

Converting Ottoman-script to Latin-script is also studied by Güngör et al. [5] and Korkut [6]. Both studies preferred detecting the root word by means of a large Ottoman lexicon and converting the suffixes using Ottoman-Latin suffix pairs instead of using a two-level morphological analyzer.

III. METHODS

A. Lexicon Collection

We made use of numerous Ottoman-Turkish dictionaries from online sources [7, 8] in order to collect Ottoman transcriptions of Turkish words and build a lexicon. Hayrat Nesriyat’s dictionary holds nearly 110,000 different words and their translations to Ottoman script, as seen in Figure 2. Instead of using Tevakkü’s conjugated verb list, we made use of root verbs and nouns from [7].

Kelimeid	Latince	Osmanlica
10453	ördümek	اوردورمك
10462	öpülmek	اوپولمك
10463	örtbas etmek	اورت باس ايتك
10468	ötürmek	اوتورمك
10470	ötümsüzleşmek	اوتوسمز لئشك
10474	ötümlüleşmek	اوتوملئشك
10480	ötmek	اوتتيرمك
10483	ötmek	اوتك
10492	ötüşmek	اوتوشك
10493	öykülemek	اويكولمك
10499	övünmek	اوگونمك
10507	övlmek	اوكلمك
10509	övmek	اوگمك
10520	örülmek	اورولمك
10522	örüklemek	اوروكلمك
10530	örtünmek	اورتونمك
10535	örtülmek	اورتولمك

Figure 2. A sample from Hayrat Nesriyat’s Ottoman dictionary [7]

B. Morphological Analysis Method

Morphological analysis of Ottoman text may be performed with two methods:

1. Detecting the possible root words by using a dictionary and trying to extract remaining suffixes by comparing syllables to a suffix list.
2. Building a finite state machine with a lexicon composed of verbs, nouns and suffixes for two-level morphological recognition and generation.

We did not prefer the first method because it does not recognize the morphotactics of Turkish language in a structured way. Also, it does not allow morphological generation, that is picking a root word and defining some suffixes and synthesizing a surface level word.

We followed the second approach and therefore we used *foma* [10], a well-known and common tool for finite-state machine compiling as it is mostly suitable for our requirements. We inserted root verbs and nouns to a lexicon file and described inflection rules by defining a set of verb and

noun suffixes. A sample rule set of noun inflections can be seen in Figure 3.

For describing verb and noun inflection rules in *foma* environment, we are inspired by Coltekin’s study

```

LEXICON NPluralSingular
+N:0 NPossessive;
+N+Pl:لر NPossessive;

LEXICON NPossessive
#;
+P1S:م NCase; !(I)m
+P2S:ئ NCase; !(I)n
+P3S:ى NCase; !(s)I
+P1P:من NCase; !(I)mIz
+P2P:گر NCase; !(I)nIz
+P3P:لر NCase; !lArI

LEXICON NCase
#;
+Acc:ى #; !(y)I
+Dat:ه #; !(y)A
+Abl:دن #; !DAn
+Loc:ده #; !DA
+Gen:ئ #; !(n)In
+Inst:له #; !(y)lA

```

Figure 3. A sample from Ottoman noun inflection rules in *foma* environment

C. Transformations on suffixes

In Turkish, inflection of a word is not always straightforward. Same suffix may take different forms when being appended to different words as shown in Table I. Therefore we needed to define these kinds of suffix transformations in *foma* environment by means of functions.

For example, “+P3S” the possessive 3rd singular person suffix (-I) is preceded with the letter “s” if the root word’s last letter is a vowel. (kitab-**ı**, araba-**sı**). Same transformation is also applied in Ottoman script by prepending the letter “س” to the suffix “-ى”.

Another case is the necessity of inserting a vowel (-I) before possessive suffixes (-m, -n, -mIz, -nIz) when the root word ends with a consonant. This happens in Ottoman script by prepending the letter “-ى” before +P1S, +P1P, +P2P possessive suffixes. We describe these transformations in the “*PossessiveKaynastirmaInsertion*” function in *foma* as described below:

```

define Vowels [ و | ي | ا | ا | ا | ا | ا ];
define Consonants [ ح | ج | ج | ث | ت | پ | ب |
ا | خ | د | ذ | ر | ز | ز | س | ش | ص | ض | ط |
ن | م | ل | ل | ك | گ | ك | ق | ف | غ | ع | ط |
];

```

```
! (I)m, (I)n, (I)mIz, (I)nIz, (s)I insertion
define PossesiveKaynastirmaInsertion
[.] -> ي || NonVowels "^" _ [ ك ز م ا ن ] ,,
[.] -> س || Vowels "^" _ [ ي ] ;
```

After $-(s)I$ and $-lArI$, the suffixes of $-DA$ and $-DAn$ become $-nDA$ and $-nDAn$, respectively, and $-(y)A$ and $-(y)I$ become $-nA$ and $-nI$, respectively. These insertions are performed in Ottoman script by inserting the letter “-” as described in the “*NInsertion*” function below:

```
define NInsertion
[.] -> [ ا | د | ه | ن ] _ "^" [ ي | ل | ر ] "^" || ن
[.] -> ن || Vowels "^" _ [ ك ; ! (n)In
```

If the root word ends with a vowel, the letter “y” (“-ي” in Ottoman) is inserted in suffixes such as: $-(y)I$, $-(y)A$, $-(y)IA$. This rule is described in “*YInsertion*” function below:

```
define YInsertion
[.] -> ي || Vowels "^" _ [ ه | ل | ا | ي ] ;
```

IV. EXPERIMENTS

At this stage of our project, we only implemented and experimented inflections of noun words in Ottoman. In order to clearly demonstrate consonant and vowel insertion scenarios of noun inflections we selected two example words:

1. چانطه - Çanta (ends with vowel)
2. كتاب - Kitab (ends with consonant)

All remaining results could be found in Appendix.

