

Università
della
Svizzera
italiana

Facoltà
di scienze
informatiche

Bachelor Project



Visualizing Scientific Contributions

Anja Guzzi

supervised by

Prof. Dr. Michele Lanza

Abstract

There is a lot of information about scientific publications and researches and Institutions in the field often want to know about their publications or the publications of their members. Searching for those information may result in much data, often organized in different ways, and this makes their understanding and comparison difficult. Making a visual tool, easy to use and with a nice graphics, it's for sure the key. IVORY provides this service at the address: <http://evo.inf.unisi.ch:8022/seaside/go/ivory>.

The goal of this project was to develop a framework for the visualization of scientific contributions by researchers. To get information about the publications of the researchers, we use DBLP¹ as information source.

With this project we exploit various means of visualization.

¹<http://dblp.uni-trier.de/>

Acknowledgments

Thanks to my parents, and to whom believe in me.

I would like to express my sincere gratitude to my supervisor, Professor Lanza, for his support through the development of IVORY and for his constructive comments.

And a special thanks Bea, to always be there for me ;-)

Contents

Abstract	i
Acknowledgments	ii
1 Introduction	1
1.1 Structure of the Document	2
2 Visualizing scientific contributions	3
2.1 Scientific contributions	3
2.2 DBLP	3
2.2.1 DBLP name	4
2.2.2 Publications	4
2.2.3 Coauthors	5
2.3 Motivation	5
3 IVORY	6
3.1 Data visualization	6
3.2 IVORY	7
3.3 Modeling strategy	8
4 IVORY at work	9
4.0.1 Interface	11
4.1 Visualizations	12
4.1.1 Parallel Visualization	12
4.1.2 Individual Visualization	14
4.1.3 Institution Visualization	17
5 Conclusions	21
5.1 Summary	21
5.2 Discussion	21
5.3 Future Work	21
A Implementation	23
B Technologies	26
B.1 Seaside	26
B.2 The Episode Framework	27
B.3 Scriptaculus	27

Chapter 1

Introduction

IVORY is a visualization tool, which takes information about scientific publications from an online database (DBLP¹) and visualize them.

The current data about contributions in the scientific field are often provided by different resources (online databases, personal web pages, university sites) and one need to browse many websites before being able to get an insight of how much a person has contributed. With this project we want to make information about scientific contributions accessible and understandable to all, but in particular to institutions and researchers in the field.

To achieve our goal, we elaborated a conceptual model of the framework behind the scientific contributions, where the researcher is the central object of interest. When exemplifying the model, we represent researchers with their size proportional to the quantity of publications he wrote, while relations between researchers are usually represented as lines between them.

We implemented three specific visualizations, which provide information such as the number of publications and the number of collaborations. The first view (the Parallel Visualization) displays researchers and their collaborators as a tree and allows to recursively and interactively inspect them (the visualization is updated every time a researcher is clicked). The Individual Visualization is the the second view that we propose and it focuses on a single researcher, showing graphs about publications and collaborations over the years. In addition to those two views, which consider researchers as a single entity, we offer the Institution Visualization. This third view aims to show a pool of researchers and to display the relationships (collaborations) among them. Researchers objects are interactive: they can be clicked and viewed in the different proposed visualization.

IVORY, written in Smalltalk, is build on top of the Seaside framework and benefit of an early version of The Episode Framework to generate SVG objects.

IVORY is available here: <http://evo.inf.unisi.ch:8022/seaside/go/ivory>.

¹<http://dblp.uni-trier.de/>

1.1 Structure of the Document

In this document we present IVORY, a tool to visualize scientific contributions.

In Chapter 2 we focus on describing one among all of the current possibility to browse scientific publications (which is DBLP, an online database of scientific contributions) and we motivate our project.

In Chapter 3 we introduce the topic of visualization and we explain the concepts behind IVORY and the modeling strategy used.

In Chapter 4 we go into deep on the proposed visualization tool, showing and explaining in details each of the three visualization implemented. In this section we also present the applications of the visualizing tool with also some screenshots of IVORY.

In Chapter 5 we discuss the advantages and the limits of IVORY and we propose some possible future work.

The Appendix section contains details on the implementation and on some technologies used to develop IVORY.

Chapter 2

Visualizing scientific contributions

2.1 Scientific contributions

Scientific contributions by a researcher may be browsed not only to obtain their titles, but also (most of the times) to get a feeling of how much did he contribute to the scientific field with his publications. The institutions (universities, research groups, etc.) need to know about the publications of their members or of any applicant: again, publications gives a insight of how much a person has already contributed.

To get those information about the publications by a researcher, there are various ways: for example browsing his/her own page looking for this information or looking up for the researcher on DBLP (an online database).

2.2 DBLP

In order to get information about scientific contributions, we decided to refer to DBLP¹ (<http://dblp.uni-trier.de/>) as information source to get data about publications.

The DBLP server provides bibliographic information on major computer science journals and proceedings. Initially the server was focused on DataBase systems and Logic Programming (DBLP), now it is gradually being expanded toward other fields of computer science. You may now read "DBLP" as "Digital Bibliography & Library Project".

The server indexes more than 870000² articles and contains several thousand links to home pages of computer scientists (April 2007).

(From the DBLP welcome page.)

A researcher's DBLP page contains information about the publications he wrote and the people who collaborated with him. From a DBLP page some more information can be extracted, such as the trend of his publications and collaborations over the years.

¹DBLP is currently maintained by Michael Ley: <http://www.informatik.uni-trier.de/~ley/addr.html>

²More than 900'000 article in June 2007.

Figure 2.1 is an example of DBLP page, where we describe its structure with the information it provides:

The screenshot shows a web browser window displaying the DBLP profile for Mircea Lungu. The URL is `http://www.informatik.uni-trier.de/~ley/db/indices/a-tree/Lungu.Mircea.html`. The page content includes:

- Full name:** Mircea Lungu
- Unique identifier:** Lungu.Mircea.html
- Publications:** A list of publications from 2006 and 2005.

2006	
4	EE Mircea Lungu, Michele Lanza, Tudor Girba: Package Patterns for Visual Architecture Recovery. <i>CSMR 2006</i> : 185-196
3	EE Mircea Lungu, Michele Lanza: Softwareaut: Exploring Hierarchical System Decompositions. <i>CSMR 2006</i> : 351-354
2	EE Marco D'Ambros, Michele Lanza, Mircea Lungu: The evolution radar: visualizing integrated logical coupling information. <i>MSR 2006</i> : 26-32
2005	
1	Mircea Lungu, Adrian Kuhn, Tudor Girba, Michele Lanza: Interactive Exploration of Semantic Clusters. <i>VISSOFT 2005</i> : 95-100
- Coauthors:** A table listing coauthors and their number of publications.

Rank	Coauthor	Count
1	Marco D'Ambros	[2]
2	Tudor Girba	[1] [4]
3	Adrian Kuhn	[1]
4	Michele Lanza	[1] [2] [3] [4]

Figure 2.1: DBLP example page

Each researcher has a unique identifier (for simplicity called “DBLP name”), a list of publications and a list of coauthors. Every time a researcher is mentioned through a DBLP page, it is linked to its own publication’s page (if he has one).

2.2.1 DBLP name

The “DBLP name” uniquely identifies each researcher. Each researcher must have his own page even when more researchers have the same first and last name, thus this special name is used to retrieve the page, as opposite to the researcher’s full name.

2.2.2 Publications

The publications are the most important part of a researcher’s DBLP page: they summarize all the researches’ contributions in one table, where the publications are separated by year. Each publication line contains some basic information, such as authors, title and venue.

We show here, in Figure 2.2 the main parts which make up a DBLP publication:

ID	Authors	Year	Type	Title	Venue
4	Mircea Lungu, Michele Lanza, Tudor Gîrba	2006	EE	Package Patterns for Visual Architecture Recovery.	CSMR 2006: 185-196
3	Mircea Lungu, Michele Lanza	2006	EE	Softwareaut: Exploring Hierarchical System Decompositions.	CSMR 2006: 351-354
2	Marco D'Ambros, Michele Lanza, Mircea Lungu	2006	EE	The evolution radar: visualizing integrated logical coupling information.	MSR 2006: 26-32
1	Mircea Lungu, Adrian Kuhn, Tudor Gîrba, Michele Lanza	2005	EE	Interactive Exploration of Semantic Clusters	VISSOFT 2005: 95-100

Figure 2.2: publications in details

As shown in the figure, each publication has five main elements: a type, a list of authors, the title, the reference to the related conference or journal, and an id, which is used for the references to the publications within the page (and not in the whole system). The various authors can be clicked to browse their own DBLP page. By clicking on the reference (conference or journal) more information about it, and some time the whole publication, can be obtained.

