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intElligent Automatic
SIgn languagE tRanslation

NLP for sign languages:

How to index sign language resources?

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Also presenting the work of Maria Kopf, Marc Schulder and Thomas Hanke

17/10/2022

About me

- Linguistics bachelor at Paris 3, NLP master at INALCO
- PhD at Lille 3 on mining social media for medication misuse
- Post-doc at IECL/ATILF in 2020 under Marianne Clausel and Mathieu Constant
  - Text mining on publications of Cancéropôle Est to highlight their research
- After that, wanted to work on another domain for a change and do more linguistics -> sign language research

Summary

1. A brief overview of sign languages
2. EASIER project
3. harmonising corpora
4. harmonising lexicons with Wordnet

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Sign languages:

The basics

Sign languages: the basics

Sign languages are natural languages

- Many SL exist
- They are not a word-to-word translation of a spoken language. They have their own grammar and vocabulary.
- They have synonyms, local variants, slang, wordplay, etc
- They are part of the culture of a minority
  - not a problem to be solved
  - complete, functional languages
  - often butchered
- They have a lot of variation (18 different “September” in a corpus of German sign language)

Sign languages: the basics

https://www.sign-lang.uni-hamburg.de/meinedgs/html/1246329_en.html

Examples of:

- Anonymisation
- A sentence of 2 signs translated to English as 11 words in 2 sentences
- Signing space used to describe locations, pronouns, time

Sign languages: the basics

- Phonetic features:
  - Manual signs have 4 articulators: shape, orientation, position, movement
  - There are 2 hands, they can have different configurations, and a movement relative to each other
  - Besides manual signs, there is mouth gestures, mouthings, facial expression, body orientation

- Use of the signing space for grammar

Obstacles to NLP

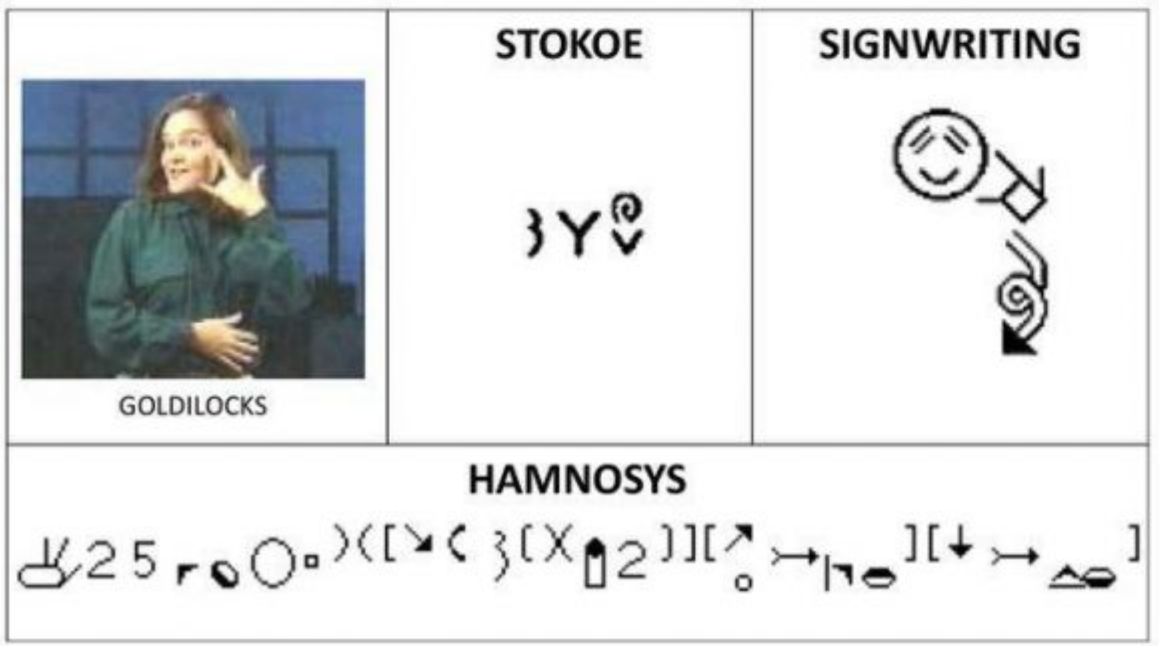
- Share issues with under-resourced spoken languages: no standardised writing, no lemmatisation software, few corpora, few dictionaries, corpora need costly manual annotation
- Requires video: more technically difficult to do well (motion blur, angles), more expensive, difficult to store and share, anonymisation is not possible

