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Reviews of 1029 - *"Multilayer Network Visualization"*

Reviewer 1 (coordinator)

Feedback

This STAR targets to report investigations regarding the multilayer Network Visualization topic.

I am not an expert of Multilayer network and I found this STAR interesting since it will gather and structure relevant information in this area.

Nevertheless, I have few concerns regarding this proposal:

-As far as I understand the sketch and the multilayer domain, the STAR will focus on this specific type of network. I fell that existing STAR (dynamic Network, multi faced network, Multivariate network) already covered a large area in this topic and that this specific multilayer network takes advantage of the combination of other type of these network type assets.

-My second concern regards the content on the STAR where the authors will focus on many application domains. This point is very important to help readers better understand the application domain and to choose adequate visualization and interaction technique devoted to multilayer network investigations. As mentioned by the author, the InfoVis community does not provide enough instance of application domains investigations with multilayer network. As such the authors will extend their investigation and will use existing classification (tasks based) to characterize this domain.

In conclusion, the authors are actual experts in the domain of Multilayer Network Visualization. They propose an interesting survey. I cannot give a top score for this survey since I still think that this specific domain already have other stars to consider where practitioner will find relevant information. This specific domain may not have enough new material (i.e. specificity) to deserve a dedicated STAR.

I know that I am not an expert and that my score will not affect the final evaluation of this STAR. I am simply concern that doing a STAR is a lot of work and it is best to

this STAR. I am simply concern that doing a STAR is a lot of work and it is best to maximize its outcomes.

Full STAR encouragement based on sketch

Discourage

Contribution:

Reasonable: Some valuable contribution in categorizing present literature

Scope (Relevance to the Event):

Core topic, fits well

References:

At large, all important references are included

Utility, Importance (Relevance in general)

Possibly

Presentation Quality:

Good: only minor typos and grammar problems

Rating

Probably reject: I would argue for rejecting this report.

Expertise

Passing Knowledge

The Review

This paper presents a review of multilayer network visualization for publication at Eurovis STAR 2018.

The structure of the paper is clear, while some typos remain, and strange sentence constructions exist, the document is easy to read and to understand.
The introduction clearly explains the notion of multilayer visualization and its different application domains. This STAR contains a lot a work and represents a very interesting process to review the current state of the art. I like the section explaining the systematic review of EuroVis, InfoVis and others conference papers.

The task analyst section provides a relevant abstraction level to understand how

multilayer network differs from standard network visualization. I would love to see an

expanded version of this section. In its current stage, I think that this section is too narrow and is too reduced to visualization linkage.
Is it possible to extend it with data type properties like temporal or geographical data semantic?

While the authors did a very nice job with work collection, this paper is too close to a nice overview and summary of existing technique and does not provide a structured overview of this research field. I am not an expert on multilayer Network Visualization, but I did not manage to retrieve the core advantages, and the justification of design choices to built and efficient multilayer network visualization system to improve existing activity. This is mainly du to my lack of expertise in this field but this paper did not manage to convince me with the usefulness of such technique compared to standard network visualizations.
For this reasons, I assessed this STAR as borderline.

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Overall recommendation primary after discussion (1st cycle)

Reject

Primary Summary Review of Discussion - 1st cycle

Scores summary : Borderline, Borderline, Accept, reject

Summary of pro/con:

The field is of interest and has not been covered by a survey recently.
Structure Issue: introduction and the network and multilayer definition
Lack of reader guide lines and field overview.

I think this paper needs of lot of work to be published. Its current structure must be improved (introduction, domain explanation…). The major issue regards the lack of read guide lines and an abstraction level to capture the structure of this emerging field. Currently the document is more a collection of existing techniques. This is more an extended version of the related work section than a STAR.

Overall Final recommendation primary (2nd cycle)

(blank)

Primary Review - 2nd cycle

(blank)

Reviewer 2 (committee member)

Feedback

The proposed survey on multi leayer networks is important to cover a growing field that will provide novel opportunities for research in visualization. The proposal is well structured and clear. It proposes a plan which seems good to provide an interesting and timely review of the state of the art in this domain.

Full STAR encouragement based on sketch

Strongly Encourage

Contribution:

Reasonable: Some valuable contribution in categorizing present literature

Scope (Relevance to the Event):

Core topic, fits well

References:

At large, all important references are included

Utility, Importance (Relevance in general)

Possibly

Presentation Quality:

Fair: some structural changes or some wordsmithing needed

Rating

Borderline: the strengths and weaknesses balance for this report.

Expertise

Knowledgeable

The Review

The paper is a survey on multilayer network visualization.

The field is of interest and has not been covered by a survey recently.

I have several concern with the structure.
The introducton starts too fast giving a lot of references without a proper definition of a network and a multilayer network. Formal definition comes later in section 2.1. At least notions of conceptual nodes represented as multiple nodes (one per layer) and edges between them in each layer, should be given at the very beginning and refer to it when using the Facebook/LinkedIn example. The list of reference apearing in the second paragraph should come in the Multilayer Network Visualization subsection.

