CSE484
HW1

Burak Kocausta

1901042605

Content

1. Problem Solution Approach

Initially I chose 10 Turkish words. I chose them based on their sound events, and variety. Then, I planned to merge those different FSTs. I didn't use an intermediate level. It goes from surface level to lexical level directly. In OpenFST library, empty FST can be created. Arcs can be added to these FSTs. With this construction, we can traverse the FSTs and evaluate it. There are also union, and determinize functions. I used them when merging different FSTs.

I created FSTs with letters, each letter means a transition. In each FST, it handles noun, plurality, and possessiveness. All of them can be happened at the same time. After creating 10 different FSTs, I merged them using union, and determinize functions. Then I wrote an evaluation function, which traverses all arcs and stores output symbols in the buffer after every transition. If it is an epsilon transition, it does not store it. This generic function works for all 10 FSTs separately, also merged version.

I did the tests on merged FST. All combinations, and some invalid words tested. Also, I draw their visualization with graphviz.

"draw.py" -> draws the .png versions of all FSTs.
"word_fsts.py" -> library function includes all fst implementations
"main.py" -> main function that tests the fst

2. Manual

- I wrote the installation steps on the Teams page as this:


```
BURAK KOCAUSTA  Pazartesi 20:46  Düzenlendi
I installed the OpenFST library as follows:

1- Download version 1.7.2. Link: https://www.openfst.org/twiki/bin/view/FST/FstDownload
2- $ ./configure --enable-far
3- $ make
4- $ make install
5- $ pip install openfst

Notes:
- Import pywrapfst instead of openfst_python
- Python 3.6 or better
- I installed it on Ubuntu and WSL

If an error such ImportError: libfstfar.so.16: cannot open shared object file: No such file or directory occurs, locate the file (might not be
libfstfar.so.16), and create symbolic link.

example:

    sudo ln -s /usr/local/lib/libfstfar.so.16 /usr/lib/libfstfar.so.16

Documents for installation: INSTALL file in openfst-1.7.2.tar.gz, and https://www.openfst.org/twiki/bin/view/FST/PythonExtension
```

Additionally, graphviz must be installed in order to visualize FSTs.

- Notation:

Function		surface	tag
	Plural	-lAr	⟨pl⟩
Possessive	First person singular	-(I)m	⟨p1s⟩
	Second person singular	-(I)n	⟨p2s⟩
	Third person singular	-(s)I	⟨p3s⟩
	First person plural	-(I)mIz	⟨p1p⟩
	Second person plural	-(I)nIz	⟨p2p⟩
	Third person plural	-lArI	⟨p3p⟩

(Çağrı Çöltekin, TRmorph, 2013)

I am using these notation for the possessiveness.
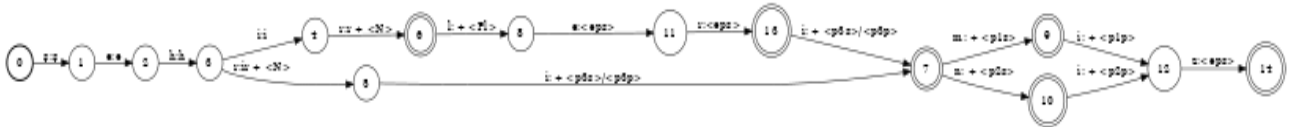
<N> -> Noun
<Pl> -> Plural

- Testing: This command prints all test results.

