

An Interactive Visual Representation to Explore Association with Hierarchical Social Circles

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Abstract

Showing the relations between the contacts of an ego network, a subset of a large social network, and these contacts' associations to different social circles enables us exploring inside behavior of the underlying ego network. Normally, these social circles contain multiple hierarchies in them and many times the social circles at the second or lower level in the hierarchy are non-mutually exclusive. In this work, we propose an intuitive design solution to visualize an ego network with associated social circles, where the inside Chord diagram represents the contacts and their relations in an ego network while the outside arcs represent the associated social circles, keeping their hierarchies and the non-mutually exclusive property. Our HiSoC-Vis tool provides a number of interaction and filtering options to make the resulting visualization more intuitive and customizable.

Categories and Subject Descriptors (according to ACM CCS): H.5 [Information interfaces and presentation]: - [-]: —H.5.2[User Interface]: Graphical user interfaces

1. Introduction and Background

In social networks, an *ego* is defined as the focal actor in a large network, while an *ego network* is a subset of this large network from the perspective of the focal actor ego, i.e., all the nodes in this ego network have a direct relation with this focal actor ego [WF94]. Recently, Mcauley and Leskovec [ML14] analyzed ego networks from the current social media perspective and called it *personal social network* of a user on social media that normally consists of family members, friends, and acquaintances of acquaintances. In our definition, an *ego* in current social media networks can be a person, a group page, or a brand page. In this context, the *ego network* would consist of the followers of this person, group page, or brand page.

Many tools have been proposed in the past to visualize aspects of social networks at different levels, e.g., Gephi [BHJ⁺09], Node-Trix [HFM07], PerSoNVis [EHAE16], and Vizster [HB05]. An important factor in analyzing an ego network is to show the associations of the nodes with different attributes (*social circles* in our context, e.g., city, education, music liking, etc.). Analyzing these associations with the related social circles would not only be useful at personal level (e.g., to know who in the contacts like a special type of music), but also for marketing purposes (e.g., to target associated contacts according to their preferences). Previously, Shannon et al. [SHQ08] used their Paired Parallel Coordinates visualization tool and provided two views: a force-directed layout to show the relations between nodes in an ego network, and a parallel coordinate view to show the association of a node with different attributes.

However, these two views require more space and users need more cognitive work to make a connection between them. Also, they lack in showing the hierarchy inside the attributes (i.e., social circles).

Previously, we proposed an enhanced two-layered Chord diagram [HEAE16] to show two levels of hierarchy in associated social circles, assuming the mutually exclusiveness in these social circles. However, when we talk about hierarchy inside these social circles, often the social circles at second or lower level are non-mutually exclusive, e.g., a *music* social circle may have three child social circles (e.g., *rock*, *folk*, and *classic*) and some of the associated nodes to the *music* social circle may be associated to two or all three categories. In this work, we propose an intuitive design layout for showing the hierarchical social circles at the outer layer of the inside Chord diagram, where this Chord diagram shows the contacts and their relations in the underlying ego network while the outside arcs represent different social circles and their hierarchies associated to the underlying ego network's nodes (contacts). The resulting visualization does not only reveal the multiple hierarchal levels inside these social circles, but also keeps their non-mutually exclusive property at any hierarchical level. We built a tool, called **HiSoC-Vis (Hierarchical Social-Circles Visualizer)**, that provides multiple interaction and filtering options in order to make the resulting visualization more intuitive and customizable on demand.

2. Designing Social Circles Hierarchy

For a proof of concept, we use dataset collected from a Facebook app, developed by Mcauley and Leskovec [ML14]. They

anonymized the associated 26 features to protect the subjects' privacy. We added an appropriate hierarchy amongst these features (i.e., social circles in our context) and allocated randomly meaningful values to the associated features of each node. As a result, these 26 features were categorized into 6 primary or first-level features (i.e., the higher level of social circles in the hierarchy), where each of them has features as sub-categories (i.e., the second level of social circles in the hierarchy), and so on. It is important to note that features at any child category can be non-mutually exclusive, so they can have an overlapping of nodes' association to multiple features at any child-level category.

In our design, we use a Chord diagram to represent the underlying ego network, i.e., nodes as the contacts in this network and chords as the relations between these contacts. We propose to use arcs around this Chord diagram to represent the associated social circles to the underlying ego network (see Fig. 1). In order to show the hierarchy, we place the first-level (primary) social circles only on the first outer arc layer. The length of an arc (i.e., a social circle) represents the number of associated nodes to this social circle compared to other social circles at this level.

