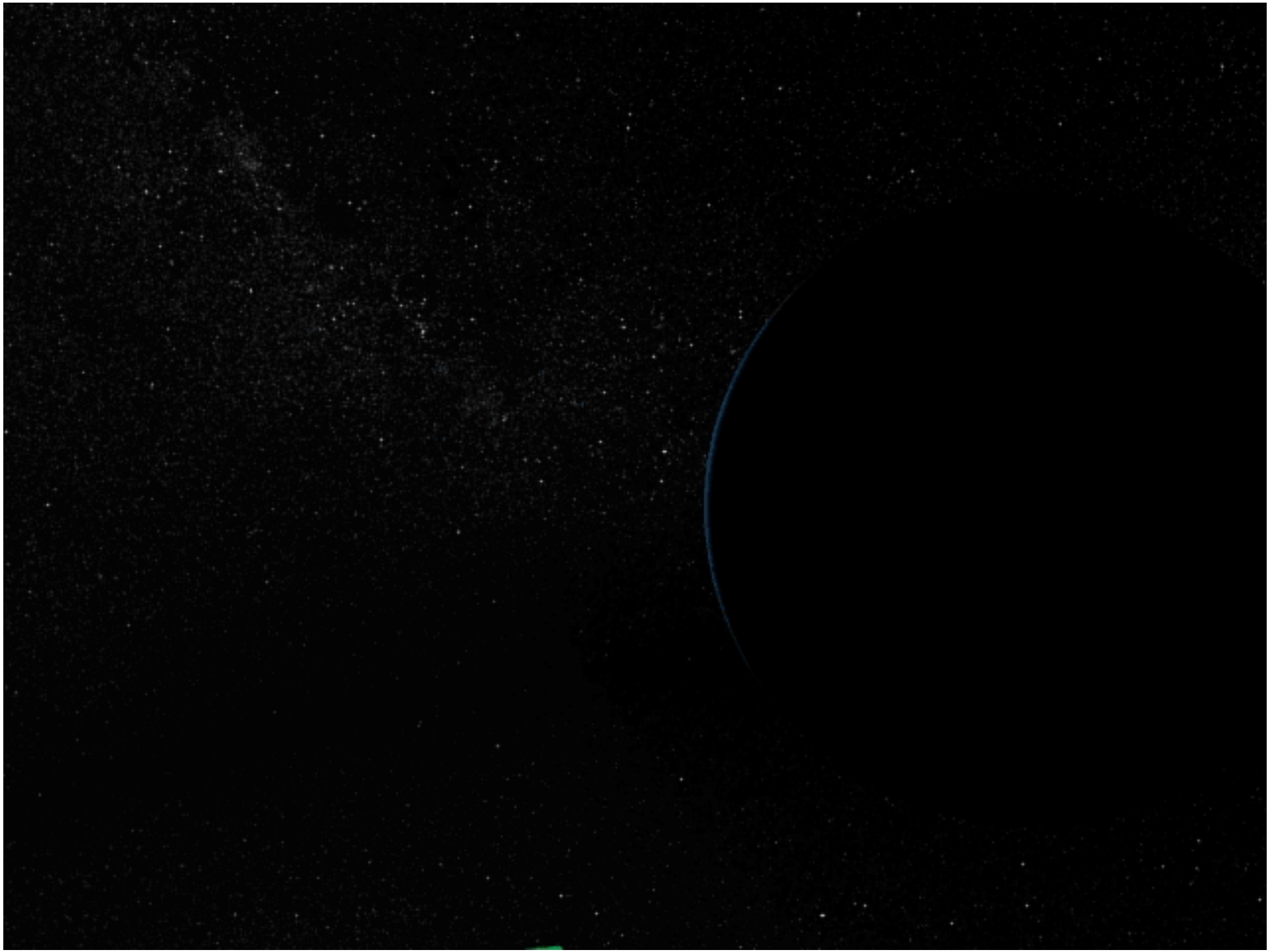
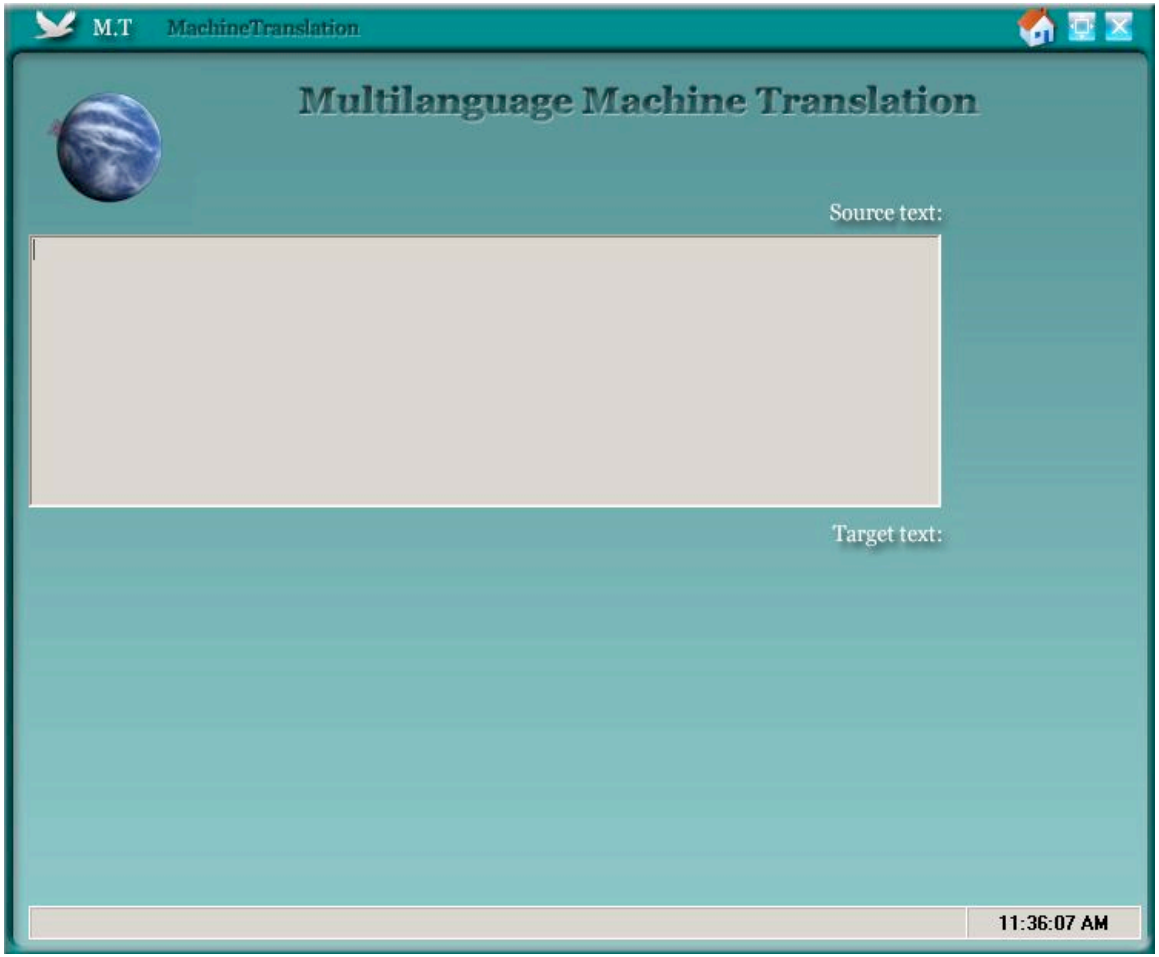
