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Master Thesis

Analysis of Community Structure in a Young Internet Domain

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Contents

Chapter 1

Introduction

In this Master Thesis we study a top level domain, `.cat`, emphasizing the property of community structure. Initially, in this chapter, we contextualize community detection, we list the main objectives of the project, and we describe the chapters and appendices in which it is organized.

1.1 An overview on the problem of community detection

Clustering is an important research and practical problem which is present everywhere. In few words, it consists in classifying elements into groups in which elements share specific properties. In problems of different areas, when the number of elements to study is big, representations of them in a higher level of granularity are interesting, as they reduce the quantity of objects to take into account. Considering these groups, instead of elements, looks as a good solution: if the election is made appropriately the loss of information when doing this simplification is less meaningful than in other possible divisions.

We find the general problem of finding clusters in *data mining*, the discipline whose objective is to extract information from data. There, the assignment of elements into groups is done depending on *similarity* measures. This problem can be treated from many different approaches, since it is difficult to assess similarity between elements.

However, clustering has a particular case. In *graphs*, systems with elements and only a binary relation between them, often *communities* are the abstractions considered. They are groups which contain elements that are more related between them than it would be expected randomly. For example, in Figure 1.1, we observe a graph with three clear communities. The problem of finding communities in graphs is also difficult, as we will see along this work, although it has an advantage: it has been defined formally in terms of quantitative measures.

One of our goals here is to study the community structure of a part of the Web, the `.cat` domain. The Web, and its subsets, can be understood as a graph, in which Web pages are the elements and *hyperlinks* the relations between them. The distribution of links between pages is not random: groups of vertices related between them usually

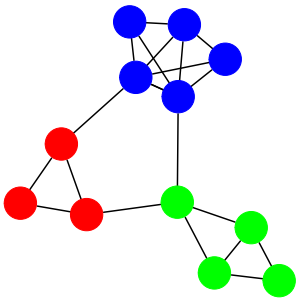


Figure 1.1: A graph showing clear community structure. Three groups of vertices have more links between them than in average.

correspond to real clusters in some sense: linguistic, political, educational, scientific, geographical, hobbies... So, if we find communities considering the Web as a graph, we will probably succeed on the problem of finding real, understandable groups in which pages can be classified.

1.2 Aim of this work

In this work we analyse the community structure of the `.cat` top level Web domain. The `.cat` is a relatively young Web domain, opened up for registration in February 2006. It is administered by Fundació puntCat,[1] a non-profit organization whose goals are to highlight the Catalan language and culture, but also include promoting its usage and encourage related research.

Since early days, Fundació puntCat has been performing monthly crawls of the whole domain. This offers an interesting study case: the possibility of watching in detail the evolution of this domain during a long period of time.

We study the evolution of the structure in the .cat domain, considering it as a complex network. Particularly we focus our interest in its community structure. Studies include:

- Preliminary analysis of the available data to decide specifically the experiments that can be carried out with them.
- Studies of basic graph properties to characterise it (like number of vertices, edges, connected components, or its in and out-degree distributions).
- Research and implementation of some methods for community identification in the literature, and the proposal of a new meta-method.
- A brief comparison among them to choose the ones that give the most meaningful and robust result (in terms of three properties: *modularity*, *similarity*, and *robustness*).

[1] Fundació puntCat. `http://www.domini.cat`

- An in-depth study of the communities detected by the chosen algorithms at several points in time, with an interpretation of the results obtained. It is divided in:
  - Analysis with methods to characterise the found communities, specially the largest ones, so as to understand them.
  - Comparing communities in different moments, in order to visualize its evolution and how similar are.

Although community structure is a very active research area, we have not found any study of community structure in subsets of the Web. Our work here, and the obtained results, are interesting specifically for a better knowledge of the `.cat` domain and also for the Web in general, as they provide ideas for future studies.

1.3 Organization

This work is organized in chapters as follows:

- In Chapter 2 we review previous work performed: basics of graph theory, Web crawling, study of Web properties, community structure, methods for community detection and clustering, and complex network properties: modularity, similarity, and robustness.
- In Chapter 3 we detail the available dataset and we perform a preliminary analysis to it.
- In Chapter 4 we perform studies which only involve data from a specific moment in time. We study basic graph properties, we apply community detection methods to the data, we select the best ones in terms of modularity, and we carry out studies with the obtained communities in order to understand them.
- In Chapter 5 we consider studies involving two or more data sets from different instants of time, comparing how similar are results and analysing community evolution.
- Finally, in Chapter 6 we elaborate the conclusions of this work and we suggest ideas for future work.

Additionally, there are two appendices:

- In Appendix A we present tables with numerical results of the different studies performed in this work.
- In Appendix B we present lists of sites and words resulting from community studies carried out also along this work.

Chapter 2

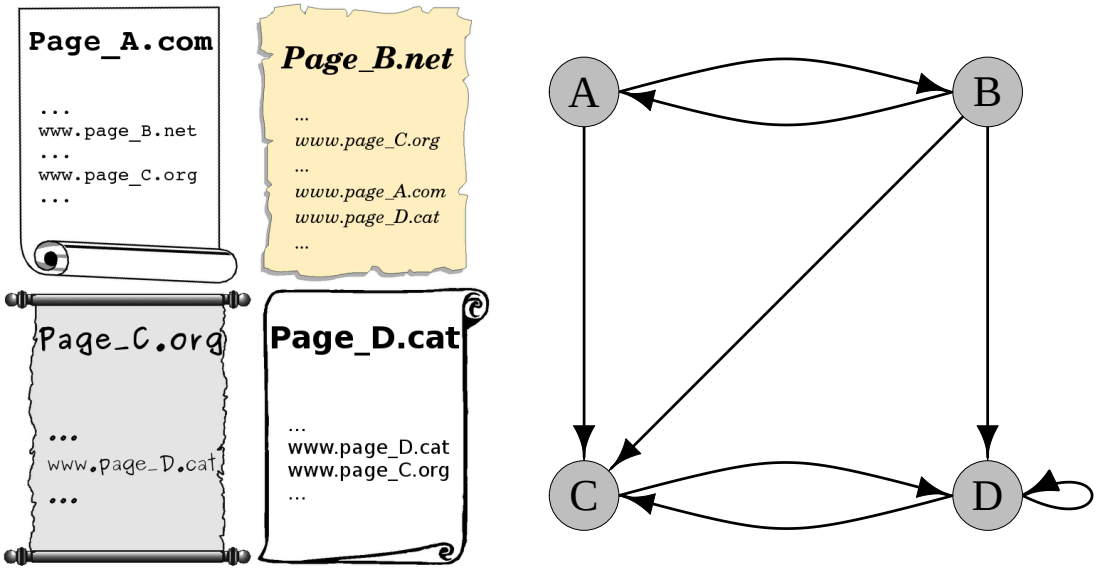
Background

In this chapter we review some of the previous work necessary to perform our studies, introducing its basic concepts. Initially, we introduce graph theory terminology, specialize it to the Web, and explain with an example the process of Web crawling. After it, we review studies of topological properties of networks: *small world*, *Web connectivity*, and *scale-freeness*, and we look into existing studies of national webs. We then start our discussion of communities, and present *modularity*, a property which evaluates quality of community partitions, and methods for community detection based on it. We also summarize the basic clustering techniques, as we use ideas from them in different parts of this work. Finally, we present two other interesting properties which will be important: *similarity* of community partitions and *robustness* of networks.

2.1 The Web as a graph

A *graph* $G = (V, E)$ is an structure composed by a set $V = V(G)$ of elements, called *vertices*, and a set $E = E(G)$ of pairs of vertices, called *edges*. A graph is *directed* if the pairs of vertices of the edges are ordered, or *undirected*, if not. Graphs can also be *weighted*, if each edge has an associated value, or *unweighted*, when each edge is supposed to have the same value. If the pair (u, v) belongs to the set of edges then u and v are called *adjacent*. In directed graphs the *in-degree* of a vertex v is the number of edges of the form (u, v), with u being any vertex of the graph, and the *out-degree* of v is the number of edges of the form (v, u). In undirected graphs the in and out-degree of each vertex coincide, and the measure is called the *degree*. The *neighbours* of a vertex are all the vertices adjacent to it, and there is a *path* between two vertices u and v if it exists a succession of vertices from u to v, where each vertex is neighbour of the previous and following vertices. *Graph theory*, the area of mathematics which studies graphs, *can model any system with a binary relation between objects*, as it is said in one of its numerous books [10]. This simple restriction allows this wide and well known theory to be applied in various areas of knowledge.

In many of them, large graphs with non-trivial properties are also called *complex networks*. In this context, vertices are also known as *nodes*, and edges as *links*. Examples



(a) Four different Web pages with hyperlinks **(b)** Their corresponding directed graph

Figure 2.1: Picture 2.1a contains an example of four different Web pages linked between them. In plot 2.1b there is its representation with a directed graph: pages are vertices, and each hyperlink is a directed edge with the origin in the page which links and the end in the page linked.

of complex networks are found in very different areas: in the physical world, with electric and telephone networks, metro stations; in biology, with food webs and metabolic paths in the cell; in economy, with ownership relations between companies or money exchanges between people; or in scientific research, with coautorship networks. A popular science book of Barabási [4] details a number of networks in which we are involved and what it implies for our everyday life.

Networks in this sense also appear often related with computing. Computer networks are groups of interconnected computers which can communicate to each other sharing devices and information. The *Internet* is a physical system of interconnected computer networks that allows the connected computers accessing information from a high number of servers and other computers. The *World Wide Web* (also known as *Web* or *WWW*) is a virtual network made from a specific software protocol, which allows accessing to data scattered on the physical Internet. The Web, as a complex network, has its pages as vertices, and the *hyperlinks*, the references between documents, are its directed edges. In Figure 2.1 we illustrate it with an example.

A typical simplification of the Web graph, which allows a reduction of the number of vertices, consists in considering sites instead of pages. In this new graph, vertices are different sites, and an edge between two sites exist if there is at least one link between

pages of these two sites. For example, if the Web page `www.page_A.com/index.html` has an hyperlink to `www.page_B.net/english/information.html` then, when considering the sites network, `www.page_A.com` and `www.page_B.net` are linked.

The fact that the Web is a non-physical network makes its dynamics free from the constraints acting on the Internet. Any individual or institution can create new Web pages with any number of links to other documents, and each page can be pointed by an unlimited number of other pages.

The Web is different from other networks. For each document it is easy to know the number of outgoing hyperlinks, but not the number of incoming hyperlinks from other documents: hyperlinks are navigable in one direction, but not in the other. Because of its big size and this directed form, the Web structure is not easy to recover.

2.2 Web crawling

When the number of Web pages existing on the Internet was low, it was easy to maintain a complete list with all of them, so-called directories. As it grew up, this register was impossible to be kept manually. *Web crawlers* were created to help to dynamically maintain an updated list of pages and links between them. They are the necessary complement of Web search engines, tools designed to search for information on the Web.

Web crawlers are software packages designed to gather pages from the Web. They explore the Web in a methodical, automated manner. Since the number of web pages on the Web is extremely big, the complete collection is unrealisable. Even the most famous search engines, Google and Yahoo, are supposed to know a little portion of all the available Web pages at each moment [6]. Each collection of pages, therefore, must be cut by some criteria, usually size restrictions or properties of the domain name. One example is a collection of pages from only one top-level domain.

Many Web crawlers have been designed, all with this basic idea. One of them is *WIRE*.[1] It is an open-source Web crawler scalable, highly configurable, with a high performance, and it generates basic statistics with the collected data. Some of their parameters are the top-level domains to be analysed, the maximum number of pages or sites, the maximum size per page, the extensions of the documents to be downloaded, or the maximum number of pages from the same site.

WIRE is composed by four main programs that are run cyclically during the crawler's execution: manager, harvester, gatherer, and seeder. The process is finished when the cycles are completed within the constraints given by the user. In summary, the four programs do the following operations:

Manager It generates the list of URLs to be downloaded in a cycle. The selection of the pages is done according to quality criteria, which prioritizes new pages or the ones not visited since a long time. The location of pages is also taken into account: pages from a site with no pages downloaded yet have more value than the others.

[1] *WIRE*: Web Information Retrieval Environment. `http://cwr.cl/projects/WIRE`

Harvester It receives a list of URLs and attempts to download them from the Web. At this point is important to notice that this process must be polite, without downloading many pages from a site at the same time. Not all the pages are downloaded successfully.

Gatherer It receives the raw content of the Web pages downloaded by the harvester and parses it. Some information, like the links or the URLs names, is also stored in special data structures allowing a fast information retrieval.

Seeder It receives the list of URLs found by the gatherer and adds some of them to the collection according to configuration parameters, such as the domains where the crawling is desired.

In our work, as we will explain in Chapter 3, we use data obtained after some WIRE crawlings over the `.cat` Web domain. In order to get it, we needed to understand in detail how the crawler works. Additionally, we modified parts of its code, which allowed us to obtain specifically our desired data.

2.3 Studies about the Web

2.3.1 Topological properties

Some structural and topological properties of the Web have been analysed since the early nineties, as summarized in a recent book of Pastor-Satorras et al. [24]. Here we review some of them: the small world property, the Web connectivity, the scale free property, and an specific growing model, preferential attachment.

Small world

The most famous example of the *small world* property is the phenomena called *six degrees of separation* [20]. This is the fact that, in the personal relationship network, if one person is at one step from every person he knows, and at two steps of each person known by one person he knows, and so on, then each person is at most six steps from each other person in the world.

In the Web, the property of small world is applied in the sense that, although the number of pages is high, the average shortest path between two of them is low (usually $\langle l \rangle \sim 11$). This fact is explained in part by the presence of *hubs*, vertices in the network with a high out-degree, and *authorities*, vertices with a high in-degree.

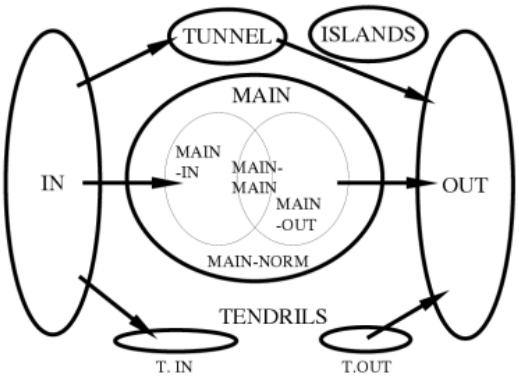
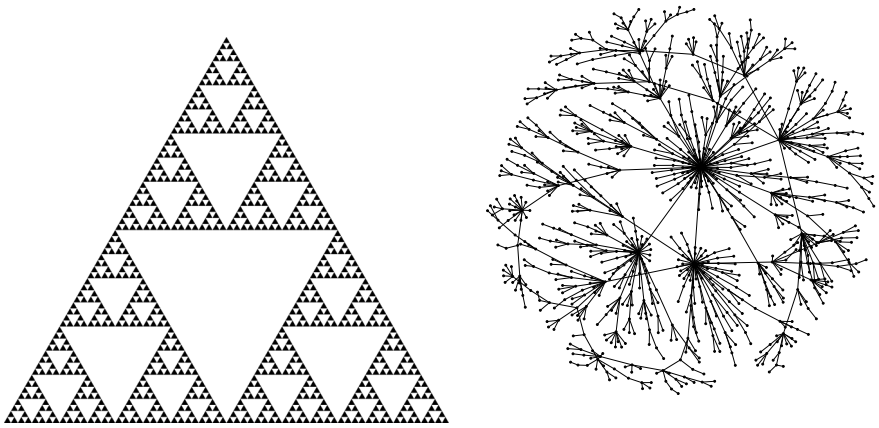


Figure 2.2: Structural components of the Web. The MAIN component contains all the sites belonging to the strongest connected component. The IN and OUT component have sites that can reach the MAIN component or are reached from the MAIN component. TENDRILS contain sites that are linked from the IN component (TIN) or link to the out component (TOUT). TUNNEL contains sites reached from the IN component that can arrive to the OUT component, whereas ISLANDS has sites without edges to MAIN. The MAIN component contains special subsets: MAIN-MAIN, with sites reached directly from IN which can reach OUT directly, MAIN-IN and MAIN-OUT, with sites reached directly from IN or which can reach OUT directly, but that are not in MAIN-MAIN, and MAIN-NORM, with the rest of sites belonging to the MAIN component. Figure extracted from an article which analyses the Chilean Web [2].

Web connectivity

An interesting study focuses in the biggest connected component of the Web, when considered as an undirected network. In this component we distinguish several parts. Basically, there is a large strong connected component, denoted as MAIN, where a directed path exists between any pair of pages. Connected to this core there are the IN and OUT components, with pages that can reach all pages of the MAIN or can be reached from all pages of the MAIN, respectively, but not conversely. Along with these sets there are smaller components. This structure, shown in Figure 2.2, appears again in most natural large subgroups of the Web, such as national domains.



(a) The Sierpinski gasket **(b)** Graph generated with the BA model

Figure 2.3: Two examples of the scale-free property. The first is the Sierpinski gasket, a fractal obtained by an iterative process removing the central part of triangle and then focusing in the remaining sub-triangles, and so on. The second is a graph with 1000 vertices generated with the Barabási-Albert model, a simple algorithm which generates networks with power law distributed degrees.

Scale-free networks

Large networks, such as the Web, often have a property known as *scale-freeness*, *self-similarity*, or *scale invariance*. This property is found in many natural and artificial systems, as detailed in a book of Caldarelli [9]. It refers to the fact that a part of an object is similar to the full object. Scale-freeness is well seen in fractals, geometric figures in which the whole figure and parts of it are equally complex. The Sierpinski gasket, shown in Figure 2.3a, is a famous example of it.

The mathematical form of self-similarity is represented by power laws. A *power law* is any function of the form $f(x) = x^\lambda + o(x^\lambda)$. The linear function $y = x$ and the quadratic function $y = x^2$ are the simplest examples. When plotting power laws in a double logarithmic scale we obtain straight lines. This follows from the properties of the logarithm, because

$$y = x^\lambda \quad \text{implies} \quad \log y = \lambda \log x.$$

From these formulas we obtain that the slope of the straight line is equal to the coefficient of the original function.

An example of a power law is the Zipf's law [28], from linguistics but generalizable to many areas. Zipf's law says that the frequency f_w of a word w in a text depends in a power law form of its rank r_w: r_w equal to 1 for the most frequent word, 2 for the second, and so on. Formally we write

$$f_w \propto r_w^{-\lambda},$$

where the sign $\propto$ indicates proportionality and λ corresponds to the exponent without the

negative sign. Since λ is in most cases equal to one, it is said usually that the frequency of a word is inversely proportional to its rank.

The statistical distributions $P_{in}(k)$ of the in-degree of the Web network, defined as the fraction of vertices of the network with in-degree equal to k, and $P_{out}(k)$ of the out-degree, defined similarly, follow power laws. We write

$$P(k) \propto k^{-\lambda},$$

where we again observe the apparition of a negative sign in the exponent, in order to work with positive values of λ: like all discrete probability distributions, it is true that $\sum_k P(k) = 1$. Usually, in different subsets of the Web, λ takes a value between 2 and 3.

Growing model: preferential attachment

Scale-free models have taken a lot of attention in the literature. The growing mechanism by which these networks acquire the scale invariance has been a rather popular research subject. Some models have been proposed. The oldest ones do not succeed in explaining this behaviour (although they are good for explaining other phenomena), whereas the newest propose mechanisms to generate scale-free networks.

The simplest graph-generating model is the *Erdős-Rény model*, or *random model* [14]. Given the n vertices of a network, each one of the $n(n-1)/2$ possible edges have the same probability p to appear in the graph. This model is correct for representing some real situations, like the telephone wiring of a set of houses. In these graphs, the degree distribution follows a binomial distribution $P(k) = \binom{n-1}{k} p^k (1-p)^{n-1-k}$, and the diameter of the graph is $D(k) \simeq \ln(n)/\ln(\langle \ln(k) \rangle)$.

The random model, however, is not able to explain the growth of many real networks. It does not produce scale-free networks with power law distributions. More complex models are needed to generate them. Additionally, to reproduce networks evolution, the graph must be build in successive time-steps, when new vertices and edges are added to the system.

Barabási and Albert developed a simple model [5] which succeeds on explaining this fact and grows in different time steps. It introduces two concepts to explain the growing behaviour: *growth* and *preferential attachment*. Growth implies that new vertices are added to the network at some time. Preferential attachment is the fact that these new vertices establish their connections preferentially with vertices that already have a high degree. A possible process to generate this model is explained in Algorithm 1.

These two simple rules produce naturally scale-free networks in the sense that the degree distribution is power law distributed, and the diameter D of the network is proportional to $\ln(n)/\ln(\ln(n))$. One example of a realization of the algorithm is in Figure 2.3b.

The preferential attachment model can be improved, including features of real networks. One is the addition of a value which represents the ability each vertex has to attract new edges, called *fitness*. This characteristic allows the growing in the degree of vertices with big fitness, although they are not the oldest in the network. Another

Algorithm 1 Barabási-Albert generating model

start with a set of n_0 vertices. It must be noted that $n_0 \geq 2$ and the degree of each vertex must be at least 1, otherwise it will remain disconnected from the rest of the network
for each time step **do**
  enter new disconnected vertices at the system
  draw m_0 new edges. This connect the new vertices with the old ones. They are chosen with a probability proportional to their degree, so vertex v has probability $P(v) = \frac{deg(v)}{\sum_v deg(v)}$
end for

is the addition of new edges between existing vertices, or the consideration of directed networks, with two degree distributions (in and out). Finally, the last is the removal of edges and vertices.

2.3.2 National Web domains

Since the last decade the Web has been expanding without foreseeable limits, and several studies about national domains have been carried out. They are interesting because each domain has its own characteristics which differentiates it from others. A summary can be found in a work of Baeza-Yates et al. [1]. It compares the results of twelve studies from different countries and regions, including Brazil, Chile, Greece, Indochina, Italy, Korea and Spain. We briefly describe them in this section, and we will repeat, in Chapter 4, some of these studies with our available data.

The studies are focused at different levels of granularity, including words, pages, sites, and domains. The topics studied are: languages, page size, page age, pages per site, sites and pages per domain, second-level domains, degree, ranking, host graph, Web structure, URL length, HTTP responses code, document formats, image formats, Web server software, programming languages used, and relations between Web characteristics and socio-economic indicators.

The results differ when analysing different countries. We show, in Figures 2.4 and 2.5, the graphics for the in and out-degree in some of these top-level domains. In our work we will repeat this study and we will compare our obtained results with these ones.

2.3.3 Web Dynamics

Although the Web is highly dynamic, little is known about its evolution. In another article of Baeza-Yates et al. [3] it is studied the evolution of the Chilean domain between 2000 and 2003. This is done by analysing the changes in the Web connectivity structure, i.e. the fraction of vertices that migrate from one component (MAIN, IN, OUT, ISLANDS, TENDRILS) (explained in Figure 2.2) to another.

In general, new sites appearing in the Web go to the ISLANDS component, because they are not linked from other sites. Then, as they become better known by other sites,

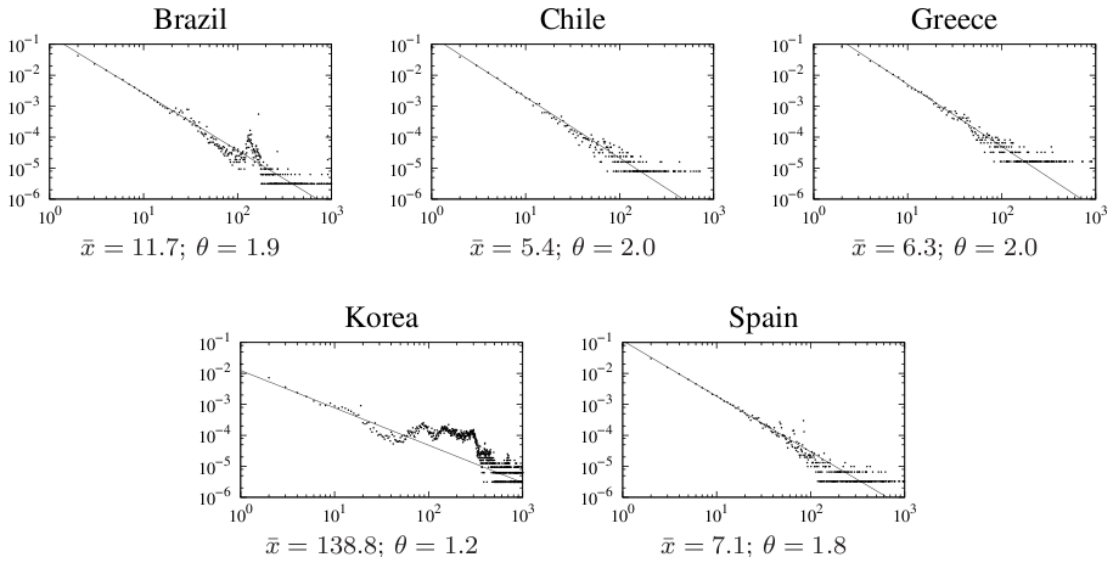


Figure 2.4: In-degree distribution of the Web sites of some countries. Power law distributions $P(x) = x^{-\theta}$, straight lines in logarithmic axes, fit well for the first values of degree x. The average degrees and the exponent θ of the function change in every country. In these cases, the average degrees for sites with at least one in-link vary from 5.4, in Chile, to 138.8, in Korea, and the exponent goes from 1.2, in Korea, to 2.0, in Greece and Chile.

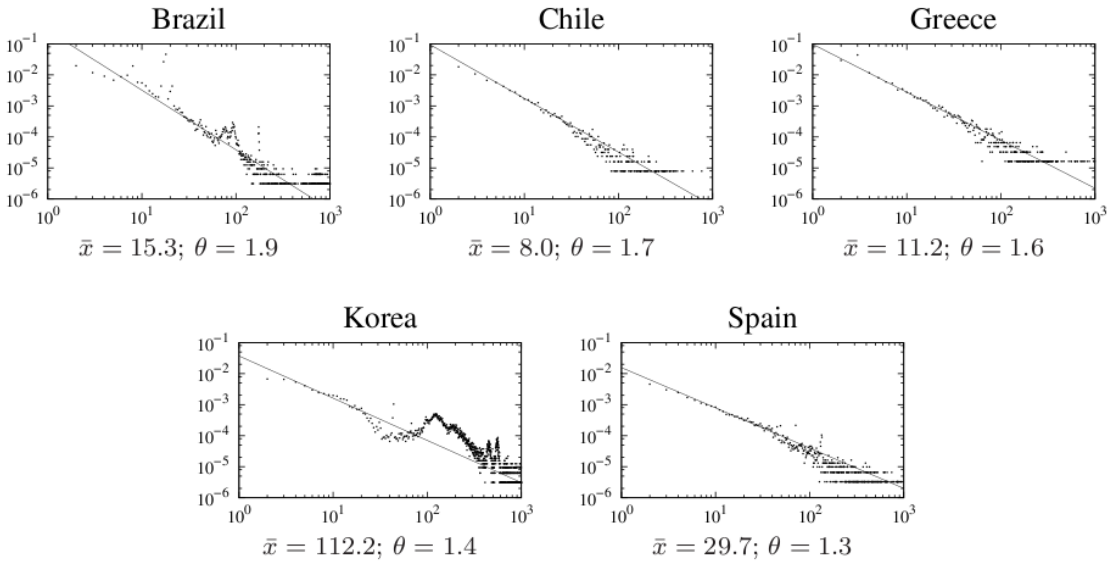


Figure 2.5: Out-degree distribution of the Web sites of some countries. Power law distributions $P(x) = x^{-\theta}$, straight lines in logarithmic axes, fit well for the first values of degree x. The average degrees and the exponent θ of the function change in every country. In these cases, the average degrees for sites wit at least one out-link vary from 8.0, in Chile, to 112.2, in Korea, and the exponent goes from 1.3, in Spain, to 1.9, in Brazil.

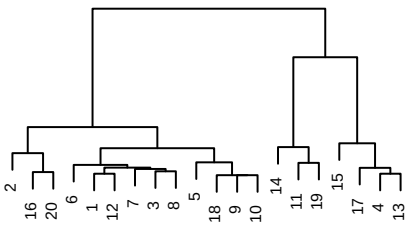


Figure 2.6: Example of a dendogram with 20 elements. Dendograms are good tools to analyse community structure, as they show a hierarchical view.

they migrate to the IN, OUT, or MAIN components.

In our work we repeat most of these studies. In Chapter 4 we check Web dynamics and scale-free distributions of the `.cat` domain, in the same manner we explained in this section.

2.4 Community structure

Intuitively, a *community* consists of a group of vertices that are more linked to each other than to other vertices. The existence of communities in complex networks is clear: for example, social networks, which exhibit different communities, each one identified with a social group, or the Web, in the perspective that can be divided into different linguistics's communities.

Communities identified in networks may overlap others, so division in communities should not be a partition of vertices. In fact, there is more than a simple classification: *community structure encompasses a complicated set of modular components, or simple clusters, and hierarchical components* [25]. Given a network with non overlapping modules, one can continue dividing each module into other sub-modules until each vertex is in its own community. This hierarchical structure can be represented by a tree, or a *dendogram*, like the one in Figure 2.6. Community structure of a network can be understood as the set of graph partitions obtained at each reasonable step of the procedure. The hierarchical structure of complex networks is also well seen in most of them. For example, in social networks each social group can be divided by other characteristics (ideology, type of music, or personal relations between members), or linguistic communities can be divided by the thematic of the page (business, education, or culture), or by its location.

Although we do not have a formal definition of what a community is, we need quantitative measures to evaluate the quality of community structure encountered in networks. Many measures have been introduced, and one of them, proposed by Newman [23], has been widely accepted in literature. It is known as *modularity*. Symbolized by Q, it is valid for undirected networks, understood as directed symmetric networks. It is defined as follows:

$$Q = \sum_r (e_{rr} - a_r^2),$$

where the sum extends over all communities r, e_{rr} is the fraction of edges that connect two vertices from community r, and a_r is the fraction of edges that point to a vertex in community r (and, symmetrically, a_r is also the fraction of edges that start in one vertex in community r). An equivalent definition of modularity, which does not need to consider directed symmetric networks, is

$$Q = \frac{1}{2m} \sum_{vw} \left[A_{vw} - \frac{k_v k_w}{2m} \right] \delta(c_v, c_w),$$

where the sum extends over every pair of vertices, m is the total of edges, A is the adjacency matrix of the graph (A_{vw} is 1 if there is an edge connecting v and w, or 0 if not), k_i is the degree of vertex i and $\delta(c_v, c_w)$ is 1 if v and w belong to the same community, or 0 if not. The definition extends to directed networks by doing simple changes. Basically we have

$$Q = \sum_r (e_{rr} - a_r b_r),$$

where e_{rr} and a_r are equally defined and b_r is the fraction of edges that start in one vertex in community r, and in the second form

$$Q = \frac{1}{m} \sum_{vw} \left[A_{vw} - \frac{k_v^{in} k_w^{out}}{m} \right] \delta(c_v, c_w),$$

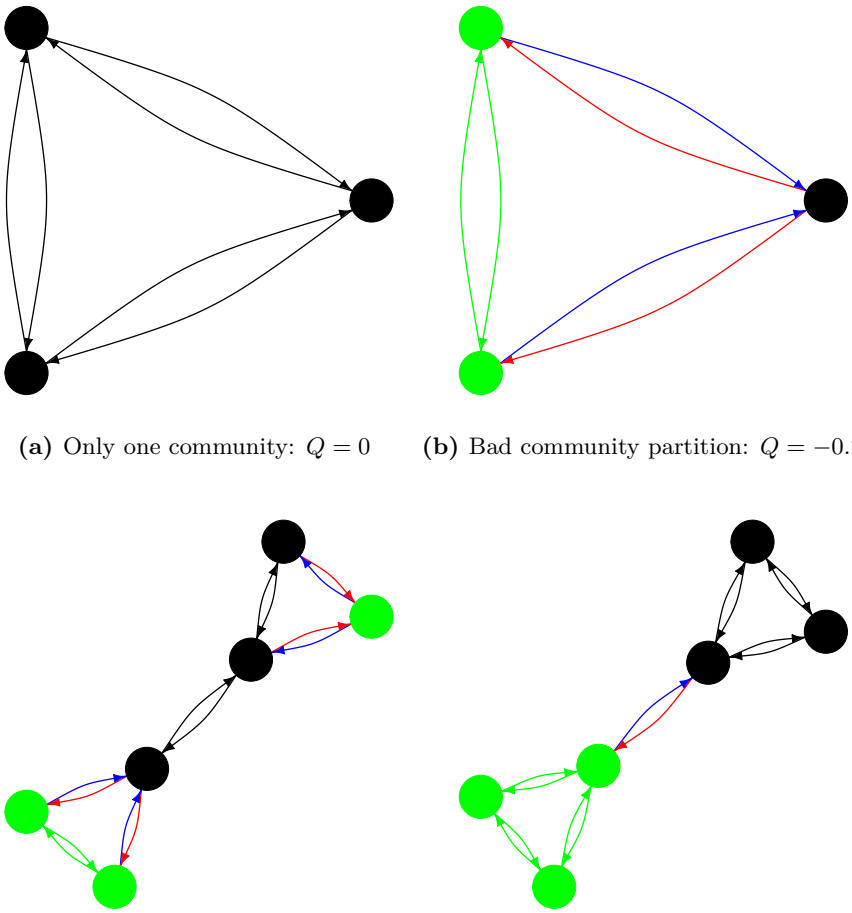
where now the adjacency matrix A_{vw} takes into account the direction of the edges, there is a distinction between in-degree and out-degree, and the denominators are not multiplied by a factor of 2.

Modularity takes values between -1 and 1, and the greater this value, the better the community structure found. Community partitions with only one community have a value of Q equal to 0. Figure 2.7 contains four examples of evaluating community structure. It is important to remark that Q is a measure which depends of a given community partition, not from the whole graph. But it is common to associate Q to a graph by considering its partition which gives the highest value.

A curious phenomena is that there are networks whose maximum values of modularity are surprisingly low, even in their best community partitions. This fact was illustrated in an article of Guimerà et al. [17], where it was proved that any network of 128 vertices and 1024 edges has a maximum of modularity of 0.208.

The general problem of finding the partition which maximizes the value of Q in a network is difficult, NP-Complete [8]. This fact and the big size of complex networks makes exhaustive methods inapplicable. Because of these difficulties, the problem has been approached heuristically from different backgrounds, as we will see in Section 2.5.

The study of community structure is the main part of our work. All analyses in Chapters 4 and 5 are related to the study of community structure.



(a) Only one community: $Q = 0$ **(b)** Bad community partition: $Q = -0.22$

(c) Bad community partition: $Q = -0.08$ **(d)** Good community partition: $Q = 0.36$

Figure 2.7: Four examples of evaluating community structure. The first two show the complete graph on 3 vertices, K_3. In 2.7a there is only one partition, with modularity equal to $Q = 6/6 - (6/6)^2 = 0$. In 2.7b there are two partitions, and modularity is $Q = 0/6 - (2/6)^2 + 2/6 - (4/6)^2 = -0.22$, so we conclude that this is not a good graph partition in communities. The last two show two different partitions of a graph with, intuitively, clear community structure. In 2.7c modularity is $Q = 2/14 - (6/14)^2 + 4/14 - (8/14)^2 = -0.08$, so we conclude that this is not a good graph partition. On the contrary, in 2.7d, the value of Q is $Q = 6/14 - (7/14)^2 + 6/14 - (7/14)^2 = 0.36$, confirming our intuition that this is the really good partition. We remark that modularity is calculated as $Q = \sum_r (e_{rr} - a_r^2)$, where terms e_{rr} correspond to the fraction of edges which start and end in vertices of community r, and terms a_r correspond to the fraction of edges that point to one vertex in community r. Different colours show different communities of vertices.

2.5 Methods for community detection

Several community detection algorithms have been developed in the last years. Surveys are presented in an article of Danon et al. [11] and in a book of Caldarelli [9], although since their publications new algorithms seem to perform better in terms of time or quality of the partition found. More recently, a new summary is found in a review article of Fortunato [15]. Two fundamental approaches to the problem are possible: the *divisive* approach, which starts from the entire network as one big community and searches for suitable sub-communities, and so on, and the *agglomerative* approach, which starts placing each vertex into a different community and searches for bigger communities, and so on. Another interesting approach is based on *spectral analysis*, focusing the study in the properties of the adjacency matrix of the network, or in matrices obtained by simple transformations from the adjacency one. In this work we use four methods, and now we explain them in detail.

2.5.1 Extremal Optimization

Extremal Optimization for community detection, of Duch and Arenas [13], is a divisive method which optimizes the modularity using an heuristic search based on the Extremal Optimization (EO) algorithm. Basically, it consists in the optimization of a global variable by improving extremal local variables. The performance of EO algorithms have been shown to outperform in efficiency classical simulated annealing and genetic algorithms.

In this case, the global variable to optimize is Q. New variables q_i are defined,

$$q_i = \kappa_{r(i)} - k_i a_{r(i)},$$

where $\kappa_{r(i)}$ is the number of edges that a vertex i belonging to community r has with vertices into the same community, k_i is the degree of vertex i, and $a_{r(i)}$ the fraction of edges that point to a vertex in community $r(i)$. We have $Q = \sum_i q_i/2L$, where L is the total of edges in the network. Rescaling the local variable q_i by the degree of vertex i we obtain a definition for the contribution of vertex i to the modularity,

$$\lambda_i = \frac{q_i}{k_i} = \frac{\kappa_{r(i)}}{k_i} - a_{r(i)}.$$

These variables λ_i are the local variables to improve. They are called *fitness*.

The heuristic proposed to find the optimal partition is summarized in Algorithm 2. It is absolutely deterministic, and like all local search methods, can be trapped into a local maximum. Instead, a variant of it is used, consisting in choosing the vertex to be changed by a probability selection based in a ranking of vertices according their fitness values, instead of the vertex with worst λ_i value.

After the execution of the heuristic, an optimization takes place. It consists of considering neighbourhood solutions of a given solution, with only one changed element. If the new solution is better, this becomes the current solution. This process is repeated until no improvement is found.

Algorithm 2 Extremal Optimization

split the vertices of the whole graph in two random partitions having the same number of vertices each one
repeat
  move the vertex with lower fitness λ_i from one partition to another
  recalculate the fitness of many vertices, because $a_{r(i)}$ involves them
until an optimal value of Q is reached
delete the edges between partitions
repeat the process with every resultant connected component, until no improvement of Q can be done

The computational cost involved in the whole process is, for networks of size n, $O(n^2 \ln^2 n)$, where a factor $n \ln n$ is the cost associated to the ranking process. However, it can be reduced using heap data structures for the ranking selection up to $O(n)$. Hence, the total cost of the algorithm is $O(n^2 \ln n)$.

2.5.2 Newman's algorithm

Newman and Girvan proposed two famous methods for community detection [16] [23], often taken as base line for comparative analysis of other methods. Apart from them, Newman also developed an interesting divisive method based on spectral analysis [22], whose main ideas are the following.

Given an undirected graph, the *modularity matrix* $\mathbf{B}$, a real symmetric matrix, is defined as

$$B_{ij} = A_{ij} - \frac{k_i k_j}{2m},$$

where A_{ij} are the elements of the adjacency matrix, m the total number of edges, and k_i and k_j, are the degrees of i and j vertices.

Using this matrix and considering the problem of dividing a network in two communities (1 and 2), modularity can be written as

$$Q = \frac{1}{4m} \sum_{ij} \left(A_{ij} - \frac{k_i k_j}{2m} \right) s_i s_j = \frac{1}{4m} \mathbf{s}^T \mathbf{B} \mathbf{s},$$

where $s_i = 1$ if vertex i belongs to group 1 and $s_i = -1$ if vertex i belongs to group 2.

Vector s can be written as a linear combination of the normalized eigenvectors $\mathbf{u}_i$ of $\mathbf{B}$, $s = \sum_{i=1}^{n} a_i \mathbf{u}_i$, with $a_i = \mathbf{u}_i^T \cdot s$. Then

$$Q' = 4mQ = \sum_i a_i \mathbf{u}_i^T \mathbf{B} \sum_j a_j \mathbf{u}_j = \sum_{i=1}^{n} (\mathbf{u}_i^T \cdot \mathbf{s})^2 \beta_i,$$

where β_i is the eigenvalue of $\mathbf{B}$ corresponding to eigenvector $\mathbf{u}_i$. From now on the study focuses in Q', omitting the constant value $1/4m$.

Assuming the eigenvectors are labelled in decreasing order, $\beta_1 \geq \beta_2 \geq \cdots \geq \beta_n$, the maximum value of Q' is obtained by choosing the optimal values for the terms in $\mathbf{s}$. This means choosing $\mathbf{s}$ so as to concentrate as much weight as possible in the terms of the sum involving the most positive eigenvalues. The problem is that elements of $\mathbf{s}$ must take only two values: 1 or -1. This optimization problem is NP-hard, so it is practically impossible to find the optimal value for $\mathbf{s}$ in big networks without heuristics.

The heuristic chosen by the method consists of maximizing the term involving the leading eigenvalue and completely ignore the others. In other words, $\mathbf{s}$ is chosen to maximize $(\mathbf{u}_1^T \cdot \mathbf{s})$, with s_i taking a positive value if the ith element of $\mathbf{u}_1$ is positive, and a negative value if not.

The method can be generalised to more than two communities. For this case, a new modularity matrix $\mathbf{B}^{(g)}$ is defined for each subgraph g as follows:

$$B_{ij}^{(g)} = A_{ij} - \frac{k_i k_j}{2m} - \delta_{ij}\left[k_i^{(g)} - k_i \frac{d_g}{2m}\right],$$

where, $k_i^{(g)}$ is the degree of vertex i within subgraph g and d_g is the sum of the total degrees k_i of the vertices in the subgraph. The subgraph modularity $Q_g = \mathbf{s^T B}^{(g)}\mathbf{s}$ gives the additional contribution to the total modularity made by the subgraph's division.

The main part of Newman's algorithm, explained in Algorithm 3, uses these concepts.

Algorithm 3 Newman's algorithm. Main part

construct the modularity matrix for the network
find its leading (most positive) eigenvalue and eigenvector
if the proposed split makes a zero or negative contribution to the total modularity of the network **then**
  leave the corresponding subgraph undivided
else
  divide the network into two parts according to the signs of the elements of this vector
end if
repeat the process for each of the parts

The results are improved with another heuristic which moves vertices from one partition to the other finding better values of modularity, detailed in Algorithm 4.

The full method is the combination of the two algorithms explained before. Firstly, it uses the modularity matrix to find a good partition of the network according to the signs of the leading eigenvector. Then, it applies the second optimization method to get more accurate results before the partition of the network in two communities. In addition, the method is able to provide a hierarchical view of the community structure found, as the entire process consists in the division in two parts of groups of vertices.

The computational cost of the method scales with the number of vertices as $O(n^2 \log n)$.

Algorithm 4 Newman's algorithm. Second heuristic

start from a given partition of the network
repeat
  find the vertex that, when moved to the other group, gives the biggest increase in the modularity of the network, or the smallest decrease if no increase is possible
  make the move
until all vertices are moved, with the restriction that one vertex can only be moved one time
search the set of intermediate states occupied by the network during the operation and find the state that has the greatest modularity
repeat the process starting from this state, until no improvement can be done

2.5.3 PBD algorithm

The Pujol, Béjar, and Delgado algorithm [26], abbreviated PBD algorithm, is an agglomerative method based on the combination of spectral analysis and modularity optimization. Spectral analysis is used to reduce the number of initial vertices of the network by creating an smaller number of groups. This is done by applying random walkers through the network and associating each vertex to the most probable random walker. After this, a hierarchical classification of the groups takes place, and the best partition is the one which gives the higher modularity.

In this process, s random walkers go through the network. The transition probability matrix M is defined as

$$M = (A + I)D^{-1},$$

where I is the identity matrix and D is a diagonal matrix of the form $D_{ii} = 1 + \sum_j A_{ij}$. The process carried out by random walkers is defined by

$$G^{t+1} = M'G^t,$$

until G^T with T equal to 3.

After this, the n vertices of the network are classified into s groups, each one in the group of the random walker visited most. This method allows a reduction of the initial number of groups, although the number cannot be equal to s: a random walker can be *precluded*, when all vertices visited by it are also visited more often by another random walker; and, since the Markov process is iterated only T times, there is no guarantee that all vertices are visited by at least one random walker.

