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The inflexion regularities for the Romanian language*

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Abstract

Three inflexion groups for romanian words are distinguished; the belonging criteria are discussed.

1 Introduction

The morphological inflexion is a necessary part to create the computational lexicons. Some ideas to resolve these problems for the Romanian language are described in [1, 2, 3]. The static method, described in [1], proceeds from the knowledge of the base word and the inflexional group in correspondence to the classification giving in [4]. The dynamic method [2] results from the base word and the morphological cathegory (the part of speech, the gender for nouns etc.). In this article we deal with dynamic method and determine the criteria to classificate romanian words in three inflexion groups: automated, partial automated and irregular. To inflect one word it is necessary to know

a) the vowel and consonant alternations,

b) the rules alternations application context,

c) the affixe series.

The affixe series tables, the alternations set and their admissible combinations [2] form the inflexion programs' base. We will consider these processes for each part of speech.

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2 The verb

The conjugation schemes of verbs are determined in [4, 2]. The main models are reduced to 56 conjugation schemes. As an example in Table 1 are shown 16 schemes which illustrate the verb inflexion rules for Idicativ Prezent Singular, Conjugation I.

Table 1. The verb

Verb	**per.I**		**per.II**		**per.III**	
	alter.	**affix**	**alter.**	**affix**	**alter.**	**affix**
a cânta	-	-	$t \to$ ţ	i	-	ă
a căuta	ă $\to a$	-	ă $\to a, t \to$ ţ	ă $\to a$	-	ă
a arăta	-	-	$t \to$ ţ	i	ă $\to a$	ă
a apăra	-	-	ă $\to e$	i	-	ă
a apăsa	-	-	ă $\to e, s \to$ ş	i	ă $\to a$	ă
a căpăta	ă $\to a$	-	ă $\to a$, ă $\to e$ $t \to$ ţ	i	ă $\to a$	ă
a asemăna	-	-	ă $\to e$	i	$e \to ea$	ă
a boteza	-	-	-	i	$e \to ea$	ă
a convoca	-	-	-	i	$o \to oa$	ă
a juca	$u \to o$	-	$u \to o$	i	$u \to oa$	ă
a afla	-	u	-	i	-	ă
a încuia	-	-	-	-	-	e
a tăia	ă $\to a$	-	ă $\to a$	-	ă $\to a$	e
a înfoia	-	-	-	-	$o \to oa$	e
a muia	$u \to o$	-	$u \to o$	-	$o \to oa$	e
a învia	-	i	-	i	-	e

Knowing these schemes we can determine the corresponding one for arbitrary verb. For this purpose we introduce two simple definitions.

Definition 1 *The verb root is a word* $R = Substr(S, 1, Length(S) - k)$, *where* $k = 2$ *for the verbs of the second conjugation,* $k = 1$ *for another cases.*

Definition 2 *The preaffix of root R with the length n (n <= Length(R)) is a set* $P(R,n) = Substr(R, Length(R) - (n-1), n)$.

Using these notions we can determine the conjugation schemes. For example:

- The verb is conjugated in accordance with the model of verb *"a căpăta"*, if: $Length(R) > 3 \& (R[Length(R)-1] =$ "ă$''$)& $(R[Length(R)-3] =$ "ă$''$)$or(R[Length(R)-4] =$ "ă$''$).
  One can easy verify this condition is satisfied by the verbs *"a căţăra"*, *"a scărmăna"*, *"a scăpăra"* etc., which can be conjugated in accordance with the sixth model from Table 1.

- In accordance with the model of verb *"a afla"* the verbs which satisfy the condition: $P(R,2) \in \{$"fl'', "cr'', "pl'', "nu'', "tr'', "bl'', "$tu''\}$ are conjugated. The verbs *"a insufla"*, *"a consacra"* belong to this set. An exception is the verb *"a lătra"*, which can be conjugated in accordance with eleventh model from Table 1.

