Lexical Resources for South Asian Languages

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- POS Taggers
- Treebanks (e.g., the Hindi Treebank)
- First Lexical Resources (e.g., Hindi WordNet; Bhattacharyya 2010)

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3. Why we can't just copy existing solutions/architectures
4. Report on current work done in Konstanz as part of UrduGram

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  - **PropBank** — provides argument role labels for verbal propositions in terms of frame sets (project initiated by Martha Palmer)

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- Most of the work to date has been on English — crosslinguistic comparison should yield a better understanding on what to represent and how.
- Some crosslinguistic work already underway, more is needed.
- In particular, very little work has been done on understanding and representing the lexical semantics of South Asian languages.

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  (Unified Lexicon; Crouch and King 2005)
- System was scaled up and used by Bing for some time

Deep Processing with Lexical Information

Demo Summary:

- Detailed information about verbs (e.g., factive vs. non-factive verbs).
- Information about what arguments a noun derived from a verb can have.
- Information about active/passive relations.
- Information about synonyms, hypernyms, etc. (coming from WordNet)

We need the same (and more) for South Asian languages.

Concrete Example: The Urdu ParGram grammar being built at the University of Konstanz.

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  - Fuji Xerox: Information Extraction from Medical Records/Texts

ParGram Languages so far

- Chinese (PARC)
- German (IMS, Stuttgart)
- English (PARC, Powerset)
- French (Xerox Grenoble, PARC)
- Georgian (Bergen)
- Hungarian (Debrecen)
- Indonesian (ANU, Canberra)
- Japanese (Fuji Xerox)
- Malagasy (Oxford)
- Norwegian (Bergen)
- Spanish (Powerset)
- Tigrinya (Bergen)
- Turkish (Istanbul)
- Urdu (Konstanz)
- Welsh (Essex)

