

## Common vocabulary of social participation: a brief inspection with preliminary expansions and short-term prevision

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Participatory democracy advances in virtually all governments. South America presents a prominent context with a very mixed culture and social predisposition. At 2012, civil, academic and governmental parties started elaborating the “Common Vocabulary for Social Participation”, as a public and online process. By May, 2013, first reference documents were online, together with the first OWL code of the vocabulary, logos for it, and a diagram of a general “public consultation”. To ease this process, the Corais platform was used, which kept online record of the process, like discussions and elaboration of texts. This article exposes this material and proposes elementary OWL uncoilings: first, expansion of the vocabulary is explored both by associating upper ontologies and by further specifying classes (upwards and downwards). Second, a preliminary OWL implementation of the consultation diagram is exposed. Further work involves association with social participation federal portal from Brazil, expansion to a more structured participation artifact, and careful study of BFO usage as an upper ontology.

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### I. INTRODUCTION

Easy access to social media is reshaping citizen participation in government affairs<sup>1</sup>. Information and communication technologies (ICTs) has exhibited such an impact on the ways individuals interacts, that new social artifacts is given place to, like Brazilian “V for Vinegar” 2013 protests and Arab springs. Worthy of redundancy: these events gathered millions of people; although recent, they already had direct and strong impact in governments and current laws; the forecast is an intensification of the process.

Concomitantly, electronic government initiatives are flourishing, favored mainly by ubiquity of Internet technology, maturing of it (e.g. Web 2.0, excellent open source technologies, etc.) and a need for renovation of current (representative) democracy. This has taken place in various platforms, including usual social networks (SN) such as Facebook, and dedicated clients conceived by both government and civil society.

A natural challenge arises: how to link all produced information into a knowledge base. This is being addressed at its core by web semantic developments, most notably the Web Ontology Language (OWL). Second version of the language, from 2009 and called OWL 2, allows not only queries and retrieval of data, but also writing into database. Endorsed by World Wide Web Consortium (W3C), current achievements include:

- reasoning by means of ontological specifications,
- linking data from different sources (e.g. databases),
- organization of a domain knowledge for clarifications and coherent consideration.

In this context, the “Common Vocabulary for Social Participation” is being proposed as an academic, civil society and governmental joint effort. Although started in 2012, a very recent initiative for these matters, it already yields relevant material. These include a public preliminary OWL file with a concise taxonomy. Also prominent are the reference documents reporting a first working phase, from July to December, 2012. As stated by the community, the initiative was propelled by three pillars: 1) to ease adoption of the vocabulary; 2) to stimulate the creation of public tools to understand, by visual-

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izations and summaries, how is participation happening; 3) to meet the need of participative initiatives to open and link their data.

Next section is dedicated to initial inspection of this vocabulary and related documents. Section III describes immediate expansions of current vocabulary. Final remarks are stated with future work, in section IV.

## II. COMMON VOCABULARY OF SOCIAL PARTICIPATION

From April to December, 2012, the Common Vocabulary of social participation was first conceived. In the process, 66 users interacted, 6 of them interacted the most<sup>2</sup>. Various materials were produced both as activity traces and as reference media. This section is dedicated to these materials.

### A. Reference documents

Main documents are:

- “Methodology commented and published”<sup>2</sup>: this document describes the public process of vocabulary conception. It is composed by brief inspections of forum topics, pointing both pertinent characteristics of the online collective process and OWL classes observations. Consideration about the Open Government Partnership and Brazilian related formal action plan take place by means to achieve usage of the ontology. There is also a proposal for mapping electronic government and related initiatives, so that the common vocabulary might be better contextualized. This writing ends by proposing an agenda of meetings with academics, entrepreneurs and governmental parties.
- “Conceptual modeling published! Version 0.1 in natural language”<sup>3</sup>: this document is a description, in ordinary English, of the OWL vocabulary. The introduction is mainly a collage of the document just described<sup>2</sup>. Both the itemized description of the vocabulary, and the considerations of its usage, are of great value as reference. Figures 4 and 5 are also associated with this document, and are further described in the next section for simplicity.

OWL code, although plain text, is presented in a dedicated subsection (IIC below).

### B. Images

There are various images associated to the vocabulary development, most notably in<sup>4</sup>. Already in use are:

- various proposals for the Common Vocabulary of Social Participation logo, such as figures 1, 2 and 3.

- Both diagram representations of the vocabulary, figures 4 and 5.
- A general model for public consultations. An OWL implementation of this model is described at section III E, while figure 6 has the diagram itself.

<VocabParticipa/>

FIG. 1. One of the various logos for the Common Vocabulary of Social Participation. See figures 2 and 3 for variants and more information.



FIG. 2. A figurative logo for the Common Vocabulary of Social Participation. There are dozens of variants of this logo, black and white, RGBY colored, mixed with text, etc. See figure 1 for a textual proposal, and figure 3 for a mixture.

Vocabulario Común  
de la Participación

FIG. 3. A logo with text and figure, a mixture of logos in figures 1 and 2.

### C. OWL

The OWL code of the common vocabulary for social participation is in Appendix A. A diagram representation of this vocabulary is presented in figure 7.

First, it is important to notice that current OWL code does not contain all relations of figures 4 and 5. Current documentation points that this is both because the vocabulary is in its early beginnings, and to ease generality for the time being. This is directly addressed in section III, which implements all relations and corrects the declaration of existential restrictions. The ontology is then expanded both downwards and upwards.