2.2.3 Coauthors

At the bottom of each DBLP page there is a table (Figure 2.3) with all the collaborators of the researcher, with the indication of which publications they co-wrote.

Coauthor Index	
1	Marco D'Ambros [2]
2	Tudor Gîrba [1] [4]
3	Adrian Kuhn [1]
4	Michele Lanza [1] [2] [3] [4]

Figure 2.3: publications in details

As in the publication table, all the researchers which have a DBLP page can be clicked. In the co-authors table, each researcher's name correspond to a set of IDs, which is the set of all the publications in common by the page's researcher and the co-author. The IDs refers to the list of publications.

2.3 Motivation

Considering what DBLP provides, we wanted to make this information more understandable and accessible.

The project aims to provide an online tool for the visualization of the data retrieved from a DBLP page, in particular statistical information on the number of publications and collaborations and relationship among researchers.

Chapter 3

IVORY

3.1 Data visualization

Visualization is any technique for creating images, diagrams, or animations to communicate a message. Visualization through visual imagery has been an effective way to communicate both abstract and concrete ideas since the dawn of man.¹

Visualizations are world-wide used: maps are drawn to explain roads, postcards with pictures are sent, graphs are drawn to present results, etc.

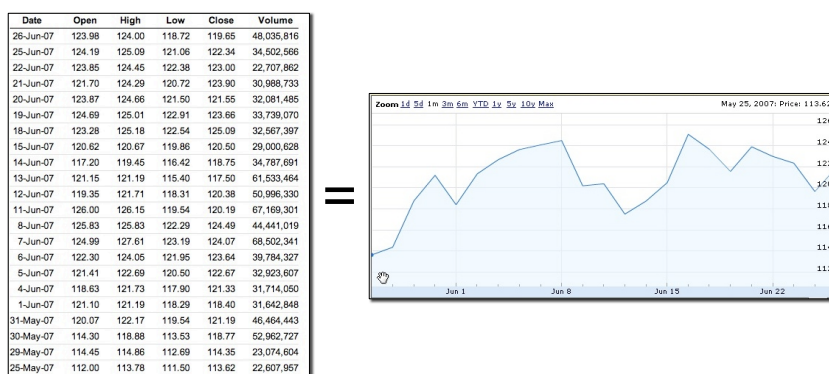


Figure 3.1: APPL - Apple Inc. 's stock market prices over the last month

Figure 3.1 shows an example of data visualization². On the left there is a table full of data, which through visualization, translates into the graph to the left, which can be read and interpreted easily.

The goal of data visualization is to present information in a visual way. Visualization is particularly useful when there is a lot of data and when the visualization shows the data in a particular and organized way, which allows to stress facts and facilitates considerations about the data. The power of visualization is that it scales on the number and type of information: the data to visualize can potentially be a huge set, and can even be abstract.

¹From Wikipedia: http://en.wikipedia.org/wiki/Visualization_%28graphic%29

²information and pictures taken from Google Finance: <http://finance.google.com/finance?q=AAPL> on June 28, 2007.

IVORY is written in VisualWorks Smalltalk³ and it is build on top of the Seaside⁴ framework, extended with the Episode⁵ framework, which allows to generate SVG objects. It also uses some functionalities (such as drag-and-drop) of the Scripta.culo.us⁶ library.

The technologies used to implement IVORY (primarily SVG) are not supported by all the browsers. Episode has been used and tested on Firefox (2.*), Opera (9.*) and Safari (3.*) during its development, but among those only Opera manages to be fast enough to be usable. This reflect on the usability of IVORY, which we grant to work only on Opera version 9 or above.

Please refer to the appendix for more details on the implementation and the used technologies.

3.3 Modeling strategy

The conceptual model behind IVORY naturally comes from the structure of the DBLP page. We identify the following agents: the researcher, the DBLP page, the publication; moreover we need a parser to extract the information from a page and an agent (Ivory), which has the responsibility to handle the parser and to fill a researcher object with the data from the corresponding DBLP page.

Figure 3.3 shows IVORY's simplified UML class diagram:

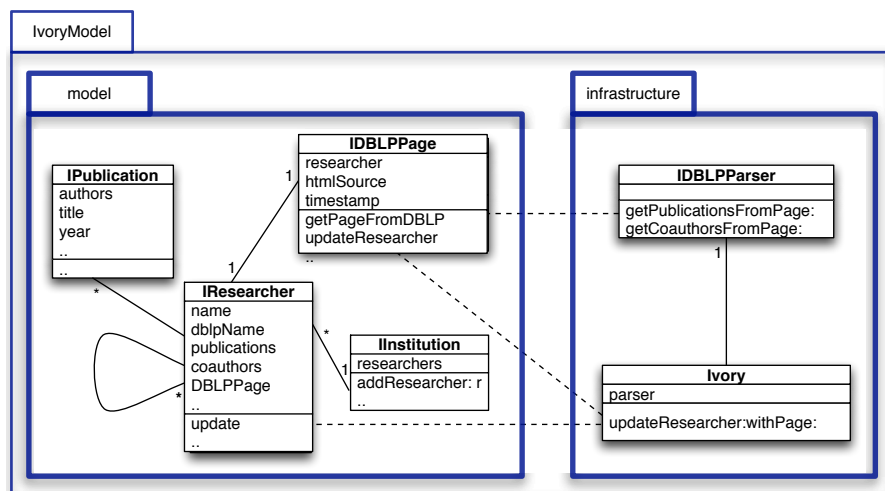


Figure 3.3: IVORY's model simplified UML class diagram

³<http://www.cincomsmalltalk.com/>

⁴<http://seaside.st/>

⁵The Episode Framework is a project by Marco Primi

⁶<http://script.aculo.us/>

Chapter 4

IVORY at work

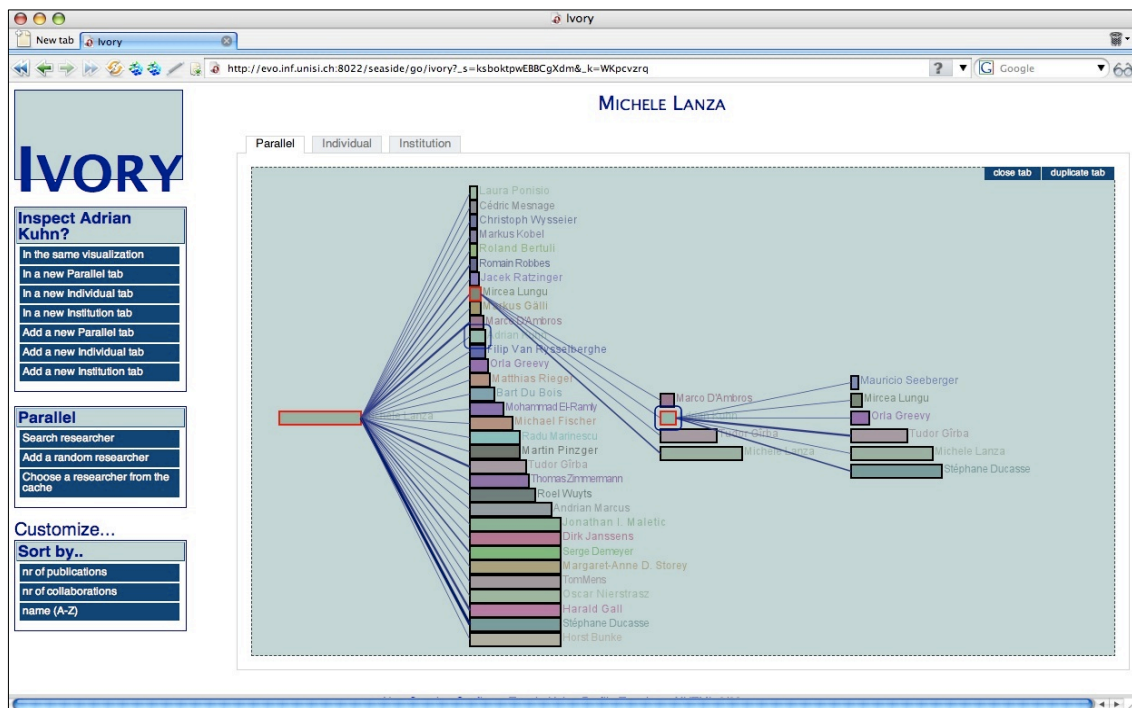


Figure 4.1: IVORY

IVORY is online at the address: <http://evo.inf.unisi.ch:8022/seaside/go/ivory>.

