Towards agent-based cross-lingual interoperability of distributed lexical resources

Claudia Soria
Maurizio Tesconi
Andrea Marchetti
Francesca Bertagna
Monica Monachini
Chu-Ren Huang
Nicoletta Calzolari

Istituto di Linguistica Computazionale - CNR - Pisa
Istituto di Informatica e Telematica - CNR - Pisa
Academia Sinica - Taipei

Motivation

- Ever-increasing expansion of language resources
- Inherent distributedness of LRs:
  - Locally developed and maintained
  - Strongly bounded to the their natural environment
- Unsatisfactory language resources:
  - Lack of adequate breadth
  - Lack of adequate detail of linguistic information
  - Lack of wide availability
  - Time and money consuming

The answer

- A “new generation” of language resources:
  - From static, closed and locally developed resources to shared and distributed language *services.*
  - LRs reside over distributed places and are choreographed by agents presiding the actions that can be executed over them:
  - ..such as querying, collaborative development and validation, cross-resource integration and exchange of information.
  - This is a long-term scenario based on content interoperability standards, sovra-national cooperation and development of accessible architectures enabling accessibility.

Aims of work

- Explore new methods and techniques allowing the realization of “new paradigm” of language resources.
- Addressing integration and interoperability of computational lexicons.
- The case of semi-automatic integration and mutual enrichment of (distributed) large-scale lexical resources.

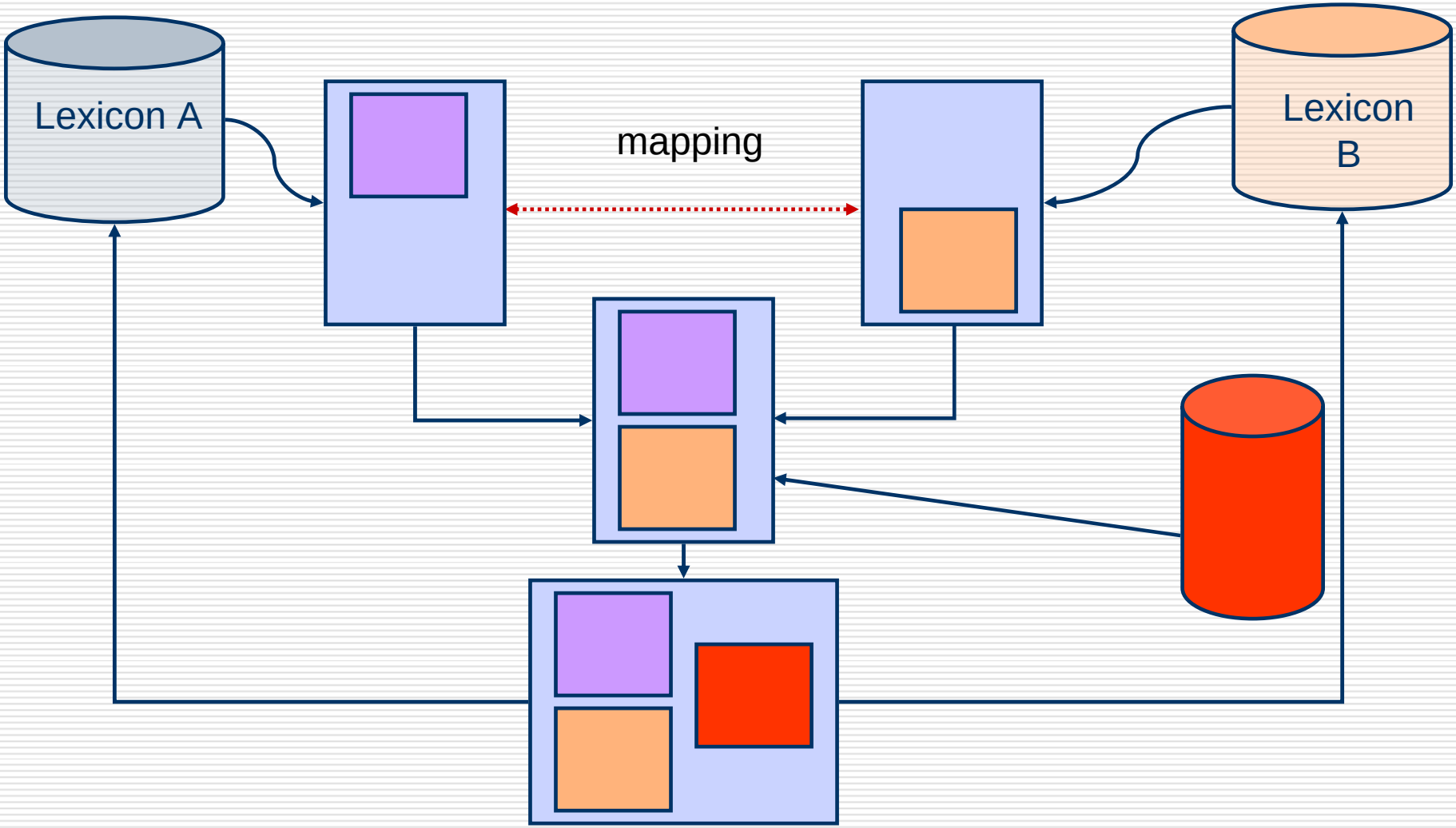
Two levels

- Global focus:
- *"..LRs are built as the result of controlled cooperation of different agents.."*
- Development of cooperative web application for the management of lexical resources
- **LeXFlow**

