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An Overview of the Advice Process and the Scientific Production of the Adviser-Advised Relationship in the Areas of Engineering

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***Abstract*—**The adviser-advised relationship, in addition to the evident propagation of knowledge, can provide an increase in the scientific production of the advisors. Specifically, in post-graduate programs, in which the advised submit diverse papers in different means of publication, these end up boosting the production of their advisor, since in general the advisors appear as co-authors, responsible for instructing and assisting in the development of the work. Therefore, to visualize the orientation process and the scientific production resulting from this relation is another important way of analyzing the scientific collaboration in the different areas of knowledge. In this work, are used the data of orientations and postgraduate supervisions from the Lattes curricula, from the main advisors who work in the Engineering area, to obtain an overview of the process of orientation of this group, and even, to produce Academic genealogical trees, where it is possible to verify how knowledge has spread in the diverse areas of engineering.

***Keywords*—**Academic genealogy, advice, engineering, lattes platform.

I. Introduction

THE evolution of scientific research has a strong influence on the training process, where researchers advisors lead new researchers that contribute to new studies in several areas of knowledge. Most of the studies carried out with orientation in Brazil are due to Postgraduate Programs (PPGs), driven by the need for training and titling of teachers and researchers.

For [1], the binomial or guiding-oriented dyad is undoubtedly the basis of PPGs, which determines the growth and expansion of Postgraduate (PG) courses and the demand for guidance. In addition, the authors emphasize that the PG student is a potential researcher, at an advanced stage of development, that is, on the way to scientific autonomy, but still dependent on a teacher, which justifies the orientation activities as effectively necessary.

In addition to the basic data that characterize linkages about the orientation process, information such as publications, area of activity and research projects can be extracted from all the elements that compose the network to be analyzed to obtain quantitative data that represent the Diffusion of knowledge from an advisor. Considering the possibilities of visualization and understanding of the orientation history and consequently the diffusion of the knowledge of a certain advisor, to carry out the modeling and characterization of academic genealogical trees appears as an interesting alternative for the analysis of how the science propagates in the several areas of study. For this, data on orientations as well as the characteristics of each of the individuals that compose the network are analyzed. In this work, the data used are the curricula that make up the Lattes Platform under the coordination of CNPq (National Council for Scientific and Technological Development). In this case, the Lattes curricula of the main advisors working in the Engineering areas are processed with the objective of obtaining an overview of the orientation process of this group, and also producing academic genealogical trees integrated with bibliographic production information, where it is possible to verify how knowledge has spread in the various areas of engineering.

The objective of this work is to apply from the entire base of previously extracted Lattes curricula, a search, to find the most productive researchers in the fields of Engineering with postgraduate advice and, consequently, all their descendants. In this way, it is possible to obtain all the academic genealogy from the researchers in question.

Later, the generated trees can be manipulated with the intention of improving the visualization of the elements that compose it and serve as subsidies for diverse analyzes that aim to understand how the adviser-advised relationship has happened in the great area of Engineering. In view of the amount of data on the orientation process registered in the Lattes curricula, this work has as main data source the records of orientation and academic formation of the curricula analyzed.

II. Related Works

For [2], academic genealogy is the quantitative study of the intellectual inheritance acquired through the guiding-oriented relationship. Therefore, understanding such a relationship may provide mechanisms for analyzing how the orientations are being conducted. Faced with this, this paper proposes a tree-based approach to the modeling of the academic genealogy of adviser's researchers, making it possible to visualize the entire hierarchical orientation historical and, consequently, how its knowledge has spread. With this, several other works can be

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proposed aiming to analyze the characterized genealogical trees.

Academic genealogical trees are characterized as trees that represent hierarchically the historical of an adviser and all his advised. Therefore, characterizing an academic genealogical network is possible to observe the whole historical of a given advisor and how his knowledge was passed on over time [3].

