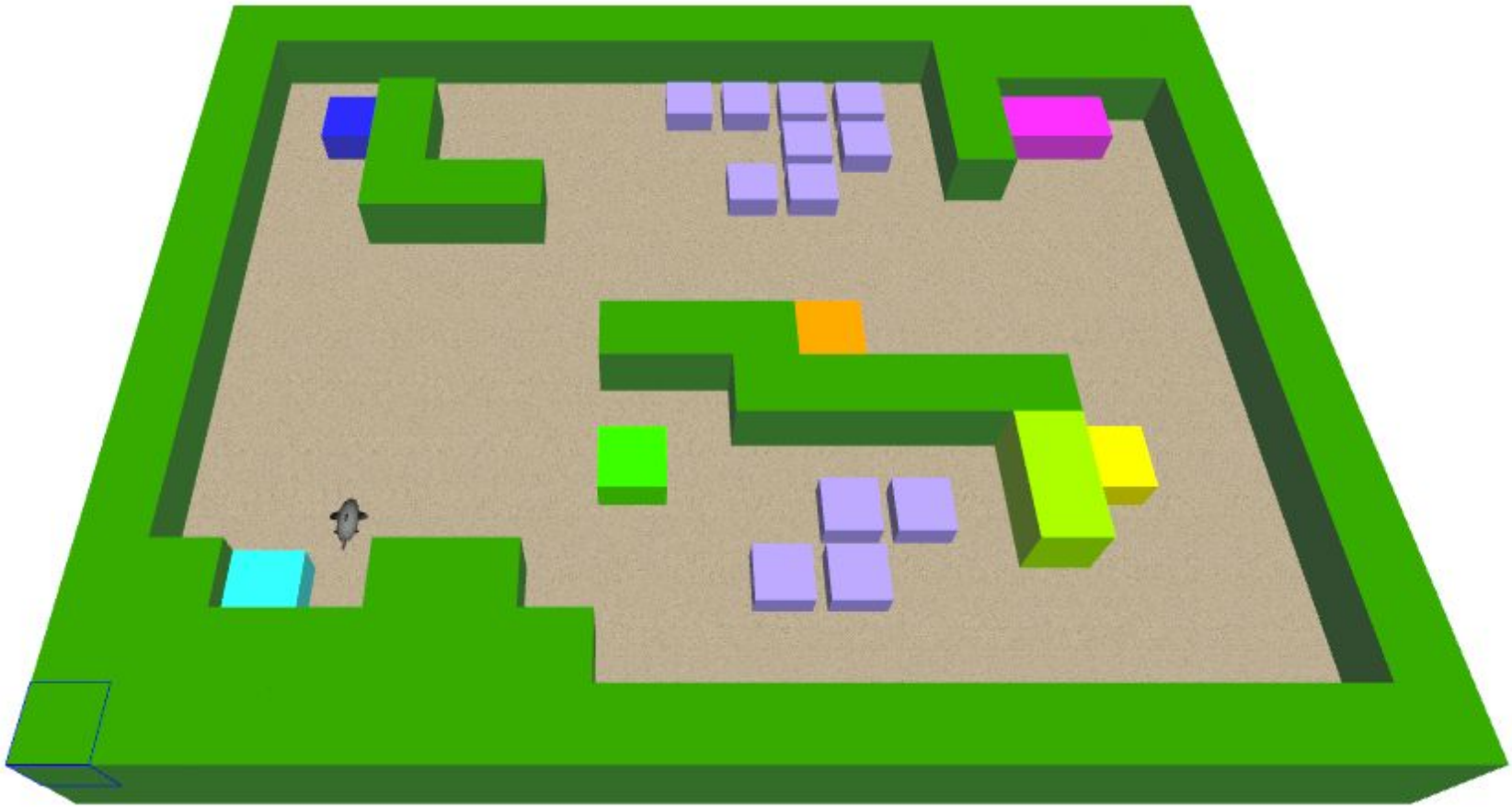
IDEAL

Interact with Ernest in 3D



IDEAL

Name: **Advene / ACAV**
Author: Yannick Prié (et al.)

