STS Infrastructural considerations

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Infrastructure

- Requirements
- Candidates
  - standoff-based architecture (Stede et al. 2006, 2010)
  - UiMA (Ferrucci and Lally 2004)
  - RDF-based architecture (Hellmann 2010, Hellmann et al. 2012)
- Comparison

Requirements

- Flexibility
  - support all necessary data structures, hierarchical, and relational
- Interoperability
  - structural („syntactic“)
    - common exchange format for all modules
  - conceptual („semantic“)
    - well-defined data categories
    - clearly specified means to address them

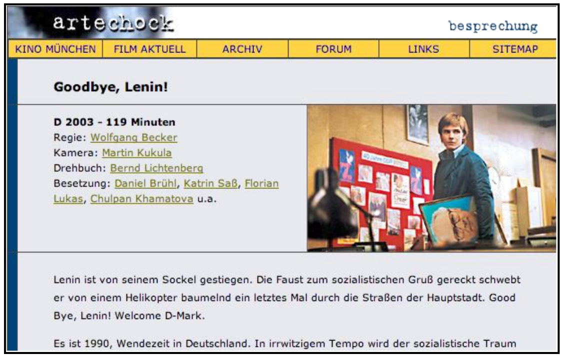
Requirements

- Availability
  - Can we build upon an existing architecture ?
- Web Services
  - Semantic modules using large knowledge bases should operate on their own servers
- Efficient interchange format
  - Easy to parse, merge and write
- Performance

1. Standoff-based architecture

- e.g., SuMMAR/MOTS (Stede et al. 2006, 2010)
  - pipeline architecture for high-quality text summarization
    - syntax, coreference, text structure, causal markers, etc.
  - standoff
    - output of different modules to be combined
    - these may also run in parallel
  - exchange format PAULA
    - standoff XML, derived from early (2004) drafts for the LAF

1. Architecture



artechock besprechung

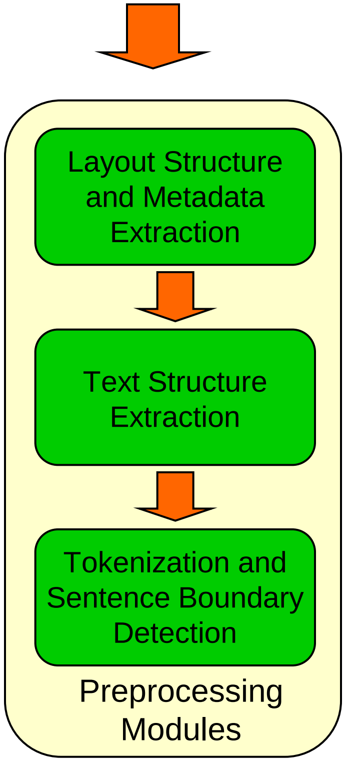
KINO MÜNCHEN | FILM AKTUELL | ARCHIV | FORUM | LINKS | SITEMAP

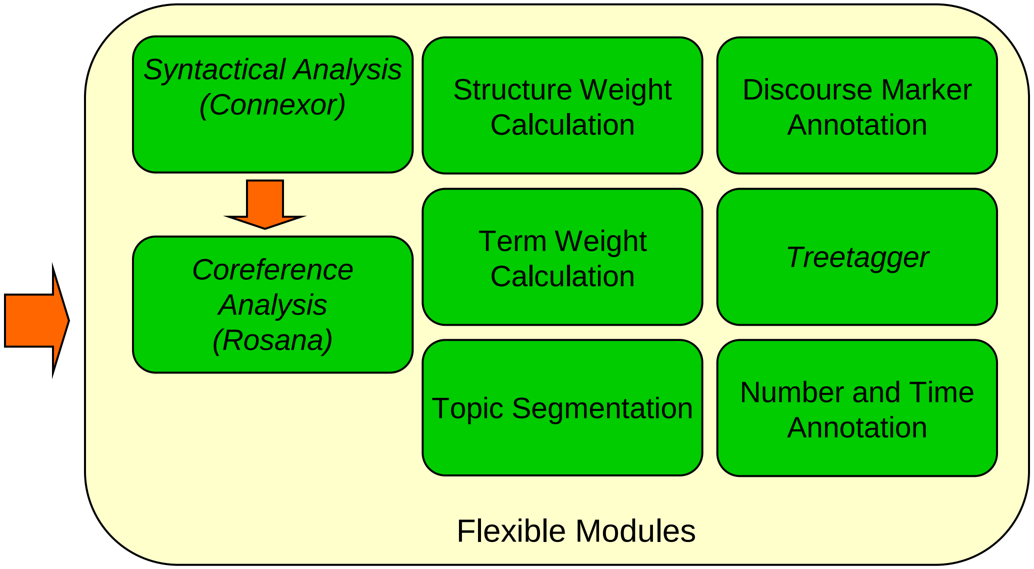
Goodbye, Lenin!