- The model of verb *"a apăsa"* satisfies the condition:
  $P(R,3) \in \{$ *"păs"*, *"făs"*, *"făt"*, *"băr"*, *"măt"*, *"băt"*, *"văţ"*, *"făţ"*, *"ărs"*, *"păl"*, *"săl"*$\}$.
  For example the verbs *"a învăţa"*, *"a înfăşa"*, *"a vărsa"* etc. are conjugated in accordance with fifth model of Table 1.

Such rules of conjugation were formulated for all schemes of verb conjugation. Of course, there are the exceptions, which are updated separately, such as auxiliary, defective verbs etc.

To conjugate a verb it is necessary to initiate a dialog in two cases: to inquire about conjugation suffix and about verb's impersonality. Knowing this information the inflexion process is performed automatically.

3 The nouns and the adjectives

The vowel and consonant alternations are characteristic for the nouns and the adjectives inflexion. They are grouped into three categories:

absolute regular, partial regular and irregular.The corresponding notion indicates the applicability degree of alternation rule (context free, dependent of context, in exceptional cases). The absolute regular alternations are divided, in its turn, in automatic absolute regular (the first group, without the alternations or with consonant alternations only) and semiautomatic (the second group, the vowel and consonant alternations).

After the affixes separation in the base word the automatic absolute regular alternations rules (specified for certain parts of speech) are applied (for example, the consonant alternations for masculine nouns, the vowel alternations $ea \rightarrow e$, $ia \rightarrow ie$ for nouns and adjectives etc.). The partial regular alternations require a detailed context analysis, sometimes asking the user for additional informations. The words with the irregularities being not so much numerous are emphasized apriori and processed in a special way. In the case when the inflexion process was not executed correctly the edit possibility is reserved.

If the word proposed for inflexion (an arbitrary noun or an adjective) does not belong to the set of irregular ones we have to determine the proper inflexion model. The word affix serves as distinctive criteria. The tables 2–5 present the lists of irregularities and affix–key to specify the inflexion model. If the affix–key belongs to the absolute regular set of nouns or adjectives (to be inflected without the user's interference) then the specified word is declined in accordance with the found inflexion model. If the affix–key belongs to the set of partial regular nouns and adjectives it is necessary to select the appropriate alternation rules from several possible variants. For this aim it initiates a dialog where the user have to select the suitable variant. To simplify the user's work the inflexion programs generate all possible variants of the alternation rules application. It is obviously, that some of these words can be strange, but this situation make the selection easy. We will illustrate this process by an example. Let us inflect the word *ramă*. It is characteristic for this word that it contains of two syllables, each of them has two letters. The first syllable contains vowel *a* and the second – *ă*. This group of words can form the plural in the following ways:

- in the first syllable the following vowel alternations proceed:
  1) $a \rightarrow e$ (*masă* (table) – *mese*),
  2) $a \rightarrow$ ă (*cană* – *căni*),
  3) the first vowel is not modified (*casă* – *case*).

- the second syllable:
  1) alternation ă $\rightarrow e$ in *casă* – *case* and *masă* – *mese*,
  2) alternation ă $\rightarrow i$ in *cană* – *căni*.

Doing all possible alternations in both syllables of word *ramă* we will obtain *rami*, *rămi*, *remi*, *rame*, *răme*, *reme*, where we can easy select the suitable word *rame*. Knowing the plural suitable variant of a word the inflexion programs perform the full inflexion of the proposed word and show the correct list of flexions.

Table 2. The masculine nouns

- **Irregularities**: *om, tată, august, soare,şarpe, bade, nene,boa etc.*

- **Absolute regularities**:
  Group I (without alternations or with consonant alternations only):

Affixes	**Cons.alt.**	**Examples**
-cons+e	$t \rightarrow$ ţ; $s \rightarrow$ ş	*rege, frate, cărbune*
-ez	–	*burghez, francez, chinez*
-ie	–	*bădie*
-y	–	*hippy, grizzly*
-i	–	*arici, pici, pui*
-stru	$s \rightarrow$ ş	*ministru, sihastru*
-og	–	*biolog, cardiolog, zoolog*
-or	–	*învăţător, aviator*
-st	$s \rightarrow$ ş	*arbust, cineast*
-ală	–	*păcală, tândală*
-ilă	–	*flămânzilă, gerilă*
-u	–	*codru, chirigiu, macaragiu*
-o	–	*flamingo, picolo, tenotino*
-ist	$s \rightarrow$ ş	*activist, naturist*
-aş	–	*părtaş, băieţaş*