IVORY (Figure 4.1) mainly provides information about collaborations and number of publications, while it does not supply rendering of publications' title, references, etc.. We decided to concentrate on the collaborations and publications numbers, because we want to focus on concepts and "numerical" information that can be mapped to a visualization, rather than being a "publications browser".

We think that using IVORY one can get a good insight on collaborations and publications by researchers. Our program gives information with clean visualizations and an easy navigable interface. Moreover the application is highly interactive, since allows it the users to navigate through the various views.

The main agent of the program is the researcher, which is represented as a rectangle with the researcher's name to the right. Figure 4.2 shows the researchers of the the faculty of informatics¹ of the University of Lugano² as example.



Figure 4.2: USI's researchers example

The metric mapped on a researcher is the length of the bar, which is proportional to the total number of publications written by the researcher. Some times, for the sake of knowing the real value, the number of the publications is written in gray to the left of the researcher's representation.

Each researcher has a color, which is derived with a function on its name, thus it is "personal". The color is used to distinguish the various researcher and to visually map them to other elements which refers to them.

Collaborations are drawn as lines, where the color and the thickness of the line is proportional (based on some thresholds) to the number of collaborations between the two representations of the researchers.

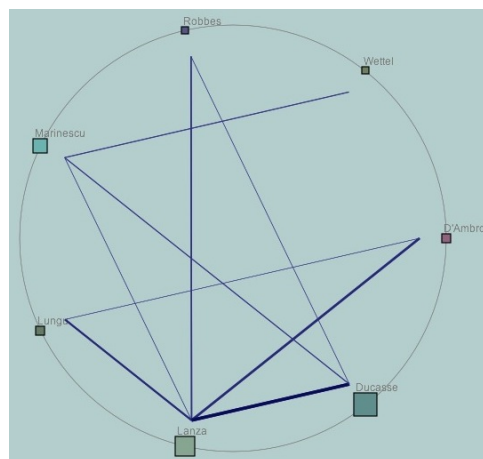


Figure 4.3: collaboration lines example

Figure 4.3 shows an example of lines drawn between some researchers.

¹<http://www.inf.unisi.ch/>

²<http://www.unisi.ch/en/>

An important concept behind IVORY is **inspecting**. Each researcher can be inspected, which could be translated as *visualize his information according to the chosen visualization type*. To inspect someone the user needs to select (by clicking on or searching) the wanted researcher, and then choose one of the visualization options provided by the program.

IVORY provides three main visualizations, which we will explain in detail in Section 4.1. The different views are: *Parallel Visualization*, *Individual Visualization* and *Institution Visualization*. Each one of those has a different purpose. The Parallel Visualization focus on the collaborations of a researcher allowing to navigate through them, the Individual Visualization shows the details of a single researcher, while the Institution Visualization allows one to view and compare a pool of chosen researchers.

4.0.1 Interface

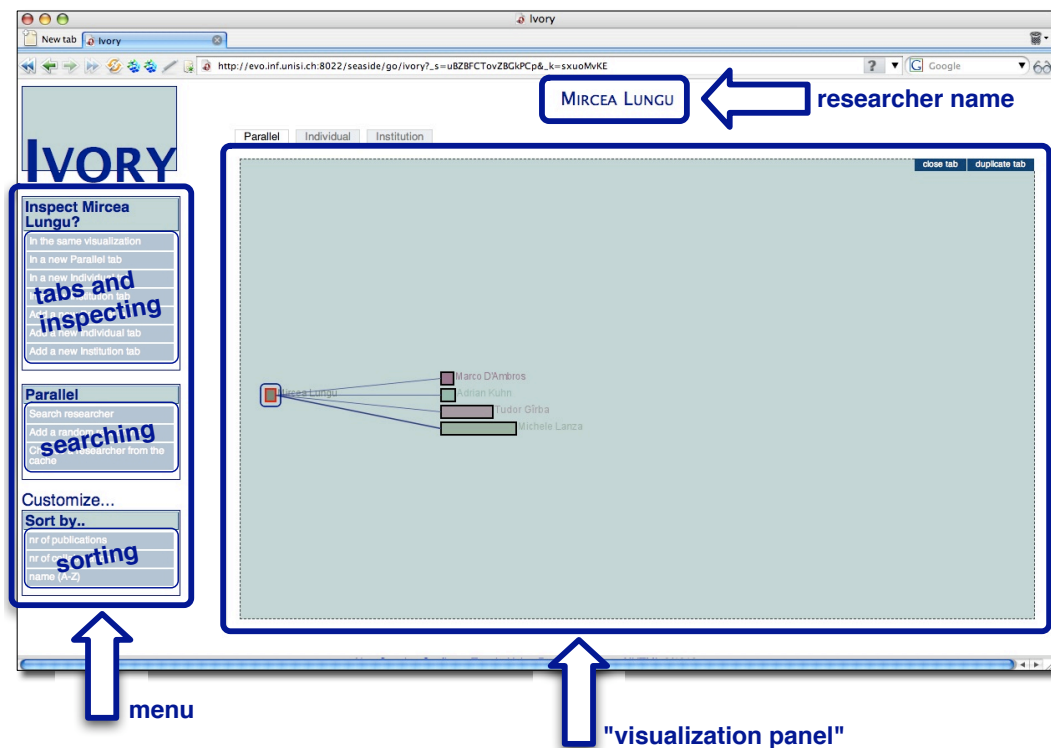


Figure 4.4: IVORY's interface explained

IVORY wants to be as simple as possible, because we think that a simple interface allows the user to understand it better and use the program with ease.

IVORY's interface consist of a single web page with two main elements: a "visualization panel" and a menu (Figure 4.4). At the top of the page there is written the name of the searched researcher or of the visualized institution (if any).

The menu is divided in three parts: one responsible for the tabs, where a user can add new tabs or chose where to inspect the selected researcher; one specific for each of the the visualization options, but where the searching facility is always provided; and the last one, which allows the user to choose the researchers' sorting policy (by number of publications, by number of collaborations or alphabetical order).

A user can not only perform a common search (writing the wanted researcher's name into a text field), but he can also choose to browse the program's cache or to let IVORY randomly choose a researcher for him.

When a researchers representation is clicked, the name of the researcher appears in the top part of the menu, where the user can chose to eventually inspect him in the visualization he wants.

The "visualization panel" part has tabs, where each tab correspond to a visualization. Using tabs, multiple search/inspection can be performed without loosing any previous view. Adding a tab to search a new researcher or inspecting the currently selected researcher in a new tab is just as easy as a click. And when a view is no more needed, in the top right corner of every visualization panel there always is the option to close the corresponding tab. A maximum of 10 tabs can be opened at a time.

4.1 Visualizations

4.1.1 Parallel Visualization

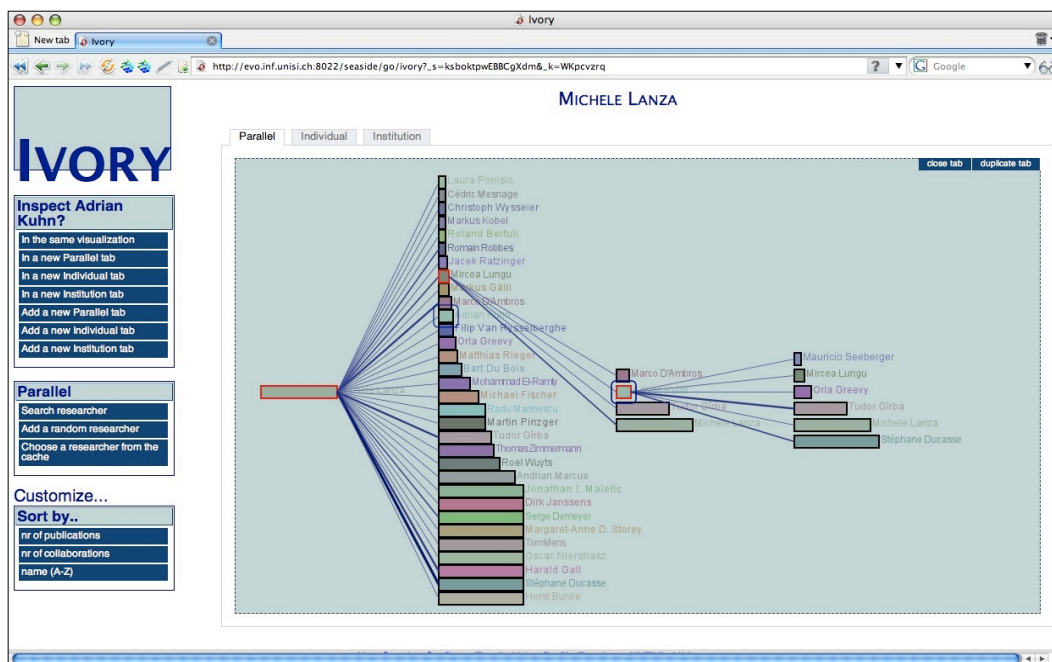


Figure 4.5: Parallel visualization

The Parallel Visualization (see figure Figure 4.5) aims to visualize researchers and their collaborators. The researchers are rendered as a tree, allowing an easy and recursive inspection from a researcher to another.

