

Propagation and aggregation of opinions in Structural Graphs

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■ Problem Definition

■ LP System

- ▶ Framework
- ▶ Layer Cake

■ LPrep Module

- ▶ For Research
- ▶ For Researchers
- ▶ For Other Entities
- ▶ Applications

■ Conclusion

Problems with current publication paradigm



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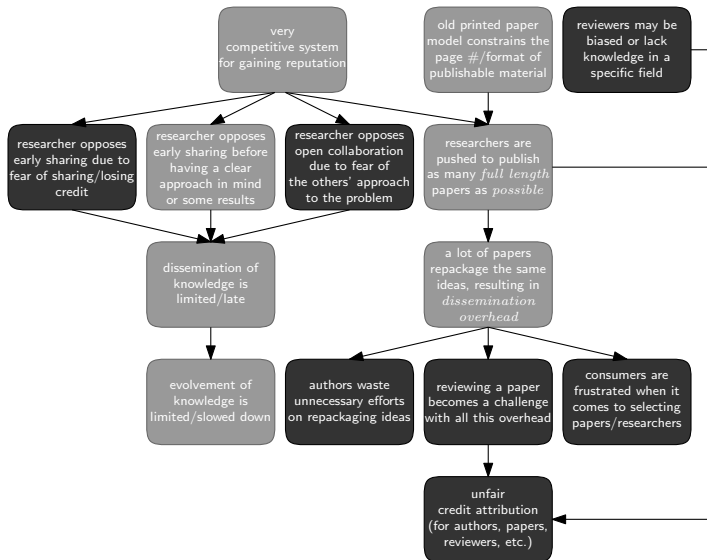
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What we plan to focus on



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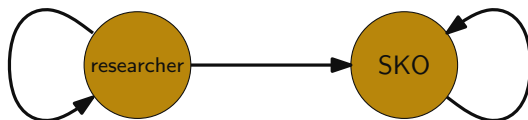
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Architectural Model



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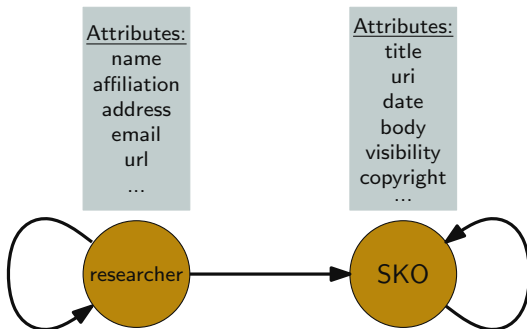
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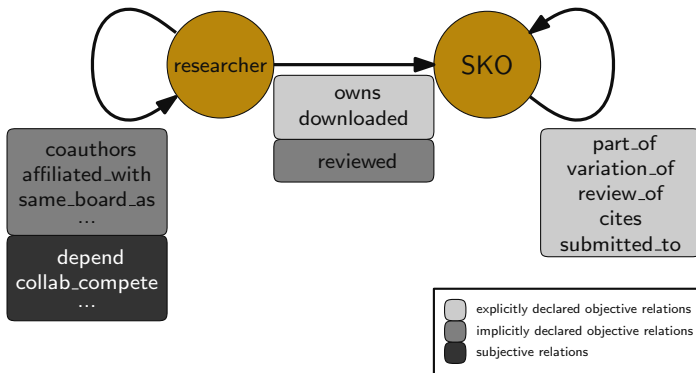
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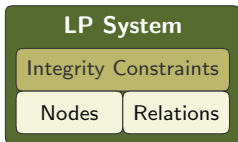
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LP Layer Cake



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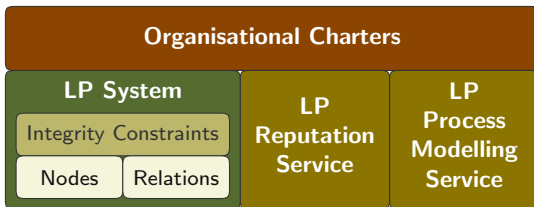
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LP Layer Cake



This layering allows the user to create complex processes for creating, sharing, and publishing to knowledge objects; it also allows the user to calculate personalised reputation measures of varied complexities/applications.