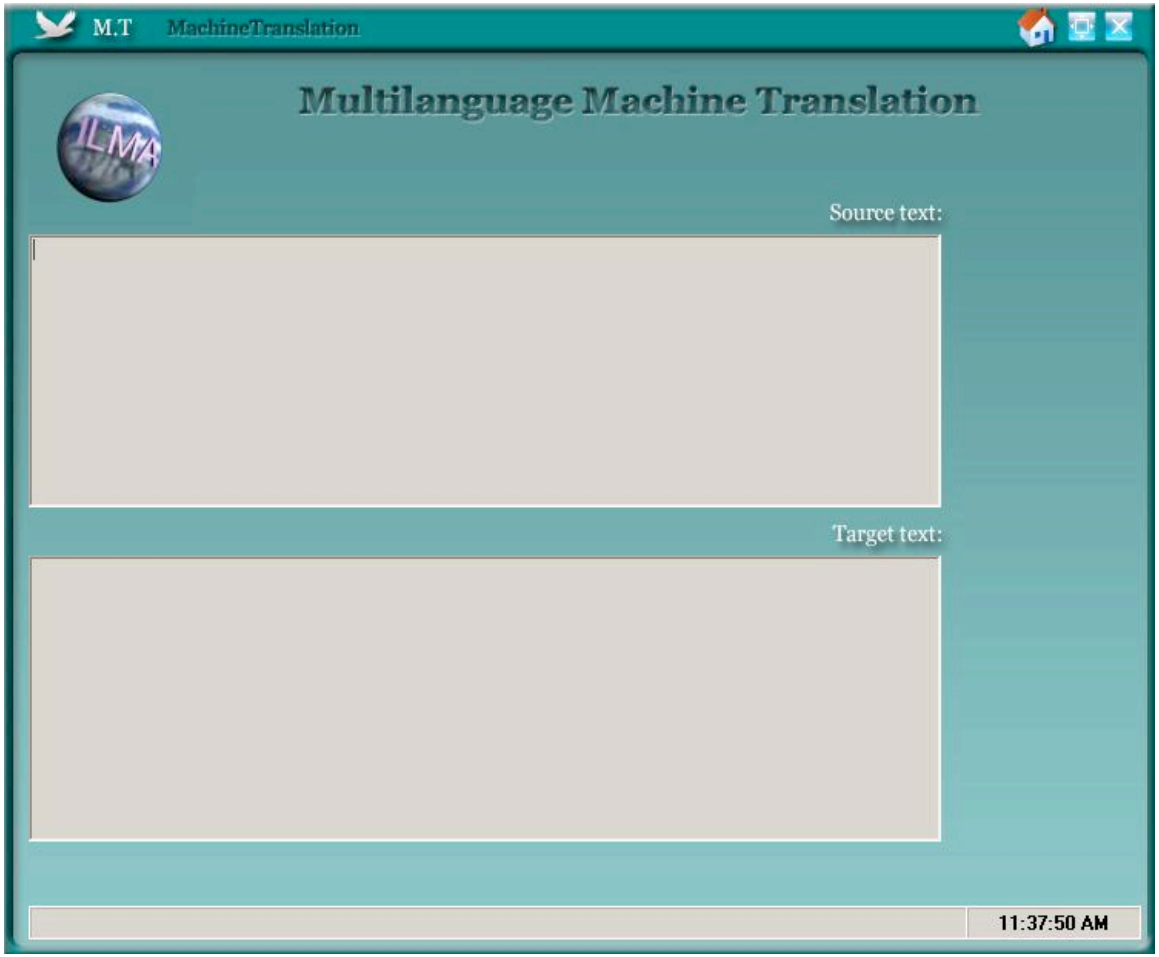