A. Surface to Lexical

We performed surface to lexical experiments in order to evaluate the accuracy of FSM. Since inflectional forms of nouns might sometimes cause ambiguities, our FSM should be able to detect possible ambiguities and list all probable parsings according to the rules of Turkish. Figure 4 depicts such a scenario with our two sample words:

```
done:
2.1 kB, 40 states, 54 arcs, 431 paths.
redefined Lexicon: 2.1 kB, 40 states, 54 arcs, 431 paths.
redefined Grammar: 3.3 kB, 58 states, 93 arcs, 431 paths.
3.3 kB, 58 states, 93 arcs, 431 paths.
foma[3]: up
apply up> ه د ن ر ل ه ط ن ا ج
ه د ن ر ل ه ط ن ا ج +N+P3P+Loc
ه ط ن ا ج +N+Pl+P3S+Loc
apply up> ن د ن ر ل ب ا ن ك
ن ب ا ن ك +N+P3P+Abl
ن ب ا ن ك +N+Pl+P3S+Abl
```

Figure 4. Listing noun inflectional ambiguities using FSM in foma environment

چانطه لارينده (Çantalarında) might express two different meanings:

1. Çanta+N+P3P+Loc (at their bag)
2. Çanta+N+Pl+P3S+Loc (at his/her bags)

B. Lexical to Surface Level

Another experiment is giving the lexical description of an inflection and checking the surface level result. As seen in Figure 5, the inflection of word “كتاب - Kitab” is given accurately in two scenarios:

1. كتاب +N+Pl+P2P+Gen: Plural noun, Possessive 2nd plural person and genitive inflection is translated to surface level as كتابلارينيز (Kitablarınızın - ... of your books) accurately.
2. كتاب+N+P1P+Inst: Singular noun, Possessive 1st singular person, instrumental inflection is translated to surface level as كتابimizle (Kitabımızla = with our book) accurately.

```
apply down> ن ب ا ن ك +N+Pl+P2P+Gen
ن ب ا ن ك
apply down> ن ب ا ن ك +N+P1P+Inst
ه ل ز م ي ب ا ن ك
```

Figure 5. Morphological generation with word “كتاب - Kitab”

V. EVALUATION

We listed a brief part of our experiments in the previous section. However there were also some wrong inflections that we observed. For example, چانطه +N+Pl+P3P (Plural noun and Possessive 3rd plural person) is translated as چانطه لار (Çantaları) although it should be translated as (Çantaları). This happens because the ruleset in our FSM description lacks this exceptional case. These kinds of errors should be observed and corrected in the remaining part of our project.

V. WORK DONE AFTER MIDWAY REPORT

In our earlier work, we stated that we will make progress by studying Ottoman verb inflections. In this section we describe our method.

A. Vowel Harmony

According to Turkish Morphology quick reference sheet [3], “Vowel Harmony” is described as: “A syllable’s vowels are formed according to the last vowel of the word it appends to. There is an A-Type harmony; if the last vowel of the word is a back vowel (a, ı, o, u), a is produced. If the last vowel is a frontal vowel (e, i, ö, ü), e is produced. There is also an I-Type harmony; if the last vowel is back and unrounded (a, ı), ı is produced. if it is back and rounded (o, u), u is produced. if it is frontal and unrounded (e, i), i is produced and lastly if it is frontal and rounded (ö, ü), ü is produced.”

In Latin script such a rule can be defined in FOMA environment [11] as below:

```
define +HIGH i|u|ı|ü;
define -HIGH e|a|o|ö;
define +BACK ı|a|o|u;
define -BACK i|e|ö|ü;
define +ROUND ö|ü|o|u;
define -ROUND e|a|ı|ı;

define HRule
H -> %+HIGH & %+ROUND & %BACK || [%BACK & %+ROUND] \V* - ''
H -> %+HIGH & %+ROUND & %-BACK || [%-BACK & %+ROUND] \V* - ''
H -> %+HIGH & %-ROUND & %BACK || [%BACK & %-ROUND] \V* - ''
H -> %+HIGH & %-ROUND & %-BACK || [%-BACK & %-ROUND] \V* - ;
```

Nevertheless, in Ottoman script defining such a rule becomes difficult because of the ambiguity caused by *u* and *o* letters which are written with the same letter “و”. In order to overcome this problem, we preferred to manually label each verb root with one of 4 category labels: *InceDuz* (frontal-unrounded), *InceYuvarlak* (frontal-rounded), *KalinDuz* (back-unrounded), *KalinYuvarlak* (back-rounded). This helped us to determine which suffix form will be appended to the verb root when it is inflected. An example can be seen below.

```
LEXICON Verb
گیت NegationInceDuz;
سو NegationInceDuz;
گور NegationInceYuvarlak;
سور NegationInceYuvarlak;
آل NegationKalinDuz;
قال NegationKalinDuz;
قوش NegationKalinYuvarlak;
اویو NegationKalinYuvarlak;
اوقو NegationKalinYuvarlak;
```