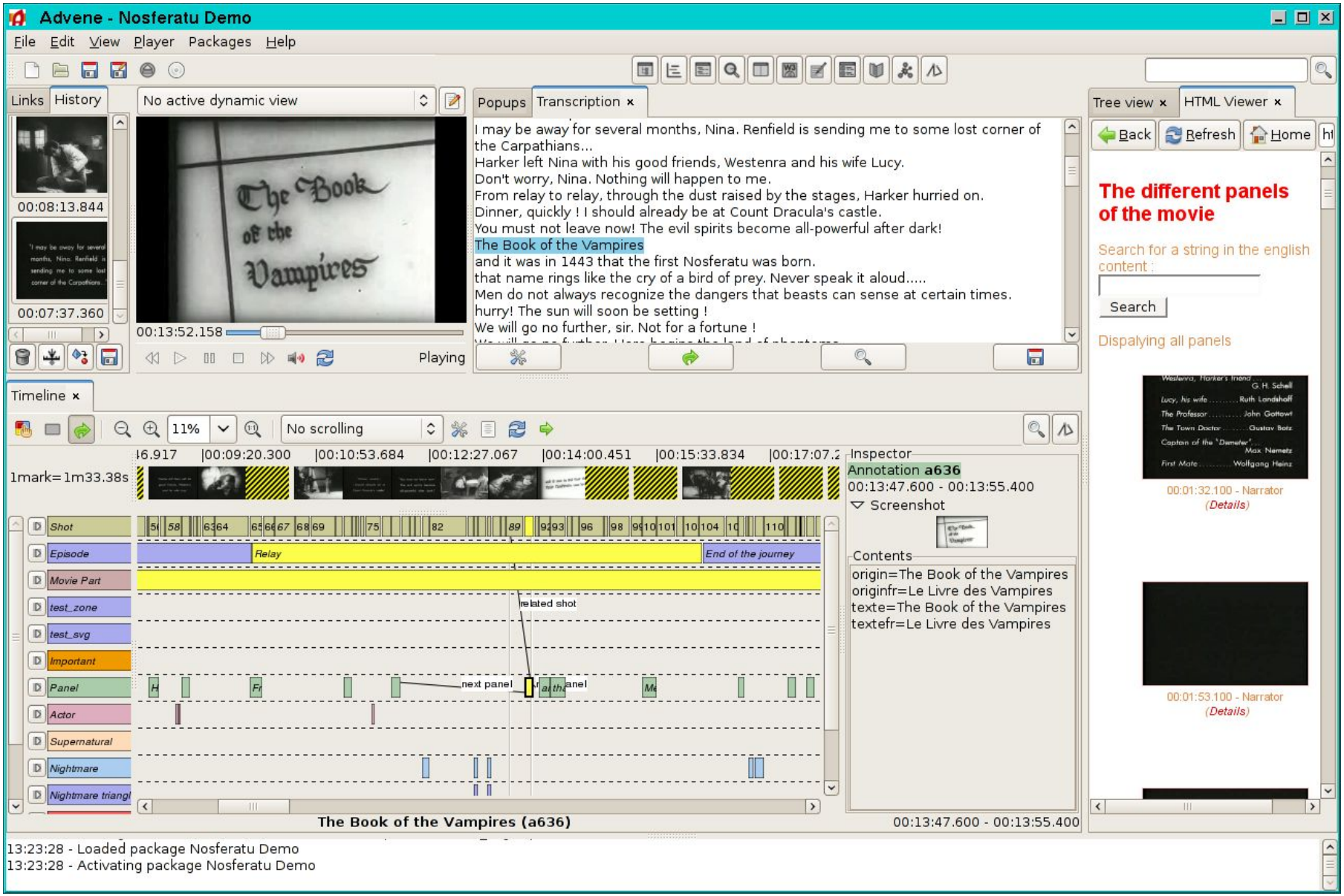
Project Type: ANR

Date: 2008-...