Parallel Representations

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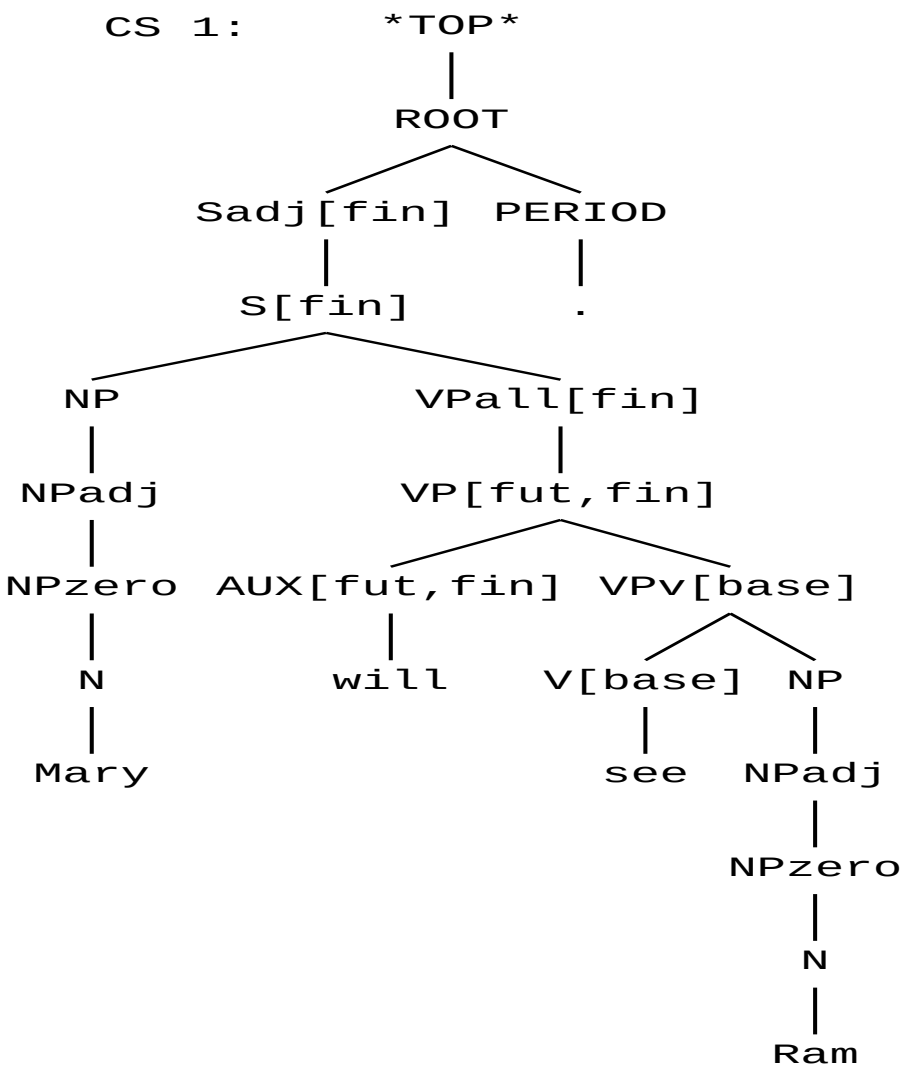
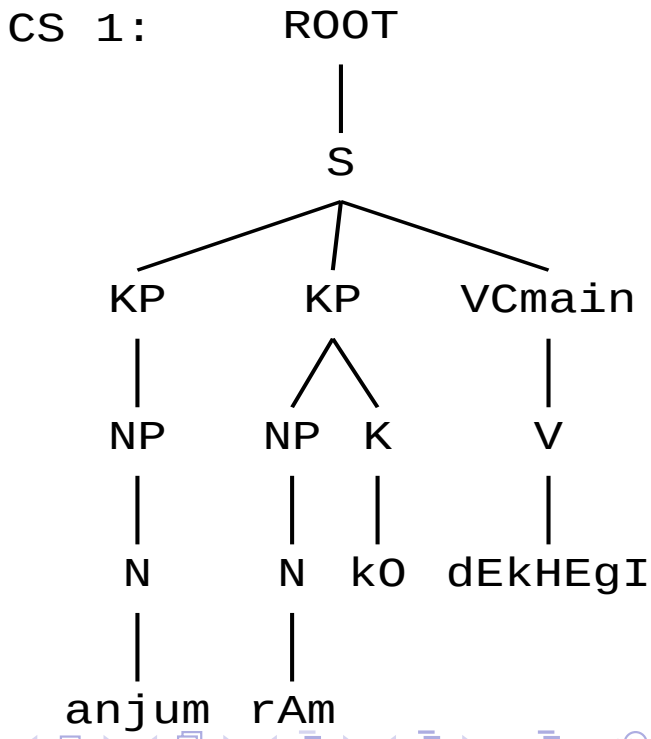
The ParGram philosophy is that analyses and representations should be as **parallel** as possible across languages:

- c(onstituent)-structure is allowed to differ (surface realization)
- f(unctional)-structure should be as similar as possible (deep structure)
- Advantages: easier Machine Translation and retrieval of semantically relevant information

Parallel Representations — Example

Non-Parallel C-structure: English vs. Urdu future tense (Butt et al. 2004)





Parallel Representations — Example

Mostly Parallel F-structure: English vs. Urdu future tense

"Mary will see Ram."

```
[PRED     'see<[1:Mary], [146:Ram]>'
 SUBJ     [PRED   'Mary'
           CHECK  [_LEX-SOURCE morphology, _PROPER known-name]
           NTYPE  [NSEM [PROPER [NAME-TYPE first_name, PROPER-TYPE name]]
                   NSYN proper]
         1 [CASE nom, GEND-SEM female, HUMAN +, NUM sg, PERS 3]]
 OBJ      [PRED   'Ram'
           CHECK  [_LEX-SOURCE morphology, _PROPER known-name]
           NTYPE  [NSEM [PROPER [NAME-TYPE first_name, PROPER-TYPE name]]
                   NSYN proper]
       146 [CASE obl, GEND-SEM male, HUMAN +, NUM sg, PERS 3]]
 CHECK    [_SUBCAT-FRAME V-SUBJ-OBJ]
 TNS-ASP  [MOOD indicative, PERF -_, PROG -_, TENSE fut]
  57 [CLAUSE-TYPE decl, PASSIVE -, VTYPE main]]
```

