



# Georgian verb database: applying conjugation rules with exceptions

## Present and Imperfect Tenses

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## Abstract

Application Georgian verbs is dedicated on Sewelis to English and French speaking persons who want to learn the Georgian language. (Sewelis stands for Semantic Web logical Information Systems).

Verb conjugation is quite hard, in particular for people not used to have markers concatenated before words. Preverbs are also difficult to work out, especially as they are only used at certain tenses. As a result, learners have great difficulties to find verbs in a regular dictionary.

Users have possibility to see that verb has Tense, Preverb, English infinitive, Postradical, Georgian form, French Infinitive, Georgian Infinitive, Root, Preradical, ending.

In our Sewelis base, forms of conjugated verbs are entered with a number of attached information (tense, person, number ...). When facing a word that they cannot find in a regular dictionary, learners can search in this base. Sewelis allows that only some of the forms of verbs are entered and that only some of the information is given. It also allows people to add information in a very flexible way: any place can be extended. For example a new field can be added to the description at any moment.

Users can add information and easily switch from navigation in the base to extension of the base and back to navigation. Also suggestion mechanism guaranties some data consistency.

**Keywords:** Data mining, morphology.

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# 1. Introduction

## 1.1 Project context

The National Institute of Applied Sciences of Rennes or INSA is a Grande Ecole of Engineers, a School of Engineering, under the authority of the French Ministry of Education and Research and part of the INSA's group.

Created in 1966, INSA Rennes is a member of the INSA Group, the leading French network of state graduate and post graduate engineering schools, composed of 6 schools in France, 7 partner schools and 1 international INSA in Morocco.

Research and innovation are the key elements of INSA training, which benefits from the expertise of its 130 professors and lecturers. With six laboratories of international renown, three technological platforms and numerous industrial partners, INSA Rennes stands out for two poles of excellence: Information & Communication Science & Technologies / Materials, Structures & Mechanics.

IRISA - (Institute for Research in Computer Science and Random Systems), founded in 1975, is a joint research center for Informatics, including Robotics and Image and Signal Processing. On these themes, Irisa is positioned as the premier research laboratory in Brittany with campuses in Rennes (35), Vannes (56), Lannion (22), and Brest (29).

750 people, 40 teams, 7 departments (Large Scale Systems/Networks, telecommunications and services/Language and Software Engineering/Digital signals and imaging, robotics/Media and communications/Data and knowledge management) explore the world of digital sciences to find applications in healthcare, ecology-environment, cyber-security, transportation, multimedia, and Industry.

LIS >>>

SemLIS - Semantics, Logics, Information Systems for Data-User Interaction.

The main objective of the SemLIS team is to bring the power to their data.

It aims at facilitating data-user interaction by making users more autonomous and agile, by providing flexibility and expressivity, and yet control and confidence in the information system. It should support users in the semantic representation of heterogeneous data, and in the collaborative acquisition of domain knowledge.

Sewelis - a LIS for the Semantic web, which stands for Semantic Web Logical Information System. Sewelis is an open source software under GPL license. Faceted search and querying are the two main paradigms to search the Semantic Web. Querying languages, such as SPARQL, offer expressive means for searching knowledge bases, but they are difficult to use. Query assistants help users to write well-formed queries, but they do not prevent empty results. Faceted search supports exploratory search, i.e., guided navigation that returns rich feedbacks to users, and prevents them to fall in dead-ends (empty results). However, faceted search systems do not offer the same expressiveness as query languages. We introduce query-based semantic faceted search, the combination of an expressive query language and faceted search to reconcile the two paradigms. A prototype, Sewelis has been implemented, and a usability evaluation demonstrated that semantic faceted search retains the ease-of-use of faceted search, and enables users to build complex queries with little training.

Georgian verb database is a Collaborative project of INSA-IRISA-SemLIS Team:

Georgian verb database: <http://www.irisa.fr/LIS/ferre/sewelis-servolis/>

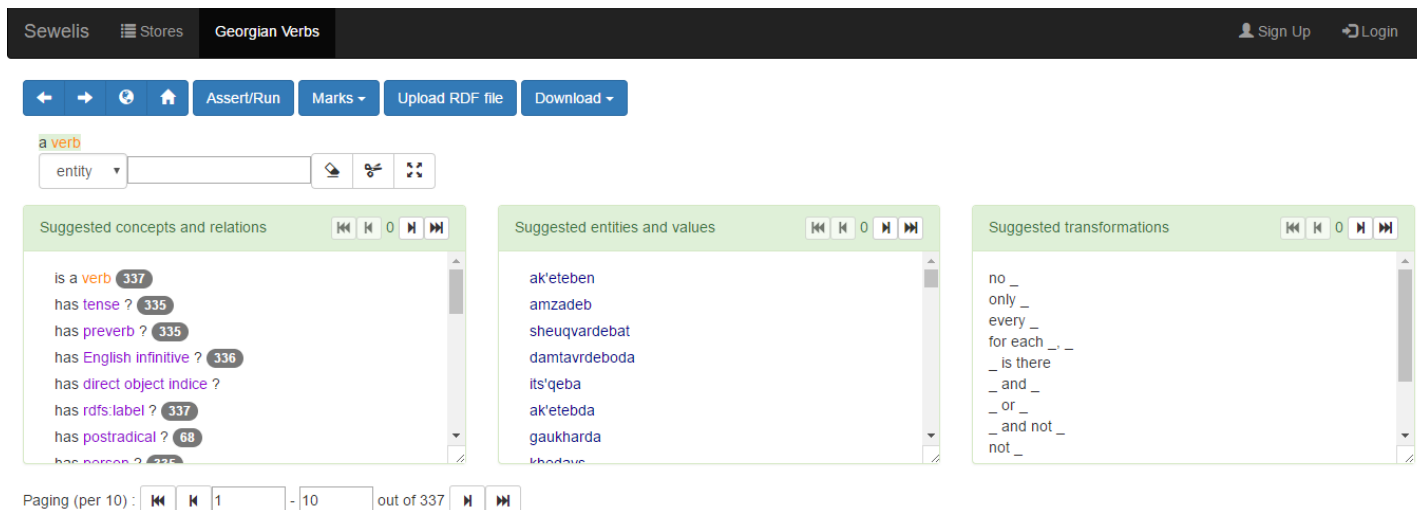


Figure 1-Georgian verb database interface

In this database are 337 Georgian conjugated forms of verbs and information about these verbs, such as: Person, Tense, Preverb, English infinitive, French infinitive, Georgian infinitive, Root, PFSF(present/future stem formant), prefix, suffix,ending.