The system imposes minimal (integrity) constraints on how to create, share, and publish knowledge objects; allowing these processes to easily evolve with time, as needed.

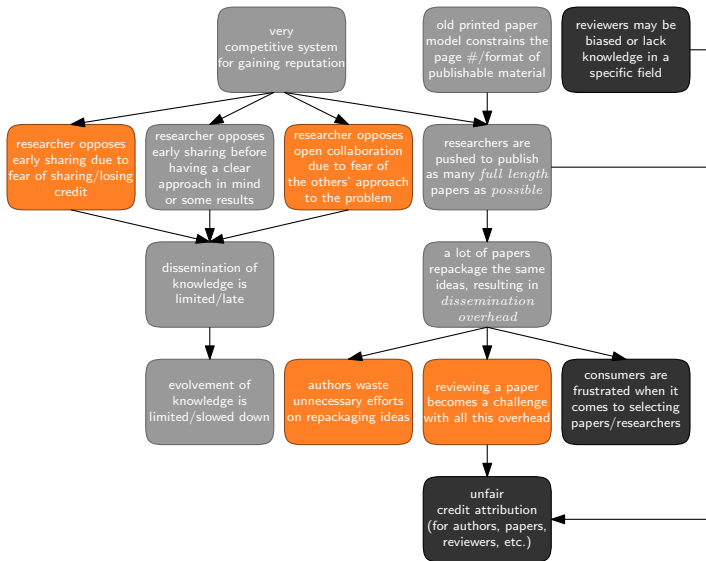
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What issues does this framework solve?



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Reputation of an SKO

Reputation of a SKO is based on opinions & citations:

$$SKOrep(n) = Crep(n)^{\gamma_1} \cdot Orep(n)^{\gamma_2} \quad (1)$$

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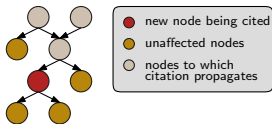
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Citation Based Reputation

We consider citations to propagate upwards in a graph.



Algorithm 1 Propagation of the citation of SKO node n_2

```
if record(cites( $n_1, n_2$ )) then
   $\mathcal{N} = \{x \mid \textit{compiles}(x, n_2)\}$ 
   $\mathcal{N}_i = \emptyset$ 
   $d = \zeta$ 
  while  $\mathcal{N} \neq \emptyset \wedge d > 0$  do
    for  $n_i \in \mathcal{N}$  do
      if cites( $n_1, n_i$ )  $\notin \mathcal{C}$  then
         $\mathcal{C} = \mathcal{C} \cup \{\textit{cites}(n_1, n_i)\}$ 
         $\mathcal{N}_i = \mathcal{N}_i \cup \{n_i\}$ 
      end if
    end for
     $\mathcal{N} = \{x \mid \forall n_i \in \mathcal{N}_i \cdot \textit{compiles}(x, n_i)\}$ 
     $\mathcal{N}_i = \emptyset$ 
     $d = d - 1$ 
  end while
end if
```

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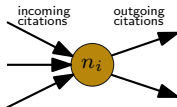
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Citation Based Reputation

Instead of simply counting the number of citations a node has, a ranking algorithm may be used to describe the importance (or degree of authority) a node has by analysing which nodes links to which other.

The rank of node n_i is the aggregation of the rank of the nodes linking to n_i . Similarly, the rank of n_i will flow to those nodes n_i links to, or cites.



PageRank is based on this idea:

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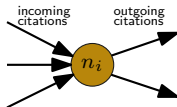
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The rank of node n_i is the aggregation of the rank of the nodes linking to n_i . Similarly, the rank of n_i will flow to those nodes n_j links to, or cites.