- Local focus:
- An application (actually a module of the previous one) enabling semi-automatic cross-lingual enrichment of lexical resources (cross-fertilization)
- **Multilingual WordNet Service**

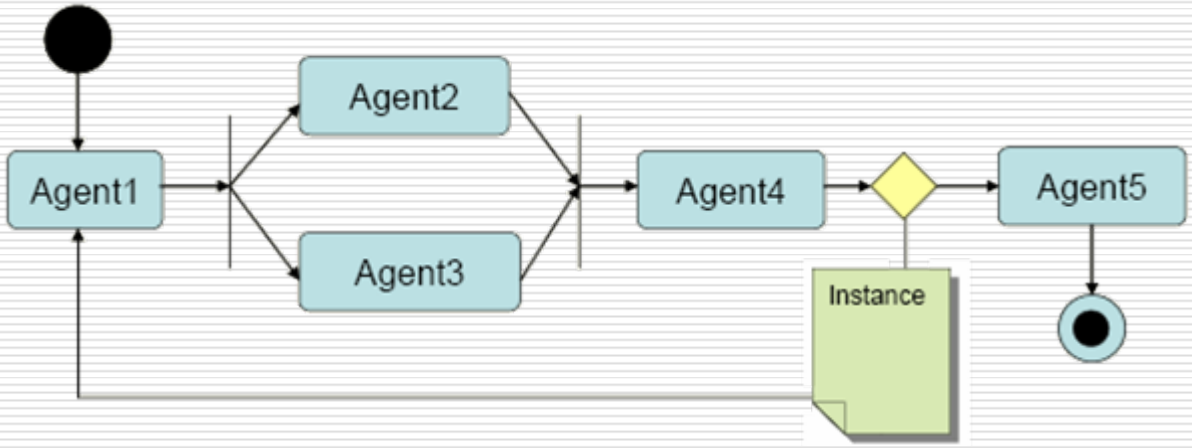
LeXFlow

- A web-based collaborative environment for the *semi-automatic integration* of lexical resources, enabling interoperability of *distributed* lexical resources that are accessed by different types of *agents*.


Lexicon A
mapping
Lexicon B

LeXFlow design

- LeXFlow gets inspired from techniques of document workflows and cooperative authoring.