Reference [4] present a temporal analysis of the adviser-advised relationship with a case study on the productivity of PhD researchers in the area of Computer Science extracting the analysis data from the Lattes curricula. In the paper, the main characteristics of the group and the relations of co-authorship are analyzed.

In [5], the influences of the adviser-advised relationship in the process of production of theses and dissertations of the PPGs in Accounting of the city of Sao Paulo are verified. The authors cite as justification for the study the importance of analyzing aspects that would have a connection with the construction of knowledge, specifically around accounting and the attempt to signal the importance of the advice thematic.

Several other studies have explored the Lattes Platform as the main source of information for characterization and analysis of academic advice [3], [6], [7]. However, the largest majority of the works mentioned above act on small sets of data previously defined, obtained manually or in a limited way.

III. Methodology

This work has as main data source the curriculum of the Lattes Platform. The Lattes Platform represents CNPq's experience in integrating databases of curricula, research groups and institutions into a single Information System, becoming a national standard in the registry of the past and present life of the students and researchers of the country [8].

The Lattes Curriculum became a national standard in the record of the past and current life of the country's students and researchers, and now is adopted by most of the country's research institutions, universities, and institutes. Due to its wealth of information and its increasing reliability and comprehensiveness, has become an indispensable and compulsory element in the analysis of the merits and competence of funding suits around science and technology [8].

Several other works for the analysis of scientific data have explored the Lattes Platform as the main source of information [9]-[11]. Although data from the Lattes Platform curricula are freely available, they are viewed through a query interface that presents the curricula individually. Therefore, techniques and tools for extracting and integrating the data with other scientific databases to complement the information are necessary [12]. For the extraction of the curricula, The data extraction and integration framework was used, developed by [12] to obtain the data to be analyzed, which stores them in XML (Extensible Markup Language) format according to Fig. 1.

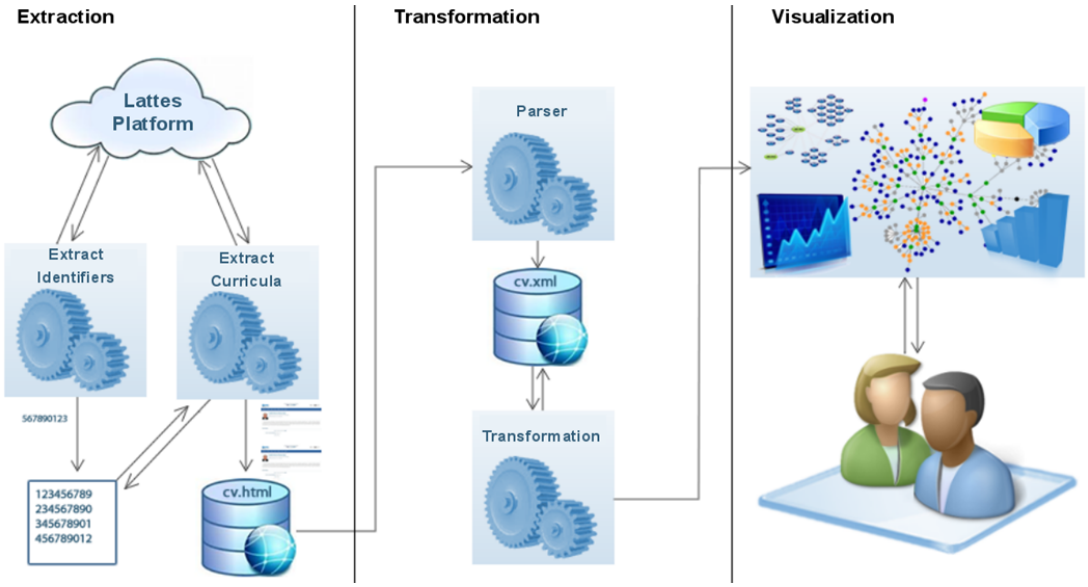

Fig. 1 Architecture of the Extraction and Integration of Scientific Data framework

With the data, the selection module is applied to obtain a list with all the researchers of the large area of Engineering.