Figure 6. Example verb roots defined in our lexicon: گیت (*Git*, to go), سو (*Sev*, to love), گور (*Gör*, to see), سور (*Sür*, to drive), آل (*Al*, to take), قال (*Kal*, to stay), قوش (*Koş*, to run), اویو (*Uyu*, to sleep), اوقو (*Oku*, to read)

B. Verb Tense Inflection

In Turkish, multiple tenses can be appended to a single verb root in order to express complicated tenses such as past perfect continuous tense. (e.g. *çalışıyordu* = he had been working) This increases the complexity of verb inflections and we leave it to our future work. For simplicity, we tried to define two basic tenses in Ottoman: *aorist* and *continuous*. In aorist tense, a verb root might take the aorist tense suffix in one of 6 different forms (*-er*, *-ar*, *-ır*, *-ir*, *-ur*, *-ür*) because of the Vowel Harmony rule that we described in previous section. [12] In Ottoman script the number of forms decreases to 4 (ا-ر), (ی-ر), (و-ر), (ی-و-ر). In continuous tense, a verb root might take 4 different forms of suffix (*-ıyor*, *-iyor*, *-uyor*, *-üyor*) but in Ottoman script this number halves (یور-), (یور-و-).

Since we defined our verb lexicon with their rounded/unrounded, frontal/back properties we were able to find the correct suffix form to append to verb root. For example, سو (*Sev*, to love) is a frontal-unrounded verb root which is to be inflected with (یور-) form of continuous tense suffix. On the other hand, قوش (*Koş*, to run) is a back-rounded verb root which is to be inflected with (یور-) form of continuous tense suffix. The inflections of those two verbs can be seen in Figure 7 and 8.

```
سو+Positive+Continuous+P1S سو بیورم
سو+Positive+Continuous+P1P سو بیور
سو+Positive+Continuous+P3P سو بیورلر
سو+Positive+Continuous+P3P سو بیورلر
سو+Positive+Continuous+P2P سو بیورسکر
سو+Positive+Continuous+P2S سو بیورسک
سو+Positive+Continuous+P3S سو بیور
سو+Positive+Aorist+P1S سورم
سو+Positive+Aorist+P1P سور
سو+Positive+Aorist+P3P سور
سو+Positive+Aorist+P3P سورلر
سو+Positive+Aorist+P2P سورسکر
سو+Positive+Aorist+P2S سورسک
سو+Positive+Aorist+P3S سورسک
```

Figure 7. The aorist and continuous tense inflections of سو (*Sev*, to love) generated by our lexicon.

```
قوش+Positive+Continuous+P1S قوشو بیورم
قوش+Positive+Continuous+P1P قوشو بیور
قوش+Positive+Continuous+P3P قوشو بیورلر
قوش+Positive+Continuous+P3P قوشو بیورلر
قوش+Positive+Continuous+P2P قوشو بیورسکر
قوش+Positive+Continuous+P2S قوشو بیورسک
قوش+Positive+Continuous+P3S قوشو بیور
```

Figure 8. The continuous tense inflections of قوش (*Koş*, to run) generated by our lexicon.

C. Verb Negation Inflection

In Turkish, negating a verb is done simply by appending (*-me*, *-ma*) suffixes to verb root before any other suffix. For example *git-miş* (he went) can be turned into a negative verb by prepending tense suffixes with *-me*, making it *git-me-miş* (he did not go). However, in aorist tense this becomes more complicated because an aorist tense suffix (*-er*, *-ar*) is transformed into (*-z*) if a negation suffix comes before it. Even more complicated, in singular 1st person and plural 1st person, the *-z* suffix also transforms into *-m* and *-yIz*, respectively. To reflect all those different inflection rules in our lexicon

requires writing additional transformation rules, as shown below:

```
! Rule to eliminate negative aorist gelme(z)m conflict.
define Zclear [ م ] ^ _ || [ م ] <- [ ز ] , ,
[ م ] ^ _ || [ ا م ] <- [ ز ] , ,
[ ز ] ^ _ || [ م ] <- [ ز ] , ,
[ ز ] ^ _ || [ ا م ] <- [ ز ] ;
```

Figure 7 and 9 and Figure 8 and 10 can be compared to see the effects of adding a single negation suffix on the verb's inflection.

سو+Negative+Continuous+P1S	سو ميبورم
سو+Negative+Continuous+P1P	سو ميبور
سو+Negative+Continuous+P3P	سو ميبور
سو+Negative+Continuous+P3P	سو ميبورلر
سو+Negative+Continuous+P2P	سو ميبورسگ
سو+Negative+Continuous+P2S	سو ميبورسگ
سو+Negative+Continuous+P3S	سو ميبور
سو+Negative+Aorist+P3P	سو مز
سو+Negative+Aorist+P3P	سو مزلر
سو+Negative+Aorist+P2P	سو مزسگ
سو+Negative+Aorist+P2S	سو مزسگ
سو+Negative+Aorist+P3S	سو مز
سو+Negative+Aorist+P1P	سو مز
سو+Negative+Aorist+P1S	سو مم

Figure 9. The negative aorist and continuous tense inflections of سو (Sev, to love) generated by our lexicon.

