An Open Source Urdu Resource Grammar

Shafqat M Virk
Department of Applied IT
University of Gothenburg
virk@chalmers.se

Muhammad Humayoun
Laboratory of Mathmatics
University of Savoie
mhuma@univ-savoie.fr

Aarne Ranta
Department of CS & Eng
University of Gothenburg
aarne@chalmers.se

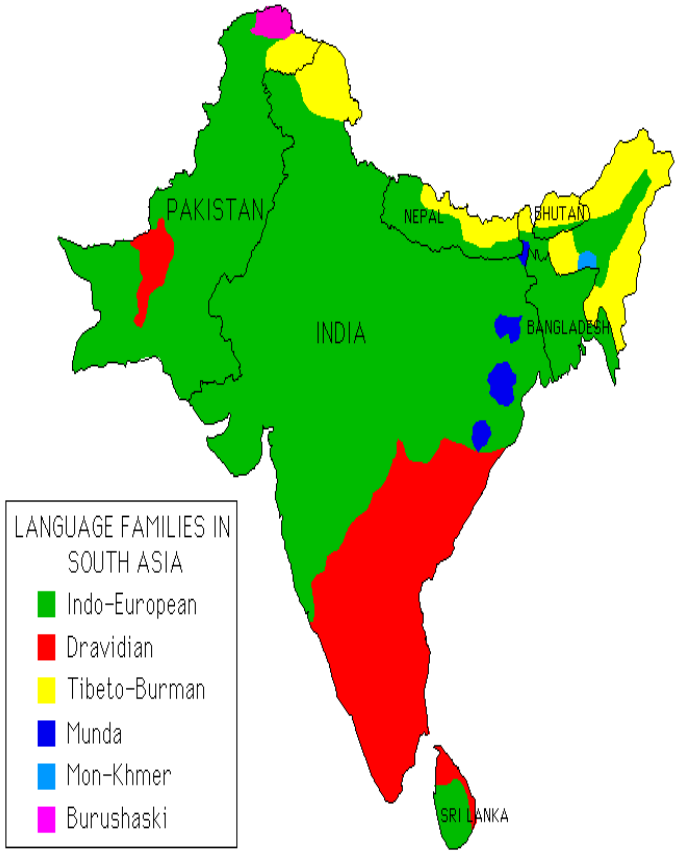
Plan

- Introduction
  - Urdu Language
  - Grammatical Framework (GF)
- Urdu Resource Grammar
  - Morphology
  - Syntax
- Attempto (An Application Grammar)
- Future Work
- Questions

Urdu Language

- Indo-European → Indo-Iranian → Indo-Aryan family
- Widely spoken in south Asia
- Closely related to Hindi
  - Phonology, morphology, syntax and day-to-day vocabulary.
  - Differs considerably in their script and scholarly writings
  - Urdu is written in a Perso-Arabic script from right to left; whereas Hindi is written in Devanagari script from left to right.
- Urdu-Hindi together
  - One of the most widely spoken language in the world with 1,017,290,000 speakers

    (Native + second language, after Chinese Rahman, 2004)



Brahui language is spoken in Pakistan, and is Dravidian
Picture from google

Grammatical Framework (GF)

- A tool for working with grammars
- Programming language for writing grammars
- A number of multilingual text generation applications (Phrasebook,Attempto,WebAlt etc) have been developed using GF and/or GF resource library

(Grammatical Framework, Ranta 2004)
http://www.grammaticalframework.org/

Levels of GF Grammars

- GF Grammars have two levels
  - Abstract Syntax
  - Concrete Syntax

Abstract Syntax

- Defines a set of Categories* and Tree building functions
- Independent of language
- Common to all languages

*Term Category is used to model different parts of speech

Abstract Syntax

- Categories
  - cat CN
  - cat NP
  - cat A
  - cat AP
  - cat V2
- Functions
  - fun PositA : A -> AP ; -- black
  - fun AdjCN : AP - > CN - > CN ; -- black cat
  - fun Compl : V2 -> NP -> VP ; -- eats bread