"anjum rAm kO dEkHEgI"

```
[PRED     'dEkH<[1:anjum], [17:rAm]>'
 SUBJ     [PRED      'anjum'
           NTYPE     [NSEM [PROPER [PROPER-TYPE name]]
                      NSYN proper]
           SEM-PROP  [SPECIFIC +]
         1 [CASE nom, GEND fem, NUM sg, PERS 3]]
 OBJ      [PRED      'rAm'
           CHECK     [_NMORPH obl]
           NTYPE     [NSEM [PROPER [PROPER-TYPE name]]
                      NSYN proper]
           SEM-PROP  [SPECIFIC +]
        17 [CASE acc, GEND masc, NUM sg, PERS 3]]
 CHECK    [_VMORPH [_MTYPE infl]
           _RESTRICTED -, _VFORM fut]
 LEX-SEM  [AGENTIVE +]
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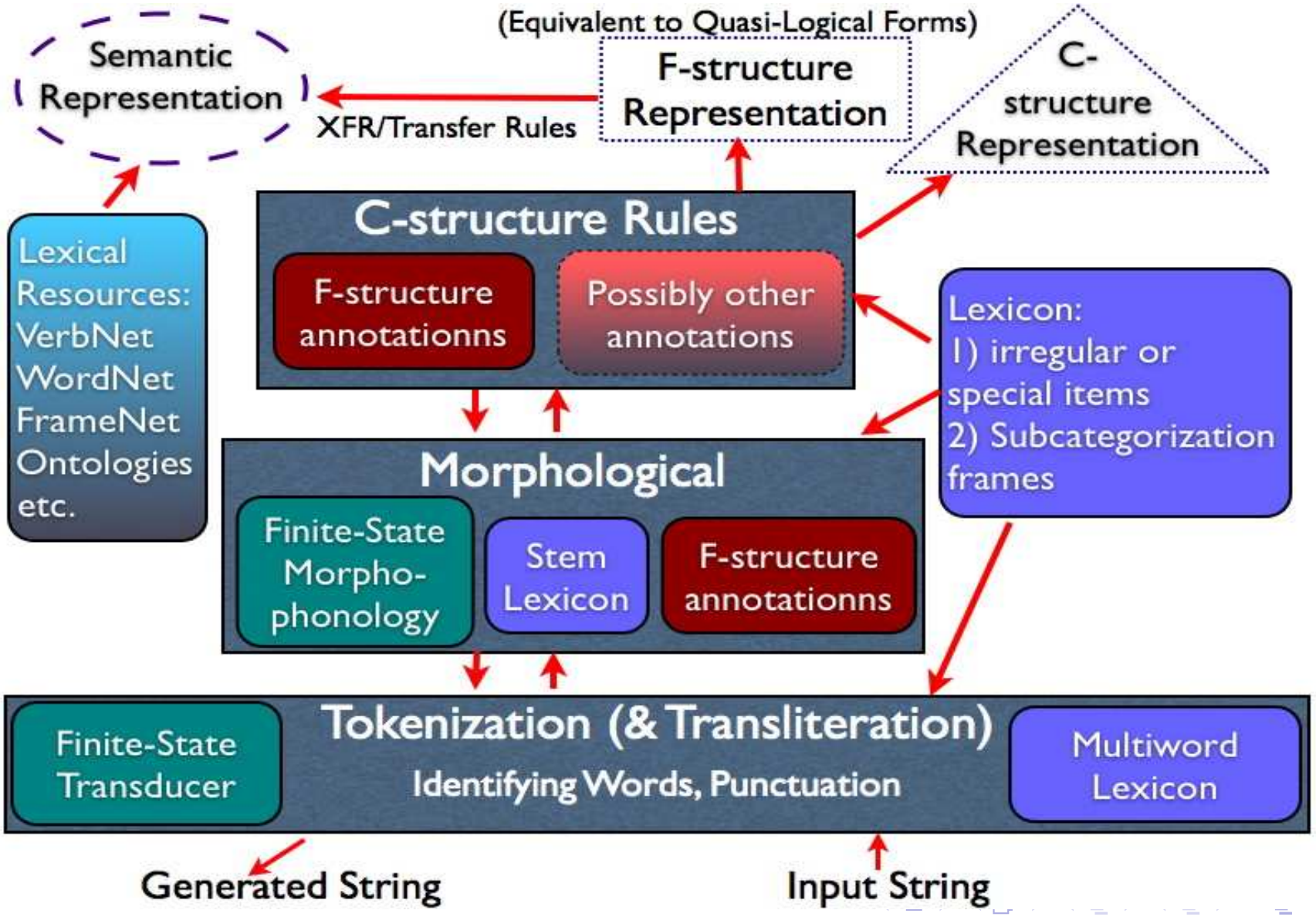
ParGram Architecture



ParGram Architecture and the Urdu Grammar

The goal for the Urdu ParGram grammar is to be large-scale and robust. We therefore work on all parts of the architecture (Butt and King 1997, Bögel et al. 2009, Bögel et al. 2007).

Also:

- Transliterator to allow for processing of both Urdu and Hindi script (Malik et al. 2010)

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- Semi-automatic acquisition and integration of lexical resources

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Work mainly done by: Tafseer Ahmed, Annette Hautli and Ghulam Raza.

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- Work on an Urdu VerbNet (Ahmed and Hautli)
- Classification of various types of complex predicates (Ahmed and Butt)
- Building of further resources in cooperation with Lahore (Sarmad Hussain) as part of a DAAD funded project.

Challenges: Variety of Complex Predicates

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  - No good ready-made solutions available.
  - Can maybe list the most frequently occurring ones as single items corresponding to a verb (e.g., Hindi WordNet)
  - But they are very productive and there are many different types of classes, not all of them easy to identify or analyze (cf. Workshop on Complex Predicates yesterday).

Different Alignment of Verb Classes

The verbal inventory of South Asian languages also does not line up straightforwardly with that of languages like English or German.

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- For example, there is no *have* — instead the verb for 'be' takes up a variety of roles.
- The verb classes established by Beth Levin for English do not necessarily reflect the verb classes of South Asian languages.

Semantically Motivated Case Alternations

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  - Ahmed (2011) — survey of 8 South Asian languages in terms of systematic employment of different types of (object) case to express semantic differences.
  - Butt and Ahmed (2011) — show that this feature was a systematic part of the language as far back as Sanskrit (but no work done on Dravidian).

Semantically Motivated Case Alternations

Example from Nepali:

(1) a.

hasan=le gaaṛi calãũ-c^{h}a
Hassan=Erg car.Nom drive-NonPast.3.Sg
'Hassan drives cars (that's what he does).'

b.

hasan gaaṛi calãũ-c^{h}a
