Legislative data portals and linked data quality

Jose Emilio Labra Gayo
WESO
WEb **S**emantics **O**viedo
University of Oviedo, Spain

About me…

In 2004, founded WESO (Web Semantics Oviedo) research group

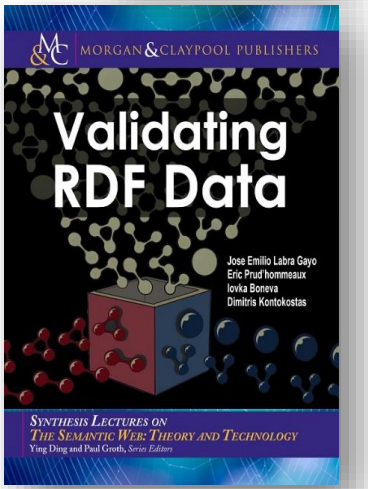
- Goal: Practical applications of semantic technologies
- Several domains: e-Government, e-Health,...

2 books:

- "*Web semántica*" (in Spanish), 2012
- "*Validating RDF data*", 2017

…and software:

- SHaclEX (Scala library, implements ShEx & SHACL)
- RDFShape (RDF playground)
- WikiShape (Wikidata playground)



HTML version: http://book.validatingrdf.com
Examples: https://github.com/labra/validatingRDFBookExamples

About this talk...

It will be divided in 2 parts

1st part

Legislative linked data portals

- Chilean National library of Congress
- Presented at ESWC'19*

2nd part

Linked data quality

- RDF description and validation
- ShEx & SHACL overview

Legislative linked data portals

Processing the History of the Law at Chile

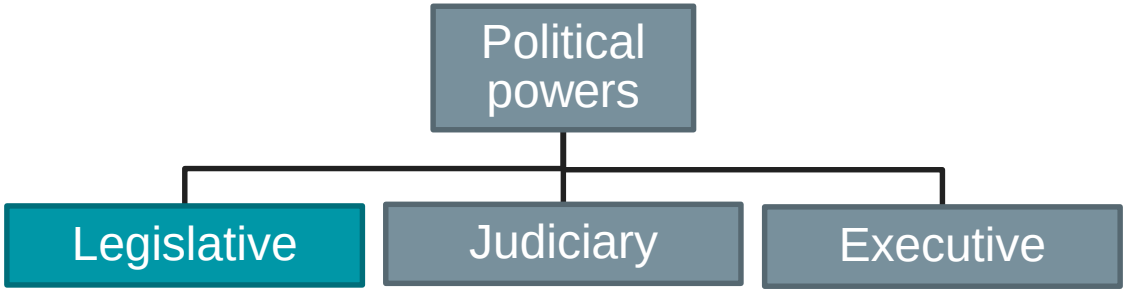
Francisco Cifuentes Silva
Library of Congress, Chile
PhD Student
WESO research group

Jose Emilio Labra Gayo
WESO research group
University of Oviedo, Spain

More information:
Cifuentes-Silva F., Labra Gayo J.E. (2019) Legislative Document Content Extraction Based on Semantic Web Technologies. In: Hitzler P. et al. (eds) The Semantic Web. ESWC 2019. Lecture Notes in Computer Science, vol 11503. Springer, Cham

Chilean Library of Congress

*In Spanish: BCN (**B**iblioteca del **C**ongreso **N**acional de Chile)*



Biblioteca del Congreso Nacional de Chile / BCN

Independent body inside the Legislative power

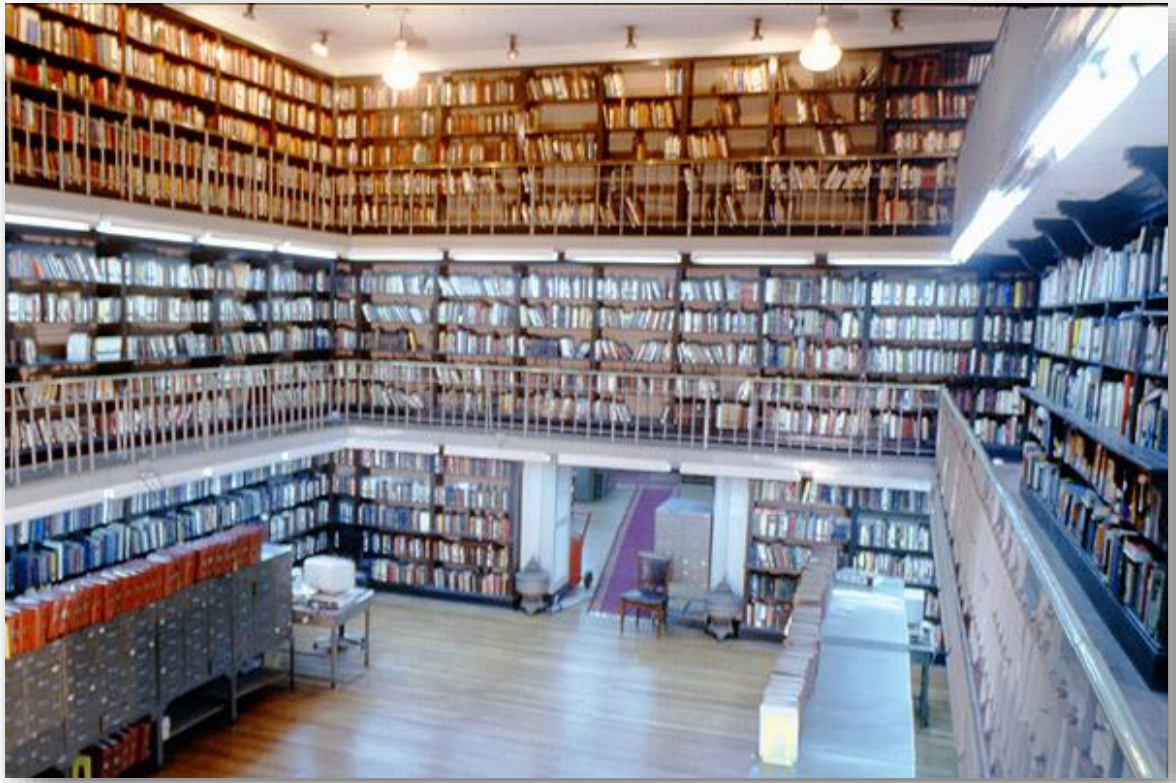
Advices the parliament and gives services to citizens

http://www.bcn.cl

2 projects at library of congress (BCN)

History of the Law

Parliamentary work



History of the Law (LeyChile)

Collect all documents generated during a law legislative process

Phases:

- An initiative sees life as a draft bill
- Subject to debates
- Validity time (it is published)
- Modifications, additions,...
- Derogation

Goal:

- Capture *the spirit* of the law
- Traceability

https://www.bcn.cl/historiadelaley

Parliamentary work

Collect all legislative activity by each Member of Parliament

Retrieve all interventions made

- Parliamentary motion
- Session journal
- Commission report

Ordered and categorised

https://www.bcn.cl/laborparlamentaria/

Both projects adopted semantic technologies

Some initial reasons:

- Semantic technologies considered one pillar of strategic plan (in 2014)
- Innovative action to generate new products
- Improve interoperability mechanisms
- Sem. Web aligned well with open & public data

Which semantic technologies?

Text mining and content enrichment

- Entity extraction
- Topic identification
- Automatic markup
- Classification

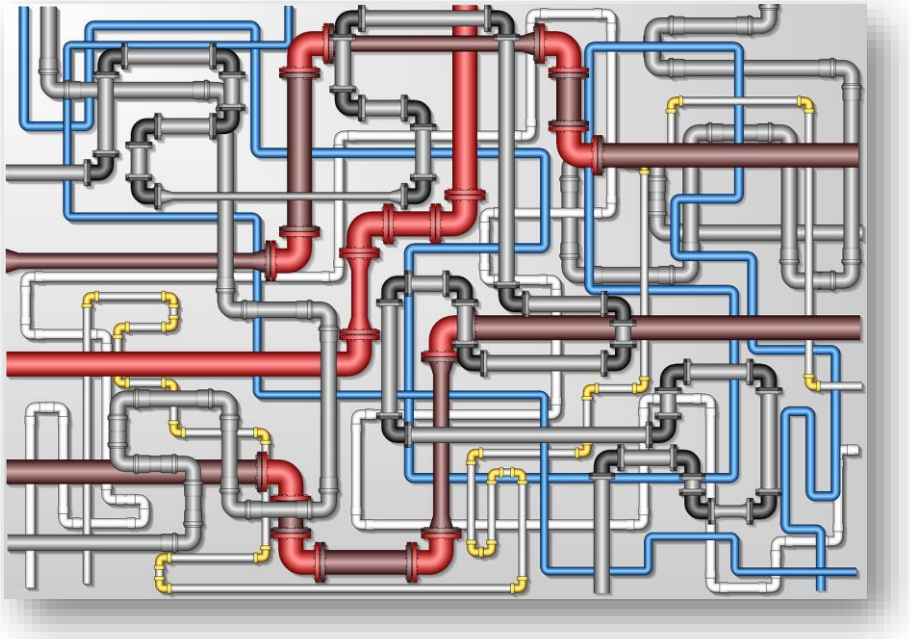
Machine readable info

- XML & URIs
- RDF
- Ontologies
- Linked Open Data

Workflow pipelines

3 main steps

- Automatic XML Marker
- RDF & Linked data generation
- Content delivery



Workflow overview

Content portals

Legislative documents
- Some docs in paper (requires OCR)
- Text documents

National library

Automatic XML marker

SVN repository Akoma-Ntoso

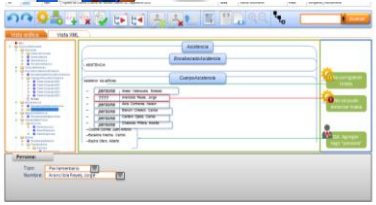
Publishing (RDF extraction From Akoma-Ntoso)