The introduciton and the abstract come with the same sentence I did not understand even after reading the paper: "Usually networks are ... if the dataset is complete and independent". What means complete and independent? Why it would prevent a network to be visualized?

Figure 1 being part of the introduciton is supposed to depict a typical example of multilayer network but nothing is explained in the caption to understand the picture. Is it a good or bad example of multilayer network visualization? What does this visualization can tell us?

In section 2.1, a layer is dealt with without proper definition. I understand that layers can encode different kind of information depending on the domain, but they have a formal definition which is used by the authors in the sequel. So this formal definition should come first then come its interpretation in different domains: the discussion is about what a formal layer encodes in application domains or for different authors, but it is not about what a layer is. The formal definition would strongly benefit from an illustration.
Also seciton 2.1 would benefit from a summary table of the different sorts of multilayer networks.

3.2, when mentionning "R1, M1, A2" or "R5, R12", it should be refered to the original taxonomy and the meaning of these codes, or at least to the table 1 where they are explained.

3.3 what means "node layers" in the first paragraph?

Overall, the section 3.4 is descriptive but lack guidelines for the reader, missing a systematic pros and cons analysis.

4.1

(However) these aspectss of Lee et al...

Authors missing for ref [Cao1] FacetAtlas

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Reviewer 3 (committee member)

Feedback

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Full STAR encouragement based on sketch

(blank)

Contribution:

(blank)

Scope (Relevance to the Event):

Core topic, fits well

References:

At large, all important references are included

Utility, Importance (Relevance in general)

Possibly

Presentation Quality:

Good: only minor typos and grammar problems

Rating

Probably accept: I would argue for accepting this report.

Expertise

Passing Knowledge

The Review

This STAR surveys researches around multiplayer network/graph visualization. The

authors well describes the concepts and classified them using several categories

such as tasks, data definition, visualization approach, and interaction approach.
Overall I quite enjoyed this paper. There are some typos, which can be easily
corrected.
Some possible improvements are as follows:
* It is not so clear from the paper what is a 'layer'. Some concrete examples of layers
and its visualization may help readers understand the concept.
* Several example visualizations are cited in the paper, but a little bit more
representative visualizations are better to be cited in the paper.
* Some typos:
- 3.3. Second paragraph: Others systems -> Other systems
- 3.5. Last paragraph: ... equivalence, In their ... -> ... equivalence. In their ...?
...the heterogeneity of the data is derived form node types, ...
-> ... the heterogeneity of the data is derived from(?) node types, ...
- Both 'Section' and 'section' are used in the paper.

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Reviewer 4 (committee member)

Feedback

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Full STAR encouragement based on sketch

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Contribution:

Reasonable: Some valuable contribution in categorizing present literature

Scope (Relevance to the Event):

Peripheral, but of interest, somehow

References:

Some important references are missing

Utility, Importance (Relevance in general)

No

Presentation Quality:

Poor: major structural changes of extensive wordsmithing needed

Rating

Probably reject: I would argue for rejecting this report.

Expertise

Passing Knowledge

The Review

OVERALL
This work seems timely and useful. However, I'm not entirely sure whether it's quite ready to be complete. My major concern, across all of the paper, is that it seems largely targeted at people who are immersed in the problem and have already read most of the relevant sources. Descriptions largely seem targeted to point the reader to relevant papers, rather then to articulate the current state of the art. I would strongly encourage a version of this paper that was more aggressive about synthesis.

ON THE PREMISE OF THE PAPER
For context, while I have extensive experience with network data analytics and visualization, it's been a number of years since I worked in the area. Therefore, I was not initially familiar with the notion of layered networks. This paper does not define a multilayered network until the bottom of the second page, and then does it formally.

Informally, if I understand correctly, the notion is that it can be valuable to look at networks where the nodes can be characterized as being in a series of layers. This allows us to model a number of different otherwise-distinct notions: a "multimodal" network is now just a series of layers (each layer is a mode); as is a time-varying network. In both of them, the same nodes extend across different layers, and so there are within-layer edges that connect the graph, and between-layer edges that maintain node identity.

In contrast, a k-partite graph is now a series of layers where edges can ONLY cross between layers. And complex networks like authorship networks can include citation links between publications; authorship links between authors and publications; editorship networks, with within-layer and between-layer representations.

I go through this because I feel it's useful to articulate out precisely what we're talking about here -- and, to be honest, because I had some difficulty understanding it. (The very first definition talks about how it was already in Moreno … but was also introduced in KAB*14, and perhaps in the sociology of the 1990s.) The report uses the ideas of "inner" and "outer" layers in 2.1 before we know what a layer is. Before THAT, it's already explained that it's hard to visualize them.

To be honest, the section on "multilayer network vis" on page 2 made me scribble the words "if it doesn't work, why bother?" next to them. As a visualization researcher, I'm accustomed to identifying specific tasks -- lumping together many types of networks makes it harder to identify those tasks, and therefore makes the visualization tools more complex. The paper should present a compelling reason why it is valuable to add this complexity, besides the mathematical appeal.

Since the formalism wasn't introduced until 2014, I would expect this paper to need to dig deep into archives to explore how these different techniques have been used.