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'Hassan is driving a car/cars.'

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- Semi-automatic acquisition of subcategorization information and automatic verb classification has therefore worked fairly well for these languages (e.g., Schulte im Walde 2006, Kuhn, Eckle and Rohrer 1998 for German).
- In contrast, in a language like Urdu/Hindi, neither position nor case provide straightforward clues about the subcategorization frame of a verb (or a noun or an adjective).

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  3. argument that is unmarked (theme)

Automatic Identification of Arguments and Adjuncts

Results:

- in the absence of reliable annotation, much of the data is not reliable and must be filtered out
- for example, complex predicates (of which there are many) have an effect on the number and type of arguments

(2) a.

ɑli=ne dosa kʰa-ya
Ali.M=Erg Dosa.M.Sg. eat-Perf.M.Sg
'Ali ate a dosa.' (simple verb, ergative subject)

b.

ɑli dosa kʰa pɑṛ-a
Ali.M Dosa.M.Sg. eat fall-Perf.M.Sg
'Ali fell to eating a dosa.' (complex predicate, unmarked subject)

Automatic Identification of Arguments and Adjuncts

Results:

- Raza's system SASU does fairly well for the portion of the data that is reliable.

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  3. Case marked arguments of nouns and adjectives
  4. non-contiguous dependencies within the NP

Multifunctionality of Case Markers

(3) a.

ɑli=ne nɪda=ko bʊla-ya
Ali.M=Erg Nida.F=Acc call-Perf.M.3Sg
'Ali called Nida.' (Accusative Argument)

b.

ɑli=ne nɪda=ko xɑt lik^{h}-a
Ali.M=Erg Nida.F=Dat letter.M.Sg.Nom write-Perf.M.3Sg
'Ali wrote a letter to Nida.' (Dative Argument)

c.

ɑli rat=ko a-ya
Ali.M. night.F=Temp come-Perf.M.3Sg
'Ali came at night.' (Temporal Adjunct)

d.

ɑli g^{h}ɑr=ko gɑ-ya
Ali.M home.M=Loc go-Perf.M.3Sg
'Ali went home.' (Locative Argument)

Multifunctionality of Case Markers

(4) a.

ɑli=ne cabi=se dɑrvaza kʰol-a
Ali.M=Erg key.F.Sg-Inst door.M.Sg open-Perf.M.3Sg
'Ali opened the door with a key.' (Instrumental Adjunct)

b.

ɑli=ne nɪda=se bat ki
Ali.M=Erg Nida.F=Com talk.M.Sg do-Perf.F.3Sg
'Ali talked to Nida.' (Comitative Argument)

c.

ɑli tezi=se dor-a
Ali.M fastness.F=Inst run-Perf.M.3Sg
'Ali ran quickly.' (Adverbial Phrase)

d.

ɑli gʰɑr=se a-ya
Ali.M home.M=Abl come-Perf.M.3Sg
'Ali came from home.' (Locative Adjunct)

e. further uses: "made of", "instrumental agent", comparison with

Multifunctionality of Case Markers

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Multifunctionality of Case Markers

- Ahmed (2011): this type of multifunctionality is not confined to Urdu/Hindi, but is typical of South Asian languages
- However, different languages break up the semantic space differently.

Functions of the Urdu/Hindi se
Instruments
Agents of passives
Expressions of (dis)ability ('Nadya cannot walk')
Non-affected and indirect causees
Comitative/Sociative (e.g., 'speak with')
Lexically required with certain verbs ('love', 'see')