Services layer

Linked Open Data

Query DB

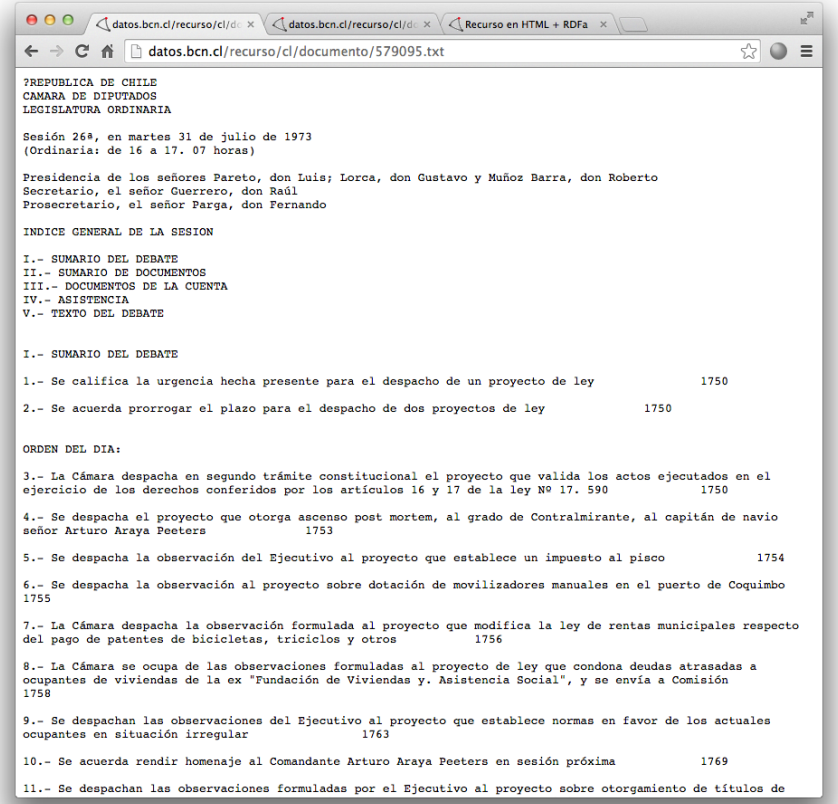
XML editor & tools

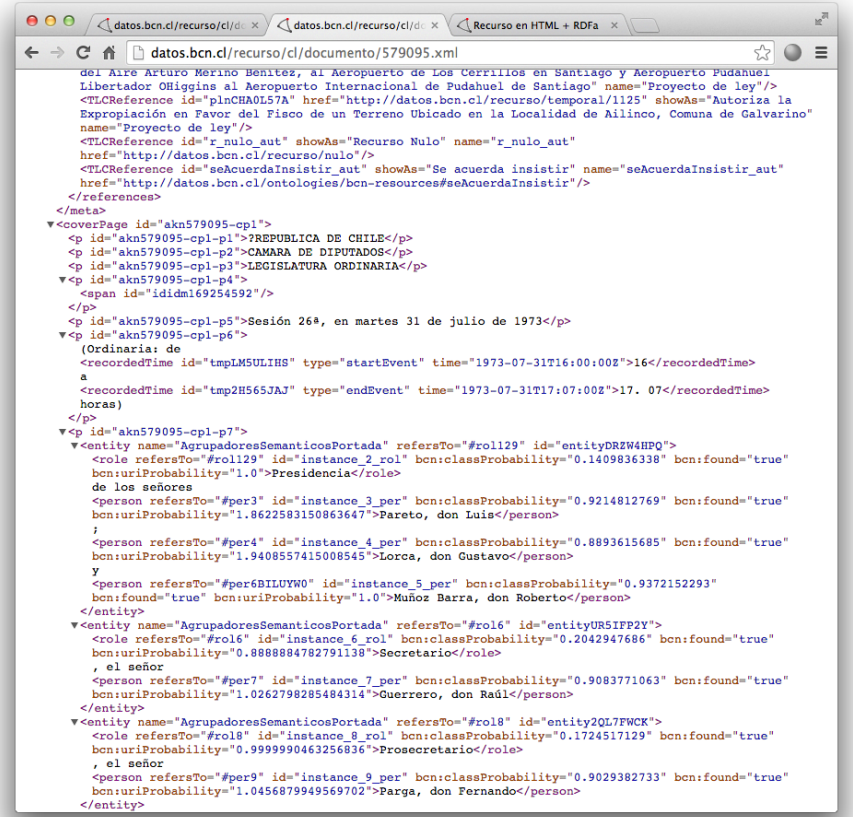


Automatic XML marker

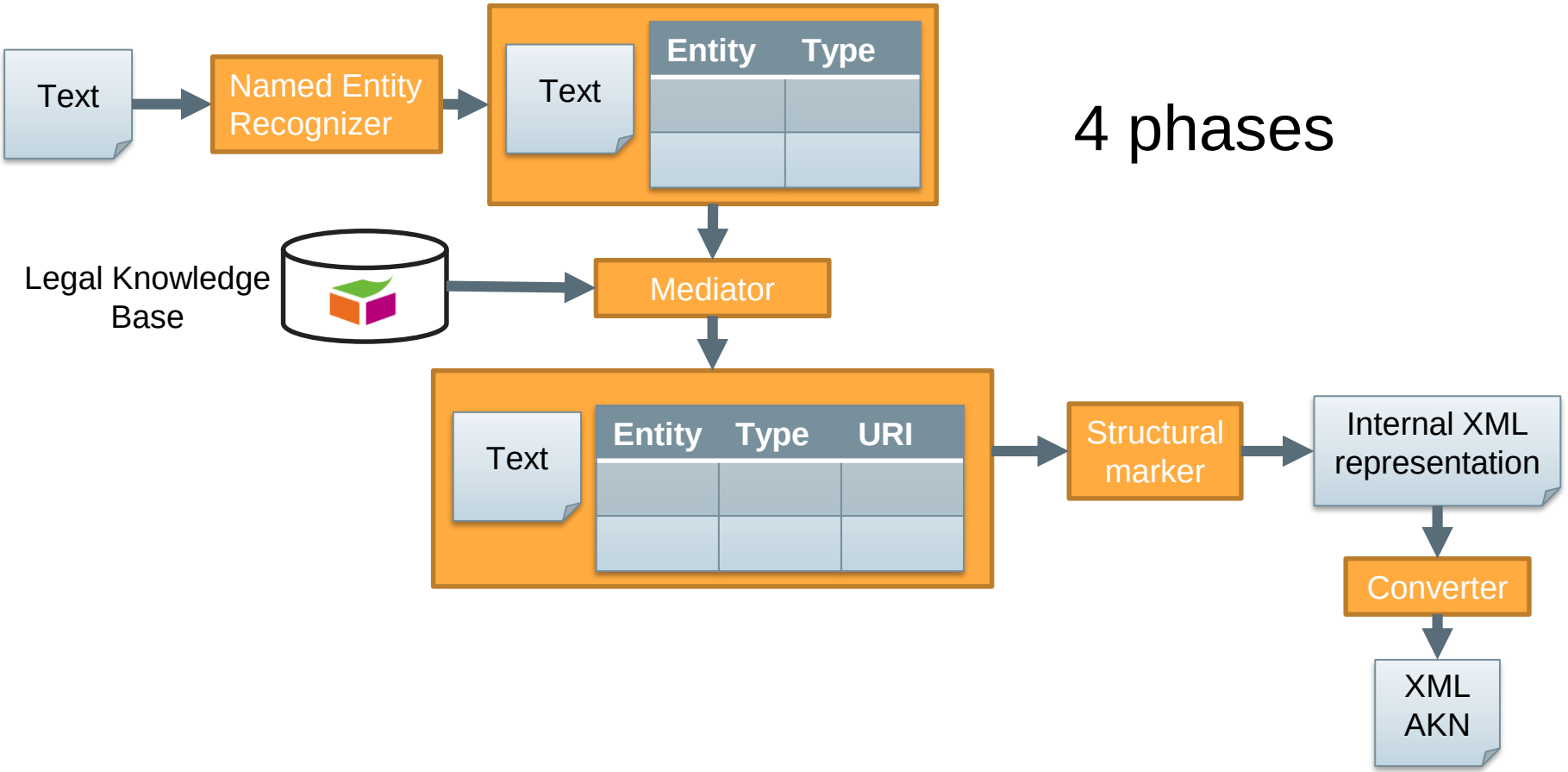
Source: Text

Target: XML following Akoma-Ntoso





Automatic XML marker

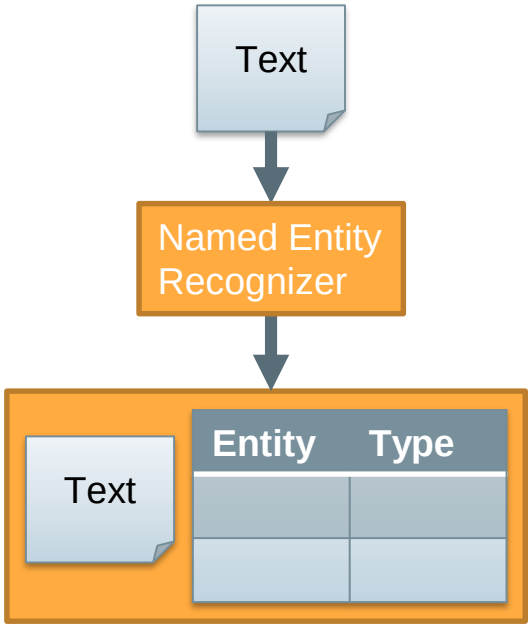


4 phases

1. Named Entity Recognizer

Detection of entities & types of entities

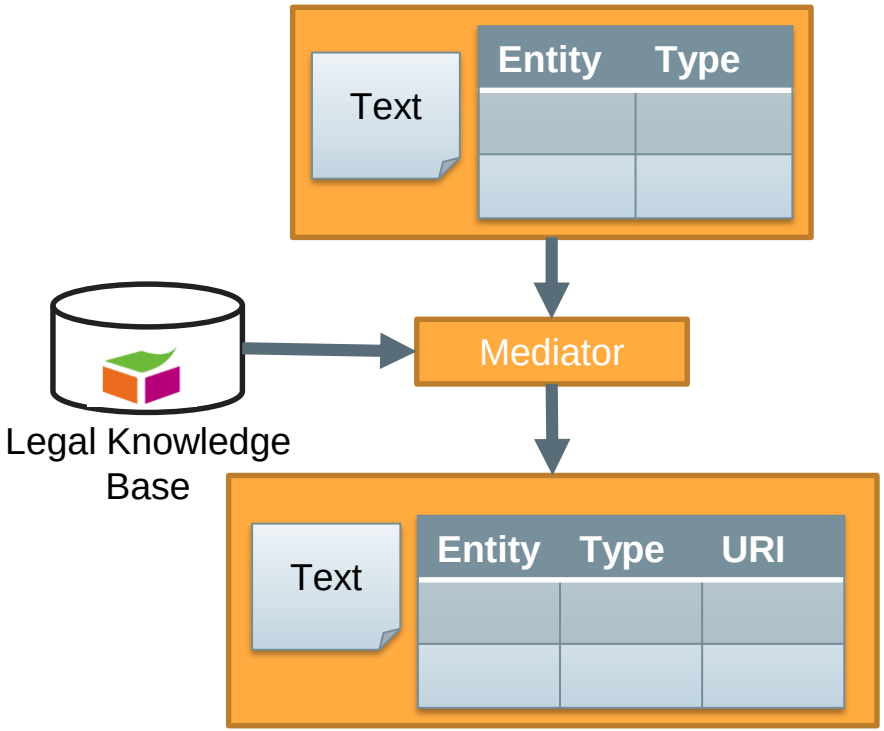
- Web service implementing the Stanford NER with a CRF classifier
- Evaluation in production: detects 97% entities



Type	Some examples	# of entities
Person	Salvador Allende, Sebastián Piñera	5.139
Organization	Ministerio de Salud, SERNATUR	2.848
Location	Valparaíso, Santiago de Chile	1.251
Document		
Role		
Events		
Law		
Dates		

```
PROYECTOS DE LEY violencIa que ha golpeado a las familias El
▼<entity>
  <body bestClass="ROL" knownFraction="1">Secretario</body>
  <class value="ROL" probability="0.2201459321"/>
</entity>
, señor
▼<entity>
  <body bestClass="PER" knownFraction="1">Raúl Guerrero Guerrero</body>
  <class value="PER" probability="0.83023132"/>
</entity>
y ei rrosecretario,
▼<entity>
  <body bestClass="PER" knownFraction="0.5">don Fernando Parga Santelices</body>
  <class value="PER" probability="0.9555160392"/>
</entity>
.
```

