Financial Regulation Ontology

Tutorial chapter two – loading the law

Importing the text of US laws and regulations into the Financial Regulation Ontology

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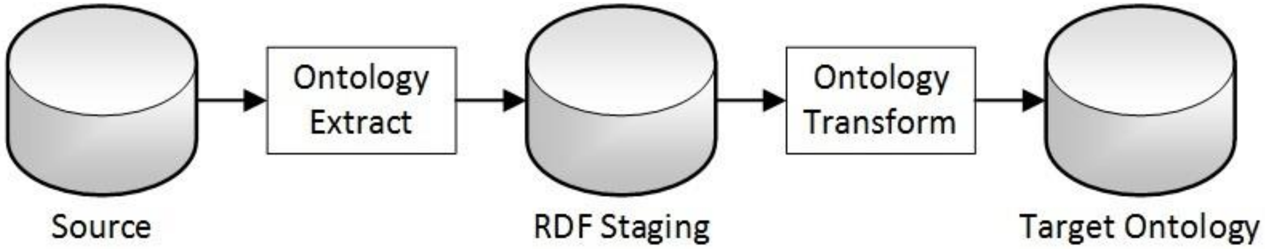
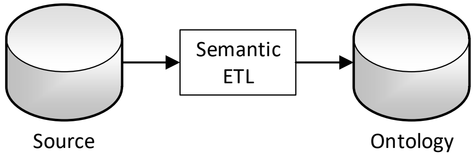


Loading the law – approach and perspectives

The chapter introduces legislative Use Cases and our approach Semantic ETL. Then we take the less complex source, Code of Federal Regulations (CFR) end-to-end from extract, transformation and load into FRO ontology. Finally we load the United State Code (USC).

BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

U.S. SECURITIES AND EXCHANGE COMMISSION MCMXXXIV



AUTHENTICATED U.S. GOVERNMENT INFORMATION GPO

Office of the Law Revision Counsel UNITED STATES CODE

ESTRELLA

Fin Reg Ont

Static Reference Data

The Federal Reserve Bank (FED) is the primary regulator for US Banks. The Securities & Exchange Commission (SEC) regulates Investment Funds. US Congress makes the law. We show how LKIF and FRO model these agents, their relationships and actions.

Semantic Integration

Semantic Data Integration is still Extract, Transform, and Load. The tutorial shows conceptual, logical and physical Data Integration model in a semantic environment. We use the TopBraid[1] ontology toolset, but other ontology platforms and RDF data stores can substitute.

XML Source

The Government Publishing Office (GPO) provides XML versions of the Code of Federal Regulations (CFR). FRO imports CFR Title 12 Banking and 17 Investment Adviser Act. The Office of the Law Revision Council (OLRC) codifies the law and publishes in XML format. FRO imports USC Title 12 and 15.

Ontology Model

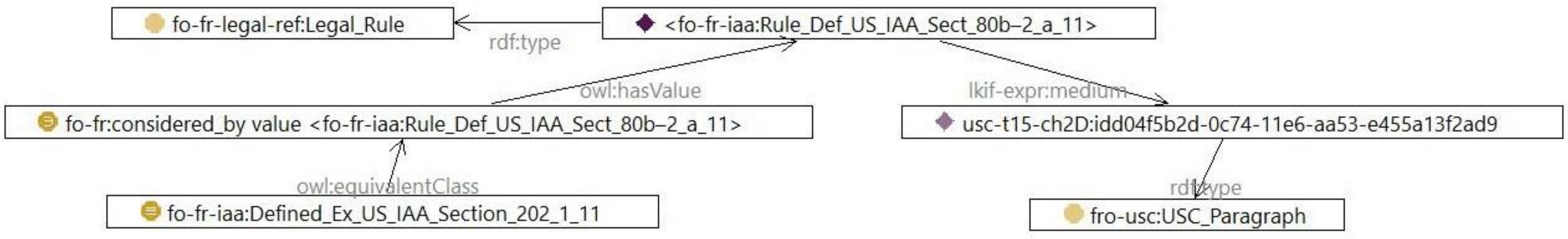
This chapter dives deeper into Estrella LKIF modules Action and Medium. We explain where reference and XML source data instantiate classes and properties. FRO extensions to the reference ontology implement a Legal Document structure of defined classes and primitives for CFR and USC

* See Nuria Casellas for an in-depth introduction and comparison of Legal Ontologies

FRO ties Legal Rules to the text of the law

The Ontology **Knowledge** layer makes the coding **logic** transparent to provide **Proof** and **Trust**.

We want the law and regulations within the ontology and directly link them to their implementation. The diagram shows a Legal Rule, Investor Adviser Act Section §80b-2a 11, the SEC definition of Investment Advisers.


fo-fr-legal-ref:Legal_Rule
rdf:type
<fo-fr-iaa:Rule_Def_US_IAA_Sect_80b–2_a_11>
owl:hasValue
lkif-expr:medium
fo-fr:considered_by value <fo-fr-iaa:Rule_Def_US_IAA_Sect_80b–2_a_11>
usc-t15-ch2D:idd04f5b2d-0c74-11e6-aa53-e455a13f2ad9
owl:equivalentClass
rdf:type
fo-fr-iaa:Defined_Ex_US_IAA_Section_202_1_11
fro-usc:USC_Paragraph

The class Ex US IAA Section 202_1_11 has the axioms for Investment Advisors to be included under the SEC Rule:

The owl:equivalentClass defines then as a UNION of
fo-fr-iaa:Defined_Ex_US_IAA_Section_202_1_11_business
and fo-fr-iaa:Defined_Ex_US_IAA_Section_202_1_11_service
and fo-fr-iaa:Defined_Ex_US_IAA_Section_202_1_11_compensation
These are subclasses that in turn define the axioms for the SEC criteria. Likewise the exclusions are encoded as Defined Classes. The Reasoner will evaluate the axiom and place matching Funds as individuals of the defined class. Chapter III – legal reasoning of the tutorial will explain in detail.

The property lkif-expr:medium ties the Legal Rule to the USC_Paragraph of the Legal Document.

The Paragraph states: “Investment adviser means any person who, for **compensation**, engages in the **business** of advising others…”

Compliance officers and ontology modeler work together translating the legal requirement into a well-defined hierarchy of class definitions. Business Requirements, mapping, business rule logic – **everything is a triple**.

Legislative context of USC and CFR

The use case diagram depicts the legislative processes and government actors that FRO is interested in

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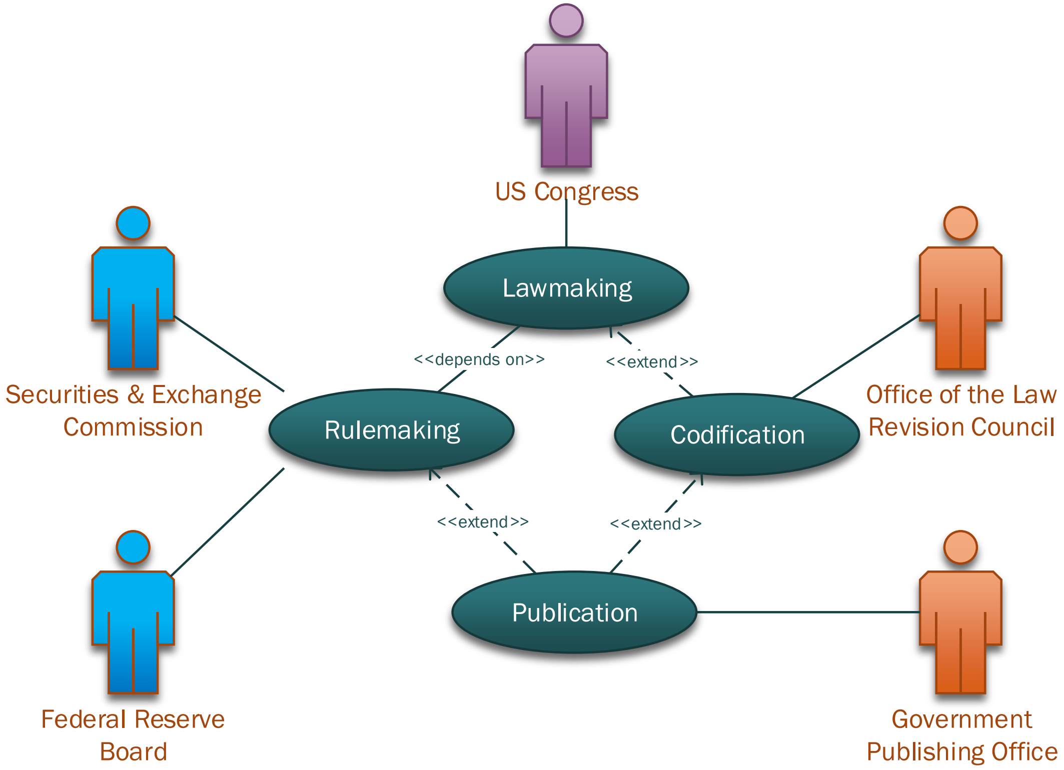
Codification and Publication produce the official version of laws and regulation.

- US Congress enacts the Law. The original bills passed are input for Rulemaking and Codification. FRO doesn't hold the bills, but rather revised and codified positive version.
- Office of the Law Revision Council codifies the law has an XML available for download.
- The financial regulators, SEC, FED and others are authors of Code of Federal Regulations.
- Government Publishing Office make the Code of Federal Regulations available in XML.

The next pages show how FRO captures government actors and processes as static reference data.



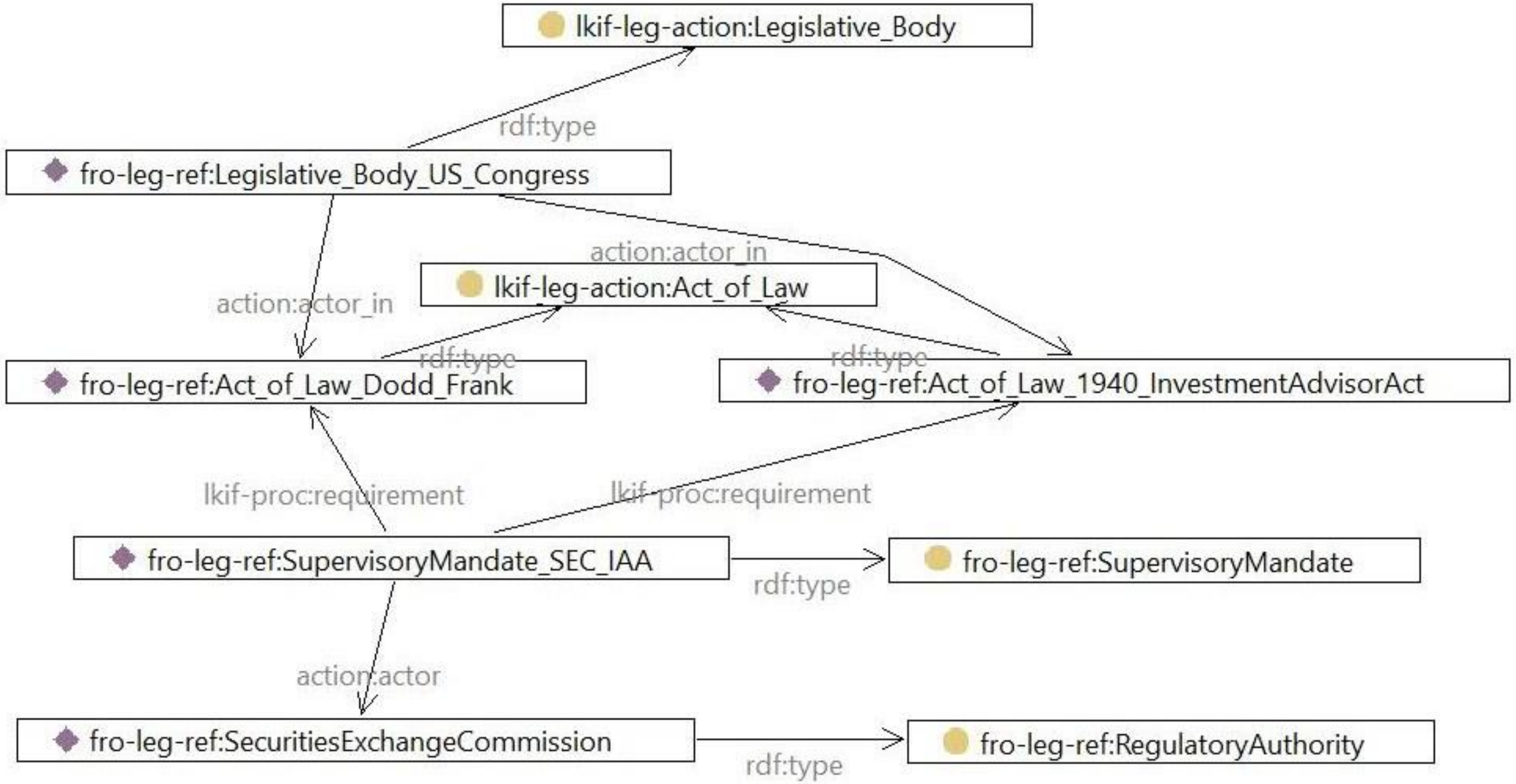
US Congress and Lawmaking in the ontology

LKIF and FRO ontology classes hold the Lawmaking use case. The diagram shows instance at the left and their classes, (rdf:type property) to the right. The Supervisory mandate connects to the SEC.

The United States Congress is a LKIF Legislative Body.

The LKIF Act of Law is the passing of a bill. That is when Dodd Frank and the Investment Adviser Act became Law.

The Act of Law authorizes the Securities and Exchange Commission(SEC) to supervise Advisers (the Investment Funds). The FRO Supervisory Mandate is a subclass of LKIF Mandate, with a Regulatory Authority (the SEC) as an actor.


lkif-leg-action:Legislative_Body
rdf:type
fro-leg-ref:Legislative_Body_US_Congress
action:actor_in
lkif-leg-action:Act_of_Law
action:actor_in
rdf:type
rdf:type
fro-leg-ref:Act_of_Law_Dodd_Frank
fro-leg-ref:Act_of_Law_1940_InvestmentAdvisorAct
lkif-proc:requirement
lkif-proc:requirement
fro-leg-ref:SupervisoryMandate_SEC_IAA
rdf:type
fro-leg-ref:SupervisoryMandate
action:actor
fro-leg-ref:SecuritiesExchangeCommission
rdf:type
fro-leg-ref:RegulatoryAuthority

Regulators and Rulemaking in the ontology

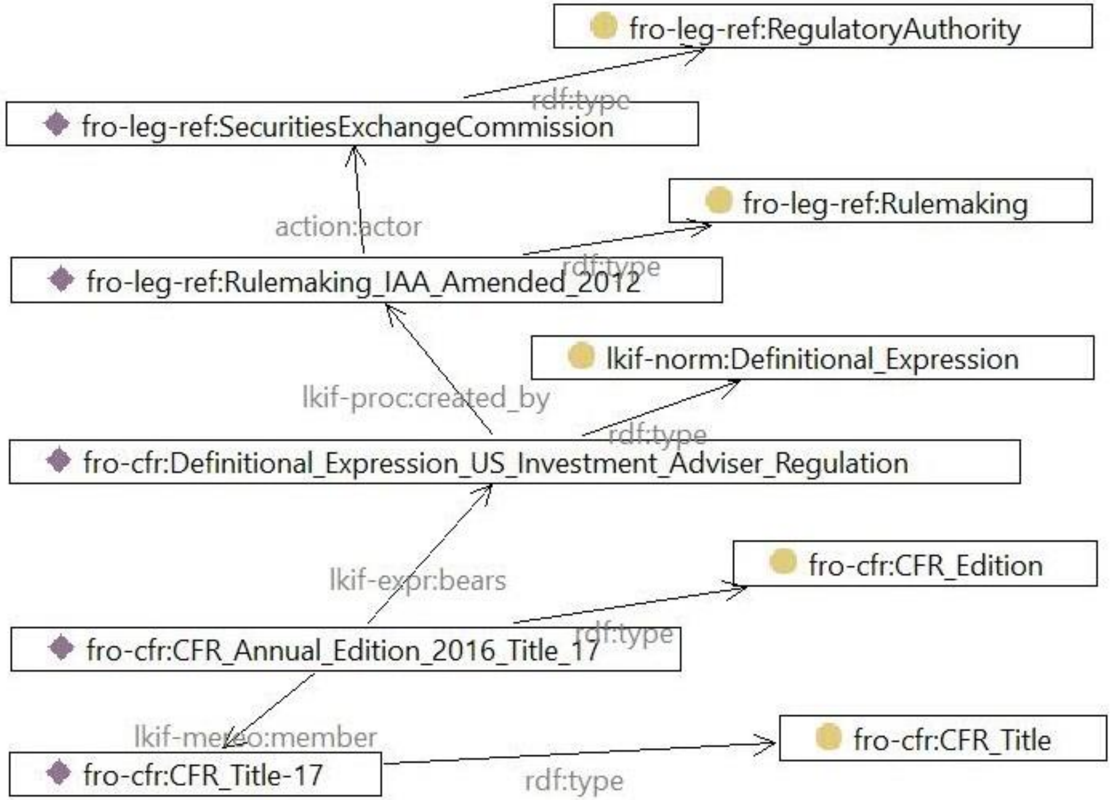
LKIF and FRO ontology classes hold the details of the Rulemaking use case. The diagram shows instance at the left and their classes, (rdf:type property) to the right. CFR Title 17, Rule and Regulations, Investment Adviser Act holds the actual text.

The Securities & Exchange Commission is a FRO Regulatory Authority, a subclass of FRO Executive Body, which is a subclass of LKIF Public Body. The SEC is lkif:actor of the Rulemaking.

The SEC's the 2012 amendment of rules for Investment Adviser Act of 1940 is a FRO Rulemaking. Rulemaking, Codification and Publishing are LKIF Public Acts, a subclass of LKIF Action and Process.

The Rulemaking creates a LKIF Definitional Expression. LKIF differentiates Expressions from the Process.

The LKIF Definitional Expression bears a Medium. The medium is the actual document. CFR Annual Edition 2016 Title 17 is the FRO Edition. An update of the rules will have a new instance of the edition.


fro-leg-ref:RegulatoryAuthority
rdf:type
fro-leg-ref:SecuritiesExchangeCommission
action:actor
fro-leg-ref:Rulemaking
rdf:type
fro-leg-ref:Rulemaking_IAA_Amended_2012
lkif-norm:Definitional_Expression
lkif-proc:created_by
rdf:type
fro-cfr:Definitional_Expression_US_Investment_Adviser_Regulation
lkif-expr:bears
fro-cfr:CFR_Edition
rdf:type
fro-cfr:CFR_Annual_Edition_2016_Title_17
lkif-mereo:member
fro-cfr:CFR_Title
fro-cfr:CFR_Title-17
rdf:type

Codification of the Law in the ontology

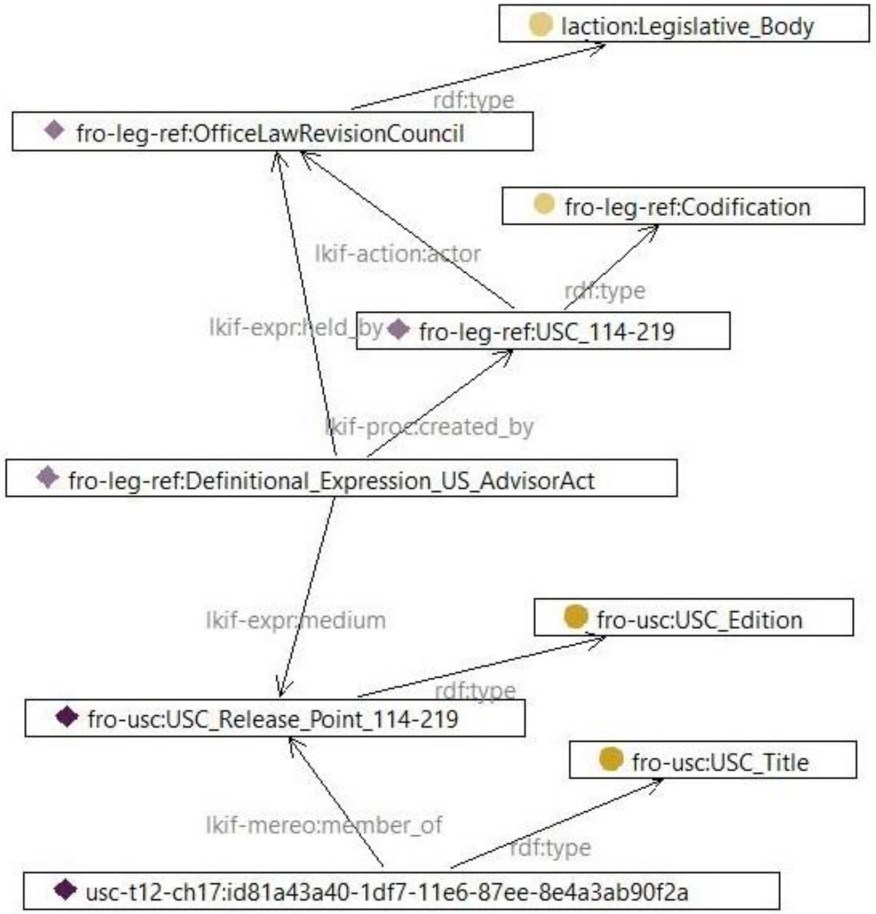
“Positive law codification by the Office of the Law Revision Counsel is the process of preparing and enacting a codification bill to restate existing law as a positive law title of the United States Code.” [1]

FRO has the Office of the Law Revision Council (OLRC) has a LKIF Legislative Body, because it works for Congress.

“USC_114-219” is the FRO Codification process, a subclass of LKIF Public Act.

The Definitional Expression US Advisor Act is created by the codification. The expression is held by OLRC thus in turn by Congress.

The medium that bears the expression is the Release Point 114-219 of 29 July 2016. FRO Edition is subclass of LKIF Statute, which is subclass LKIF Legal Document
“usc-t12-ch17:id81a43…” is the instance of the FRO USC Title, root of over 1,100 components with the text of the law.



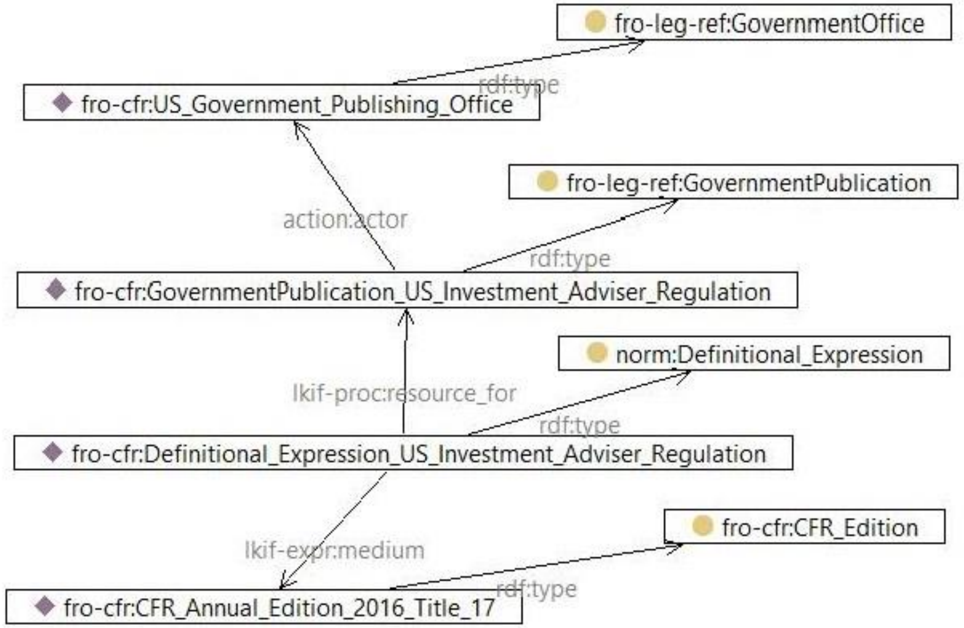
Publication of Regulations in the ontology

The Government Publishing Office (GPO) makes regulations and laws available to the public. The design pattern follows Lawmaking, Rulemaking, and Codification.

The GPO is a FRO Government Office, a subclass of LKIF Executive Body and sibling of FRO Regulatory Authority.

The Government Publication – US Investment Adviser regulation is a FRO Government Publication, sibling of Rulemaking and Codification. All subclass of LKIF Public Acts, a subclass of LKIF Action and Process.

LKIF Definitional Expression was created by the SEC Rulemaking Process we looked at before. It is the resource for the Government Publication. Both are linked to the same version of the text, CFR Annual Edition Title 17.

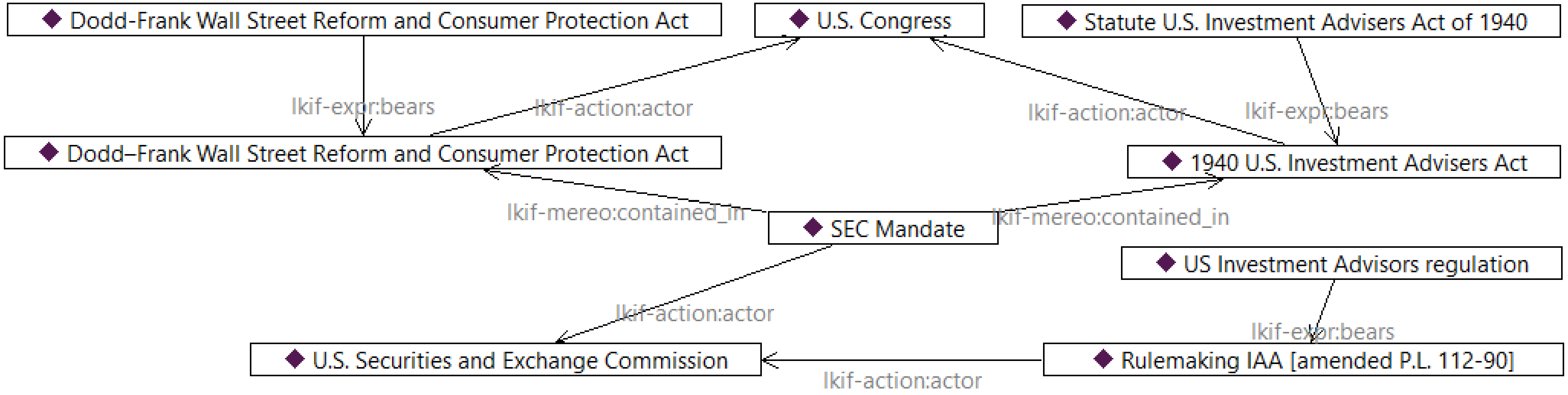


● fro-leg-ref:GovernmentOffice
rdf:type
◆ fro-cfr:US_Government_Publishing_Office
● fro-leg-ref:GovernmentPublication
action:actor
rdf:type
◆ fro-cfr:GovernmentPublication_US_Investment_Adviser_Regulation
● norm:Definitional_Expression
lkif-proc:resource_for
rdf:type
◆ fro-cfr:Definitional_Expression_US_Investment_Adviser_Regulation
● fro-cfr:CFR_Edition
lkif-expr:medium
rdf:type
◆ fro-cfr:CFR_Annual_Edition_2016_Title_17

Note: GPO also publishes PDF and text versions of the United States Code. The Office of the Law Revision Council publishes the XML version in addition. For purposes of Financial Regulation we don't need to model all intricacies of the Use Cases. Just the context of our XML sources.

The SEC Mandate in context

The diagram shows LKIF instances to define semantics of the IAA legal background.
Congress enacted (**actor**) the 1940 Investor Adviser Act and the Dodd-Frank Act. There are two instances each: The Act and the Statute. The Statute **bears** the text of the Act of Law passed in congress.



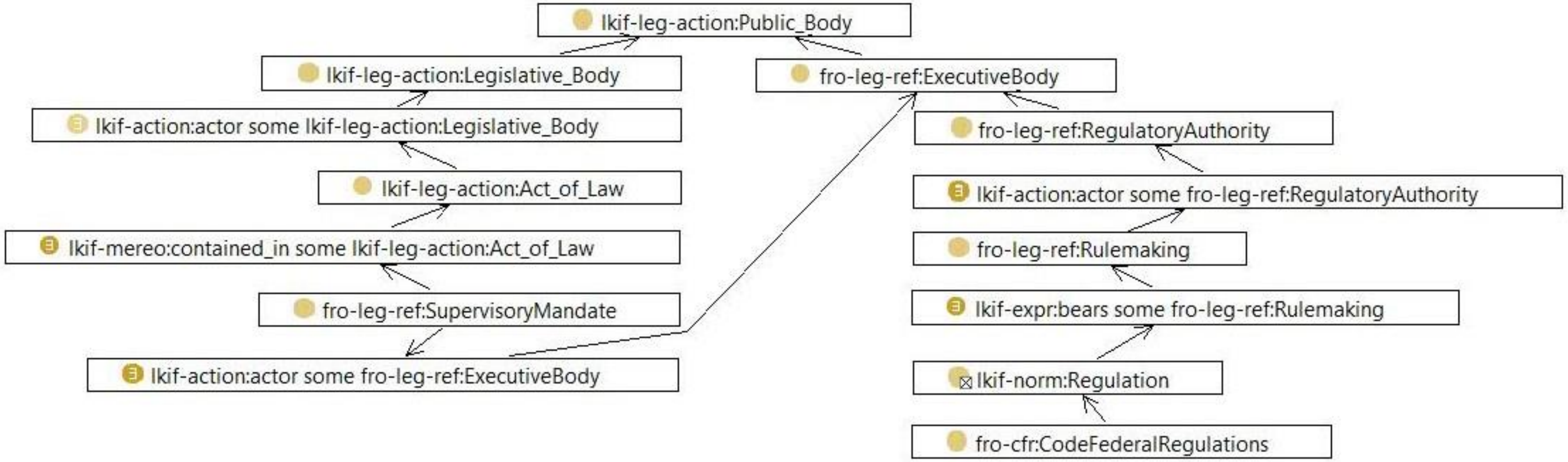
◆ Dodd-Frank Wall Street Reform and Consumer Protection Act
◆ U.S. Congress
◆ Statute U.S. Investment Advisers Act of 1940
lkif-expr:bears
lkif-action:actor
lkif-action:actor
lkif-expr:bears
◆ Dodd–Frank Wall Street Reform and Consumer Protection Act
◆ 1940 U.S. Investment Advisers Act
lkif-mereo:contained_in
◆ SEC Mandate
lkif-mereo:contained_in
◆ US Investment Advisors regulation
lkif-action:actor
lkif-expr:bears
◆ U.S. Securities and Exchange Commission
◆ Rulemaking IAA [amended P.L. 112-90]
lkif-action:actor

The laws **contain** provisions that give the Security and Exchange Commission a **mandate** to supervise Investment Advisers. The SEC **enacted** a Rulemaking (IAA amended P.L. 112-90). In other words, the SEC announced the final version the regulation. The US Investment Advisers regulation **bears** the text of the rules (e.g. CFR-2012-title 17-vol3 part 275).

Main FRO/LKIF classes in context

The graph shows some of the LKIF and HFR classes for the instances. Solid yellow dots represent primitive classes.

∃ Existential ‘some’ restriction ∀ universal ‘only’ restriction



lkif-leg-action:Public_Body

lkif-leg-action:Legislative_Body

lkif-action:actor some lkif-leg-action:Legislative_Body

lkif-leg-action:Act_of_Law

lkif-mereo:contained_in some lkif-leg-action:Act_of_Law

fro-leg-ref:SupervisoryMandate

lkif-action:actor some fro-leg-ref:ExecutiveBody

fro-leg-ref:ExecutiveBody

fro-leg-ref:RegulatoryAuthority

lkif-action:actor some fro-leg-ref:RegulatoryAuthority

fro-leg-ref:Rulemaking

lkif-expr:bears some fro-leg-ref:Rulemaking

lkif-norm:Regulation

fro-cfr:CodeFederalRegulations

Legislative Body is the class for US Congress. The **Executive Body** holds the SEC and other **Regulatory Authorities**. An existential restriction ties the Legislative Body to the **Act of Law**. The US IIA and Dodd-Frank are an acts of law. The Act of Law contains a **Supervisory Mandate**. A class restriction refers to the Executive Body that got the mandate. Corresponding to the Act of Law we have a class for the **Rulemaking**. The **Regulation** class anchor for rules.

Data sources for laws and regulations

FRO sources XML for the United States Code from OLRC and the Code of Feral Regulations XML from GPO.