### D. Blog

The blog aggregates both important discussions and documents in no more than twenty posts to date. The first post was in July 24, 2012. Last post dates from May 7, 2013. Most blog posts from the first day (almost

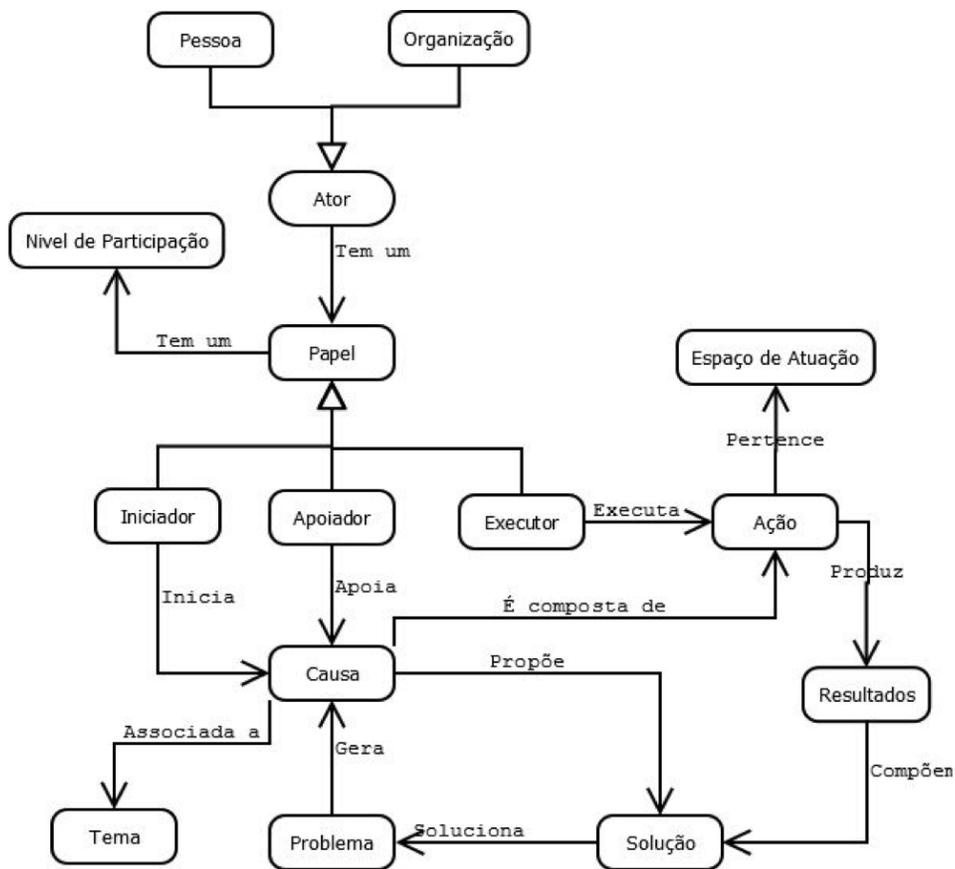


FIG. 4. Diagram representation of Common Vocabulary of Social Participation.

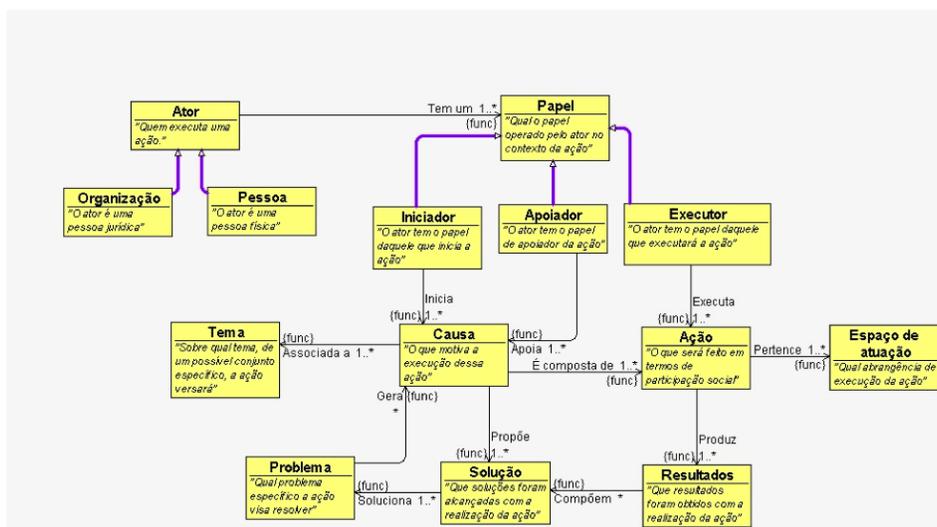


FIG. 5. The same diagram of figure 4, different markings for subclass relations (“is\_a” relations in purple) and properties (ordinary arrows) representation of Common Vocabulary of Social Participation. Also, a brief description of each class is exhibited as found in the `rdfs:comment` of each class.