Based on this introduction, I'm also torn: do I expect the techniques in this paper to cover the *superset* of all the different things that multilayer networks can be used for , or does it address the *subset* that is limited to things that generally apply to all multilayer networks? Again, now, as a reader, I'm torn.

All this is to say: for people who are not experts in multilayer visualization, the introduction needs work to get them up to speed.

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SECTION 2.1-2.1.3
The paper now identifies several different specific forms of multilayer visualization. "Aspects" (and "Multiaspect") are informally defined -- and while the paper enjoys the minutia of different terminologies, I'm not sure I followed by a "mutliaspect" is like, or unlike, an aspect. (Despite the note about using terminology, the word "aspect" never shows again.)

The next three sections address three specific instances of layers: two of them are theoretical frameworks ("multivariate" and "n-partite"), while sandwiched in the middle is the visualization technique of rendering "faceted" graphs.

SECTION 2.2
The paper now proceeds to show a variety of different application domains, with examples of networks from a number of different application fields. I was not compelled by this section: I didn't feel that it clarified to me either in the use of these networks, or in the burning problems. The paper is forced to be too short to relax into any dataset, and so the descriptions wind up being very cryptic. ("In this specific case species type can be considered a defining aspect for a layer", for example, requires me to both understand the domain of biological pathways, the ways that layers work, and perhaps the particular paper.

The section on sociology is odd with its recency bias: the entire field of social network analvsis has, as the authors note, been plaving in this space since 1955, and have a

great many formalisms and structures. While I don't expect the paper to be thorough,

the choice of only looking at citations past 2010 seems odd. (A textbook reference to Wasserman and Faust, say, would be helpful.)

The section concludes--and perhaps this was the goal--that visualizaition is necessary for these many tasks. I don't think the paper really establishes that visualization is a necessary tool in these spaces.

SECTION 3

I'm a little surprised that the methodology is limited to the VIS and HCI communities. As the paper itself notes above, lots of fields have been playing with this problem, often unaware of each others' work. I am personally aware of work published in the Journal of Statistical Software [1], American Journal of Sociology [2], and Social Networks. There are also papers coming out of the systems biology work that the authors mention earlier. While I agree that the full range of communities is too broad for exhaustive coverage, this paper would do well to at least dip into the other fields and discuss them: as a reader, my goal is after all to learn about the state of the art.

[1]
Skye Bender-deMoll, Martina Morris, James Moody (2008)
"Prototype Packages for Managing and Animating Longitudinal Network Data:
dynamicnetwork and rSoNIA"
Journal of Statistical Software. Vol. 24, Issue 7.

[2]
Moody, McFarland, Bender-deMoll (2005)
"Dynamic Network Visualization"
American Journal of Sociology, volume 110 , pages 1206–1241

I was excited to see tasks. I was a little disappointed at the start-- a little disappointed to get a pointer to no less then five task-containing literature surveys, and then to have the paper skip past that. I really like the iconic figures in 3.2: they help understand and sort out the tasks nicely. For example, I have no idea what a "detangler" task is. I would like this paper to offer more synthesis.

The subsection on data definition was very difficult to read if I am not already immersed in the literature. It isn't obvious to me that MuxViz depends on KAB*14; I was not familiar with either of them until this paper.

SECTION 3.4
This section is much easier to read overall, perhaps because it is well-illustrated. I
still find it difficult to understand -- perhaps because I don't really understand the

tasks. (It took me a few rereads, for example, of the first paragraph in "circular

representations" to realize that each of these has a different underlying task: one paper tries to compare attributes of nodes across multiple layers, when nodes are either consistent across layers, or kept in a consistent order. Indeed, these are different enough that organizing them by the fact that they are all on circles seems an odd choice.

I'm not entirely sure what the criteria for a paper getting in or out of this section. NodeTrix is a delightful system and a clever idea -- but it is in no way multilayered. "Compound" graphs might well be layered --but the term is never defined.

OVERALL
It is challenging to give a state of the art in a new domain: the reader may not be familiar enough with the domain to make real progress in it, and a lot of introductory work is needed to establish the relevant tasks and important areas. This paper seems to have a solid collection of work, but I don't yet understand how to put all the pieces together.

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MINOR ISSUES: it's a cheap shot to show a bad network visualization (Figure 1). It's not clear to me that the visualization is bad because it's a multi-layer network; it's bad because the creator had no idea what task they wanted to fulfill except to say "look, big network!". (See under: everything ever called a "map of the internet")

Section 3.2: Task set (C) doesn't seem to be quite the same type as the others: is the underlying task itself manipulating the layers? Or is it something else, that requires layer manipulation to get to?

Section 3.4: Again, I'm not in the heads of the authors. I don't necessarily know what Mac86 is, and so don't know what 'weaker visual cues' are.

Table 1 seems to have surprisingly few entries in it. Four tasks, and thirteen systems. It feels like the rest of the paper has discussed far more then this -- is this all there is?

Figure 3: Do "axes" correspond to layers here? I don't know enough about the problem or tasks to make sense of the figure.

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