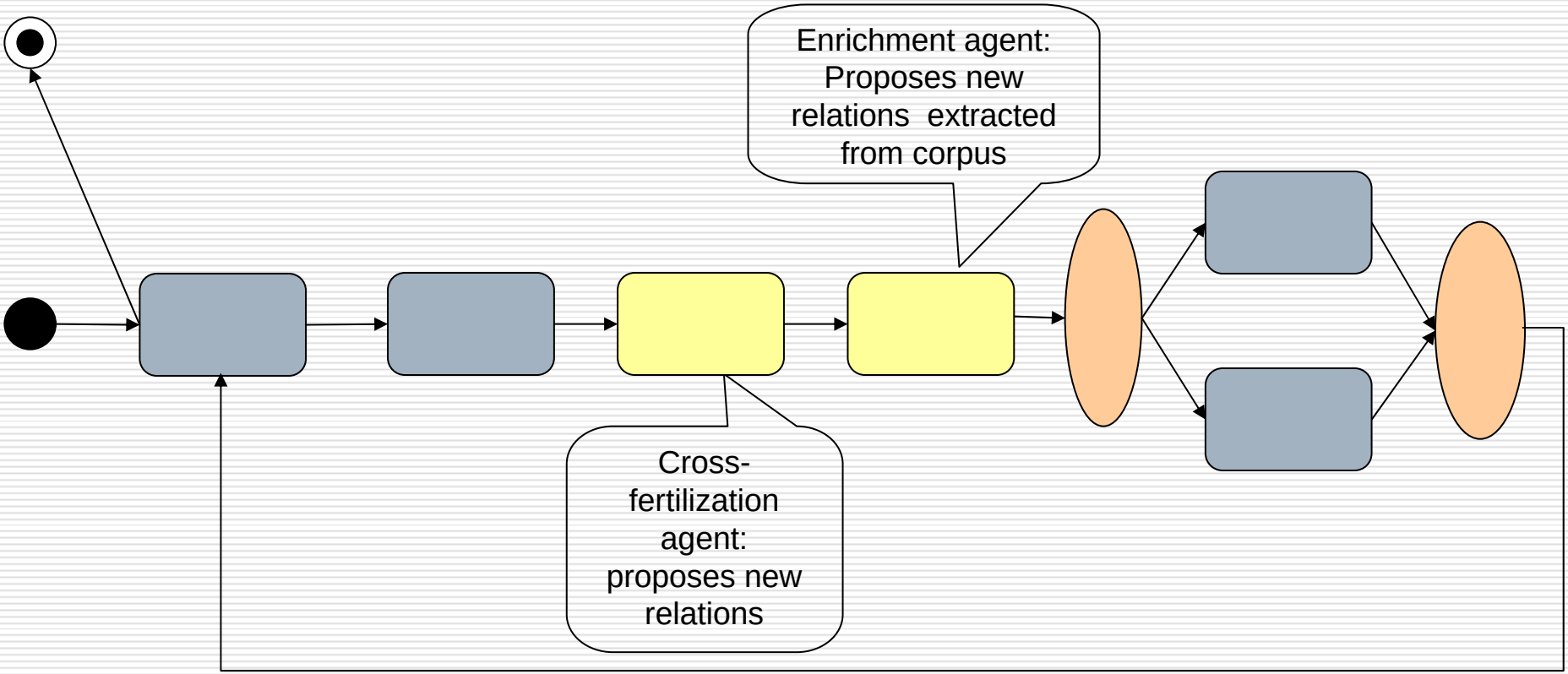


Xflow (Marchetti, Tesconi, Minutoli 2005), a cooperative web application for the management of document workflows.

From document to lexical flows

- Management of lexical resources as types of document workflows
  - Lexical entries are modelled as document instances
  - The behavior of a lexical entry is described by a Lexical Workflow Type
  - A Lexical Workflow Type describes
    - The life-cycle of a lexical entry
    - The agents allowed to act over it
    - The actions to be performed by the agents
    - The order in which the actions are to be executed

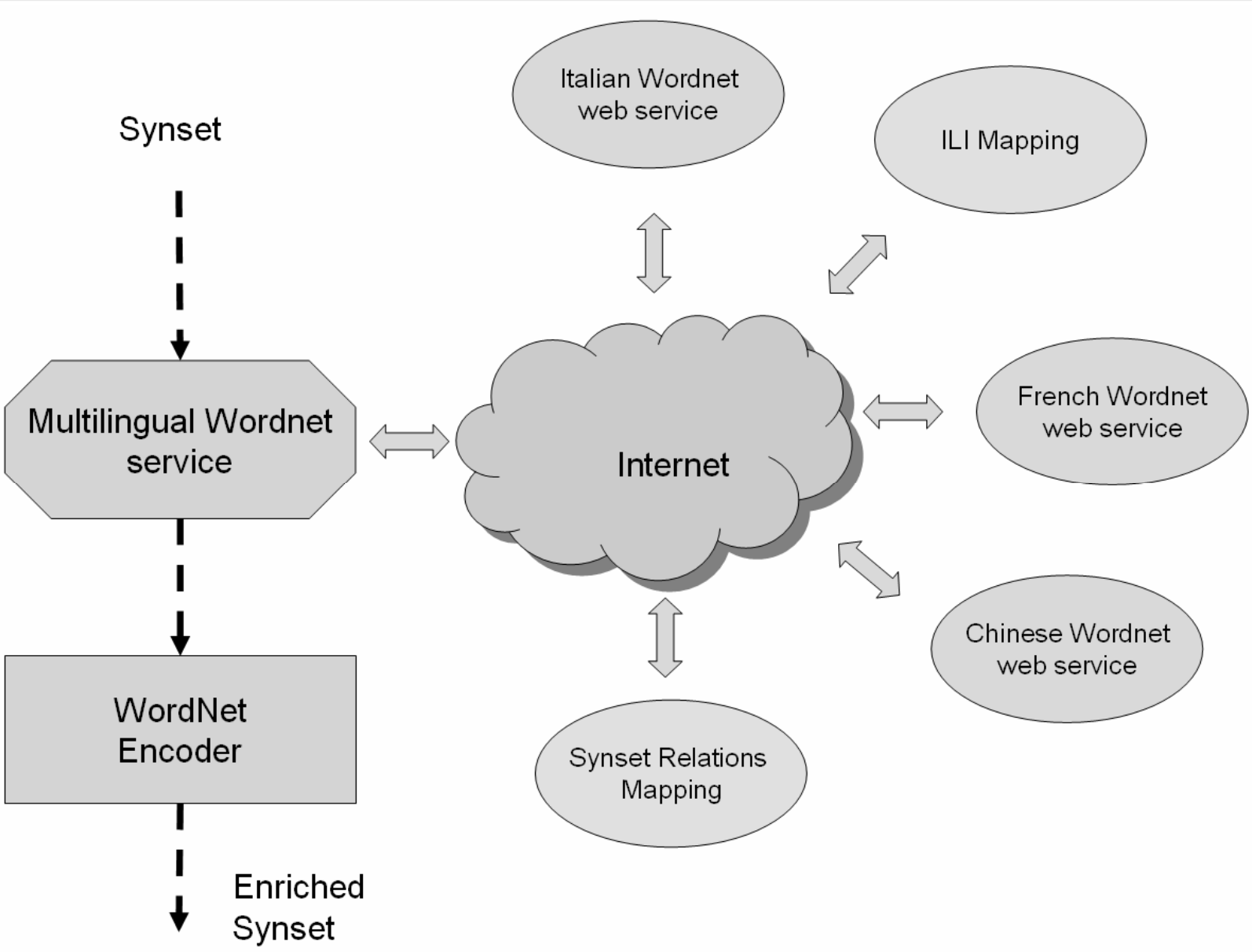
Cross-fertilization and enrichment flow



- Used and tested for integration of monolingual lexicons…
- …With differently conceived lexical architectures and diverging formats
- The same idea of *cross-fertilization*, i.e. semi-automatic induction of new information, however, can be applied in a cross-lingual perspective.