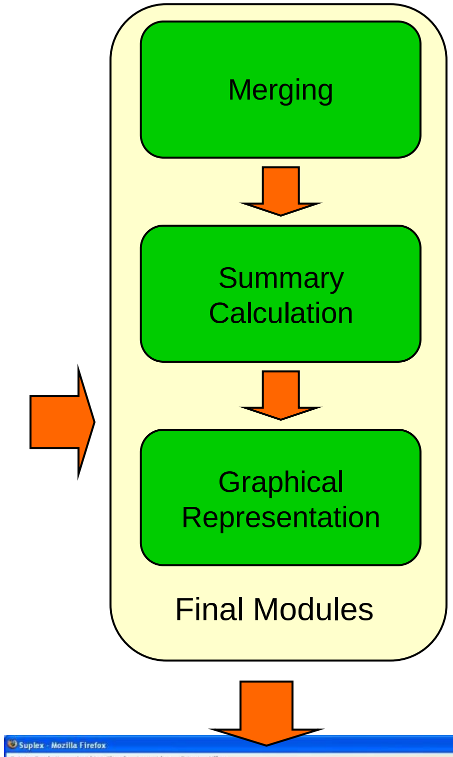
D 2003 - 119 Minuten
Regie: Wolfgang Becker
Kamera: Martin Kukula
Drehbuch: Bernd Lichtenberg
Besetzung: Daniel Brühl, Katrin Saß, Florian Lukas, Chulpan Khamatova u.a.

Lenin ist von seinem Sockel gestiegen. Die Faust zum sozialistischen Gruß gereckt schwebt er von einem Helikopter baumelnd ein letztes Mal durch die Straßen der Hauptstadt. Good Bye, Lenin! Welcome D-Mark.

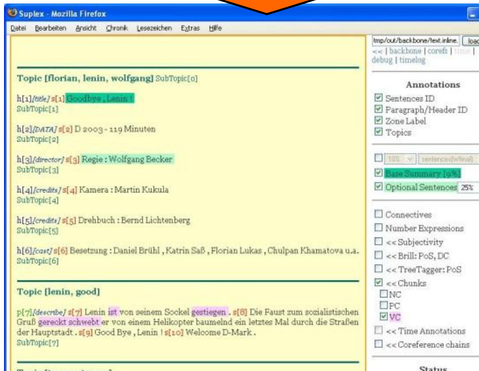
Es ist 1990, Wendezeit in Deutschland. In irrwitzigem Tempo wird der sozialistische Traum


Layout Structure and Metadata Extraction
Text Structure Extraction
Tokenization and Sentence Boundary Detection
Preprocessing Modules