For example: we can choose verb “amzadeb” and see relevant Tense, English infinitive, French infinitive, person and etc.

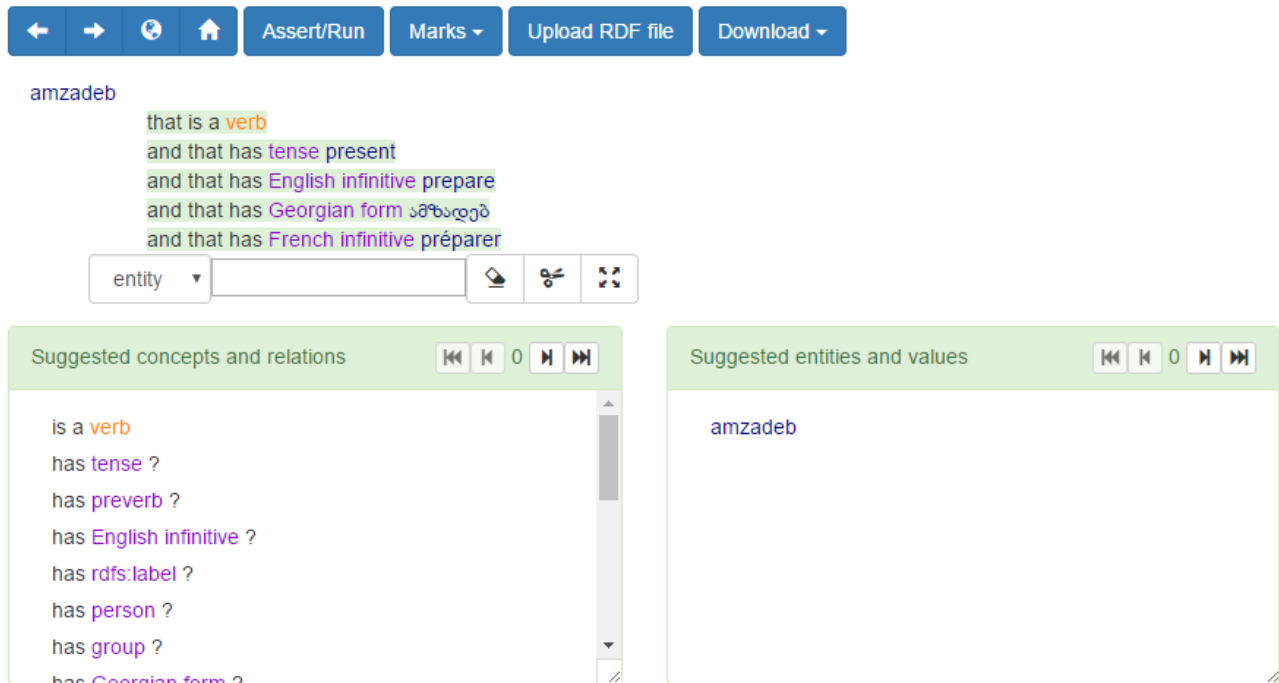


Figure 2- information about verb

Application Georgian verbs is for English and French speaking persons who want to learn the Georgian language. Learning the Georgian Verbs is very difficult. The more you master it the more you get closer to mastering the Georgian language. But first we need to know what the role of Verbs is in the structure of the grammar in Georgian. Georgian verbs are words that convey action (bring, read, walk, run), or a state of being (exist, stand). In most languages a verb may agree with the person, gender, and/or number of some of its arguments, such as its subject, or object. In general the Georgian verb is conjugated according to series. Moreover, the Georgian verb expresses the subject and object within the verb itself, which makes the Georgian verb distinguishable from other languages. This is why the Georgian grammar is complicated and that’s why each raw and series should be learnt. Verbs in the present past and future tense have a very important role in Georgian.



## 1.2 Project introduction

As for context of internship I am at INSA with Erasmus Plus program, where I'm working on my master thesis, which I mentioned is connected in Georgian verbs.

The project consists of producing conjugated forms of Georgian verbs. The objective is to fill the Sewelis pages. From a practical point of view, the aim is to develop a dedicated web interface on top of Formulis [2] that will help learners extend the database by mining and applying conjugation rules with exceptions. When new conjugated forms are entered, completion in terms of persons and tenses will be suggested, then the user could validate or modify them, then existing rules would be updated, and new rules could be mined.

The conjugation of verbs is divided into four groups and 14 subgroups (sg). Rules and examples are taken from the books of Nana Shavtvaladze, "Georgian Language for English Speakers", named "Biliki" [1]. There are no rules or examples for subgroups 12 and 13 in books II and III.

I Group	II Group	III Group	IV Group
N1 – stem -ობ (ob)	N7 მ(m) – stem -	N9 – stem- ები (ebi)	N14-
N2 – stem -ებ (eb)	გ(g) – stem -	N10 – stem- დები (debi)	
N3 – stem -ამ (am)	ო,ჰ,ბ(I,h,s) – stem –	N11 ი (i) – stem- ები (ebi)	
N4 – stem -ავ (av)	N8 მი(mi)- stem-	N12 ე(e) – stem- ები (ebi)	N15-
N5 – stem -ი (i)	გი(gi)- stem-	N13– stem- ია (ia)	
	უ(u)- stem-		

N6 – stem -0 (0)			
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Figure 3- conjugation of verb

G1 group includes the following subgroups from sg1 to sg6 and covers most regular verbs. G2 group includes the following subgroups sg7 and sg8, also most verbs are regular verbs, but we have exceptions, some verbs need own conjugation rules. G3 group includes the following subgroups from sg9 to sg13, but in this book [1] are not rules or examples for subgroups 12 and 13, and covers most regular verbs. As for G4 includes the following subgroup sg14, almost all verbs are irregulars and need own conjugation rules. Also in this group we added new subgroup 15, because all verbs (belonging to the 14 sg, according to the book [1]), that are in this subgroups requires a completely different set of rules to conjugation the verb.