2. Mediator



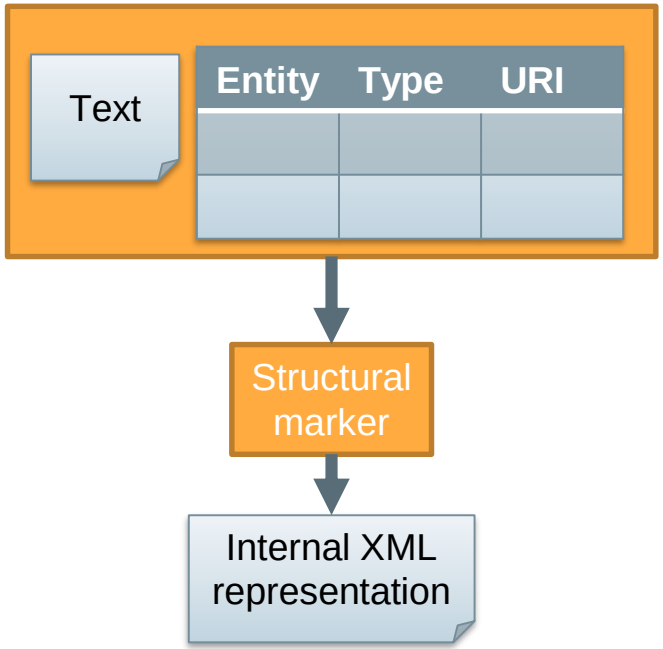
Entity linking and disambiguation

- Text similarity algorithms
- Based on Apache Lucene

In-house development

- Use of context information to narrow list of candidates
- Custom filters and association heuristics
- Specialized web services

3. Structural marker



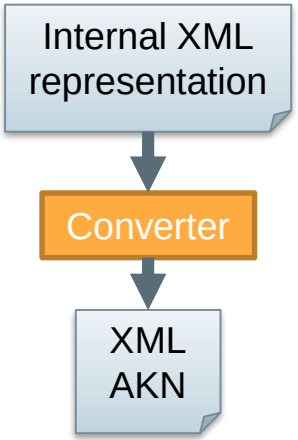
Detect structures in the text

- Titles, subtitles, paragraphs, sections,...
- Special structure for debates: participation

Regular expressions + custom rules

```
</Portada>
▼<Indice>
  <Titulo>INDICE GENERAL DE LA SESION</Titulo>
  ▼<CuerpoIndice>
    I.- SUMARIO DEL DEBATE II.- SUMARIO DE DOCUMENTOS III.- DOCUMENTOS
    DE LA CUENTA IV.- ASISTENCIA V.- TEXTO DEL DEBATE
    ▼<entity>
      <body bestClass="ORG" found="true" knownFraction="1"
      rdfLabel="camara de diputados"
      uri="http://datos.bcn.cl/recurso/cl/organismo/camara-de-
      diputados" uriProbability="0.8999994993209839">CAMARA DE
      DIPUTADOS</body>
      <class probability="0.8170063361" value="ORG"/>
    </entity>
  </CuerpoIndice>
</Indice>
▼<SumarioDelDebate>
  <Titulo>I.- SUMARIO DEL DEBATE Pág.</Titulo>
  ▼<CuerpoSumarioDelDebate>
    1.-La
```

4. XML converter to Akom-Ntoso



Programmatic approach

Internal XML representation similar to DOM

Each node converted to text in AKN-XML

```
. Prosecretario, el señor
<person bcn:classProbability="0.8929788338" bcn:found="true"
bcn:uriProbability="1.0466665840148925" id="instance_8_per"
refersTo="#per8">Parga, don Fernando</person>
~
</coverPage>
▼<preface>
 ▼<longTitle>
    <p>INDICE GENERAL DE LA SESION</p>
  </longTitle>
 ▼<toc>
    <tocItem href="/" level="0">I.- SUMARIO DEL DEBATE</tocItem>
    <tocItem href="/" level="0">II.- SUMARIO DE DOCUMENTOS</tocItem>
    <tocItem href="/" level="0">III.- DOCUMENTOS DE LA CUENTA</tocItem>
    <tocItem href="/" level="0">IV.- ASISTENCIA</tocItem>
    <tocItem href="/" level="0">V.- TEXTO DEL DEBATE CAMARA DE
    DIPUTADOS</tocItem>
  </toc>
 ▼<longTitle>
    <p>I.- SUMARIO DEL DEBATE Pág.</p>
  </longTitle>
```

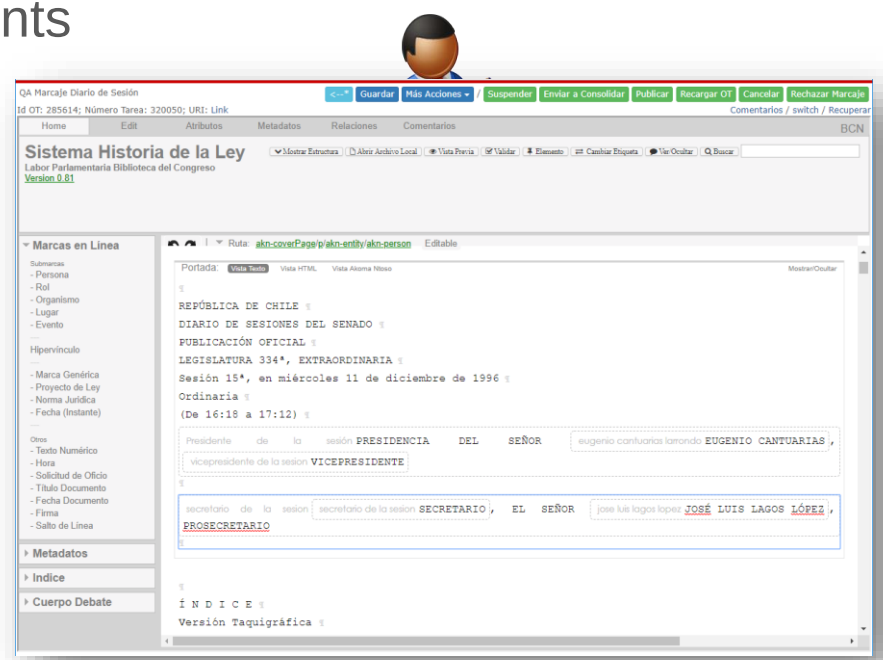
Human edition of AKN-Documents

Quality assurance by human analysts

They review the generated XML documents

2 editors:

- Ad-hoc XML editor
- Commercial editor: LegisPro (Xcential)



Linked data generation

The pilot project (2011) carefully defined a stable URI model

URIs have been maintained since them

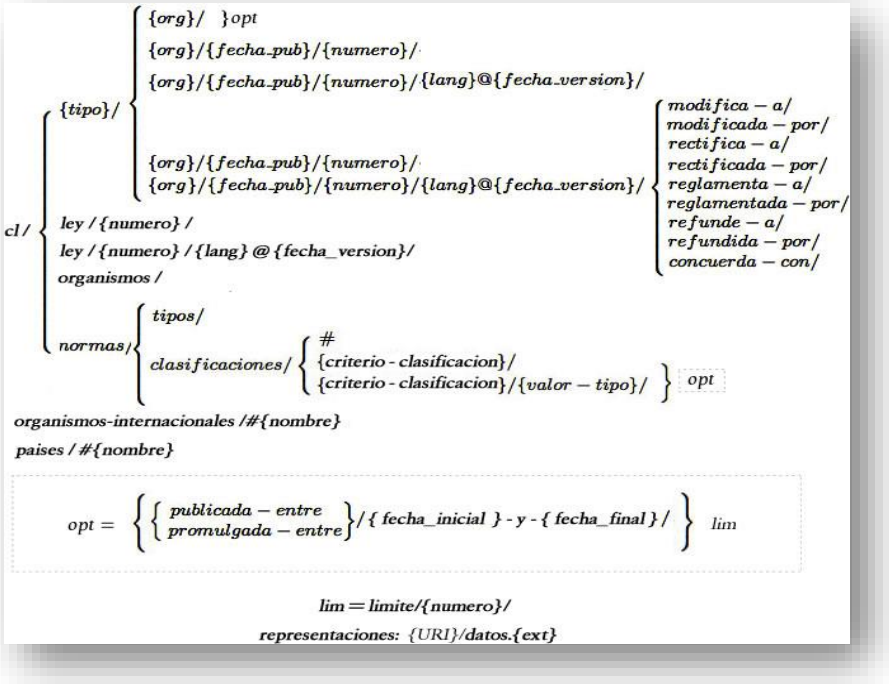
- URIs = IDs in the whole system

URIs are dereferentiable

- Content negotiation
- Custom linked data browser

Documentation (*in Spanish*)

http://datos.bcn.cl/es/documentacion



AKN2RDF

RDF extraction from Akoma-Ntoso XML

- Custom-made converter (XSL discarded for perceived complexity)
- Each XML tag implemented in one Class
- Extracted data saved into multiple databases (Relational and RDF)

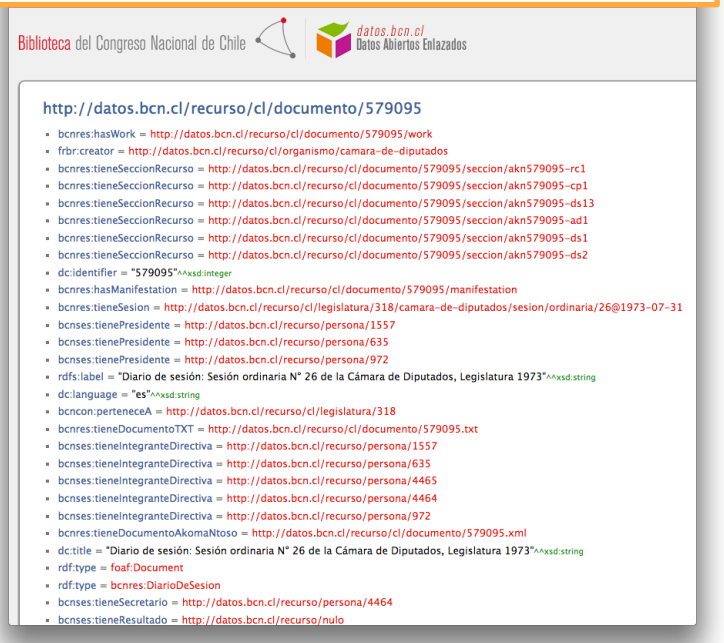
Linked data generation

Source: AKN XML documents

http://datos.bcn.cl/recurso/cl/documento/579095.xml

Target: RDF data

http://datos.bcn.cl/recurso/cl/documento/579095/



Linked data browser (WESO-DESH)

SPARQL endpoint

RDF triples are published as a public SPARQL endpoint

http://datos.bcn.cl/sparql

https://datos.bcn.cl/sparql

```
PREFIX bcnnorms: <http://datos.bcn.cl/ontologies/bcn-norms#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX dc: <http://purl.org/dc/elements/1.1/>

SELECT DISTINCT ?name (count(?norm) as ?number)
WHERE {
    ?norm bcnnorms:createdBy ?organization .
    ?organization bcnnorms:hasName ?name .
    ?organization rdf:type bcnnorms:GovernmentalOrganization.
    FILTER regex(?name, "^MUNICIPALIDAD")
}
ORDER BY DESC (?number)
```