An important aspect is that the partition of the network depends on which vertices are seeds, or origins, of the random walkers. In order to select the initial vertices G^0, an heuristic is proposed. Let R be the approximate fraction of vertices chosen as seeds, initially the ones with higher degree. R takes values between 0 and 1, experimentally found 1/5 as a good one. Let z be the maximum value that makes the partition composed of the vertices with higher degree larger or equal to R, $\sum_{j=z}^{j\leq \max(k)} p(k_j) \leq R$, where $p(k_j)$ is the proportion of vertices with degree k_j. Then, if vertex i has degree k_i greater or equal than z, a random walker starts at this vertex.

Once the initial partition is created, the method builds a hierarchical clustering, creating partitions $C_s, C_{s-1}, \ldots, C_1$ of the data, where C_s consists of s clusters, the ones obtained with the random walkers, and C_1 consists of a single group containing all the vertices. The method iteratively joins the two groups that are most similar. As a result, after $s-1$ join operations, the clustering is finished and the result is a dendogram, which reveals the structure of the data.

This is done in the following manner. For each group j of the s initials, their contribution to the total modularity is $q_j = e_{jj} - a_j^2$. The group j that contributes less to the total modularity is selected to be joined to the group i that maximizes the increment of modularity:

$$\Delta Q = (2e_{ij} + e_{ii} + e_{jj}) - (a_i + a_j)^2 - (e_{ii} - a_i^2) - (e_{jj} - a_j^2) = 2(e_{ij} - a_i a_j),$$

where the first two terms in the second equality are contribution of the merged group and the lasts the contribution of each single group.

The method is summarized in Algorithm 5.

Algorithm 5 PBD algorithm

choose the initial positions for the s random walkers
process the s random walkers traversing the network
classify the n vertices of the network into s groups, each vertex in the group of the random walker visited most
construct a hierarchical clustering with the s groups, merging the group with lower contribution to modularity with the group which makes a bigger increment
select the partition with highest modularity

The computational cost of the method for n vertices is $O(n^2)$ in the worst case, specifically $O(ns)$. The complexity of finding the seeds for the random walkers is $O(n)$. The multiplication of M and G can be done in $O(ms)$, where m is the number of edges of the network, due to the sparseness of M and G. For each random walker j, its probability scenario can be calculated in cost $O(m)$. Hence, the final cost can be considered $O(ns)$, as the number of edges scales with n in the case of bigger values of n. The contribution of each group to the total modularity can be calculated in $O(s)$, and the $s-1$ merge operations are linear with the number of groups, so they perform in $O(s^2)$.

2.5.4 Louvain

The last method, of Blondel, Guillaume, Lambiotte, and Lefebre [7], is called *Louvain* in honour to the university where it was developed. It is an agglomerative method able to find partitions of large networks in short time, and it provides a complete hierarchical structure for the network, like the previous two explained methods.

The method is divided in two phases that are repeated iteratively. Firstly, it assigns a different community to each vertex in the network, resulting in as many communities as vertices. Then, for each vertex i their neighbours j are considered. It evaluates the

gain of modularity that would occur if i was removed from its community and placed in the community of j. After it, vertex i is placed in the community for which the gain is maximum, but only if the gain is positive. This process is applied repeatedly and sequentially for all vertices until no improvement can be done.

The gain of modularity ΔQ obtained by moving an isolated vertex i into a community C can be computed by:

$$\Delta Q = \left[\frac{\sum_{in} + k_{i,in}}{2m} - \left(\frac{\sum_{tot} + k_i}{2m}\right)^2\right] - \left[\frac{\sum_{in}}{2m} - \left(\frac{\sum tot}{2m}\right)^2 - \left(\frac{k_i}{2m}\right)^2\right],$$

where $\sum_{in}$ is the sum of the weights of the edges inside C, $\sum_{tot}$ is the sum of the weights of the edges incident to vertices in C, k_i is the sum of the weights of the edges incident to vertex i, $k_{i,in}$ is the sum of the weights of the edges from i to vertices in C and m is the sum of the weights of all the edges in the network. A similar expression is used when evaluating the change of modularity when i is removed from its community.

The second phase consists in the construction of a new network whose vertices are the communities found during the first phase. When doing this, the weights of the edges between the new vertices are calculated as the sum of the weight of the edges between vertices in the corresponding communities. Edges between vertices of the same community become self-loops in the new network.

The two phases are repeated successively until no more changes happen, and the final result is the partition with maximal modularity. The method is summarized in Algorithm 6.

Algorithm 6 Louvain

repeat
  construct a network whose vertices are the communities of the previous step, with the corresponding edges. In the first step, each vertex of the original network is considered
  repeat
    for each vertex i **do**
      select the neighbour j with the best gain of modularity when placing i together with j
      if the gain is positive **then**
        assign vertex i to the community of vertex j
      end if
    end for
  until no improvement of modularity can be done
until no changes in the network

This method is extremely fast. This is because the gains in modularity can easily be computed and the number of communities decreases drastically after few iterations, so most of the running time is concentrated in the first iterations.

In Chapter 4 we check the performance of these methods over the `.cat` domain network. After analysing the results we will select the best one, and we will continue realizing studies with the results of this method.

2.6 Clustering in common data sets

Community detection in complex networks can be viewed as a particular case of the classic problem of classify elements into different groups. Some approaches to the general clustering problem have been proposed. We review only the simplest because these are the ones we use. Besides, in Section 2.7, we review some techniques from clustering research that we further use in our community detection problems.

Usual datasets do not have the structure of graphs: they look as large tables where rows are elements and columns element attributes. Clustering techniques to put elements into similar groups are a bit different. They are based in similarity measures between elements, or distances, which are obtained from the numeric values of their attributes. The main idea of these methods is to put together elements with high high similarities, or small distance values.

Once some elements are joined in a group, they are not considered any more as individuals to classify and the whole group is taken into account. Its attributes are often the average values of those from their elements. We explain briefly two classic methods for clustering: k-means and hierarchical clustering.

2.6.1 K-means

Direct partition is a method which consists in partitioning the n elements into k groups, maximizing the similarity between elements of the same cluster (intra-cluster similarity) and minimizing the similarity between elements of different clusters (inter-cluster similarity). This process is computationally hard, NP-complete, and some heuristics are used. *K-means*, in their classic heuristic form, is one of them. It consists in considering k positions, called centres, and grouping the elements to the closest center. The process is repeated iteratively, choosing each time the center as the center of the group, until there is convergence. The method is summarized in Algorithm 7.

Algorithm 7 K-means

```
select, randomly or not, k centres
for a concrete number of iterations do
  assign each individual to the closest center
  define the new partition of elements
  update the k centres of each group
  if the centres are similar to the old centres then
    exit
  end if
end for
```

The main advantage of this method is its computational cost, linear with the number of elements. In contrast, it presents two problems: the number of groups, k, must be known a priory and it finds a local optimal partition, which depends strongly of the initial choice of centrers. In fact, this method is known to be quite unstable.

2.6.2 Hierarchical clustering

The main idea of *hierarchical clustering* is to classify the n elements in a dendogram, like the one in Figure 2.6. A dendogram is basically a tree, in which nodes can contain single elements or groups of them.

Initially, individual elements are considered as distinct nodes. Then, the hierarchical structure is built by joining pairs of nodes with a low distance between them. The full process consists of $n - 1$ joining operations. The method is summarized in Algorithm 8.

Algorithm 8 Hierarchical clustering

consider the initial elements to be clustered as nodes
calculate the distances between nodes
while the number of nodes to be clustered > 1 **do**
  find the nearest pair of nodes
  join them in a single node
  update the list of nodes, removing the two older and introducing the new one
  update the matrix of distances between nodes
end while

Hierarchical clustering is not as efficient as k-means, as it uses quadratic time with the number of elements, but it gives the full classification of elements within groups, allowing the *a-posteriori* selection of any number of groups. It also informs of the whole process of finding the clusters.

These methods, k-means and hierarchical clustering, can also be applied to graphs, for example defining a similarity measure between vertices as the weight of the edge between them. However, they do not perform as well as specific community detection methods, specially adapted to the graph structure of data and the *sparseness* of complex networks, the fact that the number of edges is low, usually proportional to the number of vertices. In Chapter 4 we propose a meta-method for community detection which uses hierarchical clustering. It takes as attributes of vertices community assignments from other methods.

2.7 Similarity measures between clusterings

In the previous sections we have reviewed community detection and clustering methods. As we have seen, these methods are heuristics, and results from different methods can vary between them. However, it is clear that networks, or data frames, with clear group structure will exhibit less differences between results than others with a non well-defined structure. The property which compares results from different clusterings, or community partitions, is called *similarity*. It is important to differentiate similarity measures between elements, which are useful for clustering them into similar groups (used in the clustering methods we explained before in Section 2.6) and measures to evaluate similarity between given clusterings (the focus of this section). We review three of them: one based in pair matching, the other in set matching, and the last in information theory. Each of them has advantages in some sense and disadvantages in other aspects.

In this section we use the definitions and the notation of Meila [19]. It defines a *clustering* $\mathcal{C} = C_1, C_2, \ldots, C_K$ as a partition of a set of points, or a *data set* D of n elements into mutually disjoint subsets $C_1, C_2, \ldots, C_K$ called *clusters*, each of them with $n_1, n_2, \ldots, n_K$ elements, with $n = \sum_{k=1}^{K} n_k$. It also defines a second clustering of the same data set D, $\mathcal{C}' = C'_1, C'_2, \ldots, C'_{K'}$, with cluster sizes $n'_{k'}$.

2.7.1 Counting pairs measure: Rand index

A pair of points from D fall under one of this four possible cases, counted by variables N_{ij}:

- N_{11} number of point pairs that are in the same cluster both $\mathcal{C}$ and $\mathcal{C}'$,
- N_{00} number of point pairs in different clusters under both $\mathcal{C}$ and $\mathcal{C}'$,
- N_{10} number of point pairs in the same cluster under $\mathcal{C}$ but not under $\mathcal{C}'$,
- N_{01} number of point pairs in the same cluster under $\mathcal{C}'$ but not under $\mathcal{C}$.

The four counts always satisfy $N_{11} + N_{00} + N_{10} + N_{01} = n(n-1)/2$.

Rand index [27] is a measure based in counting pairs of points. It is defined as:

$$\mathcal{R}(\mathcal{C}, \mathcal{C}') = \frac{N_{11} + N_{00}}{n(n-1)/2}.$$

It takes values in the interval $[0, 1]$, with higher values when the clusters are more similar.

This measure is intuitive, but presents two problems: it has most of their values concentrated in a small interval near 1, and the value for the worst case differs a lot when considering different sets and partitions, in most cases it is in the interval $[0.5, 0.95]$. It complicates the interpretation of the numerical result.

2.7.2 Set matching measure: Dongen metric

Given two elements C_k and $C'_{k'}$ from clusters $\mathcal{C}$ and $\mathcal{C}'$, respectively, we denote with $n_{kk'}$ the number of elements of their intersection,

$$n_{kk'} = |C_k \cap C'_{k'}|.$$

Dongen metric [12] is based on identifying each element in one clustering with the most similar in the other, and vice-versa. Formally,

$$\mathcal{D}(\mathcal{C}, \mathcal{C}') = 2n - \sum_k \max_{k'} n_{kk'} - \sum_{k'} \max_k n_{kk'}.$$

This measure, which is a metric, takes values in the interval $[0, 2n]$, but in our work we will consider its normalized form, which consists in dividing the value by $2n$,

$$N\mathcal{D}(\mathcal{C}, \mathcal{C}') = \frac{\mathcal{D}(\mathcal{C}, \mathcal{C}')}{2n} = 1 - \frac{\sum_k \max_{k'} n_{kk'} - \sum_{k'} \max_k n_{kk'}}{2n},$$

measure called *normalized Dongen metric*, or, for more simplicity, also Dongen metric.

It presents the problem that it only finds a best match for each cluster, and does not analyse what happens to the unmatched part of the cluster.

2.7.3 Information theory measure: variation of information

This measure, of Meila [19], is a criterion based on information theory. In order to understand it, we need two concepts: how much information is in each of the clusterings, and how much information one clustering gives about the other.

Given the probability of a point to be in cluster k, $P(k) = \frac{n_k}{n}$, which is a random variable taking K values, the uncertainty about which cluster is it going to be in is equal to the *entropy* of the random variable

$$H(\mathcal{C}) = -\sum_{k=1}^{K} P(k) \log P(k),$$

known as the *entropy associated with clustering* $\mathcal{C}$. Entropy is always non-negative, and takes the value 0 only when there is no uncertainty, when there is only one cluster. Entropy is measured in bits.

Defining $P(k, k')$ as the probability that a point belongs to C_k in cluster $\mathcal{C}$ and to C'_k in $\mathcal{C}'$,

$$P(k, k') = \frac{|C_k \cap C'_{k'}|}{n},$$

the *mutual information* between the clusterings $\mathcal{C}$ and $\mathcal{C}'$ is

$$I(\mathcal{C}, \mathcal{C}') = \sum_{k=1}^{K} \sum_{k'=1}^{K'} P(k, k') \log \left(\frac{P(k, k')}{P(k)P(k')} \right).$$

Mutual information between clusterings is interpreted as the information that one clustering has about the other. Intuitively, given a point, the uncertainty about its cluster in $\mathcal{C}'$ is measured by $H(\mathcal{C}')$. Then, if we know which cluster the point belongs to in $\mathcal{C}$, the value of how much does this knowledge reduce the uncertainty about $\mathcal{C}'$ is equal to $I(\mathcal{C}, \mathcal{C}')$.

Variation of information, or *VI*, is defined as the the total uncertainty of the clusterings of all points in $\mathcal{C}$ and in $\mathcal{C}'$ minus the mutual information we know of one clustering knowing the other,

$$\begin{aligned} VI(\mathcal{C}, \mathcal{C}') &= [H(\mathcal{C}) - I(\mathcal{C}, \mathcal{C}')] + [H(\mathcal{C}' - I(\mathcal{C}, \mathcal{C}')] \\ &= H(\mathcal{C}) + H(\mathcal{C}') - 2I(\mathcal{C}, \mathcal{C}') \\ &= -\sum_{k=1}^{K} \sum_{k'=1}^{K'} \left[P(k, k') \log \left(\frac{P(k,k')}{P(k')} \right) + P(k, k') \log \left(\frac{P(k,k')}{P(k)} \right) \right] \end{aligned} .$$

VI is a metric which takes values in the interval $[0, \log n]$. It does not have the problems we have discussed for the previous measures, although its interpretation is not as intuitive as the interpretation of them.

In our work we will use its normalized form, which is called *normalized variation of information* or, for more simplicity, variation of information,

$$NVI(\mathcal{C}, \mathcal{C}') = \frac{VI(\mathcal{C}, \mathcal{C}')}{\log n} = -\frac{\sum_{k=1}^{K} \sum_{k'=1}^{K'} \left[P(k, k') \log \left(\frac{P(k,k')}{P(k')} \right) + P(k, k') \log \left(\frac{P(k,k')}{P(k)} \right) \right]}{\log n},$$

In our work we use similarity measures to compare results of community detection methods when applied to the `.cat` sites network. We are interested in evaluating how similar are this results in order to decide if communities found are significant or not. We use normalized Dongen metric and normalized variation of information in Chapters 4 and 5, although we will call them simply Dongen metric and *VI*.

2.8 Robustness

Once a community partition is obtained by some method, for example one of the explained ones in Section 2.5, we may ask ourselves if the division found is statistically significant or it could be as a result of chance. One approach to answer this question is based in the property of *robustness*, explained in an article of Karrer et al. [18].

The idea is that networks with a clear community structure have a global modularity maximum, while networks without it have many maximums of similar value, competing between them. This idea is inspired in physical experiments about glassy annealing, which revealed that high temperatures favoured poor divisions, whereas low temperatures facilitated better ones. In this second case, with good partitions, small changes to a network, for example the addition or removal of a few edges, would result in small changes in the modularity of the network. But the behaviour of the partitions found would be different depending on the strength of its community structure. In a network with a well-defined structure, small changes would result in small changes in the groups, but in a

network with a non-clear structure they may provoke important changes in the structure of communities, due to the fact of the many modularity maximums competing between them.

As a result, a simple way to determine if a network has a good community partition is to perturb the network and observe the resulting change in the optimal partition. The complete description of the method involves two problems:

1. How can we perturb a network?

2. How can we quantify changes in community structure?

We summarize a method, also from the same article [18], which succeeds in answering the two problems. This proposal is valid for undirected unweighted networks, although with little changes it could be applied to weighted and/or directed networks. It needs a community detection method to perform the study: the selected one is Newman's algorithm.

The approach to the first problem is the following. Consider the network of study as a graph G, with degree of vertex i equal to k_i. Then build a random graph G' with n vertices and m edges with the same edge distribution as the original one, an expected number of edges between vertices i and j equal to

$$e_{ij} = \frac{k_i k_j}{2m}.$$

G and G' share some properties: both have the same number of vertices and edges and the same edge distribution, but G' does not have community structure. The method, hence, consists of transforming the G into a new graph G'' with a random part and a part which remains equal to the original, both controlled with a parameter α. This is done in Algorithm 9.

Algorithm 9 Method to perturb a network

```
for each edge in the network do
  specify a threshold number α
  pick a random number r in the interval [0, 1]
  if r ≤ α then
    remove the edge from the network
    add a new edge to the network between a pair of vertices (i, j) chosen with
    probability e_ij/m
  else
    leave the edge as it is
  end if
end for
```

When α is equal to zero, no edges are moved and the method preserves the original network G. When α is equal to one, all edges are moved and the method generates a

random graph similar to G'. For intermediate values of α the method generates graphs similar to the original but with a random component, adjusted by the parameter.

This method can be arranged to consider direction of edges. In this case, the probability of each edge depends of the order of their vertices.

When applying this method, it can happen that some vertices become isolated, i.e., not related with others in the network. In this case, this vertex is considered to form a communities of only one element.

The second problem is answered using one of the measures explained in Section 2.7, intended to evaluate similarity between clusters. The measure chosen in the article of Karrer et al. is *VI*, variation of information, in its normalized form.

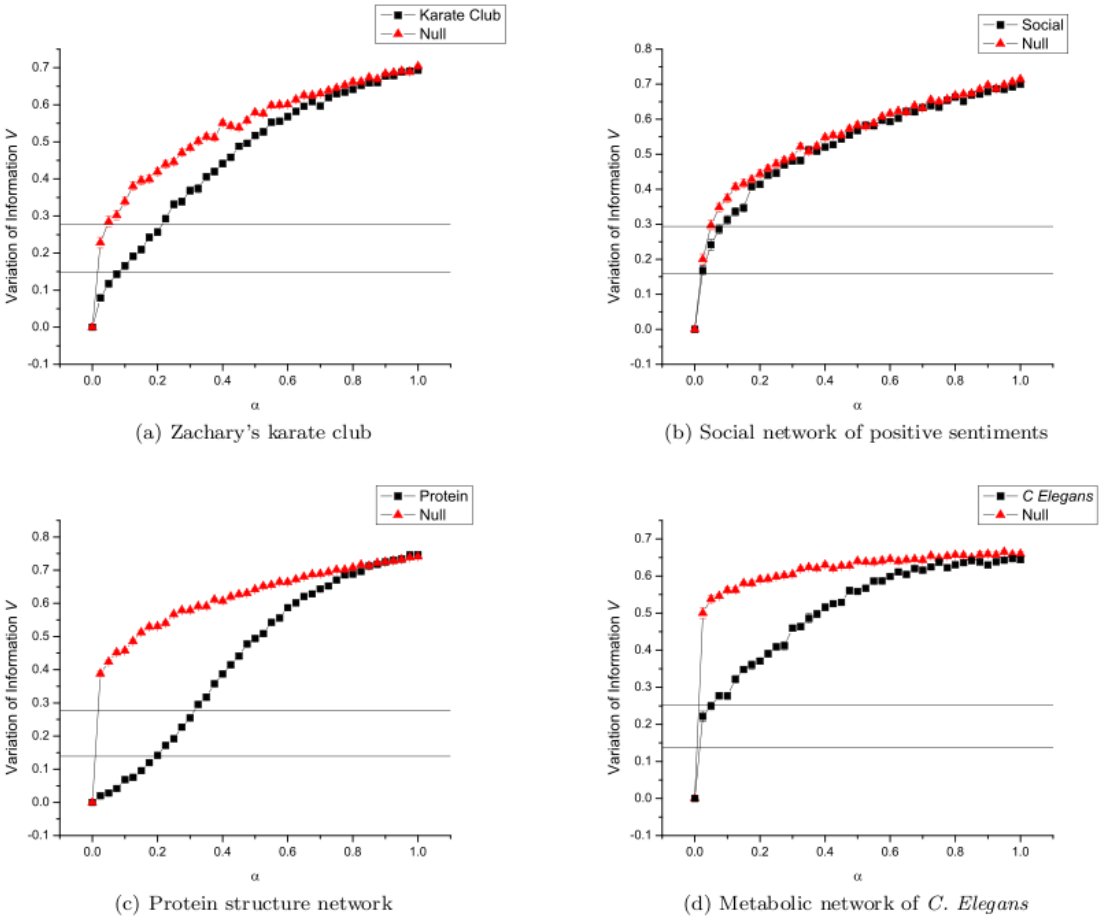
Similarity measures need to have the same vertices in each of the partitions considered. For this reason, in the first part of the method, all vertices are given in the partition, including those which are isolated from others.

The full method consists in the repetition of the two steps for different values of α, and applying the community detection method. Firstly the network is perturbed. Then the community detection method is applied to the perturbed network. In the original document, it was Newman's algorithm. Finally, *VI* is evaluated between structure of the initial networks and structure of this new network. The process is done in parallel with the original network and with a random one with the same degree distribution as the original.

This process is repeated several times (10 or 100), depending on the size of the network. In each of them, a different random network is generated. The average results are considered, as this helps to avoid the bias of one single execution. The *VI* results are the average of all repetitions. The step for α values is fixed to 0.025. As a result, α takes around 40 different values in the interval $[0, 1]$.

The interpretation of results is not trivial. In Figure 2.8 we show the examples discussed in the original document. Summarizing the main idea, *VI* on networks with no robustness of community structure has a similar evolution in the original and in the associated random network. In contrast, robust networks have values of *VI* substantially lower for the first values of *alpha* when compared to their respective random networks. Although this is true in general, interpretations must be done carefully, as other factors, like the concrete values of *VI*, give information about its robustness.

In our work we check the robustness of the `.cat` domain network, in Chapter 4. We apply the method developed by Karrer et al., although we may vary the community detection algorithm and the similarity measure.



(a) Zachary's karate club

(b) Social network of positive sentiments

(c) Protein structure network

(d) Metabolic network of *C. Elegans*

Figure 2.8: Variation of information as a function of the perturbation parameter α. Examples and figures from the original article of Karrer et al. [18]. In each case two networks are compared: the original one, with squares as symbols, and the random one with the same edge distribution, represented with triangles. In the first case, the community structure of the network is substantially more robust against perturbation than in the random graph, because in the first steps *VI* is much bigger for the random one. In the second network, *VI* is quite similar in the two cases, suggesting the community structure found in the original graph is not robust. The third example is perfect to illustrate a robust network. *VI* for the original network is approximately zero in the first steps of the perturbation, in contrast to what happens with the random network. Finally, the last example shows a graph that, although their community structure is substantially more robust than the one in the random, *VI* takes high values since the first steps, suggesting that possibly this is not as robust as it could seem in the first view.

Chapter 3

Available data

In this chapter we explain the available data for the realization of studies. We contextualize it, explaining why it is interesting, and we detail specifically in what data consists.

3.1 Context

As we explained in Section 1.2, the `.cat` top level domain is relatively young, opened up for registration in February 2009. It is administered by Fundació puntCat,[1] a non profit organization whose main objective is to promote the Catalan culture and language. The number of registered domains has been increasing since its opening: in April 2009 it had around 35.000 registered domains. In Figure 3.1 we have a graphic of its growing, and in Table A.1 the specific data.

Fundació puntCat is also interested in research around it. Since early days, this foundation has been performing monthly crawls of the pages of the whole domain, using *WIRE*, the web crawler described in Section 2.2. Now, three years after the opening, the size of the data collected is enough to be analysed. As Fundació puntCat collected data since the fist months, one of the most interesting studies that can be done is the study of its evolution, from the beginning to a reasonable level of maturity.

Fundació puntCat and Universitat Politènica de Catalunya (UPC) signed an agreement with the one puntCat data can be studied by researchers from UPC. This work is the result of this accord.

[1] Fundació puntCat. `http://www.domini.cat`

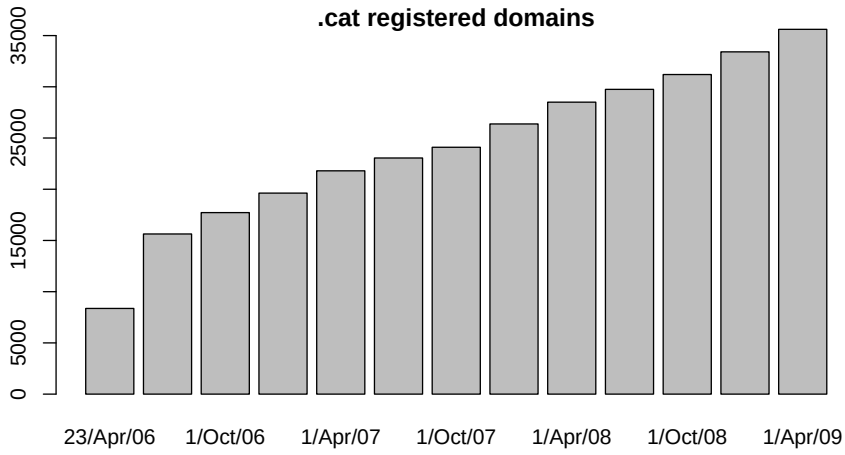


Figure 3.1: Evolution of the number of registered domains in the `.cat` top level domain. Information from Fundació puntCat web page, `http://www.domini.cat`. The number of domains increases continually. During the opening period of February-April 2006 the number of registered domains grew up until around 8.000. This quantity arrived to 35.000 in April 2009, the last month with available information.

3.2 Data selection

Initially, we disposed of the whole content of a `.cat` *WIRE* crawling, corresponding to March 2008. The dataset, including raw data, reports, and statistics, had a size of approximately 100 GB. We extracted two different graphs from this data: the `.cat` page network and and the `.cat` site network. The page network had more than a million vertices, whereas the site network had around 3.000 vertices. We applied community detection algorithms to this networks, and we observed that results for the page network were that most or all pages from the same domain appeared together in the same community. On the contrary, the site network was fully unforeseeable. With this results we discarded to analyse the page networks and we decided to focus our attention in the site ones, as presumably, analyzing at the site level provides the same information with much smaller cost.

After analysing the full dataset and defining our work, we decided that we needed the following files from the `.cat` crawlings for the realization of our studies:

- The list of existing sites in each specific moment.
- The Web component in which each of them belongs to, which we will use to perform Web dynamics studies, like the ones in Subsection 2.3.1.
- The weighted directed graph structure of the links between sites in each specific moment. It would allow the possibility of considering graphs in different manners:
  - undirected unweighted

Month	Year
May	2007
September	2007
January	2008
March	2008
May	2008
January	2009
March	2009

Table 3.1: Months with data from the `.cat` domain chosen for this study

- undirected weighted
- directed unweighted
- directed weighted

Fundació puntCat informed us that data collected in the first months was not reliable, because only a little part of the domain was taken into account in the crawlings, and that information stored by them, in those first months, only contained some statistics, not the whole graph.

Despite this problem, we intended to study data from many months, even if it did not include the beginning of the domain. We only avoid using data from consecutive months, as we thought it was not relevant when analysing evolution during a relatively long period of time. We preferred to have data from as well distributed as possible months. We also found the problem that data from some months was unusable, due to the fact that some configuration parameters, including the used version of *WIRE*, were not known. Finally, we got data from seven different months, May 2007, September 2007, January 2008, March 2008, May 2008, January 2009, and March 2009. They are shown in Table 3.1.

We were a bit disappointed for not not disposing of data from the first months, but we solved it by reorienting our studies, focused since then in community detection and community analysis, instead of community evolution. Probably, if we had disposed of the full data, we could have observed evolution of communities since its beginning. Also it could have been interesting to check the moment in which the `.cat` network became an scale-free network, or if since its beginning the network exhibited this property.

We observed that the collection of data of Fundació puntCat only included sites following the format `http://www.*.cat`, with `*` replaced by any word without full stops. This fact is a bit surprising for us, as we carried out independent crawlings of the `.cat` domain and we found an amount of sites which did not follow this format. For example, we collected around 2.000 sites from the page `http://www.bloc.cat`, specialised in blogs, which had the format `http://*.bloc.cat`. On the contrary, data from Fundació puntCat only included the site `http://www.bloc.cat` on its repository. There are reasons supporting the two options. If we do not accept sites without the

www prefix and without full stops in its middle part, we avoid repetition of sites which have the two formats, with the prefix and without it, like http://www.bloc.cat and http://bloc.cat. But, if we allow all possible sites, we collect a greater number of sites when compared to the other possible collection.

To sum up, our available data consists on the http://www.*.cat site network of seven months, which we will call the *.cat site network*, with additional information as the Web component in which each site belongs to and the complete list of existing sites in each concrete moment. The total size of this data is of approximately 10 MB, a number extremely low when compared to the initial 100 GB of a simple month. This is because we only got specific information necessary for our studies and we avoided getting unnecessary data, reports, and statistics. This data allows us to perform studies about the .cat domain, checking its evolution and growth during a period of two years, approximately. Additionally, data permits the realization of community structure studies to check if the .cat sites are grouped in any understandable way, or if not.

Chapter 4

Static studies

We present in this chapter the studies carried out involving in each time only one collection of data of one month, which we call *static studies*. Firstly, we study general properties of this graphs: basic properties, degree distributions, and migration of sites. We reproduce studies from works of Baeza-Yates et al. [1] [3], where national Web domains are considered. After it, we focus in studies about community structure of networks, the main part of this project. Specifically, they are: modularity of graphs, distribution of communities encountered, similarity of distinct community partitions and robustness of community structure. We also reproduce some experiments with little variations on the structure of networks in order to see particularities of them. Finally, we provide a method to characterise the found communities, which is not based on subjectivity of the expert, but in an objective measure. Its main idea is the following: words which appear in most sites of one community provide meaningful information about which community it is.

As we displayed in Table 3.1, we analyse data from non-consecutive months. In most of cases we consider networks in their undirected unweighted form, as it is the simplest way to analyse them. When no explicit distinction will be done, we will understand networks in this way, which we will call *classic form*.

The key point of the chapter is the study of community partitions obtained with different methods. This part is basic for further studies: similarity, robustness and the identification of communities depend strongly of it. For this reason we will explain this part in detail. We divide this chapter in two parts, for more clarity: methodology and results. In methodology, we describe the studies performed, and we include references to previous related work. In results, we show the obtained results, and we discuss and analyse them. We suggest two possible ways to read this chapter. One is to switch between the explanation of the methodology and the results of each study. This is the way in which we have written the chapter, so it will be understood perfectly. The other, of course, consists on reading the chapter linearly, starting with all the methodology and finalising with the obtained results, or only focusing in one of these two parts.

4.1 Methodology

4.1.1 Basic graph properties

Initially we perform the study of basic properties of the `.cat` site network. They are the following:

- Number of sites
- Number of links between sites
- Number of sites with links
- Number of connected components, considering the network in its classic form
- Size of the main connected component, considering the network in its classic form

The objective of this study is to observe their evolution with the passage of time, how these properties change with the advance of months. As the `.cat` domain, and the Web in general, are still in a growing phase, expected results should show a growing tendency in most of measures. In addition, results should show the fact that sites are becoming more related between them. One important thing must be remarked: when we study the number of connected components, there are shown only components of size greater than one: we do not consider sites which are not linked with any other site in the `.cat` domain. Recall again that networks are considered in their classic form, which means they are undirected and unweighted.

Like in all studies carried out in this chapter, results are shown and discussed further. Results of basic graph properties are in Subsection 4.2.1.

4.1.2 In and out-degree distributions

The next study of the `.cat` domain is focused on the in and out-degree distributions of the sites. Clearly, in this study networks are directed. We consider them also unweighted. This study consists in calculating how frequent are sites with a concrete value of the in or out-degree. As we saw in Figures 2.4 and 2.5 previously, the expected results are that degree distributions follow power laws: functions of the form $P_{in}(k) \propto k^{-\lambda}$, where $P_{in}(k)$ is the fraction of sites with in-degree equal to k, and similarly for the out-degree. In these distributions, a high number of sites have a low degree, whereas only few of them exhibit a high degree. They are the tail of the distribution.

In order to estimate the coefficient λ of the power law we have used the method `power.law.fit` from the `igraph` library,[1] which is based in maximum likelihood methods, as it is recommended in an article of Newman [21].

This study is important to check if the `.cat` site network has a complex network behaviour, with degree distributions according with their corresponding power laws, or

[1] `igraph` library for complex network research. `http://igraph.sourceforge.net`

in contrast it exhibits a different behaviour corresponding to a transitory state until the moment the graph becomes a complex network.

Results are shown and discussed in Subsection 4.2.2. Their structure is like the ones appeared in the study of other national Web domains [1].

4.1.3 Web graph

The next study puts its attention in web dynamics: how, with the passage of time, sites become related with other sites in terms of the web graph structure shown in Figure 2.2. Here we reproduce one study of dynamics of a national domain [3] applied to the `.cat` site network. We analyse the number of elements of each component of the Web graph. We want to know if there is any tendency in the sites in this graph. In this study we take profit of additional data provided with the crawler, which for each site it indicates in which component of the graph it belongs to.

Results are shown and discussed in Subsection 4.2.3.

4.1.4 Community partition: modularity

From now on we study characteristics related with the property of community structure. We apply the methods for community detection explained in Section 2.5 to the `.cat` site network: Extremal Optimization, a divisive method, Newman's algorithm, based on spectral analysis, PBD algorithm, which combines spectral analysis and modularity optimization, and Louvain, based on the construction of simple networks where vertices are communities. We analyse the quality of the partitions obtained in terms of modularity and number of communities. In the case of EO method, which generates different community partitions in each execution, as it has a random part, we apply it 3 times, and the modularity we take into account is the average of them.

When checking the performance of methods for community detection, six networks have become a benchmark. Lots of methods are tested by analysing their performance in them. Before analysing the `.cat` site network, we have repeated the experiments with our available methods, in order to check if our implementation of Newman's algorithm [22] (we do not have the original source), is correct, and to evaluate the behaviour of all methods. The benchmark networks are the following:

karate The first of these networks is the *karate* network. It represents the social interaction between a group of 34 people which were members of a karate club.

jazz The second is the *jazz* network, a network of 198 jazz musicians in which two musicians are related if they have played together in at least one occasion.

celegans The third is the *celegans* network, a network of 453 vertices representing the metabolism of this organism.

email The fourth is the *email* network, representing the emails between 1133 students.

key The fifth is the *key* network, representing the 10680 users of the PGP algorithm for secure transactions.[2]

phis The last is the *physicists* network, consisting of 27519 authors and their coautorship relations in the field of condensed matter.[3]

A new meta-method: cluster algorithm

Apart from the four explained methods, we propose a new one which uses the information generated by the others. Our idea is to have a method that, with results from the other ones, will be good enough to correct particular classification errors of a single method. We also want to check how a method not based in evaluate modularity performs in the problem of community detection.

This new method works as follows: from the partitions found by the four known methods, it generates a hierarchical clustering. In order to do this, we define a dissimilarity measure between each pair of sites of the following manner:

$$d(i,j) = 1 - \frac{[c_{EO}(i,j) + c_N(i,j) + c_{PBD}(i,j) + c_L(i,j)]}{4},$$

where $c_k(i,j)$ is 1 if method k classifies site i and site j in the same community and 0 if not. As we can see, $d(i,j)$ is a measure which takes values between 0 and 1, with low values if i and j are more similar. We remark that this measure is not proved to be a distance, it only compares how similar are each pair of vertices. But this is exactly what hierarchical clustering methods need for their classification. Once we have the hierarchical structure, we search the split of the hierarchical structure which gives the higher value of modularity. In order to avoid an excessive computation time, we only evaluate the results with a number of communities multiple of 10: 10, 20, 30, 40, and so on. Algorithm 10 summarizes the process.

Algorithm 10 Cluster algorithm using information from other methods

read the community partitions of EO, Newman, PBD and Louvain
construct the dissimilarity structure $d(i,j)$ as explained in the text
perform a hierarchical clustering of the sites
choose the partition which gives the best value of modularity

We check all the methods to networks in their classic form (undirected unweighted), for more simplicity. However, we also check the methods we can with different cases, taking the network weighted and/or directed. As we said previously, we are interested in finding the method which gives the best community partition, in terms of modularity, for further use in our studies.

All results are shown and discussed in Subsection 4.2.4.

[2] `jazz`, `celegans`, `email`, and `key` networks available in Arenas network datasets: `http://deim.urv.cat/~aarenas/data/welcome.htm`

[3] `karate` and `phis` networks available in Newman's data repository: `http://www-personal.umich.edu/~mejn/netdata/`

4.1.5 Size of communities

Size of community partitions is also a characteristic property of scale free networks. We analyse if the size of the communities found by our methods also follow power laws, which would be another confirmation of the complex network property of these networks.

Results are shown in Subsection 4.2.5.

4.1.6 Similarity

As we explained in Subsection 2.7, we can compare different community partitions of the same data found by different methods by using similarity measures. We use normalized Dongen metric, based on set matching, and normalized variation of information metric, based on information theory, and we will call them simply Dongen metric and *VI*. Both of them take values in the interval $[0, 1]$.

We compare the methods for undirected unweighted networks in each of the months. Additionally we show results of other networks. In this case, we consider separately each different execution of EO method. We think it is interesting to check if results of this algorithm are more similar between them or they are equally similar to results from other methods. We show the results in two ways, in tables and in two-dimensional plots, with methods related in a square matrix and similarity results shown in different colours, which indicate if the distance between partitions is small (high similarity, in clear colours), or big (low similarity, in dark colours).

All results are shown and discussed in Subsection 4.2.6.

4.1.7 Robustness

We apply the method explained in Section 2.8 to check robustness of the `.cat` site network against small perturbations, in order to evaluate the quality of the community partitions found.

We use, like in the article of Karrer et al. [18], *VI* to compare similarity between the successive partitions of the modified network respect to the initial ones. However, there are two differences between our application and the methodology of the original article. The fist one is the method used to detect community structure. In contrast to Newman's algorithm, used in the original article, we use Louvain algorithm, which performs faster and gives better results in terms of modularity for our networks. The second one is the fact that we do not repeat several times the process, due to time reasons. Our networks are substantially larger and in each execution we need to perturb two networks, the original and the random one, find the best community partition and evaluate its *VI* respect to the original ones. A single process of perturbing, finding community partition and evaluation of *VI* takes approximately 15 minutes in a standard PC. Variance generated with this simplification of the method is not meaningful, as we will see in the results, because we do not observe important perturbations in the tendency of *VI*. Therefore, we consider good enough this method in the way we apply it.

Before applying the method to our study case we have repeated the study with the first network of these studied in the original article, the karate network, in order to validate our method implementation. Our results coincide visually with the original ones. After this test, we consider that we are in conditions to carry out this experiment with our networks.

Our `.cat` site network is studied in their classic form (undirected unweighted). We do it in this way because the method to perturb networks does not consider direction of edges, and there is no meaningful difference between results considering weights and/or directions or without.

All results are shown and discussed in Subsection 4.2.7.

4.1.8 Variations

This subsection contains studies in which we have used variations of the `.cat` site network: studies with only the main connected component and studies with only the largest communities.

Networks of the `.cat` site domain are composed by a considerable number of connected components, as we have in Subsection 4.2.1. Now we ask if studies involving only the main connected component give the same or different results. We focus in the network of March 2008, studying modularity, similarity and robustness of the main connected component.

We also want to know if similarity changes when considering only the largest communities of each method, the minimum number of them which contain the 60% of the total number of sites, and not taking into account the dissimilarity caused by the small communities. We also use Dongen metric and *VI*, but now there is a difference with the way we applied these similarity measures before. Now, order of methods considered matters. The selection of the most relevant communities and sites depends of one method, so it is necessary to repeat the study two times, one of them depending of the first method, i, and the other depending of the second, j. Recall that similarity measures need to have the same elements in the two partitions evaluated. As a result, we have that $VI(i, j)$ can be different of $VI(j, i)$, and the same happens with $\mathcal{D}(i, j)$ and $\mathcal{D}(j, i)$. In results we show the pair of results or each pair of methods measured.

All results are shown and discussed in Subsection 4.2.8.

4.1.9 Characterization of communities

The last study of this chapter is focused on the problem of community characterization. After the application of community detection methods to a network we obtain a list of communities with vertices belonging to one of them. The problem of our attention is how can we make the result easily understandable even if the number of elements and communities is substantially big.

A semantic problem

This study is a bit different from the others explained previously in this work: all what we have done until now is valid for all kind of complex networks: biological networks, economic networks, personal relationship networks, Web networks... The interpretation of the resulting communities, however, is specific of each concrete network semantics. This means that it is necessary to know what the network's vertices and edges mean, and go back to the specific area of knowledge to interpret the results. We illustrate this with one example: the food relation web between organisms.

Example 1 *Suppose we have applied community detection algorithms on the food relation web and we have found some communities in it. A possible way to summarize them consists in analysing which vertices of the network are related, looking for common characteristics of organisms classified in the same community. Probably we will have found a different community for each subcategory of eukaryotes organisms: animals, plants, fungi..., or maybe communities will have divided organisms depending on their ecosystems: aquatic, terrestrial, marine, desert, rainforest, urban...*

The interpretation analysing the vertices classified into the same community is an interesting way to proceed. We have applied this method to the `.cat` site network.

First approach: analysing communities by site names

Firstly, we analyse the `.cat` site network as it is done in Example 1: by looking at sites classified together in the same community. Since we have to perform this study manually, for time and effort reasons we have used only the data from the last available month, March 2009. Of course, the process described here can be applied to the other months without any extra problem, only the time required to classify each community.

Although this first approach is interesting, its problems are, of course, the subjective interpretation inherent in it, and the effort required to carry it out for large communities. For communities of small size it is not an important problem, as every subjective interpretation coincides in global terms. However, with communities of large size (more than 100 elements, for example) disagreements can be important between interpretations of different people. We comment the results obtained after the application of Louvain's method to the `.cat` site network of March 2009. This discussion is found in Subsection 4.2.9. Recall that the community has 6.400 sites and 180 communities.

Second approach: analysing communities by site contents

We perform a second study to analyse communities. Like the previous one, we have focused in the interpretation of communities of March 2009, although the method we explain is valid for all available months.

Using the fact that Web pages contain information, we propose a method which analyses the content of each site, and elaborates a ranking of the most frequent words, which are used to facilitate the interpretation of communities. In order to perform this study we make three assumptions which, from our point of view, do not interfere decisively in the results. They are the following:

- We only study the content of the main page of each site, for simplicity and size restrictions.
- We assume that the topic of a site was the same when we performed this study, in May 2009, and when the original crawling took place, in March 2009. With this assumption we consider that the words found with our method are similar to the words that were in sites in the moment of the original crawling. A possible variation of the study consists in studying directly the raw data obtained from the crawling. However, we discarded this possibility due to size restrictions and due to the impossibility of collecting data from all the months we studied. This method has the advantage that does not depend of the crawler used, as data is collected independently of it.
- We assume that the content of the pages is written in Catalan language.

Our initial approaches to the problem, consisting basically in elaborating a ranking of the most frequent words for each community, were not successful. We needed to do modifications so as to get meaningful results. We took into account several facts in our final method, which are:

- Avoid the most frequent Catalan words. In our initial approaches we found the most frequent Catalan words in the most frequent words of communities, so we decided to avoid them by filtering around 250 words from a fixed list.
- Consider only words appearing in at least the 10 % of sites from each community. We decided to incorporate this restriction because we found results in which the most frequent words were exclusive from only a little portion of the sites of a community.
- Normalize the frequency of words, in order to avoid the fact that sites with long content have their words more well considered than sites with short content. We explain this with more detail in the following paragraphs.