Transcription: Phonetic transcription

Stokoe: only encodes manuals. no unicode

Signwriting: can encode non-manuals, easy to learn, used by some signers, limited unicode needs software

Hamnosys: no unicode but can be typed with special font, can encode non-manuals



Used by linguists, rarely signers

Each can have variation

No automatic transcription software

Transcription: Gloss-ID transcription

[DGS corpus (dog)]

[BSL signbank (imagine)]

[DGS corpus (DOWNWARDS1^)]

- Sign-level, not phonetic
- Easier, quicker to use
- Need to establish a vocabulary, decide lemmatisation…
  - 2 distinct signs / same sign with flexion
- Vocabularies are different between projects, even for universal signs like pointings

BSL Corpus	PT:PRO1SG
Corpus FinSL	OS:me
Corpus NGT	PT-1hand:1
DGS Corpus	ICH1
POLYTROPON	ΕΓΩ
SSLC	PRO1
PJM Corpus	WSKAZ: 1 (JA)

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EASIER Project and my work

EASIER project

- Horizon 2020 project over 2021-2023
- Goal: Create a framework for sign-to-spoken, spoken-to-sign, and sign-to-sign translation
- Partners from France (LISN Univ Paris Sud), Germany (Univ Hamburg), UK, Greece, the Netherlands, Switzerland and Belgium
- Involves the European Union of the Deaf and deaf researchers
- 7 sign languages and 7 spoken languages of Europe
    - british, german, swiss german, french, greek, dutch, italian

EASIER project

Avatar Paula

[Dimou et al, 2022]

[video]

EASIER project

Fact: There is not enough corpora to train machine translation on any European sign language

- DGS corpus: 64 000 sentence pairs
- BSL corpus: 6 000 sentence pairs
- English-German standard translation corpus: 150 000 000 pairs

The project's research question: European SL are similar enough that we can combine corpora, have machine translation produce grammatical sentences, and simply substitute vocabulary to translate to each SL

My task:

- Harmonise corpora so they can be used together as training data
- Index vocabularies so they can be used for word-to-word translation

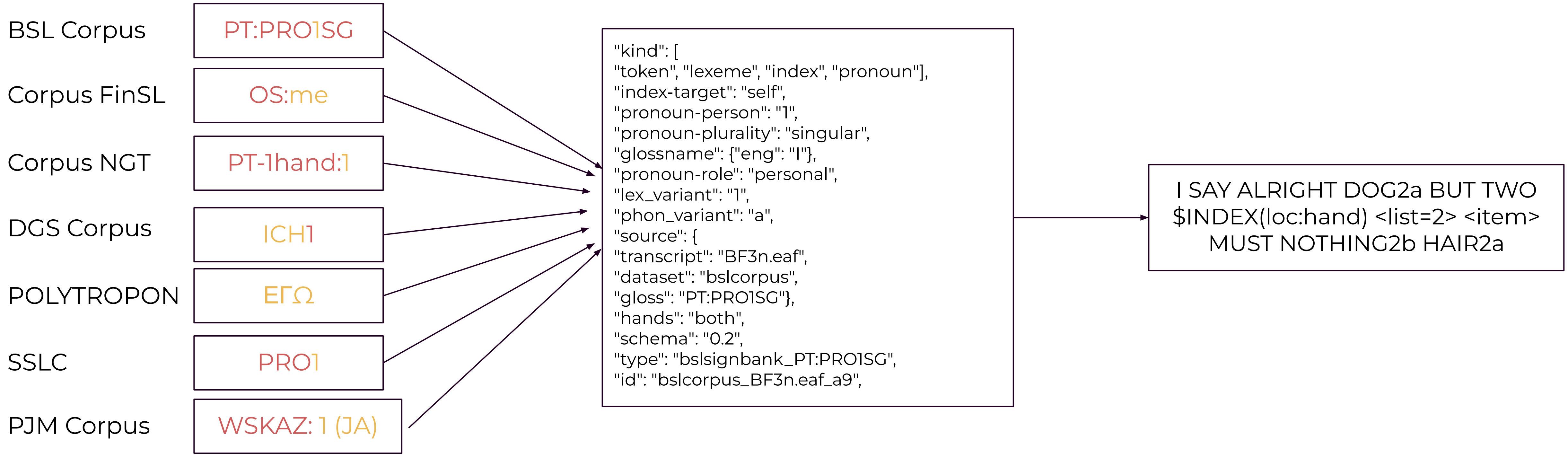
Harmonizing Corpora

Harmonising corpora

Compared available annotation conventions for over 20 aspects in 17 corpora : report by Maria Kopft