Number of norms by municipality

	name	number
1	"MUNICIPALIDAD DE PROVIDENCIA"^^xsd:string	"1257"^^xsd:integer
2	"MUNICIPALIDAD DE LAS CONDES"^^xsd:string	"930"^^xsd:integer
3	"MUNICIPALIDAD DE SANTIAGO"^^xsd:string	"783"^^xsd:integer
4	"MUNICIPALIDAD DE RANCAGUA"^^xsd:string	"546"^^xsd:integer
5	"MUNICIPALIDAD DE LO PRADO"^^xsd:string	"383"^^xsd:integer
6	"MUNICIPALIDAD DE VITACURA"^^xsd:string	"327"^^xsd:integer
7	"MUNICIPALIDAD DE LA FLORIDA"^^xsd:string	"289"^^xsd:integer
8	"MUNICIPALIDAD DE MACUL"^^xsd:string	"271"^^xsd:integer
9	"MUNICIPALIDAD DE CONCHALÍ"^^xsd:string	"247"^^xsd:integer

Content delivery

Web portals using Open Source Technologies

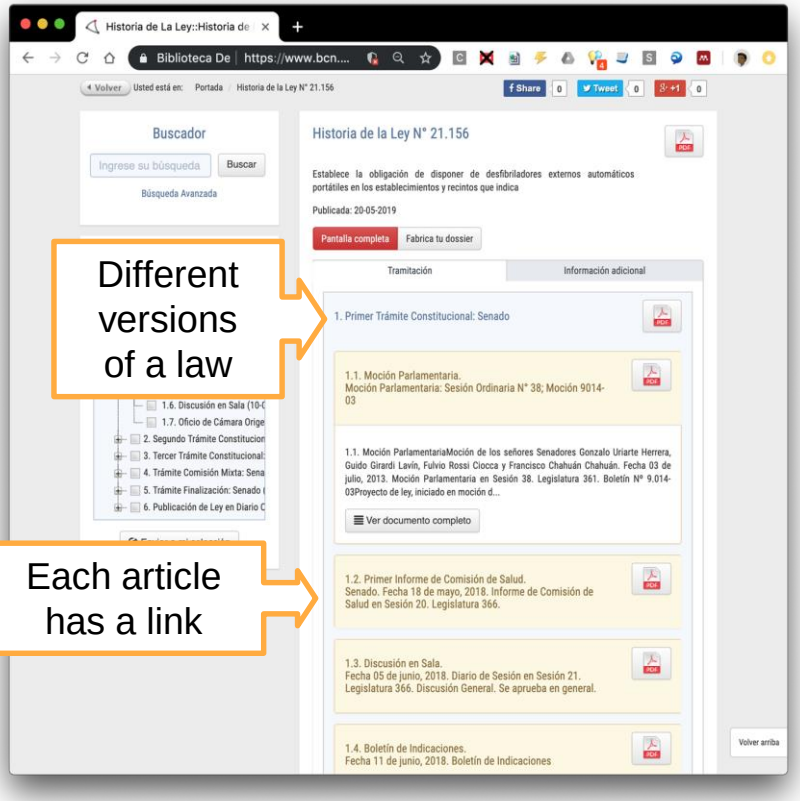
- CMS (Typo3)
- Python/Java
- Varnish
- Apache Lucene

REST Web service layers which connect to RDF triplestore and DB

Data exports to PDF, Doc and XML formats

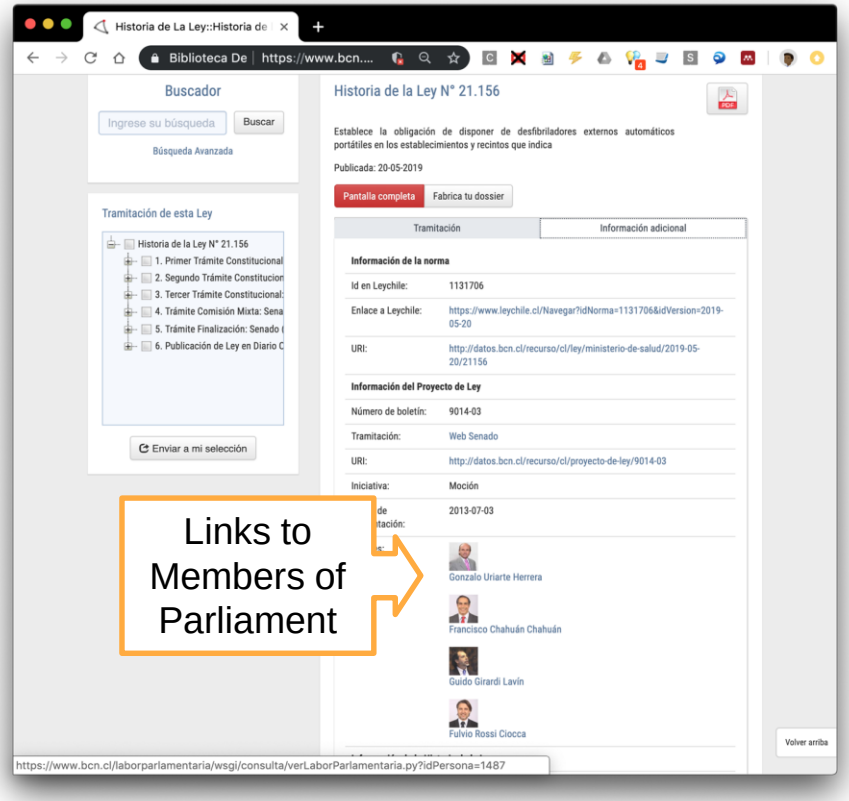
URIs of parliamentary profiles = URIs in triplestore