python main.py

3. Visualizations

- Png files can be achieved with this command:
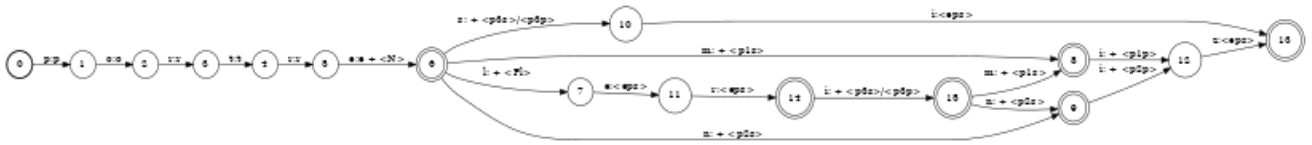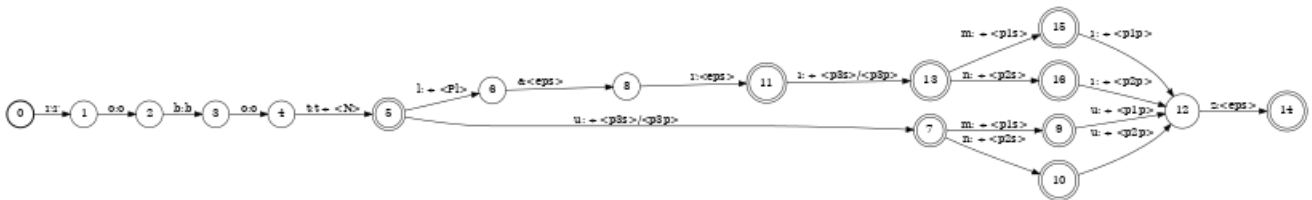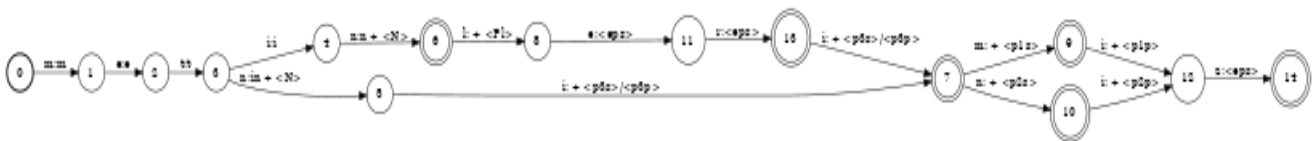python fst_draw.py