For the construction of the trees, a recursive strategy is used, in which a root is previously selected, making identification of all the advice and supervisions completed, obtaining a list of oriented that are directly linked to the root node. This process is repeated for each item in the new list, thus identifying the various levels of descendants of the root node. Consequently, resumes that do not have completed advice are becoming the leaves of the tree. This process happens until all offspring are processed, ultimately finding only leaves. Therefore, each curriculum found by the selection module becomes the root node at each iteration, generating a new tree if it has not been inserted into the tree of another

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researcher; in this case, it is not a descendant of another researcher of the area. With these data, we also obtained the work done together, from the adviser-advised relationship. The identification and characterization module proposed by [11] was used to identify the teacher's output from the collaboration with the student-advised student. Using this module, the data were processed, resulting in the advisor's scientific collaboration network. These results consist of nodes and edges, which allow the analysis of the network characterized by techniques of social network analysis, allowing to obtain knowledge about how the scientific collaboration of the analyzed researchers happens.

IV. Results

The Lattes platform now has approximately 4,700,000 resumes, and after applying the selection module, 146,840 advice were selected within the large area of Engineering in graduate programs. Although it is not the largest area with the largest number of individuals (257,144), it has a large amount of scientific production and advice, which makes it an interesting object of study.

In the case of advice, the broad field of Applied Social Sciences is the largest area with the highest volume (Fig. 2). However, much of this is due to advice of course completion work (graduations), unlike Engineering, in which a lot is advised postgraduate students, being ahead of even the large area of Applied Social Sciences given as an example.

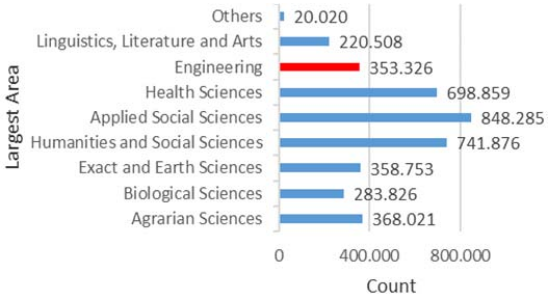

Fig. 2 Advice distributed by major areas with emphasis in Engineering

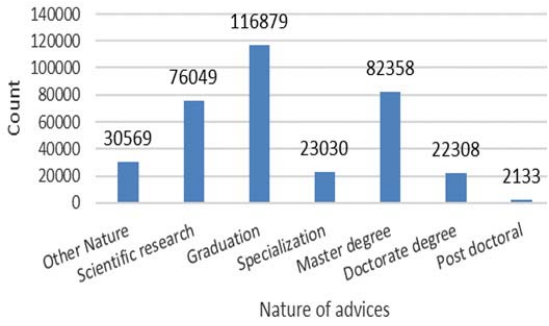

Fig. 3 Nature of the advice of the largest area of Engineering

Fig. 3 demonstrates the great amount of orientation in postgraduate courses, which together exceed the graduation advice, reinforcing the importance of the area in postgraduate courses.

After the selection of the individuals that work in the major area of Engineering, they were ranked in two ways: individuals that have advice in greater quantity and the larger trees of advice of the large Engineering area (Tables I and II, respectively). In this case, the amount refers only to postgraduate advice.

TABLE I
Largest Number of Advice

Number	Institution*	Count
1	COPPE - UFRJ	259
2	UFRJ	246
3	COPPE - UFRJ	218
3	UFSC	198
5	UNICAMP	195
6	UFF	188
7	UFSC	181
8	UFSC	181
9	UFSC	175
10	UFRJ	171

* Institution with more advice for each individual.

The greater amounts of advice indicate the great capacity of the individual in the advice process. However, this does not always mean that your knowledge is being passed on to other generations. In cases, like number 1 in Table I, it is observed that there is a large volume of advice. Initially, it can be presumed to be one of the largest networks found. However, the individual's academic genealogic tree has five generations of descendants, where the largest in this area has nine generations. This is still in the 7th when it comes to the total size of the network.