In order to explain the proposed method we need to define some measures. Given the content of a site, we define the *frequency of word w in site s*, f_s^w, as the number of

times word w appears on site s,

$$f_s^w = \text{number of apparitions of } w \text{ in } s.$$

We also define the *normalized frequency of word w in site s*, n_s^w, as their frequency divided by the sum of all frequencies of words of site s,

$$n_s^w = \frac{f_s^w}{\sum_{v \in s} f_s^v}.$$

This measure allows us to correct the bias given by pages with an extensive content, because the sum of all frequencies for each page is 1,

$$\sum_{w \in s} n_s^w = \frac{\sum_{w \in s} f_s^w}{\sum_{v \in s} f_s^v} = 1.$$

The *normalized frequency of word w in community c*, N_c^w, is obtained by adding the normalized frequencies of w in all sites from c and dividing the value by the number of sites of the community,

$$N_c^w = \frac{\sum_{s \in c} n_s^w}{\text{size of community } c}.$$

The normalized frequency of word also takes values between 0 and 1, and the total sum, for all words in a community, is 1,

$$\sum_{w \in c} N_c^w = 1.$$

This measure allows us to consider the most frequent words of each community c, with each site from community c contributing in the same quantity to the ranking. However, we must compare these frequencies with the frequencies of words in all sites, in order to detect words that are specifically important in each concrete community. To do this, we define the *total frequency of word w*, $\mathcal{F}^w$, as the number of apparitions of word w in all sites,

$$\mathcal{F}^w = \text{number of apparitions of } w \text{ in all sites},$$

and the *normalized total frequency of word w*, $\mathcal{N}^w$, defined as its total frequency divided by the sum of total frequencies of all words, analogously to what we did with the previous measures,

$$\mathcal{N}^w = \frac{\mathcal{F}^w}{\sum_v \mathcal{F}^v}.$$

Finally, we remark that the sum of the normalized total frequencies of all words is 1,

$$\sum_w \mathcal{N}^w = 1.$$

The measure in which we focus our attention is the *significance of a word w in a community c*, defined as the quotient between the frequency of w in c and the normalized total frequency of w,

$$s_c^w = \frac{N_c^w}{\mathcal{N}^w}.$$

Basically, the higher the value of s_c^w, the more meaningful word w for community c. Supposing all communities of the same size, and the same distribution of words in each of them, we would find values of s_c^w equal to 1, as the normalized frequency of word w in each community would be the same as the normalized frequency of w in the full network. We summarize it saying that meaningful words in communities must have a value of significance greater than 1. We illustrate the calculus of these measures, specially the significance, with a simple example.

Example 2 *Suppose we have two communities,* 1 *and* 2*, two pages in each of them, a and b in community* 1 *and c and d in community* 2*, and only two words, w and v in each of them, with the following frequencies:*

		w	v
1	a	$f_a^w = 1$	$f_a^v = 2$
	b	$f_b^w = 1$	$f_b^v = 1$
2	c	$f_c^w = 2$	$f_c^v = 0$
	d	$f_d^w = 2$	$f_d^v = 1$

then we have

$$\begin{array}{ll} \mathcal{N}^w = 6/10 & \mathcal{N}^v = 4/10 \\ N_1^w = \frac{1/3+1/2}{2} = 5/12 & N_1^v = \frac{2/3+1/2}{2} = 7/12 \\ N_2^w = \frac{1+2/3}{2} = 5/6 & N_2^v = \frac{0+1/3}{2} = 1/6 \end{array}$$

and the significance, for each word an community, is

$$\begin{array}{ll} s_1^w = \frac{5/12}{6/10} = 0.69 & s_1^v = \frac{7/12}{4/10} = 1.46 \\ s_2^w = \frac{5/6}{6/10} = 1.39 & s_2^v = \frac{1/6}{4/10} = 0.42 \end{array}$$

We observe that the meaningful words are v for community 1 and w for community 2, and, although w appears more times in 2 than v in 1, the fact of considering normalized frequencies contributes to give similar values of significance for them, with s_2^w equal to 1.39 and s_1^v equal to 1.46. These values are not far from 1, so the interpretation must be done carefully. We can only say that, in community 1, word v has more presence and, in community 2, word w is the dominant one.

Our method consists in obtaining the most significant words for each community, with the restrictions that they must not belong to the list of the Catalan language most common words, and they must be present in at least a 10 % of the total sites of the community. We decided to select 20 words from each community, as it is a quantity lower enough to make interpretations and higher enough to produce interesting results.

The explanation of the full method is the following, which we also summarize in algorithm 11 for a better understanding. Initially, we get the content of the associated Web pages of all sites (with the command `wget`), we convert the format from HTML to

plain text (with the command `html2text`) and we store their content. We calculate the normalized frequency of each word w in each site s, n_s^w. Once we have analysed all sites we calculate the total normalized frequency of each word w, $\mathcal{N}^w$. Then, for each community c we calculate the normalized frequency for each word w, N_c^w, and its significance, s_c^w, dividing N_c^w by $\mathcal{N}^w$. Finally, we select the 20 words with higher significance, with the conditions that they cannot belong to the most common words of Catalan language, and they must be present in at least a 10 % of the total sites of the community. These selected words are the ones we will use to identify the community.

Algorithm 11 Method to obtain meaningful words for a community

for each site s **do**
  get the content of the site's main page
  convert the HTML page to plain text
  for each word w **do**
    calculate the normalized frequency of w in s, n_s^w
  end for
end for
for each word w **do**
  obtain its normalized total frequency, $\mathcal{N}^w$
end for
for each community c **do**
  for each word w **do**
    calculate the normalized frequency of w in c, N_c^w
    calculate the significance of w in c, s_c^w, dividing N_c^w by $\mathcal{N}^w$
  end for
  select, from the words that are not common of the Catalan language, the 20 ones with higher significance in community c and that are present in at least in the 10 % of the total sites of community c
end for

In Subsection 4.2.9 we show and comment the obtained results of our method when applied to the communities found by Louvain's algorithm in the `.cat` site network of March 2009. We use the method in two ways. Initially we check its performance with the well known communities, the ones we were able to identify only with the names of the sites belonging to them. Then, we use this method to describe the unidentified communities.

4.2 Results

4.2.1 Basic graph properties

We show results of basic graph properties in two ways, which contain the same information: in Figure 4.1, graphically, better for a general overview, and in Table A.2 in one appendix, numerically. They contain the values for the basic graph properties of the `.cat` site network.

The analysis of the concrete values for each of the properties, considering the `.cat` site network in its classic form, is the following.

Sites The number of sites was bounded to 20.000 in the first two months (May 2007 and November 2007), due to errors in configuration parameters of the crawler. After this little problem, the value increases in successive months finishing on approximately 35.000 in the last month, March 2009.

Links The number of links between sites decreases between the first (7.550) and the second month (7.004). This fact is probably related with the bounded number of sites. Not all the sites were studied in these months and the ones selected in the first month had more links than the ones selected in the second month. In the other months the number of links increases, finishing with a value of approximately 30.000.

Sites with links A surprising fact is the low number of sites with links when compared with the total number of sites. Less than the 20 % of sites had links in each month. One plausible explanation is that Fundació puntCat used the full list of registered sites when doing their crawling, although many of them were relatively recent and did not have interesting content in their pages. These sites would not have appeared in the list if the crawling were not done using this a priori knowledge. The number of sites decreases between the first and the second month, and then increases, from around 2.500 to 6.500.

Number of connected components The number of connected components increases in each pair of consecutive months, from 84 in the first to 158 in the last. We remark again that this value only considers components of size greater than one: isolated vertices are not considered.

Size of the main connected component More than the 85 % of sites with links in each month belong to the main connected component of the network. We have also checked that the size of the other connected components is low, most of them only having two or three sites.

These measures agree with the growing tendency of the domain. In general we observe growing values for the number of sites, links and sites with links. A somewhat surprising result is the growing number of connected components. One could think that, as the sites of the `.cat` domain become more related between them, the number of connected

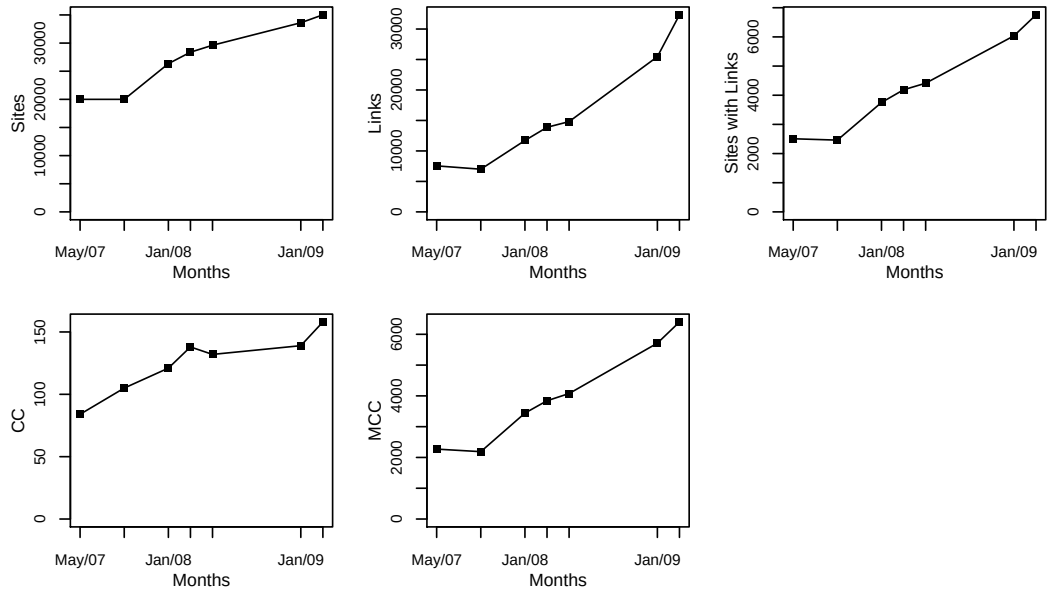


Figure 4.1: Plots of basic graph properties of the `.cat` domain. They are, from left to right: number of sites, links, sites with links, number of connected components, and size of the main connected component.

components should decrease with the pass of time. This is true, but we must also take into account the fact that at every moment new sites appear to the domain, and some of them exist for some time before adding links to their pages or being linked from another sites, or only linked to sites they know very well, for example sites from the same managerial group. These sites stay a lot of time in a connected component of small size: our manual inspection of them shows that most of them have sizes of 2 or 3. The increasing size of the main connected component is also a point in the fact of the growing tendency.

4.2.2 In and out-degree distributions

Results of degree distributions are shown in the same way than in Figures 2.4 and 2.5. They are in Figure 4.2, for the in-degree, and in Figure 4.3, for the out-degree. These figures contain the plots, in logarithmic axes, of the degree distributions of the `.cat` site network. The plots also have the values of the average degree and the λ value of the power laws: $P_{in}(k) = k^{-\lambda}$ and $P_{out}(k) = k^{-\lambda}$.

As we can see, in both cases the distributions are well adjusted, at least for the first values of degree, with straight lines corresponding to the power laws with the given exponent. This confirms that, in all months, the graph has a complex network structure, instead of an strange behaviour which would mean a transitory state. This transitory state, an interesting study case, probably would be found in previous months, but,

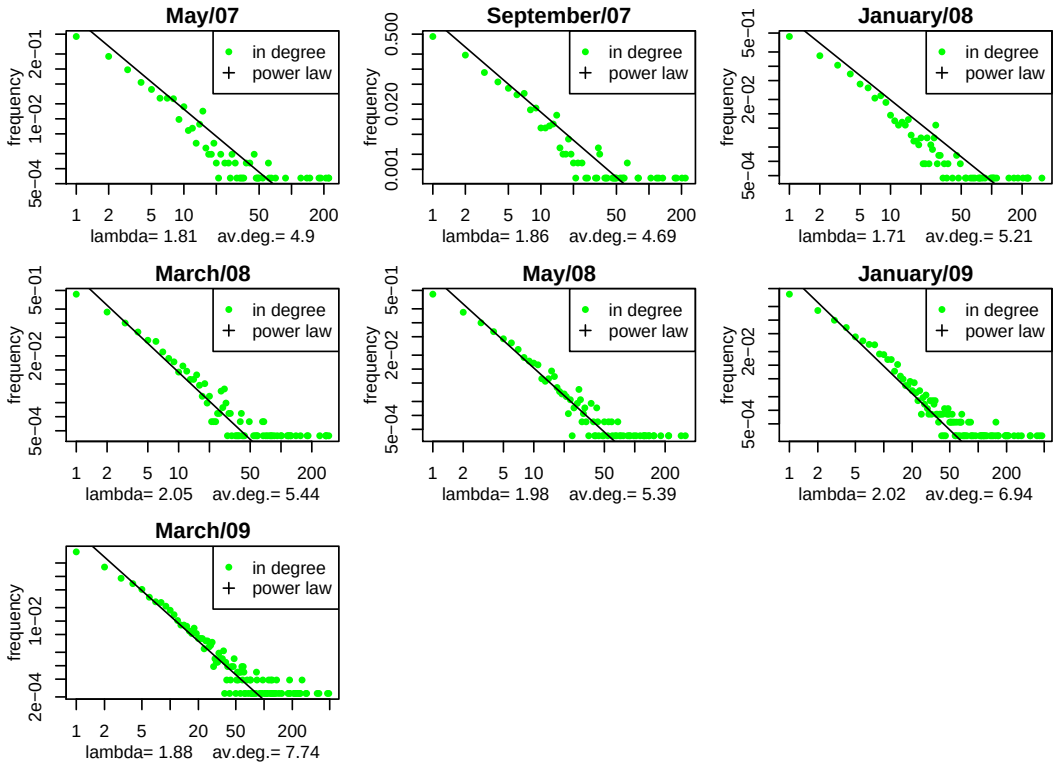


Figure 4.2: Plots of the in-degree distribution of the `.cat` site network of each month. We observe they follow power laws $P(k) = k^{-\lambda}$, with exponent λ around 2, at least for the first values of degree. They also include the average degree for sites with at least one in-link.

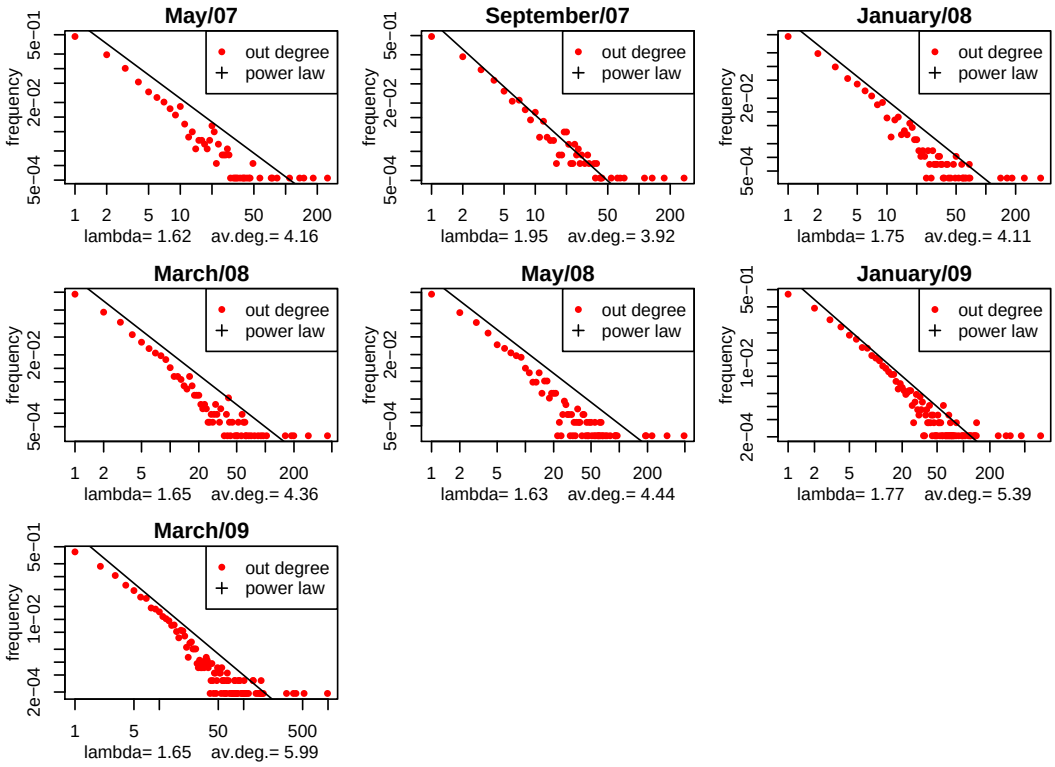


Figure 4.3: Plots of the out-degree distribution of the `.cat` site network of each month. We observe they follow power laws $P(k) = k^{-\lambda}$, with exponent λ around 1.75, at least for the first values of degree. They also include the average degree for sites with at least one out-link.

unfortunately, we do not have available data.

In the following lines we comment specifically each of the two distributions.

In-degree Values for the exponent of the power law in the in-degree distributions vary from 1.81 to 2.05. These values coincide with the encountered values in other national domains, for example the ones in Figure 2.4, where the values for the in-degree went from 1.2 to 2.0. The average in-degree varies from 4.9 to 7.74. In this case we observe different values when we compare these results to the average in-degree of other domains, which are greater, with values between 5.4 and 138.8. This is related with the fact that the `.cat` domain has few sites when compared to other national domains, its lower average degree is probably caused because each site has less possibilities to link other sites.

Out-degree Values for the exponent of the power law in the out-degree distributions vary from 1.62 to 1.95. These values also coincide with the encountered values in other national domains like the ones in Figure 2.5, with values from 1.3 to 1.9. Again, like in the in-degree case, the average degree is substantially lower than the values in other national domains. In the `.cat` domain, the average out-degree of the site network takes values from 3.92 to 5.99, whereas in other countries it moves between 8.0 and 112.2.

From the results we observe that the `.cat` site network has its degree distributions following power laws even in the first month we analysed it. It could have been a reasonable situation to have found a different structure for the network in the first studied months, for example with degree distributions not following power laws. In this case we could have studied differences between months exhibiting power law structures for its degree distributions and months without it. As results in all months share similar distributions, we do not distinguish any network and we continue our studies taking into account all of them in the same manner.

The growing tendency of the average in and out-degrees suggests that the `.cat` network has not reached yet an state in which we would observe stabilized average values. We do not know if this state is typical from national networks, or not. Future research around this measure would give more information: perhaps a situation with similar average values for near periods of time would indicate the total maturity of a complex network.

4.2.3 Web graph

Figure 4.4 contains a bar chart with the percentage of sites belonging to every component of the `.cat` site network for the available months. An explanation of the different components is found in Figure 2.2.

We observe that the structure is more or less the same in each studied month, so we will discuss the results in general terms, not focusing in particularities of a concrete month.

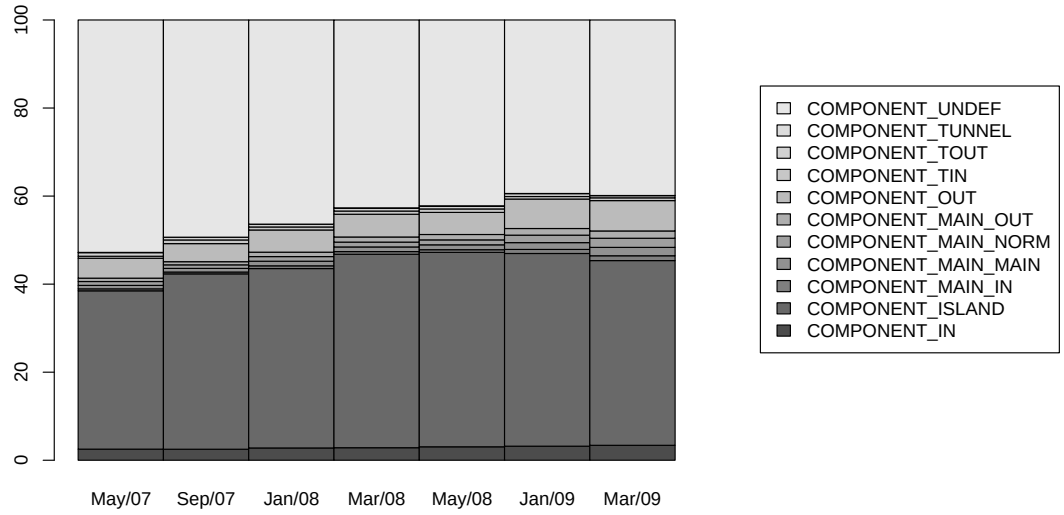
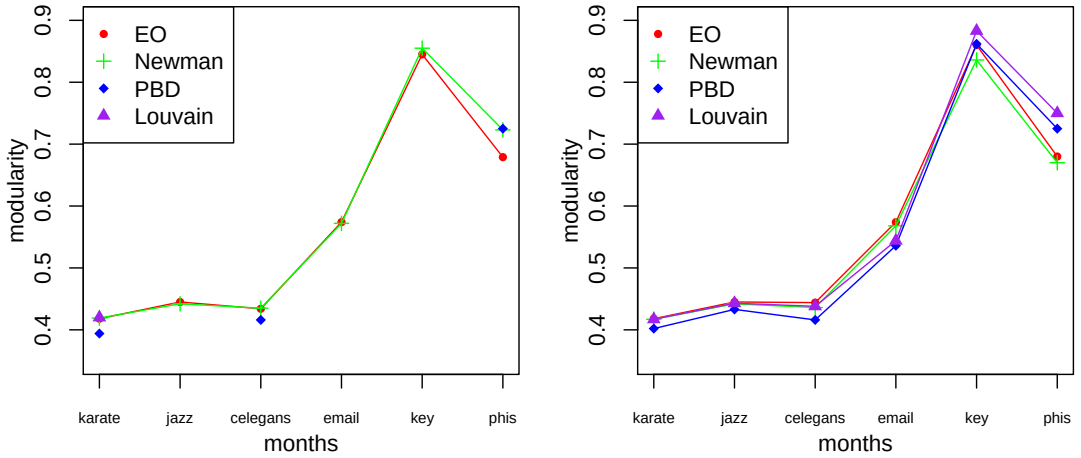


Figure 4.4: Bar chart with the percentage of sites for each component of the `.cat` site networks. The high number of sites from which the crawler does not know their status is high, between 40 % and 50 % in each month.

A high percentage of sites, more than the 40 % in each month, stay in the undefined component. This fact is surprising, and indicates that the crawler did not have enough information to classify them into any component when it finished. We notice that the percentage of sites belonging to this component decreases with the pass of time. This is probably related with a better configuration of the crawler parameters, which allowed obtaining better results. The group of ISLANDS, with disconnected vertices, is also high, with a fraction of 30% of sites. It agrees with the idea of a growing domain, with lots of pages appearing recently and not known yet by other pages. Even though this tendency is interpretable in this way, what surprises is the high value of this percentage.

Components IN, OUT, and MAIN, this last including their subcomponents, have approximately the same quantity of sites in each of them, corresponding with the 5 % of the total. TENDRILS and TUNNEL components have a negligible percentage of sites.

We have compared these results with the original ones from the Chilean web of the article of Baeza-Yates et al. [3]. Apart from the bias provided by the big number of unknown sites in our networks, our plot and the plot of the literature share things in common: in all of them the ISLANDS component is the largest one, followed by OUT, IN and MAIN. TENDRILS and TUNNEL have only a low percentage of sites.



(a) Benchmark networks. Modularity in literature **(b)** Benchmark networks. Our modularity

Figure 4.5: Results in terms of modularity for the benchmark networks. Their sizes are: 34 vertices for the karate network, 198 for the jazz, 453 for the celegans, 1133 for the email, 10680 for the key and 27519 for the physicists. Figure 4.5a shows results appeared in literature, although they are incomplete. Figure 4.5b shows our obtained results. They are nearly the same, except for Newman's method, in which our implementation is not perfect.

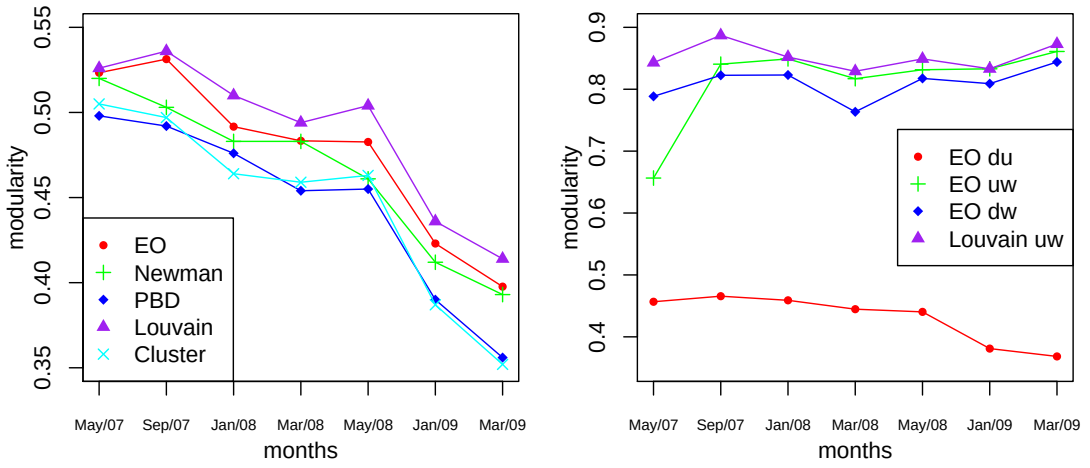
4.2.4 Community partition: modularity

Figure 4.5 and Table A.3 show values of modularity for each one of the six benchmark networks explained in Subsection 4.1.4. Our results are the same than the known ones except for Newman's algorithm. We reimplemented Newman's algorithm in `C++` language, and we used the `ARPACK`[4] library to find the required eigenvectors. One of the parameters of this computation is the precision of the eigenvalues calculated. For performance reasons, we used a lower precision, 10^{-3}, for networks of big size, when compared to the the precision we used for small networks, 10^{-5}. These apparently little changes in the precision of the calculus of eigenvectors resulted in different partitions of the network: the more precision the calculus of eigenvectors, the better the community partition found.

When performing our analysis we noticed that EO and Newman methods were slower than PBD and Louvain. EO and Newman gave better results than the others in small networks, whereas PBD and Louvain performed better in the larger ones. The better results of Louvain are particularly interesting, because it is not a very well known method in the research area, and we have not found any better method than it in the literature when analysing large networks.

Focusing in the `.cat` site network, Figure 4.6 and Table A.4 contain the results for

[4] `ARPACK` - Arnoldi package. `http://www.caam.rice.edu/software/ARPACK`



(a) `.cat` site network. Classic form

(b) `.cat` site network. Other cases

Figure 4.6: Results in terms of modularity for each month and method of the `.cat` site network, considering classic networks, in Figure 4.6a, and direction (d) and/or weight (w), in Figure 4.6b. We observe a general decreasing tendency with the pass of months. In nearly all of them Louvain is the best method.

each month. In Figure 4.6a networks are considered in their classic form, undirected and unweighted. We see that modularity decreases with the pass of months. The method which performs better is Louvain, followed by the average performance of EO. The third is Newman. PBD method and the Cluster method we propose, both of them obtaining less communities, perform in a similar way, worse than the others.

The results of our proposed method, Cluster, are comparable to the ones of the other methods. The idea of using the knowledge of our methods to construct good partitions seems useful. Probably future studies in this direction would show more visible improvements.

Numerical results suggest that networks have a meaningful community structure. Modularity of results from Louvain, the best method, takes values from 0.52, in the first month, to 0.41, in the last, values clearly above the threshold of fluctuations of random networks, which we can situate around 0.3.

For our available data, we have no doubt that Louvain is the best method. It has also the advantage that performs faster than EO, allowing us to carry out the following studies in less time.

Direction of edges and weights of them are considered in Figure 4.6b. We observe that EO applied to a directed unweighted network gives worse values in terms of modularity respect to the undirected case. However, results cannot be compared directly, because the definition of modularity changes in each of the four cases.

When considering directed networks we find that the number of communities found is substantially bigger. Methods which analyse directed networks find around 1.000

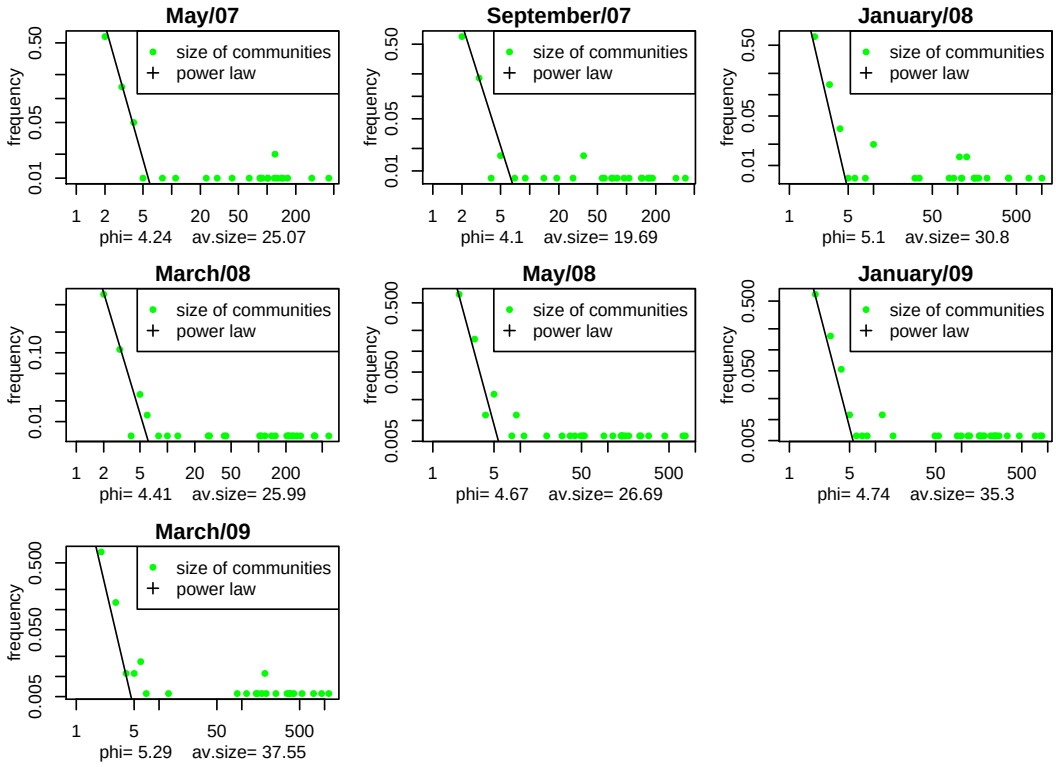


Figure 4.7: Plots of the size distribution of the `.cat` site network communities found by Louvain. They follow a power law $P(s) = s^{-\phi}$, at least for the first values of the size.

communities, with lots of communities composed by a simple pair of sites, whereas methods applied to undirected networks find around 100.

Values of modularity for weighted networks are considerably bigger than the ones for unweighted networks, with values between 0.8 and 0.9. Two methods are applied to the same network, allowing their comparison. In this case, undirected weighted networks, Louvain method performs better than EO, similarly as what happened in the unweighted case. These higher values of modularity, in the weighted case, indicate that networks present a clear community structure when considered in this form. However, weighted results are not interesting in the sense that there are only few communities of large size and many of small size, with only two or three elements. We decided to focus our studies in unweighted networks, because results showed a larger number of interesting communities and because most of research we have consulted considers networks only in its simplest form: undirected and unweighted.

4.2.5 Size of communities

Figure 4.7 contains the size distribution of the `.cat` site network communities found by Louvain, and the exponent of the power law function which adjusts these values. We have found a high percentage of communities having only two or three sites, and greater values for the size are less frequent. We observe that the power law adjustment $P(s) = s^{-\phi}$ is good for the first values of size s, but for the tail of the distribution the adjustment is bad. The exponent ϕ takes values between 4.1 and 5.2, and the average size of communities is located between 19.7 and 37.5.

4.2.6 Similarity

Figures 4.8 and 4.9 and Tables A.5 to A.11 show similarity between community partitions found by different methods: Extremal Optimization, with three different executions, Newman, PBD, Louvain and Cluster method. Interpretation of the plots must be done in the following manner: we have a matrix of results, in different colours. The color indicates the similarity results between the two methods compared, the one in the row and the other in the column. As similarity results are symmetric we only show a part of them, avoiding repetitions. The darker one square, the less similar results of the two methods.

The first thing we observe is that values obtained by Dongen metric are sensibly higher than values obtained with *VI*, as their colours are sensitively darker. But what surprises most, when analysing the results, is that all of them differ considerably from each other. There is not any pair of methods which gives a high grade of similarity, with an small distance, and very clear colours in the plots. Different executions of the EO method also result in different community partitions.

Although networks have community structure, as it was seen previously, it is not strong in the sense that there is a clear best partition: there are a high number of possible partitions of the network, like the ones chosen by our methods, that coincide in dividing crucial parts of the network and give approximately the same good results in our measures.

We expected to find that Cluster method, the method which uses partitions found for other methods, would give better results in terms of similarity due to the process to obtain its partitions: based in results of the other methods, as we explained in Subsection 4.1.4. Viewing the results, however, we do not found this hypothesis confirmed: Cluster method performs like any other method in terms of similarity.

As every pair of methods differ in the same way, with values from 0.30 to 0.55 for Dongen metric, and values from 0.25 to 0.45 for *VI*, approximately, we think that each partition is as good as the others, because none of them shows better results. The most similar pair of methods is PBD and Cluster method, with good scores in a pair of months. Curiously, they are also the ones which give community partitions with the minimum number of partitions.

Analysing results along the months we notice a growing tendency of the values taken by distances. This can be related with the fact that every month the number of sites

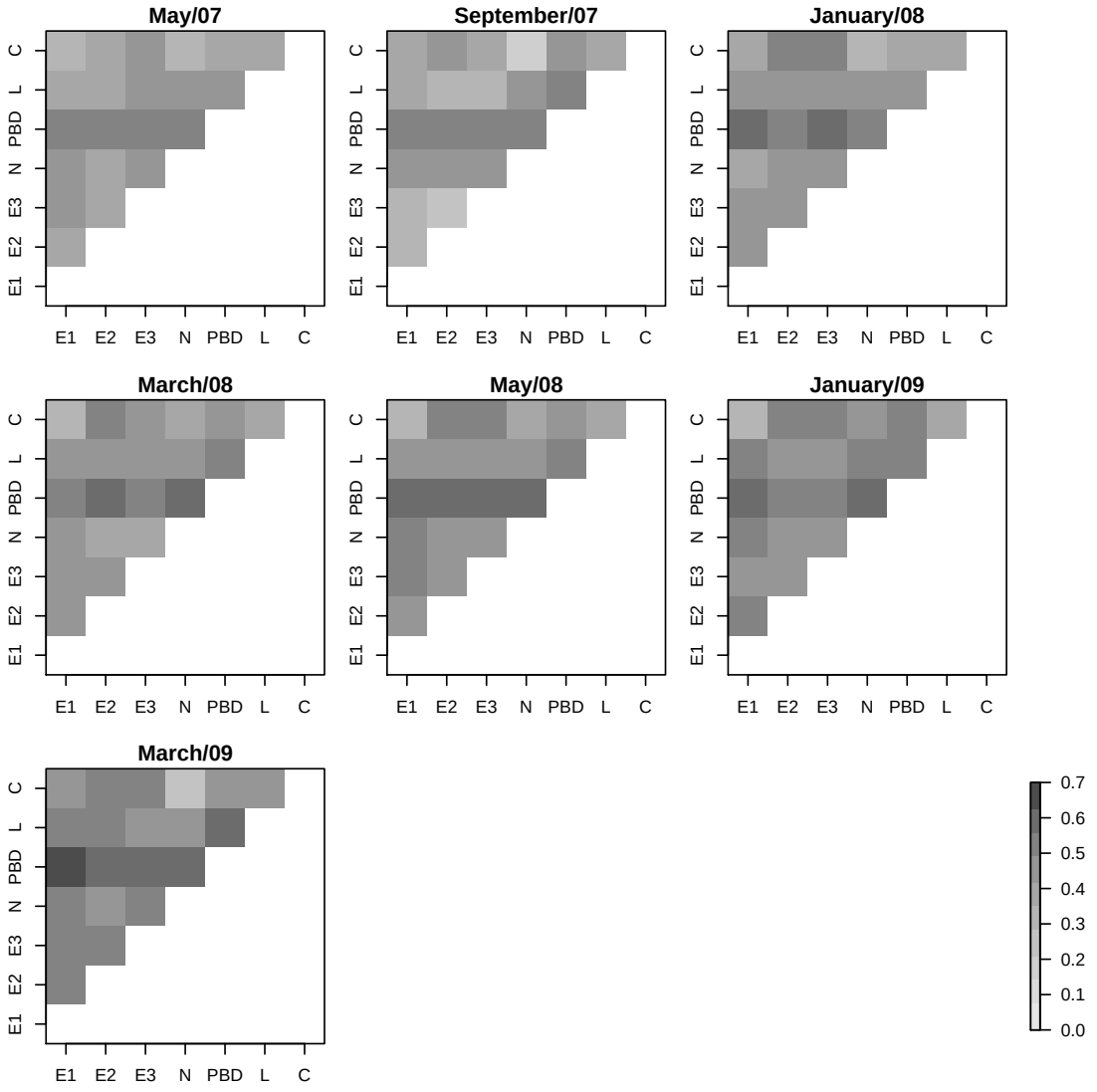


Figure 4.8: Dongen metric for the different partitions found by different methods in the classic `.cat` site network. Methods checked are: Extremal Optimization (E1, E2, E3), Newman (N), PBD, Louvain (L) and Cluster method (C).

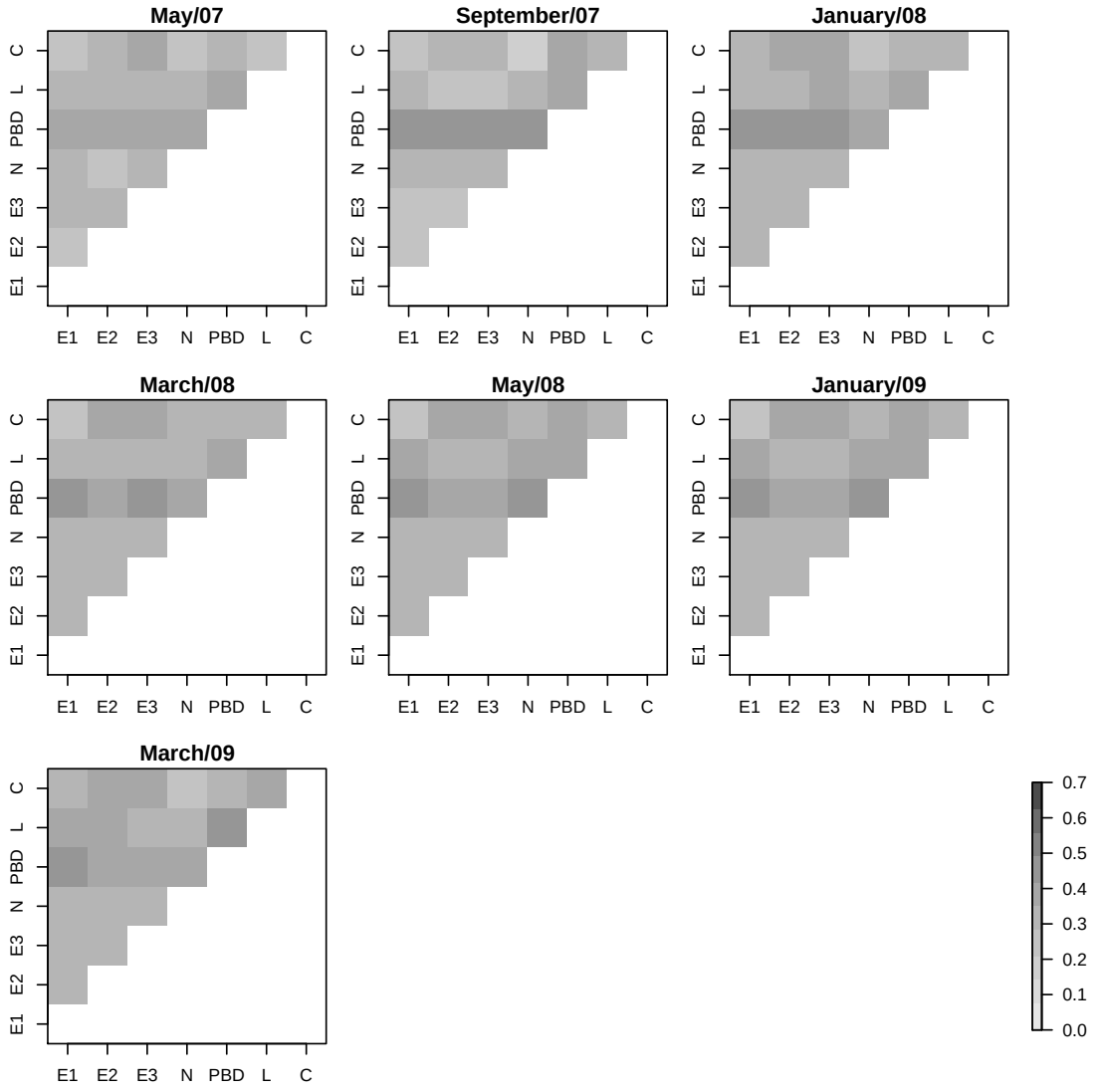


Figure 4.9: *VI* metric for the different partitions found by different methods in the classic `.cat` site network. Methods checked are: Extremal Optimization (E1, E2, E3), Newman (N), PBD, Louvain (L) and Cluster method (C).

grows when compared to previous months.

Results for directed (d) and/or weighted (w) networks are in Tables A.12 to A.18, together with some undirected unweighted methods, so as to be compared. Their tendency and values of similarity are related with results of undirected unweighted networks. In the case of directed networks, in which we have seen that methods found more communities, values of similarity are lower. This fact is probably caused by the fact that, with a big number of communities of little size, it is easier to identify similar communities in both networks. For example, communities composed by only two sites probably are found in all methods. Results when comparing methods taking into account networks in different forms do not differ specially from results when networks are fixed in one form.

All this leads us to conclude that direction and weights of edges does not produce important differences in community structure. For more simplicity, we will study what happens to networks in their classic form.

4.2.7 Robustness

Figure 4.10 shows the results of robustness of the `.cat` site network for each month, when considered in its classic form. The evolution of values of *VI* in each of the months is quite similar. Our comments are around an overview of this evolution, being valid for each month.

As we expected, perturbations in random networks are more important than perturbations in original networks. This fact suggests that our networks do have some community structure.

The first steps are the most important ones to study, when only little perturbations appear to networks. In those, *VI* in random networks quickly result in values of approximately 0.45. In contrast, in original networks, *VI* takes values around 0.25. Although it could look as a proof of strong community structure in original networks, values of *VI* of 0.25 are important, suggesting the existence of meaningful differences between community partitions. Networks with a well defined community structure exhibit substantially lower values of *VI*.

What happens to our networks is related to what is explained in the last two examples of Figure 2.8. In the two cases there are differences between results of original and random networks, but in one case *VI* for the original network is very low, suggesting strong community structure, and in the other *VI* is bigger, not as big as *VI* of the random network, but bigger enough to consider that that the network has not a very strong community structure. Our study case is identifiable with the second case.

The last steps in our networks, like in all, exhibit similar values of *VI* in the original and in the random network. Both of them finish the process with values of *VI* near 0.65. This is due to the fact that networks are fully perturbed, and do not have anything in common, except the distribution of their edges.