According this book [1] the verb consist of the following parts: preverb, preradical, root, pfsf, postradical, ending, etc. For example: verb is in present tense, singular and third person: აუკმებს - aukmebs (abolish). In this case:

- a (ა)- preradical
- ukm (უკმ)- root
- eb (ებ)- PFSF
- s (ს)- ending.

This is a table about Georgian chars, how to write Georgian letters. I use this type of letters for Prolog.

<u>Georgian</u>	ა	ბ	გ	დ	ე	ვ	ზ	თ	ი
ascii	a	b	g	d	e	v	z	t	i
<u>Georgian</u>	კ	ლ	მ	ნ	ო	პ	ჯ	რ	ს
ascii	K	l	m	n	o	P	j	r	s
<u>Georgian</u>	ტ	უ	ფ	ქ	ღ	ყ	შ	ჩ	ც
ascii	T	u	p	k	<u>gh</u>	Q	sh	<u>tch</u>	<u>ts</u>
<u>Georgian</u>	ძ	წ	ჭ	ხ	ჯ	ჰ			
ascii	dz	TS	TCH	<u>kh</u>	dj	h			

Figure 4- Georgian Chars

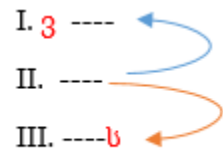
## 2. Present Tense.

Present Indicative is the simple present tense, it can be mostly the equivalent of present continuous in English, and it shows what the subject is doing now, at the moment. Its question is რას შვრება? (Ras shvreba?)-What is he/she/it doing? The answers on this simple question can be posed by simply conjugating the verb in its present tense.

Verbs	Singular	Example Singular	Plural	Example Plural
<b>Subject system</b> <b>I Group</b>	I. ვ ---- II. ---- III. ----ს	I. ვმუშობ II. მუშობ III. მუშობს	I. ვ ---- თ II. ---- თ III. ----ნ,ენ	I. ვმუშობთ II. მუშობთ III. მუშობენ
<b>Object system</b> <b>II Group(7)</b>	I. მ ---- II. გ ---- III. ჰ,ს,ი----	I. მყავს II. გყავს III. ჰყავს	I. გვ ---- II. გ----თ III. ჰსი----თ	I. გვყავს II. გყავთ III. ჰყავთ
<b>Object system</b> <b>II Group(8)</b>	I. მი ---- II. გი ---- III. უ ----	I. მინდა II. გინდა III. უნდა	I. გვი ---- II. გი----თ III. უ----თ	I. გვინდა II. გინდათ III. უნდათ
<b>Object system</b> <b>III Group(9)</b>	I. ვ ---- ები II. ---- ები III. ---- ება	I. ვთბები II. თბები III. თბება	I. ვ ---- ებით II. ---- ებით III. ---- ებიან	I. ვთბებით II. თბებით III. თბებიან
<b>Object system</b> <b>III Group(10)</b>	I. ვ ---- დები II. ---- დები III. ---- დება	I. ვბრაზდები II. ბრაზდები III. ბრაზდება	I. ვ ---- დებით II. ---- დებით III. ---- დებიან	I. ვბრაზდებით II. ბრაზდებით III. ბრაზდებიან
<b>Subject system</b> <b>III Group (11)</b>	I. ვი ---- ები II. ი ---- ები III. ი ---- ება	I. ვილლები II. ილლები III. ილლება	I. ვი ---- ებით II. ი ---- ებით III. ი ---- ებიან	I. ვილლებით II. ილლებით III. ილლებიან

Figure 5- Present tense [1]

In This Figure 4 is information about Present Tense and what is need to get conjugated verb. Input is Second singular person.



**To build first singular present** need to conjugate verb from second singular (2s) to first singular (1s) and add preradical "v". **To build Third singular present** need to conjugate verb from from 2s to 3s and add ending "s".

**To build First plural present** need to conjugate verb from from 1s to 1p and add ending "t".

**To build Second plural present** need to conjugate verb from Second Singular Present to Second singular present and add ending "t".

**To build Third plural present** need to conjugate verb from 3s to 3p and add ending "an" (sg5) or "en" (sg1, sg2, sg3, sg4, sg6).

## 2.1 Present Tense, Group1.

We discuss Present Tense, Group1 and its subgroups from Fig <5>.

**To build first singular present** need to conjugate verb from second singular (2s) to first singular (1s) and add preradical "v".

**And To build Third singular present** need to conjugate verb from from 2s to 3s and add ending "s".

From those rules we chose the following operational rules:

Input is second singular form and

- assume 2s is given
- from 2s to 1s : add preradical "v"
- from 2s to 3s : add ending "s"
- from 1s to 1p : add ending "t"
- from 2s to 2p : add ending "t"
- from 3s to 3p : add ending "an" (sg5) or "en" (sg1,sg2,sg3,sg4,sg6)

In Georgian the verb in the present tense has the only (suffix) ending -s in a singular for the third person and first person takes the preradical-v.

Example: მე ვმუშაობ (**v**mushaob) - I work

შენ მუშაობ (mushaob) - you work

ის მუშაობს (mushaob**s**) - he/she works

In Plural, the verb takes the (suffix) ending -**t** at the end of the present tense in first and second persons, plural and in the third person, plural takes the ending- **en** or **an**, it depends on subgroups, all subgroups (sg1, sg2, sg3, sg4, sg6) ending is **en**, except subgroup 5 which ending is **an**. Also first person takes the preradical-**v**.