United States Congress enacted the Investor Adviser Act in 1940 to monitor and regulate the activities of Investment Advisers.
https://www.sec.gov/about/laws/iaa40.pdf
The act placed mutual funds, closed-end funds, unit investment trusts, and exchange-traded funds under SEC regulation and supervision.
The 2010 Dodd Frank Act (DOF), Title IV required most Hedge and Private Equity Funds to register with the SEC. Full text:
https://www.sec.gov/about/laws/wallstreetreform-cpa.pdf

The Office of the Law Revision Counsel (OLRC) of the US House of Representatives codifies and publishes the United States Code. As Positive Law the OLRC provides the latest version of the act including all changes and amendments.
The OLRC website has the current laws available for download on their website:
http://uscode.house.gov/download/download.shtml

FRO uses the OLRC XML Title 12 and 15 as a data source.

The Security and Exchange Commission implements the law.
The SEC revises the Code of Federal Regulation with detailed instructions, forms, and procedures. The SEC hands over the new CFR to GPO for publication.
The SEC supervises Investment Companies and Advisers.
Note: For Banking the Federal Reserve is the main regulator. We cover the SEC in this tutorial, but the integration is the same.

The Government Publishing Office is the official source for Federal Government information.
The "bulk" data is available in on the Federal Digital System (FDSys).
https://www.gpo.gov/fdsys/bulkdata/CFR/2016
The XML schema and a user guide are also available.
http://www.gpo.gov/fdsys/bulkdata/CFR/resources/CFRMergedXML.xsd
http://www.gpo.gov/help/fdsys_user_manual.pdf

FRO uses GPO XML files as a source for CFR.

CFR and USC in FinRegOnt ontology files

Financial Regulation Ontology instance files contain the text of laws & regulations relevant to Investment and Banking.

United States Code			
Title		Chapter	
12	Banks and Banking	17	Bank Holding Companies
		53	Wall Street Reform and Consumer Protection
15	Commerce and Trade	275	Investment Companies and Advisers

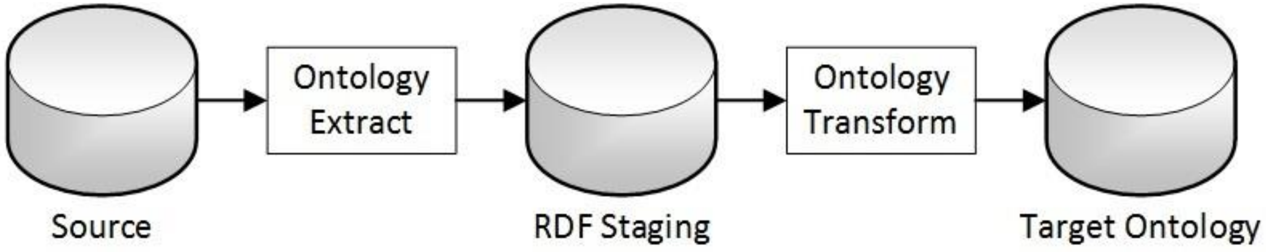
Code of Federal Regulations					
Title		Chapter		Part	
12	Banks and Banking	II	Federal Reserve System	217	Capital Adequacy of Board Regulated Institutions
				225	Bank Holding Companies and change in Bank Control (Regulation Y)
				252	Enhanced Prudential Standards
17	Commodity and Securities Exchanges	II	Securities and Exchange Commission	275	Rules and Regulations, Investment Advisers Act of 1940

http://finregont.com/fro/usc/
FRO_USC_Title_12_Chapter_17.ttl
FRO_USC_Title_12_Chapter_53.ttl
FRO_USC_Title_15_Chapter_2D.ttl

http://finregont.com/fro/cfr/
FRO_CFR_Title_12_Part_217.ttl
FRO_CFR_Title_12_Part_225.ttl
FRO_CFR_Title_12_Part_252.ttl
FRO_CFR_Title_17_Part_275.ttl

FRO Semantic Integration models

This section describes the architecture moving Legal Sources into the Financial Regulation Ontology. The Data Integration process is similar to traditional Warehouses. We adopt the Giordano's integration modelling approach (Anthony David Giordano Data Integration Blueprint and Modeling, IBM Press 2011)[1]



High Level Conceptual Semantic Integration Model

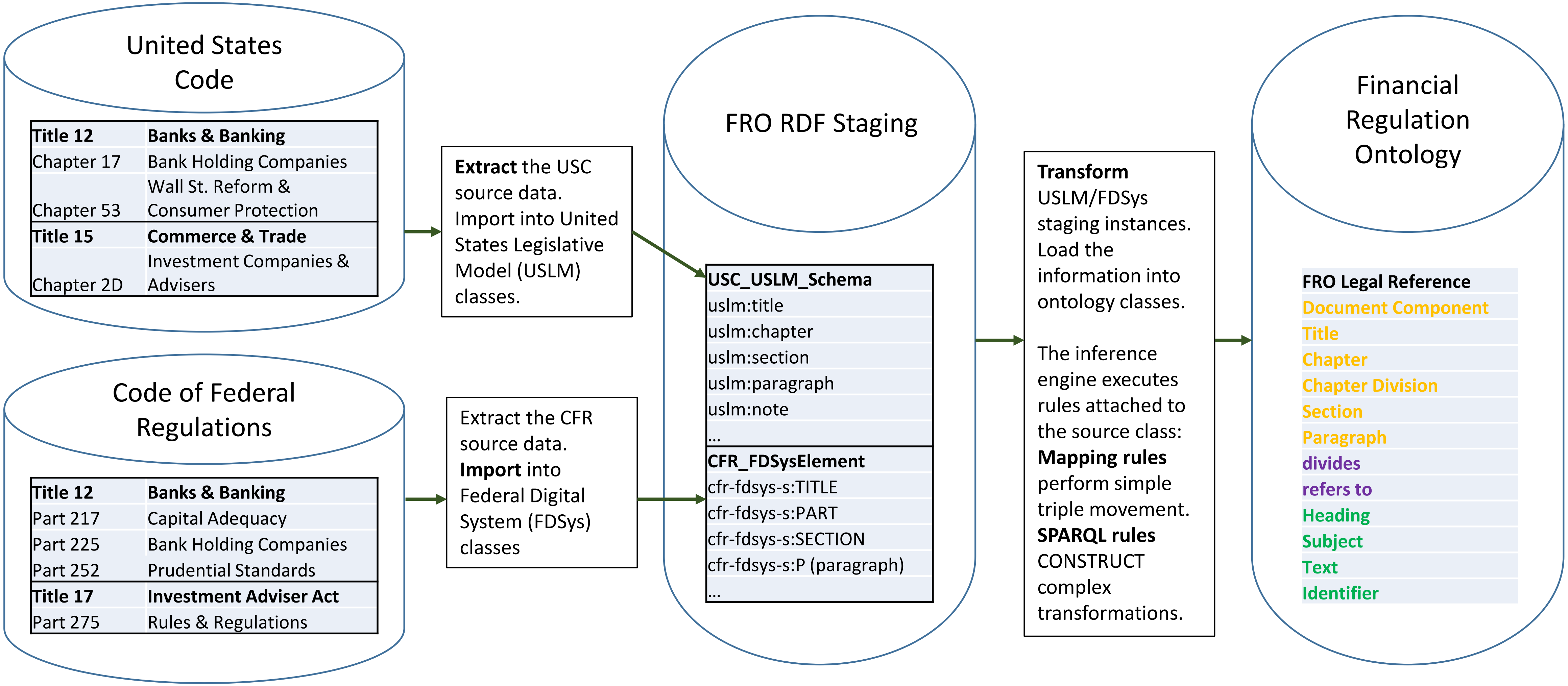
The "database" symbols stand for persistent storage in general. The rectangles denote a process.

Data sources can have various formats:
Ontology files, XML, Spreadsheets, RDF Databases, any data source with JDBC connectivity.
We use TopBraid Maestro[1] to import XML, but the Protégé and RDF Database environment also provide imports.
RDF Staging and Target Ontology can be OWL files or graphs in a RDF Database.
The Ontology Extract imports the Data Source and stores it in a "dumb" RDF Staging representation.

The Ontology Transformation operates completely in the Semantic environment. The transformation logic is encoded in SPARQL rules. We use TopBraid SPIN[2], but Protégé and RDF Database environments also support SPARQL based rules.

RDF Staging is critical to the architecture and should not be bypassed. We do not want to encode business logic in the Extract process.
We want uniform staging classes and utilize semantic transformation not matter what the data source is.

Semantic integration Logical Model



United States Code

Title 12	**Banks & Banking**
Chapter 17	Bank Holding Companies
Chapter 53	Wall St. Reform & Consumer Protection
Title 15	**Commerce & Trade**
Chapter 2D	Investment Companies & Advisers

Code of Federal Regulations

Title 12	**Banks & Banking**
Part 217	Capital Adequacy
Part 225	Bank Holding Companies
Part 252	Prudential Standards
Title 17	**Investment Adviser Act**
Part 275	Rules & Regulations

Extract the USC source data. Import into United States Legislative Model (USLM) classes.

Extract the CFR source data. **Import** into Federal Digital System (FDSys) classes

FRO RDF Staging

USC_USLM_Schema
uslm:title
uslm:chapter
uslm:section
uslm:paragraph
uslm:note
…

CFR_FDSysElement
cfr-fdsys-s:TITLE
cfr-fdsys-s:PART
cfr-fdsys-s:SECTION
cfr-fdsys-s:P (paragraph)
…

Transform USLM/FDSys staging instances. Load the information into ontology classes.

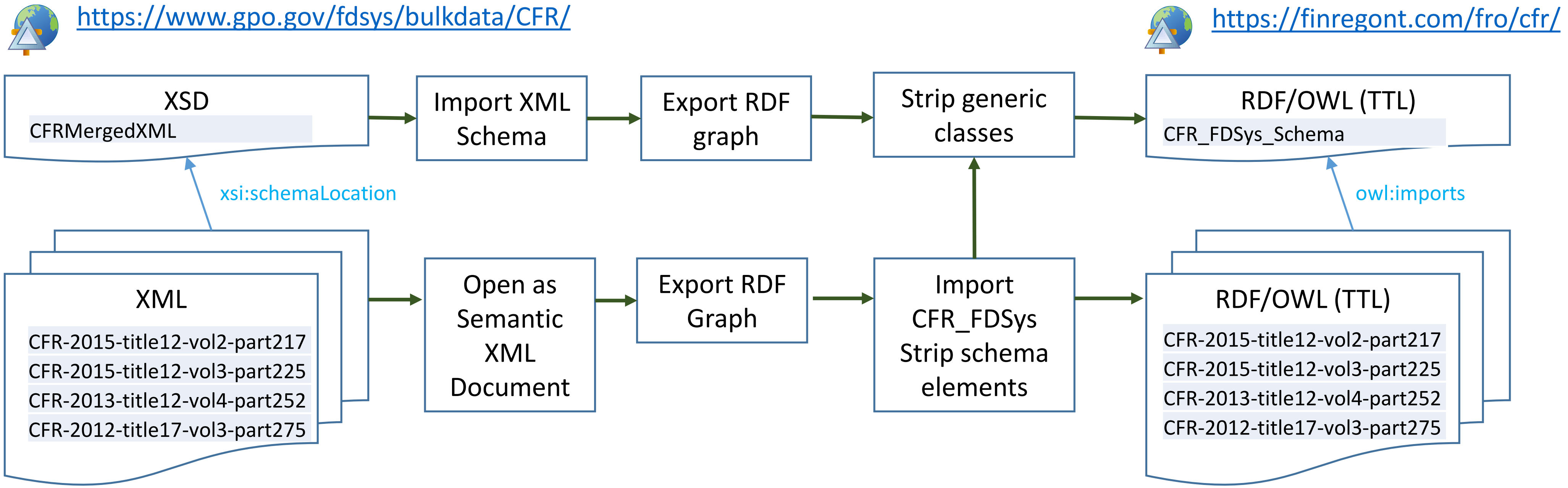
The inference engine executes rules attached to the source class: **Mapping rules** perform simple triple movement. **SPARQL rules** CONSTRUCT complex transformations.

Financial Regulation Ontology

FRO Legal Reference
Document Component
Title
Chapter
Chapter Division
Section
Paragraph
divides
refers to
Heading
Subject
Text
Identifier

Code of Federal Regulations Physical Load Model

While the Logical integration model referred to persistent storage, business concepts and ontology classes, the Physical Load Models names the websites and files.


https://www.gpo.gov/fdsys/bulkdata/CFR/
https://finregont.com/fro/cfr/
XSD
CFRMergedXML
Import XML Schema
Export RDF graph
Strip generic classes
RDF/OWL (TTL)
CFR_FDSys_Schema
xsi:schemaLocation
owl:imports
XML
CFR-2015-title12-vol2-part217
CFR-2015-title12-vol3-part225
CFR-2013-title12-vol4-part252
CFR-2012-title17-vol3-part275
Open as Semantic XML Document
Export RDF Graph
Import CFR_FDSys Strip schema elements
RDF/OWL (TTL)
CFR-2015-title12-vol2-part217
CFR-2015-title12-vol3-part225
CFR-2013-title12-vol4-part252
CFR-2012-title17-vol3-part275

We download CFR XML files and schema from the GPO website, bulk data directory. The ontology editor imports the XSD and converts XML to a Semantic view. We export the both RDF Graphs to target OWL (turtle) files.

For staging we want a single OWL file with class definitions for the CFR concepts (Section Paragraph Note etc.) All four instance data files import the common class definitions.

Understanding the CFR XML Source

We follow “Private Fund Exception” in section 203 of CFR-2012-title17-vol3-part275 from XML to FRO ontology.

The GPO website provides the XSD-Schema and documentation

- CFRMergedXML.xsd
- CFR-XML_User-Guide_v1.pdf

The XSD Schema is generic for all Federal Regulations. A good example of the Semantic Web Layers discussed previously. We get the machine readable syntax, but no semantics for the particular regulation.

The header contain identifying information about the document

The regulation text is structured in sections. <SECTION>

- Section number with the paragraph reference <SECTNO>
- Subject of the section <SUBJECT>
- And individual paragraphs <P>.

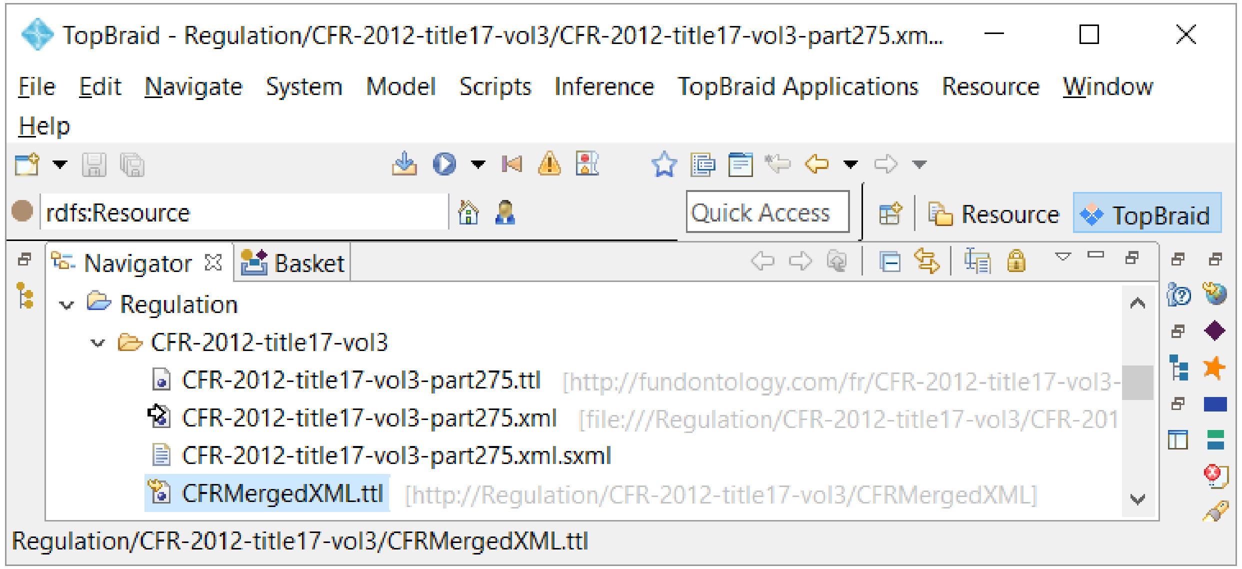
```
<?xml version="1.0"?>
<?xml-stylesheet type="text/xsl" href="cfr.xsl"?>
<CFRGRANULE xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="CFRMergedXML.xsd">
  <FDSYS>
    <CFRTITLE>17</CFRTITLE>
    <CFRTITLETEXT>Commodity and Securities Exchanges</CFRTITLETEXT>
    <VOL>3</VOL>
    <DATE>2012-04-01</DATE>
    <ORIGINALDATE>2012-04-01</ORIGINALDATE>
    <COVERONLY>false</COVERONLY>
    <TITLE>RULES AND REGULATIONS, INVESTMENT ADVISERS ACT OF 1940</TITLE>
    <GRANULENUM>275</GRANULENUM>
    <HEADING>PART 275</HEADING>
    <ANCESTORS>
      <PARENT HEADING="Title 17" SEQ="1">Commodity and Securities Exchanges</PARENT>
      <PARENT HEADING="CHAPTER II" SEQ="0">SECURITIES AND EXCHANGE COMMISSION
(CONTINUED)</PARENT>
    </ANCESTORS>
  </FDSYS>
```

```
<SECTION>
      <SECTNO>§ 275.203(m)-1</SECTNO>
      <SUBJECT>Private fund adviser exemption.</SUBJECT>
        <P>(a) <E T="03">United States investment advisers.</E> For purposes of section 203(m) of the Act (15 U.S.C. 80b-3(m)), an
        investment adviser with its principal office and place of business in the United States is exempt from the requirement to
        register under section 203 of the Act if the investment adviser:</P>
        <P>(1) Acts solely as an investment adviser to one or more qualifying private funds; and</P>
        <P>(2) Manages private fund assets of less than $150            million.</P>
```

Generating OWL classes from CFR XSD

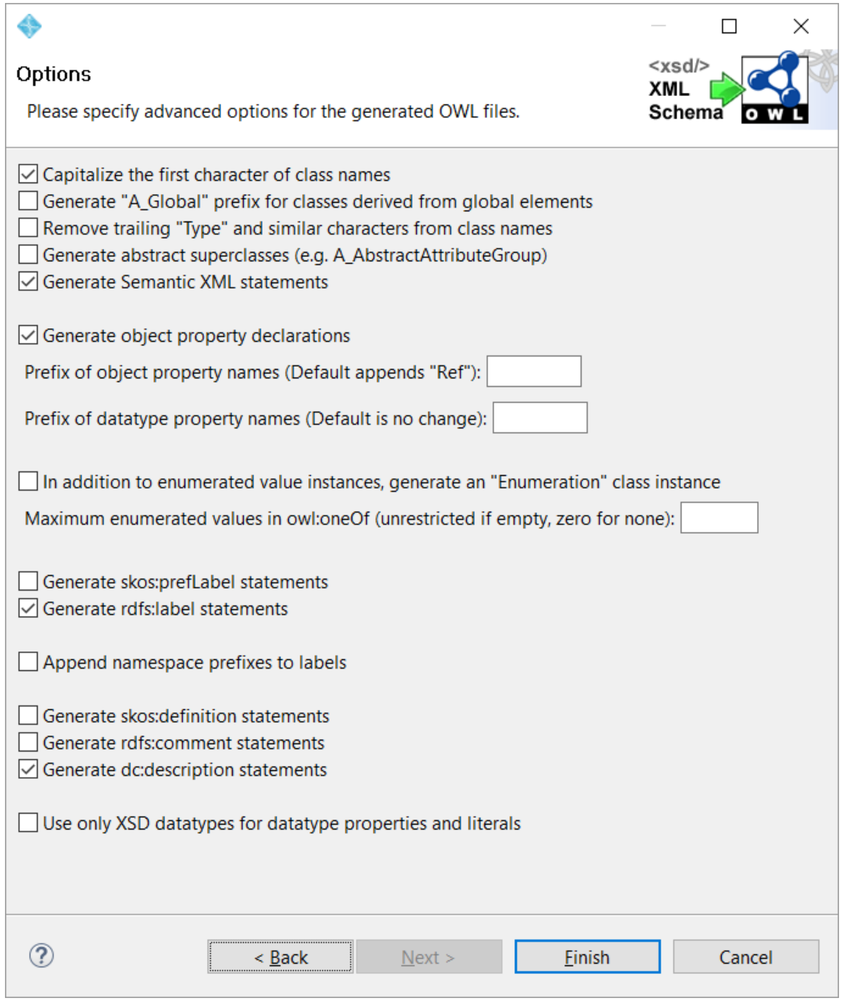
TopBraid Composer Maestro Edition[11] (TBC) is our main ontology editor.

1. First we import the XSD-Schema. There are various options to customize the import. The tool creates on OWL file CFRMergedXML.ttl with classes for the XSD elements. We open CFR-2012-title17-vol3-part275.xml with TCB's "Semantic XML". This show instances of the classes with the actual XML text fragments. Note that this is only a semantic rendition. The underlying file is still XML.
2. Finally we export the graph to create save it as OWL. This is for convenience and performance, so we don't have to repeat the import steps. We use the same filename, but with extension TTL: CFR-2012-title17-vol3-part275.ttl



- Regulation
  - CFR-2012-title17-vol3
    - CFR-2012-title17-vol3-part275.ttl [http://fundontology.com/fr/CFR-2012-title17-vol3-
    - CFR-2012-title17-vol3-part275.xml [file:///Regulation/CFR-2012-title17-vol3/CFR-201
    - CFR-2012-title17-vol3-part275.xml.sxml
    - CFRMergedXML.ttl [http://Regulation/CFR-2012-title17-vol3/CFRMergedXML]

Regulation/CFR-2012-title17-vol3/CFRMergedXML.ttl



Options

Please specify advanced options for the generated OWL files.

☑ Capitalize the first character of class names
☐ Generate "A_Global" prefix for classes derived from global elements
☐ Remove trailing "Type" and similar characters from class names
☐ Generate abstract superclasses (e.g. A_AbstractAttributeGroup)
☑ Generate Semantic XML statements

☑ Generate object property declarations
Prefix of object property names (Default appends "Ref"):
Prefix of datatype property names (Default is no change):

☐ In addition to enumerated value instances, generate an "Enumeration" class instance
Maximum enumerated values in owl:oneOf (unrestricted if empty, zero for none):

☐ Generate skos:prefLabel statements
☑ Generate rdfs:label statements

☐ Append namespace prefixes to labels

☐ Generate skos:definition statements
☐ Generate rdfs:comment statements
☑ Generate dc:description statements

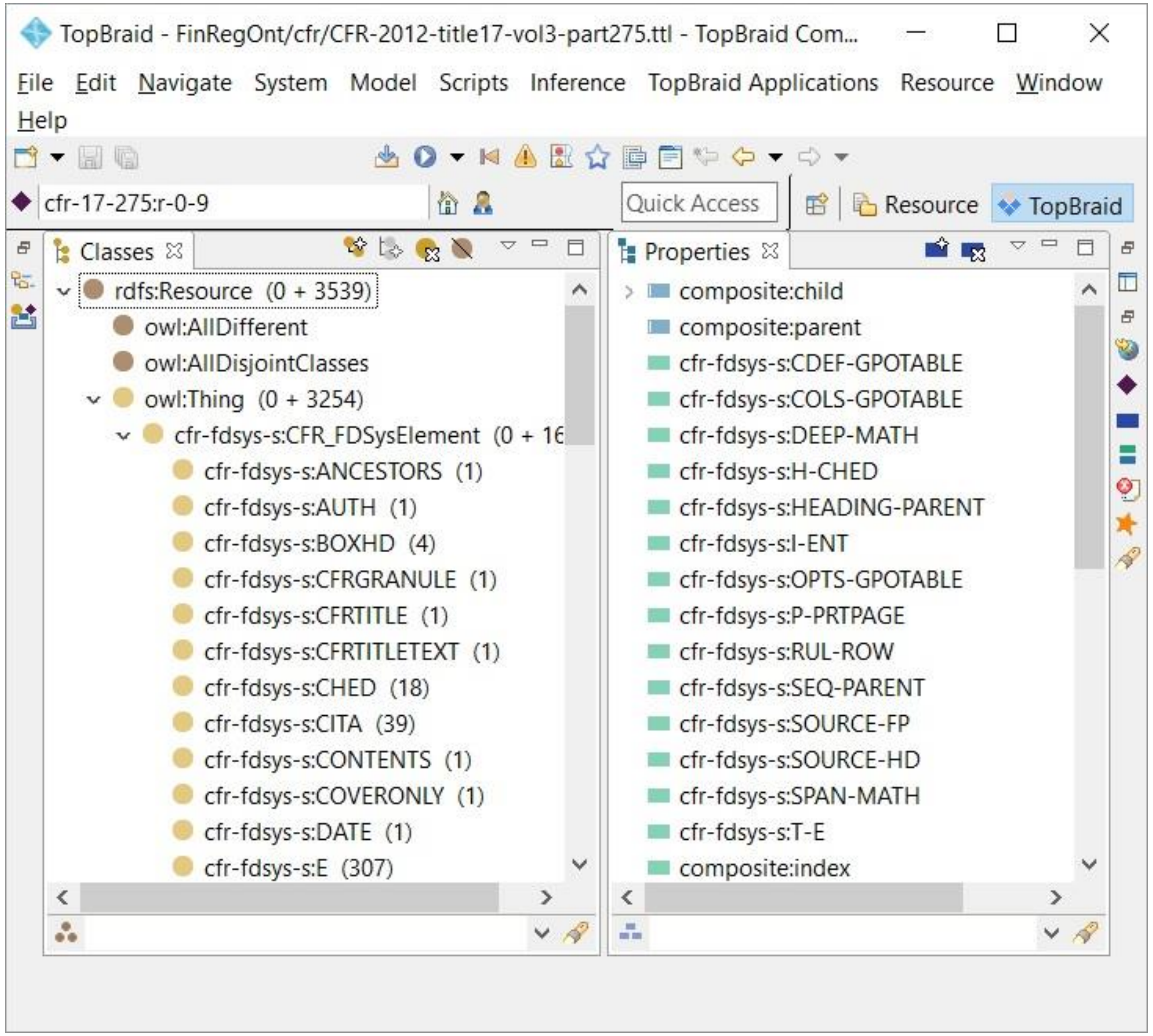
☐ Use only XSD datatypes for datatype properties and literals

Imported CFR FDSys classes & properties

The ontology browser shows CFR-2012-title17-vol3-part2752.ttl Classes and Properties.
We create the namespace "cfr-fdsys-s". (showing left of the colon on the classes/properties).
We use a collection class, CFR_FDSysElement as a superclass for all CFR classes.

The import creates 3 properties (prefix "composite", preserve the XML structure:

- Object property "composite:child" denotes that a domain instance is underneath the range. For example "Part 275" has composite:child Section "§ 275.204-5".
- Object property "composite:parent" denotes the inverse.
- Data Property "composite:index" adds a sequence number to child elements. So we can preserve an query the order of paragraph within a Section.



TopBraid - FinRegOnt/cfr/CFR-2012-title17-vol3-part275.ttl - TopBraid Com...

Classes:

- rdfs:Resource (0 + 3539)
  - owl:AllDifferent
  - owl:AllDisjointClasses
  - owl:Thing (0 + 3254)
    - cfr-fdsys-s:CFR_FDSysElement (0 + 16
      - cfr-fdsys-s:ANCESTORS (1)
      - cfr-fdsys-s:AUTH (1)
      - cfr-fdsys-s:BOXHD (4)
      - cfr-fdsys-s:CFRGRANULE (1)
      - cfr-fdsys-s:CFRTITLE (1)
      - cfr-fdsys-s:CFRTITLETEXT (1)
      - cfr-fdsys-s:CHED (18)
      - cfr-fdsys-s:CITA (39)
      - cfr-fdsys-s:CONTENTS (1)
      - cfr-fdsys-s:COVERONLY (1)
      - cfr-fdsys-s:DATE (1)
      - cfr-fdsys-s:E (307)

Properties:

- composite:child
- composite:parent
- cfr-fdsys-s:CDEF-GPOTABLE
- cfr-fdsys-s:COLS-GPOTABLE
- cfr-fdsys-s:DEEP-MATH
- cfr-fdsys-s:H-CHED
- cfr-fdsys-s:HEADING-PARENT
- cfr-fdsys-s:I-ENT
- cfr-fdsys-s:OPTS-GPOTABLE
- cfr-fdsys-s:P-PRTPAGE
- cfr-fdsys-s:RUL-ROW
- cfr-fdsys-s:SEQ-PARENT
- cfr-fdsys-s:SOURCE-FP
- cfr-fdsys-s:SOURCE-HD
- cfr-fdsys-s:SPAN-MATH
- cfr-fdsys-s:T-E
- composite:index

Comparing the XML to OWL instance and class structure

The diagram shows the “Private Fund Exception”, 203 of CFR-2012-title17-vol3-part275 graph.

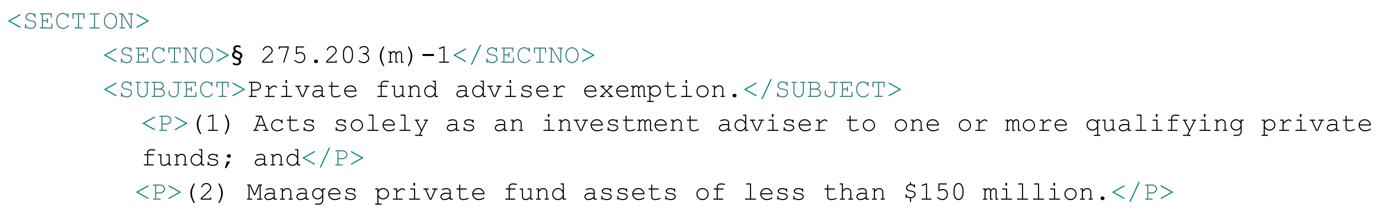
The XML <SECTION> becomes an instance of cfr-fdsys-s:SECTION class.

The XML elements within the section are generated as instances connected with the composite:child object property:

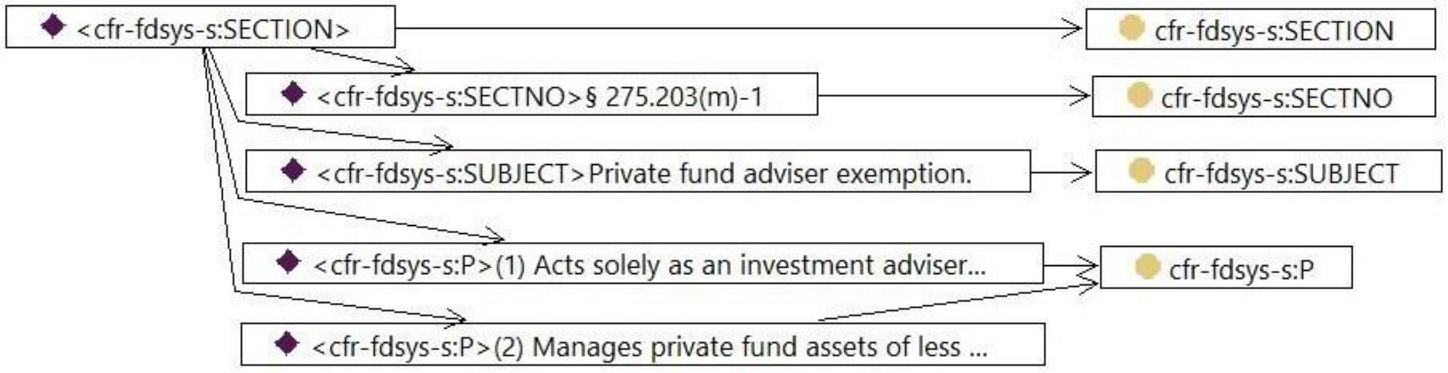
Every section has a section number, cfr-fdsys-s:SECTNO and subject, cfr-fdsys-s:SUBJECT.

Paragraphs become instances of cfr-fdsys-s:P

Object property composite:child connects the instances.



```
<SECTION>
      <SECTNO>§ 275.203(m)-1</SECTNO>
      <SUBJECT>Private fund adviser exemption.</SUBJECT>
        <P>(1) Acts solely as an investment adviser to one or more qualifying private
        funds; and</P>
       <P>(2) Manages private fund assets of less than $150 million.</P>
```



◆ <cfr-fdsys-s:SECTION>

◆ <cfr-fdsys-s:SECTNO>§ 275.203(m)-1

◆ <cfr-fdsys-s:SUBJECT>Private fund adviser exemption.