- Gloss id for common signs (pointing, fingerspelling, numbers, etc)
- Structure
  - ELAN or ilex
  - tiers structure (tiers names, separate tier for each hand, etc)
- Aspects missing (mouthings)

Corpus Annotation Harmonisation



BSL Corpus — PT:PRO1SG

Corpus FinSL — OS:me

Corpus NGT — PT-1hand:1

DGS Corpus — ICH1

POLYTROPON — ΕΓΩ

SSLC — PRO1

PJM Corpus — WSKAZ: 1 (JA)

```
"kind": [
"token", "lexeme", "index", "pronoun"],
"index-target": "self",
"pronoun-person": "1",
"pronoun-plurality": "singular",
"glossname": {"eng": "I"},
"pronoun-role": "personal",
"lex_variant": "1",
"phon_variant": "a",
"source": {
"transcript": "BF3n.eaf",
"dataset": "bslcorpus",
"gloss": "PT:PRO1SG"},
"hands": "both",
"schema": "0.2",
"type": "bslsignbank_PT:PRO1SG",
"id": "bslcorpus_BF3n.eaf_a9",
```

I SAY ALRIGHT DOG2a BUT TWO $INDEX(loc:hand) <list=2> <item> MUST NOTHING2b HAIR2a

original annotation

JSON **interchange format**
detailed format
machine readable
not very human readable

EASIER notation
more compact
human- and machine-readable
intermediate representation within the project

EASIER Notation

Signs can be more or less specified

- ○ CINEMA1A GO-THERE2A -> precise sign
- ○ CINEMA GO-THERE -> any sign with this gloss
- ○ 03032252-n GO-THERE

Can express important sign language phenomena

Examples:

- ○ <affect=smile:50><mouth=cinema> CINEMA GO-THERE
- ○ <list=3><item> FLOUR <item> MILK <item> SUGAR </list>
- ○ <ground>TABLE <figure>PLATE(loc:2) <figure>PLATE(loc:3a) <figure>PLATE(loc:3b) </ground>

Machine and human readable, human editable, cross-language

Can encode syntax, morphology, mouthings, affect, scopes and strength

Harmonizing Lexical Data using Wordnet

What’s in a SL lexicon ?

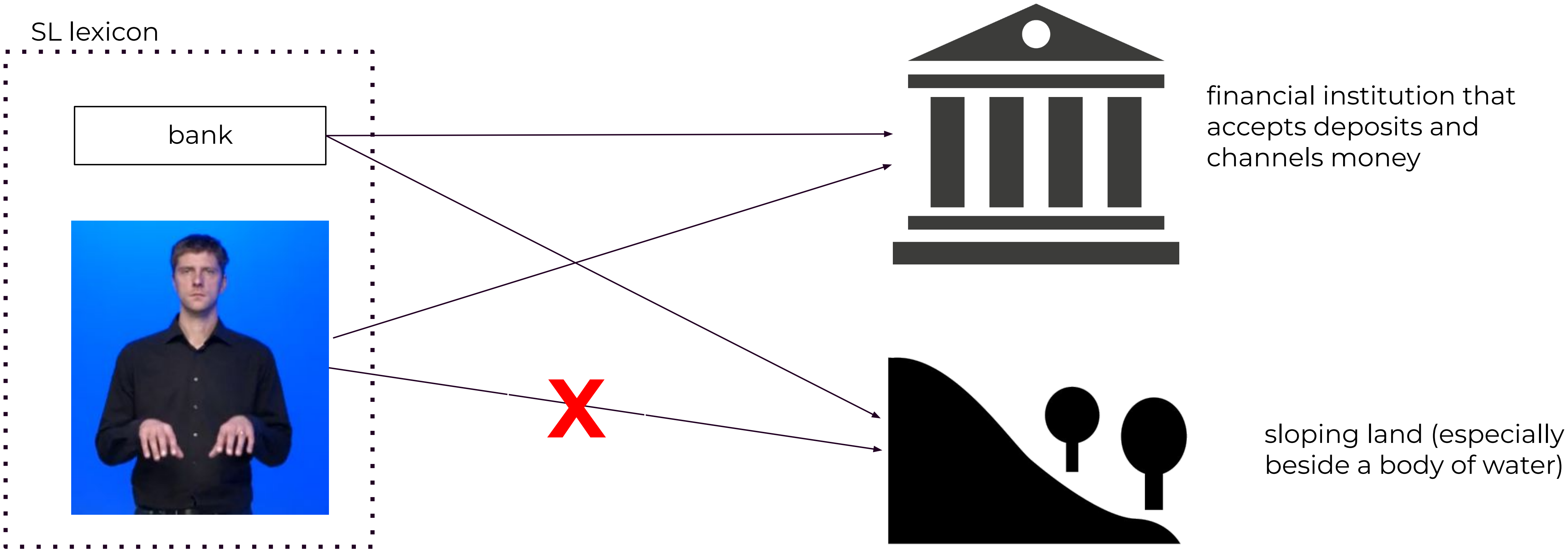
https://bslsignbank.ucl.ac.uk/dictionary/words/imagine-1.html