Differently, individual 1 of Table II, despite the small number of direct advice (112) when compared to the previous individual, had his knowledge passed on over time and this enabled his network to be the largest among all the advisers in the large area of engineering, Despite the small number of generations (only four).

Despite the differences presented, it can be noted that there is a balance between the individuals, especially in the size of the larger advice networks in postgraduate courses. Postgraduate students tend to remain in the academic environment, resulting in new advisors, passing on their knowledge to other students, and consequently, increasing their network of advice.

TABLE II
Larger Count of Descendants (Larger Networks)

Number	Institution*	Generations	Size
1	UFRJ	4	1846
2	ITA	6	1714
3	UNICAMP	6	1324
3	UFSC	4	1275
5	UFSC	4	1268
6	UFRJ	6	1210
7	COPPE - UFRJ	5	1208
8	UFRJ	5	1146
9	USP	6	1081
10	UFSC	5	1040

* Institution with more advice for each individual.

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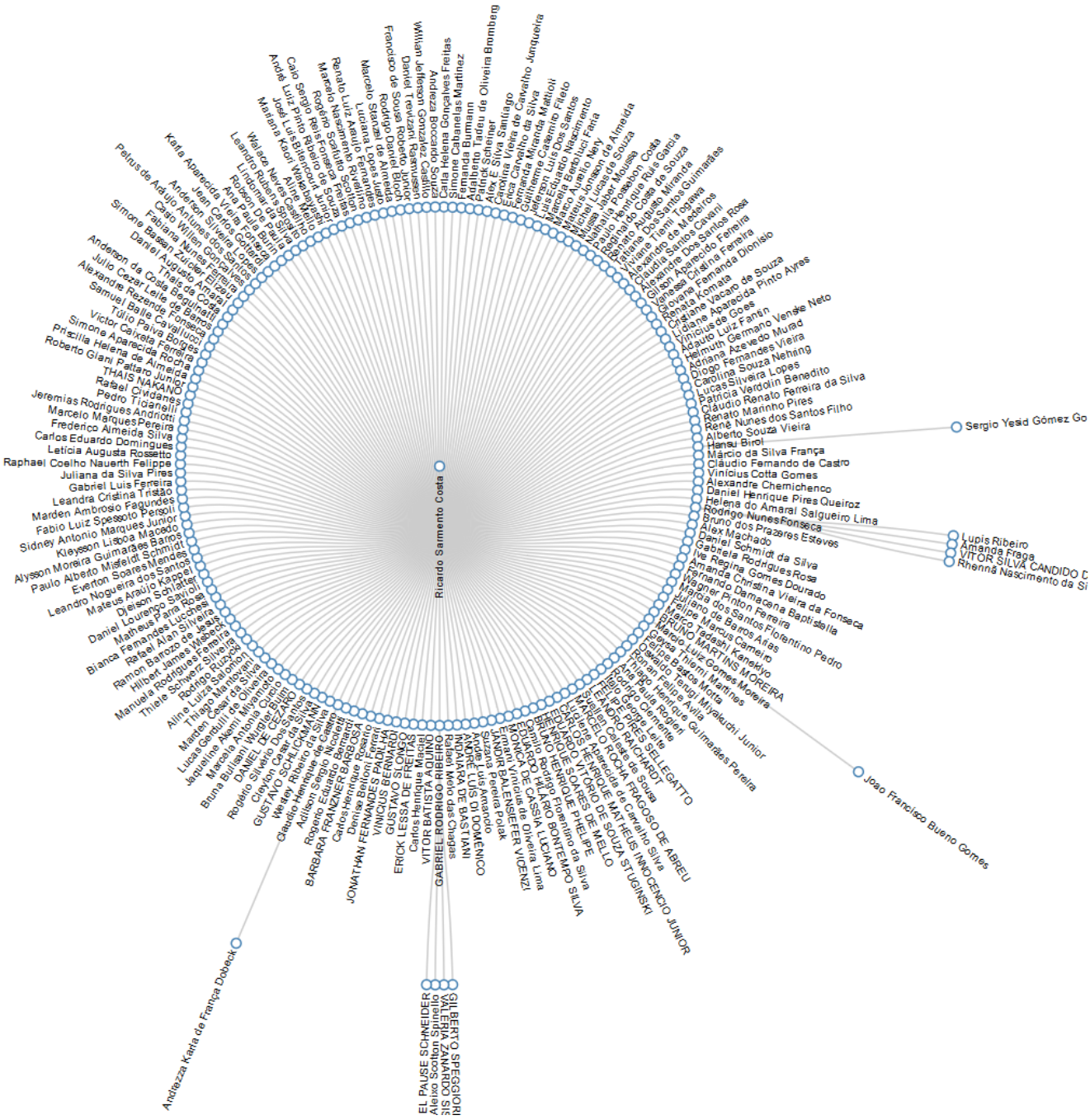