◆ <cfr-fdsys-s:P>(1) Acts solely as an investment adviser...

◆ <cfr-fdsys-s:P>(2) Manages private fund assets of less ...

● cfr-fdsys-s:SECTION

● cfr-fdsys-s:SECTNO

● cfr-fdsys-s:SUBJECT

● cfr-fdsys-s:P

Instance details in the resource form

We can introspect all details of "Private Fund Exception" in the Form tab.

The top of the window shows path and name of the open OWL file.

FinRegOnt sets the prefix as cfr-17-275, title and part of the code of federal regulations. The import generates a URI for the instance: cfr-17-275:r-0-9. "r" denotes resource. The numbers are generated based on the hierarchy level. We use an import generated URI, because the CFR XML doesn't come with an ID element. For United States Code we use the element Identifier in the XML.

The composite index means that section "§ 275.203(m)-1" is the 17th child element under the parent (Part 275).

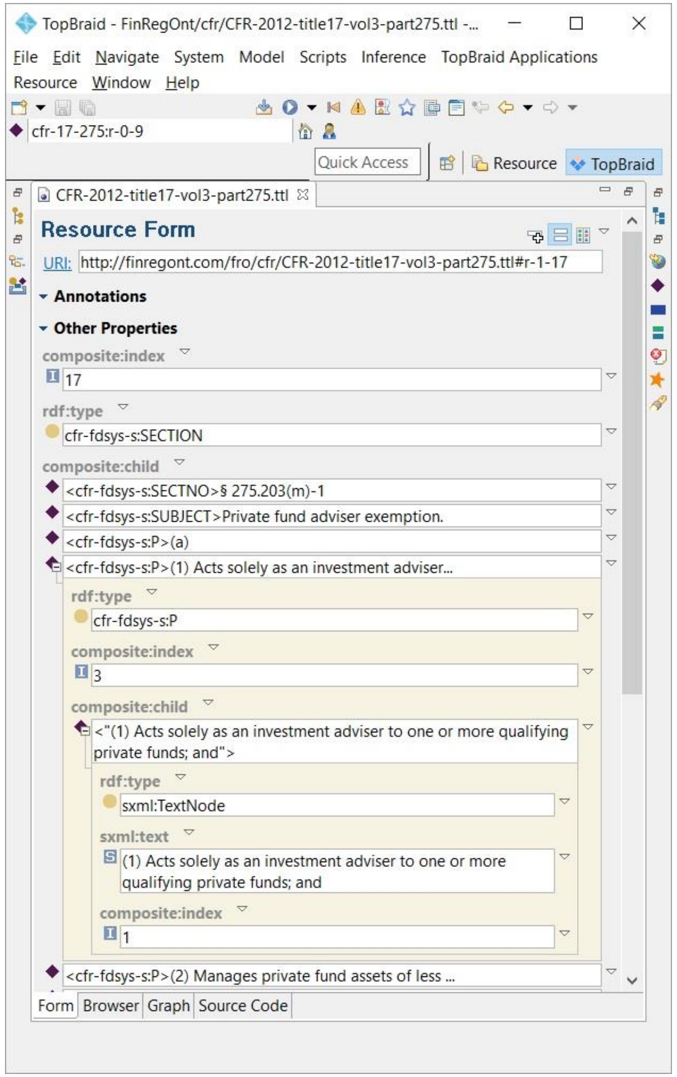
Under composite:child we find section number, subject and paragraphs. We expand paragraph (1) – "Acts solely as an investment adviser to one of more private funds …."

Again, the child elements have a composite index. We use the index number to query the paragraphs in the right order.

All text fragments are stored as sxml:TextNode, a generic Semantic-XML class with text and composite index. We use will the index number to concatenate the text fragments into the full text of a paragraph.

To use the data warehousing ETL analogy, this is just an Extract of into simple Staging classes. rather than ontology design. There are no semantics and it is hard and error prone to SPARQL query the data.

We will transform the staging structure and load into LKIF classes. First we revisit the reference ontology and extend the design. Then we use SPIN rules to move the instances.



cfr-17-275:r-0-9

URI: http://finregont.com/fro/cfr/CFR-2012-title17-vol3-part275.ttl#r-1-17

composite:index
17

rdf:type
cfr-fdsys-s:SECTION

composite:child
<cfr-fdsys-s:SECTNO>§ 275.203(m)-1
<cfr-fdsys-s:SUBJECT>Private fund adviser exemption.
<cfr-fdsys-s:P>(a)
<cfr-fdsys-s:P>(1) Acts solely as an investment adviser...

rdf:type
cfr-fdsys-s:P

composite:index
3

composite:child
<"(1) Acts solely as an investment adviser to one or more qualifying private funds; and">

rdf:type
sxml:TextNode

sxml:text
(1) Acts solely as an investment adviser to one or more qualifying private funds; and

composite:index
1

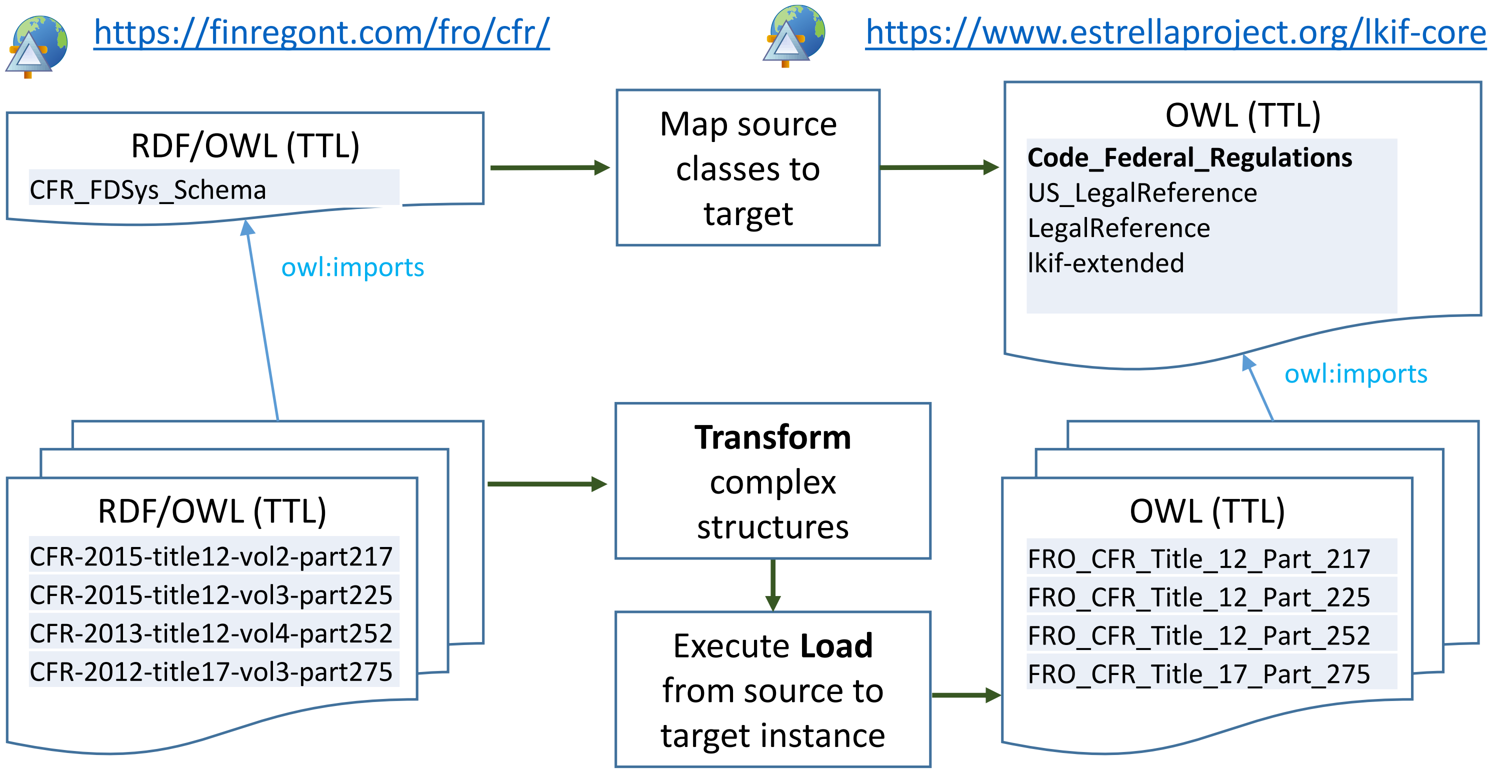
<cfr-fdsys-s:P>(2) Manages private fund assets of less ...

CFR to FRO/LKIF Physical Transform Model

The Physical Load model shows the source files and target files in the Financial Regulation Ontology.

Prerequisite of the Semantic ETL is a mapping from CFR_FDSys_Schema.ttl to the target classes in Code_Federal_Regulations.ttl. The target ontology imports US_Legal_Reference.ttl, an ontology common to CFR and USC and Legal_Reference.ttl, common to international regulations. Legal_Reference.ttl imports LKIF.

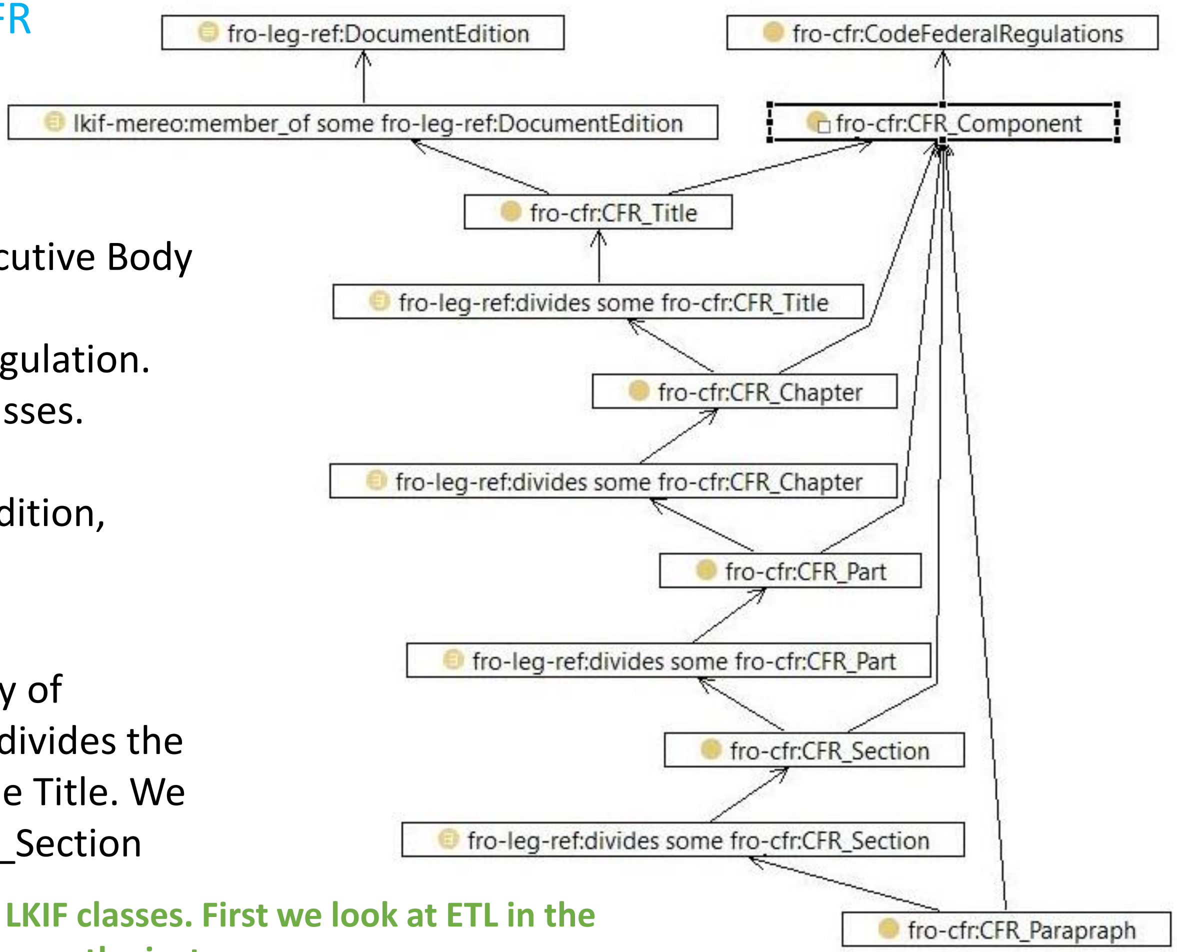
We create a target instance ontology file for very staging file.
E.g. FRO_CFR_Title12_part_275.ttl
for CFR-2012-title17-vol-3-part275.ttl
The target files only contain class and property instances. They all import the common schema, Code_Federal_Regulations.ttl



https://finregont.com/fro/cfr/
https://www.estrellaproject.org/lkif-core
RDF/OWL (TTL)
CFR_FDSys_Schema
Map source classes to target
OWL (TTL)
Code_Federal_Regulations
US_LegalReference
LegalReference
lkif-extended
owl:imports
owl:imports
RDF/OWL (TTL)
CFR-2015-title12-vol2-part217
CFR-2015-title12-vol3-part225
CFR-2013-title12-vol4-part252
CFR-2012-title17-vol3-part275
Transform complex structures
Execute Load from source to target instance
OWL (TTL)
FRO_CFR_Title_12_Part_217
FRO_CFR_Title_12_Part_225
FRO_CFR_Title_12_Part_252
FRO_CFR_Title_17_Part_275

Identifying and extending the LKIF target for CFR

We extend the model of the US Legal Context, described in previous slides to accommodate the CFR elements.


fro-leg-ref:DocumentEdition
fro-cfr:CodeFederalRegulations
lkif-mereo:member_of some fro-leg-ref:DocumentEdition
fro-cfr:CFR_Component
fro-cfr:CFR_Title
fro-leg-ref:divides some fro-cfr:CFR_Title
fro-cfr:CFR_Chapter
fro-leg-ref:divides some fro-cfr:CFR_Chapter
fro-cfr:CFR_Part
fro-leg-ref:divides some fro-cfr:CFR_Part
fro-cfr:CFR_Section
fro-leg-ref:divides some fro-cfr:CFR_Section
fro-cfr:CFR_Parapraph

Slide SEC Mandate in context defined the SEC as a LKIF Executive Body and Financial Regulation as an outcome of its Rulemaking. fro-cfr:CodeFederalRegulations is a subclass of Financial Regulation. CFR_Component is a collection class for all CFR element classes.

The top class, CFR_Title is also member of the Document Edition, described in Codification of the Law in the ontology.

The object property fro-leg-ref:divides creates the hierarchy of CFR_Components. Paragraphs divide the Sections. Section divides the Part. Part divides the Chapter and finally Chapter divides the Title. We create a class restriction: CFR_Paragraph divides **some** CFR_Section

Next pages show, how to transform the staging data and load into LKIF classes. First we look at ETL in the Semantic world. How to use SPARQL and TopBraid SPIN [2] rules to move the instances.

Mapping Rules in SPARQL

The CONTRUCT statement is the equivalent of the INSERT in a relational database.

We use SPARQL CONTRUCT statements to load the data into our target classes.

“The CONSTRUCT query form returns an RDF graph. The graph is built based on a template which is used to generate RDF triples based on the results of matching the graph pattern of the query.” (W3C SPARQL Query Language for RDF)

The example creates triples (an RDF graph) for the hasParagraphText property. We have two variables:

- ?targetInstance of our destination fro-cfr:CFR_Paragraph
- ?text The actual text that we and to construct for the CFR_Paragraph instance.

```
CONSTRUCT {
    ?targetInstance fro-cfr:hasParagraphText ?text .
}
WHERE {
    ?this composite:child ?text_node .
    ?text_node a sxml:TextNode .
    ?text_node sxml:text ?text .
    BIND (spinmap:targetResource(?this,
              cfr-context-spin:P-CFR_Parapraph) AS ?targetInstance) .
}
```

The WHERE clause specifies the result set from our Source ontology classes. This is similar to SQL “INSERT … AS SELECT”.

?this is a special variable that refers to the current instance of this class that is being evaluated by the inference rule.

For every instance of our source “cfr-fdsys-s:P” we navigate to “sxml:TextNote” and assign the “sxml:text” property to our ?text variable.

The BIND keyword assigns the value of an expression to a variable. In this case, we call a function to convert the URI of ?this to the target URI.

SPIN – SPARQL Inferencing Notation

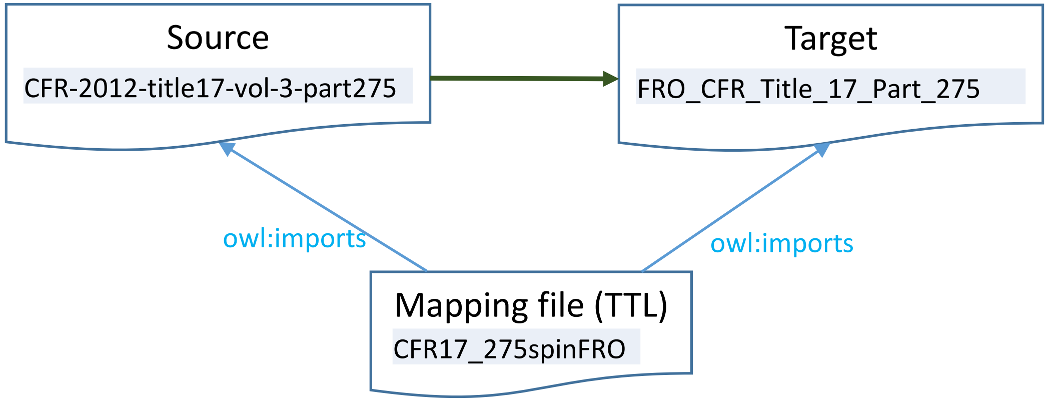
With TopBraid Composer as ontology editor, we use SPARQL Inference Notation, SPIN to define mapping rules.

"SPIN is a W3C Member Submission that has become the de-facto industry standard to represent SPARQL rules and constraints on Semantic Web models. SPIN also provides meta-modeling capabilities that allow users to define their own SPARQL functions and query templates. Finally, SPIN includes a ready to use library of common functions." (http://spinrdf.org/)

"SPINMap is a SPARQL-based language to represent mappings between RDF/OWL ontologies. These mappings can be used to transform instances of source classes into instances of target classes."[3]

There are no mapping spreadsheets or proprietary ETL files.

The mapping file is in Ontology Web Language. That means, we can query target schema and data joined with the mapping to their source.



We create a new RDF/SPIN mapping file, CFR17_275spinFRO.ttl in TopBraid Composer. The mapping file imports the required SPIN MAP elements, to support mapping rules and editor.
Next we import the source ontology, CFR-2012-title-17-vol-3-part275.ttl and target, FRO_CFR_Title_17_Part_275.ttl

Now we have visibility of source and target classes in our mapping ontology. We invoke the mapping editor.

SPIN – SPARQL Inferencing Notation

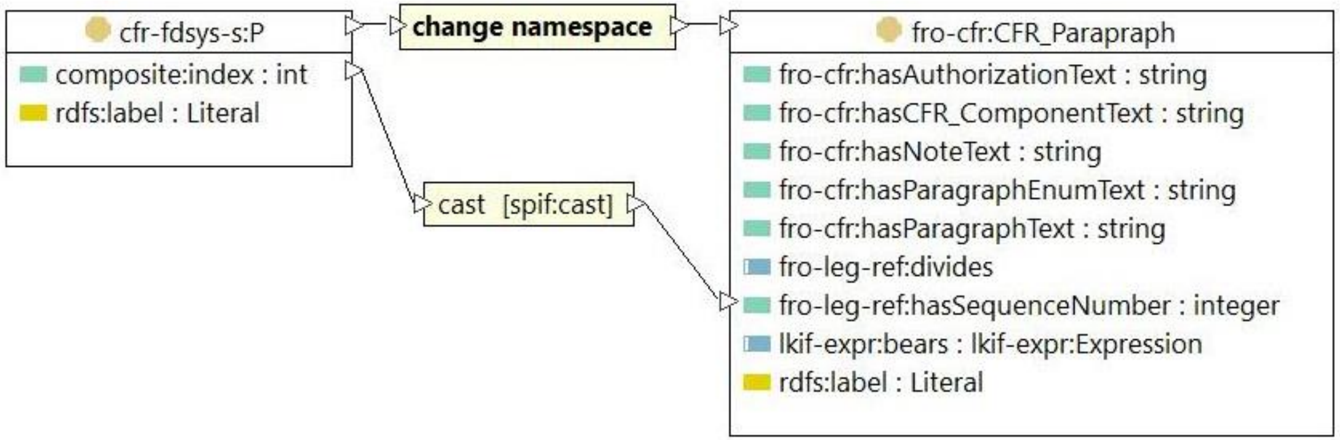
With TopBraid Composer as ontology editor, we use SPARQL Inference Notation, SPIN to define mapping rules.

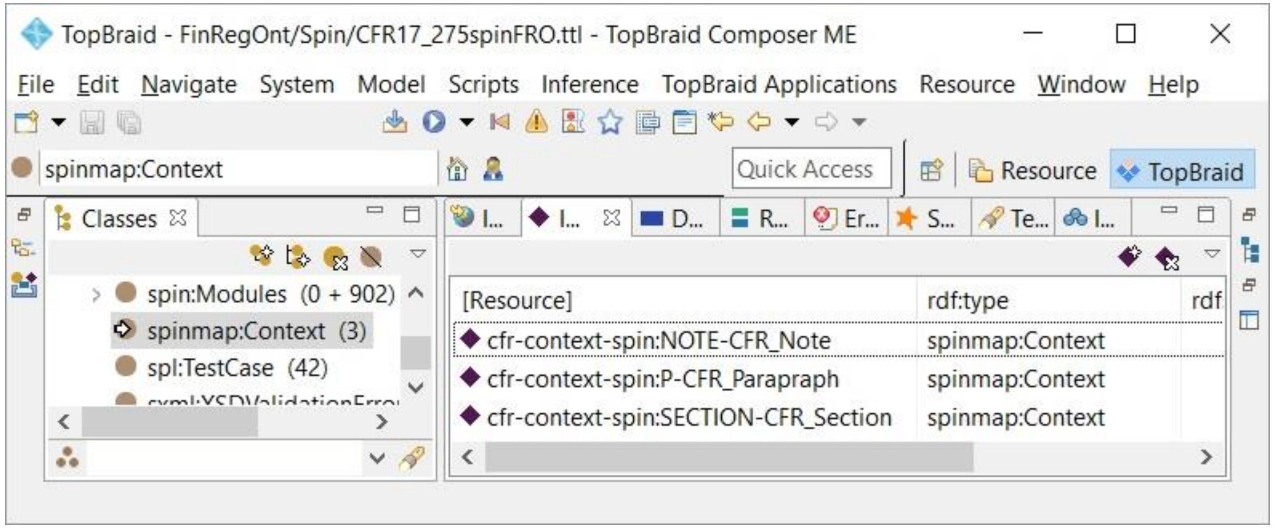
The diagram shows the CFR Paragraph mapping from
staging, cfr-fdsys-s:P to target fro-cfr:CFR_Paragraph:

We connect the two classes with a “change namespace” mapping rule. For every source instance, this will create a target instance with the URI namespace http://finregont.com/fro/cfr/FRO_CFR_Title_17_Part_275.ttl

The second rule copies data property composite:index to the target fro-leg-ref:hasSequenceNumber.

The mapping contexts for CFR Paragraph, Section and Note are stored as an instance of spinmap:Context.


cfr-fdsys-s:P
composite:index : int
rdfs:label : Literal
change namespace
cast [spif:cast]
fro-cfr:CFR_Parapraph
fro-cfr:hasAuthorizationText : string
fro-cfr:hasCFR_ComponentText : string
fro-cfr:hasNoteText : string
fro-cfr:hasParagraphEnumText : string
fro-cfr:hasParagraphText : string
fro-leg-ref:divides
fro-leg-ref:hasSequenceNumber : integer
lkif-expr:bears : lkif-expr:Expression
rdfs:label : Literal


TopBraid - FinRegOnt/Spin/CFR17_275spinFRO.ttl - TopBraid Composer ME
File Edit Navigate System Model Scripts Inference TopBraid Applications Resource Window Help
spinmap:Context
Quick Access
Resource
TopBraid
Classes
I...
I...
D...
R...
Er...
S...
Te...
I...

spin:Modules (0 + 902)
spinmap:Context (3)
spl:TestCase (42)

[Resource]	rdf:type	rdf
cfr-context-spin:NOTE-CFR_Note	spinmap:Context	
cfr-context-spin:P-CFR_Parapraph	spinmap:Context	
cfr-context-spin:SECTION-CFR_Section	spinmap:Context	

SPIN mapping context connecting classes

Connecting a source to a target class invokes the mapping rule dialog.

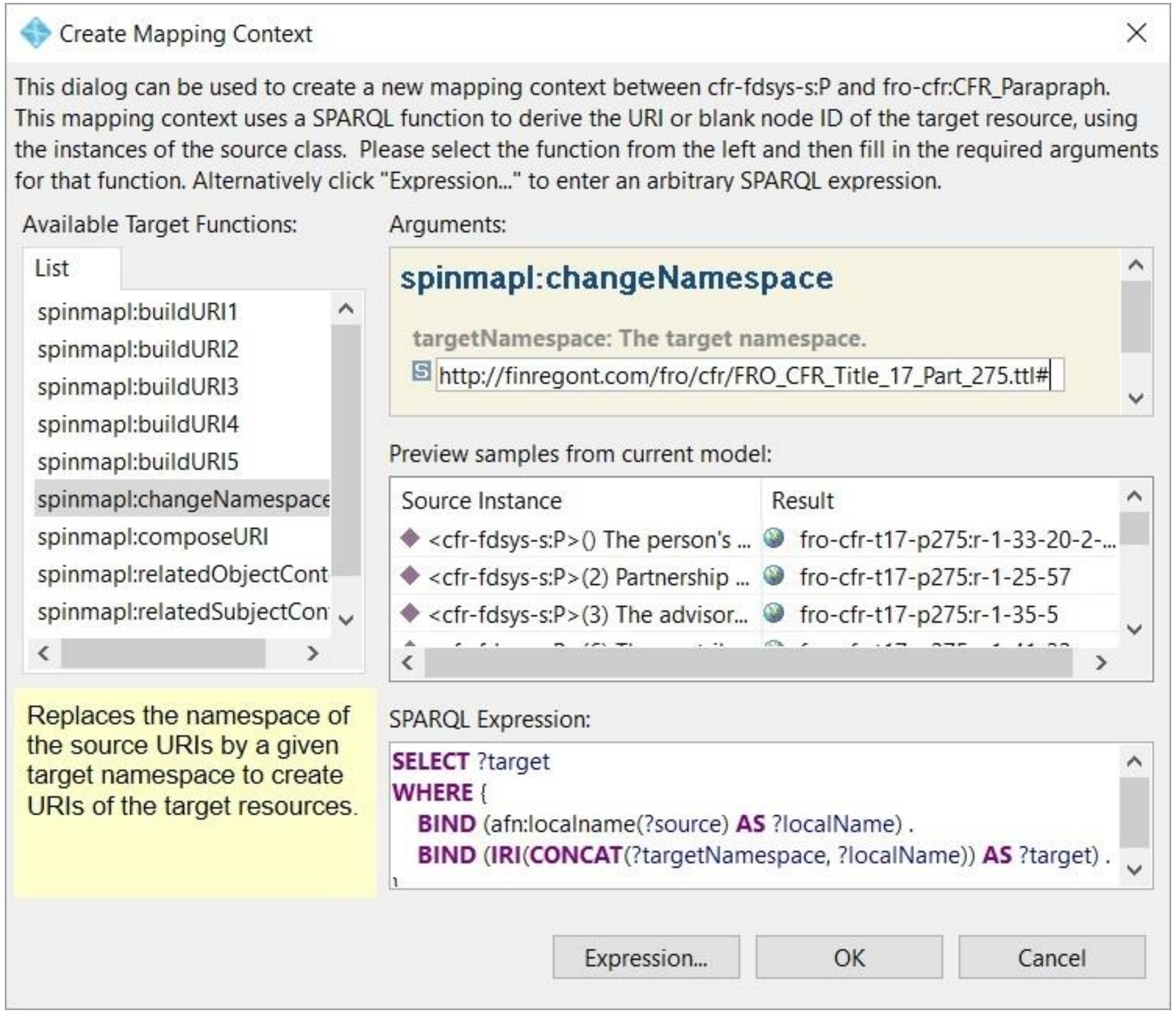
The Target Function specifies how to create the target URI.

For CFR Paragraph we simply change the namespace.

The Preview window shows how source instances are converted to target URI. The Result column shows the prefix fro-cfr-t17-p275 and instances r-33-20-2, r-1-25-57.

The SPARQL Expression is the WHERE clause for the CONSTRUCT statement.

- The first BIND extracts the local name (right of the colon) of the source URI.
- The second BIND concatenates the local Name to the target namespace.



Create Mapping Context

This dialog can be used to create a new mapping context between cfr-fdsys-s:P and fro-cfr:CFR_Parapraph. This mapping context uses a SPARQL function to derive the URI or blank node ID of the target resource, using the instances of the source class. Please select the function from the left and then fill in the required arguments for that function. Alternatively click "Expression..." to enter an arbitrary SPARQL expression.

Available Target Functions:

List

- spinmapl:buildURI1
- spinmapl:buildURI2
- spinmapl:buildURI3
- spinmapl:buildURI4
- spinmapl:buildURI5
- spinmapl:changeNamespace
- spinmapl:composeURI
- spinmapl:relatedObjectCont
- spinmapl:relatedSubjectCon

Replaces the namespace of the source URIs by a given target namespace to create URIs of the target resources.

Arguments:

spinmapl:changeNamespace

targetNamespace: The target namespace.

S http://finregont.com/fro/cfr/FRO_CFR_Title_17_Part_275.ttl#

Preview samples from current model:

Source Instance	Result
<cfr-fdsys-s:P>() The person's ...	fro-cfr-t17-p275:r-1-33-20-2-...
<cfr-fdsys-s:P>(2) Partnership ...	fro-cfr-t17-p275:r-1-25-57
<cfr-fdsys-s:P>(3) The advisor...	fro-cfr-t17-p275:r-1-35-5

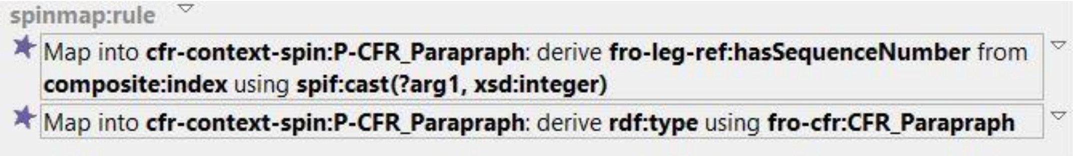
SPARQL Expression:

```
SELECT ?target
WHERE {
  BIND (afn:localname(?source) AS ?localName) .
  BIND (IRI(CONCAT(?targetNamespace, ?localName)) AS ?target) .
}
```

SPIN rules populating properties (1)

Once defined, the mapping context will be used to populate data and object properties.

The **spinmap-rules** can be examined and customized at the source class' Form tab. The inference engine (reasoner) will trigger the rules for every instance of the class. The rules "Map into" the mapping context with a "derive" rule: Derive the target fro-leg-ref:hasSequenceNumber from source composite:index, cast the value to xsd:integer.



spinmap:rule

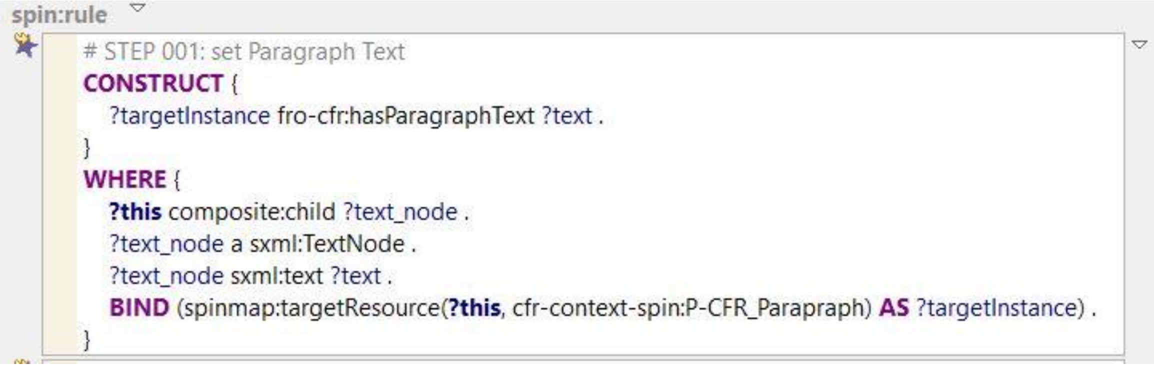
Map into **cfr-context-spin:P-CFR_Parapraph**: derive **fro-leg-ref:hasSequenceNumber** from **composite:index** using **spif:cast(?arg1, xsd:integer)**

Map into **cfr-context-spin:P-CFR_Parapraph**: derive **rdf:type** using **fro-cfr:CFR_Parapraph**

Likewise **spin-rules** show at the source class' Form tab. Spin-rules are free form SPARQL that we the inference engine to execute.