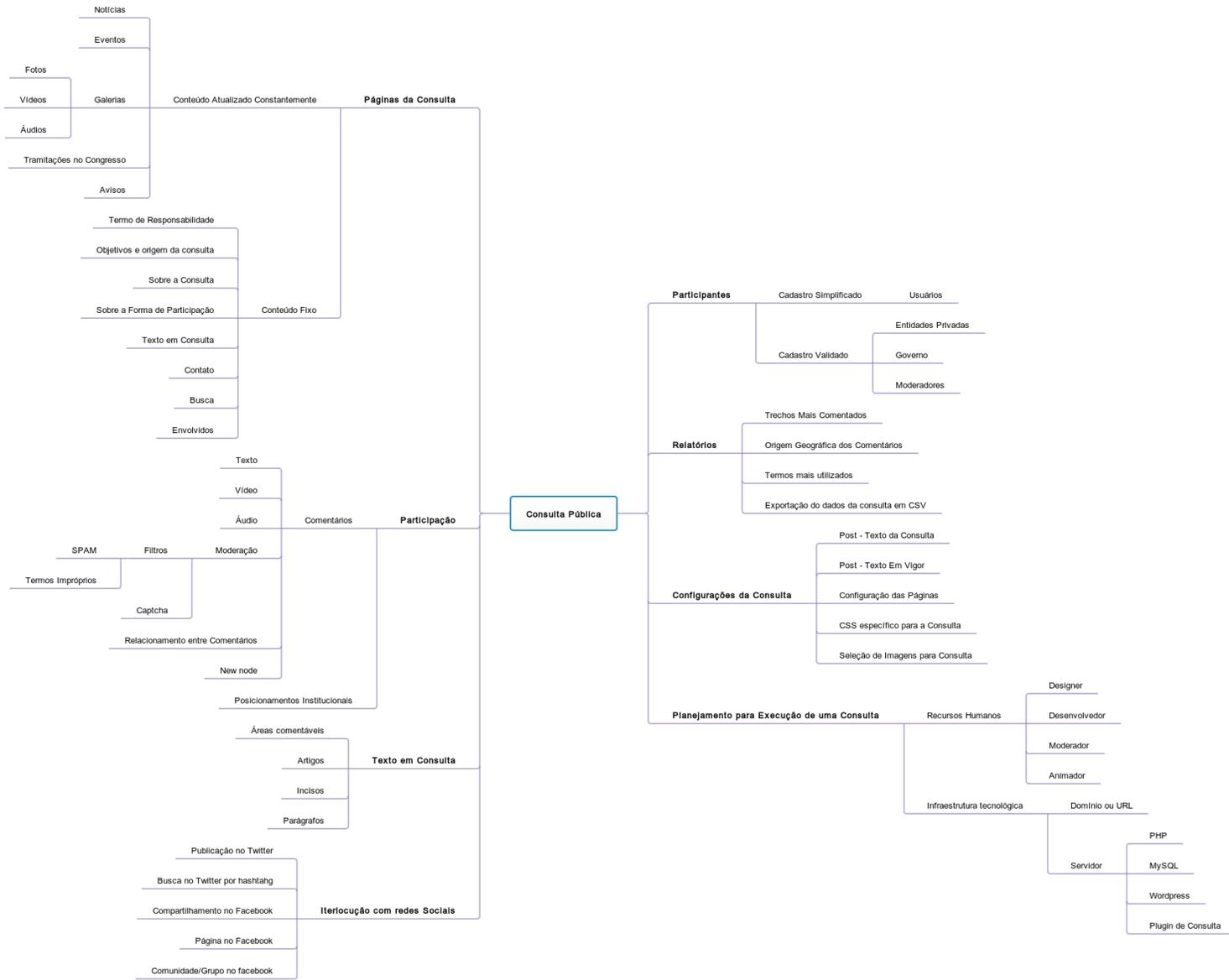


FIG. 6. A diagram representation of a general public consultation. The OWL implementation of this model is in subsection III E.

half of them) received more than twenty commentaries. Two “out-of-season” blog posts, one in August 9, 2012 and the other in October 22, 2012, both with about ten commentaries, separate first day posts from last posts.

All OWL code, final documents, public consultation mental map and images; these are all posted in the blog<sup>5</sup>. Last day posts occurred as a few days burst and a final message, a month after.

### E. Discussions and etherpads

There are numerous commentaries in the blogs, in which thus collective elaboration was registered. Besides that, four etherpads were written<sup>6</sup>:

- important words pad.
- A pad dedicated to second phase of the common vocabulary elaboration.
- A pad for the process documentation that became the first document described in subsection II A.
- For both vocabulary specification and for “questions not addressed to in the webinar”, the last pad.

### III. OWL EXPANSIONS

This section exhibits four expansions of current Common Vocabulary of Social Participation: properties

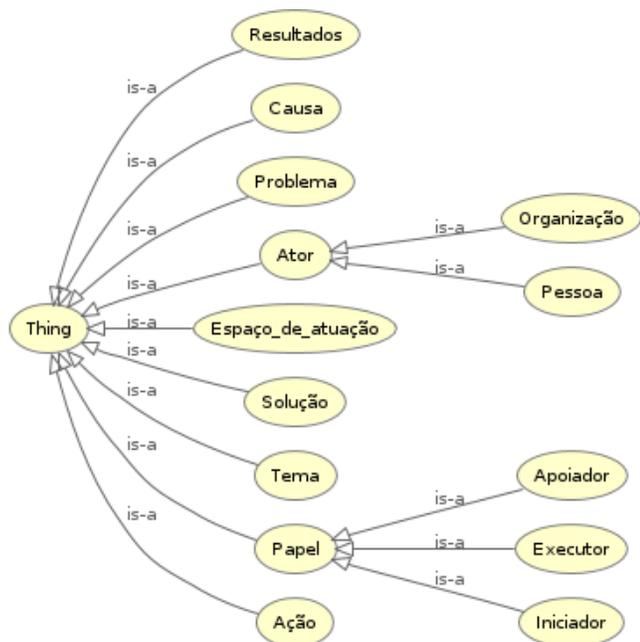


FIG. 7. A taxonomic diagram of the Common Vocabulary of Common Participation. This image was rendered inside Protege, with the OWL code in Appendix A.

present in figures 4 and 5 but not in current vocabulary, are implemented in subsection III B. Elementary further specification of subclasses is implemented in subsection III C. Consideration of upper ontologies is at subsection III D. Finally, the public consultation model exemplified in figure 6 is implemented in OWL as an expansion of the vocabulary to comprehend another ontology. First step, though, is standardization of labels and understanding of current implemented and unimplemented classes, properties and restrictions.

#### A. Standardization of labels and identification of implemented features

Labels in the languages of interest should be written in label fields. Even so, class names can be friendly to (potential) users, bearing the attention to not take the class name as the label or as a meaning restriction.

For standardization, all classes were written in Camel-Case and without accents. These class names changed:

- Espaço de ação → EspacoDeAcao
- Ação → Acao
- Solução → Solucao

while all other classes remained the same: Ator, Causa, Papel, Apoiador, Executor, Iniciador, Problema, Resultados, Tema.

Properties were a little more troublesome, as they all were to fit headlessCamelCase format, and their namings were far too generic to be helpful:

- Associada\_a → possuiTemaAssociado
- Tem\_um → temPapel
- Apoia → apoiaCausa
- Compõem → compoeSolucao
- Executa → executaAcao
- Gera → geraCausa
- Inicia → iniciaCausa
- Pertence → pertenceAoEspaco
- Soluciona → soluciona
- É\_composta\_de → possuiAcao
- Produz → produzResultado
- Propõe → propoeSolucao

A comparison of the OWL code (Appendix A), with the diagrams of figures 4 and 5, revealed that the following classes were not implemented:

- “Nível de Participação”, named NivelDeParticipacao in this article.