Syntactical Analysis (Connexor)
Coreference Analysis (Rosana)
Structure Weight Calculation
Term Weight Calculation
Topic Segmentation
Discourse Marker Annotation
Treetagger
Number and Time Annotation
Flexible Modules



flexible modules can be arranged in any order in the pipeline or be processed non-sequentially
⇒ standoff XML as common interchange format



tmp/out/backbone/text.inline.
<< | backbone | corefs | time |
debug | timelog

Topic [florian, lenin, wolfgang] SubTopic[0]

h[1]/title/ s[1] Goodbye , Lenin !
SubTopic[1]

h[2]/DATA/ s[2] D 2003 - 119 Minuten
SubTopic[2]

h[3]/director/ s[3] Regie : Wolfgang Becker
SubTopic[3]

h[4]/credits/ s[4] Kamera : Martin Kukula
SubTopic[4]

h[5]/credits/ s[5] Drehbuch : Bernd Lichtenberg
SubTopic[5]

h[6]/cast/ s[6] Besetzung : Daniel Brühl , Katrin Saß , Florian Lukas , Chulpan Khamatova u.a.
SubTopic[6]

Topic [lenin, good]

p[7]/describe/ s[7] Lenin ist von seinem Sockel gestiegen . s[8] Die Faust zum sozialistischen Gruß gereckt schwebt er von einem Helikopter baumelnd ein letztes Mal durch die Straßen der Hauptstadt . s[9] Good Bye , Lenin ! s[10] Welcome D-Mark .
SubTopic[7]

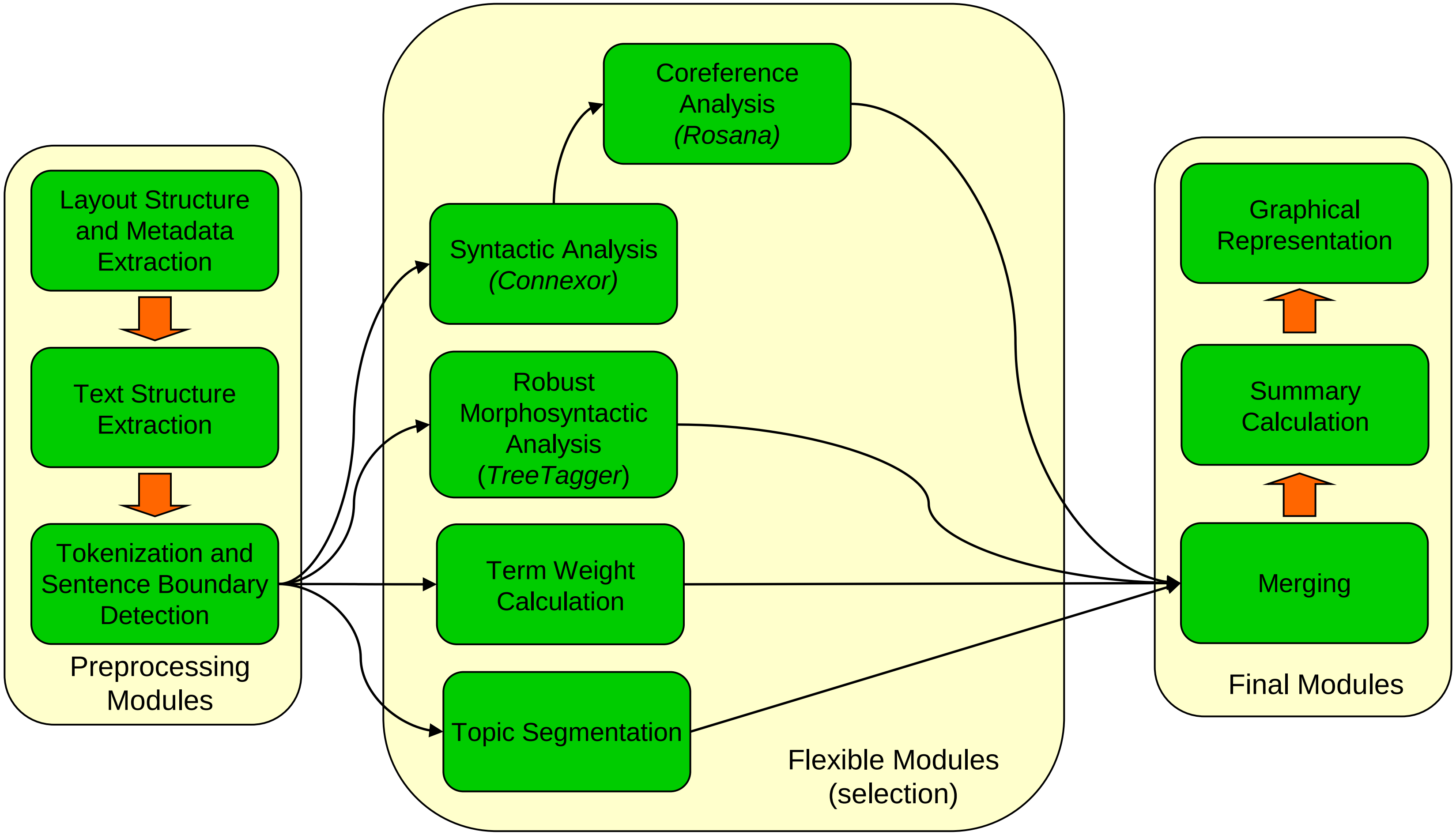
Annotations
☑ Sentences ID
☑ Paragraph/Header ID
☑ Zone Label
☑ Topics