In this case we want to CONSTRUCT the fro-cfr:hasParagraphText data property.

The WHERE clause navigates from the ?this instance to the sxml:TextNode. The BIND statement assigns the target instance using the Mapping Context.



spin:rule

```
# STEP 001: set Paragraph Text
CONSTRUCT {
  ?targetInstance fro-cfr:hasParagraphText ?text .
}
WHERE {
  ?this composite:child ?text_node .
  ?text_node a sxml:TextNode .
  ?text_node sxml:text ?text .
  BIND (spinmap:targetResource(?this, cfr-context-spin:P-CFR_Parapraph) AS ?targetInstance) .
}
```

SPIN rules populating properties (2)

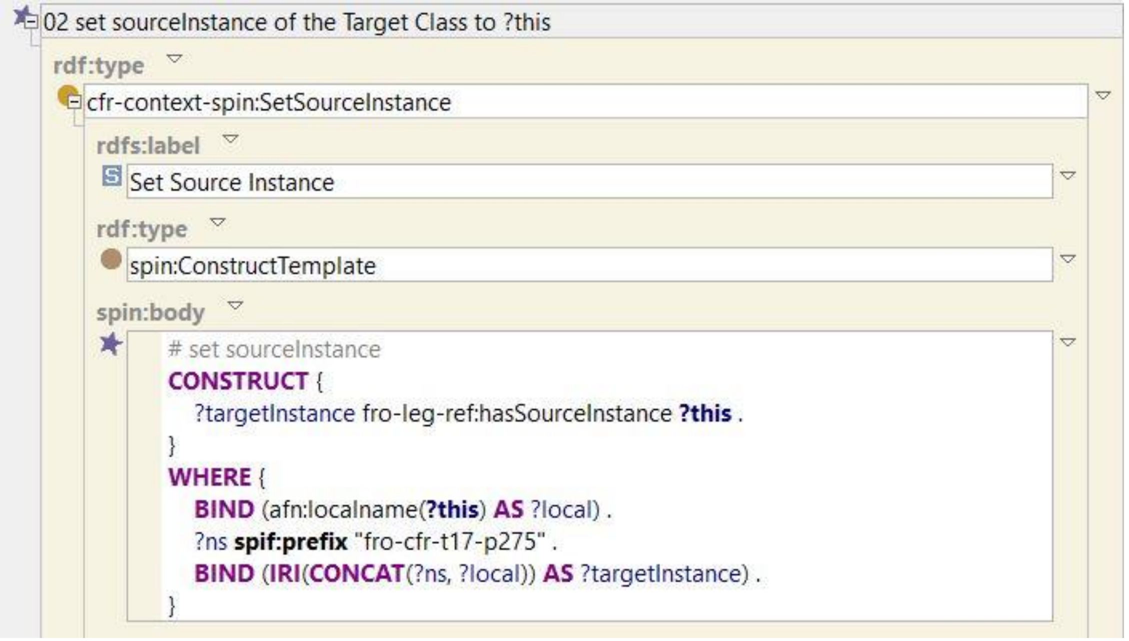
Templates facilitate reuse of common SPARQL rule statements.

All FinRegOnt instances have an object property to point to their source instance: fro-leg-ref:hasSourceInstance.

The CONSTRUCT sets the domain target instance and ?this variable range.

The WHERE clause assigns the ?targetInstance variable.

- The first BIND extracts the local name (right of the colon) of the source URI.
- The second BIND concatenates the local Name to the target namespace.



02 set sourceInstance of the Target Class to ?this

rdf:type

cfr-context-spin:SetSourceInstance

rdfs:label

Set Source Instance

rdf:type

spin:ConstructTemplate

spin:body

```
# set sourceInstance
CONSTRUCT {
    ?targetInstance fro-leg-ref:hasSourceInstance ?this .
}
WHERE {
    BIND (afn:localname(?this) AS ?local) .
    ?ns spif:prefix "fro-cfr-t17-p275" .
    BIND (IRI(CONCAT(?ns, ?local)) AS ?targetInstance) .
}
```

Running the Inference Engine

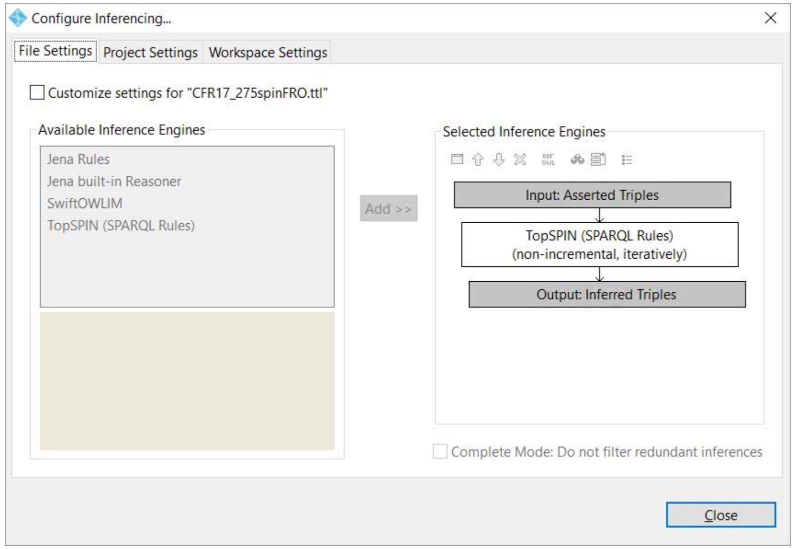
The inference engine executes SPIN-rule alongside standard reasoning.

An inference engine is a software able to infer new facts from a set of asserted facts and rules. Non-ontology Inference engines are also to derive decision based on business rules (rules engine). The reasoner generalizes the concept with a richer, ontology based semantic.

- Input Asserted Triples are facts in the included staging file CFR-2012-title17-vol-3-part275.ttl.
- The TopSPIN (SPARQL Rules) are in the mapping file: CFR17_275spinFRO.ttl

We run the engine from the TopBraid composer Menu or Button. The engine iterates trough standard reasoning for class subsumption. That is to infer that an instance must be type of a class based on its asserted properties. Chapter I of the tutorial touched how the defined class drives the reasoner. Chapter III will explain the central role of reasoning for financial compliance.

The TopSPIN engine will also execute the SPIN rules. The status window shows rule “STEP001: set Paragraph Text” on cfr-fdsys-s:P
For all instances of cfr-fdys:P the engine will execute the SPARQL and CONSTRUCT output triples. The iteration (7) means that this is the seventh pass of the engine. As configured the reasoner will iterate until there are no more new triple inferred.



☐ Customize settings for "CFR17_275spinFRO.ttl"

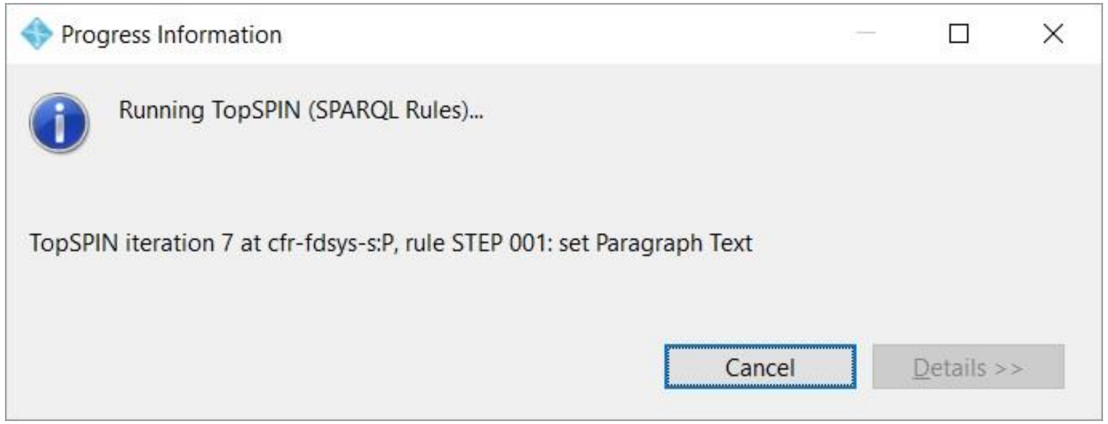
Available Inference Engines

Jena Rules
Jena built-in Reasoner
SwiftOWLIM
TopSPIN (SPARQL Rules)

Selected Inference Engines

Input: Asserted Triples
TopSPIN (SPARQL Rules)
(non-incremental, iteratively)
Output: Inferred Triples

☐ Complete Mode: Do not filter redundant inferences



Running TopSPIN (SPARQL Rules)...

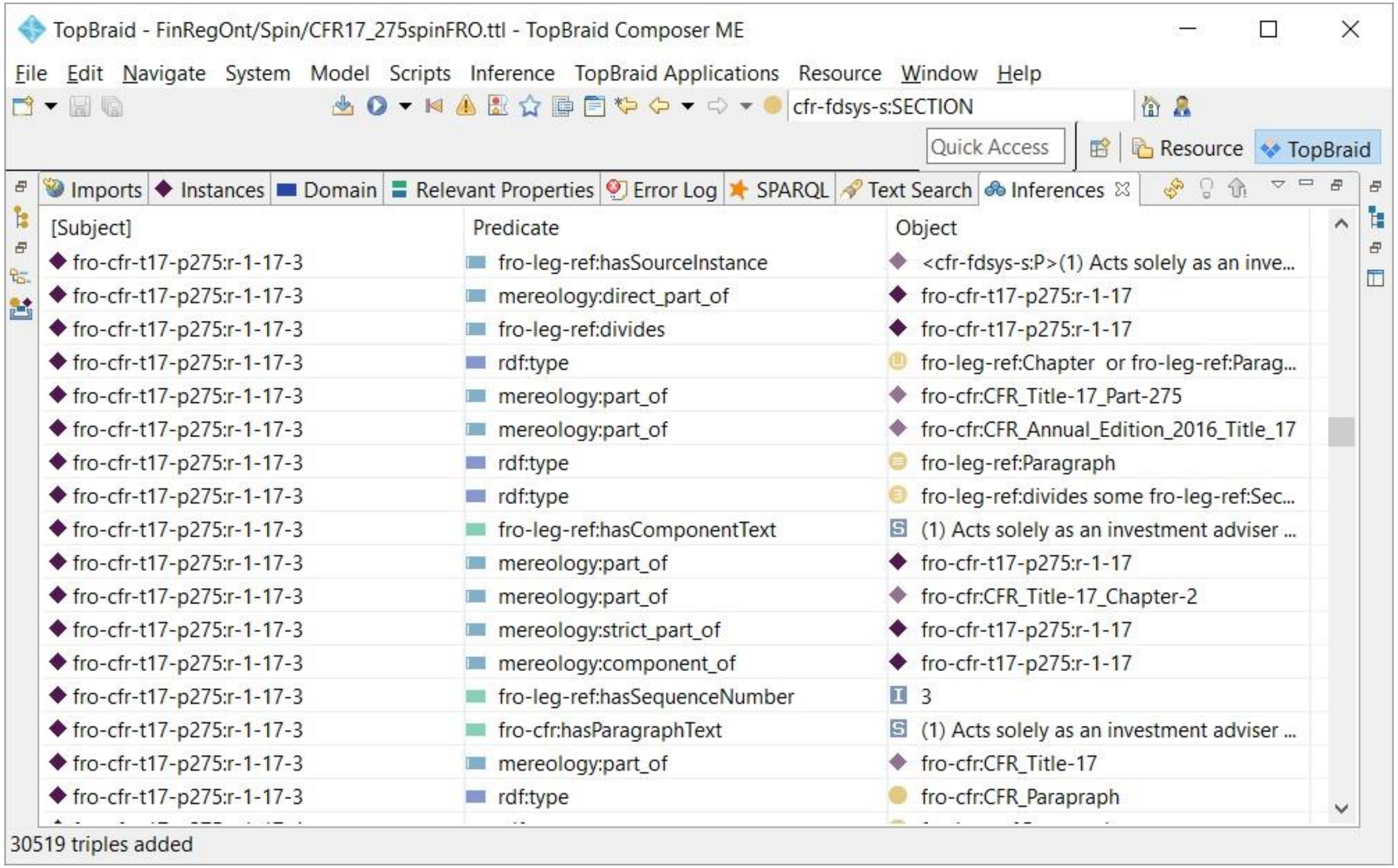
TopSPIN iteration 7 at cfr-fdsys-s:P, rule STEP 001: set Paragraph Text

Inferencing Output Triples

The Inferences tab shows the output triples in three columns, subject, predicate, and object.

We scroll down the **Subject** column fro-cfr-t17-p275:r-1-17-3, the Private Fund Adviser paragraph and
Look at **Predicate** column for object and data properties of the paragraph:

- Object Property hasSourceInstance, links to the CFR FDSys original (**Object** column).
- Paragraph text is sub property of Component Text. The engine infers a triple for the component text.
- It has a sequence number: 3
- It has a text: “Acts solely ….”
- The paragraph is a fro-cfr:CFR_Paragraph



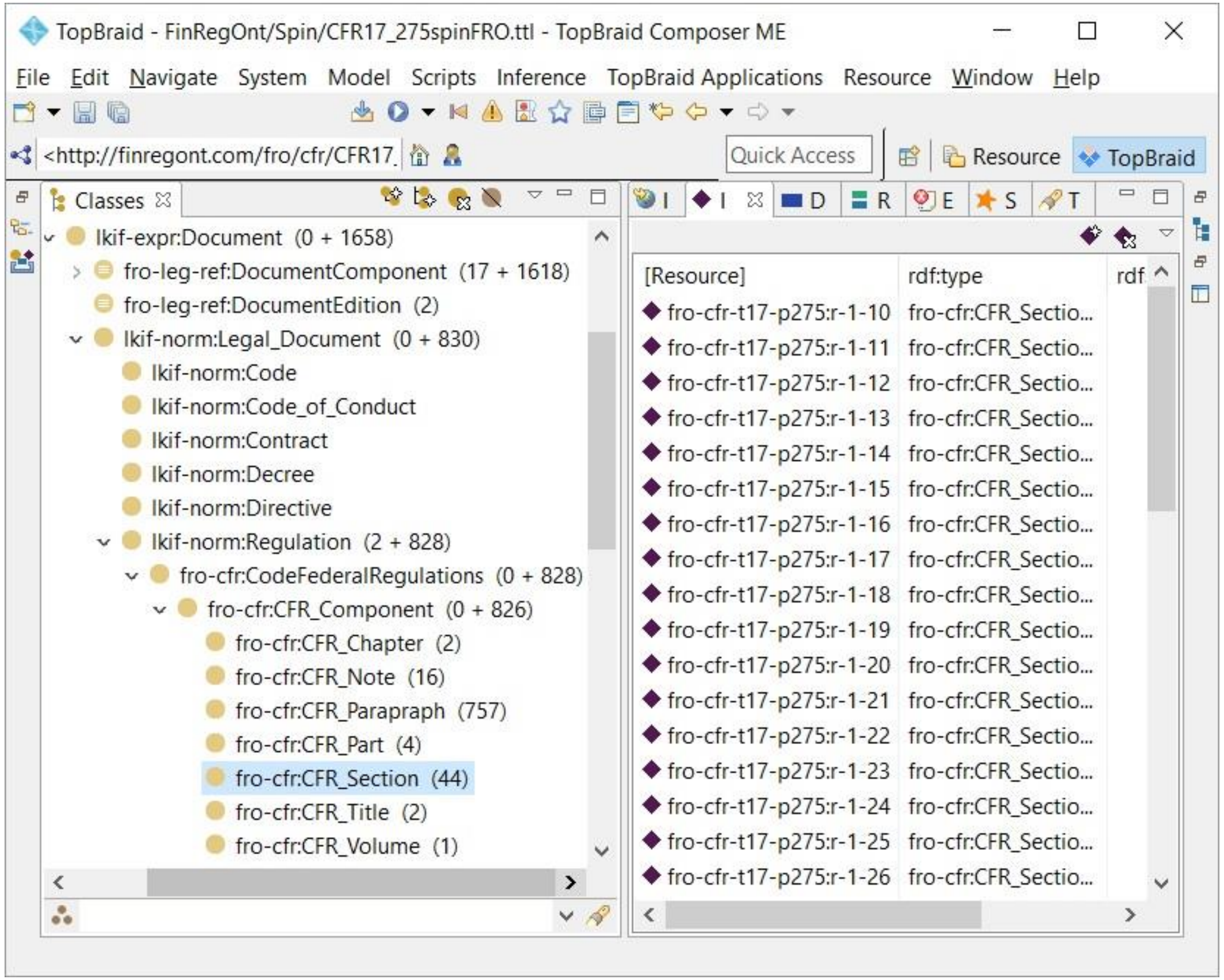
[Subject]	Predicate	Object
fro-cfr-t17-p275:r-1-17-3	fro-leg-ref:hasSourceInstance	<cfr-fdsys-s:P>(1) Acts solely as an inve...
fro-cfr-t17-p275:r-1-17-3	mereology:direct_part_of	fro-cfr-t17-p275:r-1-17
fro-cfr-t17-p275:r-1-17-3	fro-leg-ref:divides	fro-cfr-t17-p275:r-1-17
fro-cfr-t17-p275:r-1-17-3	rdf:type	fro-leg-ref:Chapter or fro-leg-ref:Parag...
fro-cfr-t17-p275:r-1-17-3	mereology:part_of	fro-cfr:CFR_Title-17_Part-275
fro-cfr-t17-p275:r-1-17-3	mereology:part_of	fro-cfr:CFR_Annual_Edition_2016_Title_17
fro-cfr-t17-p275:r-1-17-3	rdf:type	fro-leg-ref:Paragraph
fro-cfr-t17-p275:r-1-17-3	rdf:type	fro-leg-ref:divides some fro-leg-ref:Sec...
fro-cfr-t17-p275:r-1-17-3	fro-leg-ref:hasComponentText	(1) Acts solely as an investment adviser ...
fro-cfr-t17-p275:r-1-17-3	mereology:part_of	fro-cfr-t17-p275:r-1-17
fro-cfr-t17-p275:r-1-17-3	mereology:part_of	fro-cfr:CFR_Title-17_Chapter-2
fro-cfr-t17-p275:r-1-17-3	mereology:strict_part_of	fro-cfr-t17-p275:r-1-17
fro-cfr-t17-p275:r-1-17-3	mereology:component_of	fro-cfr-t17-p275:r-1-17
fro-cfr-t17-p275:r-1-17-3	fro-leg-ref:hasSequenceNumber	3
fro-cfr-t17-p275:r-1-17-3	fro-cfr:hasParagraphText	(1) Acts solely as an investment adviser ...
fro-cfr-t17-p275:r-1-17-3	mereology:part_of	fro-cfr:CFR_Title-17
fro-cfr-t17-p275:r-1-17-3	rdf:type	fro-cfr:CFR_Parapraph

30519 triples added

Validating target instance – class browser

Once the inferencing is complete, the class browser will indicate the number of triples next to the Code of Federal Regulations Classes.

This is the first consistency check. The number of target instances should match the number of elements in the CFR XML. Title 17 Part 275 has 2 Chapters, 44 Sections, 757 paragraphs and 16 Notes. We select CFR_Section and the instances tab shows the individual sections.
Scope:
FinRegOnt does not import everything from the CFR XML source. For our purpose of Legal Reasoning, we are interested in the text and structure of the regulation. The lowest level is the paragraph or note that we want to link via object properties to a Legal Expression. We do not need the XML table of contents and formatting. However, the hasSourceInstance property links to the source instance, where all details remain available for querying.



Classes:

- lkif-expr:Document (0 + 1658)
  - fro-leg-ref:DocumentComponent (17 + 1618)
  - fro-leg-ref:DocumentEdition (2)
  - lkif-norm:Legal_Document (0 + 830)
    - lkif-norm:Code
    - lkif-norm:Code_of_Conduct
    - lkif-norm:Contract
    - lkif-norm:Decree
    - lkif-norm:Directive
    - lkif-norm:Regulation (2 + 828)
      - fro-cfr:CodeFederalRegulations (0 + 828)
        - fro-cfr:CFR_Component (0 + 826)
          - fro-cfr:CFR_Chapter (2)
          - fro-cfr:CFR_Note (16)
          - fro-cfr:CFR_Parapraph (757)
          - fro-cfr:CFR_Part (4)
          - fro-cfr:CFR_Section (44)
          - fro-cfr:CFR_Title (2)
          - fro-cfr:CFR_Volume (1)

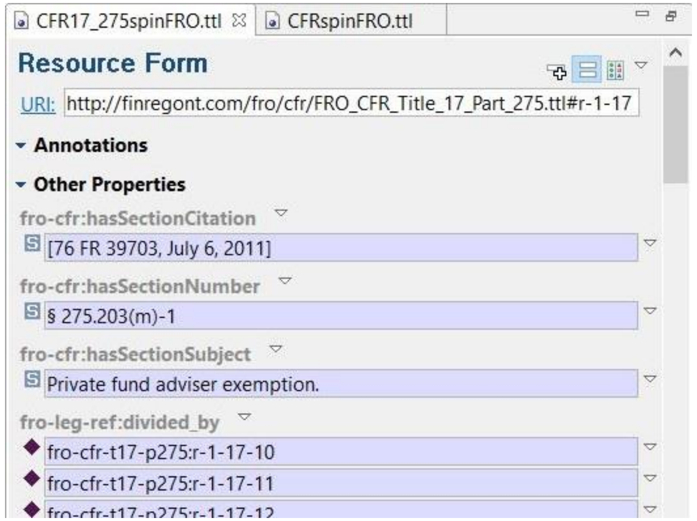
[Resource]	rdf:type	rdf
fro-cfr-t17-p275:r-1-10	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-11	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-12	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-13	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-14	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-15	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-16	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-17	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-18	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-19	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-20	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-21	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-22	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-23	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-24	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-25	fro-cfr:CFR_Sectio...	
fro-cfr-t17-p275:r-1-26	fro-cfr:CFR_Sectio...	

Validating target instances – Resource Form

The Resource Form displays all details of a class instance.

This is the next step in checking consistency of the rule output. We double click on Section 17, § 275.203(m)-1 in resource list to launch the resource from.

The class instance has a citation, [76 FR 39703, July6, 2011]. Note that SECTION has a SPIN-rule to populate the citation from its composite:child cfr-fdsys-s:CITA.
The section number § 275.203(m)-1 , populated from cfr-fdsys-s:SECTNO
The section subject "Private fund adviser exemption, populated from cfr-fdsys-s:SUBJECT
Section 17 is divided_by many paragraphs (only 3 are displayed here). A rule on SECTION constructs from SECTION composite:child with type of cfr-fdsys-s:P



CFR17_275spinFRO.ttl | CFRspinFRO.ttl

Resource Form

URI: http://finregont.com/fro/cfr/FRO_CFR_Title_17_Part_275.ttl#r-1-17

Annotations

Other Properties

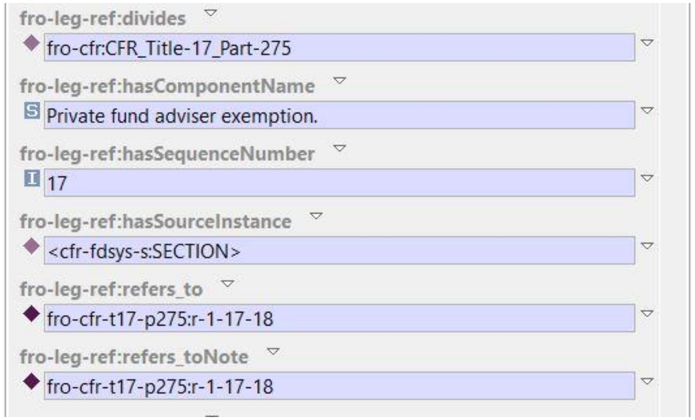
fro-cfr:hasSectionCitation
[76 FR 39703, July 6, 2011]

fro-cfr:hasSectionNumber
§ 275.203(m)-1

fro-cfr:hasSectionSubject
Private fund adviser exemption.

fro-leg-ref:divided_by
fro-cfr-t17-p275:r-1-17-10
fro-cfr-t17-p275:r-1-17-11
fro-cfr-t17-p275:r-1-17-12

The section divides Part 275 of the Code of Federal Regulations. The construct is static, because there is only one CFR Part in our source XML.
The component name is parent property of section subject. Siblings are Part text, Volume text, Chapter text and Title text. This facilitates queries across CFR Components. The value is inferred automatically. We do not need a rule.
A rule sets the source instance to the original cfr-fdsys-s:SECTION resource.
Section 17 has a note. The object property fro-leg-ref:refers_toNote links to the fro-cfr:CFR_Note instance.



fro-leg-ref:divides
fro-cfr:CFR_Title-17_Part-275

fro-leg-ref:hasComponentName
Private fund adviser exemption.

fro-leg-ref:hasSequenceNumber
17

fro-leg-ref:hasSourceInstance
<cfr-fdsys-s:SECTION>

fro-leg-ref:refers_to
fro-cfr-t17-p275:r-1-17-18

fro-leg-ref:refers_toNote
fro-cfr-t17-p275:r-1-17-18

The FinRegOnt documentation has definitions for all classes and properties on the website: http://finregont.com/ontology-documentation/

Validating target instances – the Graph

The Semantic Data Management provides complete traceability and linage. **Everything is a triple**. We can navigate and query data instance, Section § 275.203(m)-1 to Source, Mapping and Reference Data.

We start with the Section fro-cfr-t17-p275:r-1-17, “Private fund adviser exemption”. The object property fro-leg-ref:divides navigates to the higher CFR components, Part, Chapter and Title.

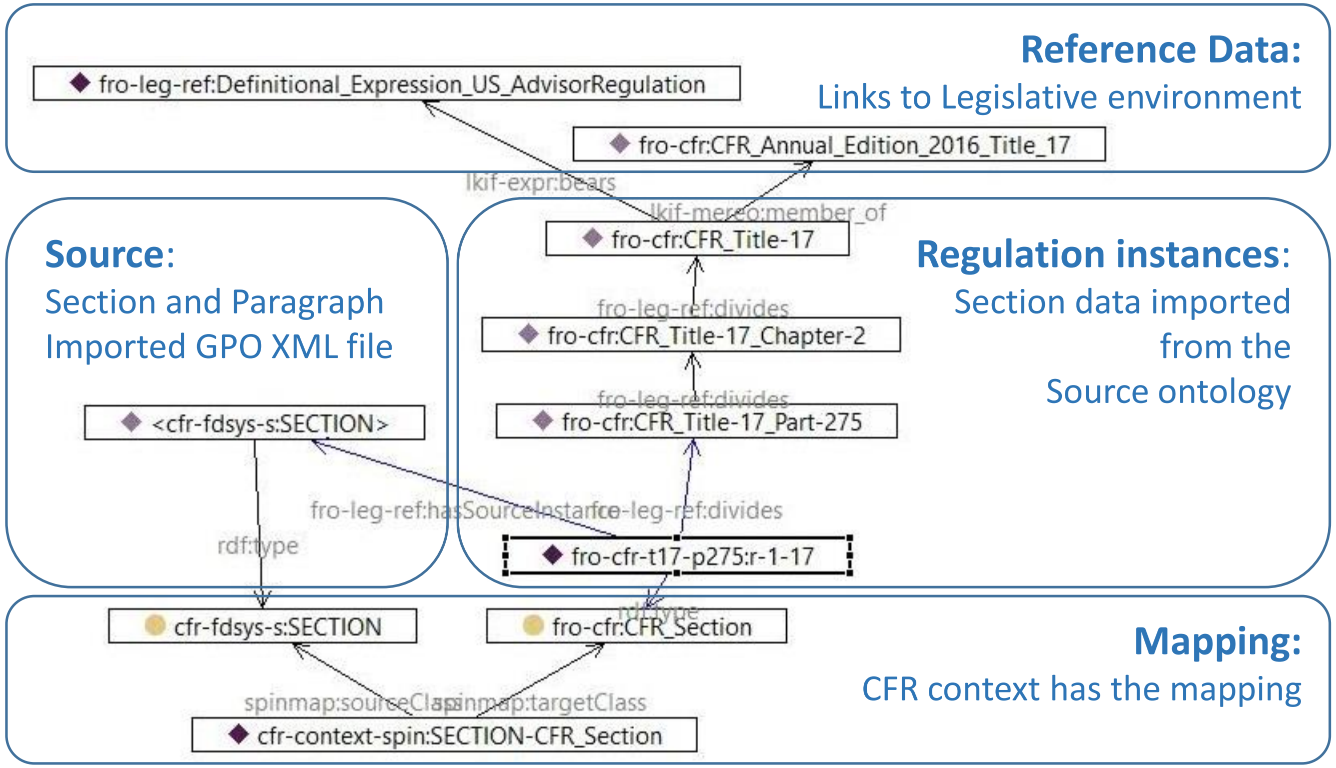
Regulation instance fro-cfr:CFR_Title-17 has object properties to the Reference Data. Title 17

- is a lkif-mereo:member_of the CFR edition.
- lkif-mereo:bears the Securities & Exchange Commission expression of the regulation.

The two anchor points let us query all information described in the Legislative Contact.

The section instance has the object property fro-leg-ref:has SourceInstance pointing to its original Section. With it we can join to all imported CFR FDSys classes and properties.

The rdf:type of the section instance is spinmap:targetClass for the mapping. From here we navigate to the spinmap:sourceClass.



Querying the meta data

We can query the graph joining our section with reference-, source, and mapping data.

SPARQL query

The query traverses the complete meta-data graph, starting with the section. Variables “**?**” and object properties perform the joins.

```
SELECT *
WHERE {
  BIND (fro-cfr-t17-p275:r-1-17 AS ?froSection) .
#reference data
  ?froSection fro-leg-ref:divides ?froPart .
  ?froPart fro-leg-ref:divides ?froChapter .
  ?froChapter fro-leg-ref:divides ?froTitle .
  ?froTitle lkif-expr:bears ?definitionalExpression .
  ?froTitle lkif-mereo:member_of ?edition .
# source
  ?froSection fro-leg-ref:hasSourceInstance ?source .
  ?source composite:child ?cfrNumber .
  ?cfrNumber a cfr-fdsys-s:SECTNO .
# mapping
  ?froSection a ?froTargetClass .
  ?spinContext spinmap:targetClass ?froTargetClass .
  ?spinContext spinmap:sourceClass ?cfrSourceClass
}
```

Query Result Set

The query is a star “*”, so all query variables show in the result set. The query can be customized to include more or even all sections. (modify or omit the BIND statement). Because everything is a triple within the ontology, we have a whole meta-data repository at hand.

[froSection]	**fro-cfr-t17-p275:r-1-17**
froPart	fro-cfr:CFR_Title-17_Part-275
froChapter	fro-cfr:CFR_Title-17_Chapter-2
froTitle	fro-cfr:CFR_Title-17
definitionalExpression	fro-leg-ref:Definitional_Expression_US_AdvisorRegulation
edition	fro-cfr:CFR_Annual_Edition_2016_Title_17
source	<cfr-fdsys-s:SECTION>
cfrNumber	<cfr-fdsys-s:SECTNO>§ 275.203(m)-1
froTargetClass	fro-cfr:CFR_Section
spinContext	cfr-context-spin:SECTION-CFR_Section
cfrSourceClass	cfr-fdsys-s:SECTION

Asserting the mapped triples

The populated FRO instances are still inferences. To make them permanent, we assert them to the target file.

Dynamic/volatile Data should be **inferred at runtime**

An ontology that needs the populated sections and paragraphs can simply import the mapping file.
That means the mapping rules will be executed every time we invoke the reasoner. This is desired for volatile information. The triples are temporary and 'lost' when we close the file. Dynamic strategies keep the target ontology in sync with the source. The cost is computing time of the inference engine.