قوش+Negative+Continuous+P1S	قوشميبورم
قوش+Negative+Continuous+P1P	قوشميبور
قوش+Negative+Continuous+P3P	قوشميبور
قوش+Negative+Continuous+P3P	قوشميبورلر
قوش+Negative+Continuous+P2P	قوشميبورسگ
قوش+Negative+Continuous+P2S	قوشميبورسگ
قوش+Negative+Continuous+P3S	قوشميبور
قوش+Negative+Aorist+P3P	قوشما ز
قوش+Negative+Aorist+P3P	قوشما زلر
قوش+Negative+Aorist+P2P	قوشما رسگ
قوش+Negative+Aorist+P2S	قوشما رسگ
قوش+Negative+Aorist+P3S	قوشما ز
قوش+Negative+Aorist+P1P	قوشما يز
قوش+Negative+Aorist+P1S	قوشما م

Figure 10. The negative aorist and continuous tense inflections of قوش (Koş, to run) generated by our lexicon.

VI. CONCLUSION

Although some exceptional cases and some other suffixes are obsolete in our current FSM description, we performed the major parts of noun inflections in Ottoman. We demonstrated some example results of two-level morphological recognition and generation (bottom-up and top-down translation).

After the midway report we focused on verb inflections which is a more difficult procedure because of the complicated inflectional nature of verbs in Turkish. For simplicity, we just implemented two tense inflections and negation inflection, and other than some exceptional cases, the inflections are correctly generated by our FOMA descriptions. We leave completing other tenses as a future work.

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APPENDIX

A. The full list of verb inflections

قال+Negative+Continuous+P1S	قالمييورم
قال+Negative+Continuous+P1P	قالمييورز
قال+Negative+Continuous+P3P	قالمييور
قال+Negative+Continuous+P3P	قالمييورلر
قال+Negative+Continuous+P2P	قالمييور سكر
قال+Negative+Continuous+P2S	قالمييور سڭ
قال+Negative+Continuous+P3S	قالمييور
قال+Negative+Aorist+P3P	قالماز
قال+Negative+Aorist+P3P	قالمازلر
قال+Negative+Aorist+P2P	قالماز سكر
قال+Negative+Aorist+P2S	قالماز سڭ
قال+Negative+Aorist+P3S	قالماز
قال+Negative+Aorist+P1P	قالمايز
قال+Negative+Aorist+P1S	قالمام
قال+Positive+Continuous+P1S	قالمييورم
قال+Positive+Continuous+P1P	قالمييورز
قال+Positive+Continuous+P3P	قالمييور
قال+Positive+Continuous+P3P	قالمييورلر
قال+Positive+Continuous+P2P	قالمييور سكر
قال+Positive+Continuous+P2S	قالمييور سڭ
قال+Positive+Continuous+P3S	قالمييور
قال+Positive+Aorist+P1S	قالرم
قال+Positive+Aorist+P1P	قالرز
قال+Positive+Aorist+P3P	قالر
قال+Positive+Aorist+P3P	قالرلر
قال+Positive+Aorist+P2P	قالر سكر
قال+Positive+Aorist+P2S	قالر سڭ
قال+Positive+Aorist+P3S	قالر
قوش+Negative+Continuous+P1S	قوشمييورم
قوش+Negative+Continuous+P1P	قوشمييورز
قوش+Negative+Continuous+P3P	قوشمييور
قوش+Negative+Continuous+P3P	قوشمييورلر
قوش+Negative+Continuous+P2P	قوشمييور سكر
قوش+Negative+Continuous+P2S	قوشمييور سڭ
قوش+Negative+Continuous+P3S	قوشمييور
قوش+Negative+Aorist+P3P	قوشماز
قوش+Negative+Aorist+P3P	قوشمازلر
قوش+Negative+Aorist+P2P	قوشماز سكر
قوش+Negative+Aorist+P2S	قوشماز سڭ
قوش+Negative+Aorist+P3S	قوشماز
قوش+Negative+Aorist+P1P	قوشمايز
قوش+Negative+Aorist+P1S	قوشمام
قوش+Positive+Continuous+P1S	قوشمييورم
قوش+Positive+Continuous+P1P	قوشمييورز
قوش+Positive+Continuous+P3P	قوشويور
قوش+Positive+Continuous+P3P	قوشويورلر
قوش+Positive+Continuous+P2P	قوشويور سكر
قوش+Positive+Continuous+P2S	قوشويور سڭ
قوش+Positive+Continuous+P3S	قوشويور
قوش+Positive+Aorist+P1S	قوشورم
قوش+Positive+Aorist+P1P	قوشورز
قوش+Positive+Aorist+P3P	قوشور
قوش+Positive+Aorist+P3P	قوشورلر
قوش+Positive+Aorist+P2P	قوشور سكر
قوش+Positive+Aorist+P2S	قوشور سڭ
قوش+Positive+Aorist+P3S	قوشور
اووقو+Negative+Continuous+P1S	اووقومييورم
اووقو+Negative+Continuous+P1P	اووقومييورز
اووقو+Negative+Continuous+P3P	اووقومييور
اووقو+Negative+Continuous+P3P	اووقومييورلر
اووقو+Negative+Continuous+P2P	اووقومييور سكر
اووقو+Negative+Continuous+P2S	اووقومييور سڭ
اووقو+Negative+Continuous+P3S	اووقومييور
اووقو+Negative+Aorist+P3P	اووقوماز
اووقو+Negative+Aorist+P3P	اووقومازلر
اووقو+Negative+Aorist+P2P	اووقوماز سكر
اووقو+Negative+Aorist+P2S	اووقوماز سڭ
اووقو+Negative+Aorist+P3S	اووقوماز
اووقو+Negative+Aorist+P1P	اووقومايز
اووقو+Negative+Aorist+P1S	اووقومام
اووقو+Positive+Continuous+P1S	اووقويورم
اووقو+Positive+Continuous+P1P	اووقويورز
اووقو+Positive+Continuous+P3P	اووقويور
اووقو+Positive+Continuous+P3P	اووقويورلر
اووقو+Positive+Continuous+P2P	اووقويور سكر
اووقو+Positive+Continuous+P2P	اووقويور سكر