Collaborations: Dailymotion
Eurecom

Research issues: Collaborative Annotations for Video Accessibility
Interaction traces

Website: http://blog.dailymotion.com/acav/


Advene - Nosferatu Demo
File Edit View Player Packages Help
Links History
00:08:13.844
00:07:37.360
No active dynamic view
The Book of the Vampires
00:13:52.158
Playing
Popups Transcription ×
I may be away for several months, Nina. Renfield is sending me to some lost corner of the Carpathians...
Harker left Nina with his good friends, Westenra and his wife Lucy.
Don't worry, Nina. Nothing will happen to me.
From relay to relay, through the dust raised by the stages, Harker hurried on.
Dinner, quickly ! I should already be at Count Dracula's castle.
You must not leave now! The evil spirits become all-powerful after dark!
The Book of the Vampires
and it was in 1443 that the first Nosferatu was born.
that name rings like the cry of a bird of prey. Never speak it aloud.....
Men do not always recognize the dangers that beasts can sense at certain times.
hurry! The sun will soon be setting !
We will go no further, sir. Not for a fortune !
Tree view × HTML Viewer ×
Back Refresh Home
The different panels of the movie
Search for a string in the english content :
Search
Dispalying all panels
00:01:32.100 - Narrator
(Details)
00:01:53.100 - Narrator
(Details)
Timeline ×
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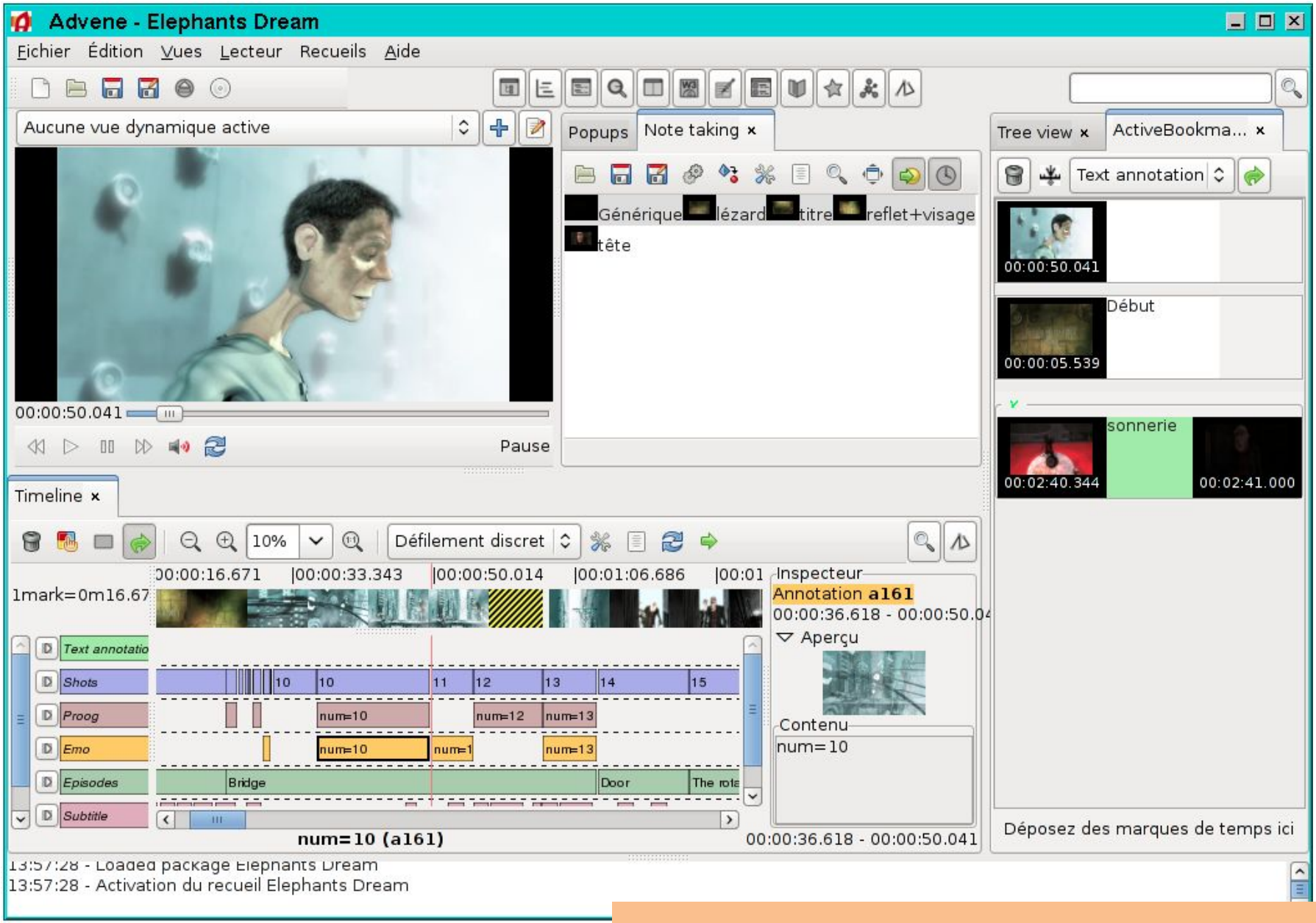
No scrolling
1mark=1m33.38s
00:09:20.300
00:10:53.684
00:12:27.067
00:14:00.451
00:15:33.834
Shot
Episode
Relay
End of the journey
Movie Part
test_zone
related shot
test_svg
Important
Panel
next panel
Actor
Supernatural
Nightmare
Inspector
Annotation a636
00:13:47.600 - 00:13:55.400
Screenshot
Contents
origin=The Book of the Vampires
originfr=Le Livre des Vampires
texte=The Book of the Vampires
textefr=Le Livre des Vampires
The Book of the Vampires (a636)
00:13:47.600 - 00:13:55.400
13:23:28 - Loaded package Nosferatu Demo
13:23:28 - Activating package Nosferatu Demo