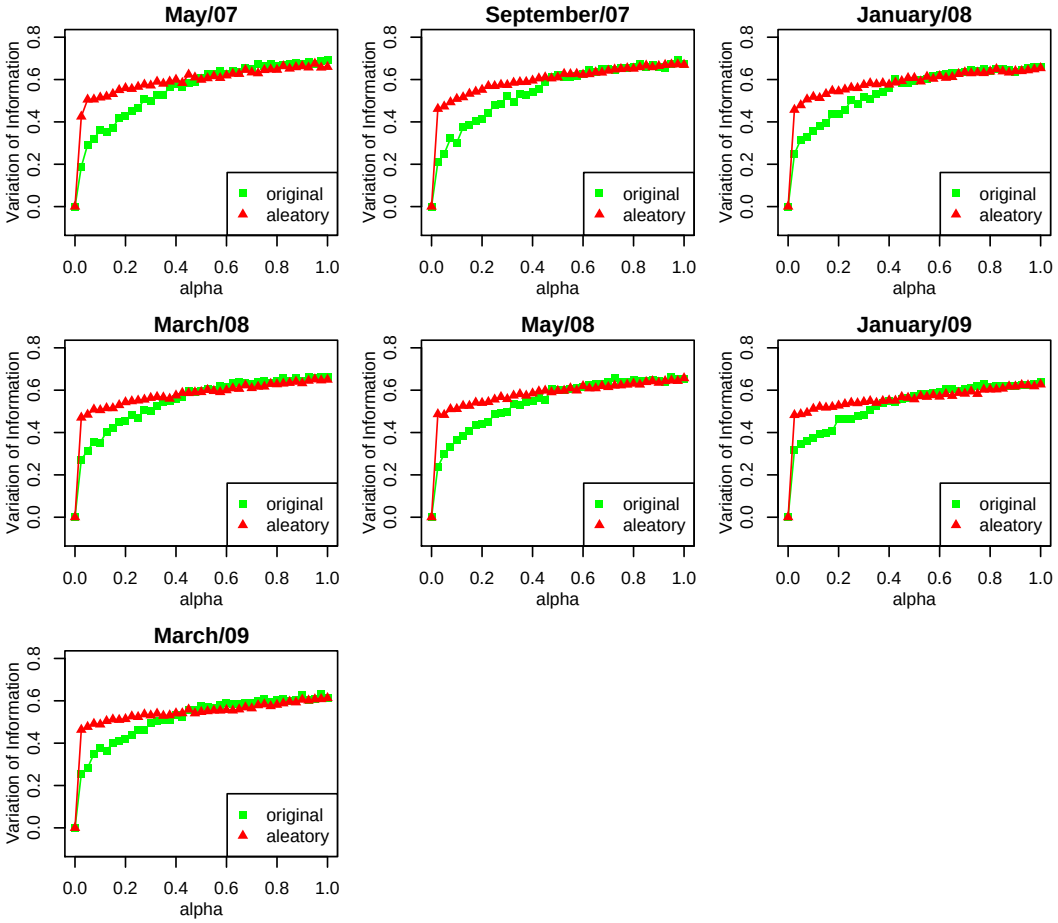


Figure 4.10: Results of the site robustness of the `.cat` site network. We observe differences between the behaviour of the random networks and the original ones.

Month	EO	Louvain
March/09	.388 (.397)	.410 (.414)

Table 4.1: Modularity for the main connected component of the `.cat` site network for the EO and Louvain algorithms. In parenthesis, results for the whole network.

Month	EO vs Louvain
March/09	.49 (.51) / .34 (.36)

Table 4.2: Similarity for the main connected component of the `.cat` site network between EO and Louvain methods. In parenthesis, results for the whole network.

4.2.8 Variations

Recall that all the performed studies in this section have used the March 2009 network.

Results in terms of modularity for the main connected component of the `.cat` site network are in Table 4.1. They are not substantially better than the results of the full network, shown in parenthesis. It rejects the hypothesis that this component has more community structure. It has similar structure than the whole network.

Table 4.2 contains the results in terms of similarity involving only the main connected component. They do not differ substantially from the results of the full network, also in parenthesis. This also leads us to conclude that the whole network ant their main connected component have a similar behaviour.

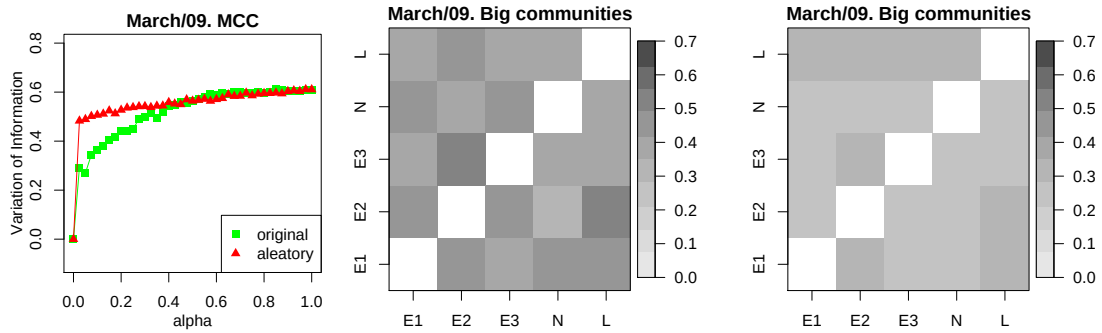
Figure 4.11 contains plots with results of the other variations proposed Figure 4.11a contains the results for the robustness of the main connected component. It exhibits the same behaviour than robustness of full networks: this network has community structure because it differs from the random network, although its structure is not strong, as with small perturbations it changes considerably.

In the other plots, in Figures 4.11b and 4.11c and in Table A.19, we see the similarity of the `.cat` site network for some methods, Extremal Optimization, Newman and Louvain methods, when only are considered the largest communities, those which contains the 60% of sites.

As we explained, now the order of methods minds, because we select the vertices in function of the first method. Plots show results in two dimensions, with the first method in the horizontal axis and the second method in the vertical one.

The values are smaller than the ones for the whole network, but they do not differ a lot. We do not observe differences between a pair of methods when changing their order: in both cases similarity is approximately equal.

We conclude that these variations of networks do not imply substantial changes in our analysis and studies of the whole networks in their classic form, undirected and unweighted, are good enough to consider as a general their conclusions.



(a) Robustness. MCC **(b)** Similarity. Dongen metric **(c)** Similarity. *VI* metric

Figure 4.11: Plot 4.11a contains the results of the robustness of the `.cat` site network when considering only the main connected component. The second plot, 4.11b, and the third, 4.11c, contain the measures of similarity (Dongen metric and *VI*, respectively) of the `.cat` site network when only are considered the biggest communities, the minimum number of them which contain the 60% of sites.

4.2.9 Characterization of communities

We provide the results of the two community interpretation methods proposed. The first one is based on site names, whereas the other is based on site contents.

First approach: analysing communities by site names

This approach to the problem consists in simply analysing the obtained results and extracting the interpretation of the communities. We use results from Louvain, the best method with our networks. In Section B.1 of the appendices there are the results of Louvain in the `.cat` site network of March 2009, the selected dataset for the realization of this study.

In Tables 4.3 and 4.4 we show two examples of how we proceed to interpret the results. For these two communities we display the community number, the community size, the community sites and our interpretation of it, by giving a topic to it and a justification of the election. They are, in terms of our topics, a group of sites from Tarragona's region and a group of sites of a political party.

We decide to center our attention only in communities with a considerable size, because the interpretation of very small communities is trivial. In Table 4.5 we summarize the number, size and selected topic of communities. Unfortunately, we are not able to identify each one of the communities, due to several facts:

- Some communities are very large.
- We do not find any thematic relation between the sites of some communities.

Community 95: 155 elements

www.vallsjove.cat
www.soctortosa.cat
www.tgd.cat
www.molafm.cat
www.venturapons.cat
www.canalte.cat
www.amte.cat
www.deltalloguer.cat
www.ciutatdigital.cat
www.centrepicasso.cat
www.santatecla.cat
www.iqua.cat
www.montserratvisita.cat
www.auvenguen.cat
www.big.cat
www.debat.cat
www.elit.cat
www.revistaamposta.cat
www.dpc.cat
www.baditri.cat
www.scurologia.cat
www.tortuga.cat
www.registradors.cat
www.xarxatecla.cat
www.totsrucs.cat
www.lluert.cat
www.perales.cat
www.gea.cat
www.code.cat
www.festivalguant.cat
www.nataliaferre.cat
www.culturaipaisatge.cat
www.espaiartsvisuals.cat
www.pixidixi.cat
www.lligacontraelcancer.cat
www.elspallaresos.cat
www.decomat.cat
www.asvol.cat
www.spiderman.cat
www.concahabitatge.cat
www.tinetbiblioteca.cat
www.diputaciodetarragona.cat
www.tinet.cat
www.altanet.cat
www.baixebre-innova.cat
www.telecentrebaixebre.cat
www.jovebaixebre.cat
www.vimbodipoblet.cat
www.tarragonajove.cat
www.arxiuvirtual.cat
www.educamposta.cat
www.montblancmedie val.cat
www.montblanc.cat
www.terrania.cat
www.pragmaedicions.cat
www.vernal.cat
www.ebredigital.cat
www.molatv.cat
www.ferrandez.cat
www.calmaginet.cat
www.adm.cat
www.calermita.cat
www.gabintec.cat
www.masferran.cat
www.tren107.cat
www.ebrelanparty.cat
www.xagatarragona.cat
www.lescireres.cat
www.lacasanovadencolomer.cat
www.vimbodi.cat
www.concadebarbera.cat
www.tortosa.cat
www.altcamp.cat
www.amposta.cat
www.montsia.cat
www.llorac.cat
www.masdenverge.cat
www.aoc.cat
www.godall.cat
www.baixebre.cat
www.esplugadefranco li.cat
www.valls.cat
www.vallfogonaderiucorb.cat
www.gandesa.cat
www.senan.cat
www.asco.cat
www.tcberga.cat
www.cinealacarta.cat
www.quintaforca.cat
www.totcinema.cat
www.pallol-finques.cat
www.mireiafeliu.cat
www.acopdeteclat.cat
www.mecanoscrit.cat
www.jjorda.cat
www.emsptortosa.cat
www.excursions.cat
www.carmebosch.cat
www.casacaritat.cat
www.pares.cat
www.txus.cat
www.titulars.cat
www.ingenium.cat
www.concadigital.cat
www.informatiualforja.cat
www.restaurantcollde nulles.cat
www.la-galera.cat
www.ccoolearvalls.cat
www.ornis.cat
www.elsmuntells.cat
www.hotelflamingo.cat
www.yupis.cat
www.femturisme.cat
www.collajovetortosa.cat
www.tastaverd.cat
www.gecko.cat
www.casafort.cat
www.vesperfeina.cat
www.nicanor.cat
www.re-canvi-valls.cat
www.gravidart.cat
www.poblevell.cat
www.ginkgobiloba.cat
www.ecad.cat
www.aemontsant.cat
www.santescreus.cat
www.pijfrancoli.cat
www.circuitcatalade cinemadigital.cat
www.cccd.cat
www.gegantsdemontblanc.cat
www.vickycristinabar celonalapelicula.cat
www.tarraconins.cat
www.eljardidelmar.cat
www.forasters.cat
www.esplugaturisme.cat
www.acmt.cat
www.gumtsa.cat
www.dipta.cat
www.santclimentdello bregat.cat
www.mesebre.cat
www.radiomontblanc.cat
www.catalunya-lgbt.cat
www.refugielsmasets.cat
www.lafila.cat
www.farmacs.cat
www.casainnova.cat
www.avvlapineda.cat
www.metrequadrat.cat
www.cebaixebre.cat
www.diversitatfuncional.cat
www.sylvaner.cat
www.catalunyaconnec ta.cat
www.stc.cat
www.diver.cat
www.concaadvocats.cat

Topic:	Tarragona's region
Justification:	We observe that several site names are related with the city and the province of Tarragona. We find sites with names like *Santa Tecla*, the patron saint of the city, *Tarragona jove* (young Tarragona), *tarraconins* (the name of Tarragona's people), and site names related to cities and towns belonging to Tarragona's province: Valls, Montblanc, Tortosa, Amposta, or Tarragona's *comarques* (organization of cities and towns, like shires or counties): Montsià, Baix Ebre, or Conca de Barberà.

Table 4.3: Summary of the interpretation done with the first method in Louvain community 95 of the `.cat` site network of March 2009. It contains the community number, its size, content, and our selected topic for it, followed with the justification of the election.

Community 117: 88 elements

www.mestura.cat	.cat	www.ceipsantjordimo llet.cat	www.molletama.cat
www.magnetic.cat	www.xavierforcada.cat	www.latortuga.cat	www.30aniversaripsc. cat
www.anticsescolans.cat	www.jsc.cat	www.guillemespriu.cat	www.cuinaria.cat
www.municipals2007.cat	www.herbahameli.cat	www.guiadebarcelona. cat	www.tallerhistoriade gracia.cat
www.marcspalou.cat	www.perenavarro.cat	www.panteresgrogues. cat	www.grupbarnaporters. cat
www.simpleweb.cat	www.mondemones.cat	www.graciatelevisio. cat	www.emmusicamolletdel valles.cat
www.ribaltalcalde.cat	www.pilardiaz.cat	www.carrio.cat	www.homesigualitaris. cat
www.macmobles.cat	www.coralharmonia.cat	www.onzecongres.cat	www.federaciodecolles desantmedir.cat
www.trenpalau.cat	www.psc.cat	www.corlafontana.cat	www.adriamartinez.cat
www.donessocialistes. cat	www.escolania.cat	www.tactum.cat	www.joseprodoreda.cat
www.elcercle.cat	www.lluisoshorta.cat	www.tallerdartsaplica des.cat	www.ampa-escolania.cat
www.socialistespala mos.cat	www.orfeogracienc.cat	www.barelfondo.cat	www.elcentregracia.cat
www.santuarielmira cle .cat	www.festamajordegra cia.cat	www.carmechacon.cat	www.arciris.cat
www.caloptic.cat	www.siuranenc.cat	www.krme.cat	www.parcgallecs.cat
www.ceeuropa.cat	www.fclluita.cat	www.europatv.cat	www.avclesseps.cat
www.socialistes.cat	www.lluisosdegracia. cat	www.cncatalunya.cat	www.mesvdx.cat
www.historieshorta.cat	www.gracianet.cat	www.chvh.cat	www.respostessocialis tes.cat
www.metalquimia.cat	www.marccamprodon.cat	www.cursmusicacervera. cat	www.13congresjsc.cat
www.psctv.cat	www.nerin.cat	www.ignitor.cat	www.causacomuna.cat
www.cuinetes.cat	www.cirici.cat	www.graciadivina.cat	
www.pscfolgueroles.cat	www.barnaseguretat.cat	www.cmmollet.cat	
www.ciumollet.cat	www.barnaporters.cat		
www.avvcelm.cat	www.iceta.cat		
www.presidentmonti lla	www.origens.cat		
	www.sattva.cat		

Topic:	*Partit dels Socialistes de Catalunya* - Catalonia's social-democrat party
Justification:	We observe that several site names are related with the politician party *Partit dels Socialistes de Catalunya* (Catalonia's social-democrat party), abbreviated PSC. Between the site names we find references to the local 2007 elections, the names of three important politicians of this party: the president of Catalonia, Montilla, a minister of Spain, Chacón, and the secretary of the party: Iceta. We also find references to local organizations of the party: Palamós and Folgueroles, and some other sites with names related with this organization: *Dones socialistes* (social-democrat women), *socialistes* (social-democrats), PSC TV, and a reference to the filial organization of the party, JSC (youth social-democrat people): *13è congrés JSC* (13th congress of JSC). Surprisingly, one site of this community is from a local delegation of a rival politic party, *Convergència i Unió* (Catalan nationalist cristian-democrat party), abbreviated CiU: CiU Mollet (local CiU's delegation of Mollet).

Table 4.4: Summary of the interpretation done with the first method in Louvain community 95 of the `.cat` site network of March 2009. It contains the community number, its size, content, and our selected topic for it, followed with the justification of the election.

Community	Size	Topic
27	13	Business group: EVP
52	425	—
70	376	—
84	190	Vic's region
93	197	—
94	175	*Convergència i Unió* - Catalan nationalist cristian-democrat party
95	155	Tarragona's region
112	921	Town halls and governmental institutions
117	88	*Partit dels Socialistes de Catalunya* - Catalonia's social-democrat party
127	388	Sports
129	736	Young people, education, town halls, business, official associations
136	352	Education
144	114	Manresa's region
150	1124	—
162	258	—
165	190	Communication media
166	149	Traditional entities and celebrations
172	534	Girona's region

Table 4.5: Table with the large communities found with Louvain in the `.cat` site network of March 2009, and our interpretation done with the first method. For each one we show its number, its size and the topic we have selected to identify it. In Section B.1 of the appendix there is the full content of the communities.

- We find many relations between the sites, but all of them only involve few sites of some communities.

In spite of these problems, we succeed in giving a topic to 13 of the 18 communities studied, which means a 72 % of them. They are the following: a small community belonging to a business group, sites belonging to different regions (Vic, Manresa, Tarragona, and Girona), sports, education, two political parties, traditional entities and celebrations, communication media, official institutions and a group in which we observe different thematics: young people, education, town halls, and official institutions. As we explained in the Methodology subsection, this kind of interpretations is very subjective, and probably belong more to a sociological study than to a computer science one. We think however that a larger study of this kind gives an additional, qualitative, perspective of the information extracted by the community-finding algorithms.

Second approach: analysing communities by site contents

As we did in the previous section, we focus only in the largest communities, the ones which need new ideas to be interpreted. The results of this method's application to the Louvain communities of the `.cat` site network of March 2009 are shown in Section B.2 of the appendices. There are listed the 20 most meaningful words for each community, and their values of significance, s_c^w.

Initially we check the results of this new method in the communities identified with the previous method. We show as examples the communities detailed before: *Tarragona's region*, and *Partit dels Socialistes de Catalunya* (Catalonia's social-democrat party). Results for them with the new method are in Tables 4.6 and 4.7, respectively. These tables contain the words in their original language, usually Catalan, their translation to English, and their values of significance. In the following lines we comment general aspects of the results.

We observe that the results of significant words do have some relation with the name we gave to the communities, although we also find words without significance in the context between the best ones. The same occurs when analysing the other communities in which we gave a topic before: many of the words with higher significance have a meaning according to the topic we gave to it, whereas some words do not mean anything special.

The second part of this study consists in using this method to extract information from communities we were not successful to identify with the previous method. We have selected two examples in order to illustrate the performance of our method: community 52, in Table 4.8 and community 93, in Table 4.9. The first community is a case in which our method is not able to give an interpretation, whereas the second one is a case where our method succeeds on it: its topic is *Music and spectacles in Tarragona's region.*

We finish this part with a table reviewing our interpretation of the communities by using this method. We show the table in the same format than Table 4.5. We considered different possibilities when identifying communities with this new method and with the old based on site names. They are summarized in the following list:

- Not being able to give a topic to some communities.
- Maintain the same topic with this method and with the old method.
- Change the topic given to some communities, in order to precise its meaning.
- Name unidentified communities with the previous method giving a topic to them.

Table 4.10 contains the results. Summarizing them, we say that, from the 18 considered communities, 2 of them remain unidentified, 10 of them maintain the same topics, 3 of them have changed their topics, and 3 are now named, what means that an 89 % of them have been identified.

Community 95: 155 elements

Word (usually in Catalan)	English translation	Significance s_c^w
conca	Conca (a region)	22.7251
tarragona	Tarragona (a city)	7.99909
administracions	administrations	7.01226
qui_som	who we are	3.97121
type]	type]	3.69455
input	input	3.67231
turisme	tourism	3.47914
serveis	services	2.87084
contacte	contact	2.81558
poden	they can	2.79639
contacta	contact	2.60725
portada	front page	2.47265
programa	program	2.06815
l'ajuntament	the town hall	2.03686
vols	do you wan	1.95553
jordi	Jordi (man's name)	1.91507
ajuntament	town hall	1.91043
nom	name	1.83367
english	English	1.59084
són	they are	1.58601

Topic:	Tarragona's region
Comments:	We gave this topic to the community with the previous method. Here we only check that the name was well given. The word *Tarragona* is the second in terms of significance, clearly above 1, with a value of 8. The first is the abbreviation of a Tarragona's region, *Conca de Barberà*. We do not find any other explicit word which references Tarragona or places related to it. We find words like *ajuntament* (town hall) or *administracions* (administrations) which confirm the fact that the community contains sites from different towns. The results do have some relation with the name we gave to the community, although we also find words without significance in the context between the best ones.

Table 4.6: Performance of our method in Louvain community 95 of the `.cat` site network of March 2009. The table contains the community number, its size, and the 20 words with higher significance, with their English translation, and the value of s_c^w. We comment the result.

Community 117: 88 elements

Word (usually in Catalan)	English translation	Significance s_c^w
nicaragua	Nicaragua	71.2937
psc	PSC (abbreviation)	23.0758
grà	—	10.2058
barcelona,	Barcelona,	6.66485
hores	hours	3.25822
local	place	3.23408
miquel	Miquel (man's name)	2.79971
des	from	2.7725
rss	rss	2.55404
vila	town	2.55309
barcelona	Barcelona	2.3307
maig	May	2.30345
grup	group	2.29372
notícies	news	2.20459
centre	centre	1.84546
president	president	1.80594
bon	good	1.79854
catalunya	Catalonia	1.64721
està	is	1.64417
activitats	activities	1.55035

Topic:	*Partit dels Socialistes de Catalunya* - Catalonia's social-democrat party
Comments:	We gave this topic to the community with the previous method. Here we only check that the name was well given. The word PSC, the initials of the politic party, is the second in terms of significance, clearly above 1, with a value of 23. The first word is Nicaragua, probably related because the PSC headquarters in Barcelona are located in Nicaragua street. A related word is the man's name Miquel, a not very common name, probably appeared in relation to the secretary of the party. Other words like Barcelona, Catalonia and president (the president of Catalonia now is from the PSC party) also appear in the list. Between the other words we find a month, May, probably due to the fact that it was in May when the last local elections took part, in 2007. In this case, and although some noisy words, the result is pretty good, with some words clearly describing the semantic of the community.

Table 4.7: Performance of our method in Louvain community 117 of the `.cat` site network of March 2009. The table contains the community number, its size, and the 20 words with higher significance, with their English translation and the value of s_c^w. We comment the result.

Community 52: 425 elements

Word (usually in Catalan)	English translation	Significance s_c^w
cap	any, head, initials of health service...	2.98259
english	English	2.49805
catalunya	Catalonia	1.29709
contacte	contact	1.2352
castellano	Spanish	1.20323
web	Web	1.175
activitats	activities	1.1449
des	from	1.10793
més	more	0.806307
barcelona	Barcelona	0.723428
juliol	July	0.697361
serveis	services	0.682694
dia	day	0.61054

Comments: We observe that only 13 words appear to the list, when we allow the apparition of 20. It means that all other words are typical from the Catalan language or they do not appear in at least the 10 % of the total sites in the community. We discard the last five words because their values of significance are below 1. Analysing the others we do not find any special word. All of them are generic words that can be applied in multiple fields: Web, Spanish, English, Catalonia... the word *cap* does not provide any information to us, because it has several meanings in Catalan language: head, any, to fit, the initials of a health service... We suppose that this words are not special of this community. They were the ones which got to pass the two restrictions we imposed on the words. Probably, if we had used a more complete list of Catalan common words, many of this would have been discarded.

Selected topic: —

Justification: Unfortunately, with the available information, we are not able to give a topic to the community.

Table 4.8: Performance of our method in Louvain community 52 of the `.cat` site network of March 2009. The table contains the community number, its size, and the 20 words with higher significance, with their English translation and the value of s_c^w. We comment the result, decide a topic for the community and justify our election.

Community 93: 197 elements

Word (usually in Catalan)	English translation	Significance s_c^w
concerts	concerts	10.7852
reus	Reus (a city)	10.1337
festival	festival	5.15291
premsa	press	5.12676
tarragona	Tarragona (a city)	4.96621
música	music	4.76074
centre	centre	2.92667
presentació	presentation	2.90221
web	Web	2.58956
club	club	2.32581
english	English	2.06398
contacte	contact	2.02482
diferents	different	1.93385
sala	room	1.83805
activitats	activities	1.69254
treball	work	1.6403
passat	past	1.53085
any	year	1.49319
són	are	1.43147
part	part	1.41263

Comments:	We observe that all the words have values of significance above 1, what suggests that they are meaningful in the community. However, we find words not illustrative of anything like part, are, year, past, Web, or contact. All the others, including the ones with higher significance are words from the area of music and spectacles. We also find references to two cities: Reus and Tarragona. The higher values of significance are greater than 10, what means that this words are very important in the community.
Selected topic:	Music and spectacles in Tarragona's region
Justification:	Considering the six more significant words of the results, clearly above the others, we extract the conclusion that the content of the community is based in two ideas: music, concerts, and spectacles and the Tarragona's region. Our choice for the name of the community takes these two aspects into account.

Table 4.9: Performance of our method in Louvain community 93 of the `.cat` site network of March 2009. The table contains the community number, its size, and the 20 words with higher significance, with their English translation and the value of s_c^w. We comment the result, decide a topic for the community and justify our election.

Com.	Size	Topic	No topic	Maint.	Changed	Named
27	13	Business group related with water			✓	
52	425	—	✓			
70	376	—	✓			
84	190	Vic's region		✓		
93	197	Music and spectacles in Tarragona's region				✓
94	175	*Convergència i Unió* - Catalan nationalist cristian-democrat party		✓		
95	155	Tarragona's region		✓		
112	921	Town halls and governmental institutions		✓		
117	88	*Partit dels Socialistes de Catalunya* - Catalonia's social-democrat party		✓		
127	388	Sports		✓		
129	736	Business, official associations, and work			✓	
136	352	Education		✓		
144	114	Manresa's region		✓		
150	1124	Catalan language				✓
162	258	Barcelona				✓
165	190	Culture and communication media			✓	
166	149	Traditional entities and celebrations		✓		
172	534	Girona's region		✓		
Total			2	10	3	3

Table 4.10: Table with the large communities found with Louvain in the `.cat` site network of March 2009. For each one we show its number, its size and the topic we have selected to identify it, using our method based on the content of its sites. We contemplate different possibilities between the topics given with the site names method and this method: not being able to give a topic, maintain the same topic, change the topic, and name communities with the new method. In Section B.2 of the appendix there is the full content of the most significant words for each community, including the small ones.

Summary of large communities

Now we comment the 16 identified communities with a bit of detail, explaining if we consider their apparition as a normal phenomena.

Five regional communities Analysing the 16 identified communities we observe that five of them depend strongly from important cities of Catalonia. They are, listed in decreasing size of population, Barcelona, Tarragona, Girona, Manresa, and Vic. All of them are cities with a long history, capital cities. We expected to find another important city, Lleida, with its own community, but it is not present. We think that the method has identified correctly these communities, as it is highly possible that sites of each one of these regions are connected more frequently with sites from their region.

Two political communities We also have found two communities depending of the most important political parties of Catalonia: PSC and CiU. It is logical that sites from each one of these organizations are more related with sites of the same political ideology. We consider these two communities perfectly identified.

Traditional entities, sports, education, and a music community It is clear that sites of these communities are linked between them. Entities of the same city are probably related: they may share members, activities, spaces... Entities also maintain relation with others from different regions focused in the same hobbies. Also sites from sports clubs, of the same city or of the same sport, are linked, as they have common interests. Sites of official organizations, like association registers or federations, contribute to the strong structure of these communities, due to their full lists of entities or clubs. The same occurs with the other two communities. These four communities present very good results in terms of the most significant words. Significance of words takes values of 21, 6, 6, and 10, respectively, for the first word, and many of the first ones are related with the topic we have chosen for the community.

Four other large communities There are four communities which, although they are not as well defined as the previous ones, clearly belong to a concrete area. They are a governmental community, with most of the town halls and official institutions sites, a community focused in Catalan language, with institutions and personal sites dedicated to this thematic, a community containing communication media and sites related with the promotion of culture, and another one containing business, official associations and sites related with work in general. The limits between these communities are probably not as well defined as in the other networks. For example, it is not clear which difference do the sites of Catalan language community have when compared to the ones from culture community.

The small network of a business group The last community is composed only by 13 sites, and its name is business related with water. As its size is relatively small, we have checked all the sites belonging to it. All of them are part of a business

group involving water works: purification, treatment of residual water... This community has been found because many of the sites are linked between them.

To sum up, we consider this method as a good tool to facilitate the interpretation of large communities, specially when used as a complement of the general method of looking to the site's names. It is a fact that we have not succeed in identifying all communities. Surely, our method is not good enough to make clear the thematic and name of each community. But we are convinced that the problem is not only in our method. The structure of the network is not robust enough to facilitate clear community partitions. In each execution of community detection methods different communities are found. The part of the network with a well defined structure probably will remain approximately in the same manner with the execution of each method, with the same communities, but the part of the network not clearly defined is likely to result in different communities when we apply different methods. These last communities, we think, are the ones in which we have not succeed in the problem of identifying them. But, probably, anybody can identify them. They are not representing anything. They are the ugly part of the interpretation of results, the part without clear meaning. In general, the part of the networks with a less robust community structure will be the first one to change when we apply different community detection methods.

Chapter 5

Dynamic studies

In this chapter we present the studies carried out involving at the same time data collections of different months, which we call *dynamic studies*. These studies, in contrast to the previous ones of Chapter 4, are very preliminary: they are only an initial approach to the problem of comparing different collections of communities from different months. The first one of them consists in evaluating similarity of communities in different months. The second tests a proposed model of communities evolution throughout the time. The last are an special kind of graphs which permit the visualization of evolution between big communities. As we did in the previous chapter, we divide this chapter in methodology and results, allowing both the reading of each concrete study or a linear lecture of methodology, initially, and finalizing with results.

5.1 Methodology

5.1.1 Similarity of communities between different months

In the previous chapter, in Subsection 4.1.6, we analysed similarity of community partitions between different methods, but restricting results to the same month. Now we want to evaluate how related community partitions of data from consecutive months are. We understand as consecutive months without any available month between them, i.e. May 2007 and September 2007, September 2007 and January 2008, and so on, following the months listed in Table 3.1. We perform this study in the same way we did previously, using normalized Dongen metric and normalized variation of information, and calling them, for more simplicity, Dongen metric and *VI*.

We take into account Louvain community partitions, as we saw previously in Subsection 4.2.4 that they were the ones with higher modularity. This study presents a problem: sites of the `.cat` site network of two analysed months are not necessarily the same, but similarity measures need the same elements in the two data sets compared, as it is explained in Section 2.7. In order to avoid this, we decided to study only sites belonging to both months studied in each evaluation of similarity, i.e. their intersection. The months compared are summarized in the first columns of Table 5.1.

First month	Second month
May 2007	September 2007
September 2007	January 2008
January 2008	March 2008
March 2008	May 2008
May 2008	January 2009
January 2009	March 2009

Table 5.1: Pairs of consecutive months. We compare similarity between their communities.

To evaluate quality of results, we also evaluated similarity between a month and a random network for the following month which substitutes the original one. This random network is chosen so as to have the same edge distribution than the original, in the same manner we did in Subsection 4.1.7. Specifically, the probability of the existence of an edge between vertices i and j is $e_{ij} = k_i k_j / 2m$, where k_i are k_j are the out and in-degrees (in undirected networks, our case of study, in and out-degrees coincide for each vertex) of i and j and $2m$ is the total number of edges. These networks do not have any relation with the community structure found in the `.cat` site networks, so we expect them to result in high values for the similarity metrics.

We show, compare, and comment results in Subsection 5.2.1.

5.1.2 A community evolution model

We propose a simple model to simulate evolution of communities with the pass of time. This model is inspired in our intuition of what happens to human communities, in which we have unions of communities, splits, apparitions of new communities... We consider interesting to check if communities in the Web also evolve in a similar way.

Specifically, our model analyses different transformations, which are shown in the following list and also graphically in Figure 5.1.

- Apparition of a community
- Extinction of a community
- A community which remains Equal
- Union of two communities
- Split of two communities
- Growth of a community
- Shrink of a community

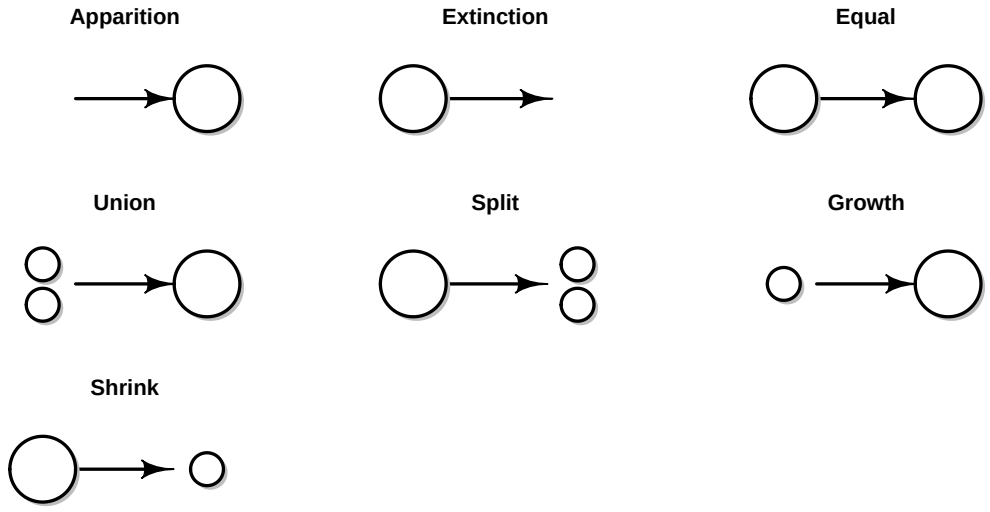


Figure 5.1: Illustration of the different transformations between consecutive instants studied with our method. They are: Apparition, Extinction, Equal, Union, Split, Growth, and Shrink.

We denote by t and $t+1$ the consecutive moments considered and by c_t, d_t, c_{t+1}, and d_{t+1} communities at times t or $t+1$, respectively. We also take into account communities with the sites which do not exist at each time t, denoted as n_t, and we call them *the non-existing communities*. The idea is to maintain them in order to observe apparitions of new communities, extinctions, growths, or shrinks. With the explained notation we define formally when each situation takes place:

Apparition A community c_{t+1} appears in instant $t+1$ if its intersection with the community of non-existing sites in instant t is greater than a threshold α multiplied by the size of c_{t+1}:

$$|c_{t+1} \cap n_t| \geq \alpha |c_{t+1}|.$$

Extinction Analogously, a community c_t disappears in instant t if its intersection with the community of non-existing sites in instant $t+1$ is greater than α multiplied by the size of c_t:

$$|c_t \cap n_{t+1}| \geq \alpha |c_t|.$$

Equal A community c_t remains equal to a community c_{t+1} different of the non-existing community if its intersection is greater than α multiplied by the size of c_t:

$$c_t \cap c_{t+1} \geq \alpha |c_t|.$$

Union The union of communities c_t and d_t into c_{t+1} takes place if c_t, d_t, and c_{t+1} are different from the non-existing communities and its intersection has a great part of

sites, specifically:

$$|c_t \cap c_{t+1}| \geq \alpha|c_t| \quad \text{and} \quad |d_t \cap c_{t+1}| \geq \alpha|d_t| \quad \text{and} \quad |(c_t \cup d_t) \cap c_{t+1}| \geq \alpha|c_{t+1}|.$$

Split The split of community c_t into c_{t+1} and d_{t+1} takes place if c_t, c_{t+1}, and d_{t+1} are different from the non-existing communities and its intersection has a great part of sites, specifically:

$$|c_t \cap c_{t+1}| \geq \alpha|c_{t+1}| \quad \text{and} \quad |c_t \cap d_{t+1}| \geq \alpha|d_{t+1}| \quad \text{and} \quad |c_t \cap (c_{t+1} \cup d_{t+1})| \geq \alpha|c_t|.$$

Growth We consider a community c_t grows to c_{t+1} if there is an union when considering the non-existing community n_t:

$$|c_t \cap c_{t+1}| \geq \alpha|c_t| \quad \text{and} \quad |(c_t \cup n_t) \cap c_{t+1}| \geq \alpha|c_{t+1}|.$$

Shrink Analogously, we consider a community c_t shrinks to c_{t+1} if there is a division when considering the non-existing community n_{t+1}:

$$|c_t \cap c_{t+1}| \geq \alpha|c_{t+1}| \quad \text{and} \quad |c_t \cap (c_{t+1} \cup n_{t+1})| \geq \alpha|c_t|.$$

Our proposed model depends on a threshold parameter α which must be between 0 and 1, preferably with values around the upper bound. The different possibilities of our model are not unique. In some cases it can classify a phenomena into different situations, for example EQUAL and SHRINK, or EQUAL and GROWTH, depending of the size of communities and the value of α. The lower values of α we choose, the more overlapping situations we find.

We also centred our attention in communities with more than 10 elements. We do not study what happens with small communities, as we think results in these communities can be too much influenced by random fluctuations.

In Subsection 5.2.2 we show the results of our model applied to Louvain communities detected in the `.cat` site network.

5.1.3 Visualization of evolution between big communities

Our final proposal is the definition of a kind of graphs which easily allow us to visualise evolution between big communities. These graphs compare communities between two consecutive months. The analysed communities are the vertices, and the size, color, and strength of the edges between them depend on different parameters. For example, an edge between vertices exists if the two associated communities have at least one site in common, i.e. its intersection is not empty. Edge parameters are the width and color, the same ones as vertices have.

Like in the previous study, we consider instants t and $t+1$, and by c_t and c_{t+1} we denote two communities in instant t and $t+1$, respectively. We also take into account, as we did before, the non-existing communities n_t and n_{t+1}, which also have associated vertices in the graphs.

These graphs are bipartite, as two communities from the same instant cannot have any repeated site. In the following list we describe in detail the parameters of the proposed graphs:

Vertices A vertex in the graph corresponds to a community in a concrete instant of the two instants taken into account, which we denote t and $t+1$. Additionally, we add a vertex for each instant including the non-existing vertices in that moment, in order to consider apparitions and extinctions of communities. In our study we only include communities greater than a threshold, fixed in 10 elements.

Vertex sizes Size of a vertex is proportional, logarithmically for a better visualization, to the size of the associated community, c_t, $\log(|c_t|)$.

Vertex colours There are four vertex colours: in dark colours we have communities of instant t, with the non-existing one differenced from the others; in clear colours we have communities of instant $t+1$, with the non-existing one also differenced.

Edges A directed edge between vertices i and j exists if the community associated to vertex i belongs to communities of instant t, c_t, the community associated to vertex j belongs to communities of instant $t+1$, d_{t+1}, and its intersection $c_t \cap d_{t+1}$ is not empty, i.e. they have at least one site in common. Here we observe that these graphs are bipartite, with edges going only from vertices corresponding to communities in instant t to vertices corresponding to communities in instant $t+1$.

Edge widths The width of an edge between vertices i and j, if this edge exists, is logarithmically proportional to the size of the intersection of the associated communities, c_t for vertex i and d_{t+1} for vertex j, $\log(|c_t \cap c_{t+1}|)$.

Edge colours The color of an edge linking vertices i and j, with associated communities c_t and d_{t+1}, depends of the proportion of elements which are in the intersection of the two communities. Specifically, we give a number between 0 and 1 to each edge, with the formula

$$\text{value}_{ij} = \frac{2|c_t \cap d_{t+1}|}{|c_t| + |d_{t+1}|}.$$

The more elements communities have in common, the greater this number, and the darker the edge.

Each graph refers to a pair of consecutive months. The obtained results are shown and discussed in Subsection 5.2.3.

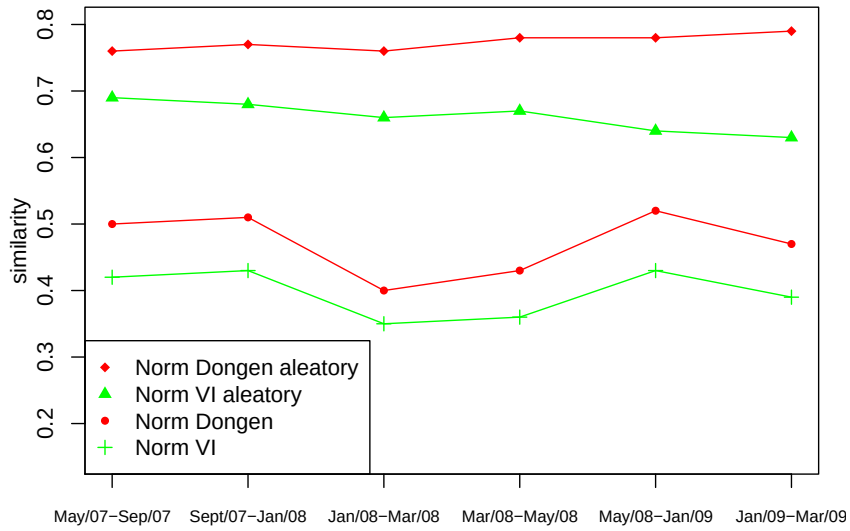


Figure 5.2: Plots of similarity measures, Dongen metric and *VI* of two consecutive months of the `.cat` site network. Months are listed in Table 5.1. We observe differences between the two measures, with values of Dongen metric higher than values of *VI*, and between the ones with a random graph and the ones with real data, with the firsts having higher values.

5.2 Results

5.2.1 Similarity of communities between different months

Figure 5.2 and Table A.20 contain the results for consecutive `.cat` site networks. Values of Dongen metric for consecutive months and pairs of real data are between 0.4 and 0.55, with lower values when months compared are nearer in time. *VI* exhibits an analogous behaviour, but values are lower, between 0.35 and 0.45.

We observe differences in similarity between real community partitions and partitions with a random graph. These last ones have higher values, with values of Dongen metric between 0.75 and 0.8 and values of *VI* between 0.6 and 0.7. This fact indicates that a part of community structure found in the `.cat` site network of one month is preserved in the following month. We must notice, however, that values of similarity higher than 0.3, like the ones we have, indicate that the two analysed community partitions are significantly different.

Variations in the values can be caused because the intervals of time are not homogeneous. For example, between the first two months taken into account, May 2007 and September 2007 there are four months of difference, whereas between January 2009 and March 2009 there are only two. This fact explains in great part the variations in the values of similarity: the shorter the period of time, the smaller the value of similarity.

We also have that available sites in each pair of months increase with the passage of time, although we do not observe variations caused by this fact. In Figures 4.8 and 4.9 we studied similarity between results of different methods applied to the same month. Values from those studies are, as we expected, substantially below the ones from the actual studies.

Summarizing this study, we consider that values of similarity are influenced by two factors: the variance caused by imprecisions of the community detection method and differences caused by changes in communities in different months. Future related studies should consider possibilities for reducing the first factor, maybe using results from different methods, in order to focus the attention in the important factor, the second one.

5.2.2 A community evolution model

Results for this study are not what we expected. We have tried different values for the threshold α and we have not got any sign that our model explains the data reasonably. We comment results when using $\alpha = 0.75$, as we think it is an intermediate value between the higher ones, in which we have not found nearly anything, and the lower ones, in which we have found lots of situations but they do not correspond to our original idea.

Table 5.2 contains results for our method. As we see, only few transformations of those in our list are detected, and most of them are overlapped by other transformations. For example, we have found, between May 2007 and September 2007, that communities 3 and 34 are considered EQUAL, SHRINK, and GROWTH, or, between January 2008 and March 2008, that communities 27 and 2 are considered also in these three different cases.

Additionally, we noticed that the in nearly all situations the same communities appeared: community 3 in May 2007, community 34 in September 2007, community 27 in January 2008, community 2 in March 2008, and community 31 in May 2007. A manual site names analysis of these communities showed that they were always the same community: a community which we could call *the sex community*, with pages of pornographic and erotic content. Probably, its extinction after May 2008 took place because Fundació puntCat banned its sites.

After these results, we cannot consider this model as a valid one. We think, however, that this study is a first approach to the problem of identifying relations between communities along the time. Our results indicate that this is going to be a complex problem, where first investigations, like the ones performed by us, cannot end with satisfactorily. We are confident that further proposals of new models will obtain more meaningful results. The next study of Subsection 5.2.3, for example, could be an initial point for getting ideas of the direction this future studies should take.

Period	May 2007 - September 2007
Situation	SHRINK Community 1, with 11 elements, shrinks to community 1, with 9 elements.
Situation	EQUAL Community 3, with 30 elements, remains equal to community 34, with 28 elements.
Situation	SHRINK Community 3, with 30 elements, shrinks to community 34, with 28 elements.
Situation	GROWTH Community 3, with 30 elements, grows to community 34, with 28 elements.
Period	September 2007 - January 2008
Situation	EQUAL Community 34, with 28 elements, remains equal to community 27, with 31 elements.
Situation	GROWTH Community 34, with 28 elements, grows to community 27, with 31 elements.
Period	January 2008 - March 2008
Situation	EQUAL Community 27, with 31 elements, remains equal to community 2, with 29 elements.
Situation	SHRINK Community 27, with 31 elements, shrinks to community 2, with 29 elements.
Situation	GROWTH Community 27, with 31 elements, grows to community 2, with 29 elements.
Situation	GROWTH Community 15, with 10 elements, grows to community 117, with 13 elements.
Period	March 2008 - May 2008
Situation	EQUAL Community 2, with 29 elements, remains equal to community 31, with 30 elements.
Situation	GROWTH Community 2, with 29 elements, grows to community 31, with 30 elements.
Situation	GROWTH Community 111, with 10 elements, grows to community 157, with 11 elements.
Period	May 2008 - January 2009
Situation	EXTINCTION Community 31, with 30 elements is extinct
Situation	GROWTH Community 135, with 5 elements, grows to community 121, with 12 elements.
Period	January 2009 - March 2009
Situation	GROWTH Community 102, with 4 elements, grows to community 27, with 13 elements.

Table 5.2: Different situations detected by our method. We observe overlapping and poor results, with less than five situations detected between each consecutive months.