□ 10% sentences(w/final)
☑ Base Summary [9%]
☑ Optional Sentences 25%

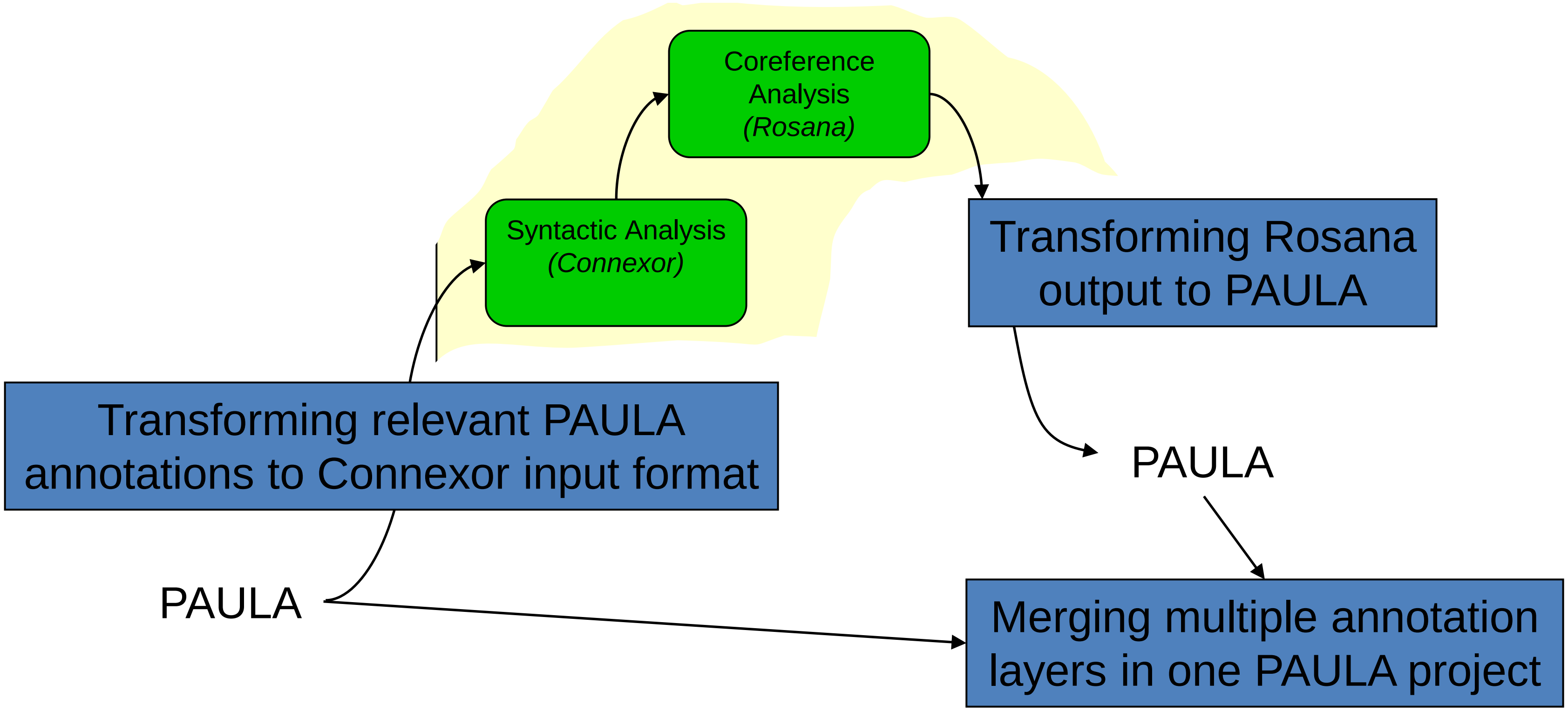
□ Connectives
□ Number Expressions
□ << Subjectivity
□ << Brill: PoS, DC
□ << TreeTagger: PoS
☑ << Chunks
□ NC
□ PC
☑ VC
□ << Time Annotations
□ << Coreference chains