https://www.sign-lang.uni-hamburg.de/meinedgs/types/type13739_en.html

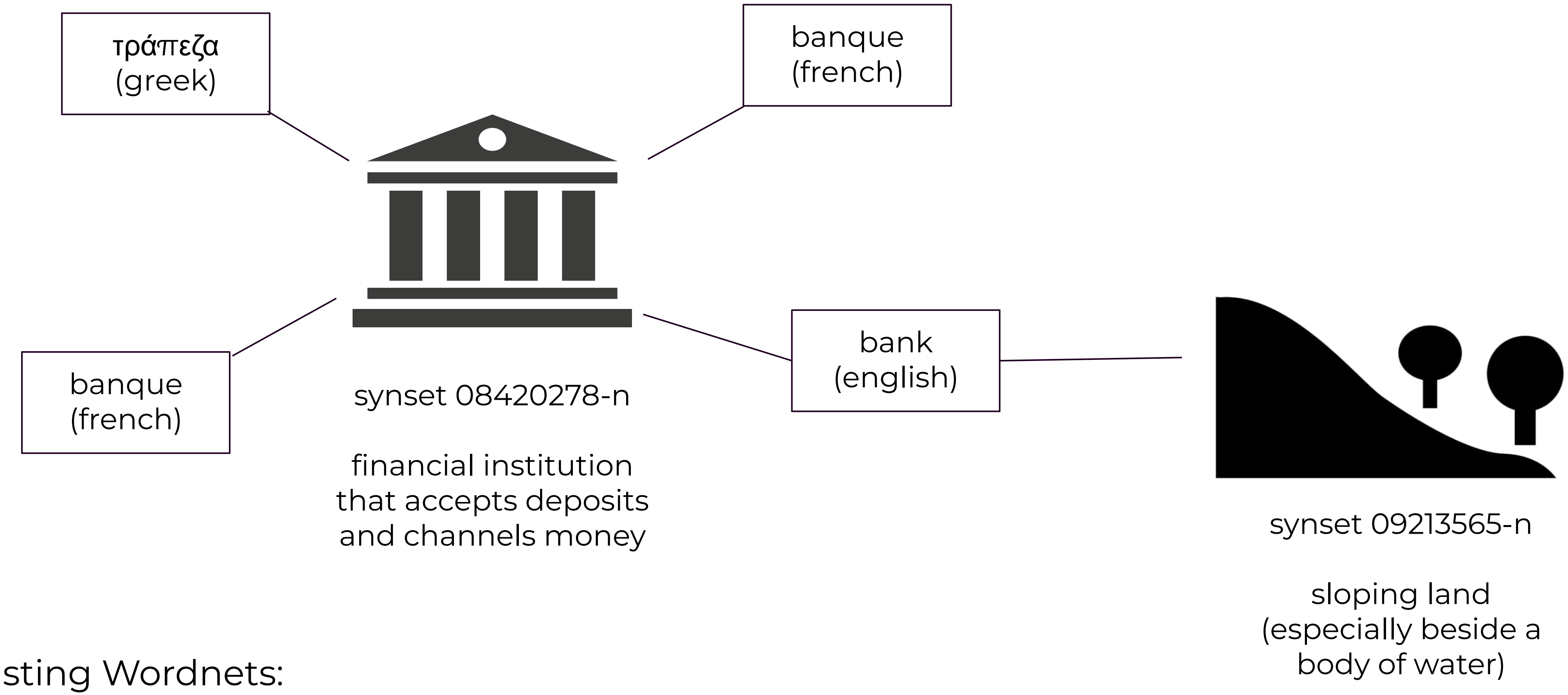
Sense typically described by gloss id / keywords in spoken language, open to mistranslation