1- şehir

2- yemek
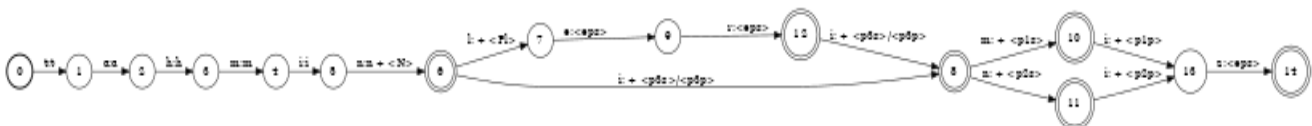

3- portre

4- robot

5- metin

6- tahmin
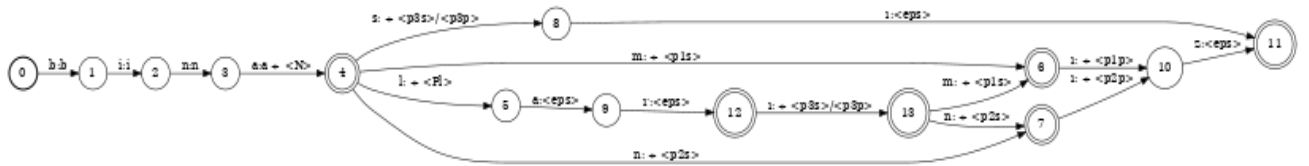

7- ders
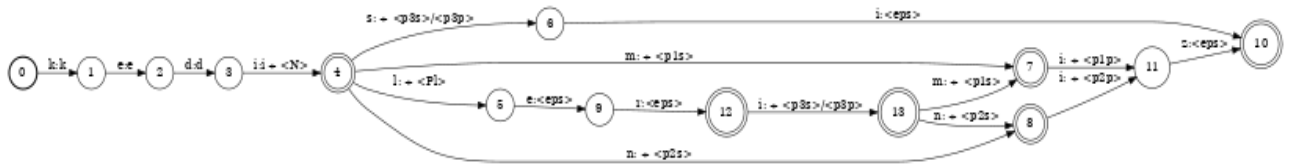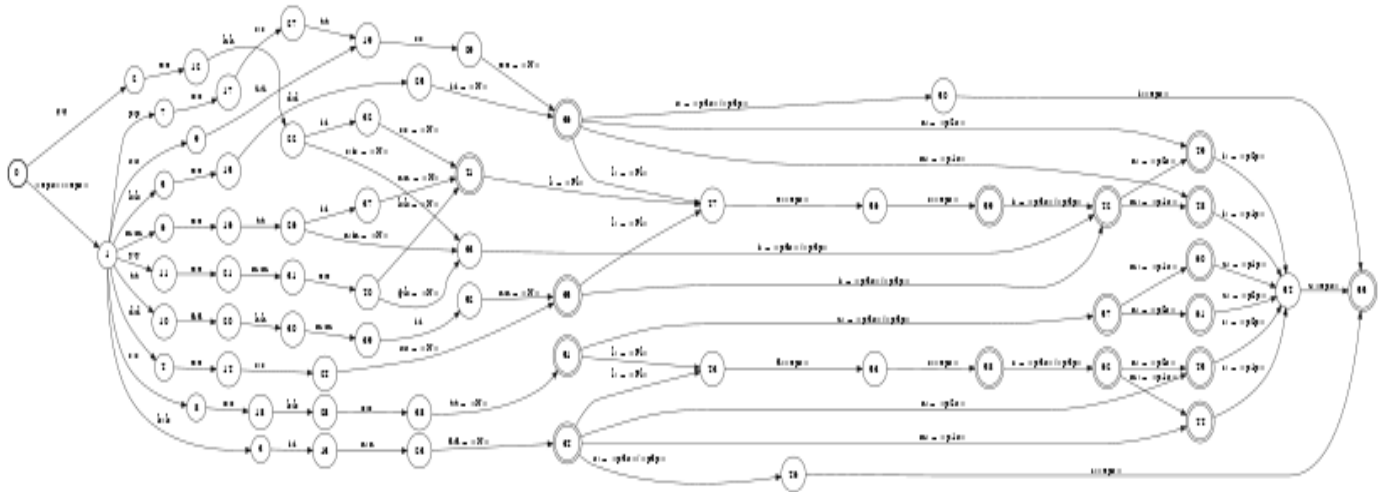
8- süre
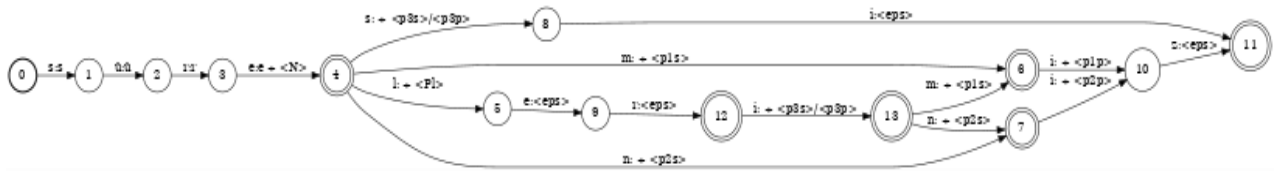
9- bina

10-   kedi

11-   Merged

Results

Note: <p3s>/<p3p> used together because it can be:
- Onun kedisi/kedileri
- Onların kedisi/kedileri

1- Şehir

```
'şehir' -> şehir + <N>
'şehirler' -> şehir + <N> + <Pl>
'şehrim' -> şehir + <N> + <p1s>
'şehrin' -> şehir + <N> + <p2s>
'şehri' -> şehir + <N> + <p3s>/<p3p>
'şehrimiz' -> şehir + <N> + <p1p>
'şehriniz' -> şehir + <N> + <p2p>
'şehirlerim' -> şehir + <N> + <Pl> + <p1s>
'şehirlerin' -> şehir + <N> + <Pl> + <p2s>
'şehirlerimiz' -> şehir + <N> + <Pl> + <p1p>
'şehirleriniz' -> şehir + <N> + <Pl> + <p2p>
'şehirleri' -> şehir + <N> + <Pl> + <p3s>/<p3p>
'şehrimizler' -> invalid
'şehirden' -> invalid
'şehrimizde' -> invalid
'şehr' -> invalid
```