Static and slowly changing data should be **asserted**

For data that does not change often, we don't want to spent reasoner time. This pertains to static reference data, transactions, and history.
The reasoner does not have to re-compute the transformation rules. The triples are permanent. This means that changes to the source are not reflected in the target ontology automatically.

For CFR we assert the triples to a new file:
FRO_CFR_Title_12_Part_275.tll

All ontology environments have routines to export inferences, results to a new graph. A challenge is to separate wanted from unwanted inferences. See our earlier example, fro-cfr-t17-p275:r-1-17-3, the Private Fund Adviser paragraph:

- We only want the rules output, new FRO class instances and their properties.
- We do not want derived inferences, like subsumption to parent classes and properties. They should be inferred in the target ontology, because the target schema may change.

For the Financial Regulation Ontology, we explicitly move triples using SPARQL Motion.

SPARQL Motion – scripting language

“SPARQLMotion is an RDF-based scripting language with a graphical notation to describe data processing pipelines.”[3]

“The basic idea of SPARQLMotion is that individual processing steps can be connected, so that the output of one step is used as input to the next. RDF graphs are the basic data structure that is passed between the steps, but named variables pointing to RDF nodes and XML documents can also be passed between steps. The behavior of each module is typically driven by SPARQL queries, for example to iterate through result sets, to construct new RDF triples and to perform updates to RDF data sources.” http://sparqlmotion.org/

SPARQL Motion is quite powerful and flexible – similar to ETL environments. The diagram shows a subset of the script to load the CFR rule inferences.

Input for the script is an import of the CFR mapping file with inferences.

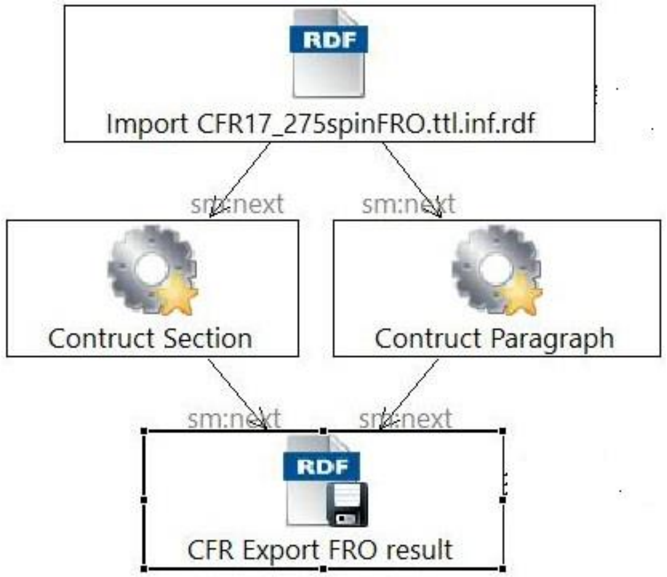
RDF Processing elements are SPARQL CONSTRUCT statements that operate on the input triples. For example:

```
CONSTRUCT {
   ?section a fro-cfr:CFR_Section .}
WHERE {
   ?section a fro-cfr:CFR_Section
```

The constructed triples become input for the next step.

The final Export step specifies to write the output to FRO_CFR_Title_17_Part275.ttl

```
CONSTRUCT {
   ?section a fro-cfr:CFR_Section .
}
WHERE {
   ?section a fro-cfr:CFR_Section .
}
```



Querying the Code of Federal Regulations

The CFR “**everything query**” contains the main Code of Federal Regulations classes and data properties. We use the query to validate the data import for FRO resource files.

The select joins the section with

- Reference data
- Section sequence number, source instance and subject.
- Section Notes and Citation
- Paragraph sequence number and text and enumeration text.

We sort by section sequence than paragraph sequence.

The query selects (almost) everything in FRO related to the Code of Federal Regulations. Besides validation, we run the query to export data into csv/MS-Excel format. Query file and Excel are in the website directory: http://finregont.com/fro/query/

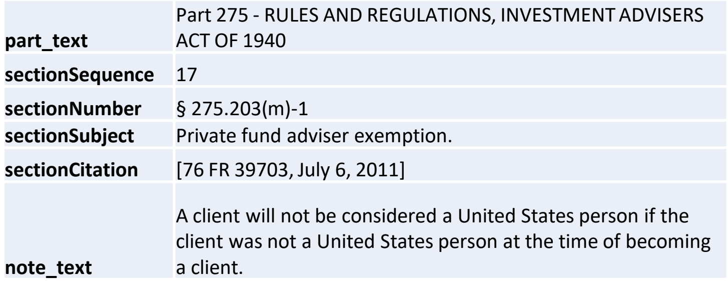
```
SELECT *
WHERE {
   ?edition fro-leg-ref:hasEditionText ?edition_text .
   ?edition lkif-mereo:member ?title .
   ?title fro-leg-ref:hasTitleText ?title_text .
   ?chapter fro-cfr:hasChapterText ?chapter_text .
   ?part fro-leg-ref:divides ?chapter .
   ?part fro-cfr:hasPartText ?part_text .
   ?section fro-leg-ref:divides ?part ;
            fro-leg-ref:hasSequenceNumber ?sectionSequence ;
            fro-cfr:hasSectionNumber ?sectionNumber ;
            fro-leg-ref:hasSourceInstance ?section_source ;
            fro-cfr:hasSectionSubject ?sectionSubject .
   OPTIONAL {?section fro-cfr:hasSectionCitation ?sectionCitation  . }
   OPTIONAL { ?section fro-leg-ref:refers_toNote ?note .
      ?note a fro-cfr:CFR_Note .
      ?note fro-cfr:hasNoteText ?note_text . }
   ?para fro-leg-ref:divides ?section ;
         fro-leg-ref:hasSequenceNumber ?paraIndex ;
         fro-leg-ref:hasSourceInstance ?para_source ;
         fro-cfr:hasParagraphText ?paraText .
   OPTIONAL {?para fro-cfr:hasParagraphEnumText ?paraEnumText}
}
ORDER BY ?sectionSequence  ?paraSequence
```

CFR Section § 275.203(m)-1 query results

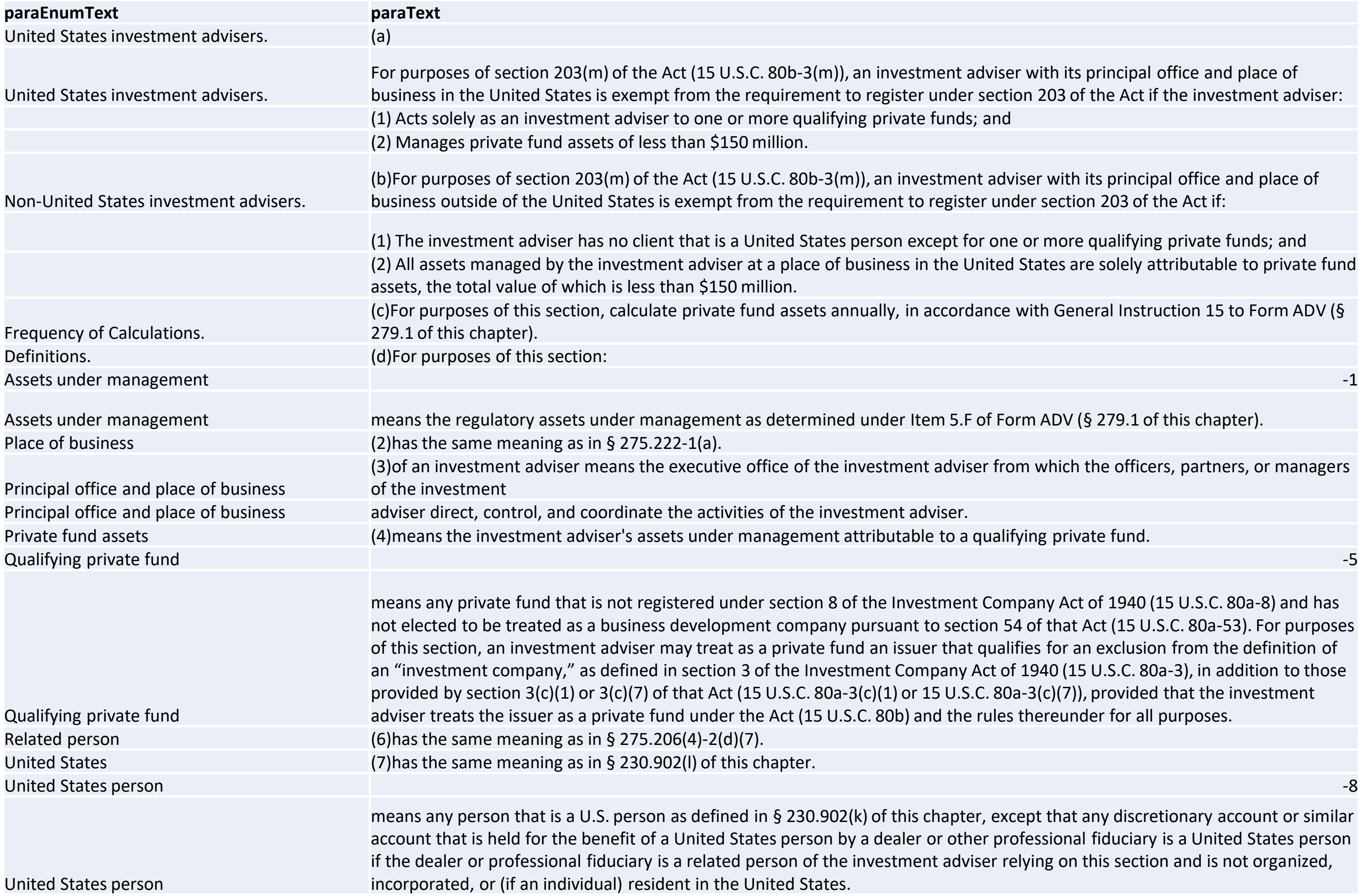
This is an excerpt of the query output Excel spreadsheet, filtered for section sequence number 17.

We hide technical column to focus on the regulation content.
Below section information is the same for all 1035 record.
To the right, we see the Paragraphs. This query reconstitutes the text of the regulation as it is in the GPO PDF download.

This concludes the tutorial on loading the Code of Federal Regulations. The United States Code is next.



part_text	Part 275 - RULES AND REGULATIONS, INVESTMENT ADVISERS ACT OF 1940
sectionSequence	17
sectionNumber	§ 275.203(m)-1
sectionSubject	Private fund adviser exemption.
sectionCitation	[76 FR 39703, July 6, 2011]
note_text	A client will not be considered a United States person if the client was not a United States person at the time of becoming a client.



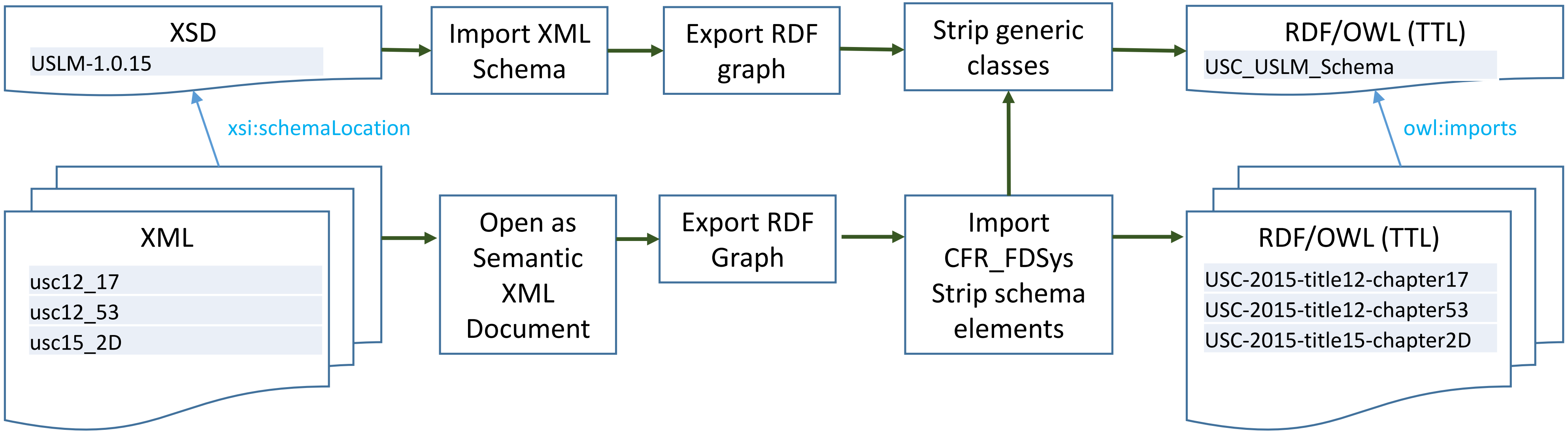
paraEnumText	**paraText**
United States investment advisers.	(a)
United States investment advisers.	For purposes of section 203(m) of the Act (15 U.S.C. 80b-3(m)), an investment adviser with its principal office and place of business in the United States is exempt from the requirement to register under section 203 of the Act if the investment adviser:
	(1) Acts solely as an investment adviser to one or more qualifying private funds; and
	(2) Manages private fund assets of less than $150 million.
Non-United States investment advisers.	(b)For purposes of section 203(m) of the Act (15 U.S.C. 80b-3(m)), an investment adviser with its principal office and place of business outside of the United States is exempt from the requirement to register under section 203 of the Act if:
	(1) The investment adviser has no client that is a United States person except for one or more qualifying private funds; and
	(2) All assets managed by the investment adviser at a place of business in the United States are solely attributable to private fund assets, the total value of which is less than $150 million.
Frequency of Calculations.	(c)For purposes of this section, calculate private fund assets annually, in accordance with General Instruction 15 to Form ADV (§ 279.1 of this chapter).
Definitions.	(d)For purposes of this section:
Assets under management	-1
Assets under management	means the regulatory assets under management as determined under Item 5.F of Form ADV (§ 279.1 of this chapter).
Place of business	(2)has the same meaning as in § 275.222-1(a).
Principal office and place of business	(3)of an investment adviser means the executive office of the investment adviser from which the officers, partners, or managers of the investment
Principal office and place of business	adviser direct, control, and coordinate the activities of the investment adviser.
Private fund assets	(4)means the investment adviser's assets under management attributable to a qualifying private fund.
Qualifying private fund	-5
Qualifying private fund	means any private fund that is not registered under section 8 of the Investment Company Act of 1940 (15 U.S.C. 80a-8) and has not elected to be treated as a business development company pursuant to section 54 of that Act (15 U.S.C. 80a-53). For purposes of this section, an investment adviser may treat as a private fund an issuer that qualifies for an exclusion from the definition of an "investment company," as defined in section 3 of the Investment Company Act of 1940 (15 U.S.C. 80a-3), in addition to those provided by section 3(c)(1) or 3(c)(7) of that Act (15 U.S.C. 80a-3(c)(1) or 15 U.S.C. 80a-3(c)(7)), provided that the investment adviser treats the issuer as a private fund under the Act (15 U.S.C. 80b) and the rules thereunder for all purposes.
Related person	(6)has the same meaning as in § 275.206(4)-2(d)(7).
United States	(7)has the same meaning as in § 230.902(l) of this chapter.
United States person	-8
United States person	means any person that is a U.S. person as defined in § 230.902(k) of this chapter, except that any discretionary account or similar account that is held for the benefit of a United States person by a dealer or other professional fiduciary is a United States person if the dealer or professional fiduciary is a related person of the investment adviser relying on this section and is not organized, incorporated, or (if an individual) resident in the United States.

United States Code - Physical Load Model

The USC Lead Model mirrors the CFR steps, however the structure of the law is more complex than regulations. There are many more components and variations in the hierarchy.

http://uscode.house.gov/download/download.shtml

https://finregont.com/fro/usc/



XSD
USLM-1.0.15

Import XML Schema

Export RDF graph

Strip generic classes

RDF/OWL (TTL)
USC_USLM_Schema

xsi:schemaLocation

owl:imports

XML
usc12_17
usc12_53
usc15_2D

Open as Semantic XML Document

Export RDF Graph

Import CFR_FDSys Strip schema elements

RDF/OWL (TTL)
USC-2015-title12-chapter17
USC-2015-title12-chapter53
USC-2015-title15-chapter2D

The Office of the Law Revision Council provides one XML file per USC Title (usc12.xml, usc15.xml). FRO only needs individual chapters - not the whole title. We used XMLSpy to spit the XML into chapter files.

The XSD is called United States Legislative Model (USLM). We adopt the abbreviation for FinRegOnt staging schema.

Understanding the USC XML header

The USC header contains version, the schema include, and metadata about the document.

The import into Financial Regulation Ontology Staging retains this information, but we only need selected elements for LKIF/FRO. The only XMLSpy edit to the was to remove chapters that we don’t need.

The <meta> section has the document title, number. Publisher is the Office of the Law Revision Council (OLRC). The Publication name refers to the OLRC release point 114-153. The files is as of 2016-04-27.

The document body starts with the <main> tag. Just like in CFR, top-level component is the Title. The id field (see title and note) provides a unique identifier for all components. , that we will use to construct the URIs in FinRegOnt.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSpy v2016 rel. 2 sp1 (http://www.altova.com) by Jurgen Ziemer (Jayzed Data Models Inc.)
-->
<?xml-stylesheet type="text/css" href="usctitle.css"?>
<uscDoc xml:lang="en" identifier="/us/usc/t15" xmlns="http://xml.house.gov/schemas/uslm/1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dcterms="http://purl.org/dc/terms/" xsi:schemaLocation="http://xml.house.gov/schemas/uslm/1.0
file:///D:/Local%20Documents/Hedge%20Fund%20Regulation%20Ontology/USC%20title%2015/schemaandcss/USLM-
1.0.15.xsd">
            <meta>
                        <dc:title>Title 15</dc:title>
                        <dc:type>USCTitle</dc:type>
                        <docNumber>15</docNumber>
                        <docPublicationName>Online@114-153</docPublicationName>
                        <dc:publisher>OLRC</dc:publisher>
                        <dcterms:created>2016-04-27T08:37:20</dcterms:created>
                        <dc:creator>USCConverter 1.1</dc:creator>
            </meta>
            <main>
                        <title id="idcfab2c69-0c74-11e6-aa53-e455a13f2ad9" identifier="/us/usc/t15">
                                    <num value="15">Title 15—</num>
                                    <heading>COMMERCE AND TRADE</heading>
                                    <note topic="miscellaneous"
                                                id="idcfab2c6a-0c74-11e6-aa53-e455a13f2ad9">
                                                <p>Current through 114-153</p>
```

Understanding the USC XML main structure

The USC main structure has more levels and content elements than CFR.

Our Private Fund Manager Exception is contained in a Subsection of 15 U.S. Code § 80b–3.

The XML has a rich set of formatting styles and a table of contents. Both is not needed in FRO for our purpose of Legal Reasoning and we don't import them. They remain available in the staging RDF. We do import:

- id
  The unique element identifier
- identifier
  The human readable index of the element
- heading
  The name/title of the element.

Section § 80b–3, breaks down into 14 `subsections`. Subsection b/1 defines exception to the registration requirement. The `chapeau` is an introductory text for the following lower levels. In this case a heading for the 7 `paragraphs`. Finally the `content` element contains the text.

```
<section style="-uslm-lc:I80" id="idd04f5b5e-0c74-11e6-aa53-e455a13f2ad9"
            identifier="/us/usc/t15/s80b-3">
            <num value="80b-3">§ 80b-3.</num>
            <heading> Registration of investment advisers</heading>
            <subsection style="-uslm-lc:I19" class="indent2 firstIndent-2"
                        id="idd04f5b5f-0c74-11e6-aa53-e455a13f2ad9"
                        identifier="/us/usc/t15/s80b-3/a">  </subsection> …
            <subsection style="-uslm-lc:I19" class="indent2 firstIndent-2"
                        id="idd04f5b60-0c74-11e6-aa53-e455a13f2ad9"
                        identifier="/us/usc/t15/s80b-3/b">
            <num value="b" class="bold">(b)</num>
            <heading class="bold"> Investment advisers who need not be
registered</heading>
            <chapeau>The provisions of subsection (a) shall not apply to—</chapeau>
            <paragraph style="-uslm-lc:I12" class="indent1"
                        id="idd04f5b61-0c74-11e6-aa53-e455a13f2ad9"
                        identifier="/us/usc/t15/s80b-3/b/1">
            <num value="1">(1)</num>
            <content> any investment adviser, other than an investment adviser who acts as
an investment adviser to any private fund, all of whose clients are residents of the State
within which such investment adviser maintains his or its principal office and place of
business, and who does not furnish advice or issue analyses or reports with respect to
securities listed or admitted to unlisted trading privileges on any national securities
exchange;</content>

            </paragraph>
```

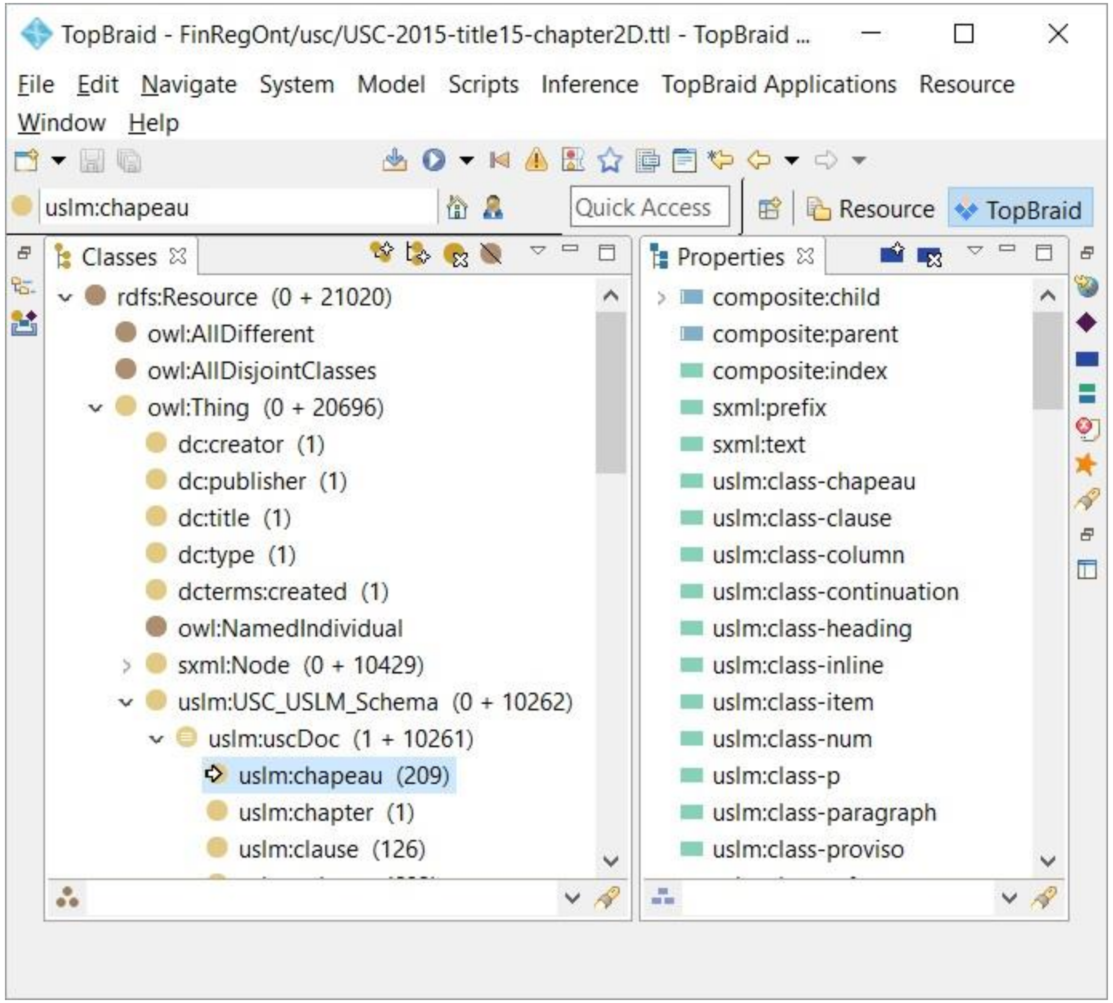
Imported USC USLM classes & properties

The ontology browser shows USC-2015-title15-chapter2D.ttl Classes and Properties.

The XML header elements, creator, publisher, title, and type have been imported as classes with the “dc:” prefix. The namespace refers to http://purl.org/dc/elements/1.1/ the Dublin Core resource metadata standard.

We create the namespace “uslm” (=United States Legislative Model, showing left of the colon on the classes/properties).
We use a collection class, USC_USLM_Schema as a superclass for all USLM classes. More than 10,000 instances have been created.

The properties list starts with object property composite:child/parent and the index - just like the CFR import.


TopBraid - FinRegOnt/usc/USC-2015-title15-chapter2D.ttl - TopBraid ...
File Edit Navigate System Model Scripts Inference TopBraid Applications Resource
Window Help
uslm:chapeau
Quick Access
Resource
TopBraid
Classes
Properties

Classes:

- rdfs:Resource (0 + 21020)
  - owl:AllDifferent
  - owl:AllDisjointClasses
  - owl:Thing (0 + 20696)
    - dc:creator (1)
    - dc:publisher (1)
    - dc:title (1)
    - dc:type (1)
    - dcterms:created (1)
    - owl:NamedIndividual
    - sxml:Node (0 + 10429)
    - uslm:USC_USLM_Schema (0 + 10262)
      - uslm:uscDoc (1 + 10261)
        - uslm:chapeau (209)
        - uslm:chapter (1)
        - uslm:clause (126)

Properties:

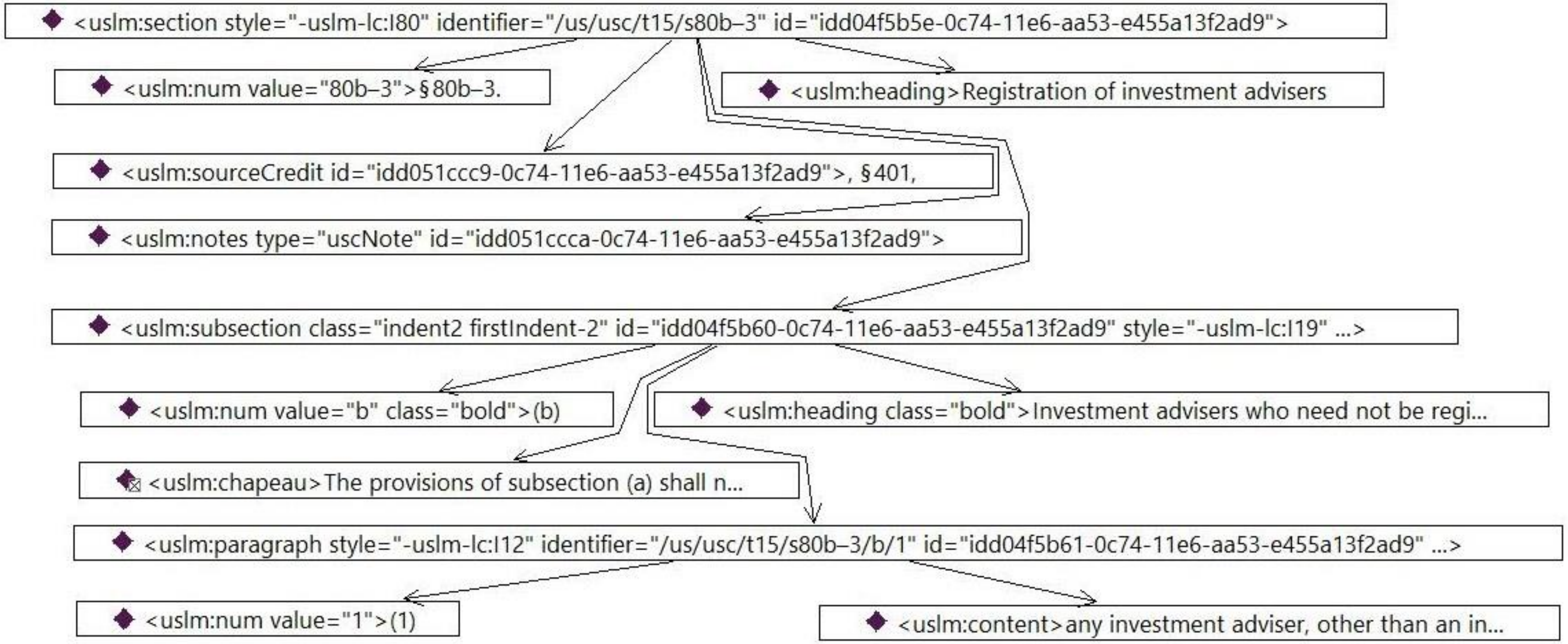
- composite:child
- composite:parent
- composite:index
- sxml:prefix
- sxml:text
- uslm:class-chapeau
- uslm:class-clause
- uslm:class-column
- uslm:class-continuation
- uslm:class-heading
- uslm:class-inline
- uslm:class-item
- uslm:class-num
- uslm:class-p
- uslm:class-paragraph
- uslm:class-proviso

Comparing the USC USLM § 80b–3 graph

The diagram shows the instance graph for the Private Fund Exemption XML.

The instance box text starts with the class name, for example “<uslm:section “. The connecting arrows, object property instances of composite:child show the hierarchy from Section via Subsection to Paragraph.

Section and **Subsection** have a heading, “Registration of Investment Advisers”. The “**num**” instance, child of section has numbering text § 80b–3. Section also shows the **Source Credit** and a **Note**. The Subsection also has a Num and Heading “Investment Advisers who need not to be registered”. The **Chapeau** “Provisions of subsection (a) shall not apply to …” precedes the list of paragraphs. **Paragraphs** have a Num value and content. The Num value helps to list the exceptions in the right order. **Content** can be a simple text or more complex structure as we shall see on transformation and query slides.

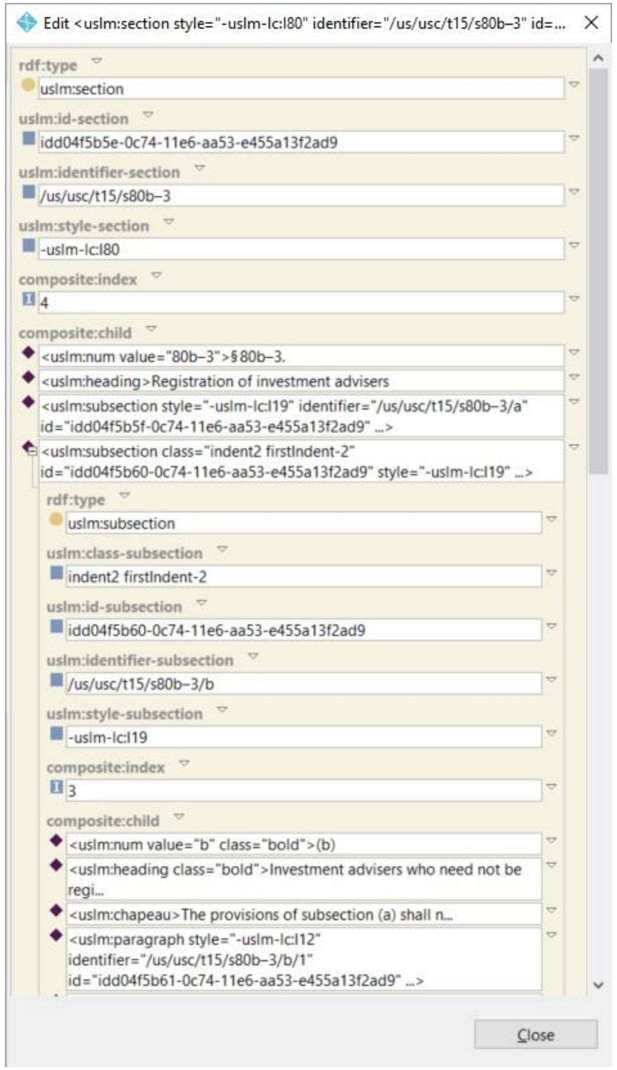