Example: ჩვენ ვმუშაობთ (**v**mushaob**t**) - we work

ჩვენ ვტყუობთ (**v**TQuit**t**) - we cheat

თქვენ მუშაობთ (mushaob**t**) - you work

თქვენ ტყუობთ (TQuit**t**) - you cheat

ოხონი მუშაობენ (mushaob**en**) - they work

ოხონი ტყუიან (TQu**ian**) - they cheat

## 2.2 Present Tense, Group2

We discuss Present Tense, Group2 and its subgroups (sg 7 and sg 8).

Input is second singular form(2s) and we have following rules:

We have chosen the following operational rules for subgroup7.

- assume 2s is given
- from 2s to 1s : change preradical "g" to "m"
- from 2s to 3s : change preradical "g" to "h"
- from 1s to 1p : change preradical "gv"
- from 2s to 2p : change preradical "gQ" add ending t
- from 3s to 3p : change preradical "hQ" add ending t

To conjugate verb from Present tense singular from Second to First must change preradical "g" to "m". From Second to Third must change preradical "g" to "h".

Example: მე დყავს (mQavs) - I have (someone)

შენ გყავს (gQavs) - you have (someone)

ის ჰყავს (hQavs) - he/she has (someone)

In Georgian to conjugate verb in the present tense plural from first Singular to First Plural must change preradical "m" to "gv". From Second Singular to Second plural must change ending "t". And from Third Singular to Third Plural must change ending "t".

Example: ჩვენ გვყავს (gvQavs) - we have (something)  
 თქვენ გყავთ (gQavt) - you have (something)  
 მათ ჰყავთ (hQavt) - they have (something)

In this subgroup we have extra cases because some verbs have different structure and need to write new rules, for example verb “gakvs” which Georgian Infinitive is “kona” from Second Singular to Third Singular don’t need to change preradical.

Example1: მე მაქვს (makvs) - I have  
 შენ გაქვს (gakvs) - you have  
 მას აქვს (akvs) - he/she have

Verb mogTSons that have preverb “mo” and its Georgian infinitive is moTSoneba from Second Singular to Third Singular need to change preradical “g” to “s”.

Example2: მე მომწონს (momTSons) - I like  
 შენ მოგწონს (mogTSons) - you like  
 მას მოსწონს (mosTSons) - he/she like

As for subgroup8, we have following rules, Input is second singular.

- assume 2s is given
- from 2s to 1s : change preradical "g" to “m”
- from 2s to 3s : change preradical "g" to “h”
- from 1s to 1p : change preradical "gv"
- from 2s to 2p : change preradical "gQ" add ending t
- from 3s to 3p : change preradical "hQ" add ending t



To conjugate verb from Second Singular to First Singular must change preradical “gi” to “mi”. From Second Singular to Third Singular must change periodical “gi” to “u”.

Example: მე მიივს (minda) - I want  
შენ გივს (ginda) - you want  
მას უივს (unda) - he/she want

To conjugate verb from First Singular to First Plural must change preradical “mi” to “gvi”. From Second Singular to Second Plural change ending “-” to “t”. And From Third Singular to Third Plural must change ending “-” to “t”.

Example: ჩვენ გვივს (gvinda) - we want  
თქვენ გივდათ (gindat) - you want  
მათ უივდათ (undat) - they want

### 2.3 Present Tense, Group 3

In this section we discuss Present Tense, Group 3 and its subgroups sg9, sg10 and sg11.

For the subgroup 9 we have following rules. Input is second singular.

- assume 2s is given
- from 2s to 1s : add preradical “-” to “v”
- from 2s to 3s : change ending “-” to “a”
- from 1s to 1p : change ending “-” to “it”
- from 2s to 2p : change ending “-” to “it”
- from 3s to 3p : change ending “-” to “ian”

To conjugate verb from Second Singular to First Singular must add preradical “-” to “v”. From Second Singular to Third Singular must change ending “-” to “a”.

Example: მგ ვთბებო (vtbebi) - I warm  
შენ თბებო (tbebi) - you warm  
ის თბება (tbeba) - he/she warms

To conjugate verb from first Singular to First Plural must change ending”-“ to “it”. From Second Singular to Second Plural must change ending”-“to “it”. ”. From Third Singular to Third Plural must change ending “-“to “ian”.

Example: ჩვენ ვთბებოთ (vtbebit) - we warm  
ქვენ თბებოთ (tbebit) - you warm  
ისინი თბებიან (tbebian) - they warm

For the subgroup10 we have following rules and input is second form singular.

- assume 2s is given
- from 2s to 1s : add preradical “-” to “v”
- from 2s to 3s : change ending “-” to “a”
- from 1s to 1p : change ending “-” to “it”
- from 2s to 2p : change ending “-” to “it”
- from 3s to 3p : change ending “-” to “ian”

To conjugate verb from Second Singular to First Singular must add preradical “-” to “v”. From Second Singular to Third Singular must change ending “-“ to “a”.

Example: მე ვბრაზდები (vbrazdebi) - I angry  
შენ ბრაზდები (brazdebi) - you angry  
ის ბრაზდება (brazdeba) - he/she angry

To conjugate verb from first Singular to First Plural must change ending "-“ to “it”. From Second Singular to Second Plural must change ending "-“ to “it”. From Third Singular to Third Plural must change ending “-“ to “ian”.

Example: ჩვენ ვბრაზდებით (vbrazdebit) - we angry  
თქვენ ბრაზდებით (brazdebit) - you angry  
ისინი ბრაზდებიან (brazdebian) - they angry

For the subgroup11 we have same situation as subgroup9 and subgroup10.

Input is Second Singular.

- assume 2s is given
- from 2s to 1s : add preradical "-“ to “v”
- from 2s to 3s : change ending "-“ to “a”
- from 1s to 1p : change ending "-“ to “it”
- from 2s to 2p : change ending "-“ to “it”
- from 3s to 3p : change ending "-“ to “ian”

To conjugate verb from Second Singular to First Singular must add preradical “-” to “v”. From Second Singular to Third Singular must change ending “-“ to “a”.

Example: მე ვიღლები (vighlebi) - I tired  
შენ იღლები (ighlebi) - you tired  
ის იღლება (ighleba) - he/she tired

To conjugate verb from first Singular to First Plural must change ending ”-“ to “it”. From Second Singular to Second Plural must change ending ”-“ to “it”. From Third Singular to Third Plural must change ending “-“ to “ian”.