Advene


Advene - Elephants Dream
Fichier Édition Vues Lecteur Recueils Aide
Aucune vue dynamique active
00:00:50.041
Pause
Popups
Note taking ×
Générique
lézard
titre
reflet+visage
tête
Tree view ×
ActiveBookma... ×
Text annotation
00:00:50.041
Début
00:00:05.539
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00:02:40.344
00:02:41.000
Timeline ×
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00:00:16.671
00:00:33.343
00:00:50.014
00:01:06.686
1mark=0m16.67
Text annotatio
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Episodes
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num=10
num=12
num=13
num=1
Bridge
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num=10 (a161)
Inspecteur
Annotation a161
00:00:36.618 - 00:00:50.04
Aperçu
Contenu
num=10
00:00:36.618 - 00:00:50.041
Déposez des marques de temps ici
13:57:28 - Activation du recueil Elephants Dream

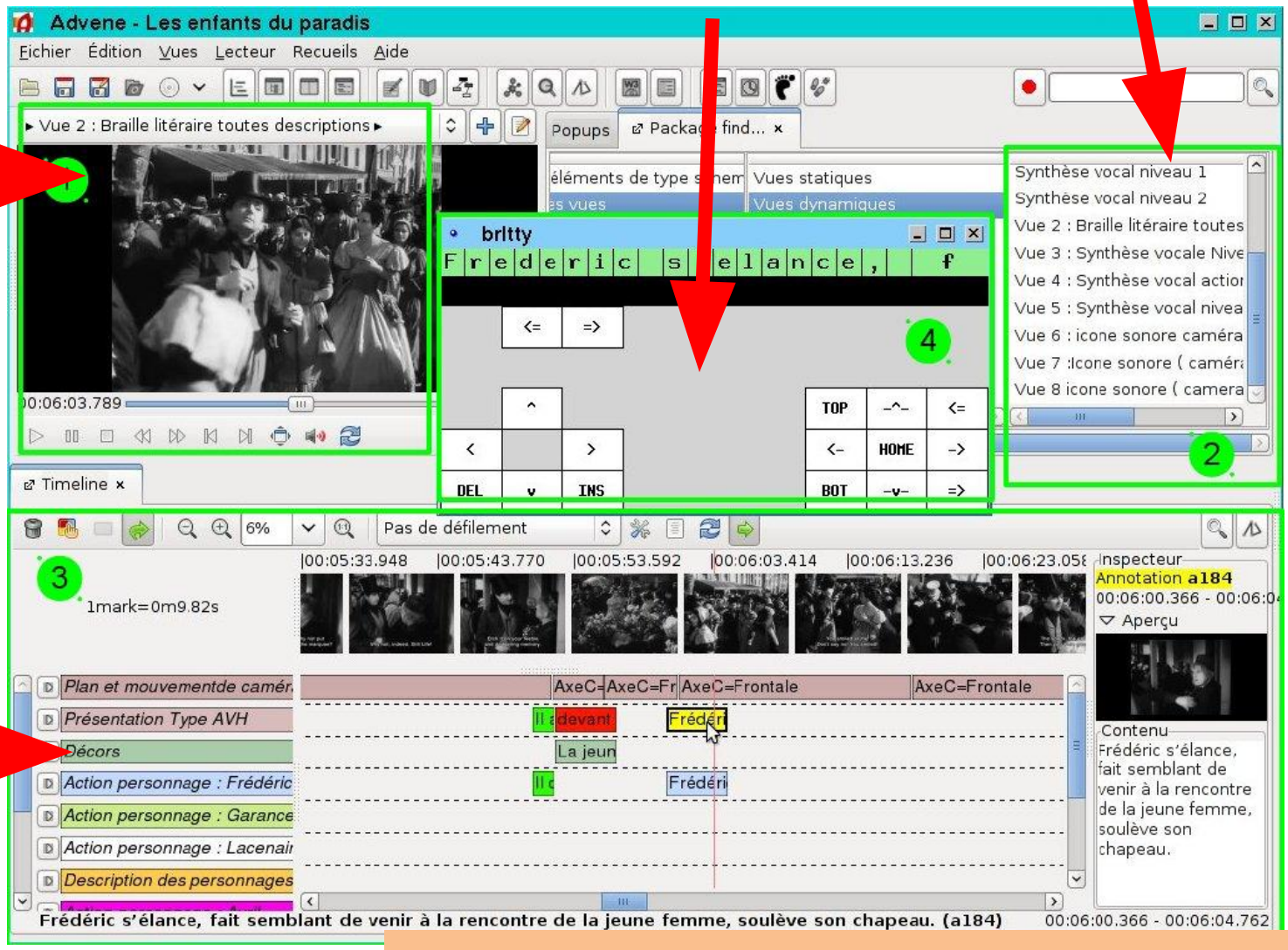
Advene

Braille emulation

Rendering views

Enriched Media Player

Timeline with typed annotations



Advene

Name: **VISU**

Author: Yannick Prié (et al.)