```
<uslm:section style="-uslm-lc:I80" identifier="/us/usc/t15/s80b–3" id="idd04f5b5e-0c74-11e6-aa53-e455a13f2ad9">
<uslm:num value="80b–3">§80b–3.
<uslm:heading>Registration of investment advisers
<uslm:sourceCredit id="idd051ccc9-0c74-11e6-aa53-e455a13f2ad9">, §401,
<uslm:notes type="uscNote" id="idd051ccca-0c74-11e6-aa53-e455a13f2ad9">
<uslm:subsection class="indent2 firstIndent-2" id="idd04f5b60-0c74-11e6-aa53-e455a13f2ad9" style="-uslm-lc:I19" ...>
<uslm:num value="b" class="bold">(b)
<uslm:heading class="bold">Investment advisers who need not be regi...
<uslm:chapeau>The provisions of subsection (a) shall n...
<uslm:paragraph style="-uslm-lc:I12" identifier="/us/usc/t15/s80b–3/b/1" id="idd04f5b61-0c74-11e6-aa53-e455a13f2ad9" ...>
<uslm:num value="1">(1)
<uslm:content>any investment adviser, other than an in...
```

USC USLM Section § 80b–3 form details

A double click on the section instance invokes the details dialog.

The instance is a **uslm:section**. The **uslm:id-section** is a unique identifier coming with the OLRC XML. We will use this ID to generate the FinRegOnt URL. The **uslm:identifier-section** is the human readable ID. It is structured as an index into the United States Code.
We ignore the **uslm:style-section**. The formatting can be retrieved from FinRegOnt Staging via the SourceInstance property.
The import generates the composite:index. As in CFR it sorts child elements with the same parent instance. I.e. our section is the 4th child of parent chapter instance.
The composite:child part shows all elements under our section. The uslm:num value is the human readable “number” of the element, § 80b–3. The heading is a short name/text for the element, “Registration of investment advisers.
Next children are all subsections. (CFR doesn’t have subsections). We expand subsection “b”. Just like sections, subsections have type, id, identifier, style and composite index.
The composite:child part shows num value and heading. The **uslm:chapeau** is an introductory text for the following sub-elements, the paragraphs.
The Subsection uslm:paragraph contain the text of Private Fund exemptions to the registration requirement.



Edit <uslm:section style="-uslm-lc:I80" identifier="/us/usc/t15/s80b–3" id=...

rdf:type
uslm:section

uslm:id-section
idd04f5b5e-0c74-11e6-aa53-e455a13f2ad9

uslm:identifier-section
/us/usc/t15/s80b–3

uslm:style-section
-uslm-lc:I80

composite:index
4

composite:child
<uslm:num value="80b–3">§ 80b–3.
<uslm:heading>Registration of investment advisers
<uslm:subsection style="-uslm-lc:I19" identifier="/us/usc/t15/s80b–3/a" id="idd04f5b5f-0c74-11e6-aa53-e455a13f2ad9" ...>
<uslm:subsection class="indent2 firstIndent-2" id="idd04f5b60-0c74-11e6-aa53-e455a13f2ad9" style="-uslm-lc:I19" ...>

rdf:type
uslm:subsection

uslm:class-subsection
indent2 firstIndent-2

uslm:id-subsection
idd04f5b60-0c74-11e6-aa53-e455a13f2ad9

uslm:identifier-subsection
/us/usc/t15/s80b–3/b

uslm:style-subsection
-uslm-lc:I19

composite:index
3

composite:child
<uslm:num value="b" class="bold">(b)
<uslm:heading class="bold">Investment advisers who need not be regi...
<uslm:chapeau>The provisions of subsection (a) shall n...
<uslm:paragraph style="-uslm-lc:I12" identifier="/us/usc/t15/s80b–3/b/1" id="idd04f5b61-0c74-11e6-aa53-e455a13f2ad9" ...>

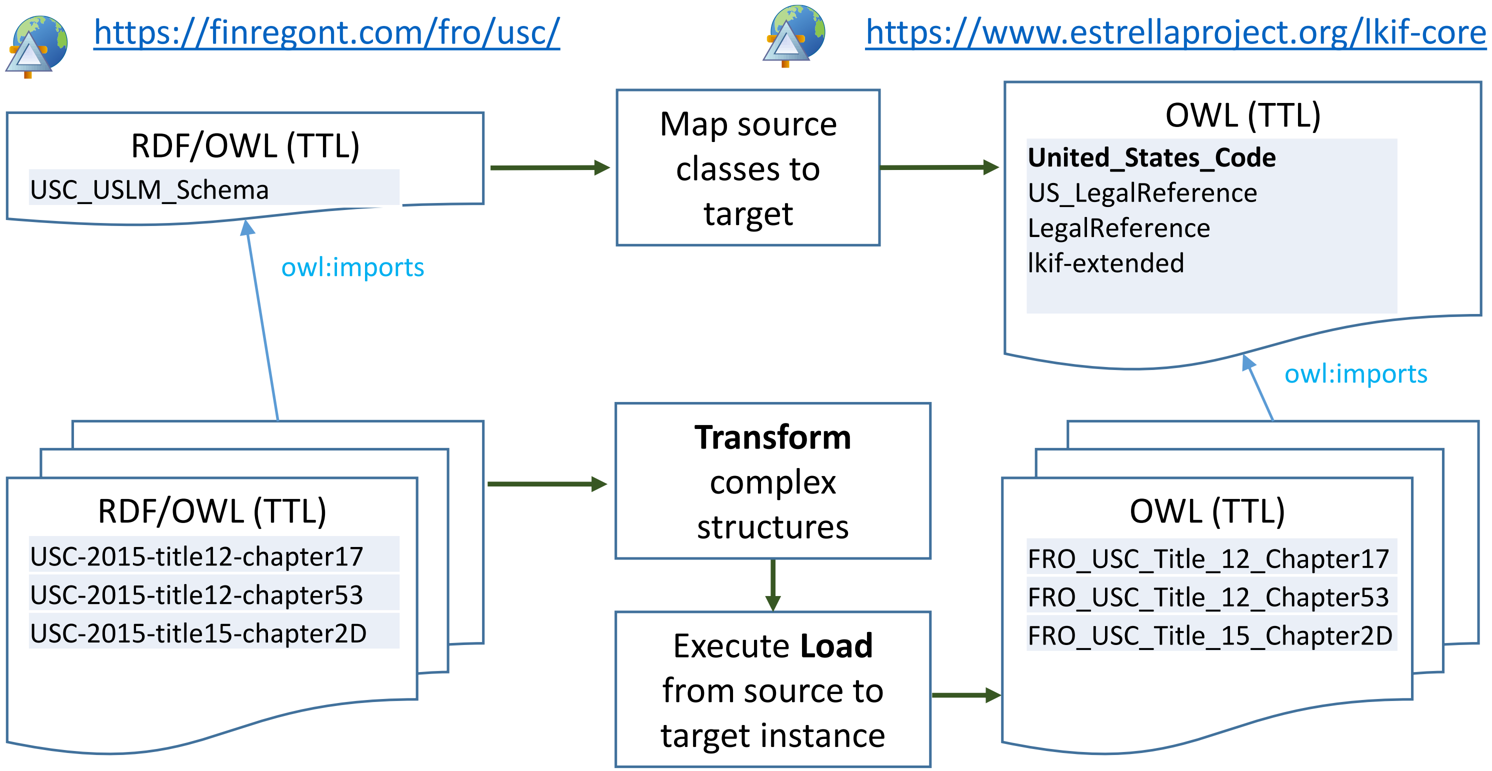
USC to FRO/LKIF Physical Transform Model

The Physical Load model is similar to CFR. The target ontology schema is United_States_Code.ttl.

We map the staging classes from USC_USLM_Schema.ttl to the target classes in United_States_Code.ttl. The target ontology imports US_Legal_Reference.ttl, Legal_Reference.ttl and lkif-extended.ttl. The imported LKIF, Legal Reference and US Legal Reference files are the same for law and regulations.

We create a target FRO instance ontology file for very staging file.

The design challenge for the FRO USC target ontology lies in the complexity of the USLM structure. For example:
What elements can have a USLM Paragraph?
Where do Clause and Sub clause appear?
What elements are composite child of Section?


https://finregont.com/fro/usc/
https://www.estrellaproject.org/lkif-core
RDF/OWL (TTL)
USC_USLM_Schema
owl:imports
Map source classes to target
OWL (TTL)
United_States_Code
US_LegalReference
LegalReference
lkif-extended
owl:imports
RDF/OWL (TTL)
USC-2015-title12-chapter17
USC-2015-title12-chapter53
USC-2015-title15-chapter2D
Transform complex structures
Execute Load from source to target instance
OWL (TTL)
FRO_USC_Title_12_Chapter17
FRO_USC_Title_12_Chapter53
FRO_USC_Title_15_Chapter2D

Analyzing the populated USC structure.

To answer questions about the USC structure we query and pivot population of classes and the composite:child relationship.

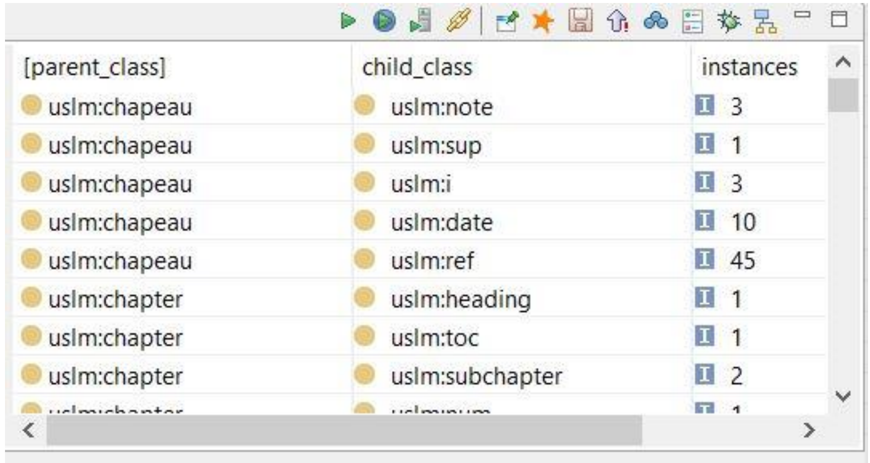
The SPARQL **SELECT** returns Parent, Child class and the number of instances.
The first line in the **WHERE** clause populates all 10,261 instances of the composite:child object property into **?parent** and **?child** variables.
The next two lines navigate to the **?parent_class** and **?child_class**. The last line in the WHERE clause limits the result-set to subclasses of our USLM collection class, **uslm:uscDoc**. We **GROUP** the results **BY** parent and child class.

```
SELECT ?parent_class ?child_class (COUNT(*) AS ?instances)
WHERE {
   ?parent composite:child ?child .
   ?parent a ?parent_class .
   ?child a ?child_class .
   ?parent_class rdfs:subClassOf uslm:uscDoc .
   ?child_class rdfs:subClassOf uslm:uscDoc .
}
GROUP BY ?parent_class ?child_class
```

We run the query against the Investor Adviser Act staging ontology, USC-2015-title15-chapter2D.ttl
The result set show:

- 3 chapeaus have a note
- 10 chapeaus have a date element.
- 45 chapeaus have a reference

This analysis drives how we design the FRO class for chapeau. For instance, we can put an OWL restriction on chapeau and the parent classes. The actual population will also drive the validation query.
The next slide shows an MS Excel pivot of the complete result set.
The top row shows the USLM parent classes.
The left column has the child classes
Cells contain the number of relationship per pair.



[parent_class]	child_class	instances
uslm:chapeau	uslm:note	3
uslm:chapeau	uslm:sup	1
uslm:chapeau	uslm:i	3
uslm:chapeau	uslm:date	10
uslm:chapeau	uslm:ref	45
uslm:chapter	uslm:heading	1
uslm:chapter	uslm:toc	1
uslm:chapter	uslm:subchapter	2
uslm:chapter	uslm:num	1

USC USLM Title 15, Chapter 2D element pivot

Sum of total	Parent																												
Child	**chapeau**	**chapter**	**clause**	**column**	**content**	**continuation**	**header**	**heading**	**inline**	**item**	**layout**	**main**	**meta**	**note**	**notes**	**p**	**paragraph**	**proviso**	**quotedContent**	**section**	**sourceCredit**	**subchapter**	**subclause**	**subparagraph**	**subsection**	**title**	**toc**	**tocItem**	**uscDoc**	**Grand Total**
chapeau			14														59			8			1	42	85					**209**
chapter																										1				**1**
clause																								126						**126**
column							6																					597		**603**
content			111							4							427			23			39	218	175					**997**
continuation																	10							5	23					**38**
date	10				42			1	2							263			7		233									**558**
docNumber													1																	**1**
docPublicationName													1																	**1**
header											4																			**4**
heading		1												289			84			93		2		50	289	1				**809**
i	3				21	3										24		2	2		1									**56**
inline								14	1										4											**19**
item			2																				2							**4**
layout																											2			**2**
main																													1	**1**
meta																													1	**1**
note	3				9			2							289	5										1				**309**
notes																				82										**82**
num		1	126							4				19			514			93		2	40	263	295	1				**1358**
p					271									685																**956**
paragraph																			14	17					483					**514**
proviso																								1	1					**2**
quotedContent																25														**25**
ref	45			367	197	11		2	2							1278			20		644									**2566**
section																						93								**93**
sourceCredit																				92										**92**
subchapter		2																												**2**
subclause			36																					4						**40**
subparagraph																	261			2										**263**
subsection																			9	286										**295**
sup	1																													**1**
title												1																		**1**
toc		1																								1				**2**
tocItem											230																			**230**
Grand Total	**62**	**5**	**289**	**367**	**540**	**14**	**6**	**19**	**5**	**8**	**234**	**1**	**2**	**993**	**289**	**1595**	**1355**	**2**	**56**	**696**	**878**	**97**	**82**	**709**	**1351**	**5**	**2**	**597**	**2**	**10261**

Extending LKIF Norm-Statute for USC USLM

Jumping ahead, the class and property browser show the outcome of our LKIF extensions.

The next pages will explain the design and population. Refer to the documentation for definitions of classes and properties:
http://finregont.com/ontology-documentation/

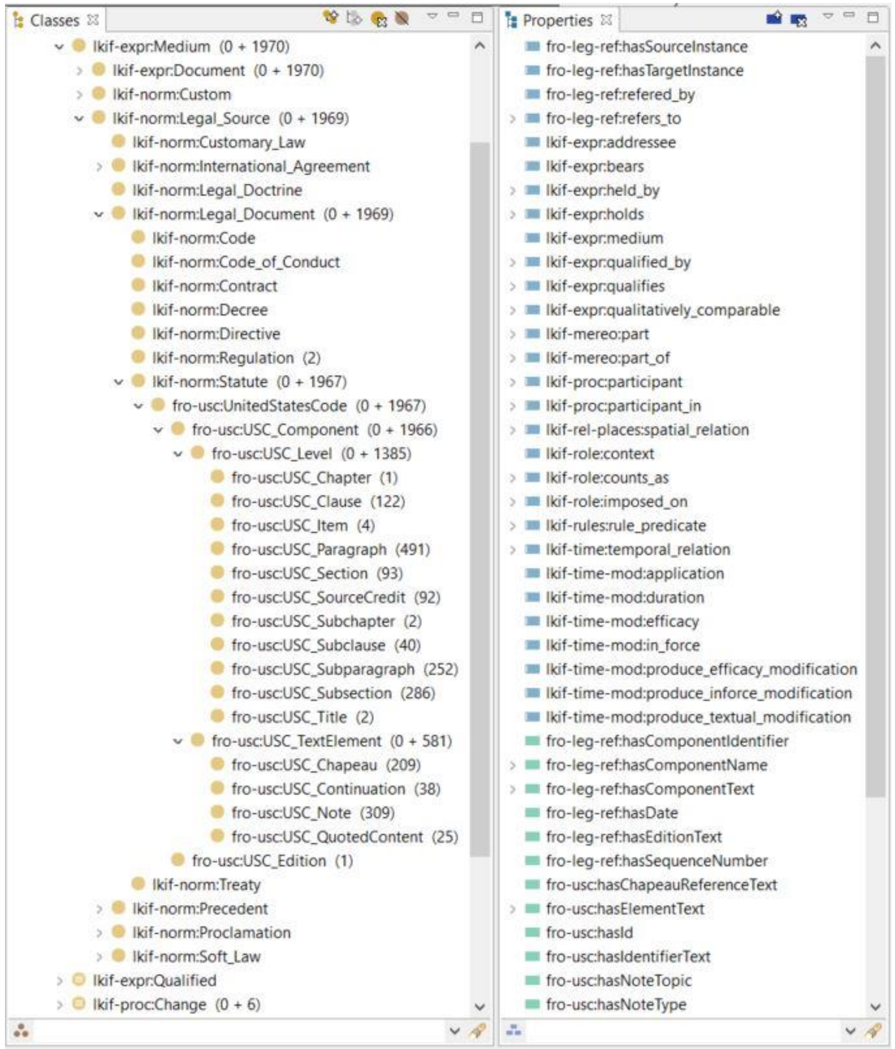
Financial Regulation Ontology classes have the prefix fro-usc.
The United States Code is a LKIF Statute. Both Statute and Regulation are LKIF Legal Documents* rolling up to Medium. The fro-usc:USC_Component is collection class for Level and Text entities.

- 11 USC_Level classes establish the hierarchy via the fro-leg-ref:divides object property.
- 4 USC_Text Element classes extend or annotate components via the fro-leg-ref:refers_to property, a subPropertyOf of lkif-mereo:part_of.

USLM Schema and User Guide available on the OLRC website (http://uscode.house.gov/download/download.shtml) and the pivot table is in the FinRegOnt query directory. They define the requirements for the design. For each USLM element we considered:

I. Major elements have a semantic importance indicated in the USLM documentation or have sufficient number of instances. They become USC Components. The distinction between Level and Text is structural in the XML Source.
    a) USC Level elements have and Identifier, the human readable index.
    b) USC Text Elements do not have an ID.

II. Minor elements have population of < than 10 instances.
    a) Denormalized into data and/or object properties.
       Examples are the Notes collection and Content class.
    b) Out of scope for FRO. We do not need table of content and formatting attributes. We skipped some elements with low population and unclear USLM definitions.



```
Classes
lkif-expr:Medium  (0 + 1970)
  lkif-expr:Document  (0 + 1970)
  lkif-norm:Custom
  lkif-norm:Legal_Source  (0 + 1969)
    lkif-norm:Customary_Law
    lkif-norm:International_Agreement
    lkif-norm:Legal_Doctrine
    lkif-norm:Legal_Document  (0 + 1969)
      lkif-norm:Code
      lkif-norm:Code_of_Conduct
      lkif-norm:Contract
      lkif-norm:Decree
      lkif-norm:Directive
      lkif-norm:Regulation  (2)
      lkif-norm:Statute  (0 + 1967)
        fro-usc:UnitedStatesCode  (0 + 1967)
          fro-usc:USC_Component  (0 + 1966)
            fro-usc:USC_Level  (0 + 1385)
              fro-usc:USC_Chapter  (1)
              fro-usc:USC_Clause  (122)
              fro-usc:USC_Item  (4)
              fro-usc:USC_Paragraph  (491)
              fro-usc:USC_Section  (93)
              fro-usc:USC_SourceCredit  (92)
              fro-usc:USC_Subchapter  (2)
              fro-usc:USC_Subclause  (40)
              fro-usc:USC_Subparagraph  (252)
              fro-usc:USC_Subsection  (286)
              fro-usc:USC_Title  (2)
            fro-usc:USC_TextElement  (0 + 581)
              fro-usc:USC_Chapeau  (209)
              fro-usc:USC_Continuation  (38)
              fro-usc:USC_Note  (309)
              fro-usc:USC_QuotedContent  (25)
          fro-usc:USC_Edition  (1)
      lkif-norm:Treaty
    lkif-norm:Precedent
    lkif-norm:Proclamation
    lkif-norm:Soft_Law
lkif-expr:Qualified
lkif-proc:Change  (0 + 6)
```

```
Properties
fro-leg-ref:hasSourceInstance
fro-leg-ref:hasTargetInstance
fro-leg-ref:refered_by
fro-leg-ref:refers_to
lkif-expr:addressee
lkif-expr:bears
lkif-expr:held_by
lkif-expr:holds
lkif-expr:medium
lkif-expr:qualified_by
lkif-expr:qualifies
lkif-expr:qualitatively_comparable
lkif-mereo:part
lkif-mereo:part_of
lkif-proc:participant
lkif-proc:participant_in
lkif-rel-places:spatial_relation
lkif-role:context
lkif-role:counts_as
lkif-role:imposed_on
lkif-rules:rule_predicate
lkif-time:temporal_relation
lkif-time-mod:application
lkif-time-mod:duration
lkif-time-mod:efficacy
lkif-time-mod:in_force
lkif-time-mod:produce_efficacy_modification
lkif-time-mod:produce_inforce_modification
lkif-time-mod:produce_textual_modification
fro-leg-ref:hasComponentIdentifier
fro-leg-ref:hasComponentName
fro-leg-ref:hasComponentText
fro-leg-ref:hasDate
fro-leg-ref:hasEditionText
fro-leg-ref:hasSequenceNumber
fro-usc:hasChapeauReferenceText
fro-usc:hasElementText
fro-usc:hasId
fro-usc:hasIdentifierText
fro-usc:hasNoteTopic
fro-usc:hasNoteType
```

* Europe's Alternative Investment Managers Directive (AIFMD) is a lkif-norm:Directive

FRO USC class graph (1) Title to Subsection

The United States Code hierarchy is more complicated than the Code of Federal Regulations.

The graph shows the USC levels from Title to Subsection.

USC Subchapter divides the Chapter, which in turn divides the Title. However, both Chapter and Subchapter can have Sections. Therefore the class restriction on USC_Section states OR.

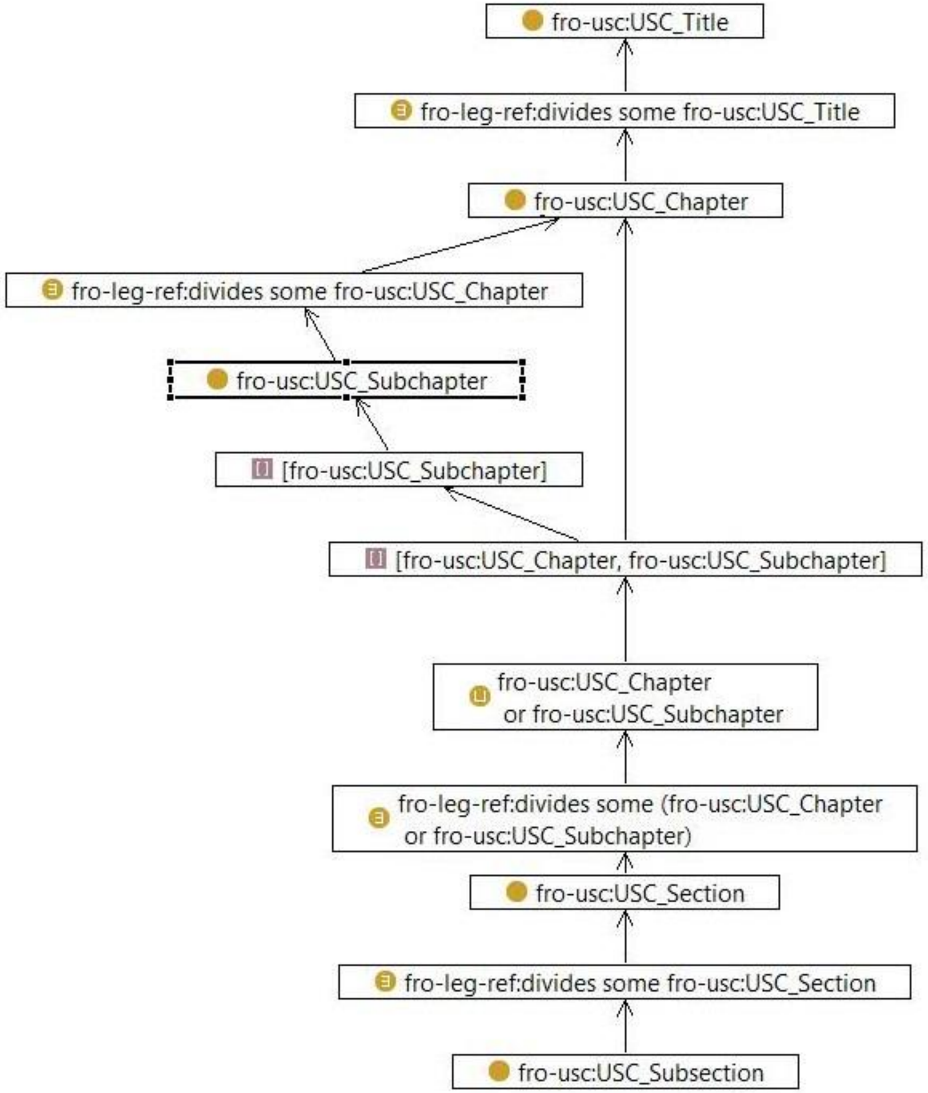
```
fro-leg-ref:divides some (fro-usc:USC_Chapter or fro-usc:USC_Subchapter)
```

The Restriction refers to a UNION (or) of the classes.