PageRank is based on this idea:

$$PR(n) = \frac{1 - d}{N} + d \sum_{\forall n_i \in M(n)} \frac{PR(n_i)}{L(n_i)}$$

where, $M(n)$ is the set of nodes linking to n ,
 $L(n_i)$ is the number of outbound links on node n_i ,
 N is the total number of nodes, and
 d is the damping factor.

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Opinion Based Reputation

Opinin Definition: $opinion(\alpha, n, pd, c)$

where, α is the reviewer,

n is the SKO node being reviewed,

pd is a probability distribution describing α 's opinion in n ,

and c describes α 'a confidence in its opinion.

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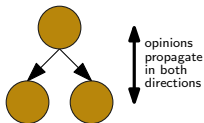
where, α is the reviewer,

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pd is a probability distribution describing α 's opinion in n ,

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We believe opinions propagate up & down a graph.



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Opinion Based Reputation

Opinion based reputation is then calculated from the probability distribution \mathbb{P} that takes into account the propagation and aggregation of opinions:

$$\mathbb{P}(n) = \mathbb{P}_{assigned}(n)^{\xi_1} \cdot \mathbb{P}_{inferred}(n)^{\xi_2} \quad (2)$$

$$\mathbb{P}_{assigned}(n) = \kappa \cdot \sum_{\forall opinion_a(\alpha, n, pd, c) \in O} r(\alpha, n) \cdot c \cdot pd \quad (3)$$

$$\mathbb{P}_{inferred}(n) = \kappa' \cdot \sum_{\forall opinion_i(\alpha, n, pd, c) \in O} r(\alpha, n) \cdot pd \quad (4)$$

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How is $r(\alpha, n)$ calculated?

How are inferred opinions ($opinion_i(\alpha, n, pd, c)$) calculated?

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How is $r(\alpha, n)$ calculated? (see next)

How are inferred opinions ($opinion_i(\alpha, n, pd, c)$) calculated?

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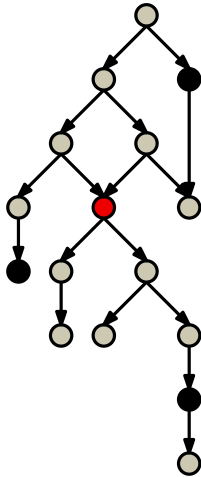
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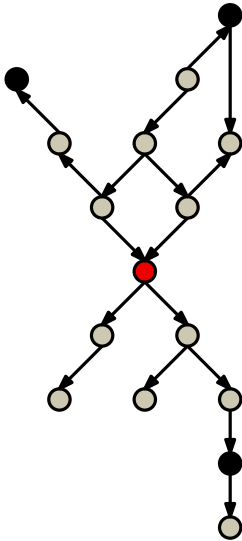
Propagation of Opinions



- a node with an assigned opinion
- a node with an inferred opinion
- a node with a newly assigned opinion

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The graph is analysed by viewing the red node to be at its centre.

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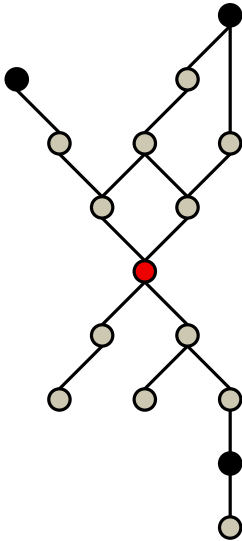
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Propagation of Opinions



Since opinions propagate both upwards & downwards, then the direction of the links no longer matter.