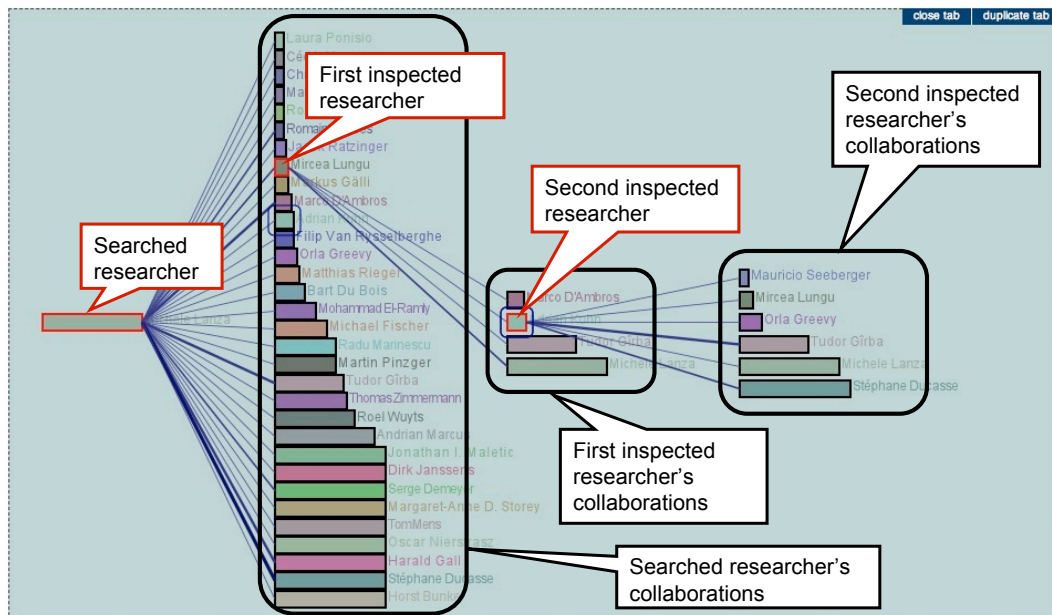


Figure 4.6: Parallel visualization with details

Figure 4.6 shows an example of this visualization, where *Michele Lanza* was added as first researcher, and then one of his collaborators (labeled as “first inspected researcher”) was clicked, thus his collaborators are shown, then a second researcher was clicked (labeled as “first inspected researcher”) and his collaborations show up. The inspected researchers have a red border, while all the representation of the last clicked researcher have a blue frame around.

The researchers can not only be inspected by clicking a collaborator in the right-most column, but they can be browsed as the user likes. To give an example, assume that a researcher is applying for a position. To be accepted he needs to present his CV, where all his publications are mentioned. The problem is that he is not known to the group’s members and so are most of the people he collaborated with. IVORY’s parallel visualization allows to search for the applying researcher and to browse all the people he collaborated with by just clicking them. First of all the group can immediately have a general idea of with how many people he collaborated with, secondly the collaborators can be ordered according to the number of publications they wrote (to get a feeling on the average number of publications per coauthor) or according the number of collaborations they had (to get a feeling on which ones he wrote most publications with). With a few clicks the user gets a feeling about the researcher’s contributions. Coauthors can also be inspected one at a time.

4.1.2 Individual Visualization

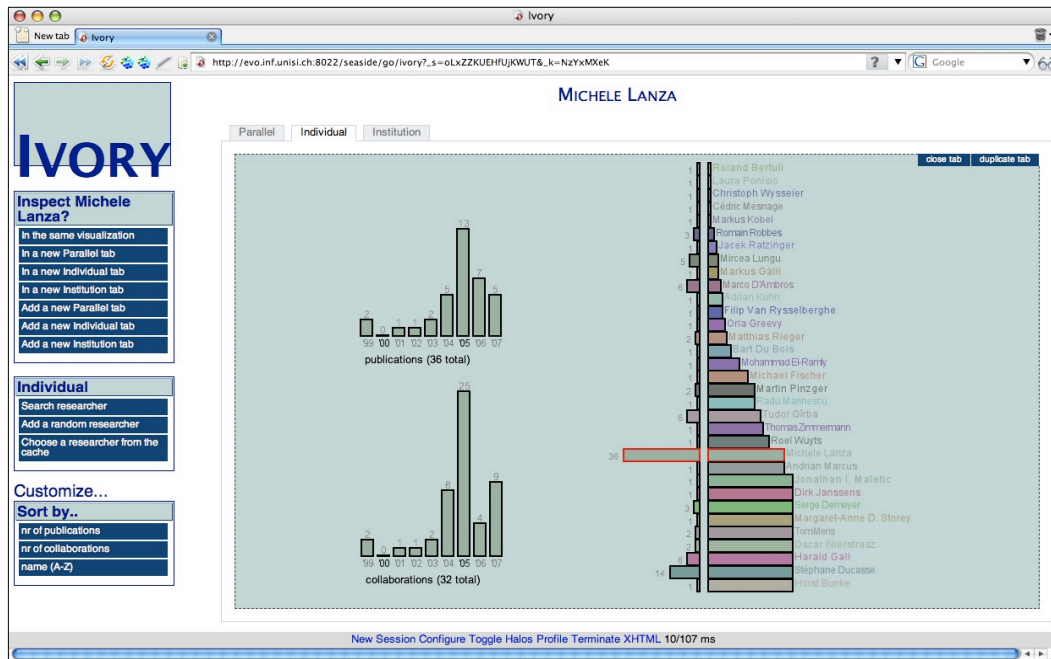


Figure 4.7: Individual Visualization

The Individual Visualization (so called because it focus on a single researcher) aims to visualize the trend of a researcher's publications and collaborations (see Figure 4.7).

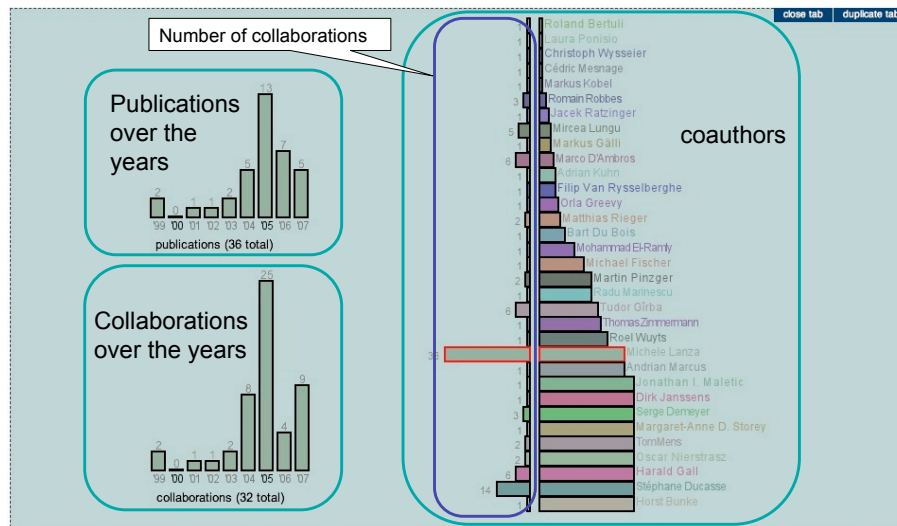


Figure 4.8: Individual visualization with details

This visualization has three main parts (see Figure 4.8). On the left side there are two histograms: on top the one which shows the number of publications over the years and on the bottom the one which shows the number of collaborations over the years.

To the right side, there is an enhanced collaborations view, which has itself two parts: on the right there is the list of researchers, always ordered according to one of the sorting policies, and on the left there is a bar which grows to the left in proportion to the number of collaboration the coauthor had with the researcher inspected in that page.