Also, these properties are not implemented:

- “Tem um”, with domain Papel and range NivelDeParticipacao. Named temNivelDeParticipacao.
- “Compõem”, with domain Resultados and range Solução. Named fazemParte.

Three restrictions are unimplemented:

- Papel temNivelDeParticipacao some NivelDeParticipacao. Both the predicate class and the property are not implemented.
- Resultados fazemParte some Solucao. Both classes are implemented, but property is not.
- Problema geraCausa only Causa. Although the property exists with correct domain and range, this restriction is found unimplemented. It seems to be the only universal restriction currently on the vocabulary.

The following restriction were found implemented:

- Ator temPapel some Papel
- Executor executaAcao some Acao
- Acao pertenceAoEspaco some EspadoDeAcao
- Acao produzResultado some Resultado

- Solucao soluciona some Problema
- Causa possuiTemaAssociado some Tema
- Causa possuiAcao some Acao
- Apoiador apoiaCausa some Causa
- Iniciador iniciaCausa some Causa

The same ontology published in March 4, 2013, but with these standardized names, is available online<sup>7</sup>, and might be considered version 0.11 of the vocabulary.

## B. Implementation of already documented classes and properties

Along with standardization of labels, the missing class, the two missing properties and the three missing restrictions were implemented. The resulting diagram of the taxonomy is exposed in figure 8. On top of the 0.1 version of the vocabulary:

- The class NivelDeParticipacao was created, as a subclass of Thing.
- These two properties were specified:
  - fazemParte, with domain Resultados and range Solucao.
  - temNivelDeParticipacao, with domain Papel and range NiveldeParticipacao.
- Three missing restrictions were applied:
  - Papel temNivelDeParticipacao some NivelDeParticipacao.
  - Resultados fazemParte some Solucao.
  - Problema geraCausa only Causa.

Existential restrictions were found incorrectly written as “min 1”. These changed to standard “some” existential restriction. The resulting OWL is available online as text<sup>8</sup> and uploaded in Stanford’s instance of Webprotege<sup>9</sup>. This might be understood as version 1.2 of the vocabulary.

## C. Common vocabulary downwards expansion

To this point, the vocabulary is complete to the point matured by the initiative online documentation. It is reasonable to assume that no unprecedented consensus was reached. Therefore, further polishing of the ontology should wait feedback and unroll of community processes.

Even so, this vocabulary, an initial ontology, lacks clearly foreseen subclasses and uses. As an example, yet another instance of the ontology is uploaded to Webprotege, in which some newly created classes and properties are exhibited<sup>10</sup>. These are:

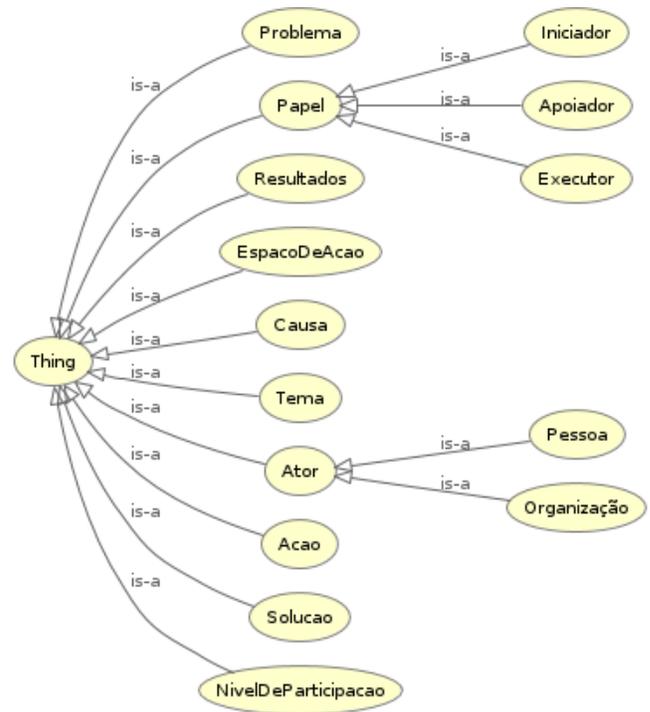


FIG. 8. A taxonomic diagram of the Vocabulary of Common Participation version 1.2. This image was rendered inside Protege, OWL code in Appendix A.

- The Organization subclasses:
  - Network, with subclasses:
    - \* FreeScaleNetwork, disjoint with:
    - \* UniformlyRandomNetwork, also both disjoint with:
    - \* GeographicNetwork.
    - \* SmallWorldNetwork. Not disjoint with any of the three previous network classes.
  - InformalOrganization, disjoint with Institution, with subclass:
    - \* Mob, with subclasses:
      - GiantMob (with mode than 10,000 Pessoa)
      - DownloadedMob (convoked by a Network)
  - Institution, disjoint with InformalOrganization, has subclasses:
    - \* PublicInstitution, disjoint with:
    - \* PrivateInstitution.
    - \* AcademicInstitution
    - \* NGO
    - \* SpuriousInstitution
    - \* ExoticInstitution

Also, to Executor, two subclasses were defined:

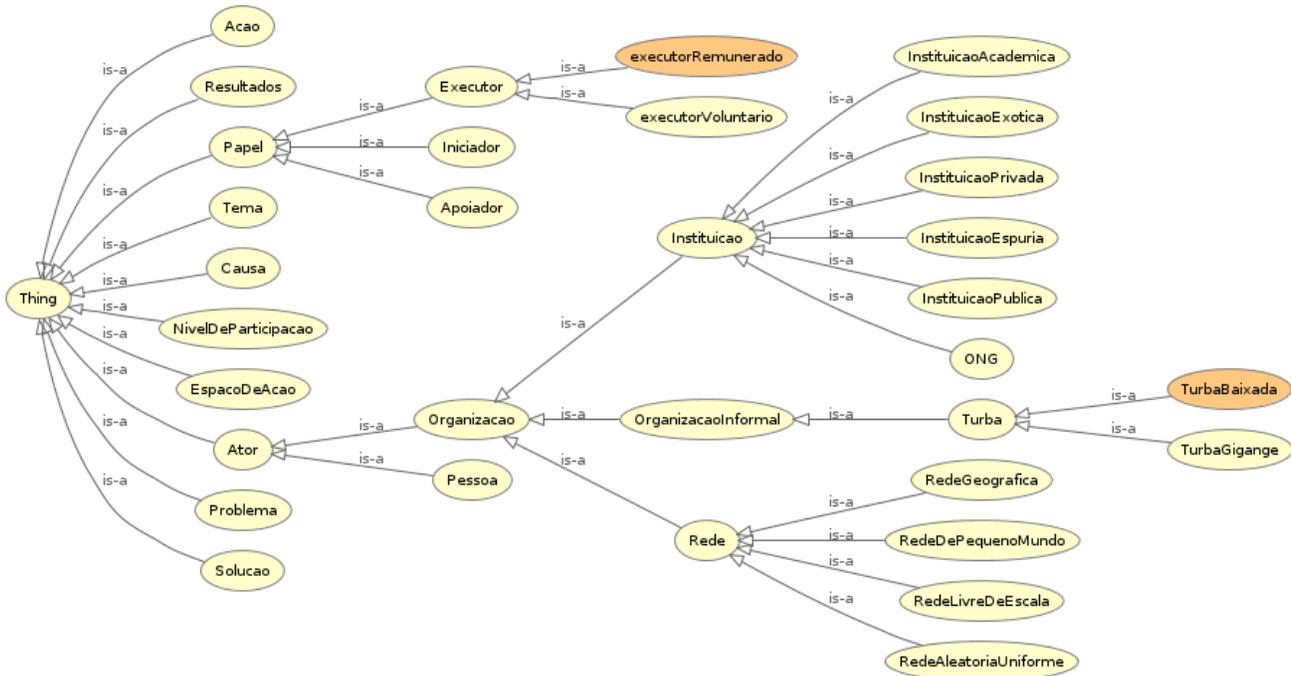


FIG. 9. An expanded Vocabulary of Common Participation taxonomic diagram. OWL code online for live editing<sup>10</sup>.

- VoluntaryExecutor, disjoint with:
- PaidExecutor, a defined class by the necessary and sufficient condition of being the subject of a relation recebeDe, which has Ator class as range.

The property “recebeDe” has an inverse: Ator “pagaPara” Executor. Also, the DownloadedMood class a defined class by the restricton: Mob convokedBy Network.

#### D. Upper ontologies and domain ontologies considered

There are, at first, a minimum of three considerations for upper ontologies:

- BFO → the Basic Formal Ontology is oriented to scientific use of data, which is very confluent with brazilian hackers approximation.
- DBpedia → “a crowd-sourced community effort to extract structured information from Wikipedia”. Convenient for bootstrapping the vocabulary to out-of-domain knowledge.
- W3C recommendations for open-government, as these are product of dedicated work of specialized groups, and are taken in high account by web semantics community.

Examples of using upper ontologies is under development and should be available in a dedicated work, as possibilities should be inspected carefully.

#### E. Public consultation

An OWL implementation of the public consultation should be made public, in the model given by diagram in figure 6. Considerations of this public consultation in respect to the Common Vocabulary of Social Participation should be addressed as well.

This implementation should also receive dedicated attention and is observed here for completeness of exposition.

#### IV. CONCLUDING REMARKS AND FUTURE WORK

The Common Vocabulary of Social Participation has already given a substantial step in achieving a social participation ontology: the community has registered activities and delivered reference documents. If on one hand such a vocabulary is difficult to be obtained in short term, in the other there already is a precedent in which deeper observations can take place. This “vocabulary” is being called so because it started with that name. Ideed, it is an *ontology*, with relations among defined classes that goes beyond taxonomic structure.

Subsections III D and III E have expansion directions for the ontology, as to upper ontologies and pertinent related ontologies. Future work involves careful consideration of Basic Formal Ontology usage, to enhance linking participation data to scientific research. Also, further detailing more subclasses should be carefully modeled for different instances, by different parties. On the practical side,

using this ontology or related developments for Brazilian federal participation portal is a very desirable possibility, as it implies usage and good maintainance.