Harmonizing lexical data

Goal: make the sense searchable across languages and disambiguated


SL lexicon
bank
X
financial institution that accepts deposits and channels money
sloping land (especially beside a body of water)

Multilingual Wordnet



τράπεζα (greek)

banque (french)

banque (french)

bank (english)

synset 08420278-n

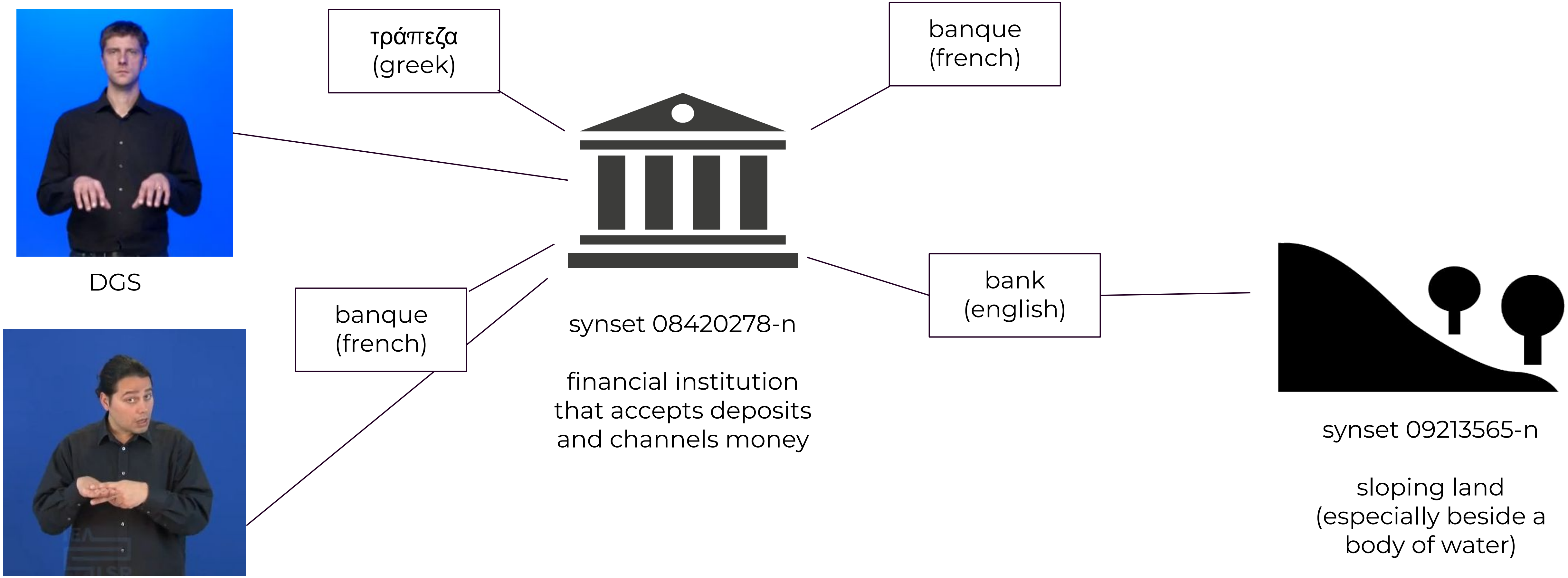
financial institution that accepts deposits and channels money

synset 09213565-n

sloping land (especially beside a body of water)