Affixes	**Cons.alt.**	**Examples**
-cons+at	$t \rightarrow \ \c{t}$	*arestat,*
-ant	$t \rightarrow \ \c{t}$	*coagulant, colorant*
-on	–	*hormon, proton, electron*
-ic	–	*voinic, comic*
-ar	–	*primar, lemnar*
-ent	$t \rightarrow \ \c{t}$	*eminent, curent*
-cons+an	–	*căpitan, american*
-eţ	–	*ursuleţ, brăduleţ*
-et	$t \rightarrow \ \c{t}$	*puiet,*
-bil	–	*nobil, combustibil*
-ol	–	*kilomol, sol, pol,*
-ul	–	*mascul,*
-ache	–	*trafandache, muţunache*
-ăr	–	*măr, păr, umăr*
-ă	$d \rightarrow z; t \rightarrow \c{t}$	*vodă, tată, popă*

Group II (the vowel and consonant alternations):

Affixes	**Vow. and cons. alt.**	**Examples**
-eac	$ea \rightarrow e$	*poleac*
-eag	$ea \rightarrow e$	*moşneag, pribeag*
-ean	$ea \rightarrow e$	*moldovean, tulcean*
-eaz	$ea \rightarrow e; z \rightarrow j$	*viteaz, cneaz*
-iag	$ia \rightarrow ie$	*sfoiag*
-iac	$ia \rightarrow ie$	*liliac*
-el	$l \rightarrow i$	*băieţel*
-ăn	$\breve{a} \rightarrow e$	*zdravăn*
-ăt	$\breve{a} \rightarrow e; t \rightarrow \c{t};$	*logofăt*

- **Partially regular alternations**:

Sing. affixes	Plur. affixes	Examples
-l	{ – *-li*	{ *copil, cal* *amiral, nobil*
-voc+at	{ *-eţi* *-aţi*	{ *băiat, leat* *refugiat, afemeiat*

Table 3. The feminine nouns

- **Irregularities**: *sfântă, soră, făină, lele, şa, cacao etc.*

- **Absolute regularities**:
  Group I (without alternations or with the consonant alternations only):

Affixes	Examples
-dine	*atitudine, ordine, aptitudine*
-ea	*stea, cafea, gogoşea*
-ere	*trecere, abreviere, durere*
-ează	*teză, portugheză*
-hă	*cehă*
-ia	*papaia, maia, paranoia*
-ie	*ediţie, evoluţie, aluzie*
-ime	*mulţime, agerime, desime*
-ire	*mâhnire, altoire, ciocnire*
-istă	*batistă, activistă*
-iţă	*fetiţă, coroniţă*
-oană	*coloană, consoană*
-oe	*aloe, benzoe*
-nţă	*ştiinţă, conferinţă*
-ogă	*filologă, politologă*
-ază	*mimoză, fructoză, batoză*
-une	*uniune, minune, acţiune*

Affixes	**Examples**
-ură	*friptură, corcitură*
-uţă	*băsmăluţă, albinuţă*
-âre	*coborâre, mohorâre*
-oagă	*hârţoagă, mârţoagă*
-oaică	*ursoaică, nemţoaică*
-eţe	*tinereţe, mândreţe*
-omană	*muzicomană, toxicomană*

Group II (the vowel and consonant alternations):