## ACKNOWLEDGMENTS

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## Appendix A: OWL code of the Common Vocabulary of Common Participation

```

1 Prefix(XMLSchema:=<http://www.w3.org/2001/XMLSchema#>)
2 Prefix(xml:=<http://www.w3.org/XML/1998/namespace>)
3 Prefix(owl:=<http://www.w3.org/2002/07/owl#>)
4 Prefix(rdfs:=<http://www.w3.org/2000/01/rdf-schema#>)
5 Prefix(Corais:=<http://lumii.lv/ontologies/Corais.owl#>)
6 Prefix(xsd:=<http://www.w3.org/2001/XMLSchema#>)
7 Prefix(owl2xml:=<http://www.w3.org/2006/12/owl2-xml#>)
8 Prefix(rdf:=<http://www.w3.org/1999/02/22-rdf-syntax-ns#>)
9 Prefix(owlFields:=<http://owlgred.lumii.lv/_plugins/fields/2011/1.0/owlgred#>)
10 Ontology(<http://lumii.lv/ontologies/Corais.owl>)
11 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Ator>))
12 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Ator> "Quem executa uma a o.")
13
14 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Organiza o>))
15 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Organiza o> "O ator uma pessoa jur dica")
16
17 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Pessoa>))
18 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Pessoa> "O ator uma pessoa f sica")
19
20 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Papel>))
21 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Papel> "Qual o papel operado pelo ator no contexto da a o")
22
23 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Iniciador>))
24 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Iniciador> "O ator tem o papel daquele que inicia a a o")
25
26 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Apoiador>))
27 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Apoiador> "O ator tem o papel de apoiador da a o")
28
29 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Executor>))
30 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Executor> "O ator tem o papel daquele que executar a a o")
31
32 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#A o>))
33 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#A o> "O que ser feito em termos de participa o social")
34
35 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Espa o_de_atua o>))
36 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Espa o_de_atua o> "Qual abrang ncia de execu o da a o")
37
38 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Resultados>))
39 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Resultados> "Que resultados foram obtidos com a realiza o da a o")
40
41 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Solu o>))
42 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Solu o> "Que solu es foram alcan adas com a realiza o da a o")
43
44 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Causa>))
45 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Causa> "O que motiva a execu o dessa a o")
46
47 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Problema>))
48 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Problema> "Qual problema espec fico a a o visa resolver")
49
50 Declaration(Class(<http://lumii.lv/ontologies/Corais.owl#Tema>))
51 AnnotationAssertion(rdfs:comment <http://lumii.lv/ontologies/Corais.owl#Tema> "Sobre qual tema, de um poss vel conjunto espec fico, a a o versar ")
52
53 SubClassOf(<http://lumii.lv/ontologies/Corais.owl#Organiza o> <http://lumii.lv/ontologies/Corais.owl#Ator>)
54 SubClassOf(<http://lumii.lv/ontologies/Corais.owl#Pessoa> <http://lumii.lv/ontologies/Corais.owl#Ator>)
55 SubClassOf(<http://lumii.lv/ontologies/Corais.owl#Apoiador> <http://lumii.lv/ontologies/Corais.owl#Papel>)
56 SubClassOf(<http://lumii.lv/ontologies/Corais.owl#Executor> <http://lumii.lv/ontologies/Corais.owl#Papel>)
57 SubClassOf(<http://lumii.lv/ontologies/Corais.owl#Iniciador> <http://lumii.lv/ontologies/Corais.owl#Papel>)
58 Declaration(ObjectProperty(<http://lumii.lv/ontologies/Corais.owl#Tem_um>))
59 SubClassOf(<http://lumii.lv/ontologies/Corais.owl#Ator> ObjectMinCardinality(1 <http://lumii.lv/ontologies/Corais.owl#Tem_um> <http://lumii.lv/ontologies/Corais.owl#Papel>))
60 FunctionalObjectProperty(<http://lumii.lv/ontologies/Corais.owl#Tem_um>)
61 ObjectPropertyRange(<http://lumii.lv/ontologies/Corais.owl#Tem_um> <http://lumii.lv/ontologies/Corais.owl#Papel>)
62 ObjectPropertyDomain(<http://lumii.lv/ontologies/Corais.owl#Tem_um> <http://lumii.lv/ontologies/Corais.owl#Ator>)
63 Declaration(ObjectProperty(<http://lumii.lv/ontologies/Corais.owl#Executa>))
64 SubClassOf(<http://lumii.lv/ontologies/Corais.owl#Executor> ObjectMinCardinality(1 <http://lumii.lv/ontologies/Corais.owl#Executa> <http://lumii.lv/ontologies/Corais.owl#A o>))
65 FunctionalObjectProperty(<http://lumii.lv/ontologies/Corais.owl#Executa>)
66 ObjectPropertyRange(<http://lumii.lv/ontologies/Corais.owl#Executa> <http://lumii.lv/ontologies/Corais.owl#A o>)
67 ObjectPropertyDomain(<http://lumii.lv/ontologies/Corais.owl#Executa> <http://lumii.lv/ontologies/Corais.

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```

owl#Executor>)
68 Declaration( ObjectProperty(<http://lumii.lv/ontologies
/Corais.owl#Pertence>))
69 SubClassOf(<http://lumii.lv/ontologies/Corais.owl#
A o > ObjectMinCardinality(1 <http://lumii.lv/
ontologies/Corais.owl#Pertence> <http://lumii.lv/
ontologies/Corais.owl#Espa o_de_atua o >))
70 FunctionalObjectProperty(<http://lumii.lv/ontologies/
Corais.owl#Pertence>)
71 ObjectPropertyRange(<http://lumii.lv/ontologies/Corais.
owl#Pertence> <http://lumii.lv/ontologies/Corais.
owl#Espa o_de_atua o >)
72 ObjectPropertyDomain(<http://lumii.lv/ontologies/Corais.
owl#Pertence> <http://lumii.lv/ontologies/Corais.
owl#A o >)
73 Declaration( ObjectProperty(<http://lumii.lv/ontologies
/Corais.owl#Produz>))
74 SubClassOf(<http://lumii.lv/ontologies/Corais.owl#
A o > ObjectMinCardinality(1 <http://lumii.lv/
ontologies/Corais.owl#Produz> <http://lumii.lv/
ontologies/Corais.owl#Resultados>))
75 FunctionalObjectProperty(<http://lumii.lv/ontologies/
Corais.owl#Produz>)
76 ObjectPropertyRange(<http://lumii.lv/ontologies/Corais.
owl#Produz> <http://lumii.lv/ontologies/Corais.owl#
Resultados>)
77 ObjectPropertyDomain(<http://lumii.lv/ontologies/Corais
.owl#Produz> <http://lumii.lv/ontologies/Corais.
owl#A o >)
78 Declaration( ObjectProperty(<http://lumii.lv/ontologies
/Corais.owl#Comp em>))
79 FunctionalObjectProperty(<http://lumii.lv/ontologies/
Corais.owl#Comp em>)
80 ObjectPropertyRange(<http://lumii.lv/ontologies/Corais.
owl#Comp em> <http://lumii.lv/ontologies/Corais.
owl#Solu o >)
81 ObjectPropertyDomain(<http://lumii.lv/ontologies/Corais.
owl#Comp em> <http://lumii.lv/ontologies/Corais.
owl#Resultados>)
82 Declaration( ObjectProperty(<http://lumii.lv/ontologies
/Corais.owl#Apoia>))
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Corais.owl#Causa>)
)

```

<sup>1</sup>Rawan T Khasawneh and EA Abu, "E-government and social media sites: The role and impact," World Journal of Computer Application and Technology 1, 10–17 (2013).