Temporal and spatial expressions with the meaning of source (ablative)
Made of Material ('made of steel')
Comparison
Manner

Multifunctionality of Case Markers

Punjabi

- *nal* 'with'
  Instruments
  Comitative/Sociative (e.g., 'speak with')
  Manner
  Made of Material ('made of steel')

- *tõ* 'from'
  Agents of passives
  Expressions of (dis)ability
  Non-affected and indirect causees
  Temporal and spatial expressions with source meaning (ablative)
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- Definitely need to encode which verbs require/allow for which kind of argument in a lexical resource.
- Then need to take a further step and identify verb classes that behave similarly.

Multifunctionality of Case Markers

Furthermore: get structural ambiguity in addition to lexical ambiguity (Raza 2011).

(5) a.

nɪda=ne [[zʊkam=se *bɑcao*]=ki dɑvai] xɑrid-i
Nida=Erg [[flu=Abl protection]=Gen.F medicine.F] buy-Perf.F
'Nida purchased medicine for protection from flu.'

b.

nɪda=ne bazar=se [zʊkam=ki dɑvai] *xɑrid-i*
Nida=Erg bazar=Abl [flu=Gen.M medicine.F.Sg] buy-Perf.F
'Nida purchased medicine for flu from the market.'

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- Which nouns and adjectives take what kinds arguments depends on whether they are originally drawn from Arabic, Persian, or are native.
- The arguments of nouns and adjectives distribute within the NP in terms of non-local dependencies.

Examples of Argument-taking adjectives in Urdu

Nr.	Type of Argument	Example of Adjective Phrase
(i)	Dative Marked	sɑdɑr=ko hasıl president=Dat possessed 'possessed by the president'
(ii)	Ablative Marked	ɑdlıyɑh=se xaıf courts=Abl afraid 'afraid of courts'
(iii)	Locative Marked	bʊxar=mẽ mʊbtɑla fever=Loc.in suffered 'suffered with fever'
(iv)	Adpositional	sıhɑt=ke lıye mʊzır health=Gen for harmful 'harmful for health'

Examples of Argument-taking nouns in Urdu

Nr.	Type of Argument	Example of Noun Phrase
(i)	Ablative	mʊqaddɑmat=se ɪstɪsna court-case.M.Pl=Abl immunity.M 'immunity from court-cases'
(ii)	Locative	sɑlamti=pɑr bɑrifig̃ security.F=Loc briefing.F 'Briefing on security'

Interaction between Arguments and Modifiers of Nouns

In NPs

- the noun head is to the very right (unless you have ezafe)
- simple adjective modifiers come just before the head
- arguments of the noun are separated from their noun head

(6) a.

mʊqaddɑmat=se ɪstɪsna
court-case.M.Pl=Abl immunity.M
'Immunity from court-cases'

b.

mʊqaddɑmat=se aini ɪstɪsna
court-case.M.Pl=Abl constitutional immunity.M
'Constitutional immunity from court-cases'

More Complex Interaction

- All heads are stacked to the right, all modifiers to the left.
- The most natural version (and one most found in the corpus) is (7a).
- This makes it extremely difficult to determine which argument belongs to which head, especially when you have several arguments marked by the same form (e.g., genitives, *se* or *pɑr*).

(7) a. sɑdɑr=ko$_1$ mʊqɑddɑmat=se$_2$ hɑsɪl$_1$
president=Dat court-cases=Abl possessed
ɑini ɪstɪsnɑ$_2$
constitutional immunity.M