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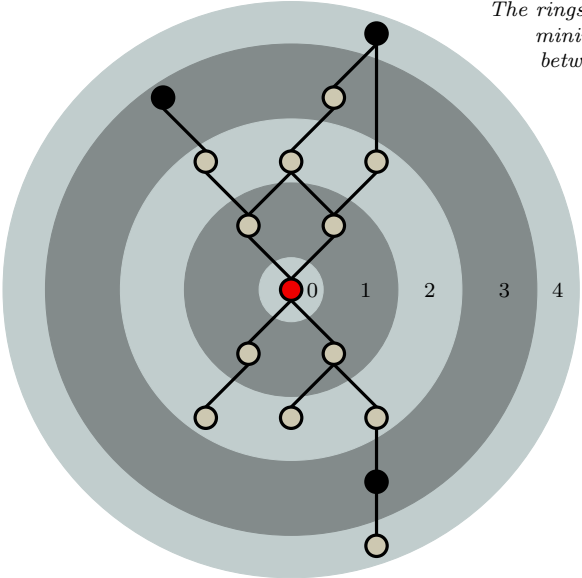
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Propagation of Opinions



The rings illustrate the minimum distance between any given node and the central one.

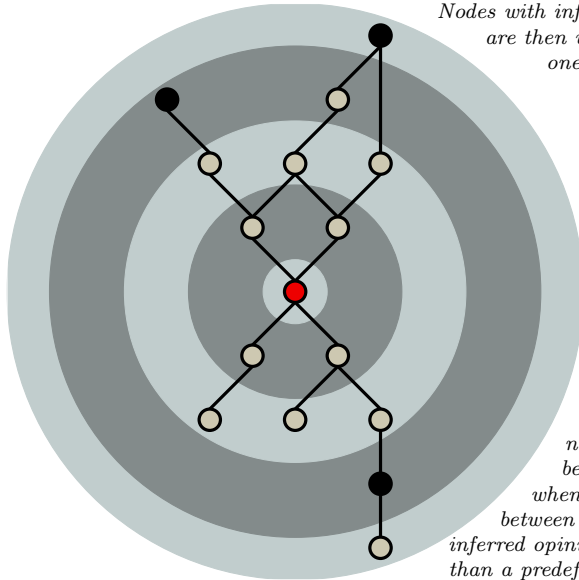
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Propagation of Opinions



Nodes with inferred opinions are then updated one by one, starting with those with the least distance from the central node.

The update stops either when no more neighbours have been updated, or when the difference between the old & new inferred opinions is smaller than a predefined threshold.