This visualization provide a feeling (and numbers) about the researcher’s activity during his career. Using the traditional DBLP Page, the user have to scroll the whole publication’s table, counting and remembering the publications in every year. This can be a bit tedious for researchers that have lots of contributions. IVORY’s Individual Visualization immediately shows the graphs and the only thing that the used has to do is looking at it and taking his considerations.

Researcher’s publications trends can be of various type, also depending on the stage of his researches: jung researchers tend to have a growing like graph, some more “mature” researchers usually have a long graph with some publications at the beginning, then often period of inactivity (could be because of teaching years) and in the more recent second half with some diminishing at the very last years. In general in most of the researcher’s publications’ histogram can be recognized some blocks of years, often gaussian bell shaped. Researcher’s collaborations graph often reflects the publication’s one, but some time it reveals interesting curiosities. Figure 4.9 shows some examples of publications and collaborations histograms.

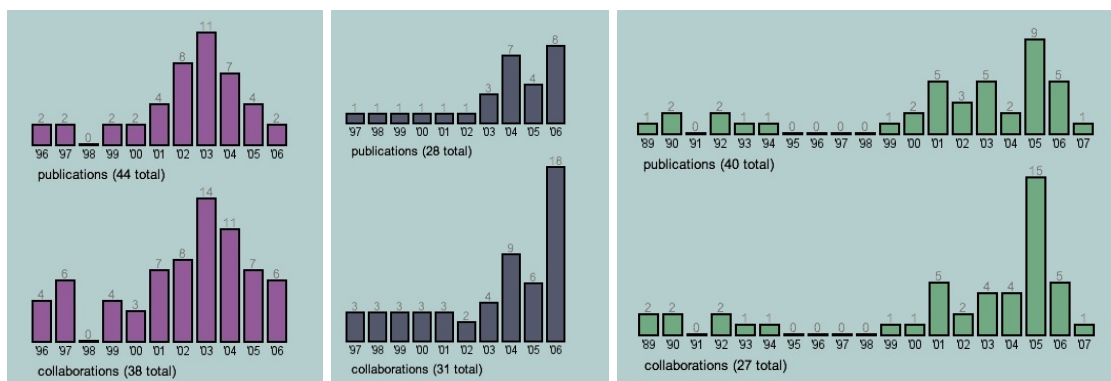


Figure 4.9: some publications and collaborations histograms

Details about the publications (or collaborations) during a particular year, can be seen by clicking the corresponding histogram’s bar.

The detailed publications view (Figure 4.10 on the left) shows all the publications in the year. Publications are represented as a boxes, each one containing the list of its authors (if they can fit in the space at disposal). On the left of every box there is the title of the publication. This is the only case in which the title of the publications are shown. We decided to do this to make the detailed view more clear and complete. The detailed collaborations view (on the right side of Figure 4.10) shows the list of all the people a researcher collaborated with. Each researcher representation is hight proportional to the number of collaborations during that year.

Each researcher's representation can be clicked: when this happens, in addition to the possibility to inspect the selected researcher, a frame is shown around all the representations of that researcher, emphasizing him among the other collaborators.

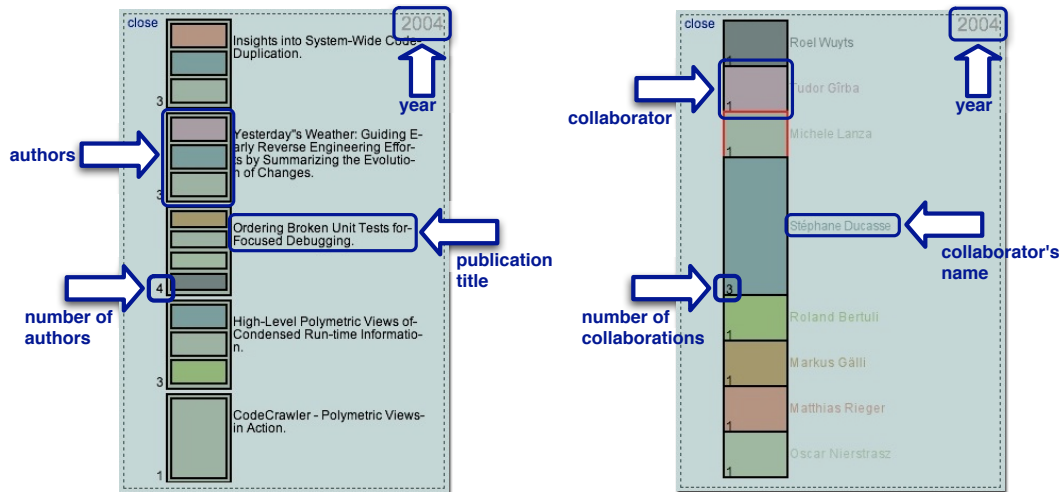


Figure 4.10: example of detailed publications and collaborations in a year

Both detailed collaborations and publications views can be opened at the same time, as Figure 4.11 shows.