History of the Law portal



Different versions of a law

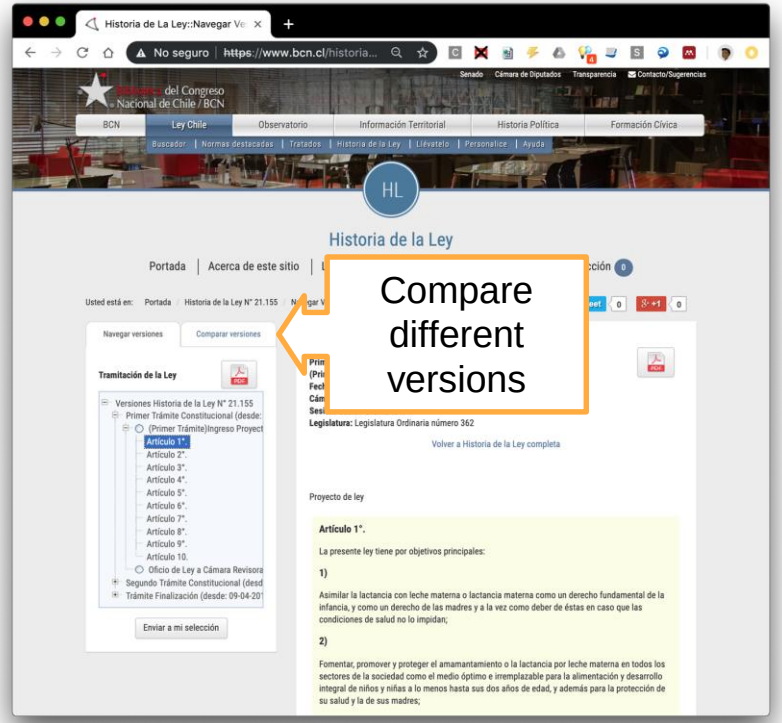
Each article has a link



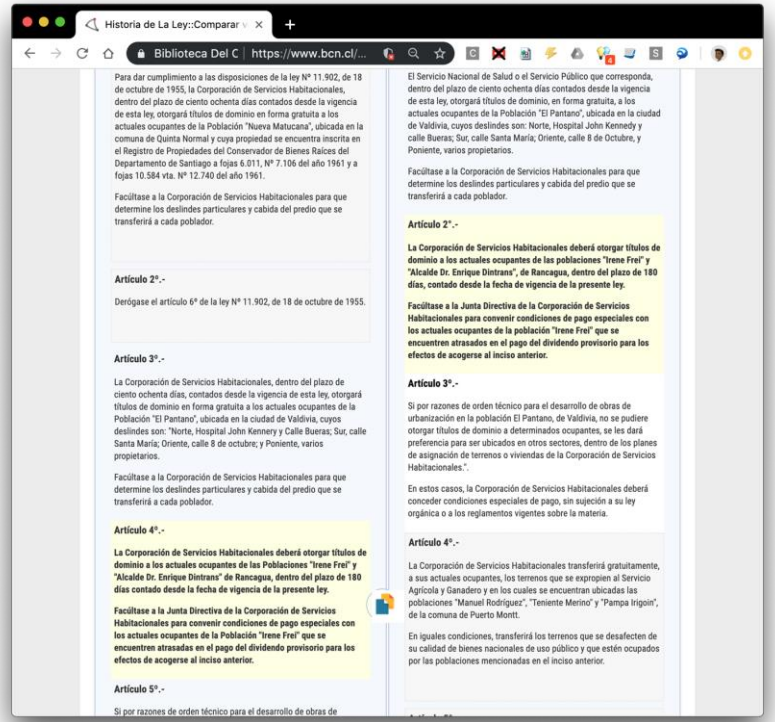
Links to Members of Parliament

https://www.bcn.cl/historiadelaley

History of the Law portal

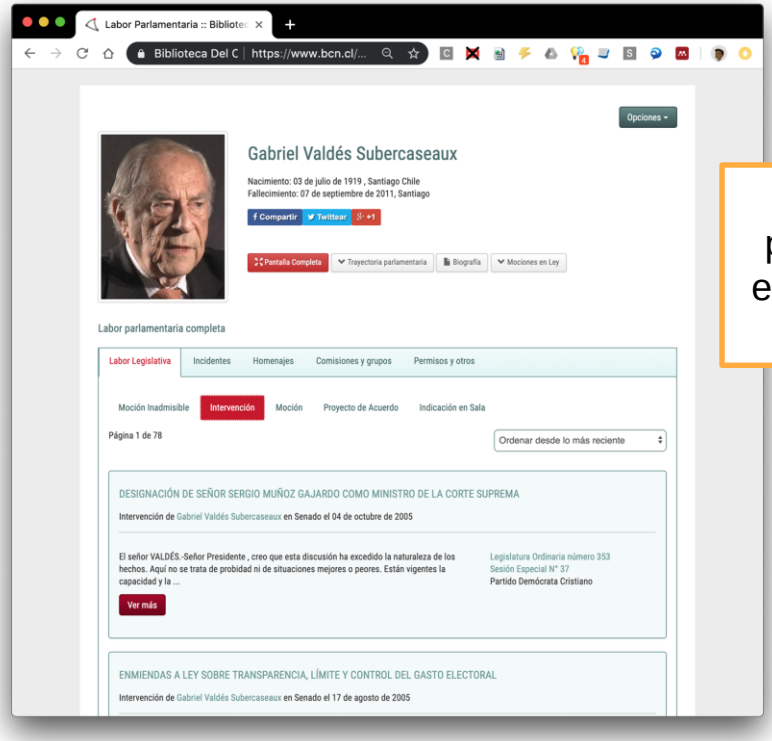


Compare different versions

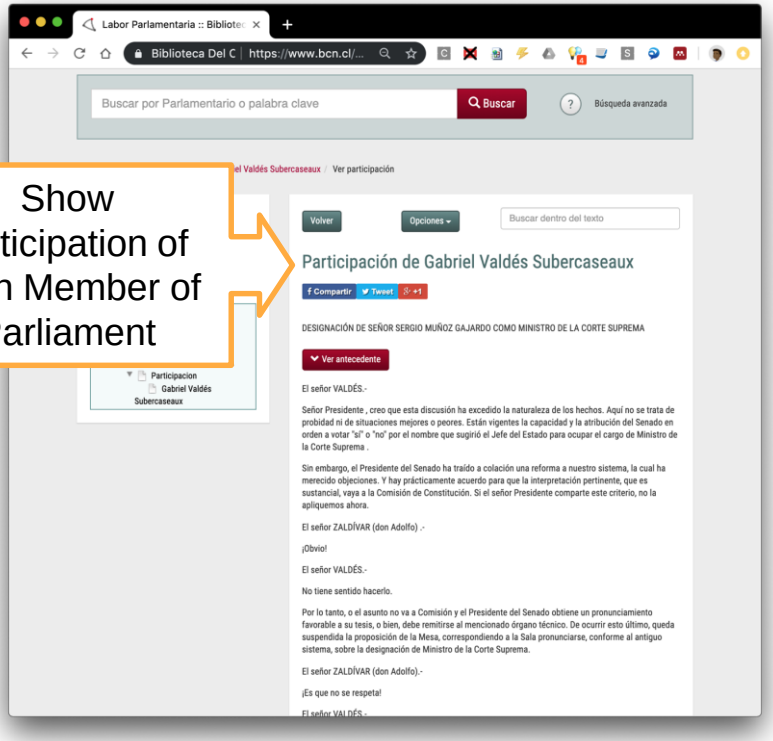


https://www.bcn.cl/historiadelaley

Parliamentary Work



Show participation of each Member of Parliament



https://www.bcn.cl/laborparlamentaria

Some experimental visualizations

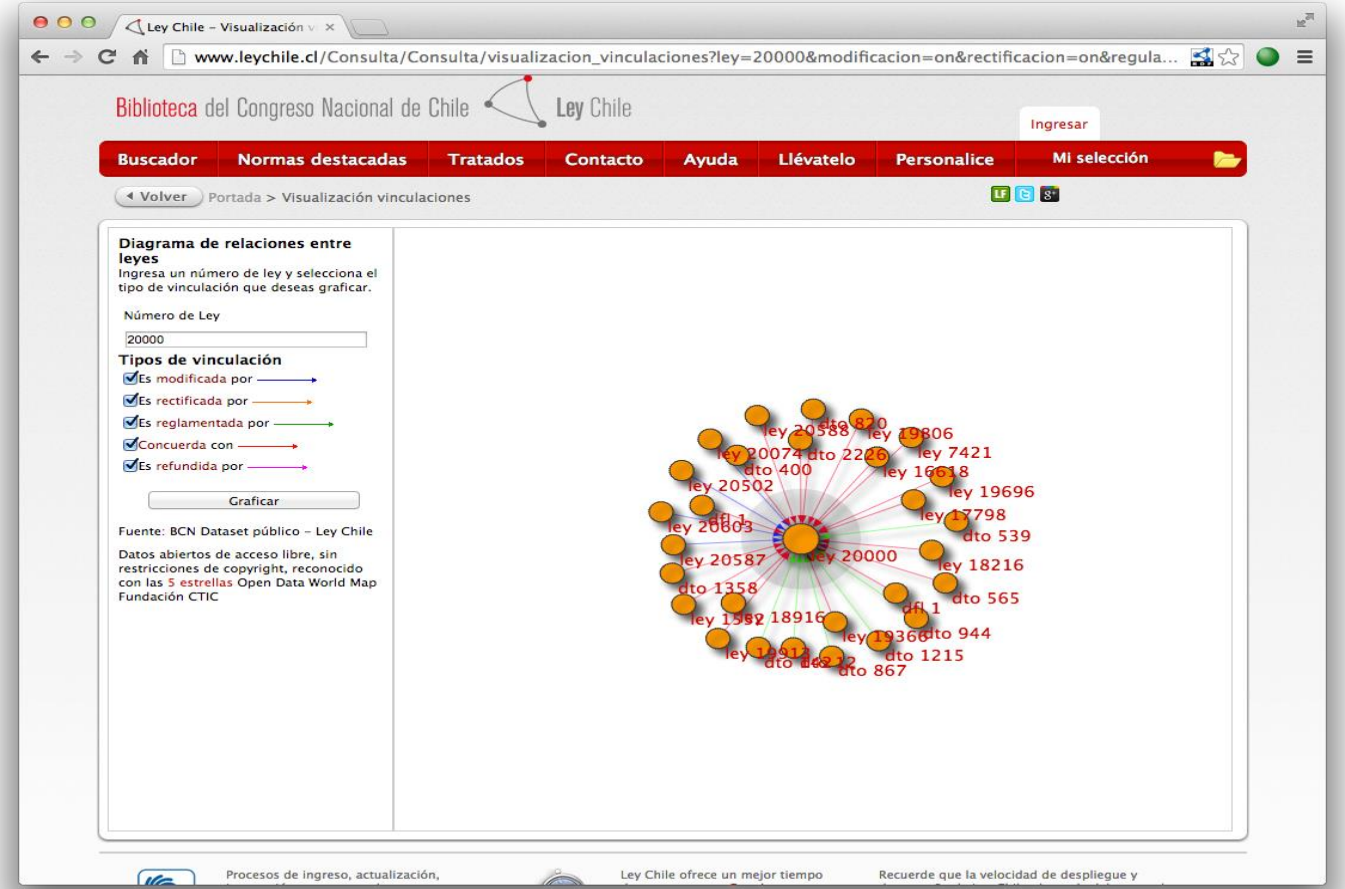
Relationships between laws

Historical Parliament

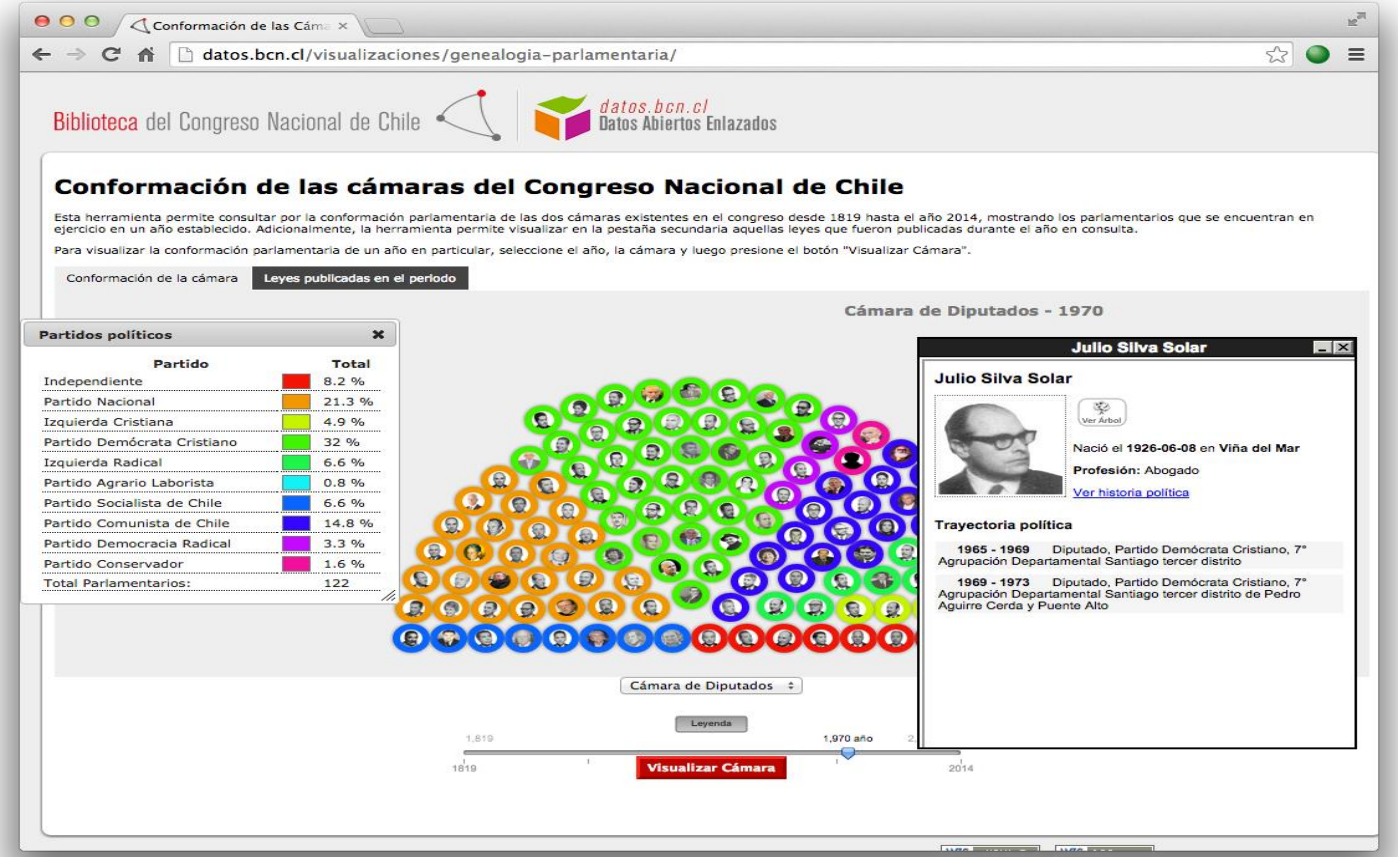
Parliamentary genealogy (family relationships)

Regions mentioned in laws (legislative hackathon)