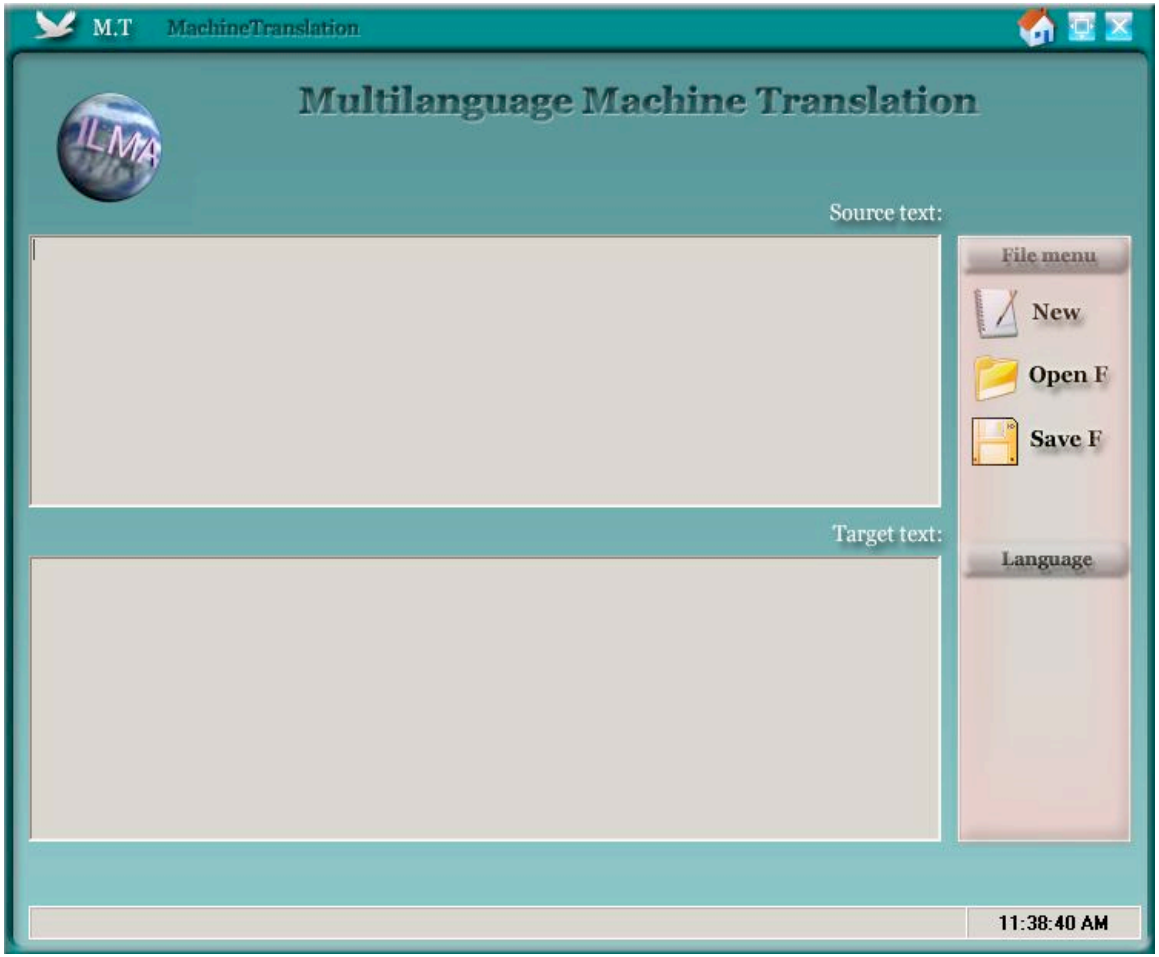
Example Based Machine Translator
User Interface Group