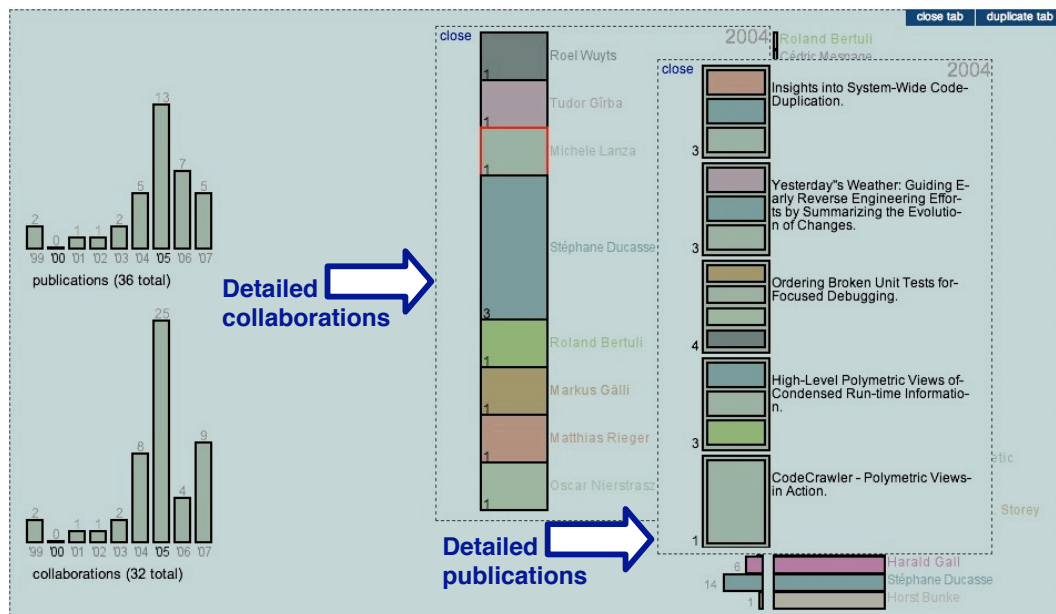


Figure 4.11: Michele Lanza's detailed publications and collaborations in 2004

4.1.3 Institution Visualization

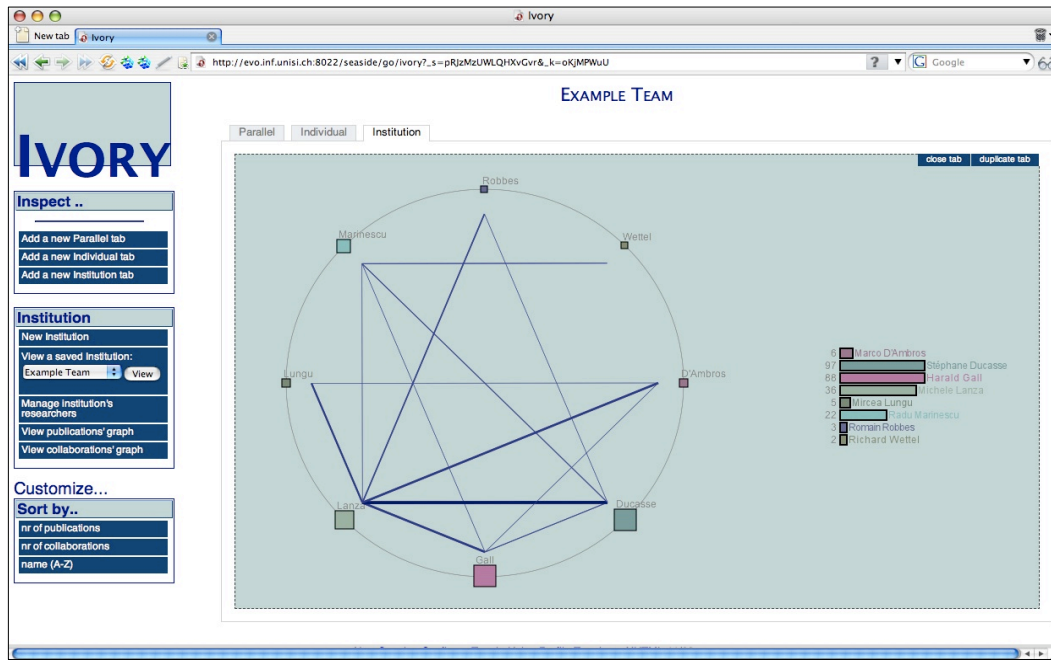


Figure 4.12: Institution Visualization

The Institution Visualization aims to visualize publications and collaborations between all the researchers pertaining to a group (see Figure 4.12). In this visualization the user can switch between three “modalities”: one consist in the composition and management of the institution, while the other two are visualizations (one focusing on the publications and one on the collaborations). We also provide some predefined institutions (such as the *Iene Team* and the *USI*, see Figure 4.15).

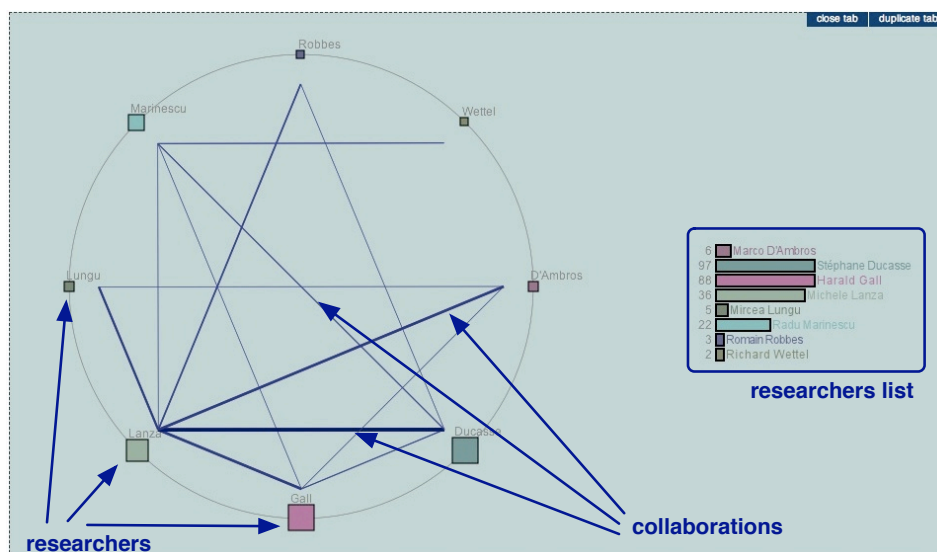


Figure 4.13: Institution collaborations view with details

The visualization in Figure 4.13 focuses on the collaborations. Researchers are represented as a square on the perimeter of a circle and lines between every pair of researchers that collaborated with each other are drawn. As it can be seen the squares are of different size and color (according to the researcher's number of publications), and also the lines have a different width (which is proportional to the number of publications they did together). This view can be displayed by clicking on the "View collaborations graph" link in the middle part of the menu.

The visualization in Figure 4.14 focuses on the publications, showing histograms for every year. Bars represent the researchers, which can be distinguished by their color. The height of each bar is given by the number of publications during that year. By default the most recent years are shown, but the user can select the starting year and if there are more histograms than the one that can fit the screen, a "previous year" and "next year" button will appear to allow the navigation through the graphs. The year of the first and the last histograms are given by the first, respectively the last, year in which any of the researchers has published at least a contribution. This view can be displayed by clicking on the "View publications graph" link in the middle part of the menu. Researchers still interactive, meaning that they can be clicked and inspected.

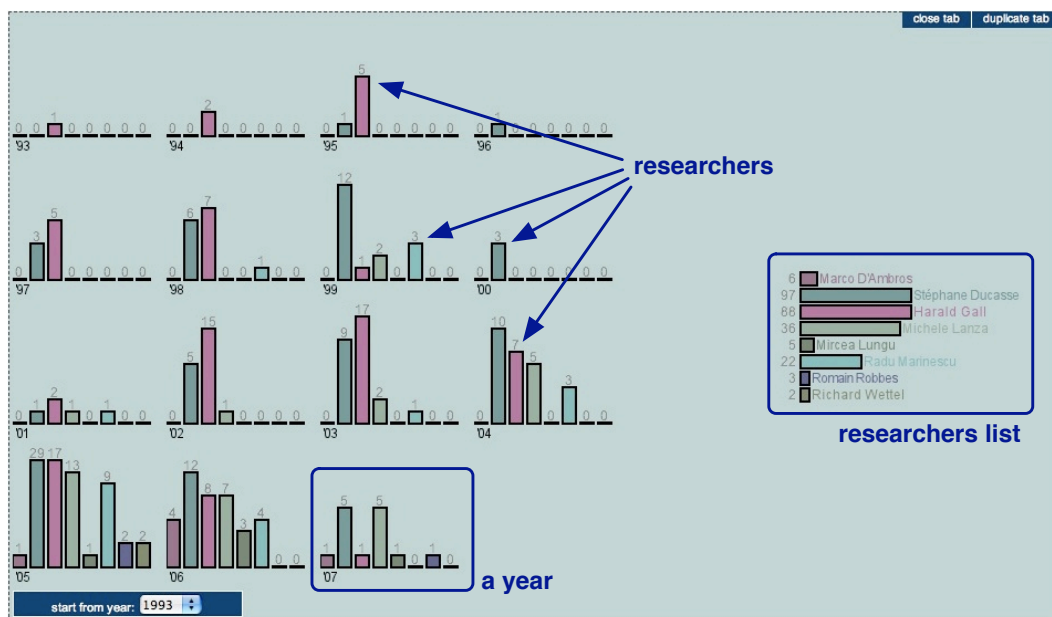


Figure 4.14: Institution publications view with details

Moreover, if the user click on a researcher in the list always present on the right side, a frame will appear around all his corresponding bars in all the histograms: this can help to keep track of a researcher in the graphs, especially if there are many researchers with similar colors.

By clicking the link "manage institutions' researchers" we give to the user the possibility add or remove researchers. To add a researcher is enough to search him in the cache or by typing the name in the apposite field, while to delete it the user need to select it (by clicking on the researcher object) and click the "remove" link that will appear. Institution can also be saved to view them later on.

The Institution Visualization shows how many researchers of a group are related among them. We choose these two simple examples to show how the institution collaborations visualization provided by IVORY allows to visualize dynamics of collaboration between researchers.

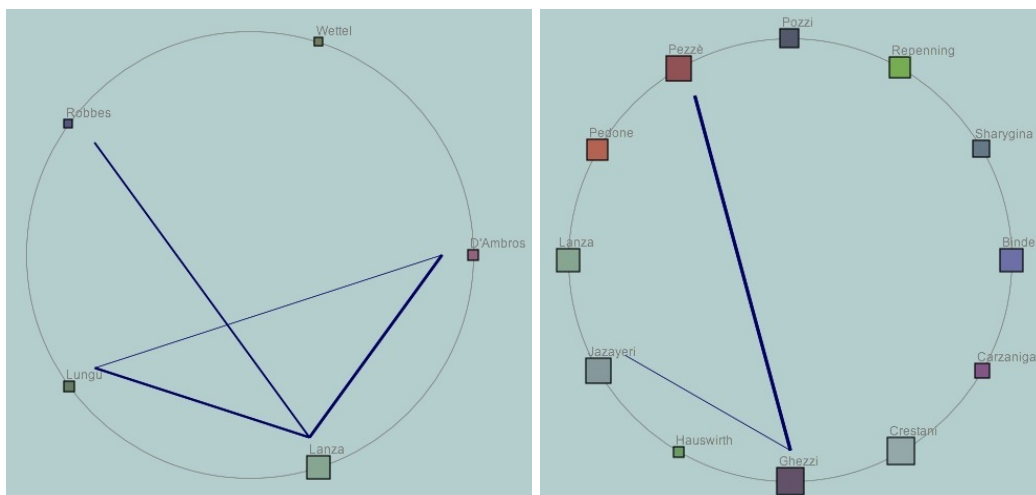


Figure 4.15: Iene and USI collaborations graphs

Figure 4.15 shows the collaborations graph of two institution: the Iene team³ and the faculty of informatics at the University of Lugano.