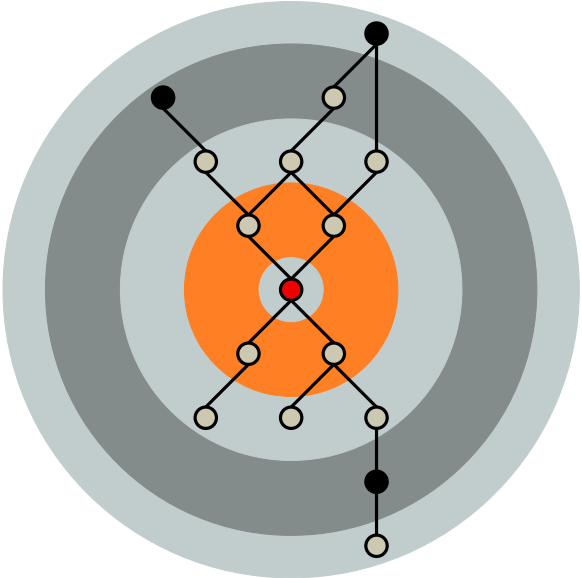
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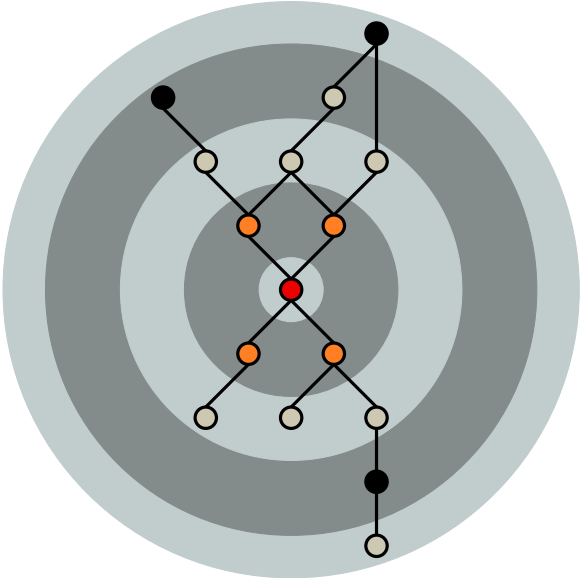
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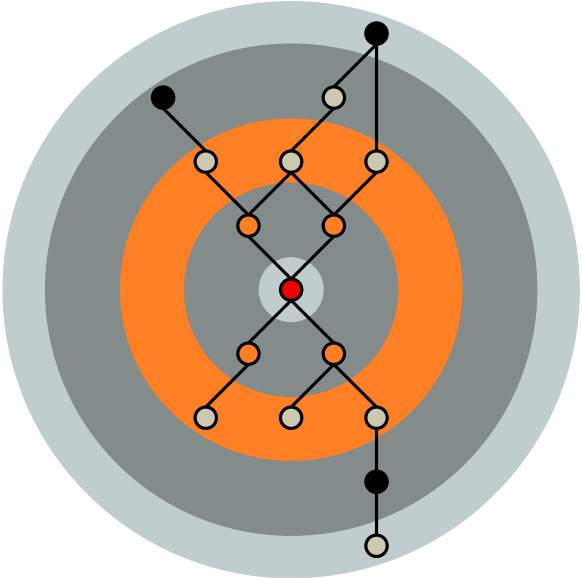
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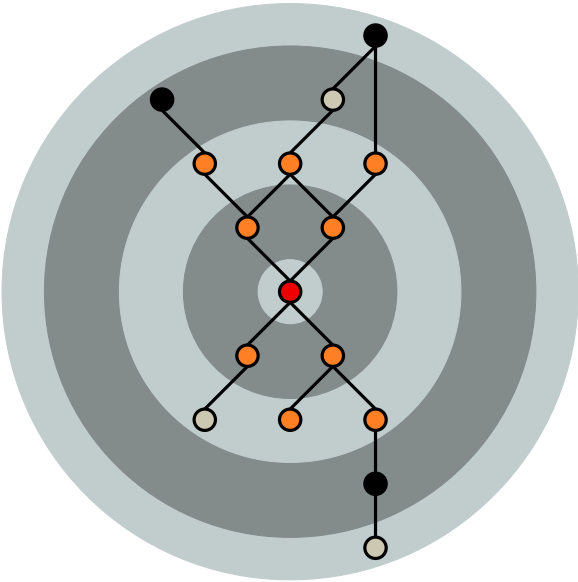
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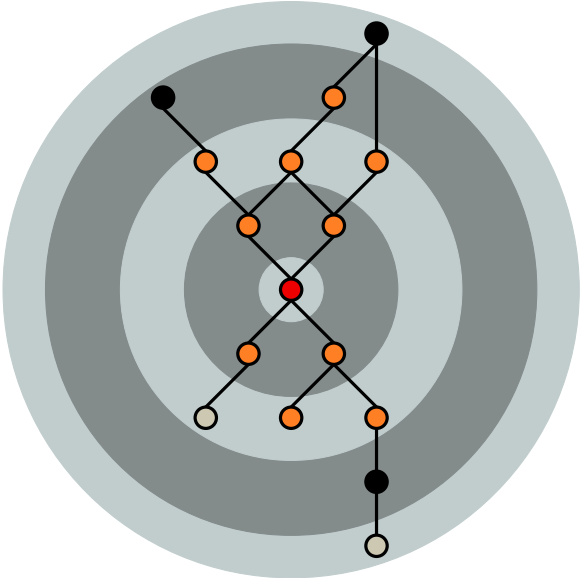
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Reputation of Authors

A researcher's reputation is dependent on the role.
It may be affected by:

- ▶ author
- ▶ reviewer
- ▶ future collaborator
- ▶ invited speaker
- ▶ ...