<sup>2</sup>Rodrigo Bandeira de Luna, "Metodologia de trabalho comentada e publicada!" (2013).

<sup>3</sup>Henrique Parra Parra Filho Isis Lima Soares Ricardo Augusto Poppi Martins e Rodrigo Bandeira de Luna Dalton Martins, Frederico Bortolato, "Modelagem conceitual publicada! verso 0.1 em linguagem natural," (2013).

<sup>4</sup><http://corais.org/vocabulariodaparticipacao/node/1517>.

<sup>5</sup>"Vocabulário comum de participação social," <http://corais.org/vocabulariodaparticipacao>, accessed: 2013-10-21.

<sup>6</sup>"Etherpads used in elaboration of the common vocabulary of social participation," <http://corais.org/vocabulariodaparticipacao/texts>, accessed: 2013-11-06.

<sup>7</sup>"Common vocabulary of social participation with standard class and property names," <http://webprotege.stanford.edu/#Edit:projectId=716e3e1d-0783-42d7-8ddd-aa2f8b53bed8>, accessed: 2013-11-06.

<sup>8</sup>"Complete owl implementation of the common vocabulary of social participation with standard class and property names and with missing classes, properties and restrictions. owl text file." <http://webprotege.stanford.edu/#Edit:projectId=3becd68f-8f35-48a7-a287-f1a32b37b7c4>, accessed: 2013-11-06.