Status

1. Summarization pipeline


Layout Structure and Metadata Extraction
Text Structure Extraction
Tokenization and Sentence Boundary Detection
Preprocessing Modules
Coreference Analysis *(Rosana)*
Syntactic Analysis *(Connexor)*
Robust Morphosyntactic Analysis (*TreeTagger*)
Term Weight Calculation
Topic Segmentation
Flexible Modules (selection)
Graphical Representation
Summary Calculation
Merging
Final Modules

1. A fragment



Coreference Analysis *(Rosana)*

Syntactic Analysis *(Connexor)*

Transforming Rosana output to PAULA

Transforming relevant PAULA annotations to Connexor input format

PAULA

PAULA

Merging multiple annotation layers in one PAULA project

one single PAULA project comprising annotations from different modules

1. Standoff XML

- advantages
  - modularization
  - trivial merge and split operations for annotations of the same document
    - add another file to the annotation project
  - clear conceptual separation of annotations
- disadvantages
  - modules exchange information through XML
    - relatively slow

2. UiMA (Ferruci and Lallas 2004)

- Unstructured Information Management Architecture
- Industry-scale architecture for NLP pipelines
  - active community, good support
- Relatively generic data model with different realizations
  - JAVA Objects, XML, others

2. UiMA

- Wrappers for various NLP tools available
- input and output representations of modules („CAS consumers“) defined by annotation types
  - e.g., a part-of-speech tag inventory
  - different annotation type systems may not be compatible with each other

  => limited interoperability

2. UiMA

- advantages
  - maturity
    - rich technological ecosystem, active community
  - efficiency
    - supports, e.g., information exchange through JAVA objects
- disadvantages
  - limited interoperability only
  - how to implement a distributed architecture ?

2. UiMA extensions

- Egner et al. (2007)
  - UiMA Grid, distributed large-scale text analysis
- Verspoor et al. (2009)
  - Abstracting the types away from a UiMA type system
  - Ontologies instead of annotation types
    - improved conceptual (`semantic‘) interoperability
    - less efficient indexing
- These extensions would have to be reimplemented for an STS pipeline
  - AFAIK, not publicly available

3. RDF-based architecture

- Hellmann (2010), Hellmann et al. (2012)
  - NLP Interchange Format (NIF)
    - http://nlp2rdf.org/nif-1-0
  - NLP2RDF: RDF wrappers for various tools
    - http://nlp2rdf.org
    - provides NLP analyses for processing with Semantic Web tools
  - applied in a large-scale European research project (LOD2)
    - adopted by several external research groups