اوقور يور سئڭ	Positive+Continuous+P2S
اوقور يور	Positive+Continuous+P3S
اوقور م	Positive+Aorist+P1S
اوقور وۇز	Positive+Aorist+P1P
اوقور	Positive+Aorist+P3P
اوقور لار	Positive+Aorist+P3P
اوقور سئڭ	Positive+Aorist+P2P
اوقور سئڭ	Positive+Aorist+P2S
اوقور	Positive+Aorist+P3S
اويو ييور م	Negative+Continuous+P1S
اويو ييور وۇز	Negative+Continuous+P1P
اويو ييور	Negative+Continuous+P3P
اويو ييور لار	Negative+Continuous+P3P
اويو ييور سئڭ	Negative+Continuous+P2P
اويو ييور سئڭ	Negative+Continuous+P2S
اويو ييور	Negative+Continuous+P3S
اويماز	Negative+Aorist+P3P
اويماز لار	Negative+Aorist+P3P
اويماز سئڭ	Negative+Aorist+P2P
اويماز سئڭ	Negative+Aorist+P2S
اويماز	Negative+Aorist+P3S
اويوماز	Negative+Aorist+P1P
اويوماز	Negative+Aorist+P1S
اويو ييور م	Positive+Continuous+P1S
اويو ييور وۇز	Positive+Continuous+P1P
اويو ييور	Positive+Continuous+P3P
اويو ييور لار	Positive+Continuous+P3P
اويو ييور سئڭ	Positive+Continuous+P2P
اويو ييور سئڭ	Positive+Continuous+P2S
اويو ييور	Positive+Continuous+P3S
اويور م	Positive+Aorist+P1S
اويور	Positive+Aorist+P1P
اويور	Positive+Aorist+P3P
اويور لار	Positive+Aorist+P3P
اويور سئڭ	Positive+Aorist+P2P
اويور سئڭ	Positive+Aorist+P2S
اويور	Positive+Aorist+P3S
ال ييور م	Negative+Continuous+P1S
ال ييور وۇز	Negative+Continuous+P1P
ال ييور	Negative+Continuous+P3P
ال ييور لار	Negative+Continuous+P3P
ال ييور سئڭ	Negative+Continuous+P2P
ال ييور سئڭ	Negative+Continuous+P2S
ال ييور	Negative+Continuous+P3S
الماز	Negative+Aorist+P3P
الماز لار	Negative+Aorist+P3P
الماز سئڭ	Negative+Aorist+P2P
الماز سئڭ	Negative+Aorist+P2S
الماز	Negative+Aorist+P3S
الماز	Negative+Aorist+P1P
الماز	Negative+Aorist+P1S
ال ييور م	Positive+Continuous+P1S
ال ييور وۇز	Positive+Continuous+P1P
ال ييور	Positive+Continuous+P3P
ال ييور لار	Positive+Continuous+P3P
ال ييور سئڭ	Positive+Continuous+P2P
ال ييور سئڭ	Positive+Continuous+P2S
ال ييور	Positive+Continuous+P3S
الرم	Positive+Aorist+P1S
الز	Positive+Aorist+P1P
الز	Positive+Aorist+P3P
الز	Positive+Aorist+P3P
الرس سئڭ	Positive+Aorist+P2P
الرس سئڭ	Positive+Aorist+P2S
الز	Positive+Aorist+P3S
سو مييور م	Negative+Continuous+P1S
سو مييور وۇز	Negative+Continuous+P1P
سو مييور	Negative+Continuous+P3P
سو مييور لار	Negative+Continuous+P3P
سو مييور سئڭ	Negative+Continuous+P2P
سو مييور سئڭ	Negative+Continuous+P2S
سو مييور	Negative+Continuous+P3S
سو م	Negative+Aorist+P3P
سو م لار	Negative+Aorist+P3P
سو م سئڭ	Negative+Aorist+P2P
سو م سئڭ	Negative+Aorist+P2S
سو م سئڭ	Negative+Aorist+P3S
سو م	Negative+Aorist+P1P
سو م	Negative+Aorist+P1S
سو مييور م	Positive+Continuous+P1S