The Iene team is shown in the left of Figure 4.15: on the bottom there is a researcher with more publications than the others, which collaborates with almost all the other people on the circle. This researcher is the team leader. Among the researcher there is a person, who does not have collaborations: he is the last entry in the team.

On the right side of figure 4.15 there is the collaborations graph of the faculty of informatics of the University of Lugano. From this view, we can see that the researchers in Lugano does not collaborate among them: this because they are in different fields.

An interesting application is inspecting a researcher using this view: IVORY will automatically build an institution composed by all the coauthors of the inspected researcher. Figure 4.16 shows an example of this application. We inspected *Laura Pozzi* in the institution visualization and the figures show the collaboration graph. We can see that the researchers all did collaborate among them: that is because they are all in the same field. The second example of this application can be seen in Figure 4.17: we inspected *Michele Lanza* and we sorted the researchers according to the number of collaborations among them. It can be seen that among Lanza's collaborations there are some researcher with quite a number of publication, which did contribute a lot with publications. In the view where researchers are sorted according to the collaborations among them, we can notice that on the bottom of the picture there is a "big" researcher (with lots of publications), which did not collaborate with the other Lanza's co-authors. A possible meaning could be that his area of researcher is slightly different.

³A research group composed by *Michele Lanza* and four PhD students: Mircea Lungu, Marco D'Ambros, Romain Robbes and Richard Wettel.

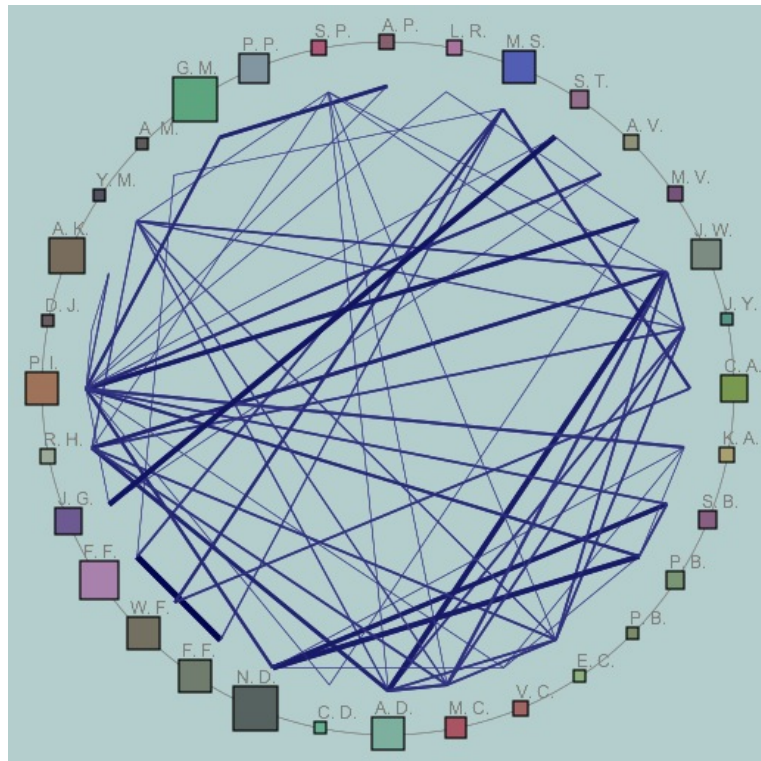


Figure 4.16: *Laura Pozzi's collaborations graph*

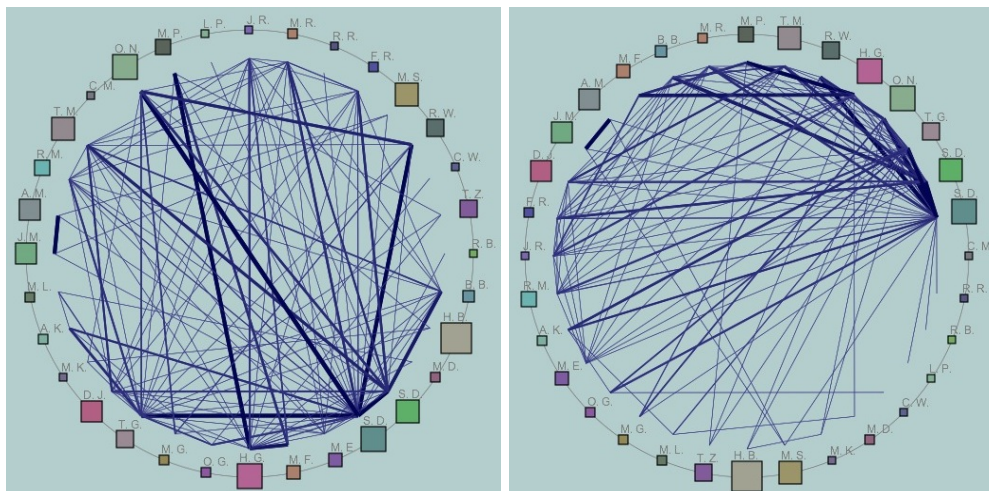


Figure 4.17: *Michele Lanza's collaborations graphs*

Chapter 5

Conclusions

5.1 Summary

We developed IVORY to visualize information about scientific publications. Our tool aim to shows informations about quantities of publications and collaborations. We developed three main view, each one is dedicated to a different visualization of this type of informations. There is a *Parallel Visualization*, which stress the aspect of collaborations between co-authors; there is the *Individual Visualization*, which shows the trend of publications and collaborations over the years for a single researcher. The third view is the *Institution Visualization*, which allows to compare the number of publications and to see collaborations among a pool of researchers.

5.2 Discussion

We think IVORY really gives an insight of how much the searched and inspected researchers contributed in the scientific field, however when there is a large set of collaborations (bigger than 50/60 collaborators) the view becomes a bit unwieldy.

5.3 Future Work

IVORY can both improved and extended.

Here we list some improvement that be made:

- vertical scrolling to allow a better view of the list of collaborations;
- display of the researcher name as tooltip;
- show a “progress bar” when IVORY is fetching pages from DBLP;
- add more options to customize the views, such as the possibility to choose the policy adopted for the size of the researchers or the coloring adopted for the researchers;
- allow the user to choose the size of the view, to better fit to his screen.

We want to present here a fourth visualization type as possible extension: the *Space Visualization*.

The goal of this visualization is to present researchers and their collaborators organized in a different way. While the *Parallel Visualization* shows those informations as a 2D tree, the *Space Visualization* would show them giving the idea to be in a 3D space.

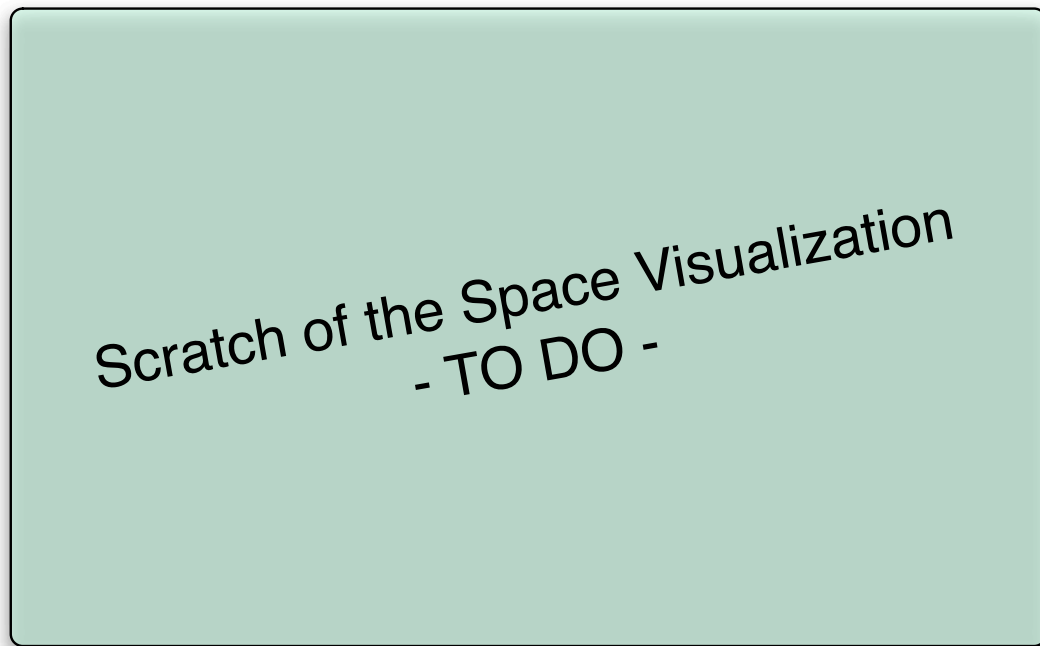


Figure 5.1: A scratch of the proposed *Space Visualization*

Figure 5.1 exemplifies this visualization type. Researchers are represented as spheres, and collaborations are drawn among them. When a researcher is clicked, it moves to the center of the scene, and the view arranges the other researchers to make space for his collaborators.