Moving to a cross-lingual perspective…

- A monolingual lexicon can be enriched by inducing the semantic information encoded in corresponding entries of other monolingual lexicons.
- To this end, the lexicons must share the same structural model
- WordNet is the most widely spread model of semantic lexicons , with many initiatives worldwide.
- Harvesting the richness of various WordNets to enrich each of them, in a cross-breeding-like manner.


Synset
Italian Wordnet web service
ILI Mapping
Multilingual Wordnet service
Internet
French Wordnet web service
Chinese Wordnet web service
WordNet Encoder
Synset Relations Mapping
Enriched Synset

Our case-study: cross-fertilization between Italian and Chinese WordNets

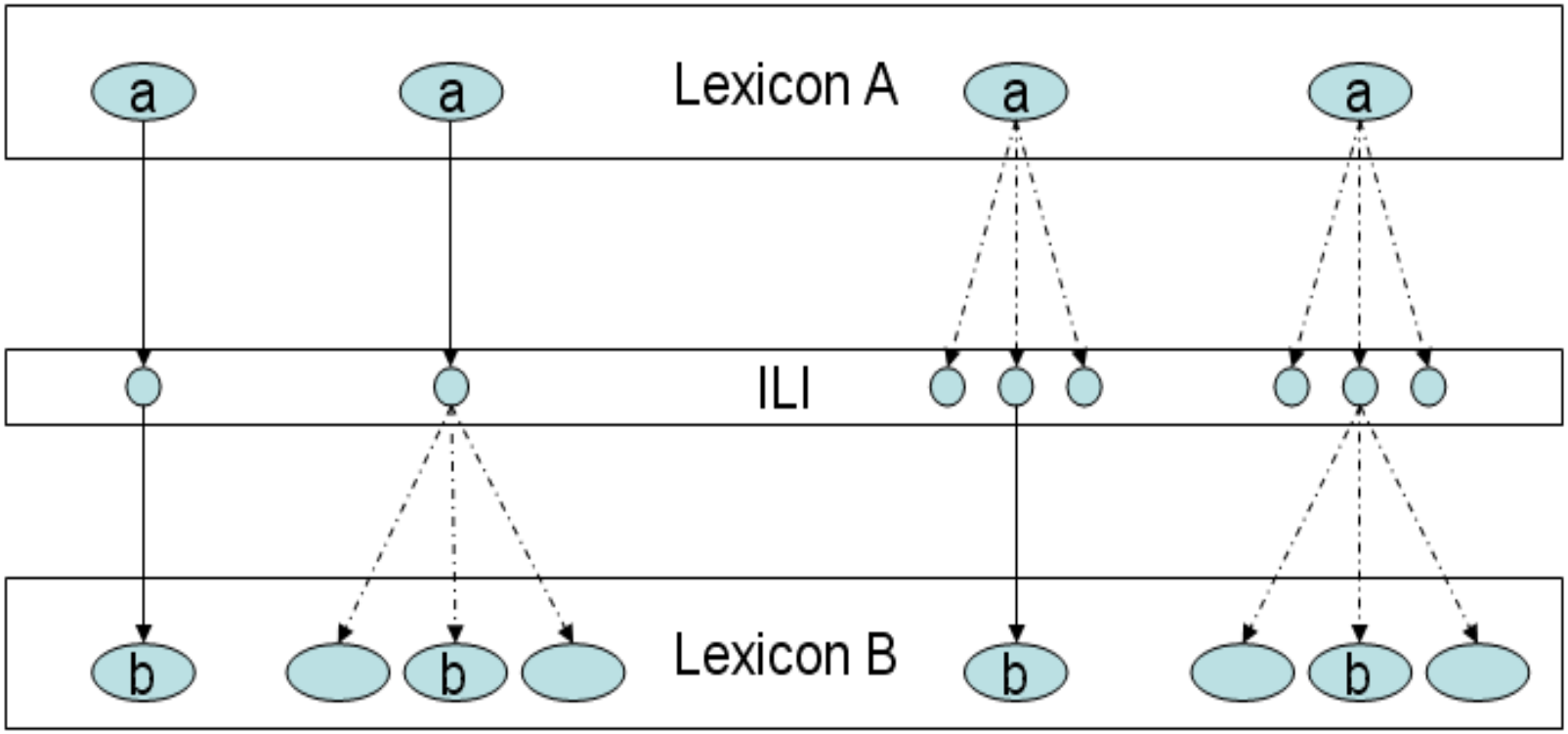
- ItalWordNet (Roventini et al., 2003)
- Academia Sinica Bilingual Ontological WordNet (Sinica BOW, Huang et al., 2004)
- Both connected to Princeton WordNet (although to different versions)
- Same set of semantic relations (EWN ones)

Some basic assumptions

- Interlingual level:
  - There must be an Interlingua providing an indirect linkage between different WordNets, such as the Interlingual Index (ILI).
- Synset correspondence:
  - If there is a S_A and a S_B that point to the same ILI, they are correspondent.
- Relation correspondence:
  - If there are two synsets in WN_A and a relation between them, the same holds between corresponding synsets in WN_B.