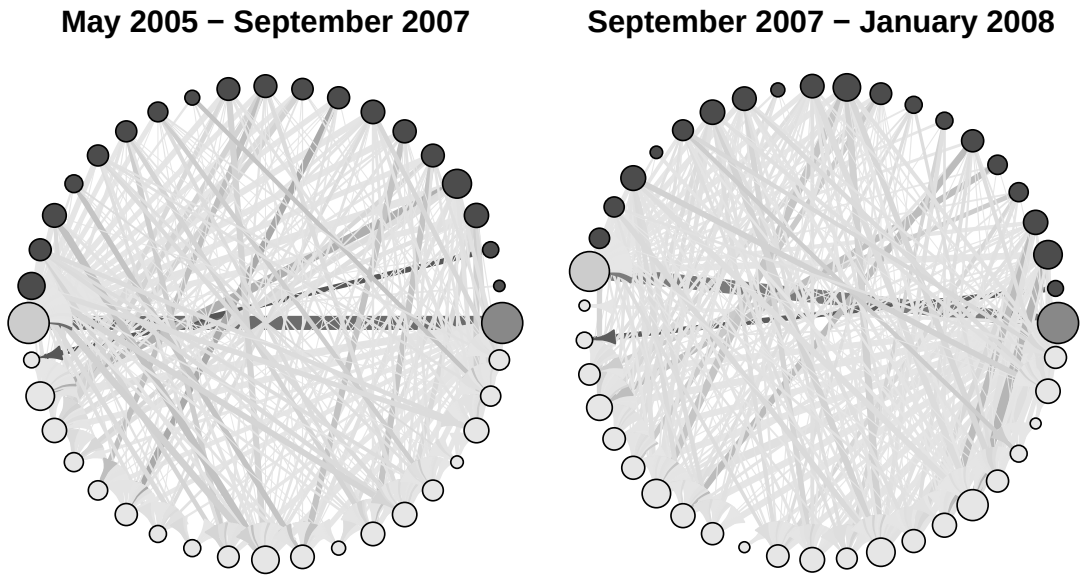


Figure 5.3: Graphs with the evolution between consecutive months for big communities and for pairs of consecutive months: May - September 2007 and September 2007 - January 2008. Parameters are explained in Subsection 5.1.3. Vertices associated to the non-existing communities are shown in lightly different colours, but also maintaining the tonality clear/dark depending on its associated month.

5.2.3 Visualization of evolution between big communities

Figures 5.3, 5.4, and 5.5 contain results for the visualization method. We observe that graphs show a complex structure, far from the simple one we expected to found with the method proposed in the previous study, which we illustrated in Figure 5.1.

Viewing the graphs, we observe that the `.cat` site network has a complicated community structure, with communities related in a non-elementary form with the pass of time. Focusing in the parameters of the graphs, we observe few dark edges, which indicates that most of them do not include a high percentage of communities involved, and vertices with darker edges are usually the smallest ones. The darkest ones, observed in Figures 5.3 and 5.4, corresponds always to the same community, the one which we detected with the community evolution method of Subsection 5.2.2.

These plots are an evidence that the study of community evolution needs even more research. In the `.cat` site network, and in complex networks in general, its community evolution is not explainable with few rules which are applied in some way. It is more complex, with multiple unions or partitions of communities with the pass of time. Our work in this direction, at least, has been useful as we have noticed the scope of this complexity and avoids us to change a bit the orientation in this research area.

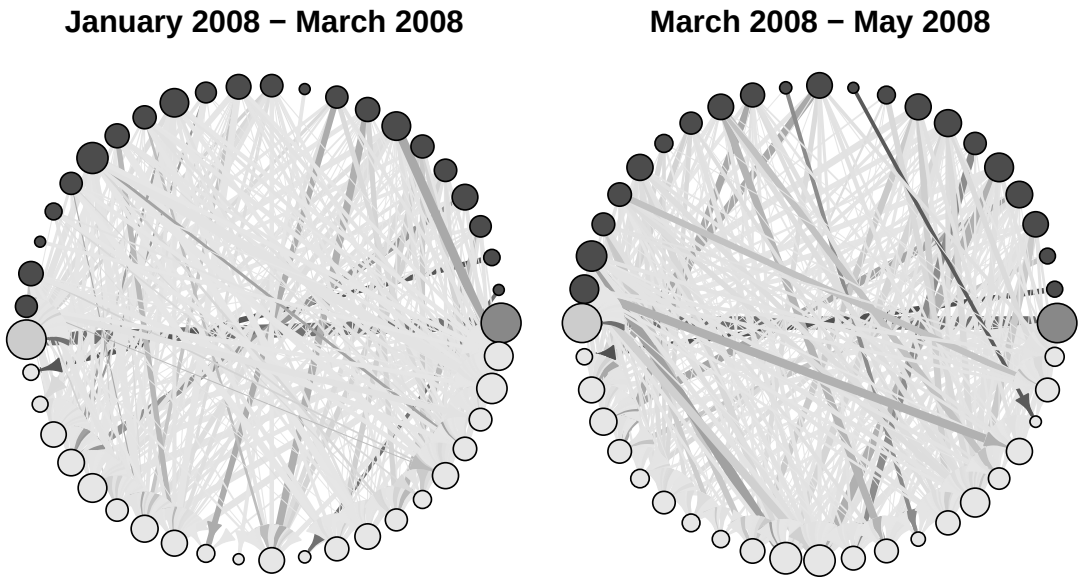


Figure 5.4: Graphs with the evolution between consecutive months for big communities and for pairs of consecutive months: January - March 2008 and March - May 2008.

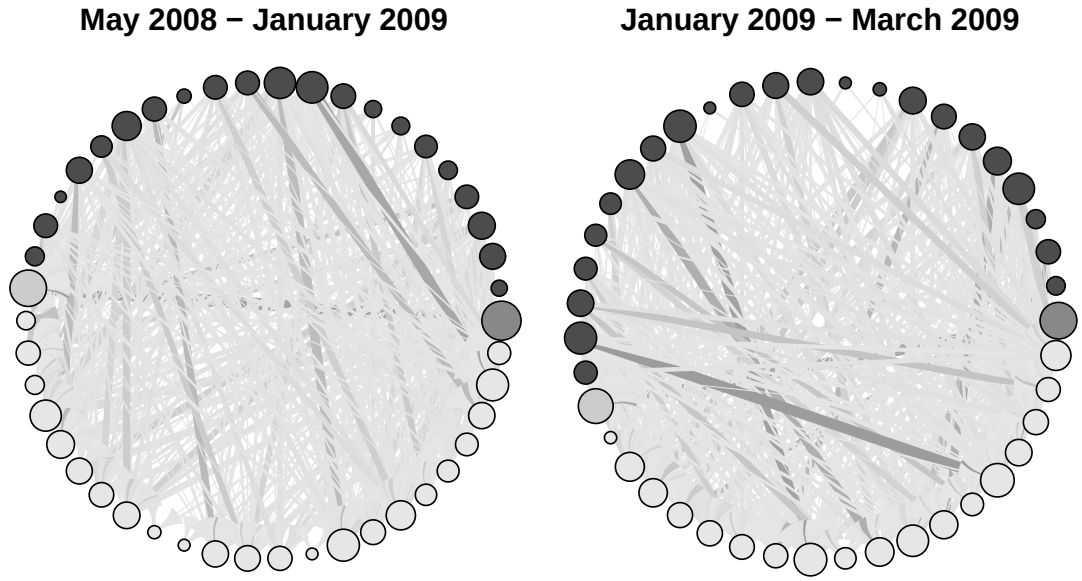


Figure 5.5: Graphs with the evolution between consecutive months for big communities and for pairs of consecutive months: May 2008 - January 2009 and January - March 2009.

Chapter 6

Conclusions and future work

In this last chapter we summarize the work carried out in this project, we review its specific contributions, and we indicate possible directions for future related studies.

6.1 Work done

Our work has taken ideas from different knowledge areas: data mining, complex network research, Web crawling, Web studies, and community detection methods. Specifically, our work has included:

- Understanding how a web crawler (WIRE) works and modifying it to obtain the desired data.
- Research of the state of the art of community detection in complex networks methods.
- Implementation of some methods (the ones for which we did not have the code).
- Comparison in terms of performance between them and selection of the best for our study.
- Development and application of a methodology for the static studies of the `.cat` domain.
- Initial approaches to the study of community evolution in the `.cat` domain.

Carrying out this variety of work has been an interesting task, as we have learned the state of the art from different research areas, some of them totally unknown for us before the starting of these studies. In addition, we have investigated in the field of complex network research, in which we have performed various studies.

6.2 Specific contributions of this work

Apart from the laborious task of doing research from different areas, our work has performed original contributions to the complex network literature. They are the following:

- In Subsection 4.2.4 we have tested four community detection methods (Extremal Optimization, Newman's algorithm, PBD algorithm, and Louvain algorithm) with six famous benchmark networks, obtaining that EO and Newman perform better for small networks and Louvain is the best with networks of big size.

- Also in the same Subsection we have developed a new meta-method which consists in using results from the four known methods to obtain new community partitions, by defining a distance between the elements in function of how many methods classify them in the same community. With this distance we have performed a hierarchical clustering to classify similar elements in the same community.

- We have checked some specific properties well-known in the `.cat` top level domain along Chapter 4. It presents a mature structure, comparable to other top level domains, at least since the first month studied, May 2007. We have checked properties specific from the complex network area: modularity and robustness, and we have used similarity, a property of clustering, to compare different community partitions.

- We have developed, in Subsection 4.1.9, a method to study the discovered communities, which selects the most meaningful words of the sites content in order to facilitate the identification task. Words are selected in terms of significance, a new measure proposed also in this study.

- We have analysed the different `.cat` site communities using the proposed method, obtaining regional, political, sports, and educational communities among others.

- From our work we can extract a methodology to study complex networks. Summarizing it consists in:

  - Studying basic graph properties
  - Plotting the in and out-degree distributions
  - Applying different community detection methods and select the best in terms of modularity
  - Comparing the results in terms of similarity
  - Checking robustness of the network with the selected method
  - Performing, if it is possible, an in-depth study of the encountered communities, with ideas from our proposed method in Subsection 4.1.9.

- We have studied evolution of communities in Chapter 5, proposing three different approaches to this problem. This studies have not produced meaningful results, but they are an initial approach to this difficult problem.

6.3 Future work

Our work has left ideas for future studies in different directions. We list the ones we identify with more clarity:

- A sociological study of communities encountered in the `.cat` domain, comparing results for the seven available months, in order to observe social tendencies in the results.
- An study focused in the evolution of the in and out-degree distributions of the `.cat` and other complex networks, in order to check if there is any relation between the average degrees and the maturity of networks.
- Development of a method which obtains good results in terms of similarity with other methods, and in terms of modularity. This new method would be the one used in communities studies. This method can take ideas from the meta-method we proposed in Subsection 4.2.4, consisting in a hierarchical clustering from results of different community detection methods.
- New tools and methods for studying community evolution. Our studies, performed in Chapter 5, have not given meaningful conclusions, and only have warned us that it is going to be a complicated problem.

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Appendix A

Tables of values

In this appendix we show tables with numerical values of studies realised. We list the tables and specify its content.

- Table A.1 contains the number of registered domains in the `.cat` top level domain
- Table A.2 contains numerical values for basic `.cat` sites network properties.
- Table A.3 contains modularity for different methods when applied to benchmark networks.
- Table A.4 contains modularity and number of communities for different methods when applied to the .cat sites network.
- Tables A.5 to A.11 contain similarity values of the results of community detection methods when applied to the .cat sites network, considering only its undirected unweighted form.
- Tables A.12 to A.18 contain similarity values of the results of community detection methods when applied to the .cat sites network, considering direction and/or weights of edges in some cases.
- Table A.19 contains similarity values of the results of community detection methods when applied to the .cat sites network, but considering only the biggest communities.
- Table A.20 contains similarity values of community partitions when comparing Louvain results from consecutive months.

Day	Reg. domains	Day	Reg. domains
23/Apr/06	8.364	1/Jan/08	26.373
1/Jul/06	15.633	1/Apr/08	28.500
1/Oct/06	17.719	1/Jul/08	29.748
1/Jan/07	19.623	1/Oct/08	31.198
1/Apr/07	21.798	1/Jan/09	33.410
1/Jul/07	23.050	1/Apr/09	35.609
1/Oct/07	24.097		

Table A.1: Number of registered domains in the `.cat` top level domain. Data from its opening to April 2009. Information from Fundació puntCat webpage, `http://www.domini.cat`.

Month	Sites	Links	Sites with links	CC	Size MCC
May/07	20000	7550	2507	84	2271
Sep/07	20000	7004	2461	105	2188
Jan/08	26342	11715	3751	121	3440
Mar/08	28380	13879	4187	138	3842
May/08	29609	14813	4412	132	4076
Jan/09	33611	25457	6036	139	5712
Mar/09	35016	32326	6756	158	6400

Table A.2: Basic graph properties of the .cat sites network. This table contains, for each month, the number of sites, links, sites with links, connected components and the size of the main connected component. We observe the growing tendency of the network with the pass of the months.

	karate	jazz	celegans	email	key	phis
EO	.418 (.418)	.445 (.445)	.444 (.434)	.574 (.574)	.860 (.845)	.680 (.679)
Newman	.417 (.419)	.442 (.442)	.436 (.435)	.568 (.572)	.836 (.855)	.670 (.723)
PBD	.402 (.394)	.433 (—)	.416 (.416)	.536 (—)	.862 (—)	.725 (.725)
Louvain	.417 (.42)	.443 (—)	.438 (—)	.544 (—)	.883 (—)	.750 (—)

Table A.3: Results in terms of modularity for the benchmark networks. Our results are the first ones, and in parenthesis there are the results published in literature. They are more or less the same except for Newman method, in which we use our implementation, not as good as the original one.

	Month													
	May/07		Sep/07		Jan/08		Mar/08		May/08		Jan/09		Mar/09	
Method	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C
eouu (1st)	.524	98	.526	119	.491	136	.486	158	.479	146	.422	157	.397	173
eouu (2nd)	.525	97	.534	123	.493	138	.478	154	.491	149	.426	157	.390	168
eouu (3rd)	.521	98	.534	117	.491	135	.486	155	.478	144	.421	150	.406	169
eodu (1st)	.444	816	.465	820	.461	1114	.429	1247	.428	1342	.378	1535	.377	1668
eodu (2nd)	.461	815	.470	840	.466	1091	.451	1245	.442	1322	.371	1592	.371	1703
eodu (3rd)	.465	828	.462	817	.450	1090	.454	1228	.451	1314	.394	1620	.357	1647
newman	.520	105	.503	125	.483	134	.483	161	.461	139	.412	152	.393	197
pbd	.498	20	.492	19	.476	18	.454	17	.455	14	.390	17	.356	11
louvain	.526	100	.536	125	.510	152	.494	161	.504	168	.436	171	.414	180
cluster	.505	30	.497	90	.464	30	.459	40	.463	30	.387	34	.352	30
eouw (1st)	.600	124	.836	154	.852	168	.822	192	.826	178	.832	234	.862	244
eouw (2nd)	.713	133	.845	145	.846	167	.812	190	.837	185	.834	207	.860	233
eodw (1st)	.789	967	.828	911	.826	1246	.747	1342	.812	1516	.818	1900	.851	2058
eodw (2nd)	.788	918	.817	895	.820	1243	.780	1391	.823	1489	.800	1893	.837	2029
lWeighted	.843	133	.887	158	.852	188	.829	207	.849	206	.833	218	.873	260

Table A.4: Results in terms of modularity for the .cat site network in different months. Different methods and different forms of the network are considered. The best results in each month are highlighted.

May/07	EO2	EO3	Newman	PBD	Louvain	Cluster
EO1	.38/.27	.43/.32	.44/.32	.50/.39	.41/.31	.33/.24
EO2		.41/.31	.38/.28	.50/.40	.41/.30	.42/.32
EO3			.43/.31	.51/.40	.45/.33	.48/.37
Newman				.51/.40	.47/.33	.34/.27
PBD					.47/.37	.40/.30
Louvain						.39/.28

Table A.5: Similarity, in May 2007, of the .cat undirected unweighted site network. Dongen metric/VI metric. The smallest values are highlited.

Sep/07	EO2	EO3	Newman	PBD	Louvain	Cluster
EO1	.35/.28	.35/.27	.45/.31	.54/.43	.39/.31	.38/.27
EO2		.27/.24	.43/.30	.53/.43	.32/.28	.44/.32
EO3			.43/.29	.56/.44	.31/.28	.41/.31
Newman				.53/.43	.46/.33	.19/.16
PBD					.51/.40	.45/.36
Louvain						.40/.29

Table A.6: Similarity, in September 2007, of the .cat undirected unweighted site network. Dongen metric/VI metric. The smallest values are highlited.

Jan/08	EO2	EO3	Newman	PBD	Louvain	Cluster
EO1	.45/.32	.49/.33	.40/.30	.57/.43	.48/.34	.37/.29
EO2		.47/.34	.46/.31	.56/.44	.47/.35	.53/.39
EO3			.48/.32	.58/.44	.49/.36	.55/.40
Newman				.55/.42	.48/.34	.33/.27
PBD					.47/.37	.42/.30
Louvain						.42/.31

Table A.7: Similarity, in January 2008, of the .cat undirected unweighted site network. Dongen metric/VI metric. The smallest values are highlited.

Mar/08	EO2	EO3	Newman	PBD	Louvain	Cluster
EO1	.48/.33	.43/.32	.44/.31	.56/.44	.48/.35	.34/.27
EO2		.44/.31	.40/.29	.57/.43	.47/.34	.53/.40
EO3			.37/.29	.55/.43	.49/.36	.48/.39
Newman				.57/.43	.48/.35	.40/.31
PBD					.53/.41	.44/.34
Louvain						.37/.29

Table A.8: Similarity, in March 2008, of the .cat undirected unweighted site network. Dongen metric/VI metric. The smallest values are highlited.

May/08	EO2	EO3	Newman	PBD	Louvain	Cluster
EO1	.46/.32	.50/.34	.50/.32	.59/.45	.46/.33	.31/.25
EO2		.48/.33	.47/.30	.59/.42	.45/.32	.51/.38
EO3			.47/.31	.58/.43	.44/.34	.52/.41
Newman				.58/.42	.46/.34	.42/.30
PBD					.50/.40	.47/.35
Louvain						.39/.30

Table A.9: Similarity, in May 2008, of the .cat undirected unweighted site network. Dongen metric/VI metric. The smallest values are highlited.

Jan/09	EO2	EO3	Newman	PBD	Louvain	Cluster
EO1	.51/.34	.45/.31	.53/.35	.60/.44	.50/.36	.33/.28
EO2		.45/.29	.49/.32	.55/.42	.47/.34	.54/.41
EO3			.49/.30	.56/.42	.47/.34	.53/.40
Newman				.59/.44	.52/.36	.44/.32
PBD					.54/.42	.51/.37
Louvain						.42/.34

Table A.10: Similarity, in January 2009, of the .cat undirected unweighted site network. Dongen metric/VI metric. The smallest values are highlited.

Mar/09	EO2	EO3	Newman	PBD	Louvain	Cluster
EO1	.51/.32	.50/.31	.52/.32	.64/.44	.51/.36	.49/.34
EO2		.55/.32	.47/.31	.62/.42	.55/.37	.56/.40
EO3			.50/.30	.63/.42	.48/.34	.55/.39
Newman				.59/.41	.48/.34	.27/.22
PBD					.59/.43	.48/.33
Louvain						.48/.36

Table A.11: Similarity, in March 2009, of the .cat undirected unweighted site network. Dongen metric/VI metric. The smallest values are highlited.

May/07	eouu2	eouu3	eodu1	eoud2	eoud3	newman	louvain	eouw1	eouw2	eodw1	eodw2	lWeig
eouu1	.38/.27	.43/.32	.43/.45	.45/.46	.46/.46	.44/.32	.41/.31	.47/.36	.47/.37	.45/.50	.46/.49	.49/.38
eouu2		.41/.31	.41/.43	.42/.44	.44/.45	.38/.28	.45/.33	.48/.35	.5/.38	.46/.49	.47/.48	.49/.37
eouu3			.44/.43	.44/.44	.45/.45	.43/.31	.45/.33	.51/.37	.51/.39	.46/.49	.45/.48	.52/.40
eodu1				.20/.14	.21/.14	.40/.42	.43/.44	.42/.44	.46/.46	.27/.25	.29/.24	.47/.46
eodu2					.14/.13	.40/.43	.44/.44	.44/.46	.47/.46	.27/.25	.27/.22	.47/.45
eodu3						.41/.43	.44/.44	.46/.47	.47/.46	.27/.25	.27/.23	.48/.46
newman							.47/.33	.46/.34	.47/.37	.44/.48	.45/.48	.45/.35
louvain								.5/.39	.5/.39	.44/.46	.46/.47	.51/.39
eouw1									.39/.32	.44/.51	.44/.49	.43/.33
eouw2										.39/.44	.40/.44	.32/.26
eodw1											.15/.15	.38/.42
eodw2												.40/.42

Table A.12: Similarity, in May 2007, of the .cat site network considering its different forms. Dongen metric/VI metric. The smallest values are highlited.

Sep/07	eouu2	eouu3	eodu1	eoud2	eoud3	newman	louvain	eouw1	eouw2	eodw1	eodw2	lWeig
eouu1	.35/.28	.35/.27	.45/.45	.43/.45	.44/.45	.45/.31	.39/.31	.53/.41	.48/.37	.46/.49	.46/.48	.46/.37
eouu2		.27/.24	.42/.44	.43/.44	.44/.45	.43/.3	.32/.28	.49/.39	.47/.38	.44/.46	.44/.47	.45/.36
eouu3			.4/.44	.42/.45	.42/.44	.43/.29	.31/.28	.5/.4	.45/.37	.43/.48	.44/.48	.43/.35
eodu1				.22/.18	.23/.18	.43/.46	.42/.43	.48/.46	.47/.47	.26/.22	.27/.23	.47/.47
eodu2					.23/.18	.43/.46	.42/.43	.48/.46	.46/.46	.26/.22	.27/.22	.45/.46
eodu3						.43/.46	.44/.44	.49/.47	.48/.47	.27/.22	.28/.23	.48/.47
newman							.46/.33	.52/.4	.5/.37	.47/.51	.47/.5	.49/.37
louvain								.51/.4	.48/.38	.43/.46	.45/.46	.46/.37
eouw1									.28/.24	.41/.41	.43/.42	.36/.28
eouw2										.39/.43	.4/.43	.27/.23
eodw1											.16/.15	.36/.4
eodw2												.38/.41

Table A.13: Similarity, in September 2007, of the .cat site network considering its different forms. Dongen metric/ *VI* metric. The smallest values are highlited.

Jan/08	eouu2	eouu3	eodu1	eoud2	eoud3	newman	louvain	eouw1	eouw2	eodw1	eodw2	lWeig
eouu1	.45/.32	.49/.33	.46/.46	.47/.45	.47/.46	.4/.3	.48/.34	.57/.42	.55/.41	.49/.51	.52/.51	.57/.42
eouu2		.47/.34	.44/.45	.44/.44	.46/.45	.46/.31	.47/.35	.56/.41	.56/.42	.47/.5	.5/.51	.57/.43
eouu3			.47/.46	.44/.45	.47/.46	.48/.32	.49/.36	.56/.41	.56/.41	.48/.51	.5/.52	.57/.43
eodu1				.26/.2	.27/.2	.45/.47	.46/.45	.51/.49	.52/.49	.31/.26	.32/.26	.52/.48
eodu2					.27/.19	.44/.45	.46/.45	.51/.48	.5/.47	.3/.26	.3/.26	.52/.48
eodu3						.44/.46	.45/.45	.51/.49	.51/.48	.32/.27	.33/.27	.53/.48
newman							.48/.34	.51/.38	.51/.39	.48/.52	.5/.53	.54/.41
louvain								.57/.42	.53/.41	.48/.49	.49/.5	.53/.41
eouw1									.33/.27	.44/.46	.46/.47	.36/.28
eouw2										.43/.45	.44/.45	.38/.29
eodw1											.2/.16	.4/.4
eodw2												.41/.41

Table A.14: Similarity, in January 2008, of the .cat site network considering its different forms. Dongen metric/ *VI* metric. The smallest values are highlited.

Mar/03	eouu2	eouu3	eodu1	eoud2	eoud3	newman	louvain	eouw1	eouw2	eodw1	eodw2	lWeig
eouu1	.48/.33	.43/.32	.48/.46	.44/.44	.49/.46	.44/.31	.48/.35	.58/.44	.56/.42	.48/.49	.5/.5	.55/.43
eouu2		.44/.31	.45/.46	.43/.44	.46/.45	.4/.29	.47/.34	.53/.4	.55/.4	.49/.5	.5/.52	.54/.41
eouu3			.47/.46	.45/.44	.5/.46	.37/.29	.49/.36	.58/.43	.56/.41	.49/.5	.5/.51	.54/.42
eodu1				.24/.18	.27/.2	.44/.44	.47/.45	.51/.48	.51/.48	.28/.24	.3/.26	.5/.47
eodu2					.25/.18	.45/.43	.46/.44	.52/.48	.51/.48	.31/.25	.32/.26	.49/.46
eodu3						.45/.44	.48/.45	.51/.48	.52/.48	.31/.25	.33/.27	.5/.47
newman							.48/.35	.55/.41	.56/.4	.47/.49	.48/.5	.52/.4
louvain								.53/.42	.56/.42	.49/.49	.5/.49	.52/.4
eouw1									.39/.3	.45/.45	.44/.45	.33/.27
eouw2										.47/.46	.47/.46	.35/.28
eodw1											.18/.18	.42/.42
eodw2												.4/.41

Table A.15: Similarity, in March 2008, of the .cat site network considering its different forms. Dongen metric/ *VI* metric. The smallest values are highlited.

May/08	eouu2	eouu3	eodu1	eoud2	eoud3	newman	louvain	eouw1	eouw2	eodw1	eodw2	lWeig
eouu1	.46/.32	.5/.34	.5/.48	.48/.47	.48/.46	.5/.32	.46/.33	.61/.45	.54/.41	.51/.54	.5/.52	.55/.43
eouu2		.48/.33	.51/.48	.48/.48	.46/.46	.47/.31	.45/.32	.59/.43	.51/.4	.49/.53	.49/.52	.54/.42
eouu3			.48/.48	.5/.48	.46/.46	.47/.31	.44/.34	.58/.43	.53/.4	.5/.55	.5/.53	.55/.42
eodu1				.29/.2	.27/.18	.45/.47	.49/.47	.54/.5	.52/.5	.31/.27	.31/.25	.51/.48
eodu2					.25/.18	.48/.48	.51/.48	.54/.5	.52/.5	.3/.27	.32/.26	.51/.47
eodu3						.44/.46	.46/.45	.52/.49	.5/.49	.3/.27	.3/.26	.5/.47
newman							.46/.34	.58/.42	.5/.39	.5/.57	.49/.55	.53/.42
louvain								.58/.44	.54/.42	.51/.52	.51/.51	.54/.41
eouw1									.39/.3	.46/.46	.47/.46	.39/.3
eouw2										.46/.47	.45/.46	.39/.31
eodw1											.23/.18	.44/.43
eodw2												.38/.4

Table A.16: Similarity, in May 2008, of the .cat site network considering its different forms. Dongen metric/ *VI* metric. The smallest values are highlited.

Jan/09	eouu2	eouu3	eodu1	eoud2	eoud3	newman	louvain	eouw1	eouw2	eodw1	eodw2	lWeig
eouu1	.51/.34	.45/.31	.48/.42	.46/.43	.46/.43	.53/.35	.5/.36	.61/.47	.62/.46	.53/.54	.55/.54	.59/.47
eouu2		.45/.29	.43/.41	.43/.42	.46/.44	.49/.32	.47/.34	.64/.48	.62/.46	.54/.55	.53/.54	.61/.47
eouu3			.41/.41	.45/.43	.47/.44	.49/.3	.47/.34	.64/.47	.6/.44	.53/.56	.54/.55	.6/.46
eodu1				.27/.17	.27/.17	.48/.41	.45/.42	.55/.48	.53/.48	.36/.31	.35/.31	.53/.48
eodu2					.27/.17	.48/.43	.47/.44	.55/.48	.53/.48	.36/.31	.37/.3	.55/.49
eodu3						.47/.43	.48/.45	.57/.5	.54/.5	.36/.31	.35/.3	.54/.49
newman							.52/.36	.65/.48	.61/.45	.54/.55	.54/.54	.61/.47
louvain								.62/.47	.6/.46	.52/.52	.54/.52	.59/.46
eouw1									.46/.34	.47/.44	.48/.44	.43/.32
eouw2										.48/.48	.49/.48	.48/.34
eodw1											.22/.19	.4/.39
eodw2												.42/.41

Table A.17: Similarity, in January 2009, of the .cat site network considering its different forms. Dongen metric/ *VI* metric. The smallest values are highlited.

Mar/09	eouu2	eouu3	eodu1	eoud2	eoud3	newman	louvain	eouw1	eouw2	eodw1	eodw2	lWeig
eouu1	.51/.32	.5/.31	.51/.45	.52/.45	.48/.42	.52/.32	.51/.36	.61/.46	.63/.47	.55/.56	.55/.55	.62/.48
eouu2		.55/.32	.52/.44	.47/.44	.46/.41	.47/.31	.55/.37	.62/.45	.63/.45	.54/.55	.54/.55	.62/.47
eouu3			.51/.45	.52/.45	.47/.42	.5/.3	.48/.34	.62/.45	.65/.46	.54/.55	.54/.55	.62/.47
eodu1				.38/.22	.33/.2	.49/.44	.48/.45	.54/.48	.57/.49	.38/.33	.41/.33	.54/.49
eodu2					.32/.19	.45/.43	.5/.45	.56/.5	.58/.5	.4/.33	.4/.33	.56/.5
eodu3						.43/.4	.47/.43	.54/.48	.54/.48	.37/.33	.38/.33	.53/.48
newman							.48/.34	.6/.44	.6/.44	.52/.54	.52/.54	.59/.45
louvain								.6/.46	.63/.47	.52/.52	.52/.52	.59/.46
eouw1									.36/.29	.46/.45	.46/.45	.39/.31
eouw2										.47/.46	.47/.46	.4/.32
eodw1											.21/.18	.38/.39
eodw2												.41/.4

Table A.18: Similarity, in March 2009, of the .cat site network considering its different forms. Dongen metric/ *VI* metric. The smallest values are highlited.

Mar/09	eouu1	eouu2	eouu3	eodu1	eoud2	eoud3	newman	louvain	eouw1	eouw2	eodw1	eodw2	lWeig
eouu1		.49/.27	.4/.26	.44/.43	.47/.44	.4/.4	.43/.26	.41/.3	.57/.45	.58/.44	.53/.59	.53/.58	.57/.47
eouu2	.46/.29		.5/.29	.47/.45	.44/.44	.42/.42	.4/.26	.48/.35	.6/.45	.61/.46	.52/.6	.54/.59	.6/.47
eouu3	.42/.27	.48/.28		.5/.47	.47/.45	.43/.42	.43/.27	.42/.3	.58/.44	.61/.45	.52/.58	.52/.58	.58/.46
eodu1	.55/.34	.56/.32	.55/.33		.55/.32	.47/.27	.53/.32	.51/.37	.6/.46	.64/.47	.55 /.49	.59/.49	.61/.48
eodu2	.56/.34	.48/.3	.56/.33	.55/.31		.47/.26	.47/.3	.54/.38	.63/.48	.65/48	.57/.5	.58/.49	.63/.5
eodu3	.5/.3	.48/.27	.49/.29	.47/.27	.46/.27		.43/.27	.49/.35	.6/.45	.59/.45	.52/.49	.54/.49	.58/.47
newman	.43/.26	.35/.23	.42/.24	.44/.44	.39/.42	.34/.39		.4/.3	.53/.42	.54/.42	.5/.58	.5/.58	.54/.45
louvain	.44/.29	.5/.32	.4/.27	.43/.43	.47/.44	.42/.41	.39/.26		.57/.44	.59/.45	.51/.56	.51/.56	.58/.46
eouw1	.6/.41	.62/.39	.61/.39	.54/.48	.56/.5	.54/.47	.59/.38	.58/.43		.35/.3	.46/.51	.46/.51	.38/.34
eouw2	.61/.42	.62/.39	.65/.41	.58/.5	.59/.51	.54/.48	.59/.39	.63/.45	.36/.3		.47/.52	.49/.52	.42/.34
eodw1	.62/.49	.6/.46	.6/.47	.54/.43	.56/.44	.51/.42	.57/.45	.56/.46	.48/.38	.48/.39		.31/.26	.35/.3
eodw2	.61/.48	.6/.45	.61/.46	.58/.43	.57/.43	.53/.42	.57/.45	.57/.46	.48/.39	.49/.39	.31/.27		.39/.32
lWeig	.6/.43	.62/.41	.62/.42	.55/.49	.58/.51	.54/.48	.6/.4	.58/.44	.38/.31	.4/.32	.38/44	.42/.46	

Table A.19: Similarity in March 2009. Only big communities. Dongen metric/ *VI* metric. The smallest values are highlited.

May 2007 Sep 2007	Sep 2007 Jan 2008	Jan 2008 Mar 2008	Mar 2008 May 2008	May 2008 Jan 2008	Jan 2008 Mar 2008
.5/.42	.51/.43	.4/.35	.43/.36	.52/.43	.47/.39
May 2007 Ale Sep 2007	Sep 2007 Ale Jan 2008	Jan 2008 Ale Mar 2008	Mar 2008 Ale May 2008	May 2008 Ale Jan 2008	Jan 2008 Ale Mar 2008
.76/.69	.77/.68	.76/.66	.78/.67	.78/.64	.79/.63

Table A.20: Similarity values when comparing community partitions of different months. We show, in the first rows, values of found community partitions in the `.cat` sites domain, and in the last rows, values when comparing a real community partition with another from an aleatory graph. Values of Dongen metric/ *VI*.

Appendix B

Lists of sites and words

In this appendix we show the result of Louvain's algorithm when applied to the .cat sites network of March 2009, in section B.1, and the most significant words for each of their communities obtained with our method, in section B.2.

B.1 Sites of communities

We list the result of Louvain's algorithm when applied to the .cat sites network of March 2009. We also have the results of other months, but in this appendix we decided to show only one month of them, the last. We indicate the number and size of each community before listing its nodes. In all sites we omitted its prefix, `www.`, and its suffix, `.cat`, always the same for each site in the .cat domain, for space reasons. For example, the first site listed is `fotografiadental`, although its full name is `www.fotografiadental.cat`, or, more specifically, `http://www.fotografiadental.cat`. We show the full list in this and in the following pages.

Communities of Louvain's algorithm.
.cat site network of March 2009

Com 1 – 2 elems	Com 5 – 2 elems	Com 9 – 2 elems	Com 13 – 2 elems	Com 18 – 2 elems
fotografiadental	osonaglobus	azm	mindthegap	
fotolandia	aircat		barrank	
Com 2 – 2 elems		**Com 10 – 2 elems**	**Com 14 – 3 elems**	**Com 19 – 2 elems**
agentsforestals	paidopsiquiatria	marcosmorales	sincronia	shops
forestals	novasageta	samdisseny	obac	informacio
Com 3 – 5 elems	**Com 6 – 3 elems**	**Com 11 – 3 elems**	**Com 15 – 2 elems**	**Com 20 – 2 elems**
banccamins	catalunyacomunica	depuradoras	optica	circutor
caixaenginyersdeca	cio	totaigua	opticasalas	suministradora
mins	betara		salasoptic	
caixacamins	cursosdenautica	**Com 12 – 2 elems**	**Com 16 – 2 elems**	**Com 21 – 2 elems**
caixa–camins		llumdelluna	ubilibet	pereporquet
caixaenginyersca	**Com 7 – 2 elems**	nyamnyam	esqui	quadernsdetaller
mins	tonico	labanqueta		
	actual		**Com 17 – 2 elems**	
Com 4 – 2 elems		**Com 13 – 2 elems**	viatge	
vns	**Com 8 – 2 elems**	nouarc	giramon	
		galib		arluk
				ptll

Com 22 – 2 elems
osmosis
agua

Com 23 – 2 elems
guell
dracma

Com 24 – 2 elems
maeso
ati

Com 25 – 2 elems
phoenixpsicologia
phoenix

Com 26 – 2 elems
farreconsulting
multipis

Com 27 – 13 elems
fscastellnou
garden
trial
baste
evp
sumed
edo
clickclub
kart–f
grupgres
ebanner
evpconsulting
chatarrassanchez

Com 28 – 2 elems
campdepadros
elfojobs

Com 29 – 2 elems
lamistat
teatrelamistat

Com 30 – 2 elems
latresca
proeixample

Com 31 – 2 elems
ipic
siesta

Com 32 – 3 elems
estudi
joanrosell
novaegara

Com 33 – 2 elems
siscom
triatlocostabrava

Com 34 – 3 elems
eimsa
fadisel
telstar

Com 35 – 2 elems
impromptu
emilipulido

Com 36 – 2 elems
microtech
batllori

Com 37 – 2 elems
jordifreixanet
freixanet

Com 38 – 2 elems
pujadascalcat
pujadas

Com 39 – 2 elems
servitec
marente

Com 40 – 2 elems
arnaudelrio
montserratsanz

Com 41 – 2 elems
rutalia
empresesdecatalunya

Com 42 – 2 elems
bivselecte
bivselectevins

Com 43 – 2 elems
viveristes
tortades

Com 44 – 2 elems
instacat
xamba

Com 45 – 2 elems
quimica
palomas

Com 46 – 3 elems
impremtabadia
amos
gabrielescultor

Com 47 – 3 elems
max
reboreda
lespingari

Com 48 – 4 elems
sintesi
bosco
mirson
rescomseravidreres

Com 49 – 3 elems
filnet
torra
nortel

Com 50 – 2 elems
karaokes
sona

Com 51 – 2 elems
llibresencatala
segonavida

Com 52 – 425 elems
pullover
xavier–blanco
videos
reneix
amunt
fundaciovalvi
apunts
mobildisco
teti
pockets
tarragonadigital
canalzina
casamitjana
mapamundi
restaurantpitarra
comunica
airun
grn
apevc
aisf
jocs
lavakan
joanfoguet
ciuvilafranca
compte
agpograf
lacasanova
grandcru
hotel–prats
esdeveniments
receptes
darwin
festivalneo
argilaguet
deli
vegetariana
aeg
iefc
museia
ggp
laguineu
iglu
ribals
cel
farreracan
icon
naturaiaventura
festesdelcampello
mintaka
torrente
elscarlins
xeflis
weblogs
mccb
meteoestartit
ombu
ecologistesenaccio
blackblanc
rede
stopself
quesoni
parentesi
xarxaprod
redessa
masiacastello
matria
idees
menssana
krick
marketing
saveu
serresdelmestral
dexeus
participaripolles
jofre
maratocatalunya
xvac
fotografia
tucasa
afc
angelpvico
alternativa
lamugacaula
nitdartistes
aransaski
cavok
broad
ensesoft
elcaudesantboi
blocs
magma
pepacaneja
adamveuip
muray–assts
calplanell
gasparo
vegueriapenedes
lasargantana
la–colla
aiguesmataro
epbcn
icp
xrqtc
tortugues
iogalatribuna
explora
disart
tpgirona
acim
masella
espai
grupars
equip
calvalls
fsjd
acna
indika
casadecultura
canjoan
sucarrats
laie
espaifotografic
panorama
ideant
avellanadigital
mobles
dos
villarodelbosc
ues
cruells
xaviss
cemcardedeu
ideasostenible
tcmsl
villaro
intervideo
gdg
bergactual
spv
mediamovil
qestudio
acciocivicacalderi na
berepublic
izard
anticemporda
fotom
ainacar
jordist
elblocdelsdijous
alexandri
canvarilla
hotelcalrei
rcg
rcc
igc
cccartografica
rocaumbert
gramanet
igualadajove
campaviaciolasenia
creaf
parcsijardins
nosaltres
ecosocialistes
casabatllo
fotoespai
raulromeva
adetca
diccionari
excursionisme
premsagratuita
hiperbolic
revistacambrils
alteregofilms
ceram
firagirona
campaments
escoltesiguies
fundaciojsans
agraits
chncb
aoapix
unescocat
unesco
acam
collarebombori
obsam
ime
salabeckett
cefarners
feec
cvbarcelona
cec
espeleologia
amicsderiudoms
uecgracia
colla
aemuntanya
madteam
laxicra
ambit7
acca
ceolot
joan
pujades
aguirre
noemi
forniol
saragossa
bartomeus
carbonell
pensamentisalut
armand
barcelona–cadaques
gmail
artrivity
reikicatalunya
vietkong
cerefalgari
taiji
caltalavero
icasellas–fotografia
centrecac
anem–hi
cartanya
dema
aeignuria
benetjoandarder
meteolasenia
brea
icaria
foment
tethys
lacuina
casinotorrent
saraualcudienc
tekhnikos

abast
queduri
riudoms
lasenia
vandellos-hospitalet
fontcolor
canselvata
iesleonardodavinci

castany
salsa
tai-txi
amicsmontella
roquessenseciment
artsana
conex
bordas
informatica
boncami
cebreda
ramoncomellas
alioth
sparagaria
tiu
catablocs
gigamail
meteotortosa
afca
viatjar
cecb
jordipinyol
letonia
obra
aetalaia
cmail
lafundacio
geoportal-idec
amicsmusicabdn
ideg
lamuntanya
cemadteam
actig
humoriscausa
icc
acom
paraularem
museuabello
gurbduatlo
lamolinace
trilogi
cime
smartnet
exland
gripaublau
monitors
gamma
cepalautordera
prodigi
ccdrassanes
piscina
endoterapiavegetal

artbcn
sbdweb
siurell
cornelladelterri
acd
revistama
audioencatala
uniauto
agil
natcha
infodetectius
gentdemar
hoteldelprado
salutmental
centpeus
vuitvents
dispunt
jordiguardans
tallerdemusica
cangirona

eradicarlapobresa
club
sonomax
geocat
talp
edicionssaragossa
ebrenavegable
latalaia
cibsub
pinedatecau
ranking
polepositionlleida

lamerceria
postersaigua
conzentra
bonart
feinespertreballar

grander
martilhuma
tallerdeiogapremia

llegirllibres
trnarquitectes
educadordegats
quihiha
clubesquiterrassa
ocuc
educabloc
locampus
gameover
perepujol
crea
coralegre
fricorsa
gaia2148
botigasetzevents
progat
oceans
adeumateria
indianwebs
eloasis
catalunyaqualitat
anar
contosnomediterraneo

moretmargui
padres
sitgesmanresa
museus2008
pcot
scan
catalandrama
euribor
kubic
cesmar
scot
geografs
encenguemlamar
lacivica
joanpons
llancer
iescostafreda
quimroser
fitfestival
litterarum
literattours
tonirodriguez
viatgers
cautarrega
lligamuntanya
gimcanagirona
megagestio
ortoxpres
iogaelpou
anydarwin
somcinema
openict
olvaneja
dharana
lleidaparticipa
agendasaraus

antonirodriguez
parapente
superkong
esbartgranollers
captures
musicaib
sap-ugt
mostrademuntanya
valldassua
aepedraforca
cookie
4vents
19arcs
cebcat-labalca
fotosub
dotaverna
noba
dades
aneu
teatreib
com-tech
proudebrou
gegantsmataro
esports10
bonadona
articula
veneziacatalunya 2009
veneciacatalunya
vilesambpersonalitat

Com 53 - 4 elems

consulting
assessorar
asesoria
assessor

Com 54 - 2 elems

rafatoteatre
montsemiralles

Com 55 - 2 elems

mireia
computergrafic

Com 56 - 2 elems

cmn
btn

Com 57 - 2 elems

voisinmateu
pardo

Com 58 - 2 elems

zen
zentortosa

Com 59 - 6 elems

webmaster
minigolf
serveisforestals
bracelona
accentescolademusica
fundacioboscos