A main difference between this view and the *Parallel* one is that in this view researchers are unique, meaning that they are displayed only once on the screen.

Appendix A

Implementation

In a simplified UML class diagram (see Figure A.1) we show the relations between the web interface of IVORY and the used frameworks:

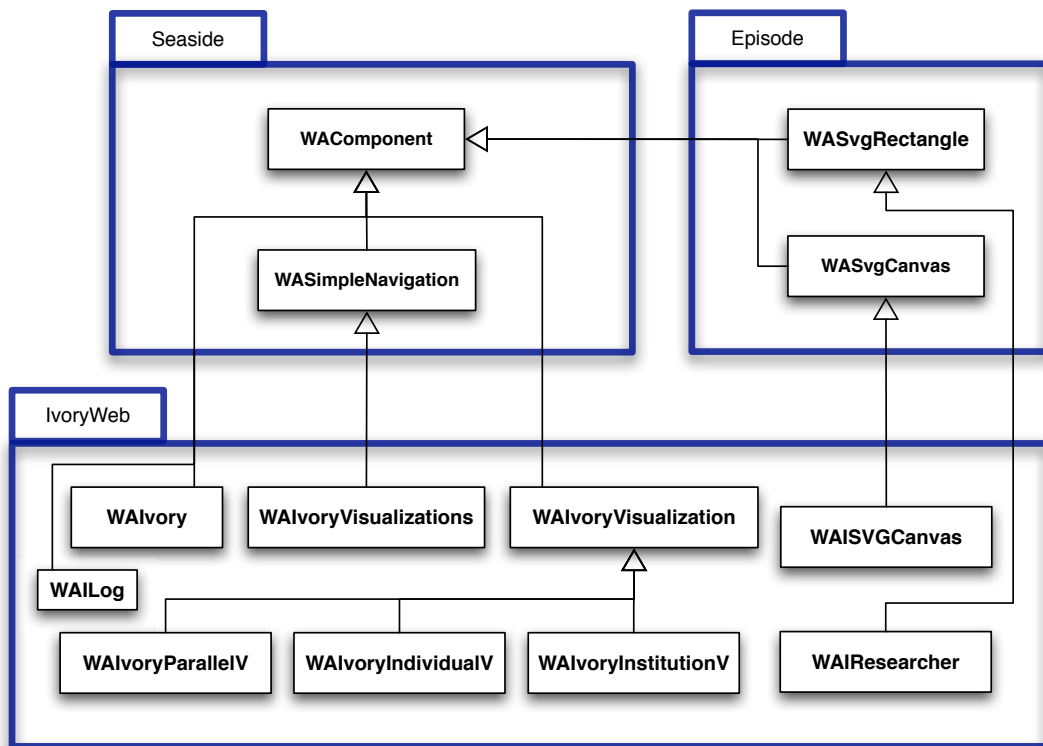


Figure A.1: Simplified IVORY's web structure

Some classes (`WAIvory`, `WAIvoryVisualization` and `WAIvoryVisualizations`) inherits directly from the classes provided by Seaside, while the `WAIResearcher` class and the `WAIsvGCanvas` class inherit from classes of the Episode framework. This is because we choose to represent the researcher as SVG object (the canvas is a container needed to render all the SVG objects).

Thanks to the use of the cache, IVORY can work even when the DBLP web site is offline (with the display of the researches limited to those in the cache).

As can be seen in Figure A.2, in the system there also is a class called *WAILog*. This class is not part of the IVORY application itself, but it is a self-standing application. It keeps track of the number of accesses to IVORY's page, the number of researchers currently in the cache and shows the logged IVORY's users' activities (such as inspection and changing of visualization). With *WAILog* we want to record some information about the main use of IVORY.

Appendix B

Technologies

Ivory is written in Smalltalk and build on top of the Seaside framework. It also uses the Episode framework to generate svg objects (such as the researcher's representations) and the Script.aculo.us library (for the drag-and-drop of some elements).

B.1 Seaside

From the seaside web page¹:

Seaside is a framework for developing sophisticated web applications in Smalltalk.

Seaside provides a layered set of abstractions over HTTP and HTML that let you build highly interactive web applications quickly, reusably and maintainably. Seaside includes:

- Programmatic HTML generation. A lot of markup is boilerplate: the same patterns of lists, links, forms and tables show up on page after page. Seaside has a rich API for generating HTML that lets you abstract these patterns into convenient methods rather than pasting the same sequence of tags into templates every time.
- Callback-based request handling. Why should you have to come up with a unique name for every link and form input on your page, only to extract them from the URL and request fields later? Seaside automates this process by letting you associate blocks, not names, with inputs and links, so you can think about objects and methods instead of ids and strings.
- Embedded components. Stop thinking a whole page at a time; Seaside lets you build your UI as a tree of individual, stateful component objects, each encapsulating a small part of a page. Often, these can be used over and over again, within and between applications - nearly every application, for example, needs a way to present a batched list of search results, or a table with sortable columns, and Seaside includes components for these out the box.
- Modal session management. What if you could express a complex, multi-page workflow in a single method? Unlike servlet models which require a separate

¹<http://seaside.st/>

handler for each page or request, Seaside models an entire user session as a continuous piece of code, with natural, linear control flow. In Seaside, components can call and return to each other like subroutines; string a few of those calls together in a method, just as if you were using console I/O or opening modal dialog boxes, and you have a workflow. And yes, the back button will still work.

Seaside also has good support for CSS and Javascript, excellent web-based development tools and debugging support, a rich configuration and preferences framework, and more.

Seaside is currently developed and supported by Avi Bryant, with the help of the Seaside community.

B.2 The Episode Framework

Episode is a project by Marco Primi.

Episode, written in Smalltalk, is an extension of Seaside. It allows to generate SVG directly as part of the xhtml page. SVG stands for Scalar Vector Graphic which is an XML language to describe 2D graphics. It produces results really similar to what we can get with Flash, except that SWF Flash objects are compiled, while SVG just text (XML).

Episode provides a way to create web interfaces on top of an existing non-web tools, as well as creating new highly graphic-intensive web application from scratch.

IVORY uses an early version of Episode.

B.3 Scriptaculus

Script.aculo.us² is a library of Java Script extensions which provides an easy-to-use, cross-browser user interface. It provides animation framework, drag and drop, Ajax controls DOM utilities, and unit testing.

Seaside provides a complete integration³ with script.aculo.us, allowing the use of the library without having to write a single line of Java Script. Everything can be configured and plugged together using Smalltalk objects.

²<http://script.aculo.us/>

³<http://scriptaculous.seasidehosting.st/>

List of Figures

2.1	DBLP example page	4
2.2	publications in details	5
2.3	publications in details	5
3.1	APPL - Apple Inc. 's stock market prices over the last month	6
3.2	IVORY's mind map	7
3.3	IVORY's model simplified UML class diagram	8
4.1	IVORY	9
4.2	USI's researchers example	10
4.3	collaboration lines example	10
4.4	IVORY's interface explained	11
4.5	Parallel visualization	12
4.6	Parallel visualization with details	13
4.7	Individual Visualization	14
4.8	Individual visualization with details	14
4.9	some publications and collaborations histograms	15
4.10	example of detailed publications and collaborations in a year	16
4.11	<i>Michele Lanza's</i> detailed publications and collaborations in 2004	16
4.12	Institution Visualization	17
4.13	Institution collaborations view with details	17
4.14	Institution publications view with details	18
4.15	Iene and USI collaborations graphs	19
4.16	<i>Laura Pozzi's</i> collaborations graph	20
4.17	<i>Michele Lanza's</i> collaborations graphs	20
5.1	A scratch of the proposed <i>Space Visualization</i>	22
A.1	Simplified IVORY's web structure	23
A.2	Simplified IVORY's web UML class diagram	24
A.3	<i>WAIvory</i> class side	24