Concrete Syntax

- Contains linearization rules for categories and trees
- Language dependent
- Each language has its own concrete syntax

Concrete Syntax [Urdu]

- Categories
  - lincat CN = {s : Number => Case => Str ; g : Gender} ;
  - lincat AP= { s: Number => Gender => Case => Degree => Str };
- Functions
  - PositA a = a ;
  - lin AdjCN ap cn = {

s = \\n,c => ap.s ! n ! cn.g ! c ! Posit ++ cn.s ! n ! c ;

g = cn.g

} ;

  - Compl v2 np = np ++ v2 ; (bread eat, rʊʈi: kʰata, روٹی کھاتا)

Concrete Syntax [Urdu]

- Categories
  - lincat CN = {s : Number => Case => Str ; g : Gender} ;
  - lincat AP= { s: Number => Gender => Case => Degree => Str };
- Functions
  - PositA a = a ;
  - lin AdjCN ap cn = {

s = \\n,c => ap.s ! n ! cn.g ! c ! Posit ++ cn.s ! n ! c ;

g = cn.g

} ;

  - Compl v2 np = np ++ v2 ; (bread eat, rʊʈi: kʰata, روٹی کھاتا)

Concrete Syntax [English]

- Categories
  - lincat CN = {s : Number => Case => Str ; g : Gender} ;
  - lincat AP = {s : Agr => Str ; isPre : Bool} ;
- Functions
  - PositA a = { s = _ => a.s ! AAdj Posit Nom ; isPre = True} ;
  - AdjCN ap cn = {

    s = \\n,c => preOrPost ap.isPre (ap.s ! agrgP3 n cn.g) (cn.s ! n ! c) ;

    g = cn.g

    } ;

  - Compl v2 np = v2 ++ np ; eat bread

Types of Grammars

- Resource Grammars
- Applications Grammars

Resource Grammars

- General purpose grammars that cover general aspects of a language linguistically
- Resource grammars encodes syntactic features of language

Application Grammars

- Typically limited to specific domains
- Encode semantic structures
- Can use resource grammars as libraries

Urdu Resource Grammar

- A resource grammar consists of
  - Lexicon
  - Grammar
- GF library currently has resource grammars for 15 languages
- Urdu is 16th in total and first South Asian language
- Almost 2700 lines of code and development time is almost seven months

Lexicon

- Test Lexicon of 350 Words
- Almost 100 Structural Words (Closed Word Categorey)
- The rules of defining Urdu morphology are borrowed from (Humayoun et el 2006)
  - An Urdu morphology was developed in Haskell using Functional morphology toolkit
  - Now we have developed in GF

Morphology + Syntax

- Nouns and Noun Phrases
- Verbs and Verb Phrases
- Adjectives and Adjectival Phrases
- Clauses
- Sentences

Urdu Nouns

- Urdu Nouns inflect in
  - Number (Singular, Plural)
  - Case (Direct, Oblique, Vocative)
- Inherent Gender

```
Noun = {s : Number => Case => Str ; g : Gender}
```

Urdu Nouns

- Urdu Nouns inflect in
  - Number (Singular, Plural)
  - Case (Direct, Oblique, Vocative)
- Inherent Gender

	Direct	Oblique	Vocative
Singular	lRka لڑکا	lRkE لڑکے	lRkE لڑکے
Plural	lRkE لڑکے	lRkwN لڑکوں	lRkw لڑکو

Different Forms of Noun 'Boy'

Noun = {s : Number => Case => Str ; g : Gender}

We* have divided Nouns into 15 different groups, based on how they end, and there is one group for worst case.