Com 60 - 3 elems

kit
jbosch
jbsi

Com 61 - 3 elems

santibaro

dominicana
dic

Com 62 - 2 elems

francescpares
siscumariscu

Com 63 - 2 elems

coqt
cosb

Com 64 - 2 elems

assolim
collfred

Com 65 - 2 elems

gestio
pigmalio

Com 66 - 2 elems

bastida
peuets

Com 67 - 3 elems

pi-2
samvitoulis
tales

Com 68 - 3 elems

disseny
erigin
fotografies

Com 69 - 2 elems

gsm
petitsresidus

Com 70 - 376 elems

alcaldebaron
mag-grup
collajoves
foratdelvent
recercaenaccio
idibell
eljoccasteller
lligall
donesjuristes
tmb
eicc
portalcomunicacio
catalansuk
coettc
idiap
grupelsisards
fast
itm
mtc
colomencspelcanvi
castellersdesantfeliu
alimarahotel
anson
eappoblesec
habitats
ciuvilanova
santpau
moixiganguers
materiagris
lafontanadibreda
cresib
vailets
forumsanitari
mosquitigre

fundacio-francescpujols
americat
campusperlapau
taulerdanuncis
ccnoguera
castellersdebadalona
veterinaris
scoe
assegurances
peyo
clubcesi
entesajuntspalafrugell
lavila
fchipica
forumsanitario
montbuiracingvalles

edreams
cetit
dominios
capitatiumaresme central
rauxa
metode
vivesmanresa
ficcat
aspe
castellersdelpoblesec
xiquetsdetarragona

manelferre
clc
barrufet
tarragonaradio
festivalaltaveu
actedi
eoibd
comt
angelmartinez
amicsdebesalu
fersalut
autocam
fotografs
vinseum
sciencia
coec
professiomedica
portalcomunicacion

covb
iom
eapsardenya
acao
collajovelh
patronatestudisosonencs
bsc
museudelvi
icasf
comg
metgesdecatalunya
mediadorsdassegurances
icavor
irbbarcelona
exitvalles
scn
atollet
basicassessors
ramc
biocat
cerclesabadelles
acup
c3po
castellersderubi
motor
humorisalutlleida
quimics

lacasadelsentre mesos
angelros
paraules
tosca
ergin
tercos
lamarsalada
canros
bmwclub
lotall
combtv
elsigualadinspregunten
elsmarges
cappproblema
metgesalexili
entesaperigualada
fit
cinc−gats
aammb
onomastica
comll
apd
altemporda
emporda
barcelonatv
bibliotecamolle russa
diaridebarcelona
tvpenedes
mollerussa
ic3
lletra
crei
politecnicamataro
eum
cbuc
sac
imim
autonoma
euss
ccetic
cetig
colbacat
cetim
tdx
padicat
digital
recercat
entorno
raco
padi
active24
pamsa
visible
grec
cadipedraforca
lesrevistes
esquitx
eltotgranollers
bondia
lafura
lacomarca
el3devuit
cataloniatoday
rtvvilafranca
radiobalaguer
radiosantfeliu
apcc
sagals
icag
castellersdellei da
arreplegats
iee
comb
circ
xiquetsdereus
humoralia
torrens−ibern
cquatre
accc
fcri
castellersdevila franca
ctv
cetill
cdl
cat−science
stats
iec
mercerodoreda
icab
fundaciomaratotv3
icatgn
cicac
dracdevallirana
cccc
xics
lapassio
marrecs
borinots
tirallongues
museudelamedicina
mjc
fcv
badminton
fca
esportsdhivern
fceh
fcpeic
ausamusic
marti
edf
laprimaverarepublicana
blanca−ribera
rafelbosch
valldellobregos
wap
laprincipaldelanit

ram
cunill
productesmedics
cesib
mag−photo
torrairesdemont blanc
falconsdevila franca
euritmia
baladre
castellersdecor nella
falconsdebarcelona

bandabarretina
webscatalans
monestirdegualter
joanmelia
vallirana
albages
linguamon
js−e
aqu
cesca
castellersdemollet

urologia
revistarelats
ub
castellersdelavila degracia
bnc
nic
acmf
icrea
lessantes
atotdrap
ndez
dracpoblenou
barcelonagaels
di8e
setmanaciencia
catalunyarock
castellersdesants
nurburgring
iciq
totmataro
anyrodoreda
wikipedia
intercampus
iespaucasesnoves
casasa
quimrt
mnat
biodiversitat
martacid
matossers
crm
cebalaguer
amac
premsa−esportiva
aluminisgranollers

eblagestiodocumental
escolamontserrat ria
elmetgedigital
catalunyaintercultural
casap
bttaddictes
nad
madorell
carles−sindreu
dannas
projectemiranda
memoriagentgran
lagoonelectrolux
entrenuvols
fundaciocoromines aco
elcargol
irb
eltempsdelescireres

lacollanada
formacioneu
analisis−bayo
totmaresme
infomed
bellvitgehospital
canalculturatv
enblanc
balaguereduca
castellersdesparre guera
flashticsalut
kinoa
juanolabassedas
immapoyatos
mmb
pebc
lapinya
ebacentelles
formaclick
revistacastells
ticsipaisatge
petitmon
angeletsdelvalles pir
serrador
gadex
lacentraldelcirc
tirantonline
fesneu
darwin2009
covll
blanesturisme
cvg
saloucom
musonka
ornitho
castellersdeter rassa
veusdelmon
innova360
elcorrector
cursosdevela
cifolc
covt
tallerhistoria celra
fempolitica
noisdelatorre
esportsgaelics
catalunyacristiana

acfid
ajilc
themobilitynode
ictus−mitjans
engineering
castellersdelasa gradafamilia
xafatolls
ccccb
quantya
castellersaltafulla

lasantjordi
finquesmora
futbolcasteller
formaciocontinuada coec
akemifujita
llibreriacatalonia

covgi
amicsdemontserrat
rosespedia
gno
iesviladegracia
motoranticgarrotxa

bioarqueologia
joanclimentferre
angcorcoles−psico terapia
dialogal
focnou
congresadvocacia
barcelonadown
associaciovelalla tinamallorca
Com 71 − 3 elems
matiasguarro−id
matiasguarroespais

matiasguarro
Com 72 − 2 elems
aclam
llevinac
Com 73 − 2 elems
maya
explotacionsrafols

Com 74 − 2 elems
drop
prevenciotextil
Com 75 − 2 elems
eixgarraf
lvacares
Com 76 − 2 elems
marc
mavi
Com 77 − 2 elems
veterinariavilanova
mimans
Com 78 − 2 elems
referencies
amazonia
Com 79 − 7 elems
calidae
ganella
jsola
totmusica
canalcatalavoriental
rogersegura
puigroca
Com 80 − 3 elems
spf
mardefons
tronat
Com 81 − 2 elems
rosa
xaviermartorell
Com 82 − 2 elems
sushistudio
orbitagironina
Com 83 − 2 elems
tresitres
nexelinguistic
Com 84 − 190 elems
sex
observatorideles port
lallauna
infoself
uetona
copc
caixamanlleu
osonaturisme
museuolimpicbcn
campdeslloses
carnavaltorello
envellint
e−weekvic
genos
ampa−andersen
picanti
informatic
fav
osonapilates
patrimonidelgarraf
ramonportet
lescarpes
torellocomerc
anigami
tasca
bisaura
karaokemania
bibliotecatona
mecakim
nurieta
adfo
bibliotecamanlleu
sex−shop

rupit
elsmosquetons
marxadelsvigatans
martiipol
ivo
unigresca
santjoandelesabadesses
vicenllac
ccparcsandaru
merceiglesias
acamisinha
ratafiabosch
espaisescrits
vig
ladisco
baula
santperedecasserres
karibu
jones
adianthus
mesosona
workinn
esportuniversitari
salavirtual
immovic
gironaerotica
donasex
barrierm
gestsoft
fundaciojoanbrossa
rocaforcada
saucollsacabra
gesbisaura
lesmasiesdevoltrega
ajtorello
ajsantquirze
armandquintana
victurisme
si-dral
impevic
impe
vilanovadesau
vic
imac
vicvirtual
ajvic
tona
uvic
el9nou
setmanariancora
radiovic
casinodevic
sexe
torellomountainfilm
ccosona
l-aem
carques
batetdelaserra
espaicat
lleidaerotica
catalunyaerotica
rostoll
skandolpublic
firadeljoc
gestoria
cronistes
territoriweb
ggserveis
lesquirol
tavernoles
folgueroles
rodadeter
stpere
rupitpruit
montesquiu
sora
verdaguer

webs
osonaesports
upisindi
vigatans
santvicencdetorello
fussimanya
osonaerotica
carlessalvador
indic
dart
katakrak
ampavallmanya
saplex
stylinox
tce
santtomas
terrassaerotica
nonsolum
rutadelter
gombau
servitona
inforaid
igebcn
barcelonaerotica
maresmerotica
gegantstorello
larevistona
bombersvic
barhermetic
serpentmanlleu
andrescuartero
manli
totfesta
girociutat
cextona
elbaixerotica
curtdegambals
osonadiari
santhipolitdevoltrega
territoriserens
paremtaula
osonosfera
torneriacastells
pdcat
sanglas
sips
esbartdansairecastelldetona
isaacperaire
incognit
calfusterdecivis
fhiso
museudelatorneria
siracusa
i-educacio
premsacomarcaldigital
controlpc
moiaerotica
laterra
lesmasiesderoda
optibusiness
astor
acudit
youbraga
societatverdaguer
cubelleserotica
zxx1
fistball
laferreriavella
mide
ticosona
sportassistance
caminsoliba
aaaa
feduart
ieducacio
badanadal
peprifa
lapiscinadetorello

sgmultimedia
torellojove
Com 85 - 2 elems
climbingworld
lassut
Com 86 - 2 elems
quincacau
joancarrera
Com 87 - 2 elems
laus
areavisual
Com 88 - 2 elems
lluismercader
gambarreta
Com 89 - 2 elems
federacioavicola
trabec
Com 90 - 2 elems
tau
daimaval
Com 91 - 2 elems
recuperat-ion
vitamin-t
Com 92 - 2 elems
caudelllop
gep
Com 93 - 197 elems
launio
fundacio-mediterrania
firamediterrania
cocobooks
blogbarcelona
icev
musicat
fcdetarragona
portaventuragolf
grangesbarber
manaiesbanyoles
portaventura
elsgroullers
revistacaramella
festivalcadaques
cg66
voramar
xipxap
elburrodelsjocs
mediterraniafm
macba
copylab
trueta
papersondemand
ampagrevol
lanoujoguines
flamenco
atot
premisbutaca
projectealcover
ultimallar
migdia
elpoblenou
espaisucre
cabina

sosa
jassera
musicaglobal
bluemoon
escacsbergueda
carrutxa
amtp
catalunyam
reustransport
crazynotes
mmvv
antropologia
burrocatala
telentrada
tenniscat
links
alleta
musicstgn
glaucs
ojokvan
sarau
iriscomunicacio
empremta
laselvadelcamp
quimera
icode
fibromialgia
tarragonaturisme
casinoprado
gorramusca
decibel
gaudicentre
disccataladelany
avublancafort
escolamariacortina
turismetorredembarra
josepsanz
barcelona4seasons
gralla
firatarrega
catalanarts
reus
sfreus
latroca
barcelona
figueres
innova
pessebre
edicionsmedol
gremieditors
informativos
apeiron
elcentrepoblenou
tradite
tradicionarius
sagradafamilia
clubtresc
trescclub
tresc
club3c
3cclub
fcec
armatstorredembarra
lavallesana
escacs
gimcat
iglesies
vesc
orfeoreusenc
lamostraigualada
nua
valinor
rgb
tresxnou
orna
sinibald
morros
esdansa
decalaix
mesclat

maps
gossos
glories
marboleny
pratsdellucanes
torredembarra
ccblanquerna
underline
tnc
escacsjuneda
maivistos
esmuc
isidre
castellvelldelcamp
apajoanrebull
barad
croma
samfainadecolors
safranar
joanisaac
arcatalunya
firacarrer
fups
posidonia
princeptotilau
compromesos
reusdigital
escena
estramp
adavilaro
guerracivil
espardenyateatre
museuexili
amuntproduccions
cordyapason
elpallol
musicatrapella
ovq
palauguell
jordibertran
ecologia
comvulguis
220
centredelpallol
projecteulisses
escacsolot
dotarragona
teuladesintegrals
apetorredembarra
alduf
miting
comeandsee
deiadisseny
viscabarcelona
qadar
lacarrau
elrajoler
manelmateo
campusdiagonalbesos
girovi
millorquenou
turismebcn2015
diatonic
ctpobla
tnt
caer
dhub-bcn
nojubilemlamemoria
dhub-barcelona
turisme2015bcn
mirna
itinerancies
setmanasantareus
masdelboto
campingstarragona
trackvendrell
ritmicatorredembarra
reusviuelvi
hotelvictoria

cestudisaltafulla
elbuffetdaltafulla
rosabcn

Com 94 - 175 elems

tersa
siresa
santivila
jocspolitics
semesa
arccoop
llonch-clima
biosfera
regesa
bicicampus
amicsdelprat
alcaldedegava
solidari
bancenginyers
spc-me
dinamis
basquetgava
bacc
ferranfalco
cdcripollet
ciulagarriga
txt
ctennissantfeliu
bonpreu
fundacioperlapau
cangur
serveisdelprincipat
jorditurull
esclat
bici
viaenergetica
iesjulioantonio
bicicleta
toniferran
abacus
sots
escolamusicala garriga
piscineslagarriga
ciusbd
codorniu
nuriasegu
ciupalautordera
salutemporda
feedback
pubillavilassar demar
radiosilenci
barcelonaenergia
ciumontsia
eixida
ciullissadevall
vedellapirineus
diaridesantcugat
meritxellbudo
aval
orangutan
elsindi
ciubadalona
vimar
centresostenibili tat
lluisbadia
ciupalleja
gig
bruneta
recoder100x100
femigualada
scomptes
parlament
compragava
cse
gavatv
elbruguers
gavaciutat
radiosellares
ametlla
patrimonigava
cetib
convergencia
udc
elpratradio
porttarragona
userda
ajlagarriga
lagarriga
ciu
cdc
convergenciaiunio
ocm
fdtriasfargas
aiguesdevilassar
saas
anglatecnic
uniodejoves
candinixcalella
fontdelsenamorats
ecodiari
joanvila
izquierdo
elportaldegava
ecoestalvi
santfeliudecodines
beeplagarriga
pintorbcn
laxinesca
vilafant
teia
barcelones
santfeliucodines
radiovilafant
canalreustv
sindicatura
intus
iesacumella
balneariblancafort
zpp
ciumoradebre
donesavui
estudisenergetics
pcivilametlla
danone
sentit-comu
prismax
irec
ciu-viladecans
comunicaglobal
plataformavilassar
amperits
elfilaberqui
pomadegirona
catalunyavolvolar mesalt
ciuelprat
cfsantfeliu
parlem-ne
davit
triatloametlla
masblanc
duranilleida
ciuterrassa
vilassardigital
aplecdebalenya
bicinstitut
ecogent
ciumanresa
lluisrecoder
tottarragona
b30
deixalles81
antonivives
cirkalia
versiooriginal
pastisseriasantjordi
criatures
apuntatalcanvi
odoart
santoma
volemlabiblioteca
anarfent
sanchezllibre
versionoriginal
ciuetdiu
sda
ciuvh
plarenove2008
enginyeria- classea
lamp
ciu-actuem
jodic
onacodinenca
reutil
cdcreus
teiatv
ciulh
grupmunicipalciu reus
asic
ices
ciugelida

Com 95 - 155 elems

vallsjove
soctortosa
tgd
molafm
venturapons
canalte
amte
deltalloguer
ciutatdigital
centrepicasso
santatecla
iqua
montserratvisita
auvenguen
big
debat
elit
revistaamposta
dpc
baditri
scurologia
tortuga
registradors
xarxatecla
totsrucs
lluert
perales
gea
code
festivalguant
nataliaferre
culturaipaisatge
espaiartsvisuals
pixidixi
lligacontraelcancer
elspallaresos
decomat
asvol
spiderman
concahabitatge
tinetbiblioteca
diputaciodetarra gona
tinet
altanet
baixebre-innova
telecentrebaixebre
jovebaixebre
vimbodipoblet
tarragonajove
arxiuvirtual
educamposta
montblancmedieval
montblanc
terrania
pragmaedicions
vernal
ebredigital
molatv
ferrandez
calmaginet
adm
calermita
gabintec
masferran
tren107
ebrelanparty
xagatarragona
lescireres
lacasanovadencol omer
vimbodi
concadebarbera
tortosa
altcamp
amposta
montsia
llorac
masdenverge
aoc
godall
baixebre
esplugadefrancoli
valls
vallfogonaderiucorb
gandesa
senan
asco
tcberga
cinealacarta
quintaforca
totcinema
pallol-finques
mireiafeliu
acopdeteclat
mecanoscrit
jjorda
emsptortosa
excursions
carmebosch
casacaritat
pares
txus
titulars
ingenium
concadigital
informatiualforja
restaurantcollde nulles
la-galera
ccooleararvalls
ornis
elsmuntells
hotelflamingo
yupis
femturisme
collajovetortosa
tastaverd
gecko
casafort
vesperfeina
nicanor
re-canvi-valls
gravidart
poblevell
ginkgobiloba
ecad
aemontsant
santescreus
pijfrancoli
circuitcatalade cinemadigital
cccd
gegantsdemontblanc
vickycristinabarce lonalapelicula
tarraconins
eljardidelmar
forasters
esplugaturisme
acmt
gumtsa
dipta
santclimentdello bregat
mesebre
radiomontblanc
catalunya-lgbt
refugielsmasets
lafila
farmacs
casainnova
avvlapineda
metrequadrat
cebaixebre
diversitatfuncional
sylvaner
catalunyaconnecta
stc
diver
concaadvocats

Com 96 - 2 elems

alxe
plecmetall

Com 97 - 2 elems

elrocio
arac

Com 98 - 2 elems

escastell
canmaurici

Com 99 - 2 elems

calendarios
calendaris

Com 100 - 2 elems

roviramontblanc
ellibres

Com 101 - 3 elems

finquesmontane
jcs
vidalassociats

Com 102 - 2 elems

xavifernandez
arslonga2002

Com 103 - 2 elems

binari
garatgeunio

Com 104 - 2 elems

bimsa
pronoubarris

Com 105 − 6 elems
ntc
essencia
centraledicions
guiadetona
guiadecalella
guiadevic

Com 106 − 3 elems
inset
reformesbarcelona
reformasbarcelona

Com 107 − 2 elems
primer
webempresa

Com 108 − 2 elems
morejon
4−photos

Com 109 − 2 elems
inducontrol
pavic

Com 110 − 2 elems
comin
bonacuina

Com 111 − 2 elems
jet
solartec

Com 112 − 921 elems
joventutdelafaran dula
cercadorexpertes
gremipa
colacatalana−cola lliure
csital
coralmixta
pastoretsdecatalu nya
resilis
llopgestio
isac
donesenxarxa
aralia
barodemaials
laveudigital
ccbages
consensus
vilamagore
justsolidari
cafetrio
serveismediambien talssitges
indesinenter
idisc
grafix
monbus
lourdesmunozsanta maria
fruitsdelbaix
baccabrils
sarfa
ccgarraf
cicsa
radioabrera
dracelcabrot
basquetpratenc
guiescingles
baixbus
sarrio
recicloil
sitgesmodelxxi
demogoda
soce
forumgastronomic
redall
paladetorroella
xim
apicesteve
spt
portaaporta
museudelsuro
carmegarcia
mercats
xatic
cebllob
emap
ebf
santsalvadordeguar diola
despientitats
baumafolk
robaamiga
impressions
taxibarcelona
festivaldecalaf
viarubricatus
taxicastellbisbal
escacscoloniaguell

baixinsercio
megabyte
zonaxxi
via21
gaudi
elspastoretsdema taro
nitbus
amed
ensmereixemunavila millor
imparables
sant−adria
labalma
xarxademusiques
bcestudi
pmeigualada
calmonjo
ateneutorrellenc
auledes
amtu
pastoretsdelven drell
amicsdecorbera
trobarhotot
institutcerda
xplai−viladecans
forumsa
24hores
arrencaceps
primaveradelesarts

accac
atmcamptarragona
miamiplatja
grupquatre
gramaradio
icps
engestur
acordio
cuimpb
irlanda
restaurantlabolera

barrimina
ubcentelles
fcampalans
transport
artsioficis
autobusoslleida
cucafera
sicom
arrosestanydepals
trosdesort
campingsdelbergueda

lasalateatre
festacatalunya
habitatgeterrassa
iemolinsderei
colonieselpinar
voleisorra
poblesdecatalunya
gremiserrallers
vueling
ategsa
radiotordera
betriu
frequencies
ccmeur
toca−sons
mmcercs
granjasoldevila
fundaciopalau
ccbserveis
coralmontau
caljoanpau
cellercubells
sarment
savosa
amersam
ginestavila
greenworldgirona
dansairesdelpenedes

ccvv
cepa
bombons
festa
bayarri
biblioabrera
abac
fogarsdemontclus
visitpalafrugell
teatreauditoridegra nollers
elvendrell
matrix
els3monts
sarbus
voluntarisperalfutur

cresidusvo
08860
canrabassa
eix
bastides
pccamiral
vinyesdelsaspres
ipep
fpt
socrates
mat−tordera
pfw
grameimpuls
informadordemarto rell
entitatscastellde fels
forumsd
fccb27
citvendrell
calrellotger
entitatsrubi
modernal
tvlf
campingelsprats
jubilatscardedeu
ocgr
pivsam
ccmaresme
ceanoia
radiocorbera
residusiconsum
cegracia
ciesc
spaidart
radionova
bjo
rubatec
cirem
ametllamar
sisal
busgranollers
premiadedalt
vilarsrurals
altbergueda
culturamatadepera
pastoretsbalsareny

salutdental
canboix
iesmolidelavila
escolavedrunaartes

coft
laveu
penyablaugranaberga

santfruitosentitats

abuli
canclarens
castellnoudebages
slot−car
lescorxador
calcolom− maspujols
mancoplana
pacteind
canburgues
lulldebou
calsenyoret
matadeperajove
totvidre
arenysinnova
indeco
segurifoc
cancoll
elbrogit
grupcerca
entesacubelles
santandreudellava neres
lavencdecornella
atmgirona
moliblanchotel
canperemarti
lismivo
coopac
rosita
hostaletsdepierola

faktotum
turismematadepera
consorcipratnord
gremihostaleria
vilaoficines
enquestadecondi cionsdevida
atmlleida
acav
festadelaigua
brgprogres
ajrubi
navarcles
santjust
donesempresaries
argentona
sindic
acm
vallesjove
diba
ccbp
fmc
amb
corbins
anoiaenviu
parcfluvial
sostenible
elbergueda
tarragones
emt−amb
besos
anoia
laroca
consorciocupacio valles
radio7valles
saldes
granollerstv
cassa
torrelles
psip
ajuntamentabrera
vilafrancadelpene des
granollersmercat
santfost
cabrerademar
conesa
santfeliu
osor
sabarca
sesentitats
firadelgall
santjoandespi
cambrils
formaciorubi
palamos
impic
sjdespi
santjuliadecerda nyola
ajripoll
sitges
compremasantfeliu
dosrius
sbg
elshostaletsdepie rola
matadepera
esplugues
visitaterrassa
arenysdemunt
smpalautordera
gramenet
vilafranca
mont−roigdelcamp
callus
cardona
viladesalt
rubi
vallfosca
calonge
turismeberga
festadelacarxofa
hostalric
promecberga
granollers
santpol
cubelles
olesam
agenda21cultura
cerdanyola
ccriberabaixa
cornellaweb
ecoviure
llinarsdelvalles
sindicadegreugesbcn

igualada
prat21
vila−seca
ajsitges
cerdanyolacomerc
cerdanyolamercats
santcugat
sostenipra
ceiptaularodona
fvo

apren
elstresturons
santjosep
iesvalltenes
ateneu
iniciativa
elspastoretsdeberga
grup-pumsa
abadiamontserrat
coressa
comfia
tac
bergacomercial
avlesbotiguesdesitges
adpc
mariusserra
punthabitatge
accents
vallesvisio
etv
consorciteledigitalmollet
radioigualada
mataroradio
comemissores
lobanyut
uabcampus
vallesoriental
salvaguardamontseny
grallersdevilafranca
lembarcada
ocab
micologia
eltatano
cavallfort
bonrotllo
josoc
polifonica
esbartdansaire
centreparroquialargentona
lluisos
scn-mm
basquetberga
cet
bmgranollers
molidelatorre
campingrieramerles
revistaigualada
edpac
casaldecalaf
oriolmorell
camins
miquelestape
cdiapsboi
illa
moreu
elspastorets
igualadaimagina
lasala
comissiosantmarti
calbarrusca
danielgabarro
esbartgualba
xolva
portell
cecalldetenes
cavall
intiam
ortografia
aeu
besernet
monestirs
nitsculturals
drecera
sant-celoni
waukikay-avia
xarxapiera
elmoianes
cineclubvila
manubens
gentdesantaeulalia
ism
lalba
ampaceipronca na
svh
savall
centelles
baga
argencola
tiana
biguesiriells
rellinars
palleja
tous
montmelo
capellades
porqueres
santaeulaliaroncana
gisclareny
castellviderosanes
gaia
martorelles
sesrovires
olesabonesvalls
orista
tordera
balsareny
carme
santantonidevilamajor
ajhortons
santpedor
santfeliusasserra
elbrull
montbui
vilanovadelvalles
olvan
gelida
odena
olost
pratsderei
altafulla
mont-roig
santagusti
seva
castelldans
vallgorguina
viladecans
morell
collsuspina
arbucies
santaeulaliariuprimer
vallcebre
cardedeu
sqvalles
perafita
canetmar
poblalillet
taradell
bellaguarda
muntanyola
polinya
cabrils
jorba
begues
alella
rajadell
calders
abrera
mataro
vacarisses
gurb
vilassardemar
staperpetua
olerdola
montornes
llagosta
masquefa
calldetenes
castellarvalles
santquintimediona
sallent
santacolomadecervello
cercs
riubregos
rubio
caldetes
elprat
palauplegamans
santjuliavilatorta
santiscle
montcada
llicamunt
alcoletge
vilamajor
vallromanes
santfruitos
monistroldemontserrat
molinsderei
llissadevall
calaf
artes
santamariapalautordera
canovelles
montclar
bergueda
collbato
avia
svmontalt
ripollet
premiademar
santceloni
montmaneu
llinars
elpapiol
santcugatsesgarrigues
montgat
castellbellielvilar
alpens
palafolls
sesgueioles
moia
viladecavalls
lesfranqueses
veciana
molletvalles
castelloli
caldesdemontbui
fontanals
castelltersol
bellprat
canyelles
casserres
constanti
santaeugeniadeberga
pujalt
puig-reig
flix
baixpenedes
castellbisbal
parets
martorell
santvi
suria
lapoblademontornes
sallavinera
baixcamp
cervello
arenysdemar
vilajuiga
avinyo
elmasnou
celra
cabrera
castelldefels
torrelavit
vilassardedalt
lapobladeclaramunt
navas
esparreguera
calongesegarra
santcliment
canetdemar
lapatum
joventutbaixcampmir
ajberga
noticx
vilassar
firadecalella
ajmataro
viladepiera
montcadaireixac
ajpolinya
secomsa
atll
atm
iesmilaifontanals
fgc
parctauli
atm-transmet
produccionintegrada
adigsa
iesriberabaixa
consum
nats
musicus
acppam
gramepark
veteransfcbarcelona
festadelconsum
dansacat
lavoz
cistell
catcert
forns
cadvor
ruscalleda
kamchatka
gisa
chpcentelles
barridelsgats
ral
ludotecaxauxa
baixmontseny
solverd
lesdeusaventura
matadeperatv
cerdanyolacultura
casallado
costadelmaresme
mancomunitatvallnes
solidanca
alimentsdorigen
comerciantsdesantaeulalia
bertranvilagines
totcamping
oasyssoft
pas
cpnl
bdigital
moianes
ortopediaalmenar
e-digital
mnactec
fotoluigi
lillet
mutuaterrassa
sam
oblatsmontserrat
altaalella
parcdelasequia
elbruc
santaka
onstage
idescat
yogamandir
ftaradell
premisinfancia
qdequads
bestsitges
coloniamodernista
intercanviador
bombonsmatadepera
donesambiniciativa
pimestic
santfruitosdigital
entitatscornella
pisoscases
comunitatmolidelavila
drolmarestaurant
torradora
naturabergueda
amicsdeformentera
sioc
programamillorasantagusti
matadeperacomerc
merceturro
emdvilamitjana
beguesentitats
imma-ajrubi
facs
calgras
avscatalunya
expolleure
xarxadistribucions
obrintvia
eldeltanegat
industriadeguerra
meteovilatorta
granollerscup
dinamitzaciocomercial
cercleinfraestructures
ferrocarrilturistic
vallesana
museuciment
cooperativaagrariatordera
uecanoia
ajuntamentdelescabanyes
iesllica
fabra
puntcall
gastroteca
barakia
cercapisos
montsenebrera
novolscaldo
jobvalles
pastoretsdecalaf
torrellesdefoix
enoturismepenedes
sitgescb
latorredeclaramunt
entitatsarenys
casalcatala
stac
artgent
2x2
artesentitats
empresamatadepera
cevo

festivalcelta
gremidiscoteques
girona
entesa-arbucies
gironabonsfogons
clubtennisarbucies

cetramsa
fondamas
caldiable
garme
laut
casabellanatura
aiguesmanresa
restaurantantaviana

cnigualada
hotelcesar
diarialcalde
castellardelriu
escolaramonllull
feliuguillaumes
atmcomarquescen
trals
dissenyrauxa
canmartinet
cresol
elfoment
fundacioviladecans

femelprimerpas
joventutsantacoloma

campinggironella
f3p
elpladelpenedes
xeic
restaurantgaia
costadebarcelona
maresme
joanboher
medran
teatrelamassa
coordinadoramaresme

ampacanta
ideesambaefecte
elplatblau
thermalia
bitxac
lacensada
granjaviader
aecv
miau-horitzontal
rogles
genesi
negrefum
maresmecn
restaurant-
cerdanya
imperdibles
anoiajove
callluis1887
xinoxano
radiopalafolls
lapassiodemolinsde
rei
perception
palamosmillora
sarasvatimusica
unitatpervilanova
ges-sitges
mercatmasuca
restaurantmercat
plaponent21
autocarsdomenech
vedellaecologica
premiainforma
cemura
navision
lima
pessebresmolins
micropobles

lacelleradeter
matarobus
confraria
ambiens
guia-web
flixgie
imis
artdemirar
comercial
daccornella
ampasantesteve
mamacasa
canperol
cempapiol
pcarol
villar-soria
lactium
gimsl
tecton
mnbagessanejament
festesdeprimavera
cedat
firadetitellaires
tamettut
arquitectesassoci
ats
consorciecop4rc
elpaisdelsfarinons

cesantboi
zonaxx1
plaestrategicgrano
llers
acaoc
emvt
fabregues
mobilitatelpla
artweb
dretsinfant
placadelmercat
restaurantlesolles

assessoriaolivella

parcfluvialanoia
okoball
donart
ajuntamentlallacuna

aquireduim
viurbana
avvsantandreu
tramuntanafestival

xaviarias
biblaria
monistroldecalders

diablesdesantcugat

yoganirmana
canoliver
amunorchi-
vallesori
ental
bioacustic
entitatssavall
anoiadiari
consumsocial
decidir
caldesmusart
auga
llibrerialamulassa

casaorlandai
guiagastronomica
ceip-elbruc
astronomia
aeball
tramitslesfranqueses

rubiguardiet
sophos

emt
alkimia-lab
coralconcordia
pessebrevivent
santfost
anexia
abelles
upmball
eurostage
cncentelles
elvendrelleduca
canovesisamalus
cacis
q-ral
vigem
joreciclo
igualadaturisme
amblesalforges
musicorum
aprendreadobe
rucsdelfar
bcnmultimedia
rocarodonaolvan
barcelonaprovincecb

pbcalaf
lacalagestio
consorcicanfilua
palausaverdera
ciocalgallifa
femllobregat
oficinahabitatge
igualada
museucoloniavidal
avellanadereus
biennaldelpessebre

08760
map-moia
centreboliviacatala

calforner-forngar
cia
agisitges
cerdanyolaesports
ajuntamentjove
gramenetimatgesoli
daria
vilassarturisme
promecomontgat
rasos100desqui
entitatsdecaldes
entitatsllavaneres

escultor
givemefive
amicsdenuria
canxic
ceip-puigventos
sintetitza
ivall
totsperargentona
esbarjo-verdi
portadeldelta
campusmutuaterrassa

rebombori

Com 113 - 2 elems

basquetmolins
cbmolinsderei

Com 114 - 2 elems

mascarell
chi

Com 115 - 2 elems

albi
biosalut

Com 116 - 2 elems

gardi
clubnauticsantpere

Com 117 - 88 elems

mestura
magnetic
anticsescolans
municipals2007
marcspalou
simpleweb
ribaltalcalde
macmobles
trenpalau
donessocialistes
elcercle
socialistespalamos

santuarielmiracle
caloptic
ceeuropa
socialistes
historieshorta
metalquimia
psctv
cuinetes
pscfolgueroles
ciumollet
avvcelm
presidentmontilla
xavierforcada
jsc
herbahameli
perenavarro
mondemones
pilardiaz
coralharmonia
psc
escolania
lluisoshorta
orfeogracienc
festamajordegracia

siuranenc
fclluita
lluisosdegracia
gracianet
marccamprodon
nerin
cirici
barnaseguretat
barnaporters
iceta
origens
sattva
ceipsantjordimollet

latortuga
guillemespriu
guiadebarcelona
panteresgrogues
graciatelevisio
carrio
onzecongres
corlafontana
tactum
tallerdartsaplica
des
barelfondo
carmechacon
krme
europatv
cncatalunya
chvh
cursmusicacervera
ignitor
graciadivina
cmmollet
molletama

30aniversaripsc
cuinaria
tallerhistoriade
gracia
grupbarnaporters
emmusicamolletdel
valles
homesigualitaris
federaciodecolles
desantmedir
adriamartinez
joseprodoreda
ampa-escolania
elcentregracia
arciris
parcgallecs
avclesseps
mesvdx
respostessocialis
tes
13congresjsc
causacomuna

Com 118 - 2 elems

srxo
elephanta

Com 119 - 2 elems

ciutadillamedieval
medievals

Com 120 - 2 elems

aegeeus
aegerus

Com 121 - 2 elems

lenmobaira
facturarserveis

Com 122 - 3 elems

catt
floppy
fustesansa

Com 123 - 2 elems

eurovacum
esvet

Com 125 - 3 elems

educat
prisma
secretaria

Com 126 - 2 elems

jaumeribasitemplus
fluid

Com 127 - 388 elems

aepiera
rem
simposi-ecnc
cmineraolesana
cnmolins
cfmatadepera
avg
jocsalairelliure

vertix
hoqueiclubmontbui
cemaresme
cfsvilamajor
hospitalmanlleu
cnbanyoles
caixagirona
barnacentre
fcptt
mitjaterrassa
caixalaietana
offroad
inproject
citric
skatingclub
nxarxa
rubes
garmo
eljardi
murria
esportissim
motorclubsentmenat

mesqueunclub
cmsc
esportiudigital
esporticiutadania
laferreria
automatica
agenciacarmel
gnuine
casamance
fedecatjudo
cpavilassardedalt
pelli
mcf
corredors
esportenmarxa
inventa
cfcunit
casaviva
cncornella
cbcic
tennisgirona
lamitja
lafontdeprades
coopsoses
catalunyapress
sercom
xonsrem
cnbadalona
cnab
creualta
sanrafael
viladordis
circuitalcarras
cfcatalunya
elconsell
clubnatacioamposta

clubpatimalgrat
radiosio
terrassafc
jiujitsu
nin
msr
cbtordera
pineda
clubatleticborges
creso
beachtennis
llongue
jeanbouin
podologia
cansole
fcvolei
asepeyo
creualtabasquet
maiamedia
gih
tenisllafranc
cecot
cegarraf

uelestartit
macoli
atletisme
ondarambla
blaneshc
ubae
gepvilafranca
mitjavendrell
cao
jmfarres
elsarcs
pedala
handbolmontgri
cebp
clubtennisvic
gimnasticdetarrago
na
caixaterrassa
labodega
cpt
mitjasabadell
candidaturajoan
laporta
ter-brugent
castellot
panathlonsabadell
atletismecalella
championchip
par3
cursasantantoni
cbolesa
radiosantquirze
martirom
centregrafic
km0
grionsorientacio
acib
cfsantjulia
agss
ceescoladelcarme
uehorta
magda
federaciocomerciant
ssc
desoses
esportsmartorell
santcugatribuna
promusa
barcelonaturisme
valldoreix
rubidigital
ginebro
esdi
escolapeterpan
3-e
esportcatala
radioaficionats
cugat
radiosantcugat
radiosabadell
lacaixa
estudia
mesvilaweb
reusdeportiu
uca
capalafrugell
rcdespanyol
fecpc
cav
nataciosabadell
reusploms
cpmanlleu
fchandbol
oargracia
fcf
fecapa
cepallarsjussa
futbol
claror
cep
tennisplatja
llinarsport
cemontsia

fctennis
clubdetennislescala

fcatletisme
cavic
consellsabadell
fcfa
ucec
cts
fctt
colomsmissatgers
natacio
cblleida
santcu
lapenya
pitchandputt
cnolot
fcbarcelona
basquetcatala
antenes
huguet
vicentedelgado
alloza
ricardmonistrol
tolosa
puigbo
lencaix
thermomix
lafactoriadejocs
fcolo
daytona
graells
archicad
ceca
afifoto
jllinas
dmoz
mussol
clubgimnasticfutbol
sala
clubpativic
molanta
tennisfigueres
elpontdesuert
bell-lloc
balaguer
sabadell
aitona
cebc
burriacatac
fundacioesportsaba
dell
digicat
topludi
okcat
cfpalautordera
ebp
ceab
tvsantcugat
ordintlatrama
escolavallsfutbol
pbmontmelo
escolamontagut
tennisvilafranca
uelleida
esportiu
manelmagrinya
esbufecs
bllc
malavida
cpcongres
pc9
atrapasomnis
tricots
karate
iessalvadorespriu
- salt
minilicor
aluvisa
clubpatimanresa
projecting
pitchputt
parramon

cambrallibre
fondistespenedes
handbolsantquirze
sergimas
casaltenerife
tennismonterols
handbolgava
aiqs
cappont
aitonaetstu
rocneu
santsilvestre
fundacioatleticvila
franca
futsalllivia
menjabe
tennisgironi
uesantandreu
voluntaris2000
cesabadell
toner
merceriaesther
cnmontjuic
ampasantmiquel
rafalopezweb
aevilabertran
jam
fepalamos
urcat
salutintegral
begudescatalanes
aitonenc
palamoscf
carrerdesants
fcmartinenc
canb
uetorrelles
spisp
cdlaguardia
forumhoqueipatins
gesport
clubcoc
circuitnatacio
unioatleticaterras
sa
cursaelcorteingles

marxainfantil
telesabadell
udagramenet
celleracf
torrenegra
finalfour-bcn
sabadellciclista
pterodactil
uesantquirze
cuinavalles
fcesport
singla
cit
fcbcamp
gimnasticrapitenc
labocat
mitjacunit
bellaquirzeband
idealtee
epiccasino
amercf
interflora
odc
catalunyafutbol
tennismollerussa
sailability
cursaintegraciola
maquinista
hcpalau
clicapersabadell
martorellatletic
fundaciocns
cfagramunt
sensemalsdecap
fspratsderei
fsparets

hebron
galeriesmalda
senglaro
100x100futbol
handbolgarbi
tabor
barraques
lacarmanyola
cpacaldesdestrac
handbolvendrell
ctvilanova
pbsafor
cfalella
cevilassar
uahorta
bombersorganya
esportadaptat
ciclesabadell
santsilvestrecunit

unioesportivalleida

gem
dommia
jovesnaves
mobicat
bcnatletisme
aefsarrels
juventus
run2livebcn
penyabarcelonista

elstamarells
elsot
lleielectoral
captura
forumsamitier
petitcomite
labors
ceriudarenes
infoperautentics
fansfcb
uerubi
serveientrades
duatlonsterraendins

basquetmanyanet
uefornells
clubtenniscelra
cfigualada
cebergueda
fsmistral
esport7
cpmasquefa
bcn10k
pbanguera
cfpineda
fsfcastelldefels
duatlocentelles
derbisolidario
cealturgell
acfc
plm
rece
ampamontagut
derbisolidari
estiuesport