Linking WordNets through the ILI

- Interlingual Index (Peters et al. 1998)
- An unstructured version of WordNet used in EuroWordNet to link wordnets of different languages.
- Each synset in a WN_A is linked to at least one record of the ILI by means of a set of equivalence relations (e.g. “eq_synonym”, “eq_near_synonym”, “eq_has_hyperonym”, etc.)

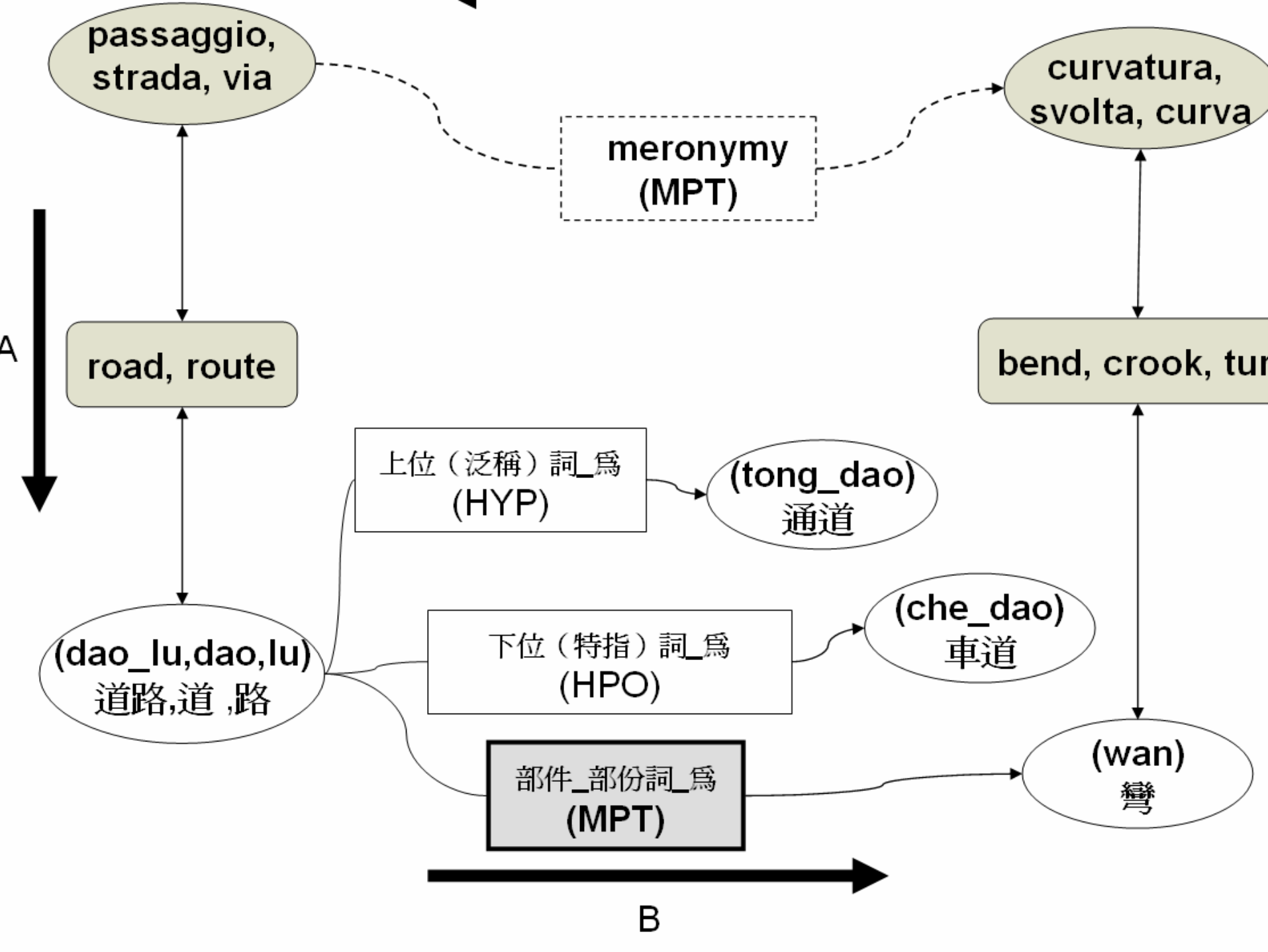

Lexicon A
a
a
a
a
ILI
Lexicon B
b
b
b
b

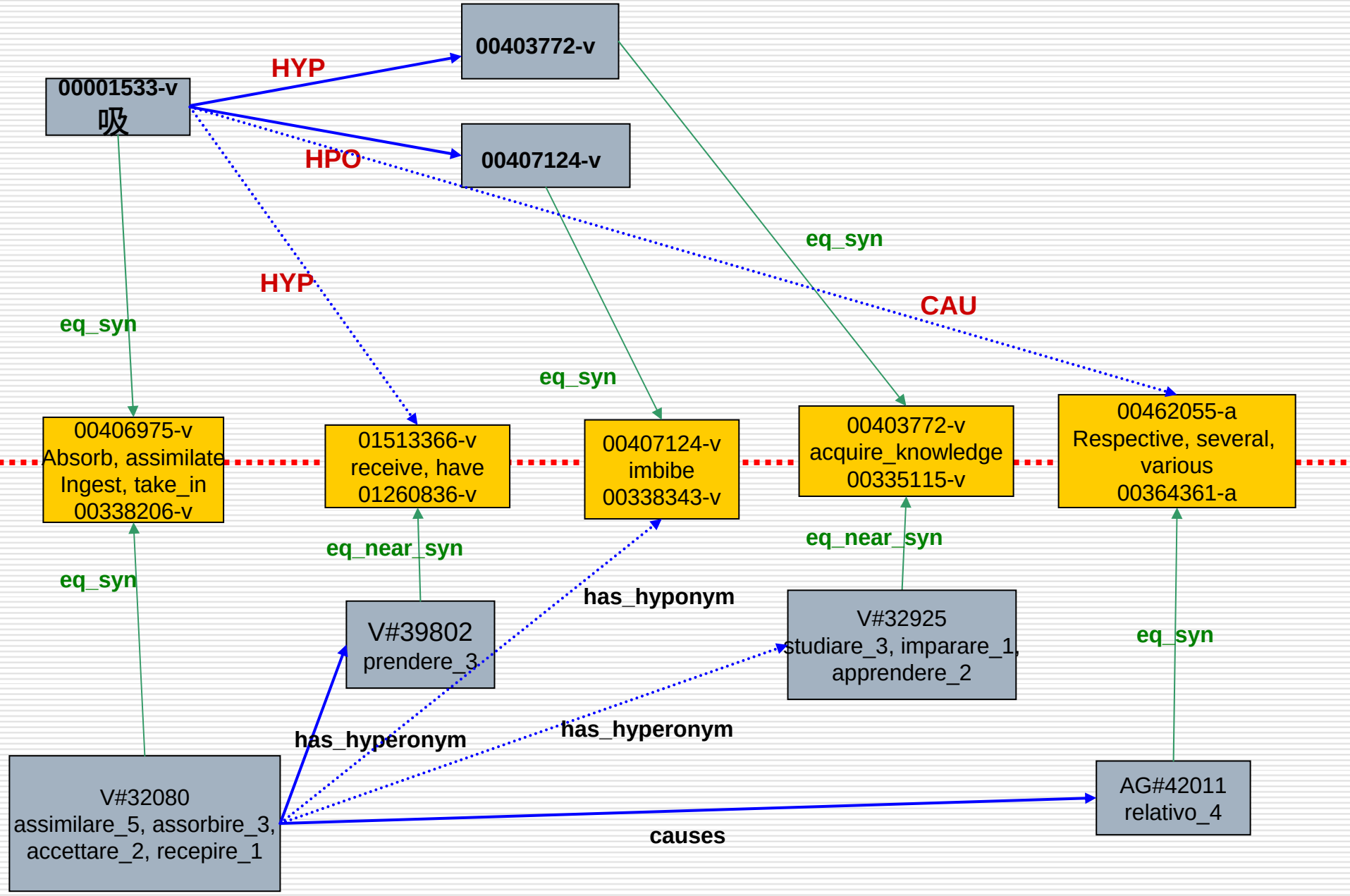
Problems

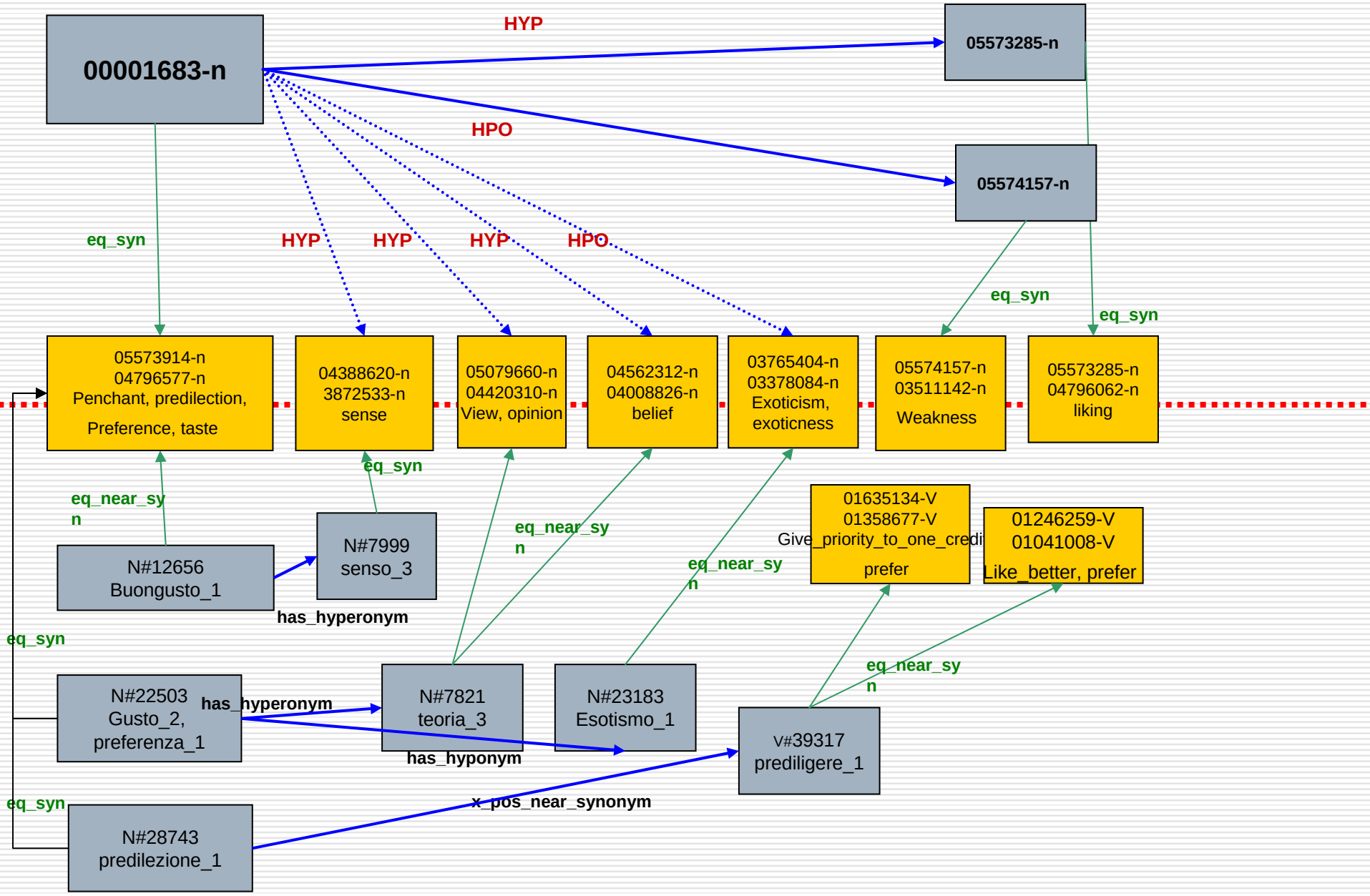
- no version of the ILI can be considered a standard