سو+Positive+Continuous+P1P
 سو+Positive+Continuous+P3P
 سو+Positive+Continuous+P3P
 سو+Positive+Continuous+P2P
 سو+Positive+Continuous+P2S
 سو+Positive+Continuous+P3S
 سو+Positive+Aorist+P1S سورم
 سو+Positive+Aorist+P1P سوز
 سو+Positive+Aorist+P3P سور
 سو+Positive+Aorist+P3P سورلر
 سو+Positive+Aorist+P2P سورسكز
 سو+Positive+Aorist+P2S سورسك
 سو+Positive+Aorist+P3S سور
 سو+Negative+Continuous+P1S سورمئورم
 سو+Negative+Continuous+P1P سورمئورز
 سو+Negative+Continuous+P3P سورمئور
 سو+Negative+Continuous+P3P سورمئورلر
 سو+Negative+Continuous+P2P سورمئورسكز
 سو+Negative+Continuous+P2S سورمئورسك
 سو+Negative+Continuous+P3S سورمئور
 سو+Negative+Aorist+P3P سورمز
 سو+Negative+Aorist+P3P سورمزلر
 سو+Negative+Aorist+P2P سورمزسكز
 سو+Negative+Aorist+P2S سورمزسك
 سو+Negative+Aorist+P3S سورمز
 سو+Negative+Aorist+P1P سورمئز
 سو+Negative+Aorist+P1S سورمم
 سو+Positive+Continuous+P1S سورويورم
 سو+Positive+Continuous+P1P سورويورز
 سو+Positive+Continuous+P3P سورويور
 سو+Positive+Continuous+P3P سورويورلر
 سو+Positive+Continuous+P2P سورويورسكز
 سو+Positive+Continuous+P2S سورويورسك
 سو+Positive+Continuous+P3S سورويور
 سو+Positive+Aorist+P1S سورورم
 سو+Positive+Aorist+P1P سورورز
 سو+Positive+Aorist+P3P سورور
 سو+Positive+Aorist+P3P سورورلر
 سو+Positive+Aorist+P2P سورورسكز
 سو+Positive+Aorist+P2S سورورسك
 سو+Positive+Aorist+P3S سورور
 سو+Negative+Continuous+P1S گورمئورم
 سو+Negative+Continuous+P1P گورمئورز
 سو+Negative+Continuous+P3P گورمئور
 سو+Negative+Continuous+P3P گورمئورلر
 سو+Negative+Continuous+P2P گورمئورسكز
 سو+Negative+Continuous+P2S گورمئورسك
 سو+Negative+Continuous+P3S گورمئور
 سو+Negative+Aorist+P3P گورمز
 سو+Negative+Aorist+P3P گورمزلر
 سو+Negative+Aorist+P2P گورمزسكز
 سو+Negative+Aorist+P2S گورمزسك
 سو+Negative+Aorist+P3S گورمز
 سو+Negative+Aorist+P1P گورمئز
 سو+Negative+Aorist+P1S گورمم
 سو+Positive+Continuous+P1S گورويورم
 سو+Positive+Continuous+P1P گورويورز
 سو+Positive+Continuous+P3P گورويور
 سو+Positive+Continuous+P3P گورويورلر
 سو+Positive+Continuous+P2P گورويورسكز
 سو+Positive+Continuous+P2S گورويورسك
 سو+Positive+Continuous+P3S گورويور
 سو+Positive+Aorist+P1S گورورم
 سو+Positive+Aorist+P1P گورورز
 سو+Positive+Aorist+P3P گورور
 سو+Positive+Aorist+P3P گورورلر
 سو+Positive+Aorist+P2P گورورسكز
 سو+Positive+Aorist+P2S گورورسك
 سو+Positive+Aorist+P3S گورور
 سو+Negative+Continuous+P1S گئتمئورم
 سو+Negative+Continuous+P1P گئتمئورز
 سو+Negative+Continuous+P3P گئتمئور
 سو+Negative+Continuous+P3P گئتمئورلر
 سو+Negative+Continuous+P2P گئتمئورسكز
 سو+Negative+Continuous+P2S گئتمئورسك
 سو+Negative+Continuous+P3S گئتمئور
 سو+Negative+Aorist+P3P گئتمز
 سو+Negative+Aorist+P3P گئتمزلر
 سو+Negative+Aorist+P2P گئتمزسكز
 سو+Negative+Aorist+P2S گئتمزسك

سوئورز
 سوئور
 سوئورلر
 سوئورسكز
 سوئورسك
 سوئور
 سورمئورم
 سورمئورز
 سورمئور
 سورمئورلر
 سورمئورسكز
 سورمئورسك
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 گورور
 گئتمئورم
 گئتمئورز
 گئتمئور
 گئتمئورلر
 گئتمئورسكز
 گئتمئورسك
 گئتمئور
 گئتمز
 گئتمزلر
 گئتمزسكز
 گئتمزسك

سو+Negative+Aorist+P3S
 سو+Negative+Aorist+P1P
 سو+Negative+Aorist+P1S
 سو+Positive+Continuous+P1S
 سو+Positive+Continuous+P1P
 سو+Positive+Continuous+P3P
 سو+Positive+Continuous+P3P
 سو+Positive+Continuous+P2P
 سو+Positive+Continuous+P2S
 سو+Positive+Continuous+P3S
 سو+Positive+Aorist+P1S
 سو+Positive+Aorist+P1P
 سو+Positive+Aorist+P3P
 سو+Positive+Aorist+P3P
 سو+Positive+Aorist+P2P
 سو+Positive+Aorist+P2S
 سو+Positive+Aorist+P3S

گئتمز
 گئتمئز
 گئتمم
 گئتمئورم
 گئتمئورز
 گئتمئور
 گئتمئورلر
 گئتمئورسكز
 گئتمئورسك
 گئتمئور
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 گئتمز