Com 128 - 2 elems

comcom
bricoflash

Com 129 - 736 elems

jssap
carnetjove
acjoventut
apps
cuinajusta
puntj
xanascat

observatori-ctesc
edpass
aer
esc
goodidiomes
obiols
davilac
cedricat
portaldelmedicament
mercantic
ciimu
museudecervera
labotigadeldrac
accioperguissona
trinxat
hemofilia
lescabanyes
foeg
itglobal
esardi
mancomunitat
edusost
txac
calrotes
grc
aiaiai
csdm
allem
cfi
centrevic
imasbcn
aci
mediavall
avired
mdai
museudelajoguina
auraioga
elstorms
gesem
hospitaldelmar
acciosolidaria
aulacat
angle
federacioapps
cevirtual
inprein
ppdm
pedagogs
reursa
picornell
ucf
indexjove
eldormitorivng
lincat
obreria
oficinacanviclima tic
cosjove
anellaindustrial
igman
lapiedra
bioemprenedorxxi
finquesvoramar
contrapunt
televall
jci
progest
observatoriforestal
livinglabs-catalunya
scsmt
vilanovaempresa
icavic
cefc
telejet-garrotxa
csi
exportextil
arriska
futur
zeba
congresforestalcatala
imat
adecat
inspirat
estudifisioterapeutic
martarovira
bsa
vilanovaturisme
lacoordi
vanture
iqs
anella
institutdelteatreheura
aulagn
intergrid
connectafp
setem
corretge
eug
arsenal
elgremi
dracmagic
diaridevilanova
prodis
hospitalmollet
neorg
avalot
clinicagirona
lexus
gavarres
adicae
uecgirona
fias
fmr
tornafort
aiguesvng
tegar
donaprenlaparaula
fecatra
acgp
envit
fundaciofias
conforcat
pmt
scaic
vivelloc
panxing
fes
equilibria
dir
coacb
alentorn
agrescat
cambragirona
usoc
ausonia
mutualitats
artyplan
neopolis
aranvacances
casescerdanya
escolaelcim
sec
cresa
diadelmigrant
ieselpedro
difale
caixa-enginyers
mercabarna
estanquers
coordinadora-ongd - lleida
exporta
psolars
pradesmontsant
jaumepahissa
cagi
adeg
noies
tpallarssobira
ribescomercial
fecavem
pautaserveis
cet-arep
chc
htvergecinta
autoescolagresol
psnet
ae2
editorialfonoll
grupalvid
capsarria
centrem
apabcn
worldtourbarcelona
fhcsaa
totapunt
adc
salutalesterresdelebre
firadenovembre
seudigital
api
obdesigualtats
edas
uap
ugtcatalunya
servisoft
grupaula
viatgerssensefronteres
alimentacio
cavatast
elcimvilanova
tauli
gpf
aico
arep
vinyeta
sefed
digital360
shindokai
teresabaro
apttc
cocarmi
fisioterapeutes
firaamposta
cambramanresa
aridsroma
cinc
dentell
barcelonactiva
lamanyana
llobregat
vng-aparcaments
apibcn
iesp
afri
agentscomercials
bancdelsenginyers
ribasalvarez
ceesc
aificc
putput
obimmigracio
acec-drascat
grid
publicom
iconica
uch
aspid
uebc
click
impo
laia
estanyivarsvilasana
unideria
sarc
catic
aspanin
csa
ccccat
plapilotmac
clubemas
cevirtualbarcelona
vedrunasantboi
peacock
gentdalella
santbonaventura
acdn
finquesserra
pallapupas
fundmaresme
nousveins-hg
iesjoanoro
cevirtualterrassa
labusca
sci
cevirtualreus
oficinadetreball
gremibcn
ficcions
guiabcn
cevirtualmanresa
manresaformacio
actas
soserveis
quindos
cevirtualgirona
tecsalsa
aspb
colpis
saf
accdv
arec
cinefilms
soft4crit
arc
icfequipaments
cssbcn
icfh
icfe
avaliscat
icfholding
avalis-sgr
avalis
icf
noguerajove
neapolis
cambrasabadell
garrotxajove
ccapenedes
grajove
pmhb
mercatflors
ampostapromocio
siaj
nivell10
vaporllonch
bellmunt
peretarres
debats
udl
treballsocial
upc
acia
uab
escolalapau
colmontserrat
periodistes
escolagem
axia
catnix
forestal
cst
lapaperera
agronoms
cofgi
lagalera
edicat
deria
lapalanca
fonoll
pirineustv
radioflaixbac
radioseu
flaixfm
ceeilleida
fjb
aprenentatgeservei
tercersector
fbofill
inform
aes
seguretatintegral
teatrelliure
conselldegremis
confecom
fes-etr
matarranya
coeic
telecos
canal
aenteg
orfeoartesenc
diablesdesitges
ueu
specialolympics
tupedala
microart
tnproduccions
jovesingles
acadi
fdc
desenvolupamentcomunitari
josepmlozano
perepau
nuriagallart
nepemial
guardia
carlesnoguera
dvd
subtil
david
orrit
aspace
grecmail
mediatk
anuaris
cangenis
enfoca
coamb
setmanacustodia
natana
comunicant
consellevangelic
slavia
launiovilanovina
fab
bolas
sinergies
bahia
sogas-riba
bibliolapalma
alturgell
santaoliva
pallarssobira
roquetes
vilalbasasserra
vilanova
artesalleida
segria
garrotxa
priorat
santsadurni
tivissa
santguim
tremp
pinedademar
castellgali
riberaebre
plaurgell
lladurs
moradebre

ccau
lleidatur
diputaciolleida
hgv
mnac
acordestrategic
ieslagarrotxa
finances
e-tributs
jove
prodeca
catalunha
gencat
catalogna
generalitatdecatalunya
gen
aeroports
alcala
lasalavng
icca
elpuntjove
tujuca
salutms
soroll
hidrofou
icomercat
larevistactesc
fundaciounio
oficinaacreditacio
aresaboats
fisiocenter
montcau
latorxa
ifercat
iesvidalibarraquer
cttc
copca
cenit
valldepi
acaparticipacio
espaijoveeixample
ampa-crespinell
ctfc
jovesbellmunt
digitalent
capelge
ccguatemala
cevirtualsabadell
i2cat
fae
jvedrunaterrassa
cevirtuallleida
eapc
itec
regadius
sinia
fcd
macmillan-lij
cvi-bcn
santmiqueldelssants
pnri
muntanyamontserrat
catalunya
govern
pacopoch
gesa
projecteboscos
tranuita
gent
generalitatofcatalonia
aiguessegarragarrigues
camidelallibertat
cvi
jovesemprenedors
mutuaevangelica
barcelonacentremedic
ivarsdurgell
radiopepe
elcastellet
puntjoveactiu
iesviladecavalls
riallera
kotoc
bagesformacio
latavella
enxarxa
aquireciclem
chv
agrupa
catedral
tecdencies
pessebresvivents
loteriadecatalunya
clubdelvi
innovadoc
penedesdigital
b-biosca
ecom
infoparticipa
e-debat
pensacom
cosmorera
acc10
regsega
ballspopularsvilanova
creal
deplan
trens
grupcatalonia
cevirtualtarragona
ctescat
viurealspirineus
gubianas
previsioterrassenca
elmartinet
gasiapratgroup
ona-fm
nce
promocioeconomica
catalunyaonline
ccsegarra
dinamo
itworldedu
teatremaresme
lavideoteca
ops
silsjove
aquasportclubs
caputxins
comerciantsborges
fic-cat
fundacioperemata
rudona
gatos
anellacultural
migracat
acpri
globalfisioterapia
regsa
catalanfilmsdb
tribunabarcelona
anexxan
collsmiralpeix
collajoveribes
lesquerda
bonitafilms
catalunyavoluntaria
ticjoves
marsol
velanomada
alimentaciococh
obertsalainnovacio
eutdh
radiosarria
parallamps
totlomon
demencies
carnavaldevilanova
jec-centrem
nomesexits
accio10
barcelonacentrefinancer
iesffg
stopmotion
clubciclistagramunt
neos
tdp
cpen
lamosqueta
donesdempresa
estiusuniversitaris
cpac
iurisdoc
jovesiconduccio
jaumegine
foruminversio
enginycat
emprenem
jornadespni
een
florejacs
barpro
internetsocial2008
cevirtualpalamos
punttic
cocolia
rodadebera
centreestudi
creatia
rogersola
caminreiau
programardi
davidegea
tecnopol
coralrenaixenca
cellerraimada
miralia
agrupaciosardanistadorganya
gercat
elmolar
casamassa
infocentre
dixit
africatv
vallverd
centreproductivitat
gospel
acci0
agendaimmigracio
onlyvng
maspedro
cusa
gestal-es
consultorsacustics
corberainnova
sinergrup
enginyeriainformatica
jaec
barcelonaconnectada
victorbalaguer
icta
wwwacc10
davidmurillo
viatgesfabra
grupbages
promociolinguistica
ajsantvi
tracamuga
seminarisgice
weus
sepal
consultajove
ivalua
adventista
vngeixamplenord
gironatempsdeflors
cantsiautors
apionline
terraisol
lacosta
pratdelariba
ramonforns
arcadisalvador
senior
gentedigital
feicat
brudieu75
firamollet
profit
laseucomercial
adegadvising
bomberstarragona
regenera
aeee
csg
borsasetelsis
asacc
fedcat
ent
scfisioterapia
catalunyaesalgomas
clusterbrandingretail
espai-africa
inserma
ajuntamentdelspallaresos
liceubarcelona
ehva
mostrafilmsdones
aeroportlleida
pessebrelinyola
detectiulogan
fecotur
gecotur
jenviva
teranga
congrestercersector
innopro
premieducaciosocial
abussexual
internetdelfutur
10motius
intecma
artmontjuic
segarra2020
fundaciocatalunya
nitempresarialdelvalles
diablesdesantaoliva
incorporatarragona
cooperaciotarragona
rsepime
meteoplanoles
fsh
imaginalabiblioteca
josepobiols
imet
rscat
comerciantsfalset
eucr
araguab
comunitatcultura
donatechxxi
aulasabadell
estirada
lapau
totcomunitats
api-online
deria2
secans
ampamontserrat
iescastello2
aviationbusinesscenter
congrescatalaesocial
urgellistan
casapinas
igtp
satecav
fretanisso
mdserra
espaishistoriafutur
cossa
artsantamonica
e-municipal
srbasesores
cedulahabitabilidad
gelidaesports
artssantamonica
carlesaloyfusteria
vicentitats
elmorter

Com 130 - 6 elems

magic
gbb
viaweb
teselen
centre-euroarab
poles

Com 131 - 2 elems

dartem
abad

Com 132 - 2 elems

aroma
aromavirtual

Com 133 - 2 elems

dolor
radiofrequencia

Com 134 - 2 elems

biomasa
biomassa

Com 135 - 2 elems

casinodecaldes
tvpalau

Com 136 - 352 elems

fapac
ullalull
ubaecentredeformacio

arxiprestatdegracia
scgenealogia
accid
euramvalles
ice
sga
sardacat
lestonnac-bcn
iespuigdesafont
esglesiaplural
elsvailets
bartramuria
martabuzzi
ferreries
sallefigueres
mestresdelasafor
covamanresa
aranow
boinc
japanzone
cpsonferriol
iesjmquadrado
bisbatsolsona
rius-camps
ugtdiba
korfbal
cevoscerdanyola
tramun
mercaconsult
gna
mestrescomarquescentrals
espaibarcanova
caixacat
auladelmusica
joanroig
ampabarrachina
bisbatgirona
annaravell
escolavoramar
tarraconense
gexaloc
religio
maristesbadalona
hotelterradets
llpuy
actecir
ampaiesronda
arquebisbattarragona
clijcat
caritasgirona
marinada
elbatec
marduix
feteugt
petitaxarxa
pregaria
amparc
salesianssabadell
opusdei
paulsdigital
teologia-catalunya
ampaieslabisbal
teatrecorpus
jesuites
ecgames
arqbcn
bisbatvic
tibidabo
vedrunaberga
tskv
gitanjali
parroquiesbarrivellgirona
xer
ges
parroquiapsang
iessantaeugenia
der
culturapractica
escolaanoia
selectividad
jesus-maria
magenta
llera
graduat
questions
maimes
accesuniversitat
selectivitat
rouredecanroca
franciscans
fundaciojaumecasademont
auditori
edubcn
martojove
museugranollers
lasalle
uic
safa
bellera
cepastorals
edn
ieslapineda
iesvirtual
iesvic
iesgiligaya
teclasala
escolatecnos
aprenents
maristes
escolasolc
tecnos
iessantjust
patronatdomenech
fep
rosasensat
cetuc
poblet
ugt
autonom
traductors
claret
cruilla
barcanova
diccionaris
digits
rac105
iearn
acte
gnomonica
pastisseria
webquestcat
ventdelpla
interactiva
penya
fcbjunior
seti
daina-isard
uro
ignasiblanch
enricribasmontsebadia
gatius
brusca
xeraco
gutierrez
xaviervernetta
mustienes
ampavoramar
ferranduran
acp-bonpastor
pensament
cefortem
irc-catalunya
amapei
iespfq
fundaciosiurana
elprofe
auladret
rapidregidor
lleure
oriolamat
somni
cataweb
guillemsprayart
ampaipsi
montsec
isona
iesribotiserra
xtec
iescasablancas
ceip-barrufet
escolasantlluis
proven
juga-la
ampalanaspa
iesbosccoma
portalgironi
edu365
elquinzet
editorialmediterania
ieselcalamot
montsecturistic
ceaborjamoll
iessalvadorsegui
iescomtederius
ieskta
normaeditorial
iesaltpenedes
escorialvic
iesmontilivi
riellsiviabrea
amicsdexina
ies-dauro
iespgirona
oriolplanas
edu3
caritasbv
ieec
iesperefontdevila
santjoanbaptista
iesducdemontblanc
prec
judo
cordemariasabastida
escolaxarxa
escolaverns
ipsi
cordemarialabisbal
narcisoller
terrabit
cordemariasantjosep
aech
angelburgas
querubi
avfontdelscapellans
ceiplagirada
santmagi
cordemariaolot
alcorlo
cordemariasantfeliu
reporteducacio
ciomanresa
iesperecalders
furest
gentdebarridepequin
quielsvaparir
lanovaimmaculada
parevitoria
gotagotham
esglesiaevangelicadecatalunya
itinerarium
iesbielmarti
cordemariablanes
xarxa-uned
iesmilabcn
cordemariasantcelonisellent
segurbaby
iesblanxart
unamadecontes
manresanet
cordemariamataro
editorialempuries
cordemariavalls
eltercer
ampasantjordi
olivia
drmasmitja
edulis
iesbarribesos
peje
espurna
xina
eoisantcugat
investigalainvestigacio
coralbellesarts
oadm
unedgarrotxa
spcn
implantcoclear
rialles-catalunya
liturgia
alcarrasparticipa
annexa-ampa
fpd
brianxa
canalzamora
serratibonastre
fntcm-ugt
monmagic
grup62infantiljuvenil
iescanet
multiplica
ugt-imeb
gira-sol
iesbaixemporda
labicicleta
olimpics
toctoc
comic
pocio
iesfmompou
parcastronomic
exploratgn
editorialclaret
obagues
improvisa
ugtgi
batxillerat-escenic
monmedieval
ampaceipelcolomer
lesobagues
consorcisg
espriu
parcastronomicmontsec
cttcollbato
iesmartamata
safaur
reijaumeprimer
rafeltorello
manresajove
latribudecamelot
escolaateneuigualadi
mallorcamg
cfaannamuria
ceg
iesernestlluch
elvioloncellistadesarajevo
iesbusquetsipunset
eltrendelensenyament
acgeogebra
escolaquiralia
fundaciobcnfp
matesinteractives
eoibergueda
dmsec-upf
mariacarbo
anuaritercersectorsocial
iesgerbert
canrigol
aixonoespotemetrepertv3
ghostgirl
contralacrisi
astronomia2009
ugtren
artdeltreball
turodeldrac
cemontseny
gretel
lagatamika
22creatalent
ampapontdelacadena
escolapublicaelspinetons
fundacioauditoriorquestra
ceipvallpalau
xescoboix
centrerobertgerhard
iesvallvera
iescarlesvallbona
ugt-tb
ampanxaneta
xesco
terradedracs
immapalahi
santjosepsantfeliudeguixols
atalaiaorquestra
canalmca
ceip-martamata
eldimonixiribelles
dbergueda

Com 137 - 3 elems

creart
millaassessors
topcyser

Com 138 - 3 elems

diverta-sona
diverta-educa
diverta

Com 139 - 2 elems

palmaespaidart
casalsolleric

Com 140 - 2 elems

cecolldepal
colldepal

Com 141 - 2 elems

edent
vitaldent

Com 142 - 2 elems

refreskcat
refrescat

Com 143 - 2 elems

gucci
intel

Com 144 - 114 elems

cna
arxiudelbages
caramelles
mandongo
jonc
grupsoler
uea
sala
pinturesplanell
laincubadora
sorri-inmobiliaria
entesa-municipal
hospitalveterinari-decatalunya
basquetmanresa
catpress
domoespai
fibranet
bufalvent
am2000
fssm
laura
tecnical
deparranda
ribasfitosanitaris
innovait
lluis
esquerra-nacional
planellserveis
audenis
gentic
memoria
arantxa
cgil
caixamanresa
salasl
fundaciotallers
quadrat
kursaal
ampans
retolsplanell
progres
casaasil
elsverds-catalunya
xaviermuniesa
peritslasalle60
ajmanresa
manresa
josepcamprubi
aixada
lakampana
josep-camprubi
segre
regio7
althaia
simfonica
imaginat
classics
entesacolomenca
factoria
porquetprat
orfeo
suacs
adinoi
asterisc
cem
sallemanresa
capelladelpi
idt
whois
clonica
cineclubmanresa
euroaudit
arga
e-index
monstbenet
montsanbenet
museudemanresa
salvarenau
ferro7
somnisdefollet
paututusaus
galliner
diaridemanresa
montane
culturaiteatre
rocainformatica
clinicasantjosep
kook
seudemanresa
mpm
mees
aliger
coordinadoradejubilatsdemanresa
mediaclic
manresainclusio
forumdenavas
jmebages
eltripartit
aira
clubscrabblemanresa
insa
gegantsdemanresa
demeter
isegon
santquirzeviu
associacioveinsvalldaura
castelladral
dianer
ticanoia
plmanresa
aims
plateajove
eleccions-usa
manresapoligons

Com 145 - 2 elems

costa-brava
trimodum

Com 146 - 2 elems

ipgrup
previsal

Com 147 - 2 elems

miboda
denuvis

Com 148 - 2 elems

aemamasllorenc
outletdemobles

Com 149 - 2 elems

tropos
transformant

Com 150 - 1124 elems

arenyautes
contrologia
laccent
xraq
prou
ateneulatorna
sindicalistesperla-sobirania
botigaesquerra
sempre
orenetes
reagrupament
capicua
borregosdecardedeu
scat
irla
fundaciocultura
araisempre
xavieramor
directa
kop
estatpropi
poble
memoriaesquerra
tallers
uob
ramontremosa
bratac
zeppelindreams
fundaciopedrolo
ona
insomni
millor
catac
biscuter
latraca
cgtcatalunya
fundaciojoseppla
calaixdesastre
elsolivers
labalanguera
fecasarm
agama
expertia
educacionline
edicionsdelpirata
emule
aeca
aadpc
country
nova
teatreprincipal
creat
iaeden
larxiu
scelmicalet
peritsjudicials
rodolins
jen
cric
tdk
moritz
divendresrei
lfac
volart
miquelpujado
penyatotil
eurogrup
radiogelida
ecogirona
eltriangle
elspets
carlespuigdemont
assembleapagesa
forumcis
socialcat
amicsdelalguer
xbs
apejuc
sitgesnews
criteriacaixacorp
tbowling
garridos
gepec
al-mayurqa
olotfotografia
alibau
uriel
coneguem-nos
robafaves
rootsculture
tocamela
eldebat
catnord
ofc
activaprospect
eldigital
bancsabadell
apecat
adenc
sabate2007
eldema
horacat
tothom
fundacioakwaba
cristianismexxi
fercam
interdomain
ciemen
europapress
fco
xarxacat
sima
fragmenta
3v2
marcvidal
tallerhistoriamas-sanet
cjib
cori
lloretinfo
abat-oliba
fmmm
xerramequ-tiquis-miquis
xat
mbmarquitectes
jmcorominas
catalunya1640
joanpuig
smestregispert
laxarxa
ornitho-emporda
espaimallorca
rafaeldalmaueditor
nuriafeliu
signescomunicacio
pifp
tupolev
fundacioqueralt
palestina
informatics
basar
pornografia
cucorba
lamurtra
caganer
elsingulardigital
tintin
puc
revolta21
toniaira
montecristo
laietans
propaganda-pel-fet
luque
mer
llibrerialacapona
histocat
joveseixample
freecatalonia
factoriadelarebelio
gisela
mondivers
psm-menorca
netics
psm
estudiseivissencs
revoltaglobal
sobiranistes
gremidellibreters
boirabaixa
ex-libris
booksincatalan
iepenedesencs
gnulinux
habemus
victimesignorades
cr3at
gnome
productesdelaterra
elmati
immi
aeditors
catalonian-airlines
ecologistes
escolamestral
joomla
bicing
guia
cultura21
refres
laclosca
vadevi
redbanner
germabel
catimperium
ara
dekrepits
elvis
mondigital
caracola
intersindical-csc
estudiantsenaccio
guionistes
elcau
marlex
labutxaca
naturisme
in2internet
edp
jornadage
psan
hayek
gremillibrevell
xiroia
formigues
hostaleria
esquerraindependen-tista
soliserena
francescferrer
otic
gruphayek
cinemacatala
lacalaixera
psm-entesa
cerdanyolaradio
matthewtree
blocjove
lesvoltes
sepc
financamentcatalu-nya
esforc
cdig
tallersperlallengua
jordicastells
alcoveradio
webacic
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veusuzuki
laportatil
pey
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infinitemotions
bloks

kraks
elcircoldereus
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solidara
viquipedia
jornal
noemibages
ampaelcarme
xpoferens
debian
partitrepublicaca tala
aeroportinterconti nental
vadejocs
fredericperers
retolsbonet
lespolsada
aratv
roset
supercom
independent
ruccatala
casalpanxo
casausher
sobiraniaiprogres
rhg
betshalom
juditpujado
rediscus
via-santperede ribes
sagetadefoc
joseptomasalvaro
jvila
dignitatnacional
300anys
fundaciomompou
fcbe
socdelaceba
directe
corrons
ibe
frankfurt2007
parlamentib
inca
arenys
perpinya
morella
normalitzacio
simat
esporles
hortadesantjoan
ctug
musicadepoetes
llanternadigital
institucio-montser rat
escolaelpuig
impli
bressola
aspepc
ccfmc
arsys
antaviana
estatcatala
estat-catala
jerc
airenou
fec
psuc
puntbarra
cup
relatsencatala
portabella
culturaviva
puigcercos
acampadajove
esquerra
elnostresindi
blocpermallorca
edicions62
edicionslacampana
saber
edicions1984
lleonardmuntaner editor
alfaguaraij
mina
alfani
proa
llibreriaoberta
entorns
obradoredendum
grup62
glenat
llibres
enciclopedia
ajelc
escriptors
pencatala
jovesescriptors
lomriudoms
grupdelllibre
lletres
illacrua
premsacomarcal
ibec
eltemps
enderrock
appec
acpg
premsaforana
tribuna
diaridegirona
tribunamallorca
avui
racocatala
naciodigital
lamiranda
presencia
quiosc
elpunt
mediapro
e-noticies
flaix
rac1
grupbarnils
jovesllengua
catweek
escacc
uce
fundaciopaucasals
paraula
femcat
paucasals
escoltes
bloc
entitatger
ccc
barretina
acampallengua
ipecc
caoc
catalunyaaccio
ceo
vuitdagost
esperanto
fceg
edu21
fad
canalcover
1714
jordipujol
barcelona2020
entesa
coralsantjordi
icestock
fboschcardellach
relleu
connecta
acp
comissiodeladigni tat
plataforma-llengua
consumcatala
fundccc
trobadesmigjorn
cal
xarxa
observatoridela llengua
llenguanacional
eltempir
adec
juristesperlallen gua
diadademallorca
illesbalears
somiseremradio
ocb
ibalears
grupblanquerna
escolagavina
alguer
obracultural
iebc
softcatala
bitassa
accat
acn
omnium
joanfuster
tr3sc
sona9
vilaweb
observatorideles tatut
ccma
federacio
acpv
folc
11setembre
partal
octubre
ctecno
franjadeponent
jnc
lluisllach
altall
festes
balletsdecatalunya
museupaucasals
museuvidarural
futsal
rugbylliga
coc
auriga
seleccions
elpou
tirambarc
cimbellpuig
estudi66
bizarre
llibertat
memoriacatalunya
claudi
dimas
cuevas
jordisalvia
miki
tonihortal
blanch
arnau
engaviats
oriol
josep
cucu
victoralexandre
danielvives
enriccanela
ballesteros
acepe
oleguer
marques
cecili
araitaca
j-o-r-d-i
casanovas
frederic
manelcamp
editorialafers
antoni
fannymari
losimo
aolivella
terricabras-filos ofia
davidvallespi
musicsperlallengua
lomarc
cecolom
capgros
deu
damia
ramongil
jordiprenafeta
prenafeta
farre
arola
vidiella
barbara
esquirol
carlesmiret
gocar
independentsxmollet
rigola
jovells
teletreballadors
kiku
binefa
asola
ginabreda
llosa
xoli
rcmelb
putxy
hipnosis
aplec
batabat
elrentaplats
matadejonc
doommaster
xalest
viladecapellades
benillup
setembrot
ppcc
moviments
cau
lallacunaonline
lliurealbir
deyzaguirre
mareterra
aventurers
partitlaborista
london
deverd
cercle21
karacters
valldigna
facil
owix
socaqui
paualabajos
linuxbcn
sergisabate
catix
l-l
full
opinioemergent
unitat
demolinguistica
rgbmanagement
enricduran
stockdeso
encatala
astroradio
esquellot
gir
salvadorcardus
laiamarques
mdt
saul
enguillem
marxadetorxes
graciaviva
meddia
poliblocs
rockviu
favb
clickartfoto
incacultura
auques
fabrica
rxi
raulpresseguer
pacoriviere
eines
tonisellas
fiep
llibertats
ericbertran
lespaijove
bitacoles
sadurni
ceskfreixas
aramateix
linguamundi
banyuts
jocsweb
lolleidata
anardetapes
impuls
e-criteri
guillemcarol
ubuntu
onanar
katharsistheatre
edeta
accesok
plede8ts
casalfoment
mossamics
mallorcaverbenatour
broudecultiu
enricvila
tots
caldesplugues
forallac
rasquera
bellvis
molletdelvalles
irta
culturalliure
galerada
elcami
lin
catalunyalliure
alacant
super-nova
gerardquintana
rrfisica
josepromeu
bibiloni
lenvelat
casaldejoves
campdeturia
celobert
revistaderipollet
xarxasantboiana
depasseig
olladegrills
terra-nostra
magimoranta
heptagon
parlem
joansafont
catalunyaviva
relk

odg
bcngrafics
elpartiqui
scrabble
masiterra
lafarga
lluisbrunet
estelada
benplantat
sexologic
empollada
terralliure
somgnu
tirabol
lvalverde
domini
mossegalapoma
qmenta
magia
repsol
transversalweb
editorialmeteora
marcmiquel
pobleviu
xecna
consueta
escolarepublicana
casaldespertaferro

nanda
llibresenxarxa
catapings
despertaferro
volcanica
fundacio
ocellnegre
orguedemontserrat
aticles
mmmerce
jeppi
enricgil
llull
mkportal
portal-estudiants
ed2
atic2
ccmontevideo
carde10
globalitza-que
codic
republi
xic
plataformaperlaso birania
literata
universitat
monjo
forum-musicae
rogerweb
jordimolto
fcatalanatwirling
drupal
calanuria
pasqualmaragall
gandia
llevadores
futura
ccescocia
sirga
idece
cossetania
enciclopedia-cata lana
ensiola
roquet
sergibuda
puntcat
akamc2
supernova
andreucaballero
ninadexangai
muixerangadesueca
pagina26
vizcaino
oriolllado
infoguixols
hightimes
gum-catala
initec
gerardfigueras
rings
telecoop
festiari
consellconsultiu
santivendrell
autodeterminacio delspobles
diaridebreda
visualkultur
ossos
alfanet
altraradio
esviver
terceravia
ateneupopulargarri guenc
ais
catalanisme
xaviermir
musicaenxarxa
laboratorideviatges

cadiroig
llibrevell
okey
cinemaenxarxa
projectefiare
finquespamies
borras
fernandez-ulrich
parlacatala
hortet
labretxa
centreexcursionis taesplugues
jovessabadell
pocafeina
xofersgene
stic
lacabana
projecte
nitsenblanc
iespolitecnic
noticiespolinya
lluquet
cclanau
lagolfa
beat
temps
jturull
calmacarro
joancasals
rcgirona
belenijosep
f66
buhos
ditespopulars
novaterra
barcelonabombarde jada
conferenciesenxarxa

esquerrabcn
famc
cercleestudissobi ranistes
meua
nocilla
pellroja
nelmarti
refugi
adeuespanya
casa-inhospita
tempsdere-voltes
granjasanfrancisco
llibresdeterramar
davidjcot
diaridemataro
fuetdevic
elliot
rogerpons
taber
granangular
danielgarciaperis
comunista
viafora
lhc
ruc
colacao
cristofol
blocosfera
entesaperlallacuna

musicarts
decidim
genisroca
peresampol
labodegueta
escolademallorqui
onzecongrespsc
somhi
europarl
agcc
cperc
esquerranacional
ujgirona
costallibreter
aplecdelaplana
holoce
quatrecoses
forumdefelanitx
ebresfera
laturba
totguixols
setmanallibre
pirenaic
catmidia
jordiportabella
santqgat
forumsocialcatala
sisradio
banderanegra
nationalia
claudesoft
columnaedicions
international-view
setzevents
lesgolfes
radiolegsdecatalu nya
gent2014
cantautors
txanny
llatzer
gmlira
tentacle
cronica
cartescatalanes
cip
asabadellmes
antonidalmau
cattrapella
ciem
pauibars
elteuvideo
cajei
lasastreria
gela
elquaderngris
aterrassames
eivissapelcanvi
agorallibres
encenall
guillemmateo
indexcat
ellluert
lescaboriesdenmon tilla
fnec
quellegeixes
aisc
jesuspurroy
portal-vallespir
melisucre
premisblocs
cardedeublogs
eljocdelangel
bagesfera
milloremmolins
leovidal
carlescampuzano
labrigada
sms25
nettv
reclamproduccions
metode-suzuki
carlesbanus
manelescriba
rocllop
musicalliure
suport-eh
stoppp
miquelquintana
flog
musiquetes
xarxamedina
finestresdesantboi

miquelmaria
la2deviladrich
protegimelterritori

joangavalda
selecciocatalana
dni
electronics
joaquimcolominas
stockdesons
silvestre
tandemserveiscul turals
debatdevi
jaumedamians
cercabloc
vicentmartinez
albertforns
maiol
tibet
blocsambestrella
lleieducacio
nosaltresmarxem
reus08
festivalcomic
mirmanda
aterrassa
c2014
jardineriapulido
tbt
atab
latabola
valencianna
gironacongressos
musicamp
schf
altrament
artistespremiade dalt
casalcatala-menorca
bettyboop
calvermell
anemfent
oficialitat
reagrupamentinde pendentista
salvemelroser
ictineu
sccff
gabrielmartinez surinyac
elpatidescobert
masiaurbana
economiadigital
revistadegirona
gomets
aen
fundacioesconvent
astridbierge
sarabailac
ojipc
jaumecabre
viatjo
elpoble
iniciativaanimalis ta
crucigramaexpres
xalandria
envelat
forumespaidepremsa

1984
hesperia
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nouscatalans
plataforma
massatgesarreu
gentcat
erclleida
70aniversariexili
eduardriudavets
francescvila
lapilotanoentraper atzar
restaurantateneu
gatamagat
olocau
psmpalma
tacostamlacultura
ccn
sallententitats
avuiterrassa
cafellengua
ramondavi
7dquatre
novolemaquestallei

gota
puntcatcomatots
jordibenito
celdonifonoll
culturacatalana
siministre
atnrestaurant
alan
ecamps
centrequimsoler
benvingut
somlleials
avuisabadell
joomlaedu
lanostratv
pdd
cienciapolitica
seleccioprofesso ratllull
dibuixos
rld
albatroc
elmonsobrerodes
focir
yesfm
iguala
rolodrom
eduardbatlle
montserrati
acontravent
laterraferma
tapiesescriu
respostaeconomist
samaniego
esperanzah

gasparhernandez
lallunaenuncove
elssecretsdelareina
escapades
asabadell
met
joancarreras
observatoriobama
vinyetpanyella
totbisbal
lom
albertmartin
espanyaescrisi
glams
detennis
revistagirona
oikocredit
congrescatalanista
ernestbenach
xavifluvia
ipo
fillsdelallibertat
marcelinus
aic
clubescacslabalanguera
nacionalitat
openerp
lamarquesa
nuriagalceran
salvadorcasanova
vibriadereus
katalanatribu
platonic
gelidaentitats
pellikana
assajos
renovemciutat
cagumelparenoel
eldau
almogaver
tuetselcanvibcn
rocasalvatella
ercaitona
rumbalbar
elteixitdelaterra
disse
observador
salva-riber
miquelnoguera
apaguemlesnuclears
llocweb
tomasetti
orgasmes
lesforques
lamuntanyarussa
noalacrisi
acorondoya
projectesmdg
meritxellgene
catalunyaestatlliure
personaidemocracia
yeswecan
migjorn
vicidebici
projectegripia
fundacioemilidarder
cdigital
junqueras
topobiografies
noensespremeu
higiniherrero
bcndisseny
pssjd
editorialaccent
televisiosensefronteres
pro-senyerafcb
navegaencatala
estudiantspelcatala
casip
neuslloveras
ideagirona
elpratantifeixista
bogarde
tecnologic
lamua
pocabroma
premixirinacs
tradulab
casanavas
cassany
podem
renovamentrepublica
totssom
elpont
sergicaravaca
Com 151 - 2 elems
lagambador
nusmariner
Com 152 - 2 elems
bitxoraro
novesgbegues
Com 153 - 2 elems
incunart
incunartenergia
Com 154 - 2 elems
organics
productes-ecologics
Com 155 - 2 elems
doulalluisa
maresdoules
Com 156 - 2 elems
settingconsultoria
moga
Com 157 - 2 elems
novetatsinfopaci ents
infopacients
Com 158 - 2 elems
marcelcobo
mb43
Com 159 - 2 elems
brunorabal
bcn14grup
Com 160 - 2 elems
boda
saloenllac
Com 161 - 2 elems
impacte
carsoutlet
Com 162 - 258 elems
parla
lugaring
farmaceuticonline
altecom
reserves
antivir
traca
athc
pizzeriadolcevita
caixacatalunya
caixasabadell
telemark
latecla
linguoc
webares
condisline
cdterrassa
promotec
guianupcial
campau
2005procat
canxaubet
feshocat
gentcomtu
riembau
uib
casobi
meridiaviatges
reitec
smscatala
bastosvic
bonarea
moltbo
steinfoto
calmarcel-li
mariadecadaques
osonacotxes
coib
tonipons
blanca
fcpe
nbsp
elguaitador
clubcataladeviatges
excursionistes
idiomatic
aiguesdebarcelona
lamuga
css
iessantanyi
nit
capdevilafuster
floristeria
hort
piropop
caixatarragona
privat
balearia
jmwebs
coralcatasons
canalsolidari
teatredemanacor
maspau
4clics
avalon
grupsagessa
floristeriaemi
malaltsdeneu
pereroca
uao
entornqualitat
ruralverd
fchockey
blocpedreguer
firabcn
diarisdebicicleta
curiositats
granjagodall
opensourcearchitecture
buc
sares
rceppa
conselldemallorca
mallorca
mitjansdigitals
costabrava
ullastrell
puigpunyent
andratx
santanyi
campanet
infomallorca
lai
sunion
eoilleida
cepasoncanals
acuc
revista
teatral
ornitologia
ufec
fobsic
butinet
fc-culturisme
squash
esquaix
esquinautic
rugby
esgrima
raquetbol
fcvoleibol
cnb
micropoint
gustaunavarro
serrano
vallve
benq-it
pirineuample
moror
cordada
angel
de-bat-a-bat
stadia
index
florsmargarita
moncaffe
tux
qrseguretat
canllorenc
aquibcn
bombersmataro
abg
floristeriabarcelona
activa
marianoros
resistencia
josepmariamontaner
florsbarcelona
noces
webarcelona
james
pmb
pixels
b-bgirona
eldirectori
atleticdelvalles
altisench
ebe
mariateresafiga
motorstock
aiguafreda
inefc
iclick
multilingue
sons
esgrimasam
fbi
gestordecontinguts
iccc
detotimes
angrill
avalua
totselsllibres
campsdaprenentatgeib
restaurants
creacions
medic
dicdidac
bodas
nonstop
b-bcostabrava
rocaguinarda
egam
escolab
bodes
album
ajcampos
lestresgermanes
jocsinfantils
socpetit
dreadful
piqueras
leonix
mireiagabernet
mecanografia
javajan
termcat
stein
francescventura
gdos
caisa
docatalunya
repsolypf
elmirador
maruny
teatreprincipaldepalma
artescenic
acofesa
amidaments
viade
fcpentatlo
postals
iformentera
lectric
ideib
barcelonametropolis
ametllavalles
miserma
psico-ajuda
b-bbarcelona
butijocs
xemeneies
canalneu
grimp
barnafrika
mohergas
assessoram
activity
baoyang
djs
apartmentsgirona
mrw
paraulesdemar
teresinaioriol
boquet
interaccions
cellerullastrell
reismags
larevista
janna
secar
balearsculturaltour
cepaarenal
cosmos-stoer

illesbalearsqualitat
pericosambwebs
iesarta
visita−virtual
voramarteatre
marketingdigital
sojove
gmv
imap
llampec
inforugby
bux
acgep
alquiler
ramel
intranet
energi
emi
fastpay
funca
comprest
muntatges
jramoneda
viserta

Com 163 − 3 elems

agendamenorca
centredelgravat
centredegravat

Com 164 − 2 elems

global
buvi

Com 165 − 190 elems

destinia
audiovisualmac
hospi
radiol−h
radiolocal
aep
massip
torax
ganesha
radiohospitalet
fundaciotrams
linkstv
avant
icveuiabarcelona
radioarenysmunt
pcc
cjc
emancipacio
enertrams
televisiol−h
apic
basquetbam
casalbcn
diaril−h
fundaciocollserola
radiobaixpenedes
8tv
rtvelvendrell
tonimolla
antenalocal
losmanolos
jviladoms
nuriaresidencia
lhesport
baraka
parcaudiovisual
pangea
pmsitges
albeniz
metropolhis
theproject
fvb
secretariat
crucemar
totporter
revistabenna
prl
xarxacom
boneslletres
punt6radio
cac
l−h
hospitaletllobregat
url
escola−proa
escolaguinardo
escolainfantjesus
escolatirol
esplac
ccoo
mlp
joancoscubiela
euia
sendra
elpunthabitatge
lamalla
elquiosc
clubdelsubscriptor
puntmotor
agendadecatalunya
elpati
badalonacom
xal
canalblau
tvbadalona
urbetv
rcb
novaradiolloret
radiomanlleu
cnjc
pac
sants3radio
cpaudiovisual
ressons
joanpelegri
canalcatala
fch
ccrtv
intracatalonia
comunicalia
cjb
uesants
roquesalbes
cimdestela
mercatsetmanal
riverhouse
radioarenys
tonesdemusica
rodadebara
badalona
casaasia
saljove
ccvictoria
ampaarturmartorell
volsbarats
fundacioprat
upec
quefanavui
tabatadreams
xtvlblocs
xn−noticies
lavillarroel
lluria
beside
ajec
ibei
esllogasofa
rtvcalella
llagosteraradio
miv
andana
acc1o
latitudjunior
catalanfilms
atlesesports
patronatcatalunya mon
orfeoatlantida
lh2010
narinant
cinemacat
institutpsicologia
unica
fundacioalternativa
garciacirera
ceprofessional
vectorbox
diversitatludica
hastalavictoria siempre
euia−ponent
orfeodesants
elpuntdelinterrogant
hospitalsitges
quadreescenicsant medir
tiac
slateman
mataroaudiovisual
academiadelcinema
evdimtrams
beachsoccer
l−obsradio
jordimestres
uepjove
museul−h
argentonacomunica cio
alcaldebadalona
cclabobila
baud
euialh
estiuprogre
orquin
reformadelalleie lectoral
parroquiasantmedir
terrassadigital
fornbalta
forumeconomiasocial
vtiger
estanydesils
carlesagues
radiomaricel
lapelidelatevavida
10encomunicacio
chep
esgrafig
jaumecollboni
crospopulardesants
cursacompanys
labobila
restaurantmorros
memora
ampaprogres
diaridebadalona
acmilan
igualtataldia
gegantsdesants
giramaresme
joventutlh
futbolplatja
documentabalear
borsadeprofessionals
eljocdebadalona

Com 166 − 149 elems

diablesderipoll
escolaipse
esbartciutatcomtal
trabucaires
stjosep
gegantsbaix
lapapallona
musiknviu
clickart
ensdecomunicacio
correfocs
patunyetes
rusticvilella
patufet
hchostalets
deumal
vilacorona
calnegre
comics
coralsjoves
trienni
dominiques
ocitania
ballaswing
grup−maig
lallobregat
collasapalomera
exitfm
canaltaronja
casal
tempsrecord
diablescarranquers
labanya
memoriacastello
violetesdelbosc
cab
rumb
kapaoltis
lacadaques
cub
cmr
clubpiasabadell
tarrega
ajtarrega
ratafia
entitatsgranollers
escolapia
ateneus
centrelectura
lalira
dinsic
granorient
diables
reeixida
elsraiers
gegantsbcn
esbarts
correfoc
cct
sardanistes
bestiari
adifolk
cclleidata
osona
grallers
clau
collabasilisc
gegants
balldebastons
esbartderubi
palamossardanista
federaciotrestombs
diablesdelleida
kayaksort
collaagora
fxescarmis
pepvela
lateranyina
paupaterres
collesgalzeran
gtggsa
diablesdigualada
gegantersdesant cugat
vinaixa
banyeres
artesadesegre
fpiei
gegantsdelpi
barraquesbanyoles
diablesdegranollers
festamajordecata lunya
catrock
cmtortosa
gegantsdemontornes
gegantssagradafamilia
iesflix
corbera
lusxipellis
diablesdelescorts
ganxets
ensballem
gegants−iluro
dimonispv
esbartsabadellda nsaire
dessota
ateneulh
onsortir
dimonisdebenimaclet
tarrega1939
emvic
aiailujuvent
joanamades
jordimolina
pardalroquer
ladiabolicademor vedre
palamosdigital
cmcpsa
terracatalana
diablesserpentsmanlleu
badabadoc
uetarrega
esplaicancolapi
meridionals
hostallamuntanya
revolta
jordipauli
federaciodecati faires
irregolare
ajlc
federaciocatalanaci neclubs
sumta
correcagarneres
radiotarrega
cineclubjosepmforn
piafonica
mouteenxarxa
kpoetika
peramas−esmandies
tonigimenez
uniodecolles
bandolers
lagranjaberga
fantasma
artquatic
ateneuadrianenc
fundaciolaroda
bestiaridefoc

balldediablesdesabadell	elgalliner	valldellemena	pardines	lespreses
bigfish	terradelaigua	albo	massaneturisme	santmiquelcampmajor
	probike	contacontes	saltjove	
Com 167 – 2 elems	publiespec	canfont	massanetdelaselva	santhilari
	finquesfreixas	magicpop	salt	vidreres
sme–ccoo	cesetgirona	paus	vilablareix	cadaques
sme–formacio	ecanet	metgerural	lloret	vilobidonyar
	nana	edicionsalbi	olot	angles
Com 168 – 2 elems	h10hotels	sorlidiscau	radiocassa	pals
	campingsantpol	vallderibes	perpignan	banyoles
basquetpalleja	seat	pous	ajgirona	breda
stiads	joventutsmusicals	adesiaraeditorial	labisbal	caldesdemalavella
	trenscat	infoconcerts	ucenatura	castellmur
Com 169 – 3 elems	dobleclic	cbsplaestany	sapalomera	selva
	lletato	gironahostaleria	cmmb	fontcoberta
haddoch	torramade	lazzigags	escola–horitzo	vallbas
artfoto	joveorquestradefigueres	beniemocions	cmg	girones
fumfumclub		giromus	adac	talarn
	focus	cinemes	cpsesquarterades	roses
Com 170 – 2 elems	remor	portalosona	conc	santgregori
	salelles	agendadegirona	schubertiadavilabertran	borrassa
nexe	pinturajordi	ias	cuinavolcanica	camprodon
terrassaneta	blanespromocio	arkeolik	cercle	sarriadeter
	artsport	aiguesdesarriadeter	cercledelectors	llanca
Com 171 – 2 elems	agegirona		alber	llagostera
	gallinablanca	mantis	bullent	torres
anestesia	spora	nostrum	geoestel	setcases
clinicadeldolor	uecaldes	dept	text	centredempreses
	casacota	aiguesdesalt	tibidaboedicions	ddgi
Com 172 – 534 elems	dissenyweb	ccfarners	teide	valldenuria
	casesrurals	publimas	fentcarrerany	lamolina
festivaljazzfigueres	sportcat	grupfer	horanova	blanes
santperepescador	oncolligagirona	focusevents	esotv	independentsperllagostera
mesarbres	agencia	motocat	fundacioernestlluch	pig
jmfigueres	fundacioromea	bonapat		basquetroses
clubvelacalella	guiamanresa	cioabelli	taca	generalitat
aiguesdegirona	basilicasantjust	piscinaroses	escolesdemusica	kgb
bsi	hotel1898	argus	fcaf	nonon
lesplanes	recursoseducatius	abm	amc	cremallerademont
museudelcinema	grupassa	poparb	premisliterarisdegirona	serrat
giroses	casadelamusica	lletnostra		ceipanglada–figueres
elsdracs	fitag	domingoconsultors	acat	micronexis
plaestanyjove	laperlagris	fcs	wiccac	diguescom
gong	entitatsgi	castellnouedicions	aiguabarreig	golfcamprodon
firaalternativa	freixenet		orfeolleidata	aiguesdeblanes
aciart	agt	campingneus	dolorsdebesalu	mac
festivalacustica	elsberrosdelacort	panella	mte	comerciantsbarrivell
teatreromea	teatrecondal	interactiu	uefigueres	marbrescosta
canaljove	plusfresc	xrepp	racc	iesilladerodes
vedellabencriada	cbblanes	filosofia–del–llenguatge	cnps	trenolot
laflautamagica	mozart	ajribesdefreser	cvblanes	salamandra
insertnet	sabater	rude	voltacatalunya	teatredesalt
lafrancesa	segonama	5azona	fcm	teatregoya
discipulosdeotilia	laselva	costabravasingular	ciclisme	celiacs
	ginexx		cnllanca	pagaia
ceslesheures	centrecivicporqueres	jesusdalmau	unigirona	teatrelaunio
codex	geo3	masiagallart	geca	bodyboard
criteria	seic	fina	artec	sopadepedres
montilivi	ofiweb	fontajau	actium	umbert
catcentre	ausatel	adin	terranostra	eram
fundaciorieragubau	botigues	guillemchacon	arxer	laproaemporda
	massegur	sibi	fontdegloria	detallsphotos
solucionat	guardiolencs	ceinr	mcdonalds	sorbus
mercataventura	octagon	timeout	antonianton	hsm
nnhotels	lariberadebre	serpa	lluisrius	fcpc
coiet	plaeducacioiconvivencia	cevilassardemar	jaumepujadas	temporada–alta
ato	rogermas	canmerla	gegantersbisbal	areaeurotrak
arqueociencia	llongueras	museusants	ptrias	vilallongadeter
labonaigua	infoperiodistes	grupgrido	qrambla	most
serrano–eng	laguagua	build	canlleter	reconstruccionhistorica
termesorion	amhg	calcampaner	mototurisme	anu
acorgue	totsalt	guixols	miquelets	glg
signia	motoclubfrancoli	quart	vadecontes	clubnauticportdaro
ceripolles	martinezlozano	besalu	phpbb	
18desetembre	ripollesturisme	plaestany	colomersdeter	buxedaassessors
ohevents	joanarmangue	ripolles	acem	laselvacomunica
baixempordadigital	pagi	cilma	joventutbisbal	atfc
	iev	selvatributs	kontrolweb	forumbtt
tvgirona	voldecoloms	xalocgirona	hca	mouresoroll
gironacatalunya	anbaso	laselvaturisme	bach	
	genroses	selvaeducacio	axc	
		selvaempresa	eldimoni	

arnauestudi	besalumedieval	voleicellera	castellodebotigues	congresconvit
incatis	aeac	konig		ascalfo
produccionsmc	llibreriacarlemany	boletaires	garrotxahostalatge	garrotxaformat
penyaboletaireberga		festivalemergent		
	portalblau	blanesjove	entitatsfigueres	Com 173 - 2 elems
lacomafd	villavecchia	associaciofringe	remediosvaro	
entitatscardona	campingcostabrava	ajuntamentdeven	somsomiatruites	cleanambience
elmig	terrassatrens	tallo	cardona1714	estalvienergetic
iesrocagrossa	trengirona	marge	elratinyol	
veinalia	museudebadalona	radiobanyoles	indi	Com 174 - 2 elems
elpol	webselva	plederiure	fcbviatge	
gironamuseus	escenaris	peeblanes	concursintro	rodon
multimascota	enduro	miniestudi	aama60	nocturn
firadelcistell	forumsostenibilitat	fodarq	portam	
mirades		akan	lleters	Com 175 - 2 elems
associaciocomer	benbedolot	nenes	cassadigital	
ciantsllanca	albergestacio	season	hotelpresident	elcel
riudart	tarragonafestival	turismeolot	infojonquera	enricmoran
actnoticies	demusica	visitlabisbal	casapia	
tecnoip	selvatans	bruel	institutdesils	Com 176 - 2 elems
trendelciment	empordatv	trendelsllacs	maitips	
icrpc	acpr	premiesniell	accioponent	viatgesitaca
mavett	banyoles2009	fotosalt	guideandgo	viatgesindependents
climentforneres	regibloc	rocatomba	bdjbodyboard	
cobet	restauranthavana	copyprint	godoycardedeu	
timfgc	iessantacolomade	lavenjancadelban	figueres2009	Com 177 - 2 elems
riberabike	farners	doler	espora	
cafeeuropa	adhara	consorciasc	firasantmartiria	satellit
ccgedicions	copdegas	comitursh s	museudelava	samarreta
splay	roc-fort	museusdebanyoles	salutpublicablanes	
casinomenestral	itot	cbescolapies		Com 178 - 2 elems
scf	terradelles	kiwiselva	aloe	
vellaescola	hotelmarblau	emg	lacate	forumeducans
lacaraba	nanook	100racc	placiblanes	aulatutor
vedrunagirona	emprenelvol	room	rutesturistiques	
janus	moto-r	norai	nens	Com 179 - 3 elems
alisis	cfcardona	terradetrobadors	cpantonimonjo	
rodalies	mda	magnacelebratio	centrefraternal	formaciocontinua
estrats	cassajove	clubgurmetbonapat	centrecatolicde	pitagora
russet	imatgeiso	hotelmarinada	blanes	igualtat
balnearifontvella	laciutadella	rosesweb	galeries-ato	
ccripolles	ecoedicio	wanscat	uniociclistalluca	Com 180 - 2 elems
cttvilablareix	ccm	bedandbike	nes	
grupfocus	perebotero	bolit	turismeiesport	image
publintur	puntualdejoventut	albergdebruguera	glocalitzacio	facilweb
casc	ceipladraga	barretades	soulcafe	

B.2 Frequent words of communities

We list the words with higher significance, a measure we defined in subsection 4.1.9, of each community found by Louvain's algorithm when applied to the .cat sites network of March 2009. The process of getting the significant has been done as we explained there. We show the most significant words followed by and its value of significance.