Example: ჩვენ ვიღლებით (vighlebit) - we are tired  
თქვენ იღლებით (ighlebit) - you tired  
ისინი იღლებიან (ighlebian) - they tired

In subgroup 11 we have verb “djebi”, which subgroup according the book [1] is subgroup14, but it works perfectly and behave like group3 and subgroup11.

## 2.4 Present Tense, Group 4

Group 4 consists of irregular verbs and these verbs are in subgroup14 and subgruop15. As for subgroup15, in this book (book of Nana Shavtvaladze, "Georgian Language for English Speakers") is not this subgroup. We added subgroup15 and write other rules, because in this subgroup are verbs, which require different rules to conjugate.

For the subgroup14 we have following rules.

- assume 2s is given
- from 2s to 1s : add preradical "-" to "v"
- from 2s to 3s : change ending "-" to "s"
- from 1s to 1p : change ending "-" to "it"
- from 2s to 2p : change ending "-" to "it"
- from 3s to 3p : change ending "-" to "ian"

To conjugate verb from Second Singular to First Singular must add preradical "-" to "v". From Second Singular to Third Singular must change ending "-“ to "s".

Example: მე ვარკვევ (varkvev) - I clear up  
          შენ არკვევ (arkvev) - you clear up  
          ის არკვევს (arkvevs) - he/she clear up

To conjugate verb from first Singular to First Plural must change ending "-“ to "t". From Second Singular to Second Plural must change ending "-“ to "t". From Third Singular to Third Plural must change ending "s“ to "en".

Example: ჩვენ ვარკვევთ (varkvevt) - we clear up  
 თქვენ არკვევთ (arkvevt) - you clear up  
 ისინი არკვევენ (arkveven) - they clear up

Also, in this subgroup we have extra cases because some verbs have different structure and require other rules, for example verb “gamogdis” and its Georgian infinitive “gamosvla”, preverb is “gamo” in this case need change preradical “g” to “m” from Second Singular to First Singular. And from Second Singular to Third Singular need change preradical “g” to “s”.

Example: მე გამომდის (gamomdis) - we do  
 შენ გამოგდის (gamogdis) - you do  
 მას გამოსდის (gamosdis) - they do

And in Plural to conjugate verb from First Singular to First Plural need change preradical ”m” to “gv” and from third singular to third plural need change ending “-“ to “t”

Example: ჩვენ გამოგვდის (gamogvdis) - we do  
 თქვენ გამოგდით (gamogdit) - you do  
 მათ გამოსდით (gamosdis) - they do

As for our new subgroup15, input is also second singular and we have following rules to conjugate verb. Therefore each of verb has own subgroup that is described in book [1], but these verbs require other rules, we pasted these verb in subgroup15.

Input form is Second Singular and to conjugate verb from Second singular to first singular need to add preradical v and change ending “xar” to “var”.

Example: მე მივდივარ (mivdivar) - I go  
 შენ მიდობარ (midixar) - you go  
 ის მიდის (midis) - he/she goes

As for plural To conjugate verb from first Singular to First Plural must add ending ”-“ to “t”. From Second Singular to Second Plural must add ending ”-“ to “khar”. From Third Singular to Third Plural must change ending “s” to “an”.

Example: ჩვენ მივდივართ (mivdivart) - we go  
 შენ მიდობართ (midikhar) - you go  
 ის მიდიან (midian) - they go

Also we have extra cases, because these verbs are irregulars and require other rules. Some verbs requires to change root in third plural, for example, verb: zis and Georgian infinite is djdoma(seat down). To conjugate verb from third singular to third plural need change root “zi” to “skhed” and change ending “s” to “an”.

მე ვზივარ  
 შენ ზიხარ  
 ის ზის

ჩვენ ვზივართ (vzivart)  
 შენ ზიხართ (zixart)  
 ისინი სხედან (skhedan)

## 2.5 Exceptions of Present tense.

Group	subgroup	number of tested verbs	number of exceptions
			present
Group1	sg1	6	
	sg2	48	
	sg3	3	
	sg4	20	
	sg5	3	
	sg6	2	
Group2	sg7	5	2
	sg8	4	
Group3	sg9	7	
	sg10	3	
	sg11	3	
Group4	sg12		
	sg13		
	sg14	9	1
	sg15	5	3

Figure 6- exceptions in Present tense

As for exceptions in present tense, we have 2 exceptions in subgroup7 from 5 verbs. One exception in subgroup14 and 3 exceptions in subgroup15.