2- Yemek

```
'yemek' -> yemek + <N>
'yemekler' -> yemek + <N> + <Pl>
'yemeğim' -> yemek + <N> + <p1s>
'yemeğin' -> yemek + <N> + <p2s>
'yemeği' -> yemek + <N> + <p3s>/<p3p>
'yemeğimiz' -> yemek + <N> + <p1p>
'yemeğiniz' -> yemek + <N> + <p2p>
'yemeklerim' -> yemek + <N> + <Pl> + <p1s>
'yemeklerin' -> yemek + <N> + <Pl> + <p2s>
'yemeklerimiz' -> yemek + <N> + <Pl> + <p1p>
'yemekleriniz' -> yemek + <N> + <Pl> + <p2p>
'yemekleri' -> yemek + <N> + <Pl> + <p3s>/<p3p>
'yemeğimler' -> invalid
'yemekten' -> invalid
'yemeğimde' -> invalid
'yemeğ' -> invalid
```

3- Portre

```
'portre' -> portre + <N>
'portreler' -> portre + <N> + <Pl>
'portrem' -> portre + <N> + <p1s>
'portren' -> portre + <N> + <p2s>
'portresi' -> portre + <N> + <p3s>/<p3p>
'portremiz' -> portre + <N> + <p1p>
'portreniz' -> portre + <N> + <p2p>
'portrelerim' -> portre + <N> + <Pl> + <p1s>
'portrelerin' -> portre + <N> + <Pl> + <p2s>
'portrelerimiz' -> portre + <N> + <Pl> + <p1p>
'portreleriniz' -> portre + <N> + <Pl> + <p2p>
'portreleri' -> portre + <N> + <Pl> + <p3s>/<p3p>
'portremizler' -> invalid
'portreden' -> invalid
'portremde' -> invalid
```

4- Robot

```
'robot' -> robot + <N>
'robotlar' -> robot + <N> + <Pl>
'robotum' -> robot + <N> + <p1s>
'robotun' -> robot + <N> + <p2s>
'robotu' -> robot + <N> + <p3s>/<p3p>
'robotumuz' -> robot + <N> + <p1p>
'robotunuz' -> robot + <N> + <p2p>
'robotlarım' -> robot + <N> + <Pl> + <p1s>
'robotların' -> robot + <N> + <Pl> + <p2s>
'robotlarımız' -> robot + <N> + <Pl> + <p1p>
'robotlarınız' -> robot + <N> + <Pl> + <p2p>
'robotları' -> robot + <N> + <Pl> + <p3s>/<p3p>
'robotumuzlar' -> invalid
'robottan' -> invalid
'robotumda' -> invalid
```

5- Metin

```
'metin' -> metin + <N>
'metinler' -> metin + <N> + <Pl>
'metnim' -> metin + <N> + <p1s>
'metnin' -> metin + <N> + <p2s>
'metni' -> metin + <N> + <p3s>/<p3p>
'metnimiz' -> metin + <N> + <p1p>
'metniniz' -> metin + <N> + <p2p>
'metinlerim' -> metin + <N> + <Pl> + <p1s>
'metinlerin' -> metin + <N> + <Pl> + <p2s>
'metinlerimiz' -> metin + <N> + <Pl> + <p1p>
'metinleriniz' -> metin + <N> + <Pl> + <p2p>
'metinleri' -> metin + <N> + <Pl> + <p3s>/<p3p>
'metnimizler' -> invalid
'metinden' -> invalid
'metnimde' -> invalid
```