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A researcher's reputation is dependent on the role.
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 - ▶ h-index based measures *
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- ▶ reviewer
 - ▶ history of bias
 - ▶ history of being right
 - ▶ history of being stubborn
 - ▶ reviewer's social relations with others helps highlight possible dependency in opinion, and collaborative/competitive behaviour
 - ▶ effect of the social network on the researcher's opinion
- ▶ future collaborator
- ▶ invited speaker
- ▶ ...

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 - ▶ reviewer's social relations with others helps highlight possible dependency in opinion, and collaborative/competitive behaviour
 - ▶ effect of the social network on the researcher's opinion
 - ▶ the opinions of the reviewer's neighbours
 - ▶ the interconnectivity parameter of the social network
 - ▶ pinpointing the group leader
- ▶ future collaborator
- ▶ invited speaker
- ▶ ...

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- ▶ invited speaker
 - ▶ the measure of interest of a person's research
- ▶ ...

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Of course, many roles share common points!

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Reputation of Authors

Numerous methods may be followed when considering an author's citation based reputation:

Citation count: $\sum_{i=1}^n c_i$, where c is the citation's count

Average citations per paper: $\frac{1}{n} \sum_{i=1}^n c_i$, where c is the citation's count

h -index: Given a set of papers ranked in decreasing order of the number of citations that they received, the h -index is the number h such that each of the top h papers have received at least h citations while the remaining papers have received at most h citations.

g -index: Given a set of papers ranked in decreasing order of the number of citations that they received, the g -index is the (unique) largest number such that the top g papers received (together) at least g^2 citations.

m -index: $\frac{h}{y}$, where h is the h -index, and y is the number of years since publishing the first paper

a -index: $\frac{1}{h} \sum_{j=1}^h c_j$, where h is the h -index, and c the citations count

...

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Reputation of Other Knowledge Entities

- ▶ a conference
- ▶ a publisher
- ▶ a library
- ▶ ...

These are usually computed based on the reputation of SKOs they include, publish, archive, etc.

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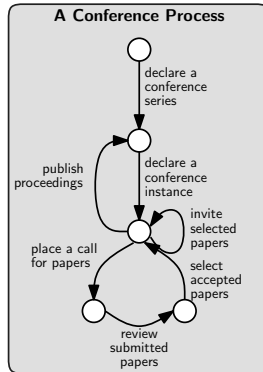
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Useful Applications

- ▶ finding an appropriate future collaborator
- ▶ fishing for new SKOs for a given conference
- ▶ deciding how many SKOs per field to accept (based on a minimum accepted quality)
- ▶ finding reputable PC members / reviewers
- ▶ deciding who to review an SKO
- ▶ deciding how many reviewers per SKO are needed
- ▶ aggregating reviewers results
- ▶ ...



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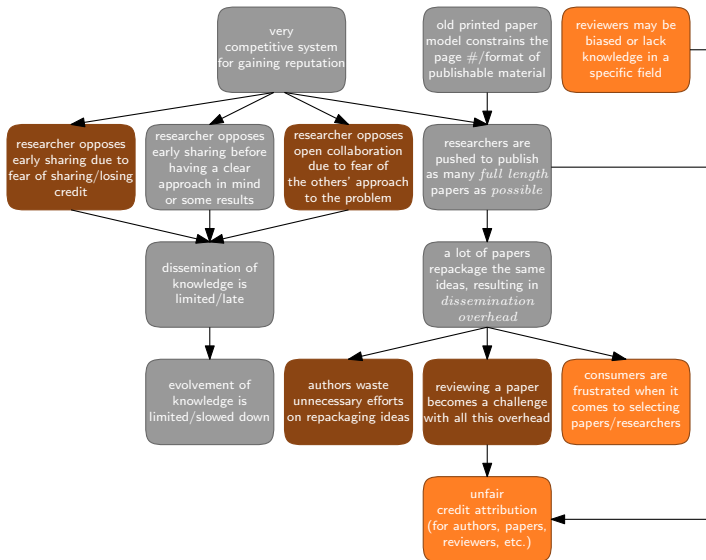
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What issues does the LPrep module solve?



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For Further Information:

<http://project.liquidpub.org/>

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