Links between laws

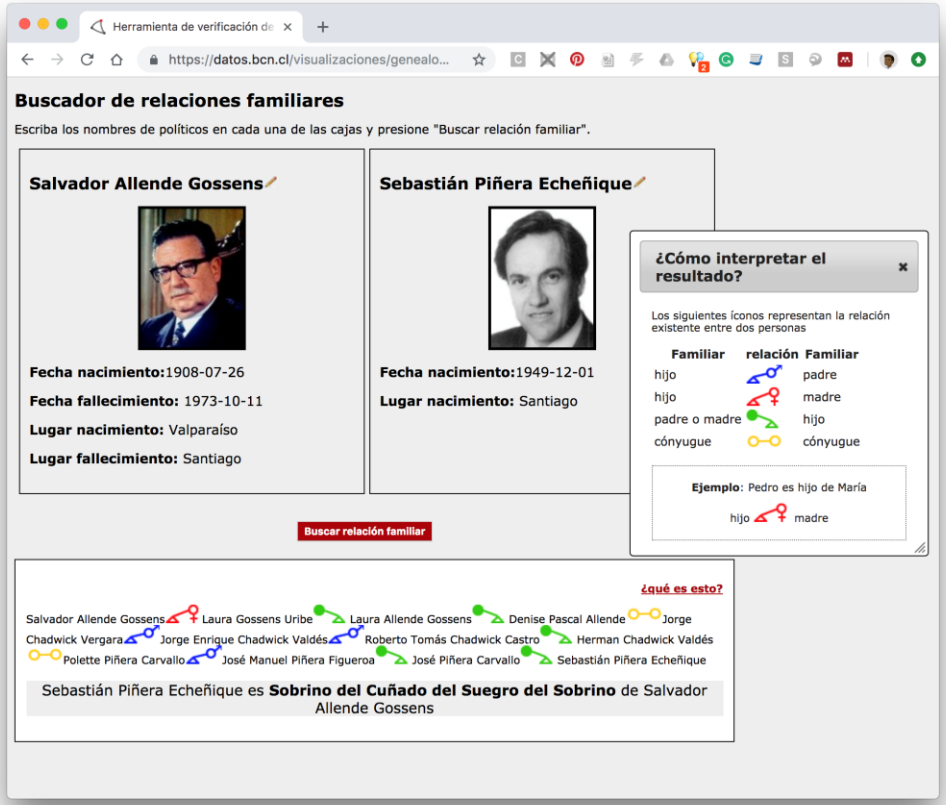


Historical parliament



http://datos.bcn.cl/visualizaciones/genealogia-parlamentaria/

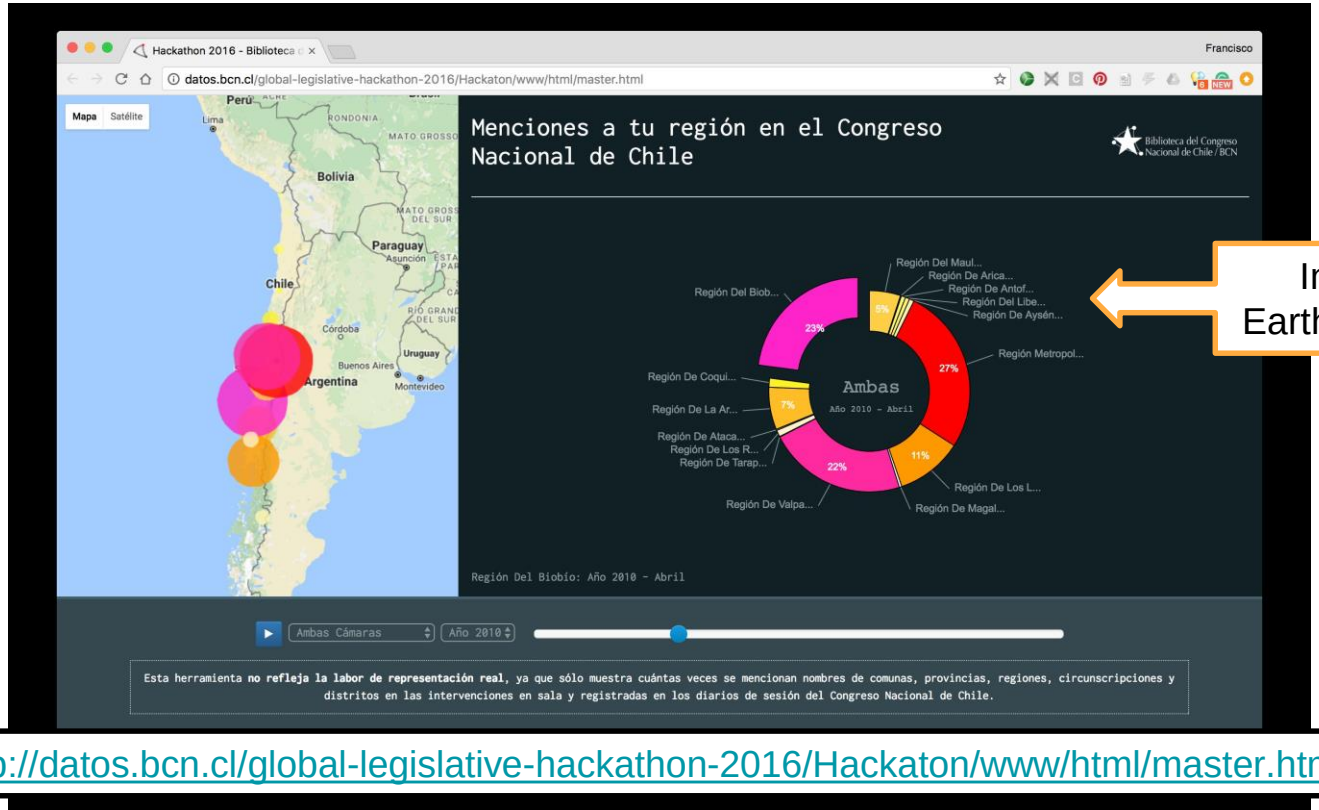
Parliamentary genealogy



http://datos.bcn.cl/visualizaciones/genealogia-parlamentaria/consulta.jsp

Regions mentioned by law

Result of a legislative hackathon



In 2010 there was an Earthquake in BioBio region

http://datos.bcn.cl/global-legislative-hackathon-2016/Hackaton/www/html/master.html

Statistics

24.368 documents (nov. 2018)

Number of RDF triples: 28 millions

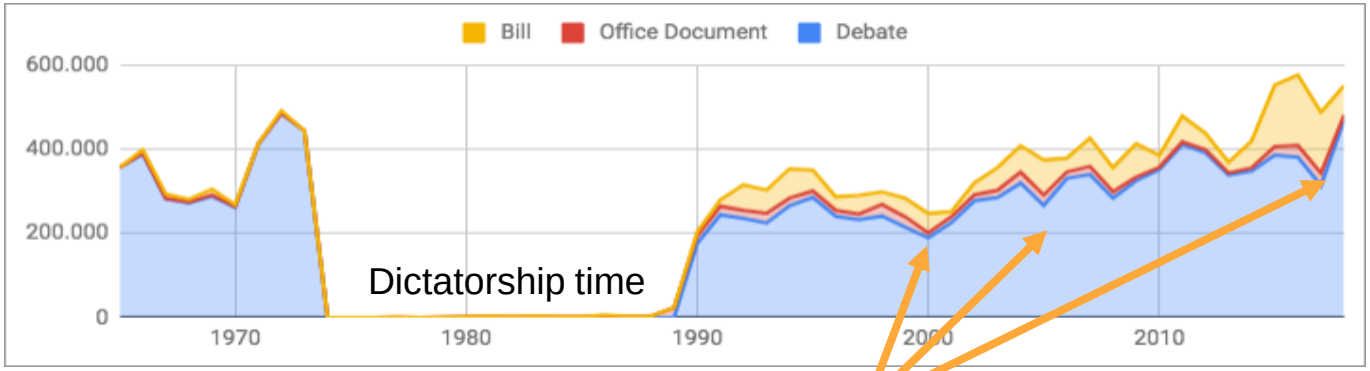
According to Google analytics

- Average browsing time: 2min 26s
- Visits received 331,481 (nov. 2016-2017) $\Rightarrow$ 476,241 (nov. 2017-2018)

Dataset		**RDF triples by document**						
Document type	*Total docs.*	*Min.*	*1st Qu.*	*Median*	*Mean*	*3rd Qu.*	*Max.*	*Stdev.*
Debate Senate	3.614	35	665	1.001	1.097	1.353	6.883	668,67
Debate Chamber of Deputies	4.298	35	1.166	1.640	1.788	2.199	11.771	961,42
Bills	2.514	37	109	308	689	864	15.934	1055,93
Others types	13.942	37	40	40	49,78	40	15.720	245,68
Total	24.368							

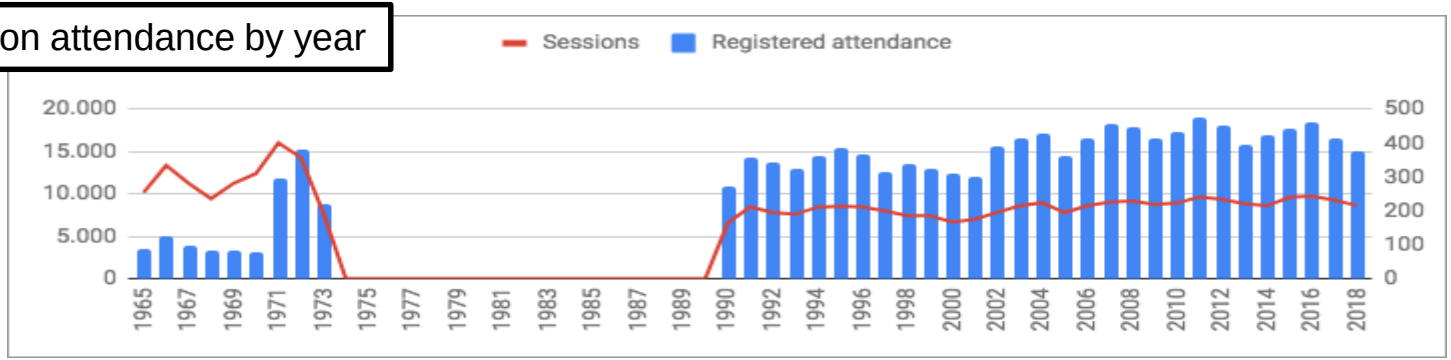
...and some findings...

RDF triples generated by year



Question: why are there some valleys?

Session attendance by year



Lessons learnt

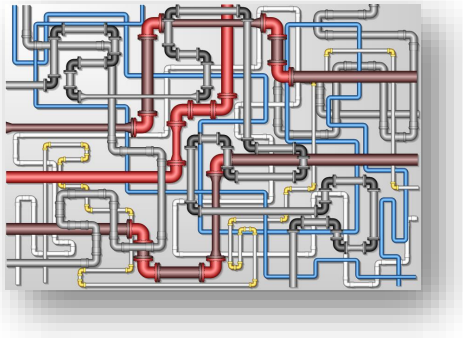
- RDF granularity & inference trade-off
  - RDF statements + inference (high running times...queries that didn't terminate)
  - *A priori* inferred triples added to triple store (high response times for large docs)
  - Small subset of RDF triples (structural parts of docs and metadata)
- Performance problems in XML editor browsing long docs (>1000pages)
- Low SPARQL endpoint usage by external apps
  - If we could start again, I would recommend ShEx
  - **Personal note**: These kind of projects led to my interest in ShEx

Conclusions & future projects

Well designed URIs can act as a perfect glue for interoperability

Automatic workflow pipelines help long-term survival of LD-based projects

- SPARQL endpoint since 2011



Future projects on top of existing ones

- National Budget as Linked data
- Diana Project: Members of Parliament linked to social network analysis
- New portal: User customization & recommender systems

2nd part
Linked data quality and Shapes

RDF, the good parts...

RDF as an integration language

RDF as a *lingua franca* for semantic web and linked data

RDF flexibility & integration

- Data can be adapted to multiple environments
- Open and reusable data by default

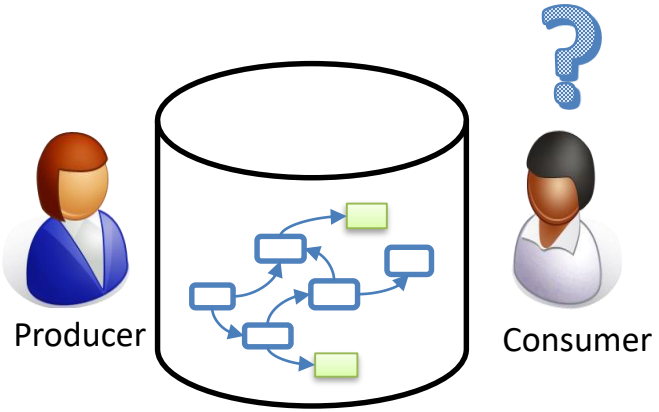
RDF for knowledge representation

RDF data stores & SPARQL

RDF, the other parts

Consuming & producing RDF

- Multiple syntaxes: Turtle, RDF/XML, JSON-LD, ...
- Embedding RDF in HTML
- Describing and validating RDF content



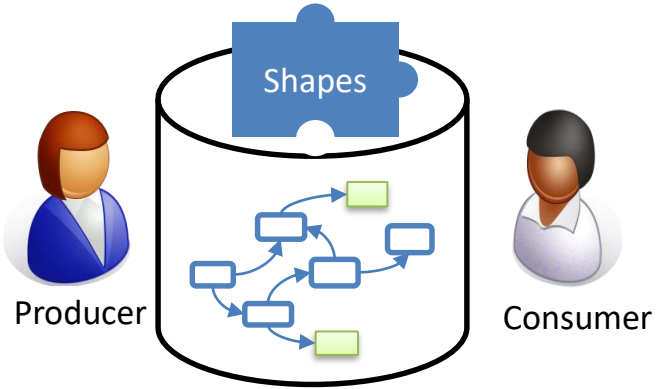
Why describe & validate RDF?