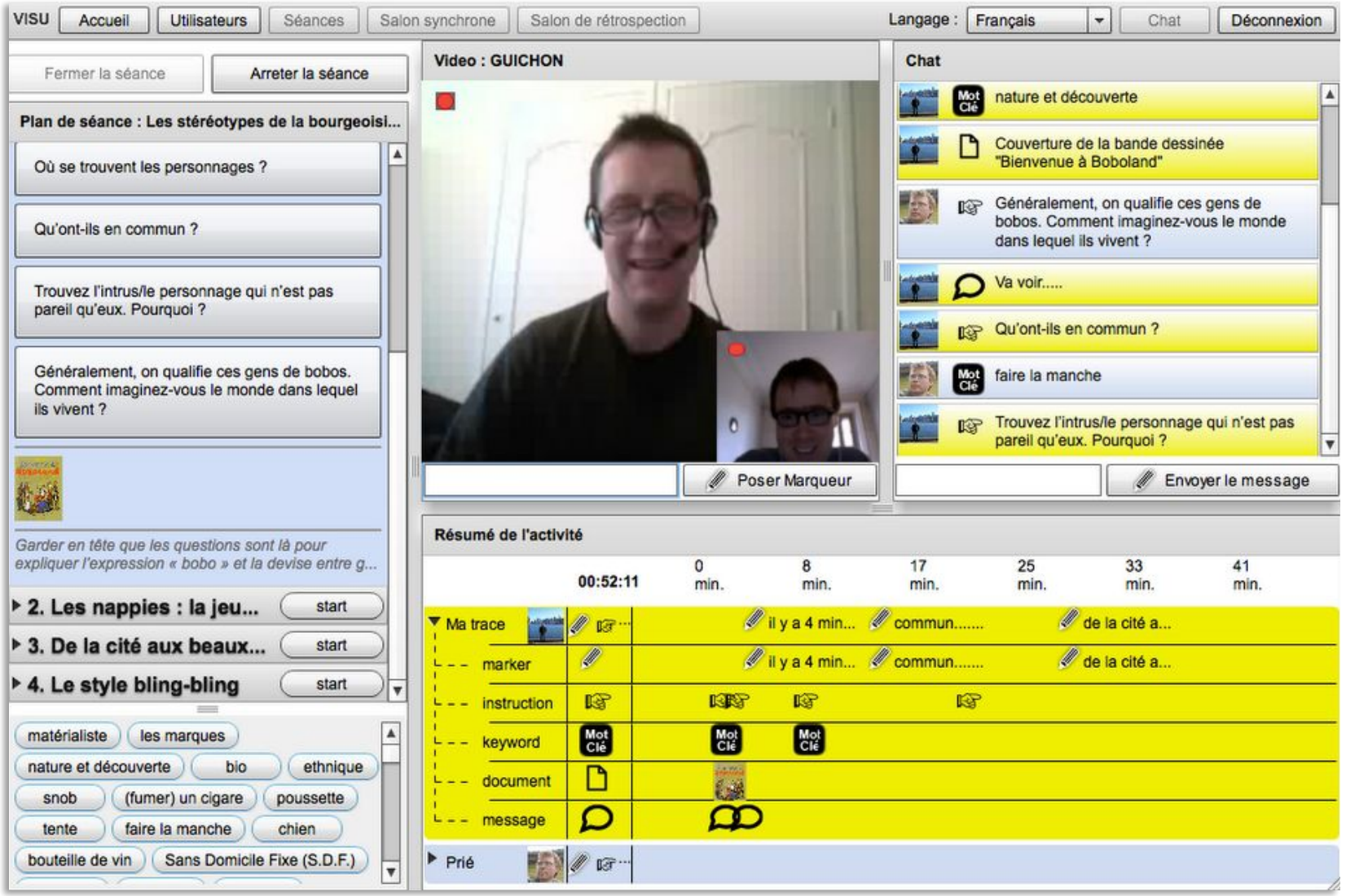
Project Type: ANR (Project ITHACA)