B. The full list of noun inflections

بابا+N
 بابا+N+P3P بابالرى
 بابا+N+P3P+Loc بابالربنده
 بابا+N+P3P+Abl بابالربندن
 بابا+N+P3P+Dat بابالربنه
 بابا+N+P3P+Gen بابالربنڭ
 بابا+N+P3P+Acc بابالربىسى
 بابا+N+P3P+Inst بابالربىلە
 بابا+N+P2P بابانگىز
 بابا+N+P2P+Loc بابانگىزدە
 بابا+N+P2P+Abl بابانگىزدن
 بابا+N+P2P+Inst بابانگىزلە
 بابا+N+P2P+Dat بابانگىزە
 بابا+N+P2P+Gen بابانگىزڭ
 بابا+N+P2P+Acc بابانگىزى
 بابا+N+P1P بابامز
 بابا+N+P1P+Loc بابامز دە
 بابا+N+P1P+Abl بابامزدن
 بابا+N+P1P+Inst بابامز لە
 بابا+N+P1P+Dat بابامزە
 بابا+N+P1P+Gen بابامزڭ
 بابا+N+P1P+Acc بابامزى
 بابا+N+P3S بابامسى
 بابا+N+P3S+Gen بابامسنىڭ
 بابا+N+P3S+Acc بابامسىسى
 بابا+N+P3S+Loc بابامسندە
 بابا+N+P3S+Abl بابامسندن
 بابا+N+P3S+Inst بابامسىلە
 بابا+N+P3S+Dat بابامسىە
 بابا+N+P2S بابانگىڭ
 بابا+N+P2S+Loc بابانگىدە
 بابا+N+P2S+Abl بابانگىدن
 بابا+N+P2S+Inst بابانگىلە
 بابا+N+P2S+Dat بابانگىە
 بابا+N+P2S+Gen بابانگىڭڭ
 بابا+N+P2S+Acc بابانگىى
 بابا+N+P1S بابام
 بابا+N+P1S+Loc بابامدە
 بابا+N+P1S+Abl بابامدن
 بابا+N+P1S+Inst باباملە
 بابا+N+P1S+Dat بابامە
 بابا+N+P1S+Gen بابامڭ
 بابا+N+P1S+Acc بابامى
 بابا+N+PI بابالر
 بابا+N+PI+P3P بابالرلى
 بابا+N+PI+P3P+Loc بابالرلربنده
 بابا+N+PI+P3P+Abl بابالرلربندن
 بابا+N+PI+P3P+Dat بابالرلربنه
 بابا+N+PI+P3P+Gen بابالرلربنڭ
 بابا+N+PI+P3P+Acc بابالرلربىسى
 بابا+N+PI+P3P+Inst بابالرلربىلە
 بابا+N+PI+P2P بابالرىگىز
 بابا+N+PI+P2P+Loc بابالرىگىزدە
 بابا+N+PI+P2P+Abl بابالرىگىزدن
 بابا+N+PI+P2P+Inst بابالرىگىزلە
 بابا+N+PI+P2P+Dat بابالرىگىزە
 بابا+N+PI+P2P+Gen بابالرىگىزڭ
 بابا+N+PI+P2P+Acc بابالرىگىزى
 بابا+N+PI+P1P بابالرىمىز
 بابا+N+PI+P1P+Loc بابالرىمىزدە