Based on existing Wordnets:
Princeton's Wordnet, Miller 1995, Fellbaum 1998
Open Multilingual Wordnet, Bond and Foster 2013

Multilingual Wordnet



DGS

GSL

τράπεζα
(greek)

banque
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sloping land
(especially beside a
body of water)

Traps

- Wordnet/OMW properties working against us
  - too fine-grained meanings: more manual work. freeze - go
  - correct meanings absent (grammatical words) me
  - low quality wordnet words in other languages (auto-translation)
    - “lumière”: having relatively few calories. WOLF Sagot and Darja 2008

- variability in annotators’ acceptability judgement
  - dialect variation
  - +- strict
  - not enough annotators to double annotate

Need to define and limit the tool’s purpose

Purpose and limits

The goal defines design choices

- Sense inventory and granularity
- Precision/recall
- Unusual meanings (domain-specific, named entities, dated, slang...)
- Semantic links: Wordnet VS ontology VS dictionary
- etc

Wordnet of SLs' purpose

Usage:

- Be used in machine translation in everyday settings
- Link lexicons by sense from several languages

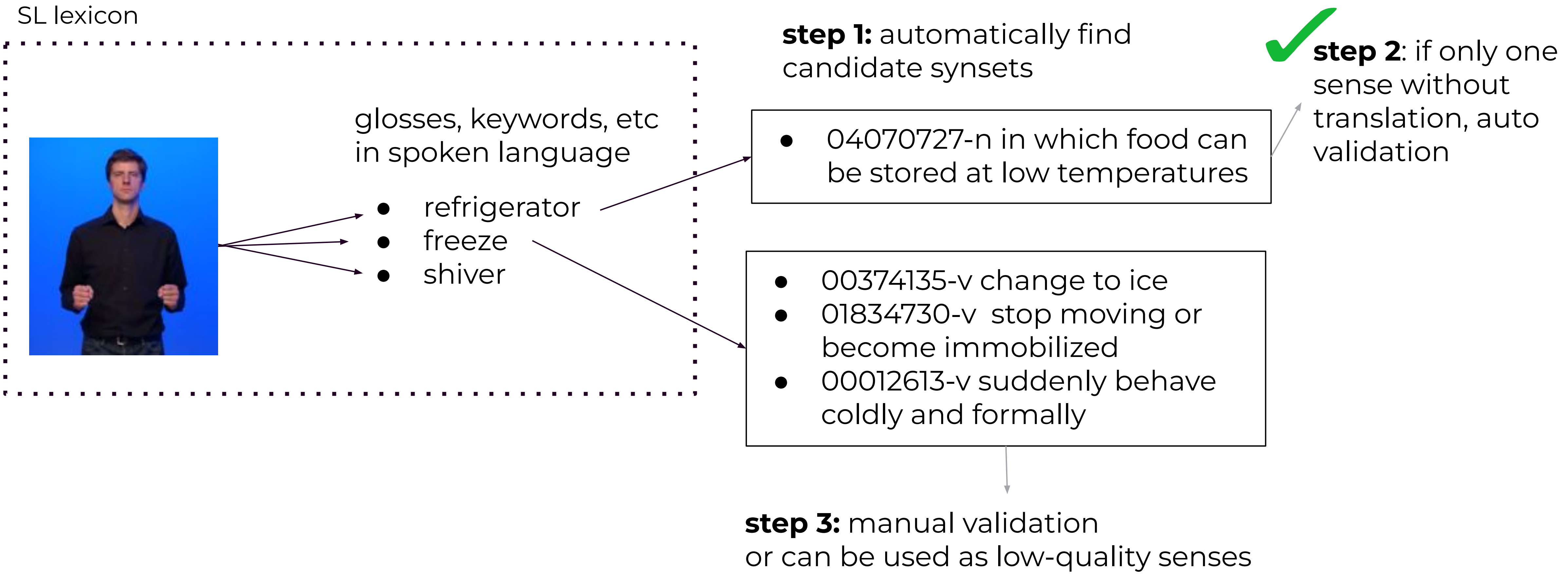
Functions:

- Sense indexation
- Disambiguation
- Simple word-by-word translation

Design choices

- Sense inventory and granularity
  - -> Only need enough precision to avoid mistranslation
- Precision/recall
  - -> Better to show a partially wrong translation than nothing, but should have a warning/confidence displayed
- Unusual meanings
  - -> Only some can be encountered in an everyday setting
- Importance of semantic links
  - -> Hypernyms can be used as alternative