```
fro-usc:USC_Chapter or fro-usc:USC_Subchapter
```

The UNION is a list of entities “[]”, referencing to Chapter and Subchapter.
We read the graph as follows: **Section divides Chapters or Subchapters.**

The Section can be broken down further into Subsections. The Subsection divides the Section (nothing else here).


fro-usc:USC_Title
fro-leg-ref:divides some fro-usc:USC_Title
fro-usc:USC_Chapter
fro-leg-ref:divides some fro-usc:USC_Chapter
fro-usc:USC_Subchapter
[fro-usc:USC_Subchapter]
[fro-usc:USC_Chapter, fro-usc:USC_Subchapter]
fro-usc:USC_Chapter or fro-usc:USC_Subchapter
fro-leg-ref:divides some (fro-usc:USC_Chapter or fro-usc:USC_Subchapter)
fro-usc:USC_Section
fro-leg-ref:divides some fro-usc:USC_Section
fro-usc:USC_Subsection

FRO USC class graph (2) Section to Subparagraph

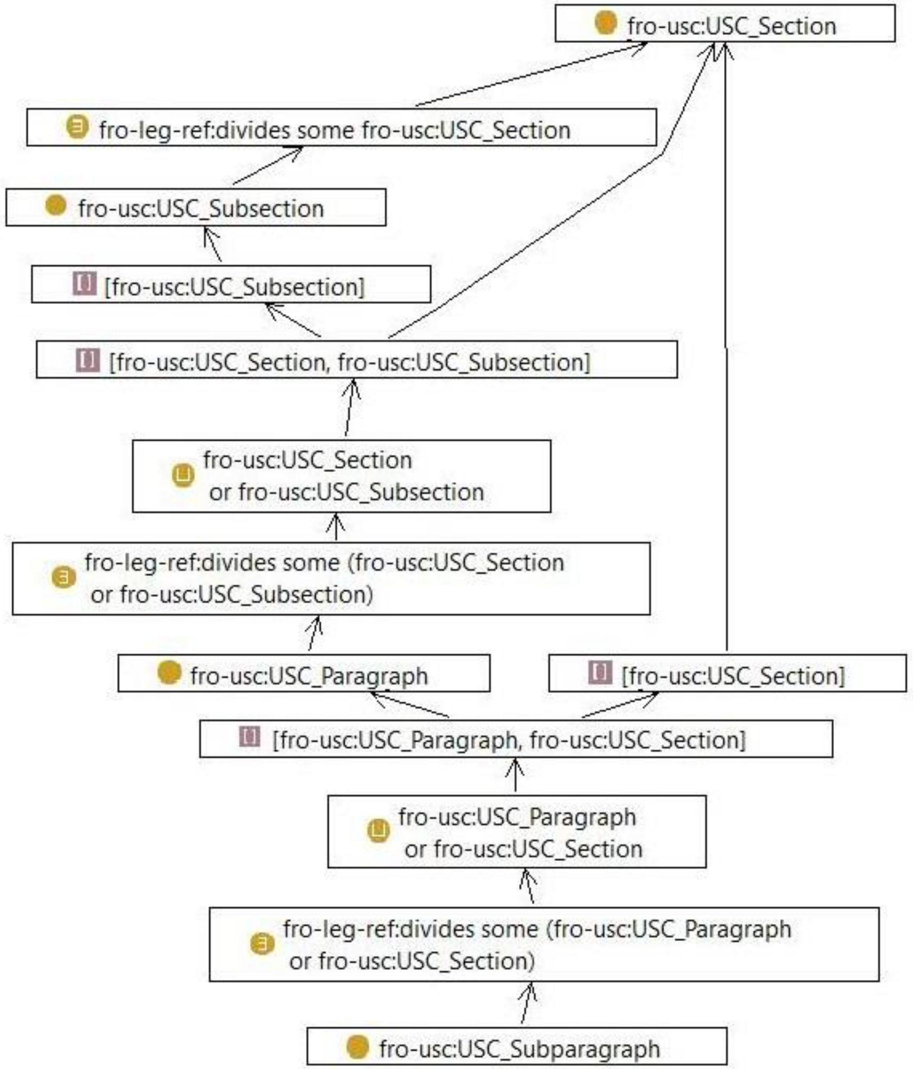
The lower elements in the USC hierarchy follow the same pattern.

Both Section and Subsection can have Paragraphs.

The Paragraph divides a Section or a Subsection.

Paragraphs can be further broken down into Subparagraphs.

The Subparagraph divides a Paragraph.


fro-usc:USC_Section
fro-leg-ref:divides some fro-usc:USC_Section
fro-usc:USC_Subsection
[fro-usc:USC_Subsection]
[fro-usc:USC_Section, fro-usc:USC_Subsection]
fro-usc:USC_Section or fro-usc:USC_Subsection
fro-leg-ref:divides some (fro-usc:USC_Section or fro-usc:USC_Subsection)
fro-usc:USC_Paragraph
[fro-usc:USC_Section]
[fro-usc:USC_Paragraph, fro-usc:USC_Section]
fro-usc:USC_Paragraph or fro-usc:USC_Section
fro-leg-ref:divides some (fro-usc:USC_Paragraph or fro-usc:USC_Section)
fro-usc:USC_Subparagraph

FRO USC class graph (3) leaf level elements

The lowest level hierarchy elements are Clause, Subclause and Item.

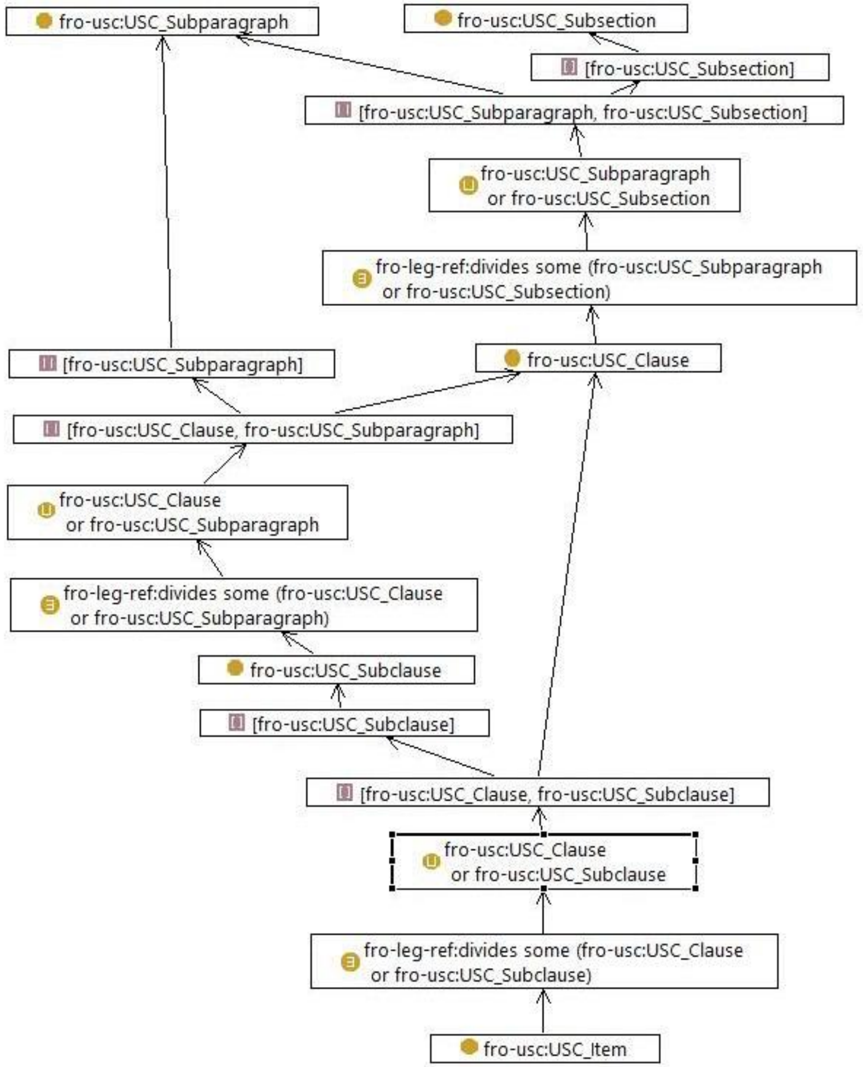
The Clause is a text, usually preceded with a lower case roman numeral. Subsection and Subparagraph can contain clauses.

The Subclause divides a Clause or a Paragraph.

The Item is a text fragment in a list, such as a numbered or bullet point list. Both Clause and Subclause may contain Items.

This completes the USC hierarchy in the Financial Regulation Ontology. The FRO USC Text Elements, Chapeau, Continuation, Note and Quoted Content are not dividing the hierarchy. They are text elements that annotate any type of USC Level element. FRO does not define class restriction on them.

We continue with transformations to populate our target ontology.



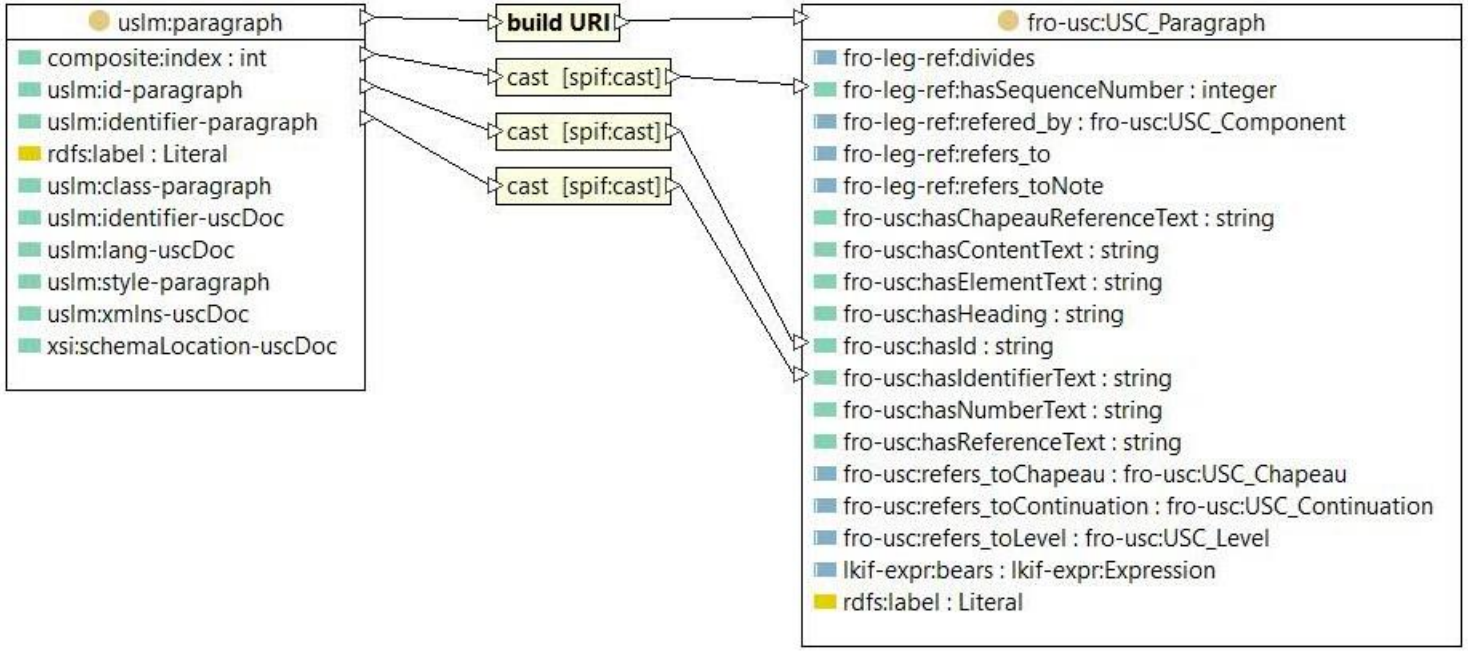
fro-usc:USC_Subparagraph
fro-usc:USC_Subsection
[fro-usc:USC_Subsection]
[fro-usc:USC_Subparagraph, fro-usc:USC_Subsection]
fro-usc:USC_Subparagraph or fro-usc:USC_Subsection
fro-leg-ref:divides some (fro-usc:USC_Subparagraph or fro-usc:USC_Subsection)
[fro-usc:USC_Subparagraph]
fro-usc:USC_Clause
[fro-usc:USC_Clause, fro-usc:USC_Subparagraph]
fro-usc:USC_Clause or fro-usc:USC_Subparagraph
fro-leg-ref:divides some (fro-usc:USC_Clause or fro-usc:USC_Subparagraph)
fro-usc:USC_Subclause
[fro-usc:USC_Subclause]
[fro-usc:USC_Clause, fro-usc:USC_Subclause]
fro-usc:USC_Clause or fro-usc:USC_Subclause
fro-leg-ref:divides some (fro-usc:USC_Clause or fro-usc:USC_Subclause)
fro-usc:USC_Item

Mapping the USLM schema to FRO-USC

The steps defining the rules to transform USLM instance data and load into USC are similar to CFR mapping.

1. Create a new RDF/SPIN mapping file USC_15_2DspinFRO.ttl
   Import the source and target ontologies: USC-2015-title15-chapter2D.ttl and FRO_USC_Tile_12_Chapter_2D.ttl
2. Define a mapping context for each of the 15 FRO target classes in the Mapping Editor.
3. Connect data properties for simple 1:1 population.
4. Create SPIN-rules for complex data and object property transformations
5. Validate the results with introspection and queries.

To map the Paragraph we pull source and target class into the mapping editor.
Then we connect the classes to invoke the Context dialog.
For CFR our context was **change namespace**, but for USC we want to build the URI from the USLM ID.


uslm:paragraph
composite:index : int
uslm:id-paragraph
uslm:identifier-paragraph
rdfs:label : Literal
uslm:class-paragraph
uslm:identifier-uscDoc
uslm:lang-uscDoc
uslm:style-paragraph
uslm:xmlns-uscDoc
xsi:schemaLocation-uscDoc
build URI
cast [spif:cast]
cast [spif:cast]
cast [spif:cast]
fro-usc:USC_Paragraph
fro-leg-ref:divides
fro-leg-ref:hasSequenceNumber : integer
fro-leg-ref:refered_by : fro-usc:USC_Component
fro-leg-ref:refers_to
fro-leg-ref:refers_toNote
fro-usc:hasChapeauReferenceText : string
fro-usc:hasContentText : string
fro-usc:hasElementText : string
fro-usc:hasHeading : string
fro-usc:hasId : string
fro-usc:hasIdentifierText : string
fro-usc:hasNumberText : string
fro-usc:hasReferenceText : string
fro-usc:refers_toChapeau : fro-usc:USC_Chapeau
fro-usc:refers_toContinuation : fro-usc:USC_Continuation
fro-usc:refers_toLevel : fro-usc:USC_Level
lkif-expr:bears : lkif-expr:Expression
rdfs:label : Literal

Create the class mapping context

The dialog shows the selected mapping function, argument, template, a preview of results and the SPARQL expression.

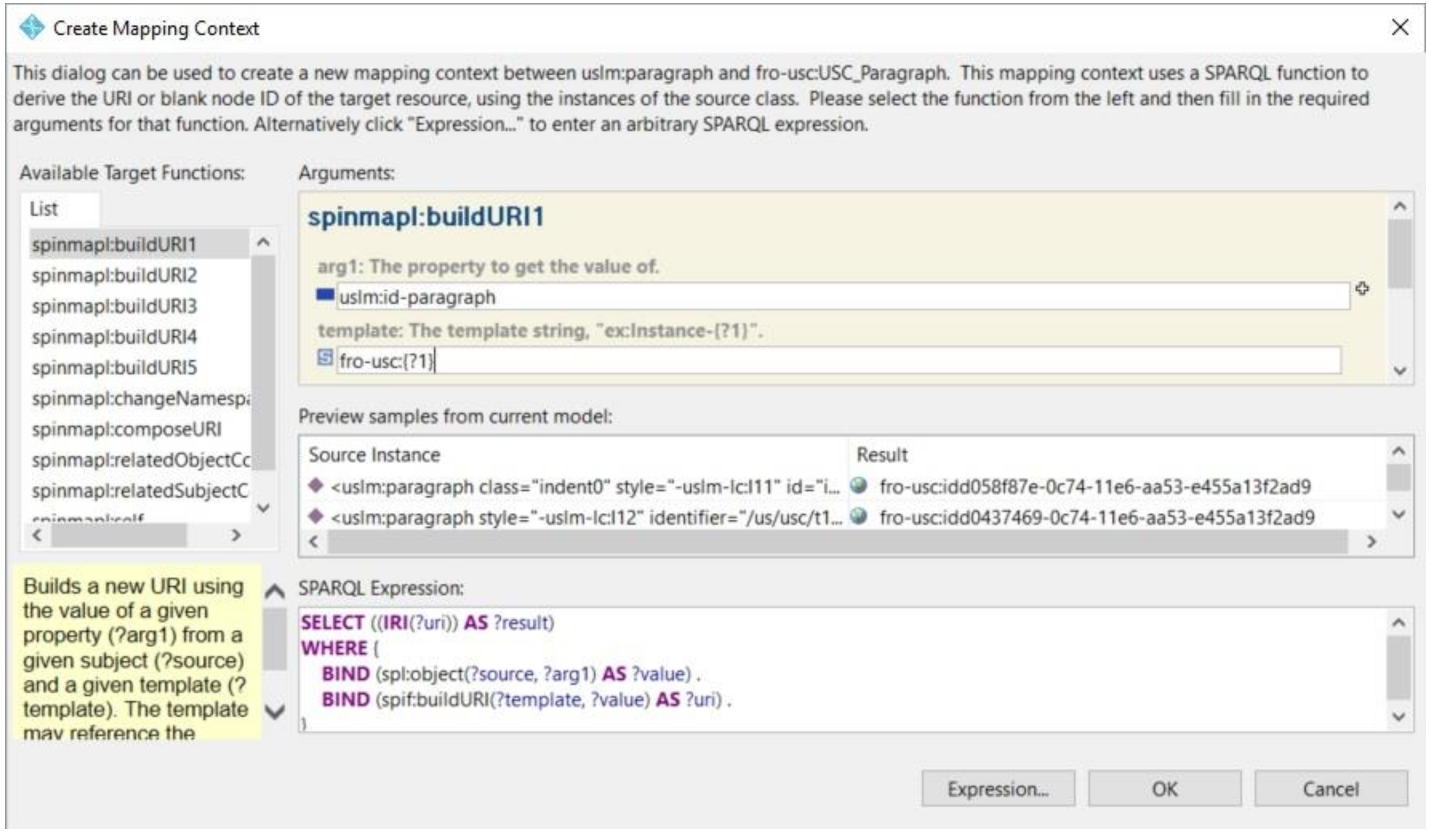
The Preview Results list box shows the target URIs - a concatenation of the namespace, prefix fro-usc and the value of the USLM ID data property.

The Target function, **buildURI1** takes one argument. The other buildURI functions operate with multiple arguments, as in a composed key.

We use the default **template**, **fro-usc:(?1)**. The variable, “?1” is a placeholder for the first argument.

The SPARQL expression returns the target IRI.

- The first BIND assigns the value based ?source, an instance of uslm:Paragraph and the name of the data property.
- The Second BIND calls the SPIN function to constructs a URI based on template and argument.



Create Mapping Context

This dialog can be used to create a new mapping context between uslm:paragraph and fro-usc:USC_Paragraph. This mapping context uses a SPARQL function to derive the URI or blank node ID of the target resource, using the instances of the source class. Please select the function from the left and then fill in the required arguments for that function. Alternatively click "Expression..." to enter an arbitrary SPARQL expression.

Available Target Functions:

List

- spinmapl:buildURI1
- spinmapl:buildURI2
- spinmapl:buildURI3
- spinmapl:buildURI4
- spinmapl:buildURI5
- spinmapl:changeNamespa
- spinmapl:composeURI
- spinmapl:relatedObjectCc
- spinmapl:relatedSubjectC
- spinmapl:self

Builds a new URI using the value of a given property (?arg1) from a given subject (?source) and a given template (?template). The template may reference the

Arguments:

spinmapl:buildURI1

arg1: The property to get the value of.

uslm:id-paragraph

template: The template string, "ex:Instance-{?1}".

fro-usc:{?1}

Preview samples from current model:

Source Instance	Result
<uslm:paragraph class="indent0" style="-uslm-lc:I11" id="i...	fro-usc:idd058f87e-0c74-11e6-aa53-e455a13f2ad9
<uslm:paragraph style="-uslm-lc:I12" identifier="/us/usc/t1...	fro-usc:idd0437469-0c74-11e6-aa53-e455a13f2ad9

SPARQL Expression:

```
SELECT ((IRI(?uri)) AS ?result)
WHERE {
  BIND (spl:object(?source, ?arg1) AS ?value) .
  BIND (spif:buildURI(?template, ?value) AS ?uri) .
}
```

USC USLM mapping context Graph

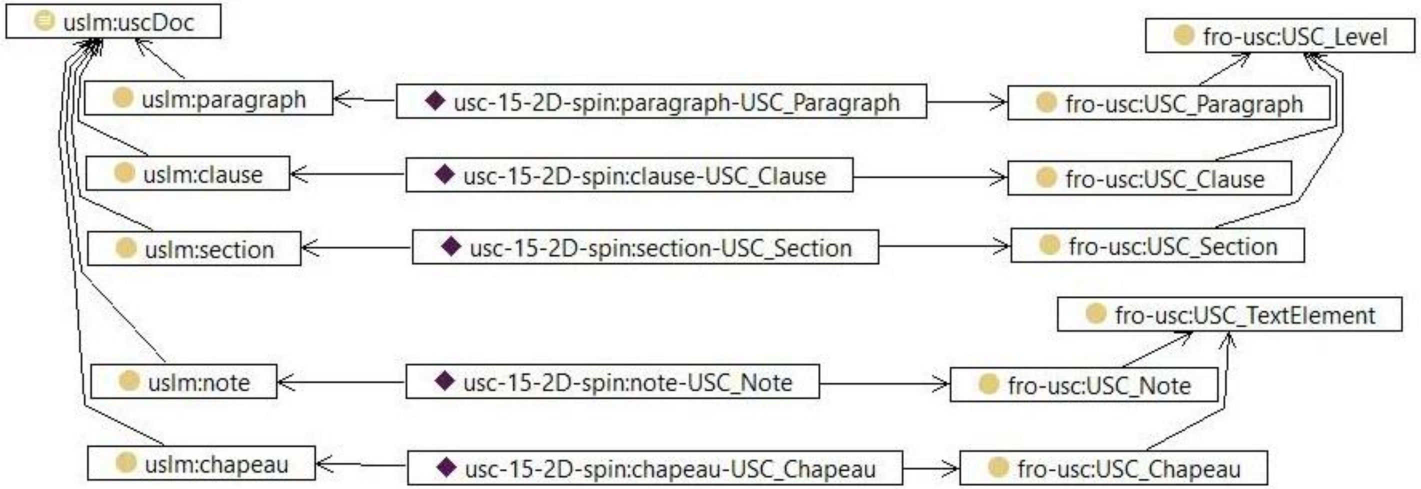
The mapping context is stored as an instance of spinmap:Context. The mapping diagram is the graph of context instances with their source and target class. (We only display 5 of the 15 contexts here).

We locate spinmap:Context in the class browser and click on the instance tab.

We select an instance and choose the Graph tab in the upper window. This will populate the graph with an instance. For example: usc-15-2D-spin:paragraph-USC_Paragraph.

We expand the graph for source class and target class. This will populate ulsm:paragraph and fro-usc:USC_Paragraph.

We can expand the class for rdfs:subClassOf to display uslm:uscDoc and fro-usc:USC_Level.



USC USLM mapping context query

Understanding the graph, we formulate a simple SPARQL to display the mapping information.

The query selects all spinmap:Context with their source and target classes.

```
SELECT ?source_class ?context ?target_class
WHERE {
   ?context a spinmap:Context ;
     spinmap:sourceClass ?source_class ;
     spinmap:targetClass ?target_class .
}
```

[source_class]	context	target_class
uslm:chapeau	usc-15-2D-spin:chapeau-USC_Chapeau	fro-usc:USC_Chapeau
uslm:chapter	usc-15-2D-spin:chapter-USC_Chapter	fro-usc:USC_Chapter
uslm:clause	usc-15-2D-spin:clause-USC_Clause	fro-usc:USC_Clause
uslm: continuation	usc-15-2D-spin:continuation-USC_Continuation	fro-usc:USC_Continuation
uslm:item	usc-15-2D-spin:item-USC_Item	fro-usc:USC_Item
uslm:note	usc-15-2D-spin:note-USC_Note	fro-usc:USC_Note
uslm:paragraph	usc-15-2D-spin:paragraph-USC_Paragraph	fro-usc:USC_Paragraph
uslm:quotedContent	usc-15-2D-spin:quotedContent-USC_QuotedContent	fro-usc:USC_QuotedContent
uslm:section	usc-15-2D-spin:section-USC_Section	fro-usc:USC_Section
uslm:sourceCredit	usc-15-2D-spin:sourceCredit-USC_SourceCredit	fro-usc:USC_SourceCredit
uslm:subchapter	usc-15-2D-spin:subchapter-USC_Subchapter	fro-usc:USC_Subchapter
uslm:subclause	usc-15-2D-spin:subclause-USC_Subclause	fro-usc:USC_Subclause
uslm:subparagraph	usc-15-2D-spin:subparagraph-USC_Subparagraph	fro-usc:USC_Subparagraph
uslm:subsection	usc-15-2D-spin:subsection-USC_Subsection	fro-usc:USC_Subsection
uslm:title	usc-15-2D-spin:title-USC_Title	fro-usc:USC_Title

Everything is within the ontology.
Everything is a triple.

Transformations for USC Paragraph

We run the inference engine and take a look at the populated instance for the Investment Adviser exemption paragraph.

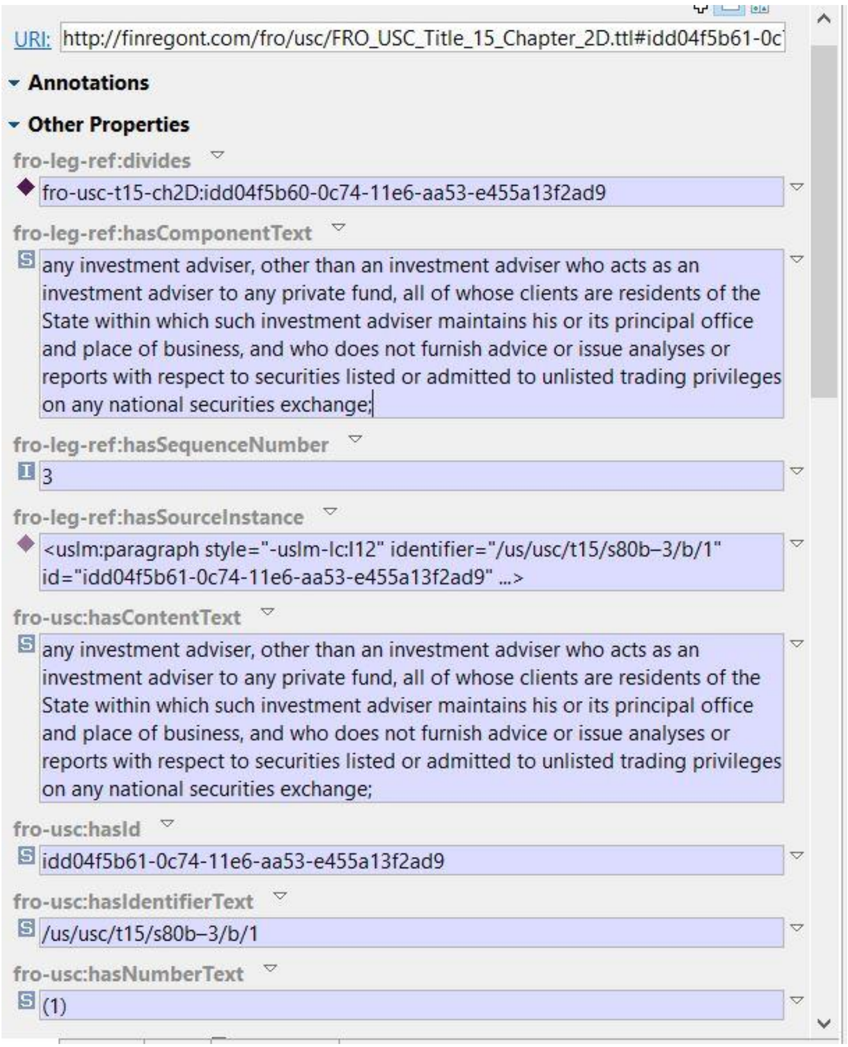
This is the record populated from the § 80b–3 XML we examined earlier.

The USC_Paragraph class has 6 data properties:

- fro-leg-ref:SequenceNumber: 3
  Direct copy of the source value in composite:index
- fro-usc:hasId: idd04f5b61-0c74-11e6-aa53-e455a13f2ad9
  Direct copy from uslm:id-paragraph
- fro-usc:hasIdentifierText: /us/usc/t15/s80b–3/b/1
  Direct copy from uslm:identifier-paragraph
- fro-usc:hasNumberText: (1)
  Custom Spin function to denormalize the uslm:num class instance into a data property
- fro-leg-ref:hasComponentText: “any investment adviser, other than …”
  This is not an ETL rule. Fro-usc:hasContentText is rdfs:subPropertyOf this data property. Population is an automatic inference.
- fro-usc:hasContentText: “any investment adviser, other than …”
  Custom SPIN-rule to denormalize the uslm:content class instance into a data property.

Object Properties:

- fro-leg-ref:hasSourceInstance: “<uslm:paragraph style="-uslm-lc:I12" identifier="/us/usc/t15/s80b–3/b/1" id="idd04f5b61-0c74-11e6-aa53-e455a13f2ad9" ...>
  Custom SPIN function to set the source instance to **?this.** (see CFR SPIN rule)
- for-leg-ref:divides: idd04f5b60-0c74-11e6-aa53-e455a13f2ad9
  The URI of the section that hold the Paragraph. A custom SPIN rule.



URI: http://finregont.com/fro/usc/FRO_USC_Title_15_Chapter_2D.ttl#idd04f5b61-0c

Annotations

Other Properties

fro-leg-ref:divides
◆ fro-usc-t15-ch2D:idd04f5b60-0c74-11e6-aa53-e455a13f2ad9

fro-leg-ref:hasComponentText
S any investment adviser, other than an investment adviser who acts as an investment adviser to any private fund, all of whose clients are residents of the State within which such investment adviser maintains his or its principal office and place of business, and who does not furnish advice or issue analyses or reports with respect to securities listed or admitted to unlisted trading privileges on any national securities exchange;

fro-leg-ref:hasSequenceNumber
I 3

fro-leg-ref:hasSourceInstance
◆ <uslm:paragraph style="-uslm-lc:I12" identifier="/us/usc/t15/s80b–3/b/1" id="idd04f5b61-0c74-11e6-aa53-e455a13f2ad9" ...>

fro-usc:hasContentText
S any investment adviser, other than an investment adviser who acts as an investment adviser to any private fund, all of whose clients are residents of the State within which such investment adviser maintains his or its principal office and place of business, and who does not furnish advice or issue analyses or reports with respect to securities listed or admitted to unlisted trading privileges on any national securities exchange;

fro-usc:hasId
S idd04f5b61-0c74-11e6-aa53-e455a13f2ad9

fro-usc:hasIdentifierText
S /us/usc/t15/s80b–3/b/1

fro-usc:hasNumberText
S (1)

Using SPARQL templates for common transformations

For data properties common across USC FRO classes, we use a template rule rather than duplicating the SPARQL code.

All USC_Component instances have a source instance and heading. All USC_Level instances have a data property for the number in the index. The SPARQL CONSTRUCTs only vary by the name of the USLM source class. We can pass the class name as an argument to a SPIN template.

The snippet shows the rules, SetHeading, SetNumberText and SetSourceInstance for uslm:paragraph in the class form. We take a close look at SetNumberText.

The template has a single Argument **spl:predicate**, an **rdf:Property**. At the bottom of the rule we see **uslm:id-paragraph** passed to the spl:predicate.

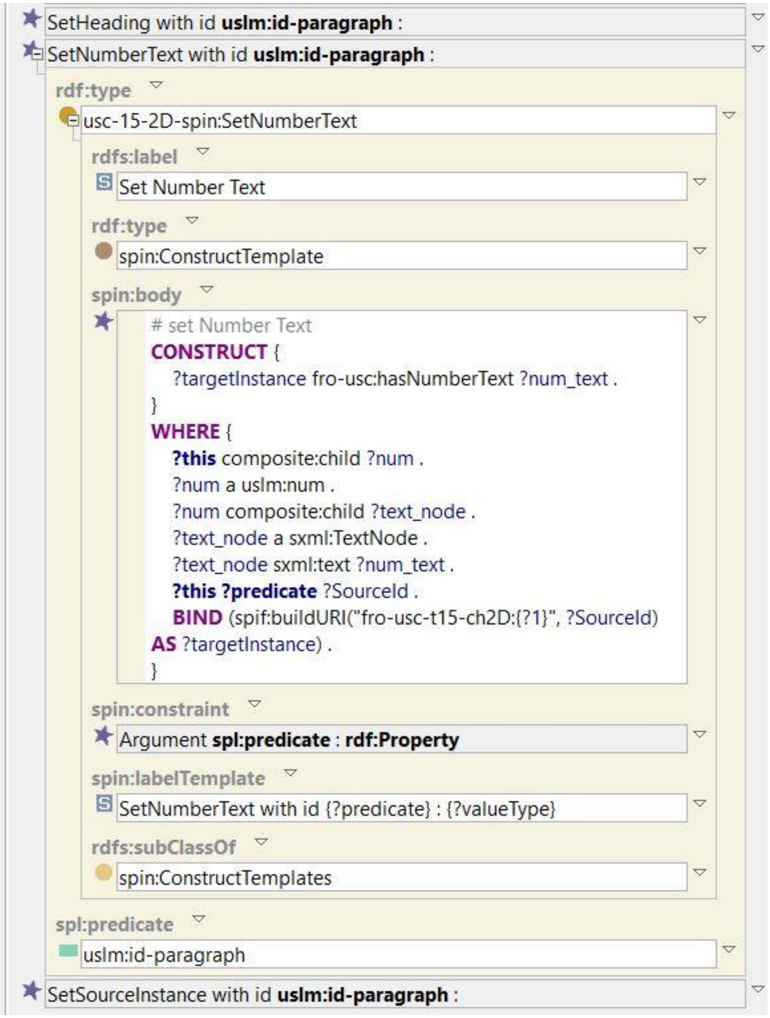
At execution the template statement line

```
        ?this ?predicate ?SourceId .
```

Will be replaced with the passed argument:

```
        ?this uslm:id-paragraph ?SourceId .
```

And we can construct the ?targetInstance with the USC identifier.



SetHeading with id **uslm:id-paragraph** :

SetNumberText with id **uslm:id-paragraph** :

rdf:type

usc-15-2D-spin:SetNumberText

rdfs:label

Set Number Text

rdf:type

spin:ConstructTemplate

spin:body

```
# set Number Text
CONSTRUCT {
  ?targetInstance fro-usc:hasNumberText ?num_text .
}
WHERE {
  ?this composite:child ?num .
  ?num a uslm:num .
  ?num composite:child ?text_node .
  ?text_node a sxml:TextNode .
  ?text_node sxml:text ?num_text .
  ?this ?predicate ?SourceId .
  BIND (spif:buildURI("fro-usc-t15-ch2D:{?1}", ?SourceId)
AS ?targetInstance) .
}
```

spin:constraint

Argument **spl:predicate** : **rdf:Property**

spin:labelTemplate

SetNumberText with id {?predicate} : {?valueType}

rdfs:subClassOf

spin:ConstructTemplates

spl:predicate

uslm:id-paragraph

SetSourceInstance with id **uslm:id-paragraph** :

Paragraph transformations content text

The USLM Paragraph is a generic structure. A query for the paragraph text sometimes involves several nested instances and variation.

FinRegOnt denormalizes into straight forward data and object properties, where appropriate.

The custom SPIN rule is attached to the source class uslm:paragraph. It will be executed for every instance of the class. (see CFR SPIN rules populating properties).

The CONSTRUCT shows the triple. The target (fro-usc) paragraph content text property will be populated with a “full text”.

The WHERE clause starts joining (any) child of the paragraph into a variable.

A challenge with the USLM paragraph structure is that content text is either

a) directly under uslm:content
b) nested within a uslm:P structure.

The OPTIONAL segments explore both possibilities and call a custom SPIN function to concatenate the text. We end up with either ?content_full_text or ?p_full_text bound.

The FILTER statements makes sure that ?full_text as a value. (some paragraphs don’t have a text.

Finally, we bind ?targetPara to the ?this variable. The spinmap:targetResource function uses the paragraph mapping context.

```
# set Complex Type  Text
CONSTRUCT {
   ?targetPara fro-usc:hasContentText ?full_text .
}
WHERE {
   ?this composite:child ?complex_type .
   OPTIONAL {
      ?complex_type a uslm:content .
      BIND (usc-15-2D-spin:getUSLMComplexTypeText(?complex_type)
      AS ?content_full_text) .
   } .
   OPTIONAL {
      ?complex_type composite:child ?p .
      ?p a uslm:p .
      BIND (usc-15-2D-spin:getUSLMComplexTypeText(?p)
      AS ?p_full_text) .
   } .
   BIND (IF(bound(?content_full_text), ?content_full_text,
                  ?p_full_text) AS ?full_text) .
   FILTER bound(?full_text) .
   BIND (spinmap:targetResource(?this,
          usc-15-2D-spin:paragraph-USC_Paragraph) AS ?targetPara) .
}
```

Concatenating complex text structures

The previous Paragraph transformation rule called a custom function to build the text.

The function usc-15-2D-spin:getUSLMComplexTypeText takes a uslm:content or uslm:p instance as an argument and returns the text.

USLM contains both content of the law and formatting. The XML reflect this having a text block broken down into small fragments of text nodes, references, dates, iterations and inline elements. Financial Regulation Ontology is only interested in the semantic. That is human readable smallest fragment of the law, that we connect to a Legal Reasoning rule. Hence, FinRegOnt concatenates the text fragments into a string data property. Other transformation rules retain the references, uslm:ref and resolve them into object property links. For example: If a reference (="/us/usc/t15/s80b–3") points to a section, FinRegOnt populates the object property fro-leg-ref:refers_to with the URI.

The function's query has three nested selects. The innermost query selects the text of the text of the different class instances under ?complex_type.

The next SELECT layer performs a GROUP CONCAT of the result set.

The outmost query FILTERs to ensure that ?full_text is bound and casts the value to xsd:string.

```
SELECT ?full_text_str
WHERE {
    {
        SELECT ?complex_type ((GROUP_CONCAT(?complex_text)) AS ?full_text)
        WHERE {
            {
                SELECT ?complex_type ?complex_text
                WHERE {
                    ?complex_type composite:child ?complex_child .
                    ?complex_child composite:index ?child_index .
                    OPTIONAL {
                        ?complex_child a sxml:TextNode .
                        ?complex_child sxml:text ?complex_text .
                    } .
                    OPTIONAL {
                        ?complex_child a uslm:ref .
                        ?complex_child composite:child ?ref_text_node .
                        ?ref_text_node sxml:text ?complex_text .
                    } .
                    OPTIONAL {
                        ?complex_child a uslm:date .
                        ?complex_child composite:child ?date_text_node .
                        ?date_text_node sxml:text ?complex_text .
                    } .
                    OPTIONAL {
                        ?complex_child a uslm:i .
                        ?complex_child composite:child ?i_text_node .
                        ?i_text_node sxml:text ?complex_text .
                    } .
                    OPTIONAL {
                        ?complex_child a uslm:inline .
                        ?complex_child composite:child ?i_text_node .
                        ?i_text_node sxml:text ?complex_text .
                    } .
                    FILTER bound(?complex_text) .
                }
                ORDER BY (rdfs:Resource("child_index"^^xsd:string))
            } .
        }
        GROUP BY ?complex_type
        ORDER BY (rdfs:Resource("complex_type"^^xsd:string))
    } .
    FILTER (bound(?full_text) && (str(?full_text) != "")) .
    BIND (spif:cast(?full_text, xsd:string, xsd:string, xsd:string) AS ?full_text_str) .
}
```

Rules for paragraph object properties.

The main object properties linking FRO USC instances are fro-leg-ref:divides and fro-leg-ref:refers_to.

The rule pattern is to query the composite:child structure and CONTRUCT the target.

The rule CONSTRUCT sets the divided by object property for the Section of the Paragraph.

The WHERE clause joins (any) Subject with a child of **?this**. We test the populated variable for being a uslm:section. (Remember that paragraphs can also occur under Subsections.)

Finally, we BIND target section and paragraph using the mapping context.