- often the various lexicons exploit different version of WordNet as ILI
- Potential inaccuracy of the linking to ILI
- “Noise” induced by non-full synonymy relations.

Procedure

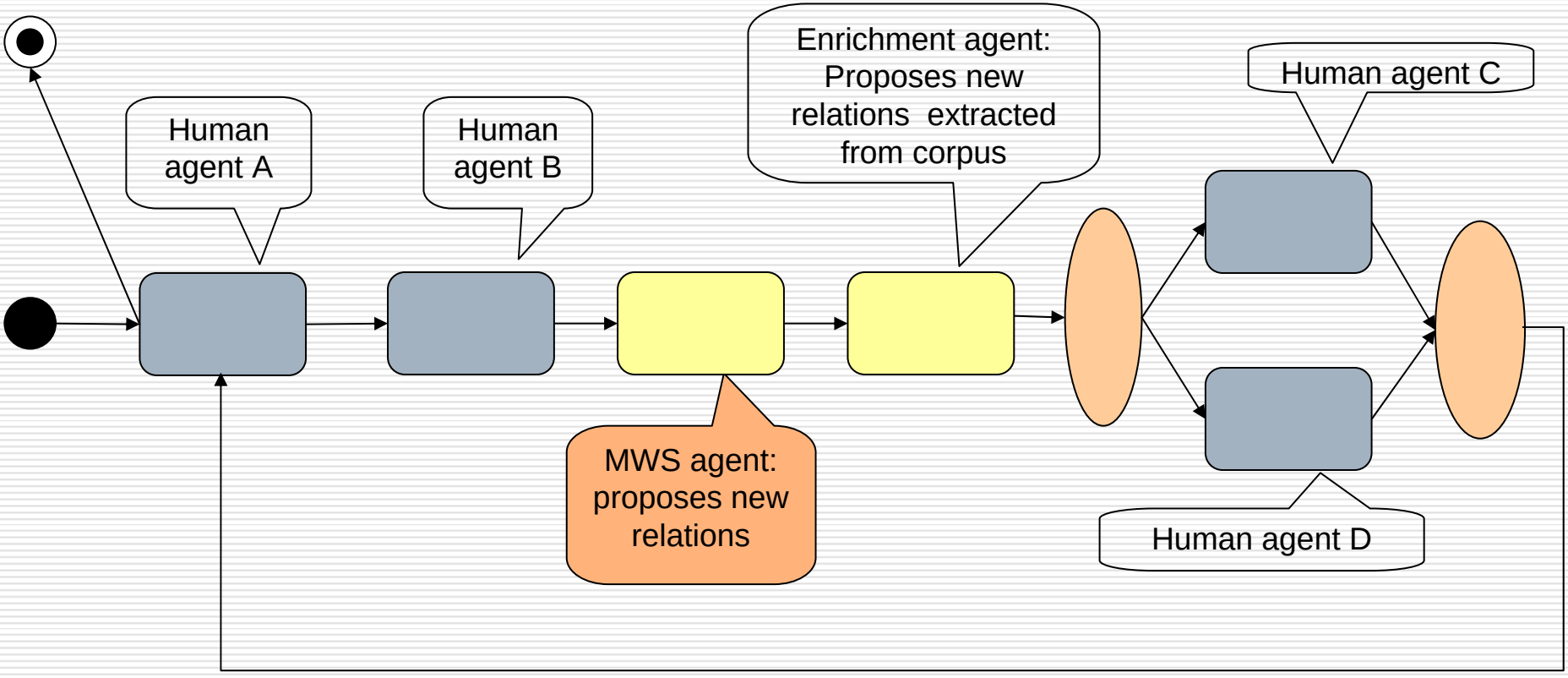
- Enrichment is performed on a synset-by-synset basis
- On the basis of ILI linking, a synset can be enriched by importing the relations contained in the corresponding synset(s) belonging to another wordnet.
- A certain synset is selected from a wordnet resource, say WN(A).
- The cross-lingual module identifies the corresponding ILI synset, on the basis of the information encoded in the synset.
- It then sends a query to the WN(B) web service providing the ID of ILI synset together with the ILI version of the starting WN.
- The WN(B) web service returns the synset(s) corresponding to the WN(A) synset, together with reliability scores.
- If WN(B) is based on a different ILI version, it can carry out the mapping between ILI versions (for instance by querying the ILI mapping web service).
- The cross-lingual module then analyzes the synset relations encoded in the WN(B) synset and for each of them creates a new synset relation for the WN(A) synset.