### 3. Imperfect

Verbs	Singular	Example Singular	Plural	Example Plural
<b>Subject system</b> <b>I Group</b> <b>(1,2,3,4,5,6)</b>	I. ---- <b>დი</b> II. ---- <b>დი</b> III. ---- <b>(ს)და</b>	I. ვმუშაობ <b>დი</b> II. მუშაობ <b>დი</b> III. მუშაობ <b>და</b>	I. ---- (თ) <b>დით</b> II. ----(თ) <b>დით</b> III. ----(ენ) <b>დნენ</b> (1,2,3,4,6) ----- <b>(ან)დნენ</b> (5)	I. ვმუშაობ <b>დით</b> II. მუშაობ <b>დით</b> III. მუშაობ <b>დნენ</b>
<b>Object system</b> <b>II Group(7)</b>	I. ---- <b>(ს)ოდა</b> II. ---- <b>(ს)ოდა</b> III. ---- <b>(ს)ოდა</b>	I. გამომდი <b>(ს)ოდა</b> II. გამოგდი <b>(ს)ოდა</b> III. გამოსდი <b>(ს)ოდა</b>	I. ---- <b>(ს)ოდა</b> II. ---- <b>(თ)ოდათ</b> III. ---- <b>(თ)ოდათ</b>	I. გამოგვი <b>(ს)ოდა</b> II. გამოგდი <b>(თ)ოდათ</b> III. გამოსდი <b>(თ)ოდათ</b>
<b>Object system</b> <b>II Group(8)</b>	I. ---- <b>ოდა</b> II. ---- <b>ოდა</b> III. ---- <b>ოდა</b>	I. მიხარ <b>ოდა</b> II. გიხარ <b>ოდა</b> III. უხარ <b>ოდა</b>	I. ---- <b>ოდა</b> II. ---- <b>ოდათ</b> III. ---- <b>ოდათ</b>	I. გვიხარ <b>ოდა</b> II. გიხარ <b>ოდათ</b> III. უხარ <b>ოდათ</b>
<b>Object system</b> <b>III Group</b> <b>(9,10,11)</b>	I. ---- (ი) <b>ოდი</b> II. ---- (ი) <b>ოდი</b> III. ---- (ა) <b>ოდა</b>	I. ვთბებ(ი) <b>ოდი</b> II. თბებ(ი) <b>ოდი</b> III. თბებ(ა) <b>ოდა</b>	I. ---- (ით) <b>ოდით</b> II. ---- (ით) <b>ოდით</b> III. ---- (იან) <b>ოდნენ</b>	I. ვთბებ (ით) <b>ოდით</b> II. თბებ (ით) <b>ოდით</b> III. თბებ (იან) <b>ოდნენ</b>
<b>Object system</b> <b>II Group(15)</b>	I. ---- <b>(ვარ)ოდი</b> II. ---- <b>(ხარ)ოდი</b> III. ---- <b>(ს)ოდა</b>	I. მივდი <b>(ვარ)ოდი</b> II. მიდი <b>(ხარ)ოდი</b> III. მიდი <b>(ს)ოდა</b>	I. ---- <b>(ვარ)ოდით</b> II. ---- <b>(ხართ)ოდით</b> III. ---- <b>(ან)ოდნენ</b>	I. მივდი <b>(ვარ)ოდით</b> II. მიდი <b>(ხართ)ოდით</b> III. მიდი <b>(ან)ოდნენ</b>

Figure 7-Imperfect tense

### 3.1 Imperfect Tense, Group 1

We discuss Imperfect Tense, Group1 and its subgroups.

Input is FirstSingPresent for FirstSingImperfect, SecondSingPresent for SecondSingImperfect and etc.

- from 1s to 1si : add ending "di"
- from 2s to 2si : add ending "di"
- from 3s to 3si : change ending "s" with “da”
- from 1p to 1pi : change ending "t" with “dit”
- from 2p to 2pi : change ending "t" with “dit”
- from 3p to 3pi : change ending “an” with “dnen” (sg5) or "en" with “dnen”  
(sg1,sg2,sg3,sg4,sg6)

In Georgian the verb in the present to imperfect first person add ending(di), second person also add ending (di) and third person add ending (da)

Example: მე ვმუშაობ-დი (mushaob**di**) - I worked

შენ მუშაობ-დი (mushaob**di**) - you worked

ის მუშაობ-და (mushaob**da**) - he/she worked

In Plural, the verb takes the (suffix) ending –**dit** at the end of the imperfect tense in first and second persons, plural and in the third person, plural takes the ending- **dnen** .

Example: ჩვენ ვმუშაობდით (vmushaob**dit**) - we worked

თქვენ მუშაობდით (mushaob**dit**) - you worked

ისინი მუშაობდნენ (mushaob**dnen**) - they worked

### 3.2 Imperfect Tense, Group 2

We discuss Imperfect Tense, Group 2 and its subgroups 7 and 8.

Input is FirstSingPresent for FirstSingImperfect, SecondSingPresent for SecondSingImperfect and etc.

- from 1s to 1si : add ending "oda"
- from 2s to 2si : add ending "oda"
- from 3s to 3si : change ending "s" with “oda”
- from 1p to 1pi : change ending "s" with “oda”
- from 2p to 2pi : change ending "t" with “odat”
- from 3p to 3pi : change ending “t” with “odat”

In Georgian the verb in the present to imperfect first person add ending(oda), second person also add ending (oda) and third person also add ending (oda)

Example: მე გამოძდი-ოდა (gamomdi**oda**) - I did

შენ გამოგძდი-ოდა (gamogdi**oda**) - you did

მას გამოსძდი-ოდა (gamosdi**oda**) - he/she did

In Plural, the verb takes the (suffix) ending **-oda** at the end of the imperfect tense in first person plural, in the second and third person, plural takes the ending- **odat**.

Example: ჩვენ გამოგვძდი-ოდა (gamogvdi**oda**) - we did

თქვენ გამოგძდი-ოდათ (gamogdi**odat**) - you did

მათ გამოსძდი-ოდათ (gamosdi**odat**) - they did

Also, in this subgroup we have extra cases because some verbs have different structure and require other rules, for example verb “gakvs” and its Georgian infinitive “kona”, in this case need change root “akv” to “kon”(all form) and change ending ”s” to “da”(imperfect singular:first,second,third. plural singular:first) and change ending ”t” to “dat”(plural imperfect:second,third).

Example: მე მქონდა (mkonda) - I had  
შენ გქონდა (gkonda) - you had  
მას ქონდა (konda)- they had

And in Plural

Example: ჩვენ გვქონდა (gvkonda) - we did  
თქვენ გქონდათ (gkondat) - you did  
მათ ქონდათ (kondat) - they did

in this subgroup we have extra cases because some verbs have different structure and require other rules, for example verb “gegona” and its Georgian infinitive “egona”, in this case need

<b>Present To Imperfect</b>					
<b>Singular</b>	<b>Present</b>	<b>Imperfect</b>	<b>Preradical</b>	<b>Root</b>	<b>Postradical</b>
<b>1</b>	<b>mgonia</b>	<b>megona</b>	“m” to “me”	“gon” to “gon”	“ia” to “a”
<b>2</b>	<b>ggonia</b>	<b>gegona</b>	“g” to “ge”	“gon” to “gon”	“ia” to “a”
<b>3</b>	<b>gonia</b>	<b>egona</b>	“-” to “e”	“gon” to “gon”	“ia” to “a”
<b>Plural</b>					
<b>1</b>	<b>gvgonia</b>	<b>gvegona</b>	“gv” to “gve”	“gon” to “gon”	“ia” to “a”
<b>2</b>	<b>ggoniat</b>	<b>gegonat</b>	“g” to “ge”	“gon” to “gon”	“ia” to “a”
<b>3</b>	<b>goniat</b>	<b>egonat</b>	“-” to “e”	“gon” to “gon”	“ia” to “a”

in this subgroup we have extra cases because some verbs have different structure and require other rules, for example verb “gkonda” and its Georgian infinitive “kona”, in this case need