Affixes	**Vow. and cons. alt.**	**Examples**
-cons+are	$a \to ă$	*lucrare*
-ască	$a \to ă; sc \to şt$	*mască, cască*
-ate	$a \to ă; t \to ţ$	*activitate, absurditate*
-eagă	$ea \to e$	*peceneagă*
-eană	$ea \to e$	*moldoveană*
-iană	$ia \to ie$	*elveţiană*
-eancă	$ea \to e$	*suceveancă*
-eară	$ea \to e$	*seară*
-ească	$ea \to e; sc \to şt$	*moldovenească*
-eaşcă	$ea \to e; şc \to şt$	*ceaşcă*
-easă	$ea \to e$	*mireasă*
-eală	$ea \to e$	*oboseală*
-ială	$ia \to ie$	*cheltuială*
-eacă	$ea \to e$	*teacă*
-e	$a \to ă; oa \to o; t \to ţ$	*mare, floare, noapte*

- **Partially regular alternations**:

Sing. affixes	**Plur. affixes**	**Examples**
-aie	*- ăi* *-aie*	*baie* *apăraie*
-ee	*-ee* *-ei*	*orhidee* *idee*
-ină	*-ini* *-ine*	*găină* *duzină*
-oaie	*-oaie* *-oi*	*căsoaie* *ploaie*
-oare	*-oare* *-ori*	*învăţătoare* *semănătoare*
-oară	*-oare* *-ori*	*surioară* *vioară*
-scă,-şcă	*-şti* *-şte*	*gâscă, gâluşcă* *muscă, muieruşcă*

Sing. affixes	**Plur. affixes**	**Examples**
-anăă	*-ane* *-ăni* *-ene*	*stranăă* *canăă* *panăă*
-eaţăă	*-euri* *-eţi* *-eţe*	*verdeaţăă* *dimineaţăă* *cântăreaţăă*
-aţăă	*-eţi* *-eţe* *-aţe*	*viaţăă* *povaţăă* *aţăă*
-a	*-le* *-e*	*manta* *leva*
-arăă	*-ări* *-ere* *-eri*	*călimarăă* *varăă(cousin)* *varăă(summer)*
-ăă	*-e* *-i*	*casăă* *vacăă*
-icăă	*-ele* *-ici* *-ice*	*vioricăă* *bunicăă* *ursoaicăă*

Table 4. The neuter nouns

- **Irregularities**: *fier, cap, grâu, sombrero etc.*
- **Absolute regularities**:
  Group I (without alternations or with consonant alternations only):

Affixes	**Examples**
-ism	*capitalism, budism*
-aj	*utilaj, machiaj*
-ent	*monument, eveniment*
-ing	*marcheting*
-i	*brici, beci*
-y	*hobby*
-ou	*maiou, radiou*
-iu	*seminariu, gimnaziu*
-o	*moto, radio*
-iv	*reactiv, seditativ*
-ge	*faringe, sporange*
-ce	*apendice*
-e	*nume*

Group II (the vowel and consonant alternations):

Affixes	**Vow. alt.**	**Examples**
-voc+on	$o \rightarrow oa$	*creion, avion*
-ău	$ău \rightarrow aie$	*pârău*
-sor	$o \rightarrow oa$	*grosor*
-fon	$o \rightarrow oa$	*microfon, magnetofon*
-gon	$o \rightarrow oa$	*poligon*
-ton	$o \rightarrow oa$	*proton*
-tron	$o \rightarrow oa$	*electron*
-lon	$o \rightarrow oa$	*nailon, salon*
-tor	$o \rightarrow oa$	*motor*
-zor	$o \rightarrow oa$	*polizor*
-csor	$o \rightarrow oa$	*iezuşor*

Affixes	**Vow. alt.**	**Examples**
-for	$o \rightarrow oa$	*semafor*

- **Partially regulare alternations**:

Sing. affixes	**Plur. affixes**	**Examples**
-eţ	*-eţe* *-eţuri*	*trenuleţ* *preţ*
- âu	*-ie* *-uri*	*frâu* *brâu*
-or	*-oruri* *-oare*	*decor* *covor*
-oc	*-oace* *-ocuri*	*cojoc* *toc*
-voc+u	*-ee* *-uri* *-eie*	*muzeu* *eseu* *curcubeu*
-cons+u	*-e* *-uri*	*teatru* *lucru*

Sing. affixes	Plur. affixes	Examples
-col	*-cole* *-coale* *-coluri*	*miracol* *ocol* *ocol*
-cons	*-e* *-uri*	*fir* *dulap*