<sup>9</sup>"Complete owl implementation of the common vocabulary of

- social participation with standard class and property names and with missing classes, properties and restrictions. webprotege interface to the ontology.” <http://webprotege.stanford.edu/#Edit:projectId=3becd68f-8f35-48a7-a287-f1a32b37b7c4>, accessed: 2013-11-06.
- <sup>10</sup> “Complete owl implementation of the common vocabulary of social participation with standard class and property names and with missing classes, properties and restrictions,” <http://webprotege.stanford.edu/#Edit:projectId=3cd4408b-5d6c-4b73-a19b-e79b8545b441>, accessed: 2013-11-06.
- <sup>11</sup> Matthew Horridge, “Review of protege and protege-owl,” *Ontogenesis*(2010).
- <sup>12</sup> Robert Arp and Barry Smith, “Function, role, and disposition in basic formal ontology,” *Nature Preceedings*, 1–4(2008).
- <sup>13</sup> Marcelo Pita and Goedson Paixao, “Arquitetura de busca semântica para governo eletrônico,” in *II Workshop de Computação Aplicada em Governo Eletrônico & Congresso da Sociedade Brasileira de Computação, Belo Horizonte* (2010).
- <sup>14</sup> Alejandro Barros, Diego Rafael CANABARRO, and Marco CEPIK, “Para além da e-ping: o desenvolvimento de uma plataforma de interoperabilidade para e-serviços no brasil,” *Panorama da Interoperabilidade. Brasília: Ministério do Planejamento, Orçamento e Gestão*, 137–157(2010).
- <sup>15</sup> “The organization ontology,” <http://www.w3.org/TR/vocab-org/>, accessed: 2013-10-21.
- <sup>16</sup> Costas Vassilakis and George Lepouras, “An ontology for e-government public services,” *Encyclopedia of E-Commerce, E-Government and Mobile Commerce*, 865–870(2006).
- <sup>17</sup> Peter Salhofer, Bernd Stadlhofer, and Gerald Tretter, “Ontology driven e-government,” in *Software Engineering Advances, 2009. ICSEA’09. Fourth International Conference on (IEEE, 2009)* pp. 378–383.
- <sup>18</sup> “e-ping homepage,” <http://www.governoeletronico.gov.br/acoes-e-projetos/e-ping-padrees-de-interoperabilidade>, accessed: 2013-10-21.
- <sup>19</sup> “Vocabulário controlado do governo eletrônico,” <http://www.governoeletronico.gov.br/acoes-e-projetos/e-ping-padrees-de-interoperabilidade>, accessed: 2013-10-21.
- <sup>20</sup> “Gtinda: Grupo de trabalho da infraestrutura nacional de dados abertos,” <http://wiki.gtinda.ibge.gov.br/>, accessed: 2013-10-21.
- <sup>21</sup> Demetrios Sarantis and Dimitris Askounis, “Knowledge exploitation via ontology development in e-government project management,” *International Journal of Digital Society* **1**, 246–255 (2010).
- <sup>22</sup> Boryana Deliyaska and Roumiana Ilieva, “Ontology-based model of e-governance,” *Annual of Section Informatics of the Union of Bulgarian Scientists* **4**, 103–119 (2011).
- <sup>23</sup> Matthew Horridge, S Jupp, G Moulton, A Rector, R Stevens, and Wroe, “A practical guide to building owl ontologies using protegé 4 and co-ode tools. edition 1.2. the university of manchester,” (2011).
- <sup>24</sup> Matthew Horridge, S Jupp, G Moulton, A Rector, R Stevens, and Wroe, “Ontologia inglesa proposta como formalizacao publica das responsabilidades de cada funcionatio publico,” (2011).
- <sup>25</sup> Alexei Vázquez, João Gama Oliveira, Zoltán Dezső, Kwang-Il Goh, Imre Kondor, and Albert-László Barabási, “Modeling bursts and heavy tails in human dynamics,” *Physical Review E* **73**, 036127 (2006).
- <sup>26</sup> Jukka-Pekka Onnela, Samuel Arbesman, Marta C González, Albert-László Barabási, and Nicholas A Christakis, “Geographic constraints on social network groups,” *PLoS one* **6**, e16939 (2011).
- <sup>27</sup> Gergely Palla, Albert-László Barabási, and Tamás Vicsek, “Quantifying social group evolution,” *Nature* **446**, 664–667 (2007).
- <sup>28</sup> Julián Candia, Marta C González, Pu Wang, Timothy Schoenharl, Greg Madey, and Albert-László Barabási, “Uncovering individual and collective human dynamics from mobile phone records,” *Journal of Physics A: Mathematical and Theoretical* **41**, 224015 (2008).
- <sup>29</sup> Tao Jia and Albert-László Barabási, “Control capacity and a random sampling method in exploring controllability of complex networks,” *Scientific reports* **3** (2013).
- <sup>30</sup> Yang-Yu Liu, Jean-Jacques Slotine, and Albert-László Barabási, “Control centrality and hierarchical structure in complex networks,” *Plos one* **7**, e44459 (2012).
- <sup>31</sup> Yang-Yu Liu, Jean-Jacques Slotine, and Albert-László Barabási, “Controllability of complex networks,” *Nature* **473**, 167–173 (2011).
- <sup>32</sup> Vasyl Palchykov, Kimmo Kaski, Janos Kertész, Albert-László Barabási, and Robin IM Dunbar, “Sex differences in intimate relationships,” *Scientific reports* **2** (2012).
- <sup>33</sup> James P Bagrow, Dashun Wang, and Albert-Laszlo Barabasi, “Collective response of human populations to large-scale emergencies,” *PloS one* **6**, e17680 (2011).
- <sup>34</sup> Gourab Ghoshal, Nicholas Blumm, Zalan Forro, Maximilian Schich, Ginestra Bianconi, Jean-Philippe Bouchaud, and Albert-Laszlo Barabasi, “Dynamics of ranking processes in complex systems,” (2012).
- <sup>35</sup> Réka Albert and Albert-László Barabási, “Topology of evolving networks: local events and universality,” *Physical review letters* **85**, 5234 (2000).
- <sup>36</sup> Soon-Hyung Yook, Hawoong Jeong, A-L Barabási, and Yuhai Tu, “Weighted evolving networks,” *Physical Review Letters* **86**, 5835 (2001).
- <sup>37</sup> Dashun Wang, Zhen Wen, Hanghang Tong, Ching-Yung Lin, Chaoming Song, and Albert-László Barabási, “Information spreading in context,” in *Proceedings of the 20th international conference on World wide web (ACM, 2011)* pp. 735–744.
- <sup>38</sup> Nicholas Blumm, Gourab Ghoshal, Zalan Forró, Maximilian Schich, Ginestra Bianconi, Jean-Philippe Bouchaud, and Albert-László Barabási, “Dynamics of ranking processes in complex systems,” *Physical Review Letters* **109**, 128701 (2012).
- <sup>39</sup> M. E. J. Newman, “The structure and function of complex networks,” *SIAM REVIEW* **45**, 167–256 (2003).
- <sup>40</sup> Mark EJ Newman, Steven H Strogatz, and Duncan J Watts, “Random graphs with arbitrary degree distributions and their applications,” *Physical Review E* **64**, 026118 (2001).
- <sup>41</sup> Mark EJ Newman, “Random graphs with clustering,” *Physical review letters* **103**, 058701 (2009).
- <sup>42</sup> Aaron Clauset, Cosma Rohilla Shalizi, and Mark EJ Newman, “Power-law distributions in empirical data,” *SIAM review* **51**, 661–703 (2009).
- <sup>43</sup> Mark EJ Newman, “Analysis of weighted networks,” *Physical Review E* **70**, 056131 (2004).
- <sup>44</sup> Mark EJ Newman, “Assortative mixing in networks,” *Physical review letters* **89**, 208701 (2002).
- <sup>45</sup> Mark EJ Newman, “Modularity and community structure in networks,” *Proceedings of the National Academy of Sciences* **103**, 8577–8582 (2006).
- <sup>46</sup> MEJ Newman, “Community detection and graph partitioning,” arXiv preprint arXiv:1305.4974(2013).
- <sup>47</sup> MEJ Newman, “Communities, modules and large-scale structure in networks,” *Nature Physics* **8**, 25–31 (2011).
- <sup>48</sup> Aaron Clauset, Cristopher Moore, and Mark EJ Newman, “Hierarchical structure and the prediction of missing links in networks,” *Nature* **453**, 98–101 (2008).
- <sup>49</sup> MEJ Newman, “Complex systems: A survey,” arXiv preprint arXiv:1112.1440(2011).
- <sup>50</sup> Elizabeth A Leicht and Mark EJ Newman, “Community structure in directed networks,” *Physical review letters* **100**, 118703 (2008).
- <sup>51</sup> Elizabeth A Leicht, Gavin Clarkson, Kerby Shedden, and Mark EJ Newman, “Large-scale structure of time evolving citation networks,” *The European Physical Journal B* **59**, 75–83 (2007).
- <sup>52</sup> Brian Ball and Mark EJ Newman, “Friendship networks and so-

- cial status,” arXiv preprint arXiv:1205.6822(2012).
- <sup>53</sup>G. Deleuze, *Difference and Repetition* (Continuum, 1968).
- <sup>54</sup>F. de Saussure, *Course in General Linguistics* (Books LLC, 1916).
- <sup>55</sup>A. Papoulis S. U. Pillai, *Probability, Random Variables and Stochastic Processes* (McGraw Hill Higher Education, 2002).
- <sup>56</sup>R. A. Johnson D. W. Wichern, *Applied Multivariate Statistical Analysis* (Prentice Hall, 2007).
- <sup>57</sup>C. W. Therrien, *Discrete Random Signals and Statistical Signal Processing* (Prentice Hall, 1992).
- <sup>58</sup>R. O. Duda P. E. Hart D. G. Stork, *Pattern Classification* (Wiley-Interscience, 2000).
- <sup>59</sup>L. da F. Costa R. M. C. Jr., *Shape Analysis and Classification: Theory and Practice (Image Processing Series)* (CRC Press, 2000).
- <sup>60</sup>D. Papineau, *Philosophy* (Oxford University Press, 2009).
- <sup>61</sup>B. Russel, *A History of Western Philosophy* (Simon and Schuster Touchstone, 1967).
- <sup>62</sup>F. G. G. Deleuze, *What Is Philosophy?* (Simon and Schuster Touchstone, 1991).