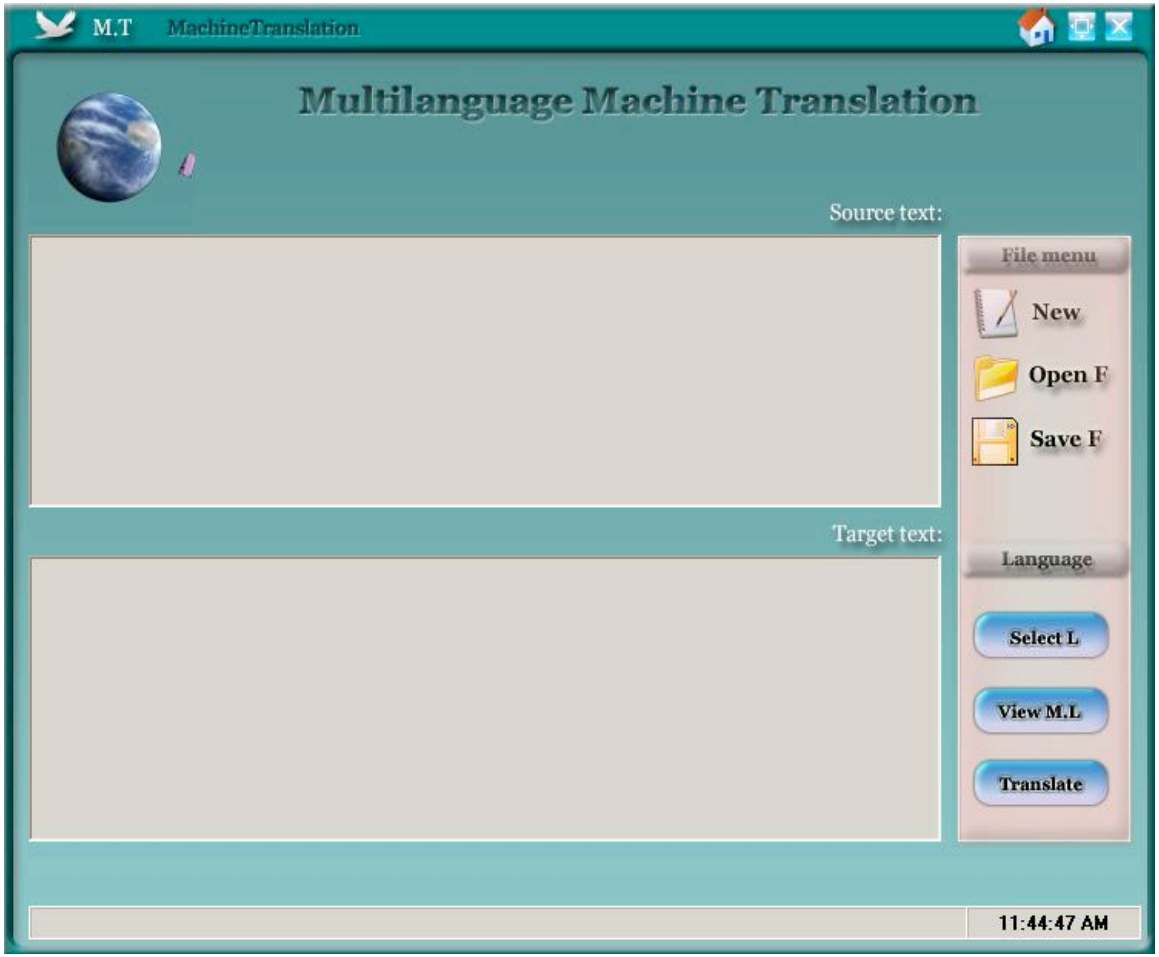
Example Based Machine Translator
User Interface Group