<b>Present To Imperfect</b>					
<b>Singular</b>	<b>Present</b>	<b>Imperfect</b>	<b>Preradical</b>	<b>Root</b>	<b>Ending</b>
<b>1</b>	makvs	mkonda		“akv” to “kon”	“s” to “da”
<b>2</b>	gakvs	gkonda		“akv” to “kon”	“s” to “da”
<b>3</b>	akvs	konda		“akv” to “kon”	“s” to “da”
<b>Plural</b>					
<b>1</b>	gvakvs	gvkonda		“akv” to “kon”	“s” to “da”
<b>2</b>	gakvt	gkondat		“akv” to “kon”	“t” to “dat”
<b>3</b>	akvt	kondat		“akv” to “kon”	“t” to “dat”

## In subgroup sg8

Input is FirstSingPresent for FirstSingImperfect, SecondSingPresent for SecondSingImperfect and etc.

- from 1s to 1si : change ending with "oda"
- from 2s to 2si : change ending with "oda"
- from 3s to 3si : change ending with "oda"
- from 1p to 1pi : change ending with "oda"
- from 2p to 2pi : change ending with "odat"
- from 3p to 3pi : change ending with "odat"

In Georgian the verb in the present to imperfect first person , second person and also third person add ending (oda)

Example: მე მინდ-ოდა (mindoda) - I wanted

შენ გინდ-ოდა (gindoda) - you wanted

მას უნდ-ოდა (undoda) - he/she wanted

In Plural, the verb takes the (suffix) ending **-oda** at the end of the imperfect tense in first person plural, in the second and third person plural takes the ending- **odat**.

Example: ჩვენ გვინდოდა (gvindoda) - we wanted

თქვენ გინდოდათ (gindodat) - you wanted

მათ უნდოდათ (undodat) - they wanted

in this subgroup we have extra cases because some verbs have different structure and require other rules, for example verb “shedgzlo” and its Georgian infinitive “shedzleba”, in this case need

Present to Imperfect				
Singular	Present	Imperfect	Preradical	Postradical
1	shem <b>idz</b> lia	shem <b>edz</b> lo	“mi” to “me”	“ia” to “o”
2	she <b>gidz</b> lia	she <b>gez</b> lo	“gi” to “ge”	“ia” to “o”
3	she <b>udz</b> lia	she <b>edz</b> lo	“u” to “e”	“ia” to “o”
Plural				
1	she <b>gvidz</b> lia	she <b>gvedz</b> lo	“gvi” to “gve”	“ia” to “o”
2	she <b>gizli</b> at	she <b>gedz</b> lot	“gi” to “ge”	“ia” to “o”
3	she <b>uzli</b> at	she <b>edz</b> lot	“u” to “e”	“ia” to “o”

SingularImperfect

Example: მე შემედლ-ო (shemedzlo)

შენ შეგედლ-ო (shegezlo)

მას შეედლ-ო (sheedzlo)

PluralImperfect



Example: ჩვენ შეგვეძლო (shegvedzlo)

თქვენ შეგეძლოთ (shegezlot)

მათ შეეძლოთ (sheedzlot)

### 3.3 Imperfect Tense, Group 3

In this section we discuss Imperfect Tense, Group3 and its subgroups sg9, sg10 and sg11.

For the subgroup 9,10,11 we have following rules. Input is FirstSingPresent for FirstSingImperfect, SecondSingPresent for SecondSingImperfect and etc.

- from 1s to 1si : change ending “i” with "odi"
- from 2s to 2si : change ending “i” with "odi"
- from 3s to 3si : change ending "a" with “oda”
- from 1p to 1pi : change ending "it" with “odit”
- from 2p to 2pi : change ending "it" with “odit”
- from 3p to 3pi : change ending “ian” with “odnen”

Singular Imperfect Example:

მე ვთბებოდი (vtbebodi) - I warmed

შენ თბებოდი (tbebodi) - you warmed

ის თბებოდა (tbeboda) - he/she warmed

Plural Imperfect Example:

- ჩვენ ვთბებოდით (vtbe**odit**) - we warmed  
თქვენ თბებოდით (tbe**odit**) - you warmed  
ისინი თბებოდნენ (tbe**odnen**) - they warmed

### 3.4 Imperfect Tense, Group 4

Group 4 consists of irregular verbs and these verbs are in subgroup14 and subgroup15

For the subgroup14 we have following rules, it same of Group1:

- from 1s to 1si : add ending "di"
- from 2s to 2si : add ending "di"
- from 3s to 3si : change ending "s" with "da"
- from 1p to 1pi : change ending "t" with "dit"
- from 2p to 2pi : change ending "t" with "dit"
- from 3p to 3pi : change ending "en" with "dnen"

In Georgian the verb in the present to imperfect first person add ending(di), second person also add ending (di) and third person change ending "s" to "da"

- Example: მე ვარკვევდი (varkve**di**) - I cleared up  
შენ არკვევდი (arkve**di**) - you cleared up  
ის არკვევდა (arkve**da**) - he/she cleared up

In Plural Imperfect, the verb in first and second form change ending “t” to “dit”, and in third form change ending ”en” to “dnen”

Example: ჩვენ ვარკვევდით (varkvev**dit**) - we cleared up  
თქვენ არკვევდით (arkvev**dit**) - you cleared up  
ისინი არკვევდნენ (arkvev**dnen**) - they cleared up

For the subgroup15 we have following rules:

- from 1s to 1si :change ending ”var” with "odi"
- from 2s to 2si : change ending "khar" with “odi”
- from 3s to 3si : change ending "s" with “oda”
- from 1p to 1pi : change ending "vart" with “odit”
- from 2p to 2pi : change ending "khar" with “odit”
- from 3p to 3pi : change ending "an" with “odnen”

In Georgian the verb in the present to imperfect first person change ending “var” to “odi”, second person also change ending “khar” “odi” and third person change ending “s” to “oda”

Example: მე მივდიოდი (mivdiodi) - i went  
შენ მიდიოდი (midiodi) - you went  
ის მიდიოდა (midioda) - he/she went

In Plural Imperfect, the verb in first form change ending "vart" to "odit", second form change ending "khar" to "odit", and in third form change ending "an" to "odnen"

Example: ჩვენ მივდიოდით (mivdiodit) - we went  
 თქვენ მიდიოდით (midiodit) - you went  
 ისინი მიდიოდნენ (midiodnen) - they went

We have also extra cases for this verbs: "TSola", "djdoma", "dgoma". all of them change preradical, root and ending.

For example verb "iTSeqi" and its Georgian infinitive "TSola", in this case need:

Present To Imperfect					
Singular	Present	Imperfect	Preradical	Root	Ending
1	vTSevar	viTSeqi	"v" to "vi"	"TSe" to "TSe"	"var" to "qi"
2	TSevkhar	iTSeqi	"-" to "i"	"TSev" to "TSe"	"khar" to "qi"
3	TSevs	iTSva	"-" to "i"	"TSev" to "TSv"	"s" to "a"

<b>Plural</b>					
<b>1</b>	<b>vTSevart</b>	<b>viTSeqit</b>	“v” to “vi”	“TSe” to “TSe”	“vart” to “qit”
<b>2</b>	<b>Tsevkhart</b>	<b>iTSeqit</b>	“-” to “i”	“TSev” to “TSe”	“khart” to “qit”
<b>3</b>	<b>TSvanan</b>	<b>iTSvnen</b>	“-” to “i”	“TSva” to “TSV”	“nan” to “nen”

For example verb “ijeqi” and its Georgian infinitive “djdoma”, in this case need:

<b>Present To Imperfect</b>					
<b>Singular</b>	<b>Present</b>	<b>Imperfect</b>	<b>Preradical</b>	<b>Root</b>	<b>Ending</b>
<b>1</b>	<b>vzivar</b>	<b>vijeqi</b>	“v” to “vi”	“zi” to “je”	“var” to “qi”
<b>2</b>	<b>zikhar</b>	<b>ijeqi</b>	“-” to “i”	“zi” to “je”	“khar” to “qi”
<b>3</b>	<b>zis</b>	<b>ijda</b>	“-” to “i”	“zi” to “jd”	“s” to “a”
<b>Plural</b>					
<b>1</b>	<b>vzivart</b>	<b>vijeqit</b>	“v” to “vi”	“zi” to “je”	“vart” to “qit”
<b>2</b>	<b>zikhart</b>	<b>ijeqit</b>	“-” to “i”	“zi” to “je”	“khart” to “qit”
<b>3</b>	<b>skhedan</b>	<b>iskhdnen</b>	“-” to “i”	“skhed” to “skhd”	“an” to “nen”

And for example verb “ideqi” and its Georgian infinitive “dgoma”, in this case need:

Present To Imperfect					
Singular	Present	Imperfect	Preradical	Root	Ending
1	vdgavar	videqi	“v” to “vi”	“dga” to “de”	“var” to “qi”
2	dgakhar	ideqi	“-” to “i”	“dga” to “de”	“khar” to “qi”
3	dgas	idga	“-” to “i”	“dga” to “dga”	“s” to “-”
Plural					
1	vdgavart	videqit	“v” to “vi”	“dga” to “de”	“vart” to “qit”
2	dgakhart	ideqit	“-” to “i”	“dga” to “de”	“khart” to “qit”
3	dganan	idgnen	“-” to “i”	“dga” to “dg”	“nan” to “nen”

## 4. Prolog

Expected interface: To conjugation verb we need to input was in second singular and user gives second singular and the software proposes conjugated forms, the user should be able to validate.

For this we use the code of the prolog.

Short for Programming Logic, Prolog is a high-level programming language based on formal logic.

Unlike traditional programming languages that are based on performing sequences of commands, Prolog is based on defining and then solving logical formulas. Prolog is sometimes called a declarative language or a rule-based language because its programs consist of a list of facts and rules. Prolog is used widely for artificial intelligence applications, particularly expert systems.

For example: verb in second singular in prolog looks like this:

```
verb(ConcreteForm, GeorgianInfinitive, EnglishInfinitiveSet, FrenchInfinitiveSet, GeorgianForm,
Group, SubGroup, Tense, Person, Number, Preverb, Preradical, Root, PostRadical, PFSF, Ending,
[PotentialPreverbList, [FuturePreradical, PresentPerfectPreradical | Others]]).
```

Verb (kiraob, kiraoba, [rent], [louer], 'ქირაობ', g1, sg1, present, second, singular, -, -, kira, -, ob, -, [[-],[i, u]]). Where is an information about root, tense, person, preradical, pfsf and etc.

The appropriate rule to conjugate verb will look like this: where input is Second Singular and we will get the verb in First Singular and all verbs, which are in sg1, sg2, sg3, sg4, ag5, ag6, ag9, sg 10, sg11 and sg14 will add preradical v.

შენ - აუქმებ -> მე- **ვ**აუქმებ

You – aukmeb (abolish) -> I – **v**aukmeb (abolish).

```
build_first_sing(GeorgianInfinitive, SubGroup, SecondSing, FirstSing) :-
```

```
    change_person(second, first, SecondSing, Form),
```

```
    build_first_sing_do(GeorgianInfinitive, SubGroup, Form, FirstSing).
```

```
build_first_sing_do(_GeorgianInfinitive, SubGroup, SecondSing, FirstSing) :-
```

```
    member(SubGroup, [sg1, sg2, sg3, sg4, sg5, sg6, sg9, sg10, sg11, sg14]),
```

```
    add_preradical(_Preradical, v, SecondSing, FirstSing).
```

## References

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