Date: 2008-2011

Collaborations: Lyon 1, Lyon 2, TECFA

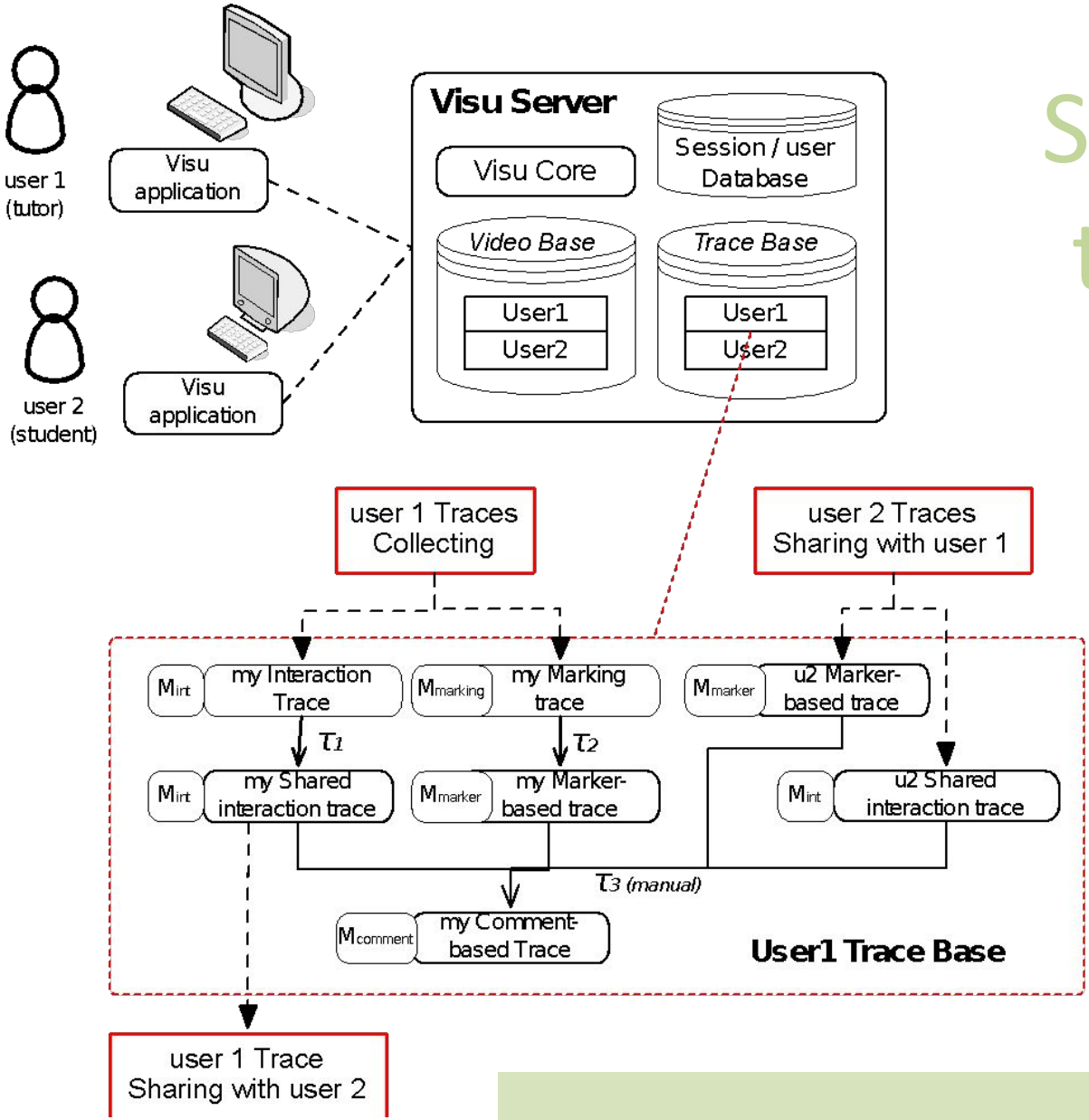
Research issues: Interactive Traces for Humain Awareness Collaborative Annotation Online tutoring tool

Websites: http://liris.cnrs.fr/ithaca/


VISU
Accueil
Utilisateurs
Séances
Salon synchrone
Salon de rétrospection
Langage :
Français
Chat
Déconnexion
Fermer la séance
Arreter la séance
Plan de séance : Les stéréotypes de la bourgeoisi...
Où se trouvent les personnages ?
Qu'ont-ils en commun ?
Trouvez l'intrus/le personnage qui n'est pas pareil qu'eux. Pourquoi ?
Généralement, on qualifie ces gens de bobos. Comment imaginez-vous le monde dans lequel ils vivent ?
Garder en tête que les questions sont là pour expliquer l'expression « bobo » et la devise entre g...
2. Les nappies : la jeu...
start
3. De la cité aux beaux...
start
4. Le style bling-bling
start
matérialiste
les marques
nature et découverte
bio
ethnique
snob
(fumer) un cigare
poussette
tente
faire la manche
chien
bouteille de vin
Sans Domicile Fixe (S.D.F.)
Video : GUICHON
Poser Marqueur
Chat
nature et découverte
Couverture de la bande dessinée "Bienvenue à Boboland"
Généralement, on qualifie ces gens de bobos. Comment imaginez-vous le monde dans lequel ils vivent ?
Va voir.....
Qu'ont-ils en commun ?
faire la manche
Trouvez l'intrus/le personnage qui n'est pas pareil qu'eux. Pourquoi ?
Envoyer le message
Résumé de l'activité
00:52:11
0 min.
8 min.
17 min.
25 min.
33 min.
41 min.
Ma trace
il y a 4 min...
commun.....
de la cité a...
marker
il y a 4 min...
commun.....
de la cité a...
instruction
keyword
document
message
Prié

VISU

Sharing traces



What's
Next?