3. RDF

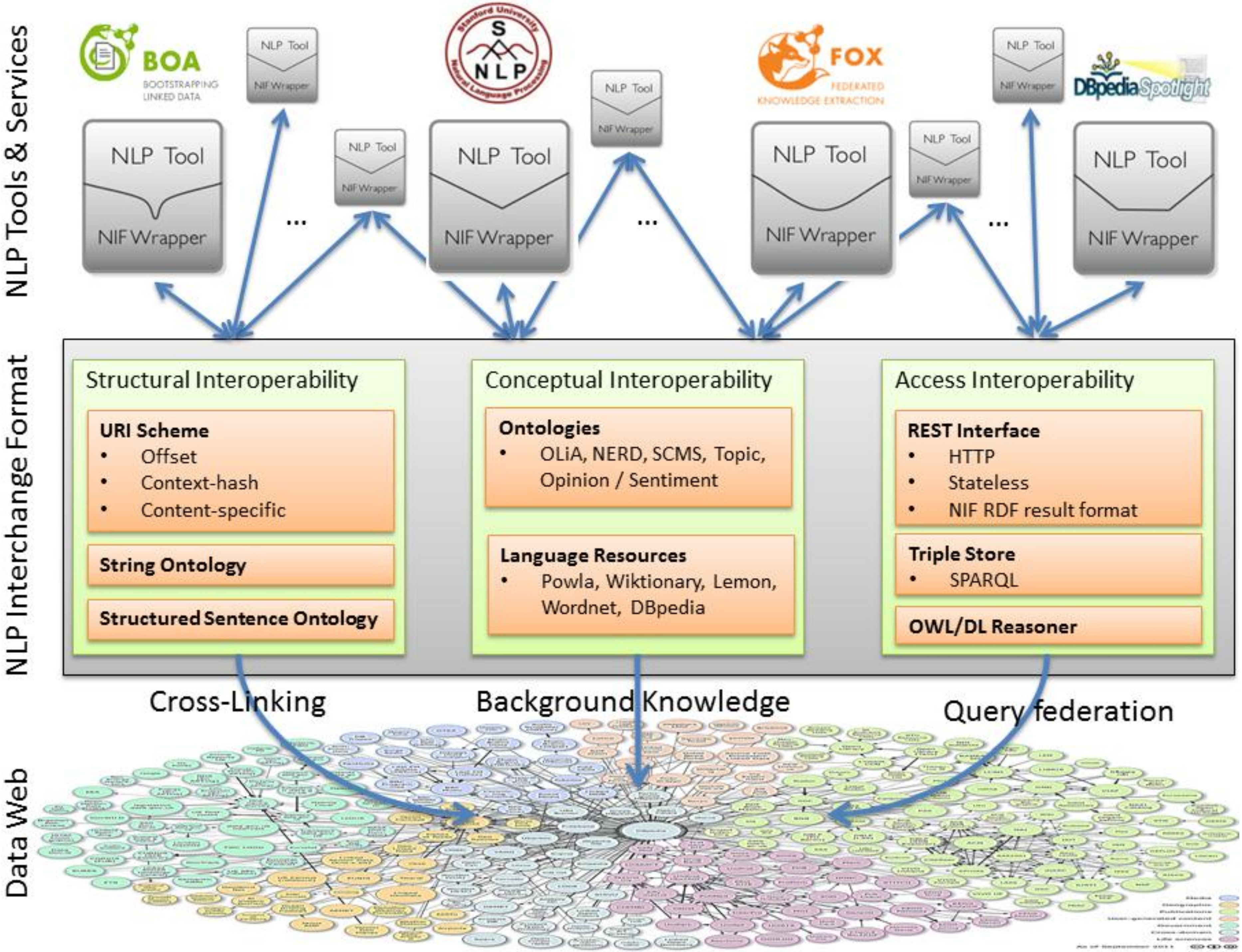
- Resource Description Framework
  - W3C standard
  - formalizes labeled directed multigraphs

    (like XML standoff formats)
  - sublanguages define specialized vocabularies
    - RDF Schema: concept hierarchies
    - SKOS: semi-structured terminology bases
    - OWL: ontologies