N+PI+P3P+Gen	ماصهار لار ننگ	N+PI+Acc	کتابیمی
N+PI+P3P+Acc	ماصهار لار نسی	N+PI	کتابلر
N+PI+P3P+Inst	ماصهار لار نیله	N+PI+P3P	کتابلر لاری
N+PI+P2P	ماصهار یگز	N+PI+P3P+Loc	کتابلر لار ننده
N+PI+P2P+Loc	ماصهار یگز ده	N+PI+P3P+Abl	کتابلر لار نندن
N+PI+P2P+Abl	ماصهار یگز دن	N+PI+P3P+Dat	کتابلر لار ننه
N+PI+P2P+Inst	ماصهار یگز له	N+PI+P3P+Gen	کتابلر لار ننگ
N+PI+P2P+Dat	ماصهار یگز ه	N+PI+P3P+Acc	کتابلر لار نسی
N+PI+P2P+Gen	ماصهار یگز گ	N+PI+P3P+Inst	کتابلر لار نیله
N+PI+P2P+Acc	ماصهار یگز ی	N+PI+P2P	کتابلر یگز
N+PI+P1P	ماصهار یمز	N+PI+P2P+Loc	کتابلر یگز ده
N+PI+P1P+Loc	ماصهار یمز ده	N+PI+P2P+Abl	کتابلر یگز دن
N+PI+P1P+Abl	ماصهار یمز دن	N+PI+P2P+Inst	کتابلر یگز له
N+PI+P1P+Inst	ماصهار یمز له	N+PI+P2P+Dat	کتابلر یگز ه
N+PI+P1P+Dat	ماصهار یمز ه	N+PI+P2P+Gen	کتابلر یگز گ
N+PI+P1P+Gen	ماصهار یمز گ	N+PI+P2P+Acc	کتابلر یگز ی
N+PI+P1P+Acc	ماصهار یمز ی	N+PI+P1P	کتابلر یمز
N+PI+P3S	ماصهار ی	N+PI+P1P+Loc	کتابلر یمز ده
N+PI+P3S+Loc	ماصهار ی ننده	N+PI+P1P+Abl	کتابلر یمز دن
N+PI+P3S+Abl	ماصهار ی نندن	N+PI+P1P+Inst	کتابلر یمز له
N+PI+P3S+Dat	ماصهار ی ننه	N+PI+P1P+Dat	کتابلر یمز ه
N+PI+P3S+Gen	ماصهار ی ننگ	N+PI+P1P+Gen	کتابلر یمز گ
N+PI+P3S+Acc	ماصهار ی نسی	N+PI+P1P+Acc	کتابلر یمز ی
N+PI+P3S+Inst	ماصهار ی نیله	N+PI+P3S	کتابلر ی
N+PI+P2S	ماصهار گ	N+PI+P3S+Loc	کتابلر ننده
N+PI+P2S+Loc	ماصهار گ ده	N+PI+P3S+Abl	کتابلر نندن
N+PI+P2S+Abl	ماصهار گ دن	N+PI+P3S+Dat	کتابلر ننه
N+PI+P2S+Inst	ماصهار گ له	N+PI+P3S+Gen	کتابلر ننگ
N+PI+P2S+Dat	ماصهار گ ه	N+PI+P3S+Acc	کتابلر نسی
N+PI+P2S+Gen	ماصهار گ گ	N+PI+P3S+Inst	کتابلر نیله
N+PI+P2S+Acc	ماصهار گ ی	N+PI+P2S	کتابلر گ
N+PI+P1S	ماصهار یم	N+PI+P2S+Loc	کتابلر گ ده
N+PI+P1S+Loc	ماصهار یم ده	N+PI+P2S+Abl	کتابلر گ دن
N+PI+P1S+Abl	ماصهار یم دن	N+PI+P2S+Inst	کتابلر گ له
N+PI+P1S+Inst	ماصهار یم له	N+PI+P2S+Dat	کتابلر گ ه
N+PI+P1S+Dat	ماصهار یم ه	N+PI+P2S+Gen	کتابلر گ گ
N+PI+P1S+Gen	ماصهار یم گ	N+PI+P2S+Acc	کتابلر گ ی
N+PI+P1S+Acc	ماصهار یم ی	N+PI+P1S	کتابلر یم
N	کتاب	N+PI+P1S+Loc	کتابلر یم ده
N+P3P	کتابلر ی	N+PI+P1S+Abl	کتابلر یم دن
N+P3P+Loc	کتابلر ننده	N+PI+P1S+Inst	کتابلر یم له
N+P3P+Abl	کتابلر نندن	N+PI+P1S+Dat	کتابلر یم ه
N+P3P+Dat	کتابلر ننه	N+PI+P1S+Gen	کتابلر یم گ
N+P3P+Gen	کتابلر ننگ	N+PI+P1S+Acc	کتابلر یم ی
N+P3P+Acc	کتابلر نسی	N	کدی
N+P3P+Inst	کتابلر نیله	N+P3P	کدی لری
N+P2P	کتابیگز	N+P3P+Loc	کدی لار ننده
N+P2P+Loc	کتابیگز ده	N+P3P+Abl	کدی لار نندن
N+P2P+Abl	کتابیگز دن	N+P3P+Dat	کدی لار ننه
N+P2P+Inst	کتابیگز له	N+P3P+Gen	کدی لار ننگ
N+P2P+Dat	کتابیگز ه	N+P3P+Acc	کدی لار نسی
N+P2P+Gen	کتابیگز گ	N+P3P+Inst	کدی لار نیله
N+P2P+Acc	کتابیگز ی	N+P2P	کدی نگز
N+P1P	کتابیمز	N+P2P+Loc	کدی نگز ده
N+P1P+Loc	کتابیمز ده	N+P2P+Abl	کدی نگز دن
N+P1P+Abl	کتابیمز دن	N+P2P+Inst	کدی نگز له
N+P1P+Inst	کتابیمز له	N+P2P+Dat	کدی نگز ه
N+P1P+Dat	کتابیمز ه	N+P2P+Gen	کدی نگز گ
N+P1P+Gen	کتابیمز گ	N+P2P+Acc	کدی نگز ی
N+P1P+Acc	کتابیمز ی	N+P1P	کدی میز
N+P3S	کتابی	N+P1P+Loc	کدی میز ده
N+P3S+Loc	کتابی نده	N+P1P+Abl	کدی میز دن
N+P3S+Abl	کتابی نندن	N+P1P+Inst	کدی میز له
N+P3S+Dat	کتابی ننه	N+P1P+Dat	کدی میز ه
N+P3S+Gen	کتابی ننگ	N+P1P+Gen	کدی میز گ
N+P3S+Acc	کتابی نسی	N+P1P+Acc	کدی میز ی
N+P3S+Inst	کتابی نیله	N+P3S	کدی سی
N+P2S	کتابی گ	N+P3S+Gen	کدی سی ننگ
N+P2S+Loc	کتابی گ ده	N+P3S+Acc	کدی سی نسی
N+P2S+Abl	کتابی گ دن	N+P3S+Loc	کدی سی نده
N+P2S+Inst	کتابی گ له	N+P3S+Abl	کدی سی نندن
N+P2S+Dat	کتابی گ ه	N+P3S+Inst	کدی سی نیله
N+P2S+Gen	کتابی گ گ	N+P3S+Dat	کدی سی نیله
N+P2S+Acc	کتابی گ ی	N+P2S	کدی ننگ
N+P1S	کتابیم	N+P2S+Loc	کدی ننگ ده
N+P1S+Loc	کتابیم ده	N+P2S+Abl	کدی ننگ دن
N+P1S+Abl	کتابیم دن	N+P2S+Inst	کدی ننگ له
N+P1S+Inst	کتابیم له	N+P2S+Dat	کدی ننگ ه
N+P1S+Dat	کتابیم ه	N+P2S+Gen	کدی ننگ گ
N+P1S+Gen	کتابیم گ	N+P2S+Acc	کدی ننگ ی