Table 5. The adjectives

- **Irregularities**: *bej, atroce, roş, pursânge, roz, kaki, etc.*
- **Absolute regularities**:
  Group I (without alternations or with consonant alternations only):

Affixes	Cons. alt.	Examples
-ant	$t \to ţ$	*interesant, fascinant*
-ar	–	*amar, elitar, liniar*
-as	$s \to ş$	*gras, rămas*
-asc	$sc \to şt$	*fantasc*
-asg	–	*pelasg*
-cons+at	$t \to ţ$	*format, ciudat*
-bil	–	*comestibil, invizibil*
-tic	–	*tomnatic, acvatic*
-ui	–	*căprui, verzui*
-us	$s \to ş$	*opus, distrus*
-ut	$t \to ţ$	*acut, nevăzut, umplut*
-uu	–	*continuu, perpetuu*
-vor	–	*carnivor, plantivor*
- ât	$t \to ţ$	*urât, mohorât*
-ai	–	*bălai, lai*
-ci	–	*dibaci, dreptaci*
-eh	–	*ceh*

Affixes	**Cons. alt.**	**Examples**
-ent	$t \rightarrow ţ$	*conştient, eficient*
-est	$s \rightarrow ş$	*manifest, malonest*
-fic	–	*ştiinţific, benefic*
-gic	–	*magic, analogic, energic*
-nic	–	*voinic, puternic, armonic*
-ns	$s \rightarrow ş$	*dens, convins, distins*
-is	$s \rightarrow ş$	*scris, precis*
-ist	$s \rightarrow ş$	*trist, altruist*
-iu	–	*auriu, sălciu, luciu*
- âu	–	*molâu, osmanlâu*
-iv	–	*activ, buziv, adoptiv*
-ixt	$x \rightarrow cş$	*mixt*
-lic	–	*metalic, evanghelic*
-lu	–	*simplu, triplu*
-ru	–	*acru, sibru*
-pod	$d \rightarrow z$	*dipod, macropod*
-mod	$d \rightarrow z$	*incomod*
-icol	–	*agricol, piscicol, ridicol*
-cons+av	–	*trândav, concav*
-ur	–	*nesigur, obscur*
-un	–	*bun, oportun*
-aş	–	*codaş, grăgălaş*
-rm	–	*exoterm, omoform*
-rn	–	*modern, extern*
-al	–	*ideal, continental*
-cons+an	–	*mitocan*
-eu	–	*instantaneu*
-ez	–	*burghez, chinez, vietnamez*
-sc	$sc \rightarrow şt$	*brusc*
-ah	–	*valah*
-it	$t \rightarrow ţ$	*fericit, dospit, mâhnit*

Affixes	**Cons. alt.**	**Examples**
-ol	–	*domol*
-ău	–	*prostălău, bălălău*
-ou	–	*nou*

Group II (the vowel and consonant alternations):

Affix.		**Vow.and cons.alt.**	**Ex.**
-ăd	*adj. masc. plur.*	$ă \to e; d \to z$	*galfăd*
	adj. fem. sing.	–	
	adj. fem. plur.	$ă \to e; d \to z$	
-ăt	*adj. masc. plur.*	$ă \to e; t \to ţ$	*proaspăt*
	adj. fem. sing.	–	
	adj. fem. plur.	$ă \to e; t \to ţ$	
-eac	*adj. masc. plur.*	$ea \to e$	*poleac*
	adj. fem. sing.	–	
	adj. fem. plur.	$ea \to e$	
-iac	*adj. masc. plur.*	$ia \to ie$	*austriac*
	adj. fem. sing.	–	
	adj. fem. plur.	$ia \to ie$	
-eag	*adj. masc. plur.*	$ea \to e$	*dulceag*
	adj. fem. sing.	–	
	adj. fem. plur.	$ea \to e$	
-ean	*adj. masc. plur.*	$ea \to e$	*moldovean*
	adj. fem. sing.	–	
	adj. fem. plur.	$ea \to e$	
-ian	*adj. masc. plur.*	$ia \to ie$	*elveţian*
	adj. fem. sing.	–	
	adj. fem. plur.	$ia \to ie$	
-eaz	*adj.masc.plur.*	$ea \to e; z \to j$	*viteaz*
	adj.fem.sing.	–	
	adj.fem.plur.	$ea \to e$	
-ead	*adj.masc.plur.*	$ea \to e; d \to z$	*smead*
	adj.fem.sing.	–	
	adj.fem.plur.	$ea \to e$	