passaggio, strada, via
meronymy (MPT)
curvatura, svolta, curva
A
road, route
bend, crook, tur
上位（泛稱）詞_爲 (HYP)
(tong_dao) 通道
(dao_lu,dao,lu) 道路,道 ,路
下位（特指）詞_爲 (HPO)
(che_dao) 車道
部件_部份詞_爲 (MPT)
(wan) 彎
B


00001533-v
吸
00403772-v
00407124-v
HYP
HPO
HYP
CAU
eq_syn
eq_syn
eq_syn
eq_syn
00406975-v
Absorb, assimilate
Ingest, take_in
00338206-v
01513366-v
receive, have
01260836-v
00407124-v
imbibe
00338343-v
00403772-v
acquire_knowledge
00335115-v
00462055-a
Respective, several,
various
00364361-a
eq_near_syn
eq_near_syn
eq_syn
V#39802
prendere_3
has_hyponym
V#32925
studiare_3, imparare_1,
apprendere_2
eq_syn
has_hyperonym
has_hyperonym
V#32080
assimilare_5, assorbire_3,
accettare_2, recepire_1
AG#42011
relativo_4
causes


00001683-n
HYP
05573285-n
HPO
05574157-n
eq_syn
HYP
HYP
HYP
HPO
eq_syn
eq_syn
05573914-n
04796577-n
Penchant, predilection,
Preference, taste
04388620-n
3872533-n
sense
05079660-n
04420310-n
View, opinion
04562312-n
04008826-n
belief
03765404-n
03378084-n
Exoticism,
exoticness
05574157-n
03511142-n
Weakness
05573285-n
04796062-n
liking
eq_syn
eq_near_sy
n
N#12656
Buongusto_1
N#7999
senso_3
has_hyperonym
eq_near_sy
n
eq_near_sy
n
01635134-V
01358677-V
Give_priority_to_one_credi
prefer
01246259-V
01041008-V
Like_better, prefer
eq_syn
N#22503
Gusto_2,
preferenza_1
has_hyperonym
N#7821
teoria_3
has_hyponym
N#23183
Esotismo_1
eq_near_sy
n
V#39317
prediligere_1
eq_syn
N#28743
predilezione_1
x_pos_near_synonym

Cross-fertilization and enrichment flow



Conclusions

- We have presented a proposal for making distributed wordnets interoperable.
- This proposal lends itself to different applications in lexical resource processing:
  - Enrichment of existing lexical resources
  - Creation of new resources
  - Validation of existing resources
- If combined with LeXFlow, it can support the cooperative and collective creation and management of LRs, by providing a web-based environment for the collaboration and interaction of distributed agents and resources.

Conclusions

- Prototype of a web application supporting the GlobalWordNet Grid initiative, i.e. a shared multi-lingual knowledge base for cross-lingual processing based on distributed resources over the Grid.

Links

- LeXFlow:
  http://xmlgroup.iit.cnr.it:8888/xflow/login
- MWS:

http://xmlgroup.iit.cnr.it:88/exist/wordnet/wordnet

- GlobalWordNet Grid:

www.globalwordnet.org/gwa/gwa_grid.html