Example Based Machine Translator
User Interface Group

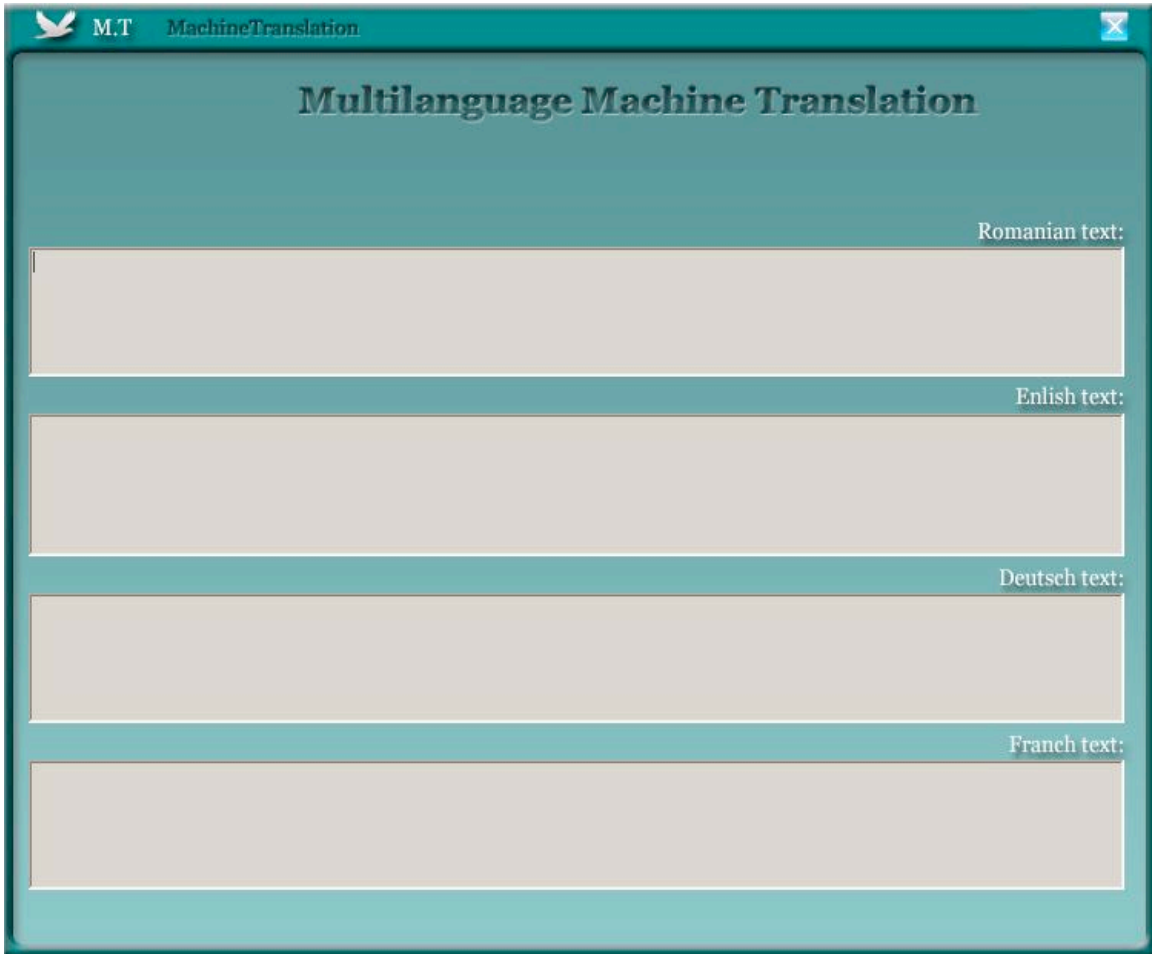


Example Based Machine Translator
User Interface Group



Example Based Machine Translator
User Interface Group

Example Based Machine Translator
User Interface Group



Example Based Machine Translator
Language Resource Group
Romanian-French

Task

- Create a DB containing the linguistic resources.
- Divide sentences into chunks and give their parallel translation.
- Create a lexicon of all the words and their translation