3. RDF

- different linearizations
  - XML (verbose), Turtle (compact), others
- rich technological ecosystem
  - data bases („triple stores“)
  - APIs and (syntactic) validators
  - query language SPARQL
- OWL/DL
  - despription logics
  - defining and checking constraints (axioms)

    => formally defined user-specific data types


NLP Tools & Services
BOA
BOOTSTRAPPING LINKED DATA
Stanford University
S
NLP
Natural Language Processing
FOX
FEDERATED KNOWLEDGE EXTRACTION
DBpedia Spotlight
NLP Tool
NIF Wrapper
...
NLP Interchange Format
Structural Interoperability
URI Scheme
• Offset
• Context-hash
• Content-specific
String Ontology
Structured Sentence Ontology
Conceptual Interoperability
Ontologies
• OLiA, NERD, SCMS, Topic, Opinion / Sentiment
Language Resources
• Powla, Wiktionary, Lemon, Wordnet, DBpedia
Access Interoperability
REST Interface
• HTTP
• Stateless
• NIF RDF result format
Triple Store
• SPARQL
OWL/DL Reasoner
Cross-Linking
Background Knowledge
Query federation
Data Web

3. RDF

- advantages
  - rich ecosystem, large and active community
  - native support for distributed processing
  - direct integration with LOD resources
    - may be relevant for STS
  - conceptual interoperability through linking with terminology repositories

Comparison

	standoff XML	UiMA	NLP2RDF
flexibility	+	(+)	+

flexibility:

+ support for all necessary data structures

(+) UiMA: multiple ways to represent trees

Comparison

	standoff XML	UiMA	NLP2RDF
flexibility	+	+	+
structural interoperability	+	(+)	+

structural („syntactic“) interoperability:
+ same format for all modules
(+) UiMA: multiple ways to define trees

Comparison

	standoff XML	UiMA	NLP2RDF
flexibility	+	+	+
structural interoperability	+	(+)	+
conceptual interoperability	(-)	(+)	+

conceptual („semantic“) interoperability:

+ interoperability through reference to a terminology repository
(+) UiMA: interoperability if the same annotation type system is used
(-) standoff: links to terminology repositories *can* be provided, but no standard has been established to do so

Comparison

	standoff XML	UiMA	NLP2RDF
flexibility	+	+	+
structural interoperability	+	(+)	+
conceptual interoperability	(-)	(+)	+
availability	- (SuMMAR)	+	+

availability:

-	unknown/restricted licence
+	open license

Comparison

	standoff XML	UiMA	NLP2RDF
flexibility	+	+	+
structural interoperability	+	(+)	+
conceptual interoperability	(-)	(+)	+
availability	- (SuMMAR)	+	+
maturity	(-)	++	+

maturity:

++	industry-scale
+	used in multiple research groups
(-)	used in one research group

Comparison

	standoff XML	UiMA	NLP2RDF
flexibility	+	+	+
structural interoperability	+	(+)	+
conceptual interoperability	(-)	(+)	+
availability	- (SuMMAR)	+	+
maturity	(-)	++	+
web services	(+)	(+)	+

support for distributed processing (web services):
+ available
(+) possible

Comparison

	standoff XML	UiMA	NLP2RDF
flexibility	+	+	+
structural interoperability	+	(+)	+
conceptual interoperability	(-)	(+)	+
availability	- (SuMMAR)	+	+
maturity	(-)	++	+
web services	(+)	(+)	+
performance/ efficiency	-	+/(+)	(+)

performance/efficiency

+	direct exchange of objects (without serialization) possible
(+)	compact serialization
-	verbose serialization

Todo: Rank criteria

	standoff XML	UiMA	NLP2RDF
flexibility	+	+	+
structural interoperability	+	(+)	+
conceptual interoperability	(-)	(+)	+
availability	- (SuMMAR)	+	+
maturity	(-)	++	+
web services	(+)	(+)	+
performance/ efficiency	-	+/(+)	(+)

Which to chose ?

Combination of multiple architectures ?