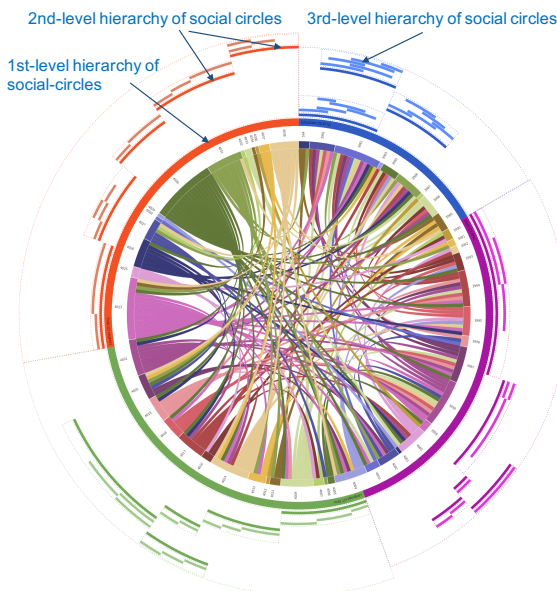


Figure 1: An ego network with 66 contacts, 415 relations between these contacts, 4 primary- and 18 secondary- social circles.

For the second-level social circles, we decided to place arcs, representing these social circles, towards the outer side of their parent social circles' arcs. The arc length at this level represents the number of associated nodes with this social circle. As we explained earlier, the child level (second and lower levels) social circles can be non-mutually exclusive with regard to their parent social circle; therefore, all child arcs are placed on top of each other further outside of their parent arc in order to show the overlapping. We place them on each other in a manner that the overlapping part of the arcs represent the number of associated nodes in two or more social circles. Intuitively, viewers can easily find out the overlapping between two or more than two social circles at the same level. Any

further hierarchy of social circles is also shown in the same manner as of second-level hierarchy. In this case, other sibling social circles of the parent social circle are placed after the hierarchy of this parent social circle. We apply this approach for any number of further levels in the hierarchy. A dotted boundary is used around the child social circles that come under the same parent social circles at all levels.

3. The HiSoC-Vis Tool

We built a web-based tool (called HiSoC-Vis), using JavaScript and D3.js library, to visualize an ego network and the associated hierarchical social circles according to our proposed design solution. HiSoC-Vis provides two options for visualizing and navigating social circles. The first one is to show all the social circles and their hierarchies at once (as in Fig. 1) while the second one is to navigate it on demand in order to show only the required social circles for a clean view. Mouse hovering over a social circle arc or node in the Chord diagram brings a tool tip showing all the necessary details, e.g., no. of associated nodes, child-level social circles, etc. When mouse hovering over a particular node (i.e., contact) in the Chord diagram (Fig. 2a) or a social circle arc (Fig. 2b), HiSoC-Vis greys out all non-associated nodes and social circles, while highlighting only the associated ones. In the case of mouse hovering a node, HiSoC-Vis also changes the colors of this node's relations according to the opposite nodes (Fig. 2a) to provide a clear view.

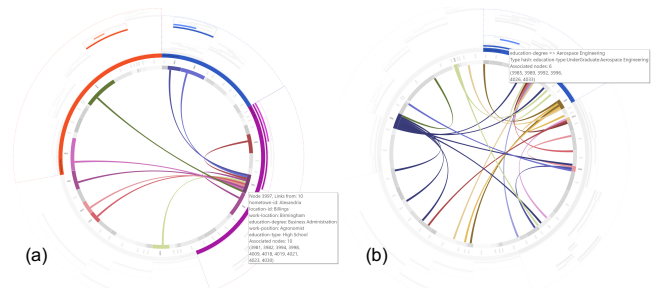


Figure 2: Resulting visualizations after mouse hovering (a) over a node and (b) over a social circle.

4. Conclusion and Future Work

In this work, we presented our intuitive design layout and a tool to visualize associated social circles of an ego network at different hierarchical levels while preserving their non-mutually exclusive property. Such interactive visualization not only helps individual person to explore the personal contacts and their behavior, but can also be useful for companies for marketing purposes as they can easily explore the associations of their followers to different social circles. This work can be used to extract hierarchy in dynamic networks in various domains like in bioinformatics (e.g., metabolic networks, protein-protein interaction, etc.) or in social sciences (e.g., airline routes, disease transmission networks, etc.). In the future, we plan to implement more interaction and filtering options in the tool and intend to see how we can use it in different domains to get benefits of our proposed layout.

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