Fig. 4 Individual with more direct advice

Analyzing the results in the large area of engineering regardless of the nature of the advice, an individual with advice in the Fundação Getúlio Vargas Institution was identified.

Fig. 4 represents the genealogical tree of the individual mentioned above (greater quantity of direct advice), displaying this as the central node and all its descendants in the different levels of the tree. From this method, several trees can be produced with the intention of representing advice and how their knowledge has been passed over time.

The individual in Fig. 4 has a total of 736 instances of direct advice, being more than double the number of the first individual in Table I. However, even with the greater level of advice, little of his knowledge was passed on to other generations (he counts only two generations). In front of this, the tree with the largest network of direct advice of the vast Engineering field was also produced (Fig. 5). It has five generations of descendants and 1208 nodes, the central node being the number one individual in Table I, also presented in Table II.

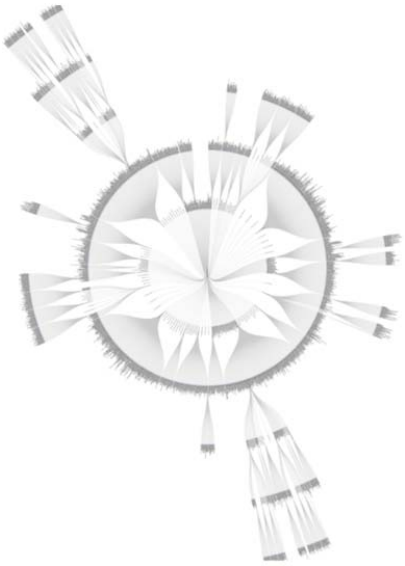

Fig. 5 Network of the individual with the highest number of direct descendants

In view of this, we note that a large volume of direct advice does not necessarily result in large networks, but rather the quality and nature of the advice.

V. Conclusion

In this work, all the curricula of the platform were processed, to obtain an overview of the process of academic advice in the broad field of Engineering.

The largest majority of these do not have advice identified by the platform, these being transformed into the leaves of the trees generated. That is, it is not known exactly which individual platform was advised in most cases. This is due to the lack of user-defined links within the Lattes platform.

There is a great difficulty to identify such individuals, since there is no link between this and its advisor. The greater the number of advice, the greater the collaboration network and its production becomes more accentuated with those advised.

It was possible to find characteristics of certain advisors per the applied classifications: advisors with a quantity of advice above normal, these being in most of the cases of minor importance, and counselors with fewer direct advice, but with larger networks and consequently larger numbers of descendants. This is mainly due to advice in postgraduate courses, where many of those advised have the intention to enter the academic environment, increasing the network of their advisors.

It was also possible to generate trees of important advisers per the classification made, allowing to verify the mentioned characteristics through a visual medium.

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