* Humayoun et el 2006

Noun Phrases

(M) H (M)

NP : Type = {s : NPCase => Str ; a : Agr} ;

- *NPCase = NPC Case | NPErg | NPAbl | NPIns | NPLoc1 | NPLoc2;*
  - NPErg: Ergative case with case marker ‘ne: نے’
  - NPAbl: Ablative with case marker ‘se: سے’
  - NPIns: Instrumental case with case marker ‘se: سے’
  - NPLoc1: Locative case with case marker ‘mi: ɳ میں’
  - NPLoc2: Locative case with case marker ‘pr پر’

NPErg:
lRkE ne: ktab Xrydy
The boy bought book.

NPAbl:
lRkE se: ktab lkh-y gyy
The book was written by boy.

NPIns:
lRkE nE pnsl se: lkh-a
The boy wrote with pencil.

NPLoc1:
lRka kmrE mi: ɳ hE
The boy is in the room.

NPLoc2:
Ktab myZ pr hE
The book is on the table.

Verbs

- Urdu Verb inflects in
  - Gender (Masculine, Feminine)
  - Number (Singular, Plural)
  - Person (First, Second {casual,familiar,respectfull} ,Third {near,distant})
  - Tense (Subjunctive, Perfective, Imperfective)

```
Verb = {s : VerbForm => Str}
VerbForm = VF VTense UPerson Number Gender
         | Inf
         | Root
```

Verbs

VF Subj Pers1 Sg Masc => kh-aw^N	کھاوں
VF Subj Pers1 Sg Fem => kh-aw^N	کھاوں
VF Subj Pers1 Pl Masc => kh-ay^N	کھاییں
VF Subj Pers1 Pl Fem => kh-ay^N	کھاییں
VF Subj Pers2_Casual Sg Masc => kh-a	کھا
VF Subj Pers2_Casual Sg Fem => kh-a	کھا
VF Subj Pers2_Casual Pl Masc => kh-aw^	کھاو
VF Subj Pers2_Casual Pl Fem => kh-aw^	کھاو
……	
……	
VF Imperf Pers1 Sg Masc => kh-ata	کھاتا
VF Imperf Pers1 Sg Fem => kh-aty	کھاتی
VF Imperf Pers1 Pl Masc => kh-atE	کھاتے
VF Imperf Pers1 Pl Masc => kh-atyN	کھاتیں
……	
……	
Inf => kh-ana	کھانا
Root => kh-a	کھا

Verb Phrases

```
VPH : Type = {
    s     :  VPHForm => {fin, inf : Str} ;
    obj   : {s : Str ; a : Agr} ;
    vType : VType ;
    comp : Agr => Str;
    embComp: Str;
    ad   : Str;
   } ;
```

```
VPHForm  =
    VPTense VPPTense Agr
  | VPReq HLevel
  | VPStem
```

```
PTense  =
        VPPres
      | VPPast
      | VPFutr
```

```
HLevel  =
        Tu
      | Tum
      | Ap
      | Neutr
```

```
VType = VIntrans | VTrans |
VTransPost
```

Verb Phrases

```
VPH : Type = {
  s :  VPHForm => {fin, inf : Str} ;
  obj  : {s : Str ; a : Agr} ;
  vType : VType ;
  comp : Agr => Str;
  embComp : Str;
  ad  : Str;
 } ;
```

- s: {fin : Copula
  inf : actual form of verb}
- obj: object of the verb
- vType : Type of verb, will be used in Ergativity
- comp: Complement of verb
- embComp: Used in case of embeded sentences
- ad: adverb

Verb Phrases

He says that she runs.

وہ کہتا ہے کہ وہ دوڑتی ہے

She wants to run

وہ دوڑنا چاہتی ہے

Noun ++ VP.obj ++ VP.adverb ++ VP.complement ++ VP.verb++ VP.copula

He says that she runs.

وہ کہ وہ دوڑتی ہے کہتا ہے

She wants to run.