Affix.		**Vow.and cons.alt.**	**Ex.**
-ept	*adj.masc.plur.*	$t \rightarrow ţ$	*deştept*
	adj.fem.sing.	$e \rightarrow ea$	
	adj.fem.plur.	$ea \rightarrow e$	
-es	*adj.masc.plur.*	$s \rightarrow ş$	*des*
	adj.fem.sing.	$e \rightarrow ea$	
	adj.fem.plur.	$ea \rightarrow e$	
-os	*adj.masc.plur.*	$s \rightarrow ş$	*fricos*
	adj.fem.sing.	$o \rightarrow oa$	
	adj.fem.plur.	–	
-oş	*adj.masc.plur.*	–	*fleoş*
	adj.fem.sing.	$o \rightarrow oa$	
	adj.fem.plur.	–	
-oi	*adj.masc.plur.*	–	*vioi, greoi*
	adj.fem.sing.	$oi \rightarrow oaie$	
	adj.fem.plur.	–	
-tor	*adj.masc.plur.*	–	*silitor*
	adj.fem.sing.	$o \rightarrow oa$	
	adj.fem.plur.	–	
-esc	*adj.masc.plur.*	$sc \rightarrow şt$	*ceresc*
	adj.fem.sing.	$e \rightarrow ea$	
	adj.fem.plur.	$ea \rightarrow e; sc \rightarrow şt$	
-uan	*adj.masc.plur.*	$ă \rightarrow e$	*zdravăn*
	adj.fem.sing.	–	
	adj.fem.plur.	$ă \rightarrow e$	

- **Partially regular alternations**:

Sing. affixes	**Plur. indef. C.N.A. affixes**	**Examples**
-ce	*-ci* *-ce*	*eficace* *tenace*
-eat	*-eţi* *-eaţi*	*urecheat* *împerecheat*
-e	*-i* *-e*	*limpede* *cumsecade*

Sing. affixes	**Sing. indef. fem. affixes**	**Examples**
-et	*-eată* *-etă*	*biet* *complet*
-oc	*-ocă* *-oacă*	*univoc* *dobitoc*
-or	*-ară* *-oară*	*sonor* *rotunjor*

Sing. affixes	**Sing. indef. fem. affixes**	**Examples**
-og	*-ogă* *-oagă*	*analog* *olog*

The obtained results illustrated in the tables 2–5 were used for nouns and adjectives automatic inflexion programs'optimization.

4 Conclusions

As it was mentioned above the verb conjugation proceeds in the automatic way, the dialog being necessary only to specify the information about the verb impersonality and conjugation with or without suffix.

The statistical data are presented in the table below which indicates the inflexion process automatization degree.

	Part of speech	Number of words	Gr.I	Gr.II	Dialog	Irreg.
1.	Adjectives	20700	59%	28%	12%	0.7%
2.	Feminine nouns	22000	59%	32%	9%	0.5%
3.	Masculine nouns	3160	80%	13%	7%	0.2%
4.	Neuter nouns	6720	70%	4%	26%	0.2%
	Total	52580	62%	26%	12%	0.6%

Analyzing this table one can conclude the 88% of nouns and adjectives can be declined automatically and only 12% need a dialog.

Knowing all word forms we can determine the number of inflexion groups in accordance with [4]. So we can reduce the presentation of all word forms in the vocabulary to the static method.

The described methods were used to create a vocabulary of about

65.000 base words (the main sources being [5, 6]). It was used to elaborate the spelling checker (named ROMSP) for the Romanian language.

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