Most significant words of communities of Louvain's algorithm. .cat site network of March 2009

Comunitat 1	incorporadas 5343.99	does 38.6891
bautizos , 5343.99	fotógrafo 5343.99	browser 37.3857
creaciones 5343.99	expresamente 5107.35	not 37.374
prenatales , 5343.99	ley , 5105.87	support 36.9984
bodas , 5343.99	reproducción , 5105.87	frames . 35.8366
comuniones 5343.99	virtud 4966.45	your 34.3967
tenerel_plugin_de_flash_8.0.si 5343.99	aprueba 4709.22	Comunitat 3
tuteladas 5343.99	refundido 4709.22	código 1068.8
técnico , 5343.99	intelectual . 4505.34	rendibilitat : 1068.8
calificarse 5343.99	totalidad 4389.92	americano 1068.8
	bebés , 4246.27	
	Comunitat 2	

cierre_mixto_en_las_bolsas_americanas. 1068.8
foncam 1068.8
resoluciones 1068.8
fixa: 1068.8
rendibilitats 1068.8
fam_caminos 1068.8
recomienda 1068.8
productes_d'estalvi 1068.8
b.e.: 1068.8
centre_de_càlcul 1068.8
entidad_gestora_de_fondos_de_pensiones 1068.8
productes_crediticis 1068.8
productes_d'inversió 1068.8
presión_vendedora_en_las_bolsas_asiáticas. 1068.8
ccocesmm. 1068.8
el·laborat 1068.8
el_dow_jones_se_revaloriza_un_0,53%_el_lunes. 1068.8

Comunitat 4

px_transp.gif] 2672
activitats_per_empresa 2672
aeronaus 2672
alrededores. 2672
la_cerdanya, 2672
vuelos_turísticos 2672
incentiu_d'empresa, 2672
incentivos_de_empresa. 2672
ir_en 2672
vuelos_en_globo, 2672
vosté 2672
vuelo_en_globo. 2672
vols_en 2672
vols_turÍstics 2672
viatjar_en_globus 2672
vol_en_globus 2672
volar_en_globus 2672
volar_en_globo. 2672
contingudes 2672
convinem 2672

Comunitat 5

esquizofrènia 5344.01
psicodinÃ 5344.01
trics 5344
terapèutica 5344
tr. 5344
l'adolescent 5344
cognitives 5344
severs 5344
autisme 5344
conductista 5344
files/images/m- 5344
grupal 5344
neurològics 5344
elstir.com 5344
metòdica 5344
mica: 5344
l'alcohol 5344
vih 5344
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info@catalunyacomunicacio.cat 2672
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cat 708.409

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requires 651.5
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info@labanqueta.cat 1781.34
info@llumdelluna.cat 1781.34
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elturo@elturo.info 1781.34
nyamnyam 1781.34
nyamnyam@nyamnyam.cat 1781.34

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info@nouarc.cat 5344
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arc 1248.91
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vendre 930.977
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realitzades 645.943
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màxima 322.159

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pdf:_sri 2672

Comunitat 17

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Comunitat 18

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www.shops.cat 5344.01
http://informacio.cat 5344.01
s'integrarà 5344.01
informacio.cat 5344.01
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old 4741.37
antiga 1629.95
servidores_dedicados 1526.85
arsys.es 1526.85
housing 1504.71
dominios 1455.24
adsl 1299.45
alojamiento_web 1276.55
construcción 1001.68
parking 835.236
breu 553.395
http:// 388.944
anterior 373.687

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taller 569.98
entrar 70.1294

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continguts 601.109
benvinguts 166.715

Comunitat 24

Comunitat 25

nuestro_centro 2672
phoenix@phoenixpsicologia.es
2672
meridiana 2522.87
versión_en_castellano 2444.1
desp. 1346.36
telf.: 1168.54
avinguda 335.927
visita 180.361
e-mail: 139.086
barcelona 20.5917
web 11.3554

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a...] imatge_corporativa 2672
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elfo 2672

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does 38.6891
browser 37.3857
not 37.374
support 36.9984
frames. 35.8366
your 34.3967

Comunitat 30

acces/2.gif] 5344.01
accionariat 5344.01
indis 5344.01
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illa 5344.01
valors_corporatius 5344.01
interiors_d'
illa_en_recuperació
5344.01
interiors_d'illa_recuperats
5344.01
s'omplen 5344.01
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home.jpg] 5344.01
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postcolonial 5344.01
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5344.01
passat_i_present 5344.01

pla_d'actuació_municipal_2003_-2007 5344.01
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plànol_de_localització 5344.01

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e-mail:info@ipic.cat 2672.01
ipicsl.com 2672.01
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dreamweaver 1701.62
photoshop 1411.39
mac 641.279

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fusionen 1712.99
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càmares 1157.69

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urc-9050 1781.33
urc9050 1781.33
telstar 1781.33
telstar@telstar.cat"> 1781.33
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homecast 1781.33
href="mailto: 1781.33
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màniga_ampla_com_de_la_màniga_estreta._ arriscar-se_a 2671.99
www.impromptu.cat 2671.99
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estirar_més_el_braç_que_la_màniga_ i,_en_cas_de_no_tenir_de 2671.99
què_fer_mànigues,_saber_callar._ la_companyia_ impromptu_ha 2671.99
saltar_al_buit_en_mànigues_de_camisa, _fer_mans_i_mànigues_i 2671.99
conciència 2649.76
gestalt 2528.15
compañía 2426.75

Comunitat 36

hostalatge: 5344
microtech_sistemes[img/pix.gif] 5344

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charset="en-utf-8"> 2672
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montamos 5344
timthumb.php?src=http://pujadascalcat.cat/wp-content/uploads/2009/06/5344
embaras.jpg&w=40&h=40&zc=1] 5343.99
preocuparte. 5343.99
enviarlo 5343.99
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montamos_tu_Ã¡lbum_digital_(hofmann) 5343.99
usa01.jpg&w=40&h=40&zc=1] 5343.99
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vivers 1459.36
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plantes 1244.73
arbres 1103.22
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c., 5014.69
g., 4810.89

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http://phobos.xtec.net/iesmila/examens.php 2672
uipsa@uipsa.com 2672
torraspapel 2672
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petó" 1781.34
l'idioma: 1781.34
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www.gabrielescultor.cat 1781.33

Comunitat 47
bravehost 1781.33
lespingari@ya.com 1781.33
l'espingari 1781.33
adreços_d'interès 1781.33
www.zigazaga.org 1781.33
altres_adreços_d'interès 1781.33
www.montcadaenbici.org 1781.33
havaneres 1660.32
marinera 1468.27
reixac 997.473
construction 991.327
cançó 950.545
website 675.508
montcada 609.436
under 554.893
telèfon: 188.029
pàgina_principal 152.923
e-mail: 139.086
juny 35.3098
contactar 34.5796

Comunitat 48
contactar-nos. 1781.34
fusta 1781.34
maestros_del_web 1781.34
veloÃ§]ja 1781.34
web_estilo 1781.34
diu&Â 1781.34
estudi@bosco.cat 1781.34
suplantar 1781.34
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mirson 1781.34
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abizanda 5343.98
aleixa 5343.98
alfonso_josé 5343.98
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balbina 5343.98
ballonga 5343.98
pintó 5343.98
forcat 5343.98
fornell 5343.98
perlacia 5343.98
pernau 5343.98
xuriguera 5343.98
baldrich 5343.98
cantarell 5343.98
pere_joan 5343.98
candàliga 5343.98
canellas 5343.98
filomena 5343.98
pepeta 5343.98
pellisé 5343.98

Comunitat 50
c/nostra 5344
info@sona.cat 5344
il.luminació 5344
sonoritzacio 5344
montserrat,4 5344
noticies_|contactar_| 5344
serveis| 4140.98
movil. 4070.31
d'empordà 2997.61
tel/fax. 2417.53
d'equips 1626.65
sra. 1610.46
audiovisuals 1052.73
bisbal 830.174
lloguer 506.129
venda 296.414
girona 71.911
català 15.6487
castellano 14.895

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purpose 5344
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Comunitat 52
cap 2.98259
english 2.49805
catalunya 1.29709
contacte 1.2352
castellano 1.20323
web 1.175
activitats 1.1449
des 1.10793
més 0.806307
barcelona 0.723428
juliol 0.697361
serveis 0.682694
dia 0.61054

Comunitat 53
http://www.asesoria.cat 1336
info@pigmalio.net 1336
ba55.gif] 1213.3
ba57.gif] 1129.39
ba5.gif] 1030.79
ba4.gif] 1030.79
ba200.gif] 905.448
abast 403.914
site_map 307.133
domini 113.191
millor 48.9137
contactar 14.4082

Comunitat 54
bienvenidos_a_nuestra_web 2672.01
teatrales 2672.01
rafató 2672.01
miralles] 2196.41
visitarnos 2163.05
visitar-nos 1999.84
teatrals 476.808
endif]> 405.619
gracias 401.894
if 336.289
servicios 92.2459
gràcies 71.3532
benvinguts_a_la_nostra_web 52.3923
teatre 36.2095
por 29.2218
serveis 5.69454

Comunitat 55
germanística 2672
mireia_llinàs_grau 2672
gestió_acadèmica 2672
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alta_als_buscadors 2672
altres_marques_en 2672
merca-art 2672
assesorament_i 2672
làmines 2672
manipulat 2672
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català/english/italiano/ 2672
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looooooooltlf.: 2672
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banderafranceweb.jpg] 2672
info@cmn.cat 2672
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enllaços 1.27738
calendari 1.23812
contactar 1.16258
notícies 1.12131
gran 1.1197
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més 1.06884
sant 1.02803
informació 1.02017
serveis 0.977276
activitats 0.96006
dia 0.954329
cap 0.898359
agenda 0.881814
nova 0.873846
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mavi@mavi.cat 5343.99
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efímers 5343.99
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efectivitat 4630.95
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rambla 664.162
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tel 280.422
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own 497.888
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joves 2.43572
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contacte 1.99345
dia 1.85259
informació 1.61448
partir 1.47426
setmana 1.4305
més 1.37759
barcelona 1.26673
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també 1.16803
dies 1.1559
tel. 1.0837

Comunitat 85

climbingworld 2672.01
info@climbingworld.cat 2672.01
team,_2007____·____info@lassut.cat____·____by_montsant_natura_sl 2672
especial_calÇotades_2009 2672
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team 628.864
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tel: 109.612
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intro/spacer.gif] 2672
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kbps 2152.2
requeriments 1470.89
connexió 1001.46

webmaster: 894.671
lloc: 346.164
resolució 68.8283
spacer.gif] 59.5717
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Comunitat 89

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apache 1465.06
last_modified 372.996
description 367.217
size 363.758
name 350.812
port 310.188
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reus 10.1337
festival 5.15291
premsa 5.12676
tarragona 4.96621
música 4.76074
centre 2.92667
presentació 2.90221
web 2.58956
club 2.32581
english 2.06398
contacte 2.02482
diferents 1.93385
sala 1.83805
activitats 1.69254
treball 1.6403
passat 1.53085
any 1.49319
són 1.43147
part 1.41263

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ciu 20.0047
eleccions 5.3909
unió 5.25875
govern 3.75003
nova 2.44856
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campanya 1.90977
municipal 1.89597
setmana 1.80053
estan 1.78823
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cop 1.71009
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pla 1.68485
manera 1.53886
més 1.48208
avui 1.4628
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conca 22.7251
tarragona 7.99909
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qui_som 3.97121
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input 3.67231
turisme 3.47914
serveis 2.87084
contacte 2.81558
poden 2.79639
contacta 2.60725
portada 2.47265
programa 2.06815
l'ajuntament 2.03686
vols 1.95553
jordi 1.91507
ajuntament 1.91043
nom 1.83367
english 1.59084
són 1.58601

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netpro_solutions,_s.l. 1303.41
formulario 1283.84
usuario 1228.81
acceso 889.673
enlaces 630.983
inicio 455.92
powered 180.826
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pisos_obra_nova 5344.01
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cases_obra_nova 5344.01
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jcs 5344.01
locals_amb_traspàs 5344.01
vidal_piqué_i_associats 5344.01
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rendibilitzar 4696.98
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solars 2759.86
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volver 1813.75
http 1363.01
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archivo 934.988
service, 888.111
available 879.034
informàtica 848.291
testing 778.74
tarde. 656.258
tard 559.435

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d'empresa 5344.01
memòria_de_l'empresa 5344.01
missatge_de_l'alcalde 5344.01
instruccions_internes_de_contractació 5344.01
ajudar-nos! 5344.01
comuniquin 5344.01
contractació: _perfil_del_contractant 5344.01
gestió_del_sòl 5344.01
veure_totes_les_licitacions_> 5344.01
garajes) 5344.01
general). 5344.01
fileadmin/templates/img/lupa.gif] 5344.01
rebre_informació_automàticament_> 5344.01
asesga 5344.01
composició_mesa_contractació 5344.01
plenari_de_districte 5344.01
pronoubarris_s.a. 5344.01
participa_> 5344.01

Comunitat 105

actius, 1336
corporal. 1336
electrÒnica 1336
lamdors, 1336
d'avinyó 1336
turístiques, 1336
www.centraledicions.cat 1336
www.pulseramania.es 1336
zero, 1336
guia_avinyo_petit.jpg] 1336
guia_roses_petita.jpg] 1336
cap- 1336
geògrafs, 1336
gironafashion 1336
revista_manco_petita.jpg] 1336
privada: 1336
central.jpg] 1336
planol_calella_petit.jpg] 1336
planol_gironajove09petit.jpg] 1336
planol_gironajove_petit.jpg] 1336

Comunitat 106

info@inset.cat 5344
interiorismo. 5344
inset 5344
muntaner, 4289.71
vivienda 2648.9
restaura 2209.86
reformas 2085.43
reforma 1719.82
proyectos 848.407
integral 544.556
e 180.263
local 135.3
catalÀ 105.827
s.l. 92.9712
para 70.6602
fax: 69.2136
su 42.1472
barcelona 39.536
tel. 28.0873
english 20.6189

Comunitat 107

contracta_el_teu_web 2672.01
joomla] 2672.01
webs_d'exemple 2672.01
fes-te_distribuïdor 2672.01
respecte_joomla 2672.01
bugaderia. 2672.01
webempresa 2672.01
distribuïdors. 2672
nosaltr@s: 2672
mateix/a 2672
cercador_de_dominis 2672
lgi 2672
joomla]allotjament 2672
joomla]formació 2672
joomla]suport 2672
josepa_m. 2672
joomla]programació 2672
carlos_v. 2672
info@webempresa.com 2672
web_empresa_-_disseny_web_joomla 2672

Comunitat 108

baltà, 2672.01
fotogràf. 2672.01
www.morejon.cat/fotograf 2671.99
email:info@4-photos.cat 2671.99
tel:+34 2671.99
www.lluisbernat.com 2671.99
morejón 2670.45
compartides 2534.63
c/mare 2533.04
desemparats 2515.9
nº5 2427.62
link 696.439
mòbil: 543.401
entrada 385.303
fotografia: 269.332
fotografies 229.752
a: 220.913
joan 71.7238
endif]> 31.9453
if 26.4851

Comunitat 109

casos_d'èxit 2672
codi»[nemail 2672
en_2_min. 2672
treballem... 2672
usuari[nname 2672
contrastat 2672
inducontrol 2672
inducontrol_ 2672
info@inducontrol.com 2672
ver_google_maps 2672
pavic@pavic.cat 2672
d'osona) 2589.98
mora, 2449.26
avançats 2060.13
tecnològicament 1894.14
ajuda_online 1766.88
econòmiques 1470.14
camprodon, 1416.07
anàlisis 633.94
f. 462.629

Comunitat 110

castellano_/català 5344.01
menú_diari 5344.01
visiti_els_establiments 5344.01
menjars_cuinats 5344.01
selecció_de_plats 5344.01
la_nostra_filosofia 4514.77
qui_som 210.425
contactar 115.265

Comunitat 111

administracion@euroairlines.aero 2672
catalÂ 2672
luis@jet.cat 2672
silvia@jet.cat 2672
vostè, 2529.58
dediquin 2470.88
jet 2455.67
sota. 2403.89
trajectes 2328.12
exclusive 1957.39
executius 1766.92
flota 1336.34
resultats. 1318.38
service 621.402
correo 597.974
millorant 548.169
treballem 396.684
siguiente 378.923
negoci 296.761
millorar 125.263

Comunitat 112
ajuntament 3.68063
entitats 2.94029
l'ajuntament 2.91662
municipi 2.88214
municipal 2.78795
crèdits 2.48567
actualitat 2.42921
festa 2.15279
juliol 2.13135
mapa_web 2.08421
agenda 2.03
plaça 1.95366
informació 1.53878
servei 1.53147
sant 1.40349
contactar 1.39135
des 1.35004
tel. 1.31154
avís_legal 1.30131
activitats 1.29499

Comunitat 113
joomlacat.org_-_la_casa_del_joomla!_català 1851.22
kb] 780.6
línia? 728.347
d'entrada 533.577
gnu/gpl. 519.644
fes-ho_aquí 499.504
sindicació 443.703
registrar-te? 433.416
http://web.nominalia.com/courtesy/nominalia.com/index.html 381.715
rei 325.511
recuperar_contrasenya? 229.76
bàsquet 195.262
elements 195.007
molins 194.31
mostrar 180.209
recordar-me 175.736
llicència 173.053
enquestes 170.167
joomla! 135.785
programari 134.478

Comunitat 114
urlparams="1"> 2672.01
val2="1024" 2672.01
val3="750" 2672.01
val9="true" 2672.01
val8="true" 2672.01
val7="true" 2672.01
val6="true" 2672.01
val5="true" 2672.01
val10="true" 2672.01
val1="_top" 2672.01
val4="true" 2672.01
català 372.316
castellano 85.6464

Comunitat 115
avalats 2672.01
azuki, 2672.01
biosalut 2672.01
soja, 2672.01
salutividaalplat 2672.01
soja 2672.01
cigrons, 2672.01
germintas 2672.01
raves, 2672.01
puy, 2672.01
pèsol, 2672.01
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d'exigència 2672.01
lombarda, 2672.01
l'alfals, 2672.01
mix, 2672.01
redimw.php?img=../public/2/links/c9f0f895fb98ab9159f51fd0297e236d.jpg&l=143] 2672.01
ajuntament@albi.cat 2672.01
public/2/links/45c48cce2e2d7fbdea1afc51c7c6ad26.jpg&l=143] [incs_web/ 2672.01
f033ab37c30201f73f142449d037028d.jpg&l=143] [incs_web/redimw.php?img=../public/ 2672.01

Comunitat 116
amarradors 2672
cuina_de 2672
d'activitats... 2672
info@clubnauticsantpere.com 2672
tu+2) 2672
imago3disseny 2672
img_2897p.thumbnail.jpg] 2672
sites/default/files/images/ 2672
gardi 2672
gasolinera 2672
grua, 2672
rampa_i 2672
amarres, 2672
club_nàutic_sant 2672
pescador. 2672
pluges_(hora 2672
emporweb 2672
l'armentera, 2672
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utic: 2672

Comunitat 117
nicaragua 71.2937
psc 23.0758
grÃ 10.2058
barcelona, 6.66485
hores 3.25822
local 3.23408
miquel 2.79971
des 2.7725
rss 2.55404
vila 2.55309
barcelona 2.3307
maig 2.30345
grup 2.29372
notícies 2.20459
centre 1.84546
president 1.80594
bon 1.79854
catalunya 1.64721
està 1.64417
activitats 1.55035

Comunitat 118
cireres... 2672
cocktail? 2672
mandarina... 2672
mare", 2672
deixarÀ 2672
indiferent! 2672
irresistibles.. 2672
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curt-metratges.. 2672
d'absenta, 2672
gana? 2672
vidalet,37 2672
txai, 2672
fent_cultura 2672
tes, 2672
disseny:ddeloi_____il·lustració:srxo 2672
dolços 2672
nuelephanta@gmail.com 2672

Comunitat 119
ciutadilla 5344
configurado 2404.65
flotantes 2404.65
admite 2359.62
marcos 2248.88
mostrarlos. 1917.84
actualmente 1122.79
medieval 1068.37
está 460.085
para 120.443
explorador 113.227

Comunitat 120

Comunitat 121
charset="iso-8859-1"> 2672
d'impostos/ 2672
s.l.), 2672
posar-t'hi? 2672
charset="windows-1252"> 2672
mà? 2672
d'impostos. 2672
info@lenmobaira.cat 2672
lenmobaira 2672
gestió_administrativa 2672
immobiliàries. 2672
gestió_comptable 2672
gestió_fiscal 2672
gestió_laboral 2672
text/html"; 2672
estàtiques 2671.99
frm 2671.99
programació,s.l. 2671.99
programari/programes 2671.99
cobraments 2671.99

Comunitat 122
carles.costa@floppy.cat 1781.33
floppy, 1781.33
floppy.cat 1781.33
inaccessibles. 1781.33
vendes... 1781.33
vertiginosa. 1781.33
http://www.catt.es 1781.33
semblaven 1728.17
floppy 1715.62
renovar-se 1667.59
demana. 1647.63
solucions, 1638.22
horitzons, 1601.54
navegació, 1401.2
morir. 1167.02
ofereix, 1099.21
atractius, 640.411
còmode 632.812
tarja 620.548
menys. 491.806

Comunitat 123
a_la_meua_bola 2672.01
calculadora_còsmica 2672.01
do_events 2672.01
fragments_de_claror 2672.01
fried 2672.01
el_concurs 2672.01
expressar-te 2672.01
quadern_de_cuina 2672.01
sabem_que_ho_saps 2672.01
pollock) 2672.01
pootol: 2672.01
pootol_aventurer 2672.01

pootol_viatger 2672.01
el_corsari 2672.01
els_trenets_d'en_quimet 2672.01
petition_banner] 2672.01
assemblador 2672
t1.extreme-dm.com/i.gif] 2672
actualitzat_l'1_d'abril_del_2009 2672
destructor 2672

Comunitat 124

control_reproductiu_en_granges_de_vacu_lleter 5343.99
esvet.cat 5343.99
programes_preventius 5343.99
www.esvet.cat 5343.99
medicina_i_cirurgia_bovina 5343.99
esvet 5343.99
inseminació_artificial 5343.99
http://www.esvet.cat 5343.99
veterinari 4476.46
reproducció 2099.77

Comunitat 125

a_eina_de_convivència_ 1781.34
bases_logopèdiques_dins 1781.34
eina_diagnÃ'stica_(40 1781.34
lectoescriptura_(100 1781.34
les_intelÂ·ligències 1781.34
la_mediació_escolar_com 1781.34
la_programació 1781.34
la_síndrome_d'asperger_ 1781.34
hiperactivitat_(40_hores) 1781.34
l'àmbit_escolar_(100 1781.34
emocional_(40_hores) 1781.34
formatius._la_vostra 1781.34
enquesta_d'interessos 1781.34
neurolingüística_en 1781.34
opinió_ens_interessa! 1781.34
entorns_educatius_(40 1781.34
múltiples_a_l'aula_(40 1781.34
les_dificultats 1781.34
el_dibuix_infantil_com_a 1781.34
trastorn_per_dèficit 1781.34

Comunitat 126

pensalla 5344.01
stacks 5344.01
criteria_caixacorp,_"la_caixa" 5343.99
ddb 5343.99
la_comisión_científica_del 5343.99
langa 5343.99
itemplus,_jaume_ribas 5343.99
l'eixample" 5343.99
unaymedia 5343.99
woman'secret 5343.99
catalunya_web_a_web,_generalitat_de 5343.99
cita_web_del_"consorci_d'atenció_primària_de_salut_de 5343.99
centro_de_ciencias_pedro_pascual 5343.99
el_programa_co2_neutral,_volkswagen 5343.99
elàstic 5343.99
oesia 5343.99
pacífico,_csic 5343.99
natalia@fluid.cat 5343.99
newsletter_boolab 5343.99
mispacientes_per_iphone 5343.99

Comunitat 127

equips 6.79141
campionat 6.73927
futbol 6.37938
temporada 6.02831
club 5.48748
resultats 5.15343
final 3.70901
avui 3.20785
jornada 3.00003
equip 1.94999
catalana 1.94176
copyright 1.67245
festa 1.60707
general 1.59589
està 1.59298
català 1.53316
gran 1.51469
juny 1.5002
estat 1.48702
proper 1.36824

Comunitat 128

mínima 2672
prefereixes. 2672
prefieres. 2672
versió_accesible_xhtml/css 2672
versió_accessible_xhtml/css 2672
versión_accesible_xhtml/css 2672
http://www.comcom.cat/bricoflashweb 2672
ingresar 2616.79
necesaria 1994.33
ingressar 1430.39
instalÂ·lat 1335.4
necesitas 1166.58
navegador. 1063.56
flashplayer 842.622
necessaria 719.741
puedes 499.614
plugin 264.369
visualizar 247.479
instalado 189.739
tener 145.788

Comunitat 129

empreses 2.69839
professionals 2.60463
social 2.35474
treball 2.11533
persones 1.78095
avís_legal 1.64013
programa 1.63072
barcelona 1.47819
servei 1.45535
catalunya 1.45037
english 1.41361
empresa 1.39948
centre 1.38687
notícies 1.37771
està 1.37374
enllaços 1.34997
diferents 1.24919
serveis 1.24639
nova 1.23158
juliol 1.22119

Comunitat 130

www.teselen.cat/ 1068.8
black; 1068.8
mso-fareast-font-family: 1068.8
serif‘; 1068.8
mso-fareast-language: 1068.8
arabe.gif] 1068.8
liderado 1068.8
arial;>para 1068.8
instituciones, 1068.8
ar-sa 1068.8
gif.gif]búsqueda 1068.8
gif.gif]búsqueda_avanzada 1068.8
gif.gif]contacto 1068.8
gif.gif]novedades 1068.8
gif.gif]inicio 1068.8
urn:schemas-microsoft- 1068.8
com:office:office 1068.8
fareast-language: 1068.8
residente 1068.8
es; 1068.8

Comunitat 131

brando 2672.01
herències 2672.01
il.lustre 2672.01
criminologia. 2672.01
endif]>soci 2672.01
exercent 2672.01
pizarro@abad.cat 2672.01
endif]>col.legiat 2672.01
endif]>curs 2672.01
endif]>llicenciat 2672.01
endif]>màster 2672.01
dartem 2672.01
gi-45660 2672.01
feu-vos_col.laborador 2672.01
b17976051 2672.01
legsislacio 2672.01
bta. 2672
teconologies 2373.07
seguretat_informàtica 2218.53
successions 1970.91

Comunitat 132

tè 5343.99
buy3.jpg] 5343.99
bomboles_'amaretti' 5343.98
bomboles_avellana 5343.98
codi:49 5343.98
codi:98 5343.98
coffee, 5343.98
mug_'raya'_(ref. 5343.98
manresa-barcelona 5343.98
mastercard] 5343.98
codi:90 5343.98
lung_ching_grau_nº_1 5343.98
llauna_de_te_100g 5343.98
lot_nadal_nº_5 5343.98
b-62912647 5343.98
codi:30 5343.98
codi:34 5343.98
jamaica_blue_mountain 5343.98
cafe, 5343.98
codi:24 5343.98

Comunitat 133

http://www.dolor.cat 2672
http://web.me.com/sergi_tapies 1336

Comunitat 134

Comunitat 135

info@tvpalau.cat. 2672
www.tvpalau.cat 2672
edifici._sala_gran 2672
edifici._söko_club 2672
c/_forn,_15 2672
edifici._bar 2672
fotos_1er_cicle_de_teatre_de_tardor 2672

fotos_festa_major_'07 2672
fotos_sopar_ball_2008 2672
fotos_the_momo_live_show_'09 2672
setembre.us 2672
fotos_pastorets_'08 2672
fotos_sessió_lírica_'08 2672
fotos_sopar_ball_2007 2672
relacio_de_preus_properes_activitats 2672
l'honor, 2672
l'intimitat 2672
he_oblidat_l'usuari_o_contrassenya 2672
tvpalau.cat 2672
samsó 2672

Comunitat 136

escola 6.77265
l'escola 6.31923
alumnes 5.92504
copyright 3.65974
curs 3.4156
calendari 3.07212
contrasenya 2.58057
suport 2.17979
d'usuari 2.12446
maig 2.02463
centre 1.9824
principal 1.85036
nom 1.75528
partir 1.54121
any 1.4417
passat 1.41961
podeu 1.40638
treball 1.36434
enllaços 1.36398
activitats 1.32982

Comunitat 137

Comunitat 138

animada, 1781.34
comunions! 1781.34
festes_i_fires 1781.34
tallers_lÃºdico-educatius 1781.34
familiars! 1781.34
serveis_musicals 1781.34
petits... 1781.34
discomòbil 1781.34
el_que_necessitis 1781.34
encarades 1781.34
equip_i_colÂ·laboradors 1781.34
novetats_/_productes 1781.34
majors! 1781.34
necessitats! 1781.34
diverta 1781.34
info@diverta.cat 1781.34
lloguer_de_material 1781.34
gestió_i_management 1781.34
images/diverta-educa.jpg] 1781.34
s'acosten 1374.59

Comunitat 139

Comunitat 140

real] 5344
temps 942.053

Comunitat 141

http://www.edent.cat 5343.99

Comunitat 142

does 38.6891
browser 37.3857
not 37.374
support 36.9984
frames. 35.8366
your 34.3967

Comunitat 143

centrino 2672.01
empresas] 2672.01
mi_cuenta 2672.01
intel.cat 2672.01
fabricante:hp 2672.01
hp_compaq_cq2000es 2672.01
t3400 2672.01
proliant 2672.01
pago: 2672.01
languages/espanol/images/ 2672
href="http://www.intel.cat/ 2672
product_info.php/products_id/ 2672
includes/ 2672
procesador: 2672
modelo: 2672
detalles...] 2672
languages/espanol/ 2672
images/buttons/ 2672
fabricante: 2672
b17672155 2672

Comunitat 144

manresa 33.1566
manresa. 28.5047
manresa, 16.8817
telèfon 9.91368
s.l. 6.9276
avís_legal 6.41544
pot 6.20962
teatre 4.88337
serveis 3.95758
informació 3.56208
contactar 3.43973
l'ajuntament 3.05211
d'aquest 2.93212
premsa 2.91608
ciutat 2.87964
podeu 2.61908
noticies 2.61671
mapa_web 2.50848
principal 2.40102
any 2.38893

Comunitat 145

appartements_begur 2672.01
begur] 2672.01
mer_situé_à_begur,_costa 2672.01
appartements_empuriabrava 2672.01
appartements_pals 2672.01
avec_magnifique_vue_sur 2672.01
villas 2672.01
brava._piscine_privée. 2672.01
sur_la_mer 2672.01
piscine_et_vues 2672.01
plages 2672.01
privée 2672.01
costa_dorada] 2672
kilòmetres 2672
côte 2672
d'appartement_à 2672
d'empuriabrava 2672
ont 2672
villas_piscine_empuriabrava 2672
villas_empuriabrava 2672

Comunitat 146

assessorar-lo 2672
id="logo" 2672
iles/img/logo_ipgrup.gif", sizingmethod="scale");" 2672
software. 2672
satisfacció. 2672
equips/ 2672
ipgrup 2672
www.infopc.es/proves/ipgrup1/files/img/ipgrup.jpg] 2672
tpv's, 2672
emmagatzement 2626.58
castella.png] 2590.41
meres 2300.23
xarxes. 2178.86
tècnic, 1820.67
fic. 1526.4
obtingui 1387.56
sat 1181.02
programació. 951.795
d'anys 775.21
on_trobar-nos 704.162

Comunitat 147

algunes_músiques 5344
classes_de_vals_... 5344
trepitjar?! 5344
un_regal_per_als_nuvis 5344
un_regal_per_als_convidats 5344
com_ho_organitzem? 5344
denuvis@gmail.com 5344
solter 5344
comiats_de_solter/soltera 5344
deixant-te 5344
denuvis.cat 5344
matrimonial 5344
soltera 5291.88
practicat 4459.49
irrepetible 3562.7
passos. 3108.63
tranquilitat 3086.73
comiats 2564.73
oferim? 2368.19
vals 2300.12

Comunitat 148

aprofitar-se 5344
de_l'_outlet 5344
del_outlet 5344
difícils. 5344
mobles] 5344
mobles_güell. 5344
llancem 5344
mapa_del_lloc/ 5344
veure_outlet 5344
trucs_de_decoració 5344
bandera_esp.gif] 5344
d'excedents 5344
i_horari 5344
l'outlet 5344
bandera_ing.gif] 5344
club_socis_outlet 5344
prestatgeries, 5344
economics] 5344
outlet_de_mobles 5344
outlet_mobles 5344

Comunitat 149

adaptació_a_nous_llocs_de_treball 2672.01
blog_jordi_pagès 2672.01
missió_i_valors 2672.01
conferència_dama 2672.01
el_nostre_mètode_de_treball 2672.01

el_nostre_mètode_per_transformar 2672.01
millora_en_habilitats_emocionals , _de_comunicació_i_ de_gestió_de 2672.01
materials_per_a 2672.01
materials_per_a_tu 2672.01
eines_de_motivació_i_ automotivació 2672.01
el_nostre_esperit 2672.01
blog_de_tropos 2672.01
definició_de_models_de_ gestió_per_competències 2672.01
direcció_per_objectius 2672.01
les_nostres_ofertes 2672.01
intuïtiu , 2672.01
kennedy] 2672.01
tropos_estrena_nou_web 2672.01
trobar_parella 2672.01
tranformant_estrena_nou_web 2672.01

Comunitat 150

llengua 3.3435
catalans 3.26498
fent 2.50674
campanya 2.26051
jordi 2.23969
catalÃ 2.23961
hores 2.20236
havia 2.16688
marc 2.07144
estÃ 1.98903
josep 1.91719
cap 1.91682
dir 1.90634
era 1.76336
govern 1.75416
contra 1.75094
tenir 1.74882
podeu 1.70636
president 1.69616
però 1.57697

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http://www.nusmariner.cat 2672
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mariner 2327.23
nus 2284.47
gaudeixi 1124.46
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counterwebkit2008 550.404
endif]> 145.206
donem 122.788
if 120.387
esperem 78.9042
benvinguda 58.1324
restaurant 39.2705
web 2.06462

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afiliacion.jpg] 5344.01
apartarnos 5344.01
aplicando 5344.01
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Comunitat 153

disseny_web:_www.marcjuli.com 5344
geotèrmia_i_aerotèrmia 5344
hidroelèctriques , 5344
inesgotable , 5344
info@incunart.cat 5344
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llenya 4496.25

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aliment_sec_animals 5344
aperitius 5344
carn_i_ous 5344
carregem 5344
d'aquets 5344
cura_de_la_pell 5344
verdura 5344
iogurts 5344
criades 5344
info@monviu.com 5344
infusions 5344
tofu_i_tempeh 5344
higiene_personal 5344
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nodreix 5000.4
lluïsa 4208.58
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acaba 1440.5
família 1010.51

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edifici_40 5344.02
llobet_a_barcelona 5344.02
joan_capri_a 5344.02
construïdes 5344.02

Comunitat 160

alianzas 2672.01
ascendente 2672.01
bouquetnuvis.com. 2672.01
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lucchino]victorio_&_lucchino 2672.01
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boda? 2672.01
coruña) 2672.01
las_mil_y_una_boda 2672.01
leer_noticia 2672.01
www.boda.tv 2672.01
www.bouquetnuvis.comparticipar 2672.01
la_garriga_de_castelladral 2672.01
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Comunitat 161

info@impacte.cat 2672.01
cursos_amb_matricula_oberta 2672
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telecomunicacions). 2672
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Comunitat 162

barcelona 2.01998
servei 1.95521
catalana 1.65843
millor 1.61373
sant 1.51345
serveis 1.29851
més 1.24285
web 1.19825
català 0.976145
castellano 0.881171
dia 0.853498
catalunya 0.798901
juny 0.696613
des 0.690977
juliol 0.64288
contacte 0.635877

Comunitat 163

aïlla 2672.01
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obra_gràfica_conmemorativa 2672.01
centenaria 2672.01
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gravat] 2672.01
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mÃºsica_i_dansa 2672.01
cig 2672
compositora 2672
concert: _trompetistes_del_malmÃ¶_college_of_music 2672
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parlem_amb...: _fidel_masreal_del_seu_llibre_conviure_amb_la_depressió 2672
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afm.jpg] 2672
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salto.jpg] 2672
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Comunitat 165

conjunt 3.40997
internacional 2.79549
programa 2.59819
juny 2.46481
joan 2.35594
cultura 2.15132
catalunya 2.07096
anys 1.96733
maig 1.88609
qui_som 1.8746
dies 1.77743
mapa_web 1.76679
treball 1.76421
d'una 1.7422
té 1.73795
correu 1.69879
juliol 1.64968
proper 1.63888
ciutat 1.63019
trobar 1.5278

Comunitat 166

colles 21.1226
concurs 9.10218
tradicional 8.29728
colla 7.76805
participar 3.48452
cultural 3.44924
major 3.37853
festa 2.89815
anys 2.45164
plaça 2.26438
joan 1.95087
entitats 1.81477
agenda 1.71228
també 1.6995
diferents 1.527
proper 1.51266
nom 1.40619
l'any 1.39137
grup 1.38046
podeu 1.36663

Comunitat 167

contacto_y_formulario_de_contacto 5344
cursos_para_otros_cuerpos 5344
maneta.gif] 5344
matricularse 5344
sme 5344
cursos_per_a_mossos 5344
sabrÃ¡n 5344
seguirÃ¡ 5344
operativo 5344
queridos 5344
pago_de_los_cursos 5344
www.sme-ccoo.cat 5344
www.sme-formacio.cat 5344
instrucciones 4838.72
policiales 4329.64
servicaixa 4280.87
ningun 4220.93
podrÃ¡n 4153.23
saludo 3979
edición 3889.05

Comunitat 168

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mi1_524.jpg] 5344
stiads 5344
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econòmics. 4320.43
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pallejà, 3677.03
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navig/ 2531.36
partits. 2295.78
gratuïts 2223.38

Comunitat 169

judit@artfoto.cat 1781.34
www.artfoto.cat 1781.34
cayucos_small.jpg] 1781.33
logo_40wht.gif] 1781.33
club][logo2009_trans.gif]...[film.gif]..[pere_petit.gif] 1781.33
simo 1735.54
fum] 1715.42
fotoperiodisme 1692.97
fum 1640.35
retalls_de_premsa 1626.87
d'aventura 1515.33
llibertat 807.281
multimedia 743.816
judit 708.628
reportatge 618.004
viatges 209.54
actes 195.468
fotografia 186.704
dies 151.659
club 80.93

Comunitat 170

com_arribar-hi_??? 2672
n-150, 2672
terrassa.neta@terrassa.cat 2672
n.150 2672
neta, 2618.65
identity 2585.8
respectem 2411.54
grafico 2398.86
graphic 2195.8
corporate 2107.77
gráfico 2029.87
neta 1952.44
logos 1913.74
residus, 1712.95
tels. 1645.43
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garantim 1569.05
diseño 1444.37
imagen 1006.3
image 796.279

Comunitat 171

http://www.anestesia.cat 2672
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Comunitat 172

girona 3.8682
gran 1.74608
serveis 1.48065
dia 1.40186
tel. 1.35508
web 1.33189
passat 1.28921
sant 1.28649
agenda 1.20649
informació 1.15453
contacte 1.14941
juliol 1.11306
activitats 1.10207
notícies 1.07776
servei 1.0726
lloc 1.06138
juny 1.02466
des 0.883905
més 0.835388
catalunya 0.748713

Comunitat 173

administracio@cleanamience.cat 2672.01
d'enllumenat, 2672.01
telegestió, 2672.01
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computercraft 2672.01
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portàtil) 2672.01
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www.cleanambience.cat 2672
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alternativo 1242.12
navegadores 1210.78
creación 968.166
proporcionar 924.293
contenido 550.304
aquí. 477.314
debe 466.445
obtener_flash 260.682
requiere 205.778
html 176.116
este 153.851
player. 121.451
adobe 104.394
para 53.5304

Comunitat 176

viatgesitaca.cat 2672
www.basicalia.com 2672
by: 1555.6
copyright 290.943
web 54.5059

Comunitat 177

han_confiat_en_nosaltres 2672.01
kina 2672.01
amb_els_nostres 2672.01
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clients_ens_avalen! 2672.01
jo_faig_pinya 2672.01
catalunya_deco 2672.01
crear_compte 2672.01
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samarreta.cat 2672.01
samarretes_(barÇa)_(2) 2672.01
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pitagora 1781.34
www.formaciocontinua.cat 1781.34
www.pitagora.cat 1781.34
advanced.com 1781.33
advanced, 1781.33
info@pitagora- 1781.33
projè 1781.33
elÂ·laboració 1781.33
mostra_estereotips 1781.33
normativa_/_subvencions 1781.33
l'absentisme 1781.33
l'excelÂ·lència 1781.33
bibliografia_de_gènere 1781.33
d'igualtat, 1781.33
implantats 1781.33
assesorament 1781.33
com_implantar-lo 1781.33
que_és 1781.33
proje 1781.33
còrsega 1729.35

Comunitat 180

entrar_a_la_web 3689.7