For producers

- Developers can understand the contents they are going to produce
- Ensure they produce the expected structure
- Advertise and document the structure
- Generate interfaces

For consumers

- Understand the contents
- Verify the structure before processing it
- Query generation & optimization



Similar technologies

Technology	Schema
Relational Databases	DDL
XML	DTD, XML Schema, RelaxNG, Schematron
Json	Json Schema
RDF	?

Fill that gap

ShEx and SHACL

2013 RDF Validation Workshop

- Conclusions of the workshop:
  - *There is a need of a higher level, concise language for RDF Validation*
- ShEx initially proposed (v 1.0)

2014 W3c Data Shapes WG chartered

2017 SHACL accepted as W3C recommendation

2017 ShEx 2.0 released as Community group draft

2019 ShEx adopted by Wikidata

Short intro to ShEx

ShEx (Shape Expressions Language)

Concise and human-readable language for RDF validation & description

Syntax similar to SPARQL, Turtle

Semantics inspired by regular expressions & RelaxNG

2 syntaxes: Compact and RDF/JSON-LD

Official info: http://shex.io

Semantics: http://shex.io/shex-semantics/, primer: http://shex.io/shex-primer

Simple example

Prefix declarations as in Turtle/SPARQL

```
prefix schema: <http://schema.org/>
prefix xsd:    <http://www.w3.org/2001/XMLSchema#>

<User> IRI {
 schema:name  xsd:string   ;
 schema:knows @<User>     *
}
```

Nodes conforming to `<User>` shape must:

- Be IRIs
- Have exactly one `schema:name` with a value of type `xsd:string`
- Have zero or more `schema:knows` whose values conform to <User>

RDF Validation using ShEx

Schema

```
<User> IRI {
 schema:name   xsd:string   ;
 schema:knows @<User>     *
}
```

Shape map

```
:alice@<User>✓
:bob  @<User>✓
:carol@<User>✗
:dave @<User>✗
:emily@<User>✗
:frank@<User>✓
:grace@<User>✗
```

Try it (RDFShape): https://goo.gl/97bYdv
Try it (ShExDemo):https://goo.gl/Y8hBsW

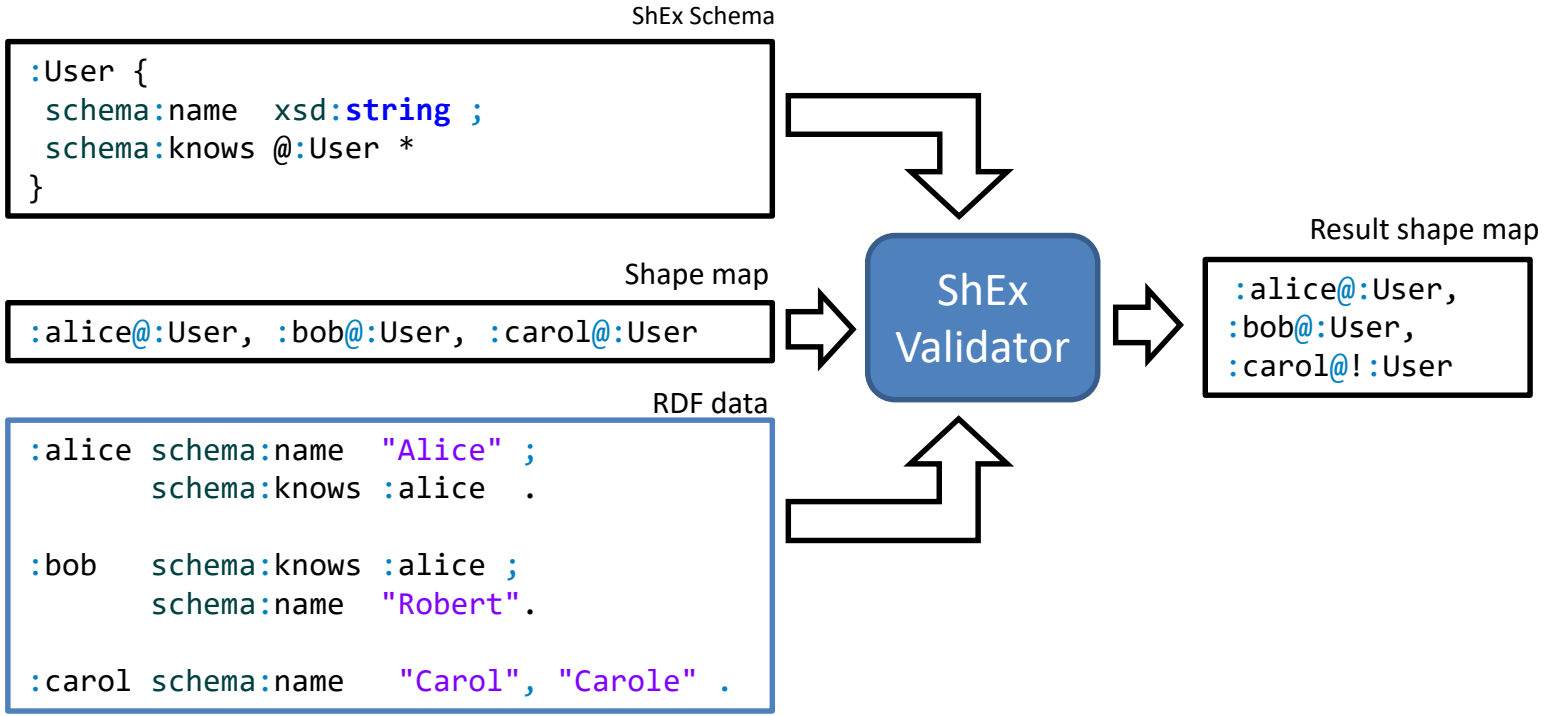
Data

```
:alice schema:name  "Alice" ;
       schema:knows :alice  .

:bob   schema:knows :alice ;
       schema:name  "Robert".

:carol schema:name   "Carol", "Carole" .

:dave  schema:name   234 .

:emily foaf:name     "Emily" .

:frank schema:name "Frank" ;
       schema:email <mailto:frank@example.org> ;
       schema:knows :alice, :bob .

:grace schema:name "Grace" ;
       schema:knows :alice, _:1 .

_:1 schema:name  "Unknown" .
```

Validation process

Input: RDF data, ShEx schema, Shape map

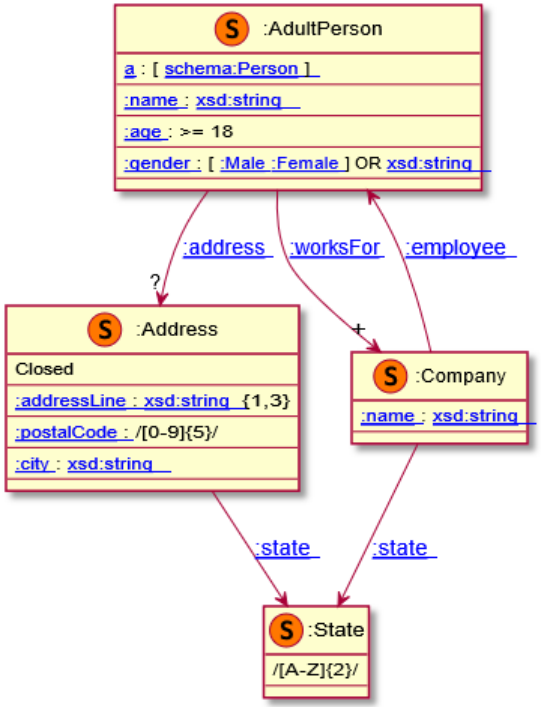
Output: Result shape map



Example with more ShEx features

```
:AdultPerson EXTRA rdf:type {
 rdf:type    [ schema:Person ]              ;
 :name       xsd:string                     ;
 :age        MinInclusive 18                ;
 :gender     [:Male :Female] OR xsd:string  ;
 :address    @:Address ?                    ;
 :worksFor   @:Company +
}
:Address CLOSED {
 :addressLine xsd:string {1,3}
 :postalCode  /[0-9]{5}/
 :state       @:State
 :city        xsd:string
}
:Company {
 :name      xsd:string
 :state     @:State
 :employee  @:AdultPerson *
}
:State    /[A-Z]{2}/
```

```
:alice rdf:type :Student, schema:Person ;
 :name       "Alice" ;
 :age        20 ;
 :gender     :Male ;
 :address    [
  :addressLine   "Bancroft Way" ;
  :city          "Berkeley" ;
  :postalCode    "55123" ;
  :state         "CA"
 ] ;
 :worksFor   [
  :name        "Company" ;
  :state       "CA"      ;
  :employee    :alice
] .
```



Try it: https://tinyurl.com/yd5hp9z4

SHACL

SHACL (Shapes Constraint Language)

W3C recommendation:

https://www.w3.org/TR/shacl/ (July 2017)

RDF vocabulary

2 parts: SHACL-Core, SHACL-SPARQL

Same example with blank nodes

```
prefix :       <http://example.org/>
prefix sh:     <http://www.w3.org/ns/shacl#>
prefix xsd:    <http://www.w3.org/2001/XMLSchema#>
prefix schema: <http://schema.org/>

:UserShape a sh:NodeShape ;
   sh:targetNode :alice, :bob, :carol ;
   sh:nodeKind sh:IRI ;
   sh:property [
    sh:path schema:name ;
    sh:minCount 1; sh:maxCount 1;
    sh:datatype xsd:string ;
  ] ;
  sh:property [
   sh:path schema:email ;
   sh:minCount 1; sh:maxCount 1;
   sh:nodeKind sh:IRI ;
  ] .
```

Shapes graph

```
:alice schema:name "Alice Cooper" ;
       schema:email <mailto:alice@mail.org> .

:bob   schema:firstName "Bob" ;
       schema:email <mailto:bob@mail.org> .

:carol schema:name "Carol" ;
       schema:email "carol@mail.org" .
```

☹ ☹

Data graph

Try it. RDFShape https://goo.gl/ukY5vq

Longer example

In ShEx

```
:AdultPerson EXTRA a {
 a           [ schema:Person ]              ;
 :name       xsd:string                     ;
 :age        MinInclusive 18                ;
 :gender     [:Male :Female] OR xsd:string  ;
 :address    @:Address ?                    ;
 :worksFor   @:Company +                    ;
}
:Address CLOSED {
 :addressLine xsd:string {1,3}              ;
 :postalCode  /[0-9]{5}/                    ;
 :state       @:State                       ;
 :city        xsd:string
}
:Company {
 :name     xsd:string                       ;
 :state    @:State                          ;
 :employee @:AdultPerson *                  ;
}
:State   /[A-Z]{2}/
```