Process: semi-automatic word matching



SL lexicon

glosses, keywords, etc in spoken language

- refrigerator
- freeze
- shiver

step 1: automatically find candidate synsets

- 04070727-n in which food can be stored at low temperatures

- 00374135-v change to ice
- 01834730-v stop moving or become immobilized
- 00012613-v suddenly behave coldly and formally

✓ **step 2**: if only one sense without translation, auto validation

step 3: manual validation
or can be used as low-quality senses

Manual validation

Not enough native signers. How to make the job easier and faster?

- Use non-native signers
  - corpus examples
  - good-enough signer to know what they don’t know
  - keep natives for what’s left
- Interface: Use it yourself. Be responsive
- Give examples
- Give only the best candidates, remove noise, but:
- Giving low-quality candidates is better than nothing: easier to decide if a sense is correct or not than imagining them.
- Sort senses: used in other SLs ; frequency

Manual validation

Excluded unlikely senses:

- named entities except if only one sense
- domain-specific Ex: “reflection”
  - “The phenomenon of a propagating wave (light or sound) being thrown back from a surface” domain: optics, physics
  - “The image of something as reflected by a mirror (or other reflective material)” normal sense

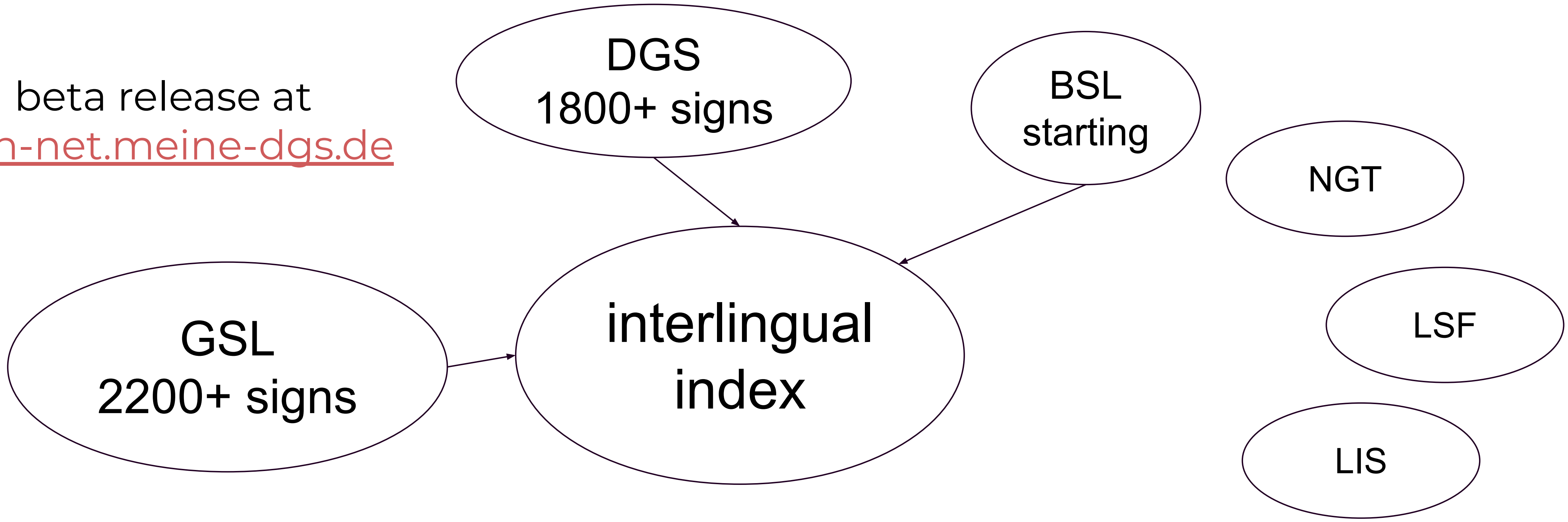
New synsets

created synsets for common signs:

- question words
- pronouns
- basic pointing

Current state

beta release at
sign-net.meine-dgs.de



Perspectives

- Use corpus for word embeddings
- Cluster similar meanings
- Recognise identical forms, to index per form

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THANKS

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