- Create a tables containing the stems of the words in the lexicon with their partial morphological analysis and with an index which would point to the translation and the analysis of the word in the parallel table.

Example Based Machine Translator
Language Resource Group
Romanian-French

Intended Task

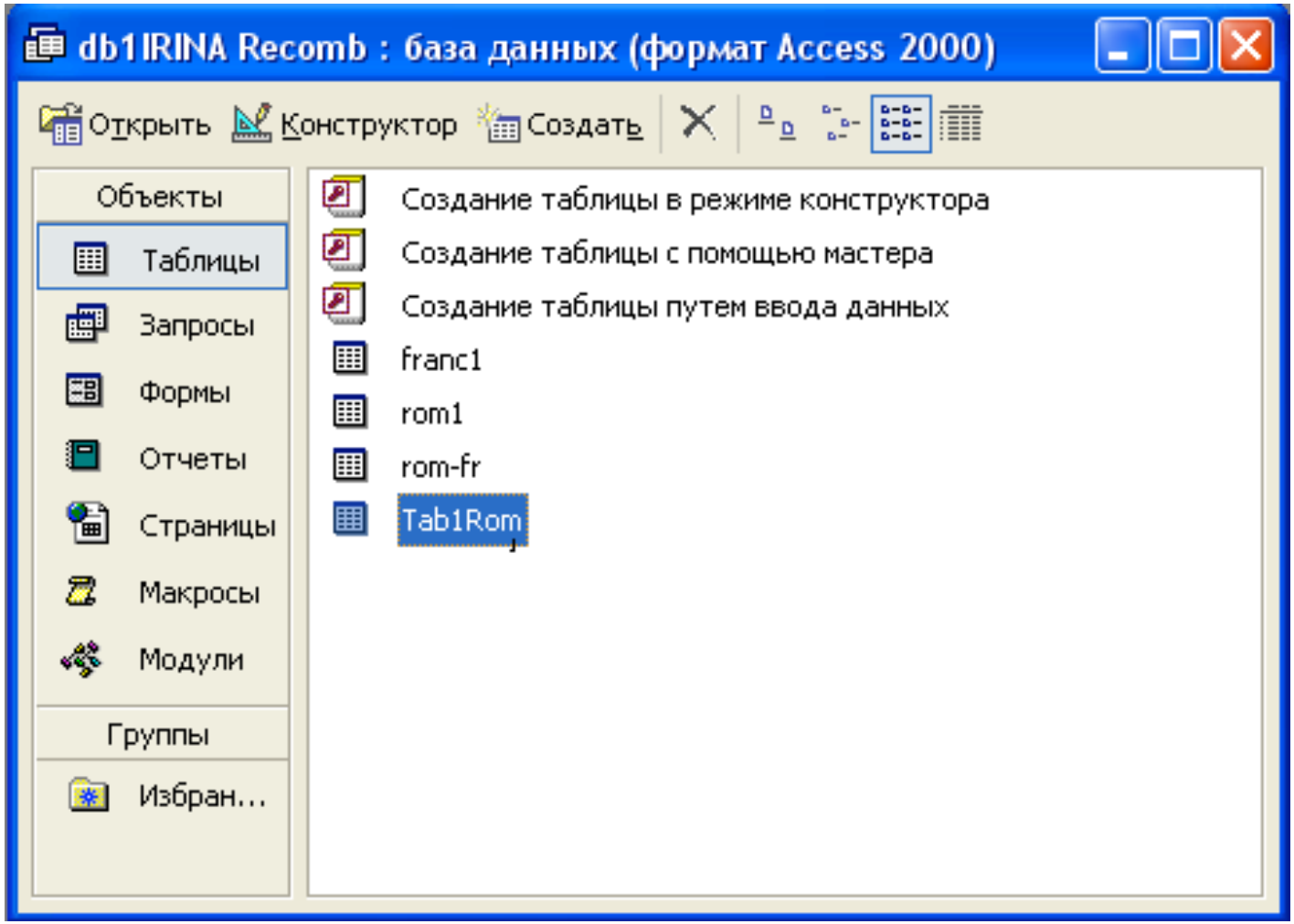
- Create a complete representative database containing ample linguistic information.
- Separate lexicon from the examples database.
- Try to cover in the bilingual lexicon as much as possible from the domain. In the lexicon indicate at least the Stem and a pointer to the corresponding word in the other language.