In SHACL

```
:AdultPerson a sh:NodeShape ;
  sh:property [
   sh:path rdf:type ;
   sh:qualifiedValueShape [
      sh:hasValue schema:Person
   ];
   sh:quali
   sh:quali
 ] ;
 sh:targetl
   sh:prop
    sh:min
    sh:dat
 ] ;
 sh:prope
   sh:minC
   sh:in (
 ] ;
 sh:prope
   sh:maxC
   sh:minI
 ] ;
 sh:proper
   sh:node
   sh:minCount 1 ; s
 ] ;
 sh:property [ sh:path :worksFor ;
   sh:node :Company ;
   sh:minCount 1 ; sh:maxCount
 ].
```

```
:Address a sh:NodeShape ;
 sh:closed true ;
 sh:property [ sh:path :addressLine;
   sh:datatype xsd:string ;
   sh:mi
 ] ;
 sh:prope
   sh:pat
   sh:mi
 ] ;
 sh:prope
   sh:dat
   sh:mi
 ] ;
 sh:prope
   sh:noc
 ] .
```

```
:Company a sh:NodeShape ;
 sh:property [ sh:path :name ;
   sh:datatype xsd:string
   ] ;
 sh:property [
   sh:path :state ;
   sh:node :State
 ] ;
 sh:property [ sh:path :employee ;
   sh:node :AdultPerson ;
 ] ;.

:State a sh:NodeS pe ;
   sh:pattern "[A ]{2}" .
```

Its recursive!!! (not well defined SHACL)
Implementation dependent feature

Try it: https://tinyurl.com/ycl3mkzr

Some challenges and perspectives

Theoretical foundations of ShEx/SHACL

Generating shapes from data

Validation Usability

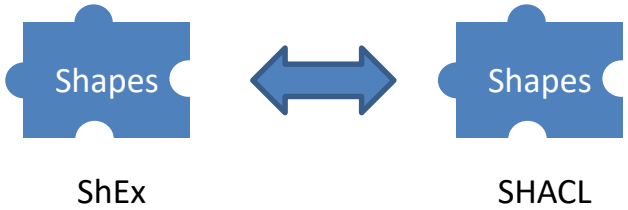
RDF Stream validation

Schema ecosystems

- Wikidata
- Solid

Theoretical foundations of ShEx/SHACL

- Conversion between ShEx and SHACL
  - SHaclEX library converts subsets of both
  - Challenges
    - Recursion and negation
    - Performance and algorithmic complexity
    - Detect useful subsets of the languages
  - Convert to SPARQL
- Schema/data mapping



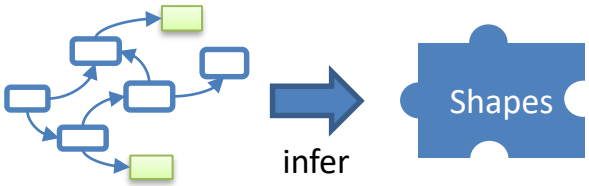
Generating Shapes from Data

Useful use case in practice

Knowledge Graph summarization

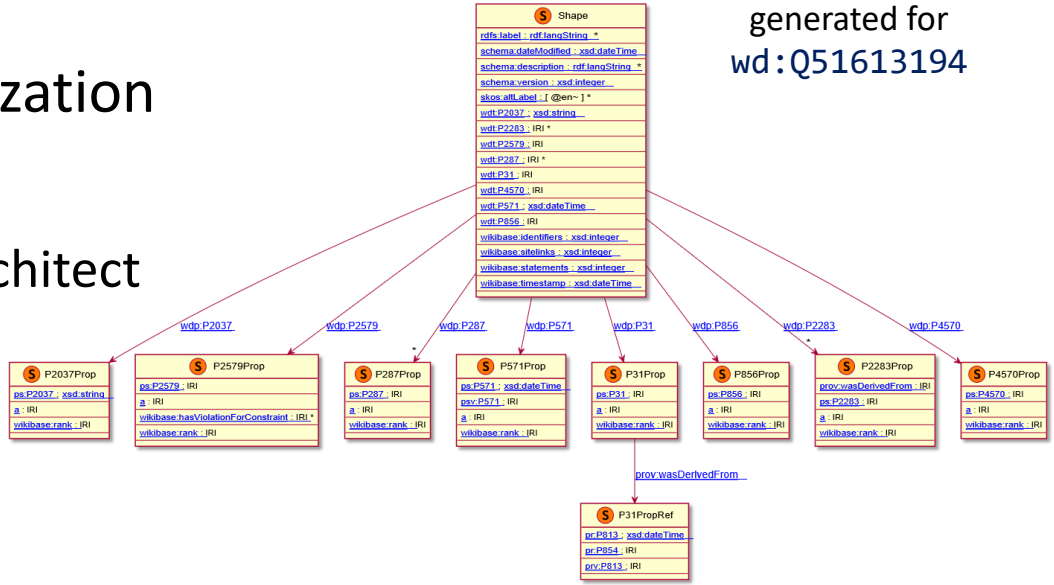
Some prototypes:

ShExer, RDFShape, ShapeArchitect



RDF data

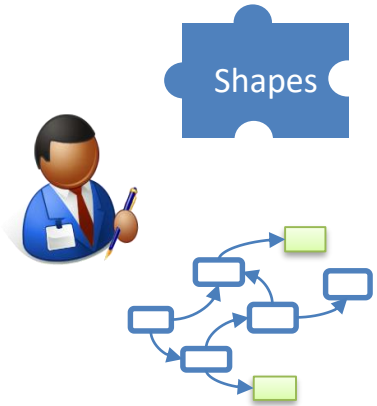
Shape Expression generated for `wd:Q51613194`



Try it with RDFShape:
https://tinyurl.com/y8pjcbyf

Validation usability

- Learning from users
  - Early adopters: WebIndex, HL7 FHIR, Eclipse Lyo, GenWiki,…
  - Improve error information/visualization/navigation/repairing
- Authoring/visualization tools
- Propose annotation sets
  - UI generation
  - Error reporting/suggestion (SHOULD/MUST/…)

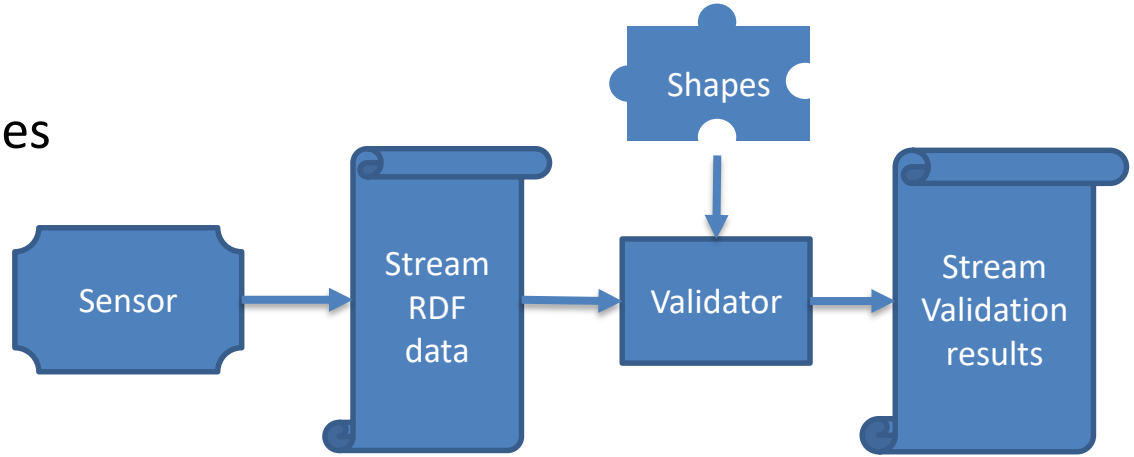


RDF Stream validation

Validation of RDF streams

Challenges:

- Incremental validation
- Named graphs
- Addition/removal of triples



Schema ecosystems: Wikidata

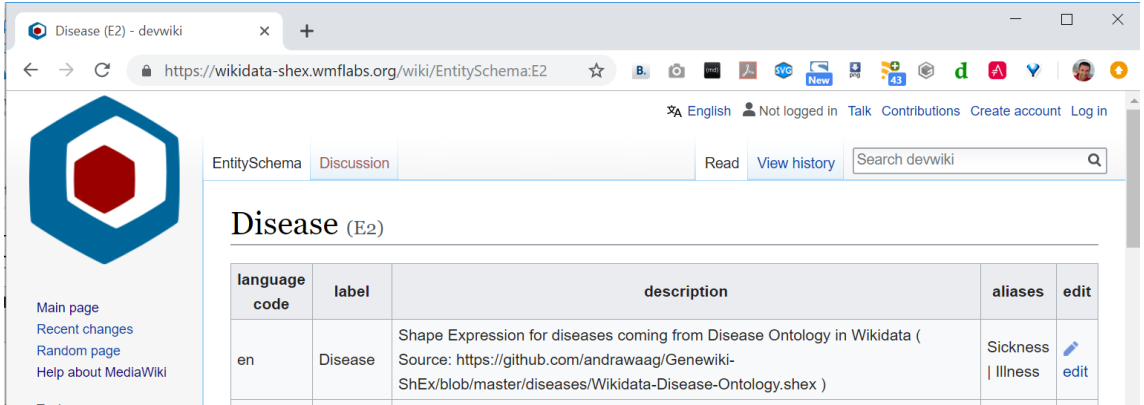
In May, 2019, Wikidata announced ShEx adoption

New namespace for schemas

Example: https://www.wikidata.org/wiki/EntitySchema:E2

It opens lots of opportunities/challenges

Schema evolution and comparison



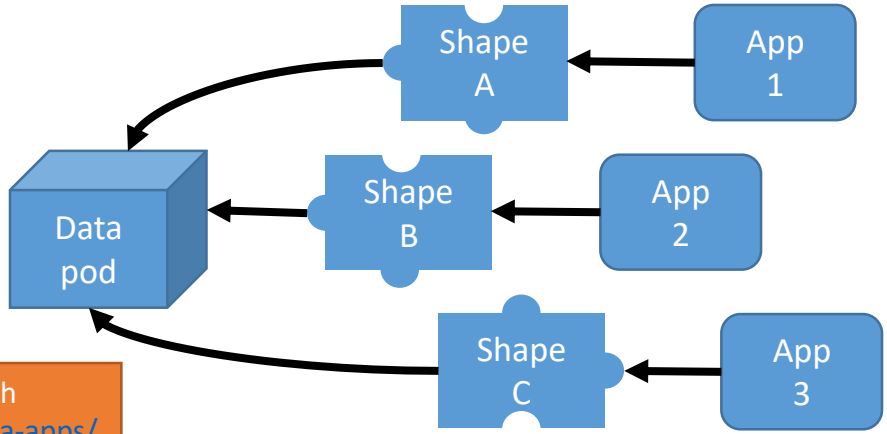
Schema ecosystems: Solid project

SOLID (SOcial Linked Data): Promoted by Tim Berners-Lee

Goal: Re-decentralize the Web

- Separate data from apps
- Give users more control about their data
- Internally using linked data & RDF

Shapes needed for interoperability



"...I just can't stop thinking about shapes.", Ruben Verborgh
https://ruben.verborgh.org/blog/2019/06/17/shaping-linked-data-apps/

Conclusions

Explicit schemas (shapes) can improve linked data quality

2 languages proposed: ShEx/SHACL

Towards an ecosystem of shapes for data portals

New challenges and opportunities

More info

About ShEx

ShEx by Example (slides):

https://figshare.com/articles/ShExByExample_pptx/6291464

ShEx chapter from Validating RDF data book:

http://book.validatingrdf.com/bookHtml010.html

About SHACL

SHACL by example (slides):

https://figshare.com/articles/SHACL_by_example/6449645

SHACL chapter at Validating RDF data book

http://book.validatingrdf.com/bookHtml011.html

Comparing ShEx and SHACL

http://book.validatingrdf.com/bookHtml013.html

Biblioteca del Congreso Nacional de Chile / BCN

End of presentation

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