6- Tahmin

```
'tahmin' -> tahmin + <N>
'tahminler' -> tahmin + <N> + <Pl>
'tahminim' -> tahmin + <N> + <p1s>
'tahminin' -> tahmin + <N> + <p2s>
'tahmini' -> tahmin + <N> + <p3s>/<p3p>
'tahminimiz' -> tahmin + <N> + <p1p>
'tahmininiz' -> tahmin + <N> + <p2p>
'tahminlerim' -> tahmin + <N> + <Pl> + <p1s>
'tahminlerin' -> tahmin + <N> + <Pl> + <p2s>
'tahminlerimiz' -> tahmin + <N> + <Pl> + <p1p>
'tahminleriniz' -> tahmin + <N> + <Pl> + <p2p>
'tahminleri' -> tahmin + <N> + <Pl> + <p3s>/<p3p>
'tahminimizler' -> invalid
'tahminden' -> invalid
'tahminimde' -> invalid
```

7- Ders

```
'ders' -> ders + <N>
'dersler' -> ders + <N> + <Pl>
'dersim' -> ders + <N> + <p1s>
'dersin' -> ders + <N> + <p2s>
'dersi' -> ders + <N> + <p3s>/<p3p>
'dersimiz' -> ders + <N> + <p1p>
'dersiniz' -> ders + <N> + <p2p>
'derslerim' -> ders + <N> + <Pl> + <p1s>
'derslerin' -> ders + <N> + <Pl> + <p2s>
'derslerimiz' -> ders + <N> + <Pl> + <p1p>
'dersleriniz' -> ders + <N> + <Pl> + <p2p>
'dersleri' -> ders + <N> + <Pl> + <p3s>/<p3p>
'dersimizler' -> invalid
'dersten' -> invalid
'dersimde' -> invalid
```

8- Süre

```
'süre' -> süre + <N>
'süreler' -> süre + <N> + <Pl>
'sürem' -> süre + <N> + <p1s>
'süren' -> süre + <N> + <p2s>
'süresi' -> süre + <N> + <p3s>/<p3p>
'süremiz' -> süre + <N> + <p1p>
'süreniz' -> süre + <N> + <p2p>
'sürelerim' -> süre + <N> + <Pl> + <p1s>
'sürelerin' -> süre + <N> + <Pl> + <p2s>
'sürelerimiz' -> süre + <N> + <Pl> + <p1p>
'süreleriniz' -> süre + <N> + <Pl> + <p2p>
'süreleri' -> süre + <N> + <Pl> + <p3s>/<p3p>
'süremizler' -> invalid
'süreden' -> invalid
'süremde' -> invalid
```

9- Bina

```
'bina' -> bina + <N>
'binalar' -> bina + <N> + <Pl>
'binam' -> bina + <N> + <p1s>
'binan' -> bina + <N> + <p2s>
'binası' -> bina + <N> + <p3s>/<p3p>
'binamız' -> bina + <N> + <p1p>
'binanız' -> bina + <N> + <p2p>
'binalarım' -> bina + <N> + <Pl> + <p1s>
'binaların' -> bina + <N> + <Pl> + <p2s>
'binalarımız' -> bina + <N> + <Pl> + <p1p>
'binalarınız' -> bina + <N> + <Pl> + <p2p>
'binaları' -> bina + <N> + <Pl> + <p3s>/<p3p>
'binamızlar' -> invalid
'binadan' -> invalid
'binamda' -> invalid
```

10-   Kedi

```
'kedi' -> kedi + <N>
'kediler' -> kedi + <N> + <Pl>
'kedim' -> kedi + <N> + <p1s>
'kedin' -> kedi + <N> + <p2s>
'kedisi' -> kedi + <N> + <p3s>/<p3p>
'kedimiz' -> kedi + <N> + <p1p>
'kediniz' -> kedi + <N> + <p2p>
'kedilerim' -> kedi + <N> + <Pl> + <p1s>
'kedilerin' -> kedi + <N> + <Pl> + <p2s>
'kedilerimiz' -> kedi + <N> + <Pl> + <p1p>
'kedileriniz' -> kedi + <N> + <Pl> + <p2p>
'kedileri' -> kedi + <N> + <Pl> + <p3s>/<p3p>
'kedimizler' -> invalid
'kediden' -> invalid
'kedimde' -> invalid
```