وہ دوڑنا چاہتی ہے

Noun ++ VP.obj ++ VP.adverb ++ VP.complement ++ VP.verb ++ VP.copula ++ VP.embComp

وہ کہتا ہے کہ وہ دوڑتی ہے

وہ دوڑنا چاہتی ہے

Adjectives

- Urdu Adjectives inflect in
  - Number (Singular,Plural)
  - Gender (Masculine,Feminine)
  - Case (Direct,Oblique,Vocative)
  - Degree (Posit,Compar ,Superl)

```
Adjective = { s: Number => Gender => Case => Degree =>
   Str };
```

Adjectival Phrases

AP = { s: Number => Gender => Case => Degree => Str };

Sg Mas Dir Posit => kala	کالا
Sg Mas Dir Compar => bht kala	بہت کالا
Sg Mas Dir Superl => sb sE kala	سب سے کالا
.....	
.....	
Sg Fem Dir Posit => kaly	کالی
Sg Fem Dir Compar => bht kaly	بہت کالی
Sg Fem Dir Superl => sb sE kaly	سب سے کالی

Clauses

Clause : Type = {s : VPHTense => Polarity => Order => Str} ;

- VPHTense =
  VPGenPres
  | VPPastSimple
  | VPFut
  | VPContPres
  | VPContPast
  | VPContFut
  | VPPerfPres
  | VPPerfPast
  | VPPerfFut
  | VPPerfPresCont
  | VPPerfPastCont
  | VPPerfFutCont
  | VPSubj

- *Polarity = Pos | Neg ;*
- *Order = ODir | OQuest ;*

Sentenses

- S = {s : Str}
- UseCl : Temp -> Pol -> Cl -> S

```
UseCl  temp p cl =
 { s = case <temp.t,temp.a> of {
    <Pres,Simul> => temp.s ++ p.s ++ cl.s ! VPGenPres ! p.p ! ODir;
    <Pres,Anter> => temp.s ++ p.s ++ cl.s ! VPPerfPres ! p.p ! ODir;
    <Past,Simul> => temp.s ++ p.s ++ cl.s ! VPImpPast ! p.p ! ODir;
    <Past,Anter> => temp.s ++ p.s ++ cl.s ! VPPerfPast ! p.p ! ODir;
    <Fut,Simul>  => temp.s ++ p.s ++ cl.s ! VPFut ! p.p ! ODir;
    <Fut,Anter>  => temp.s ++ p.s ++ cl.s ! VPPerfFut ! p.p ! ODir;
    <Cond,Simul> => temp.s ++ p.s ++ cl.s ! VPSubj ! p.p ! ODir;
    <Cond,Anter> => temp.s ++ p.s ++ cl.s ! VPSubj ! p.p ! Odir
  }
}
```

Ergativity

- Final verb agreement is with direct subjective except in the transitive perfective tense
- In transitive perfective tense verb agreement is with direct object

Girl ate apple VS Girl ate bread.

لڑکی نے روٹی کھای لڑکی نے سیب کھایا

lɽki: ne: rʊʈi: kʰai: VS lɽki: ne: si:b kʰai:a

{Fem: روٹی ,Fem: کھای }

{Masc: سیب ,Masc: کھایا }

Ergativity

```
mkClause : NP -> VPH -> Clause = \np,vp -> {
    s = \\vt,b,ord =>
     let
      subjagr : NPCase * Agr = case vt of {
       VPPast => case vp.subj of {
            (Vtrans| VTransPost)     => <NPErg, vp.obj.a> ;
             _                       => <NPC Dir, np.a>
            } ;
       _ => <NPC Dir, np.a>
       } ;
     ……
     ……
```

Attempto

- A grammar for Controlled Language
- Implemented for English then was ported to Finnish, French, German, Italien, Swedish
- Ported to Urdu

Attempto Home Page : http://attempto.ifi.uzh.ch/site/

Future Work

- Bigger Lexicon (A lexicon of 6600 words has been completed recently)
- Language Specific Module (under construction)
- Hindi Resource Grammar (almost completed)
- Application Grammars (SMS translator)

Questions/Suggestions