'Constitutional immunity from court-cases possessed by the president'

b. mʊqɑddɑmat=se$_2$ sɑdɑr=ko$_1$ hɑsɪl$_1$ ɑini ɪstɪsnɑ$_2$

c. *hɑsɪl$_1$ mʊqɑddɑmat=se$_2$ sɑdɑr=ko$_1$ ɑini ɪstɪsnɑ$_2$

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  - knowledge about the make-up the NP
  - some initial list of seed words
  - an annotated corpus like the Hindi/Urdu treebank (Palmer et al. 2007, Bhatt et al. 2009)

Complex Predicates

- A further complication is introduced by N-V and Adj-V complex predicates.
- These also require arguments, but in a different manner than what we saw NP internally (syntax and semantics differs considerably).

(8) a.

ɑli=ne kɑhani [yad k-i]
Ali.M=Erg story.F.Sg memory.M.Sg do-Perf.F.Sg
'Ali remembered Nida.'

b.

ɑli=ne kɑmre=ko [saf ki-ya]
Ali.M=Erg room.M.Obl=Acc clean do-Perf.M.Sg
'Ali cleaned the room.'

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- Ahmed and Butt (2011): corpus study showing that semantic factors such as eventivity vs. stativity of a noun and agentivity vs. experience of an action play a role in the combinatory possibilities.
- **Conclusion:** Need very detailed information about the lexical semantics of verbs, adjectives and nouns.

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  - How can one tell complex predicates from a simple verb with modifiers like *barbecue* = 'cook on an open fire in the outdoors'.
  - More precisely: how can one tell whether one has a verbal equivalent to an English verb in Urdu and when not?

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- There seems to be a class of *ingestive* verbs which pattern alike (e.g., 'drink, eat, read, learn').
- Some work on Unaccusatives vs. Unergatives (Bhatt, Ahmed 2010, Richa 2009)

Verb Classes

Based on Levin's methods, Ahmed (2011) identifies several different verb classes across South Asian languages

Class	Subject Marking	2nd Arg. Marking	Examples
I	NOM/ERG, DAT	ABL	fear
II	NOM/ERG	ABL	resign
III	NOM/ERG	LOC-on/ DAT	attack, bless
IV	NOM/ERG, DAT	LOC-on/ DAT	trust, doubt
V	NOM/ERG	COM/DAT	meet, marry
VI	NOM/ERG, DAT	COM	love, hate

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  - Investigation of case distribution and function
  - Identification of verb classes based on Levin's methods
- This should be coupled with concerted computational efforts
  - Corpus studies to detect patterns hitherto unnoticed phenomena and patterns of distribution
  - Implementation and gradual improvement of automatic subcategorization acquisition algorithms.
  - Experiment with existing semantic clustering methods — not sure if these would work well ...

Summary and Conclusion

- It seems that much of the needed resources will have to be compiled manually and very slowly, as they were originally done for English.
- But perhaps the process can be speeded/assisted if we do get better and better POS-taggers as well as more and more annotated corpora.

In either case: great and interesting challenges still lied ahead!

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