```
# set paragraph divides (Section)
CONSTRUCT {
   ?targetSection fro-leg-ref:divided_by ?targetPara .
}
WHERE {
   ?section composite:child ?this .
   ?section a uslm:section .
   BIND (spinmap:targetResource(?section, usc-15-2D-spin:chapeau-USC_Chapeau)
                                AS ?targetSection) .
   BIND (spinmap:targetResource(?this, usc-15-2D-spin:paragraph-USC_Paragraph)
                                AS ?targetPara) .
}
```

The second example follows the same pattern. We want check, if the paragraph has a chapeau and set it.

The CONSTRUCT sets the refers to Chapeau object property for the paragraph. (if it has a chapeau).

The WHERE clause joins composite:child of the paragraph, **?this**. We test, if the child is a uslm:chapeau and BIND target chapeau and paragraph via the mapping context.

```
# set reference to Chapeau
CONSTRUCT {
   ?targetPara fro-usc:refers_toChapeau ?targetChapeau .
}
WHERE {
    ?this composite:child ?chapeau .
    ?chapeau a uslm:chapeau .
    BIND (spinmap:targetResource(?chapeau, usc-15-2D-spin:chapeau-
USC_Chapeau) AS ?targetChapeau) .
    BIND (spinmap:targetResource(?this, usc-15-2D-spin:paragraph-
USC_Paragraph) AS ?targetPara) .
}
```

USC Inferencing and validation

Running the inference engine to populates FRO USC following the same steps as explained for CFR inferencing.

The screenshot shows the class browser with number of instances and the list of inference triples, scrolled for our paragraph.

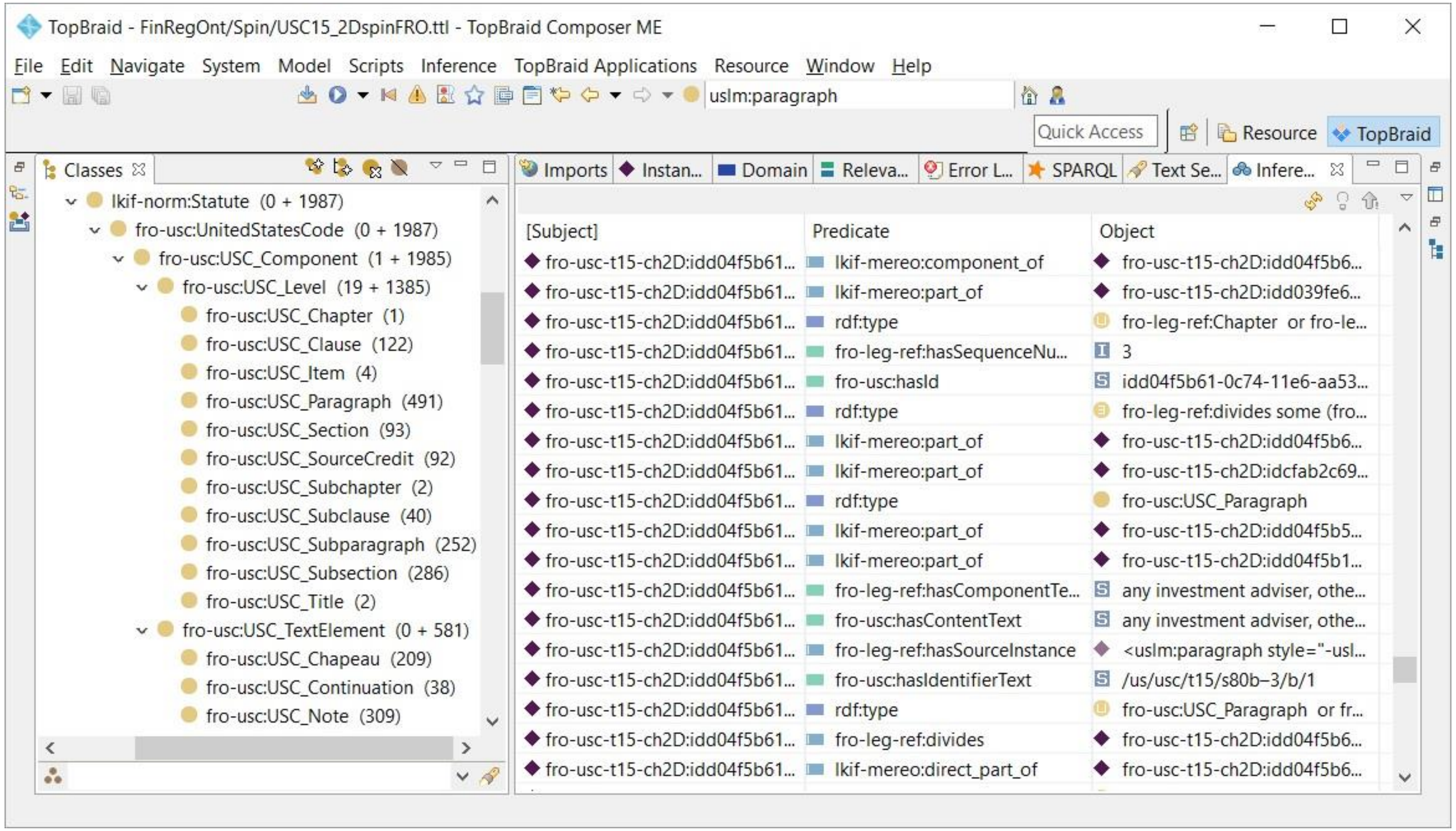
There are 1985 USC_Component instances.

Initial validation follows the same steps as for FRO CFR:

1. Compare instance counts to the USCUSLM data source ontology.
2. Examine sample class instances in the Resource Form.
3. Draw and explore the graph for the Private Fund Exception.
   - Follow the hierarchy up to section and chapter.
   - Expand chapeau and notes associated with the level elements.

As for CFR we make the triples persistent in the target ontology file. The file is available on the FinRegOnt website: FRO_USC_Title_15_Chapter_2D.ttl

We won't repeat these steps here, but rather drill deeper into data and metadata queries on the United States Code.



- lkif-norm:Statute (0 + 1987)
  - fro-usc:UnitedStatesCode (0 + 1987)
    - fro-usc:USC_Component (1 + 1985)
      - fro-usc:USC_Level (19 + 1385)
        - fro-usc:USC_Chapter (1)
        - fro-usc:USC_Clause (122)
        - fro-usc:USC_Item (4)
        - fro-usc:USC_Paragraph (491)
        - fro-usc:USC_Section (93)
        - fro-usc:USC_SourceCredit (92)
        - fro-usc:USC_Subchapter (2)
        - fro-usc:USC_Subclause (40)
        - fro-usc:USC_Subparagraph (252)
        - fro-usc:USC_Subsection (286)
        - fro-usc:USC_Title (2)
      - fro-usc:USC_TextElement (0 + 581)
        - fro-usc:USC_Chapeau (209)
        - fro-usc:USC_Continuation (38)
        - fro-usc:USC_Note (309)

[Subject]	Predicate	Object
◆ fro-usc-t15-ch2D:idd04f5b61...	lkif-mereo:component_of	◆ fro-usc-t15-ch2D:idd04f5b6...
◆ fro-usc-t15-ch2D:idd04f5b61...	lkif-mereo:part_of	◆ fro-usc-t15-ch2D:idd039fe6...
◆ fro-usc-t15-ch2D:idd04f5b61...	rdf:type	fro-leg-ref:Chapter or fro-le...
◆ fro-usc-t15-ch2D:idd04f5b61...	fro-leg-ref:hasSequenceNu...	3
◆ fro-usc-t15-ch2D:idd04f5b61...	fro-usc:hasId	idd04f5b61-0c74-11e6-aa53...
◆ fro-usc-t15-ch2D:idd04f5b61...	rdf:type	fro-leg-ref:divides some (fro...
◆ fro-usc-t15-ch2D:idd04f5b61...	lkif-mereo:part_of	◆ fro-usc-t15-ch2D:idd04f5b6...
◆ fro-usc-t15-ch2D:idd04f5b61...	lkif-mereo:part_of	◆ fro-usc-t15-ch2D:idcfab2c69...
◆ fro-usc-t15-ch2D:idd04f5b61...	rdf:type	fro-usc:USC_Paragraph
◆ fro-usc-t15-ch2D:idd04f5b61...	lkif-mereo:part_of	◆ fro-usc-t15-ch2D:idd04f5b5...
◆ fro-usc-t15-ch2D:idd04f5b61...	lkif-mereo:part_of	◆ fro-usc-t15-ch2D:idd04f5b1...
◆ fro-usc-t15-ch2D:idd04f5b61...	fro-leg-ref:hasComponentTe...	any investment adviser, othe...
◆ fro-usc-t15-ch2D:idd04f5b61...	fro-usc:hasContentText	any investment adviser, othe...
◆ fro-usc-t15-ch2D:idd04f5b61...	fro-leg-ref:hasSourceInstance	<uslm:paragraph style="-usl...
◆ fro-usc-t15-ch2D:idd04f5b61...	fro-usc:hasIdentifierText	/us/usc/t15/s80b–3/b/1
◆ fro-usc-t15-ch2D:idd04f5b61...	rdf:type	fro-usc:USC_Paragraph or fr...
◆ fro-usc-t15-ch2D:idd04f5b61...	fro-leg-ref:divides	◆ fro-usc-t15-ch2D:idd04f5b6...
◆ fro-usc-t15-ch2D:idd04f5b61...	lkif-mereo:direct_part_of	◆ fro-usc-t15-ch2D:idd04f5b6...

United States Code: “everything query”

The query SELECTs all USC instances and properties. This is to validate target population comprehensively.

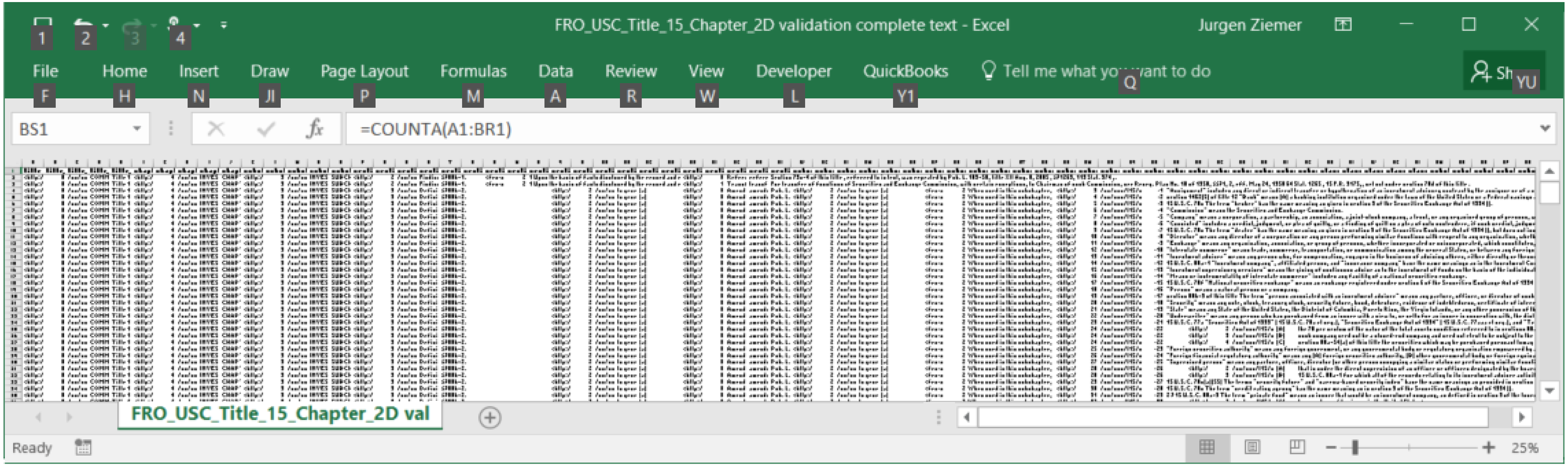
The SPARQL statement is quite long (115 lines) and execution may take a few minutes. The screenshot is a zoom-out of the Excel result set (70 columns and 160,000 rows). We use the zoom-out to eyeball consistency. Any blank row should be investigated:

a) There is a break in the population or the query

b) There is a valid reason that the particular USC chapter doesn’t have the particular field(s).

The website query directory contains various queries and result sets for CFR and USC chapters in Excel format. http://finregont.com/fro/query/

The following pages show sections of the “everything query” as standalone SELECTS and results sets.



FRO_USC_Title_15_Chapter_2D validation complete text - Excel

BS1 =COUNTA(A1:BR1)

USC query: Title to Subchapter

The query SELECTs all USC instances and properties. We show the SPARQL and samples of the result set.

The WHERE clause for title and chapter is straightforward. The OPTIONAL ensures that ?subchapter is bound, dividing either chapter or subchapter.

title_seq	0
title_ident	/us/usc/t15
title_heading	COMMERCE AND TRADE
title_number	Title 15—
chapter	<http://finregont.com/fro/usc/FRO_USC_Title_15_Chapter_2D.ttl#idd039fe6a-0c74-11e6-aa53-e455a13f2ad9>
chapter_seq	4
chapter_ident	/us/usc/t15/ch2D
chapter_heading	INVESTMENT COMPANIES AND ADVISERS
chapter_number	CHAPTER 2D—
subchapter	<http://finregont.com/fro/usc/FRO_USC_Title_15_Chapter_2D.ttl#idd04f5b18-0c74-11e6-aa53-e455a13f2ad9>
subchapter_seq	3
subchapter_ident	/us/usc/t15/ch2D/schII
subchapter_heading	INVESTMENT ADVISERS
subchapter_number	SUBCHAPTER II—

```
# USC query header information Title to Subchapter
SELECT DISTINCT ?title_seq ?title_ident ?title_heading ?title_number
                ?chapter ?chapter_seq ?chapter_ident ?chapter_heading
                ?chapter_number
                ?subchapter ?subchapter_seq ?subchapter_ident
                ?subchapter_heading ?subchapter_number
WHERE {
# Title properties
   ?title a fro-usc:USC_Title ;
            fro-leg-ref:hasSequenceNumber ?title_seq ;
            fro-usc:hasIdentifierText ?title_ident ;
            fro-usc:hasHeading ?title_heading ;
            fro-usc:hasNumberText ?title_number .
# Chapter properties
   ?title fro-leg-ref:divided_by ?chapter .
   ?chapter fro-leg-ref:hasSequenceNumber ?chapter_seq ;
            fro-usc:hasIdentifierText ?chapter_ident ;
            fro-usc:hasHeading ?chapter_heading ;
            fro-usc:hasNumberText ?chapter_number .
# Some Titles do not have a subchapter. The Sections are directly underneath
the Chapter
# Subchapter properties
   OPTIONAL {
      ?chapter fro-leg-ref:divided_by ?subchapter .
      ?subchapter a fro-usc:USC_Subchapter ;
                    fro-leg-ref:hasSequenceNumber ?subchapter_seq ;
                    fro-usc:hasIdentifierText ?subchapter_ident ;
                    fro-usc:hasHeading ?subchapter_heading ;
                    fro-usc:hasNumberText ?subchapter_number ;
                    fro-leg-ref:divided_by ?section .
   }
}
```

USC query: Investment Advisers, Sections

The query SELECTs all Sections under Subchapter II – INVESTMENT ADVISERS

section_ident	section_heading	section_number
/us/usc/t15/s80b–1	Findings	§ 80b–1.
/us/usc/t15/s80b–10	Disclosure of information by Commission	§ 80b–10.
/us/usc/t15/s80b–10a	Consultation	§ 80b–10a.
/us/usc/t15/s80b–11	Rules, regulations, and orders of Commission	§ 80b–11.
/us/usc/t15/s80b–12	Hearings	§ 80b–12.
/us/usc/t15/s80b–13	Court review of orders	§ 80b–13.
/us/usc/t15/s80b–14	Jurisdiction of offenses and suits	§ 80b–14.
/us/usc/t15/s80b–15	Validity of contracts	§ 80b–15.
/us/usc/t15/s80b–16	Omitted	§ 80b–16.
/us/usc/t15/s80b–17	Penalties	§ 80b–17.
/us/usc/t15/s80b–18	Hiring and leasing authority of Commission	§ 80b–18.
/us/usc/t15/s80b–18a	State regulation of investment advisers	§ 80b–18a.
/us/usc/t15/s80b–18b	Custody of client accounts	§ 80b–18b.
/us/usc/t15/s80b–18c	Rule of construction relating to the Commodities Exchange Act	§ 80b–18c.
/us/usc/t15/s80b–19	Separability	§ 80b–19.
/us/usc/t15/s80b–2	Definitions	§ 80b–2.
/us/usc/t15/s80b–20	Short title	§ 80b–20.
/us/usc/t15/s80b–21	Effective date	§ 80b–21.
/us/usc/t15/s80b–3	Registration of investment advisers	§ 80b–3.
/us/usc/t15/s80b–3a	State and Federal responsibilities	§ 80b–3a.
/us/usc/t15/s80b–4	Reports by investment advisers	§ 80b–4.
/us/usc/t15/s80b–4a	Prevention of misuse of nonpublic information	§ 80b–4a.
/us/usc/t15/s80b–5	Investment advisory contracts	§ 80b–5.
/us/usc/t15/s80b–6	Prohibited transactions by investment advisers	§ 80b–6.
/us/usc/t15/s80b–6a	Exemptions	§ 80b–6a.
/us/usc/t15/s80b–7	Material misstatements	§ 80b–7.
/us/usc/t15/s80b–8	General prohibitions	§ 80b–8.
/us/usc/t15/s80b–9	Enforcement of subchapter	§ 80b–9.

We select instances of type FRO USC Subchapter where the heading matches our search criteria. And join Sections that divide the Subchapter.

The result set lists identifier, heading and section number, including the Registration of investment Advisers that we examined before.

We will continue to navigate down to the Private Fund Exemption in the next query

```
# USC query INVESTMENT ADVISERS, Sections
SELECT *
WHERE {
   ?subchapter a fro-usc:USC_Subchapter .
   ?subchapter fro-usc:hasHeading "INVESTMENT ADVISERS" .
   ?subchapter fro-usc:hasHeading ?subchapter_heading .
   ?subchapter fro-leg-ref:divided_by ?section .

#  Section properties
   ?section a fro-usc:USC_Section ;
            fro-leg-ref:hasSequenceNumber ?section_seq ;
            fro-usc:hasIdentifierText ?section_ident ;
            fro-usc:hasHeading ?section_heading ;
            fro-usc:hasNumberText ?section_number .
}
ORDER BY ?section_ident
```

USC query: Registration Subsection

The query SELECTs all Subsections under Section § 80b–3 -Registration of investment advisers.

ident	subsection_heading	#	Subsection_text
/us/usc/t15/s80b–3/a	Necessity of registration	(a)	Except as provided in subsection (b) and section 80b–3a of this title , it shall be unlawful …
/us/usc/t15/s80b–3/b	Investment advisers who need not be registered	(b)	
/us/usc/t15/s80b–3/c	Procedure for registration; filing of application; effective date of registration; amendment of registration	(c)	
/us/usc/t15/s80b–3/d	Other acts prohibited by subchapter	(d)	Any provision of this subchapter (other than subsection (a) of this section) which prohibits …
/us/usc/t15/s80b–3/e	Censure, denial, or suspension of registration; notice and hearing	(e)	
/us/usc/t15/s80b–3/f	Bar or suspension from association with investment adviser; notice and hearing	(f)	The Commission, by order, shall censure or place limitations on the activities of any person …
/us/usc/t15/s80b–3/g	Registration of successor to business of investment adviser	(g)	Any successor to the business of an investment adviser registered under this section shall be …
/us/usc/t15/s80b–3/h	Withdrawal of registration	(h)	Any person registered under this section may, upon such terms and conditions as the Commission finds …
/us/usc/t15/s80b–3/i	Money penalties in administrative proceedings	(i)	
/us/usc/t15/s80b–3/j	Authority to enter order requiring accounting and disgorgement	(j)	In any proceeding in which the Commission may impose a penalty under this section, …
/us/usc/t15/s80b–3/k	Cease-and-desist proceedings	(k)	
/us/usc/t15/s80b–3/l	Exemption of venture capital fund advisers	(l)	
/us/usc/t15/s80b–3/m	Exemption of and reporting by certain private fund advisers	(m)	
/us/usc/t15/s80b–3/n	Registration and examination of mid-sized private fund advisers	(n)	In prescribing regulations to carry out the requirements of this section with respect to investment advisers acting as …

Filter criteria is the section number, "§ 80b–3. The paragraph text (OPTIONAL) is blank for sections that have text only in the underlying paragraphs.

The sections have a subsection as we will see in the next query.

```
# USC Query - section 80-b3 Registration subsections
SELECT *
WHERE {
   ?section a fro-usc:USC_Section .
   ?section fro-usc:hasNumberText ?section_number .
   ?section fro-usc:hasNumberText "§ 80b-3." .
# Subsection properties - (not every section has a
subsection)
   OPTIONAL {
      ?section fro-leg-ref:divided_by ?subsection .
      ?subsection a fro-usc:USC_Subsection .
      ?subsection fro-leg-ref:hasSequenceNumber
                                   ?subsection_seq ;
          fro-usc:hasIdentifierText ?subsection_ident ;
          fro-usc:hasHeading ?subsection_heading ;
          fro-usc:hasNumberText ?subsection_number .
          OPTIONAL { ?subsection fro-usc:hasContentText
                                    ?subsection_text . }
   }
}
ORDER BY ?subsection_number
```

USC query: Registration Subsection

The query SELECTs all Paragraphs under Subsection § 80b–3/b - Registration Exemption

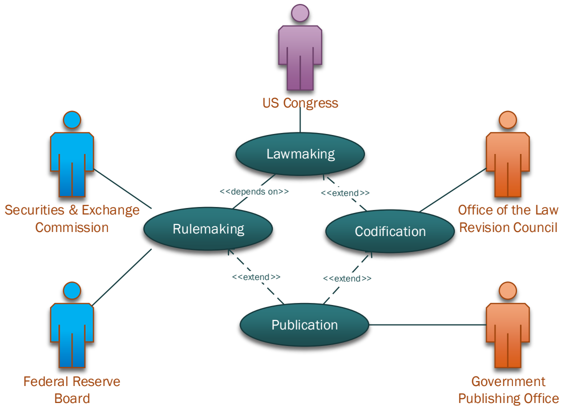
Finally, we drilled down from Title 15 all the way to the Investment Adviser Registration exemption. The piece of USC OLCR XML that we started with.

Note that paragraphs 5,7 and don't have a text, because they have content in Subparagraphs.

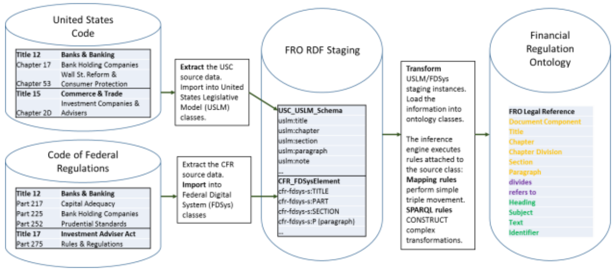
```
SELECT *
WHERE {
   ?subsection a fro-usc:USC_Subsection .
   ?subsection fro-usc:hasIdentifierText "/us/usc/t15/s80b-3/b" .
   ?subsection fro-leg-ref:divided_by ?subsection_para .
   ?subsection_para a fro-usc:USC_Paragraph .
   ?subsection_para fro-leg-ref:hasSequenceNumber ?subsection_para_seq .
   ?subsection_para fro-usc:hasIdentifierText ?subsection_para_ident .
   OPTIONAL {?subsection_para fro-usc:hasHeading ?subsection_para_heading . }
   ?subsection_para fro-usc:hasNumberText ?subsection_para_number .
   OPTIONAL {?subsection_para fro-usc:hasContentText ?subsection_para_text .}
}
ORDER BY ?subsection_para_number
```

subsection_para_ident	subsection_para_number	subsection_para_text
/us/usc/t15/s80b–3/b/1	(1)	any investment adviser, other than an investment adviser who acts as an investment adviser to any private fund, all of whose clients are residents of the State within which such investment adviser maintains his or its principal office and place of business, and who does not furnish advice or issue analyses or reports with respect to securities listed or admitted to unlisted trading privileges on any national securities exchange;
/us/usc/t15/s80b–3/b/2	(2)	any investment adviser whose only clients are insurance companies;
/us/usc/t15/s80b–3/b/3	(4)	any investment adviser that is a foreign private adviser;
/us/usc/t15/s80b–3/b/4	(5)	
/us/usc/t15/s80b–3/b/5	(6)	any plan described in section 414(e) of title 26 , any person or entity eligible to establish and maintain such a plan under title 26, or any trustee, director, officer, or employee of or volunteer for any such plan or person, if such person or entity, acting in such capacity, provides investment advice exclusively to, or with respect to, any plan, person, or entity or any company, account, or fund that is excluded from the definition of an investment company under section 80a–3(c)(14) of this title ;
/us/usc/t15/s80b–3/b/6	(7)	
/us/usc/t15/s80b–3/b/7	(8)	

Summary and conclusion



Code of Federal Regulations and the United States Code are LKIF Legal Documents: Statute and Regulation.
The legislative context for laws & regulations consists of actors (LKIF Public Bodies and Public Acts), and Public Acts (lawmaking, rulemaking, codification and publication). LKIF expression ties the Public Act to the Legal Document.


United States Code

Title 12	Banks & Banking
Chapter 17	Bank Holding Companies
Chapter 53	Wall St. Reform & Consumer Protection
Title 15	Commerce & Trade
Chapter 2D	Investment Companies & Advisers

Code of Federal Regulations

Title 12	Banks & Banking
Part 217	Capital Adequacy
Part 225	Bank Holding Companies
Part 252	Prudential Standards
Title 17	Investment Adviser Act
Part 275	Rules & Regulations

Extract the USC source data. Import into United States Legislative Model (USLM) classes.

Extract the CFR source data. **Import** into Federal Digital System (FDSys) classes

FRO RDF Staging

USC_USLM_Schema
uslm:title
uslm:chapter
uslm:section
uslm:paragraph
uslm:note
…
CFR_FDSysElement
cfr-fdsys-s:TITLE
cfr-fdsys-s:PART
cfr-fdsys-s:SECTION
cfr-fdsys-s:P (paragraph)
…

Transform USLM/FDSys staging instances. Load the information into ontology classes.

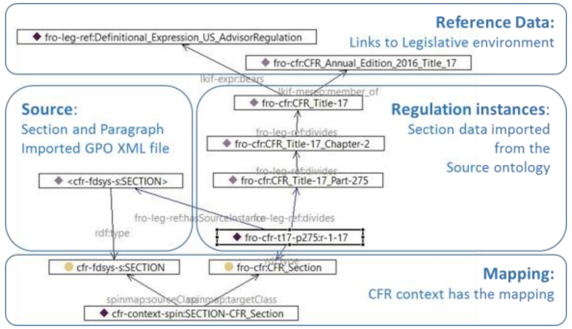
The inference engine executes rules attached to the source class: **Mapping rules** perform simple triple movement. **SPARQL rules** CONSTRUCT complex transformations.

Financial Regulation Ontology

FRO Legal Reference
Document Component
Title
Chapter
Chapter Division
Section
Paragraph
divides
refers to
Heading
Subject
Text
Identifier

Government publishers provide the laws and regulations in XML format.

- **E**xtract and convert the source file into FRO RDF Staging.
- **T**ransform the RDF representation into FRO ontology with semantic mapping and Inference Rules.
- **L**oad the inference triples into the target FRO ontology.


Reference Data:
Links to Legislative environment

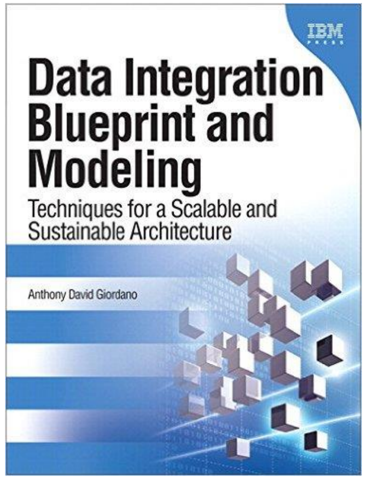
Source:
Section and Paragraph
Imported GPO XML file

Regulation instances:
Section data imported
from the
Source ontology

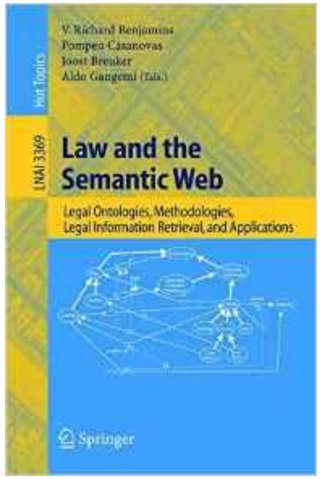
Mapping:
CFR context has the mapping

The result is a standard Legal Ontology (LKIF) with FRO extensions populated with the full text of Finance Laws and Regulations.
The Semantic Web approach has everything within the ontology and available for SPARQL query: Requirements, Schema, Data, Linage to source, and Mapping.

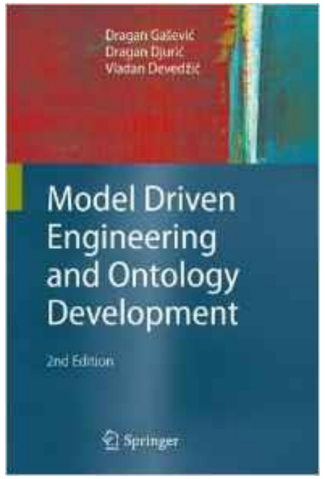
Chapter II – books, recommended companion reading


IBM PRESS
Data Integration Blueprint and Modeling
Techniques for a Scalable and Sustainable Architecture
Anthony David Giordano

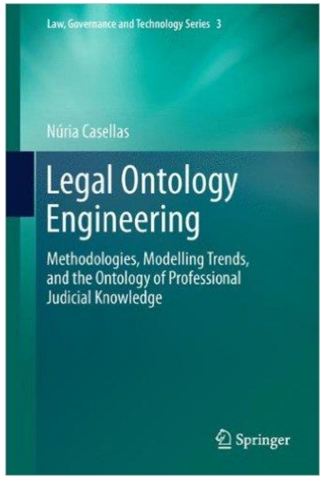
Data Integration Blueprint and Modeling
Anthony David Giordano
IBM Press, 2011



Law and the Semantic Web: Legal Ontologies, Methodologies, Legal Information Retrieval, and Applications
Richard Benjamins, Pompeu Casanovas, Joost Breuker, Aldo Gangemi
Springer, 2009



Model Driven Engineering and Ontology Development
Dragan Gasevic, Dragan Djuric, Vladan Devedzic
Springer, 2010


Law, Governance and Technology Series 3
Núria Casellas
Legal Ontology Engineering
Methodologies, Modelling Trends, and the Ontology of Professional Judicial Knowledge
Springer

Legal Ontology Engineering
Nuria Casellas
Springer, 2011

Chapter II - references

1. Financial Regulation Ontology
    1. Tutorial (online PowerPoint and softcopies): http://finregont.com/financial-regulation-ontology-tutorial/
    2. Documentation: http://finregont.com/ontology-documentation/
    3. SPARQL queries and result sets in Excel: http://finregont.com/fro/query/
    4. Source Files (OWL-turtle): http://finregont.com/fro/
       Subdirectories CFR, USC and REF
2. TopBraid Composer Maestro website: http://www.topquadrant.com/tools/IDE-topbraid-composer-maestro-edition/
3. TopQuadrant, SPIN SPARQL Inferencing Notation: http://www.topquadrant.com/technology/sparql-rules-spin/
4. TopQuadrant, SPINMap ontology mapping: http://www.topquadrant.com/2011/04/21/spinmap-sparql-based-ontology-mapping-with-a-graphical-notation/
5. W3C, Recommendation: SPARQL Query Language for RDF: http://www.w3.org/TR/rdf-sparql-query/
6. SPIN – SPARQL Inferencing Notation website: http://spinrdf.org/
7. SPARQL Motion website: http://sparqlmotion.org/

FRO Chapter III – Legal Reasoning

Chapter 3 will be added to FinRegOnt.com as a separate deck in November.