Example Based Machine Translator
Language Resource Group
Romanian-French

Completed Task

- Elaborated the Language resource database for Romanian and French.
- Created separate tables containing the stems of the words in the 2 languages and their partial morphological analysis.
- The DB was organized in such way that the indexes of the words in the lexicon can point to their stems and respectively the morphological analysis in the other tables, thus making the access to the information faster.

The Database



Text romanian-french

nr	TextRom	TextFranc
1	ritmul a devenit rapid	le rythme devint rapide
2	se realizau în stil clasicist	étaient réqlisés en style classique
3	o biserica clasică	une église classique
4	a devenit mai rapid	devint plus rapide
5	au fost ridicate clădirea dumei şi cea a băncii	on a construit le batiments de la douma et de la banque
6	stilizator talentat	très doué pour la stylisation
7	în stil neobizantin	style néo-byzantin
8	unirea Basarabiei cu România	l'union de la Bassarabie avec la Roumanie
9	un puternic centru economic	un puissant centre économique
10	sau efectuat lucrări de restaurare	on a effectué des restauration
11	a fost instalată în centru	on a installé au centre
12	este opera sculptorului Alexandru Plămădeală	est l'œuvre du sculpteur Alexandru Plămădeală
13	a suferit mari distrugeri	a été sévèrement ravagée
14	arhitectorul Şciusev	l'architecte Şciusev
15	a devenit capitala R.S.S.M.	est devenu la capitale de la R.S.S.M.
16	în această epocă	à cette époque
17	vechea aglomerație rurală de la Chişinău	l'ancienne agglomération rurale de Chişinău
18	a fost construită calea ferată	on a construit le chemin de fer
19	au fost pavate străzile	on a pavé les rues
20	a fost înființată presa locală	on a inauguré la presse locale
21	se impune eclectismul	s'impose l'éclectisme
22	prima urmează tradițiile	le premier suit les traditions
23	a cunoscut o evoluție complexă	a connu une évolution complexe
24	pînă în zilele noastre	jusq'à nos jours
25	în această epocă	à cette époque

The words Romanian-French

Rom-Franc		
nr	cuv rom	cuv franc
1	ritmul	le rytme
2	se	étaient
3	realizau	réalisés
4	în	en
5	stil	style
6	clasicist	classique
7	clasică	classique
8	mai	plus
9	ridicate	construit
10	clădirea	batiments
11	Dumei	Duma
12	şi	et
13	cea	de
14	băncii	banque
15	a	la
16	stilizator	pour la styliisation
17	talentat	très doué
18	neobizantin	néo-byzantin
19	unirea	l'union
20	Basarabiei	de la Bassarabie
21	România	la Roumanie

Rom-Franc		
Nr	cuv rom	cuv franc
22	cu	Avec
23	un	un
24	puternic	puissant
25	centru	centre
26	s-au efectuat	a effectué
27	lucrări de restaurare	des restaurations
28	instalată	installé
29	opera	oeuvre
30	sculptorului	sculpteur
31	Alexandru	Alexandru
32	Plămădeală	Plămădeală
33	a suferit	a été
34	mari	sévèrement
35	distrugeri	ravagée
36	arhitectorul	l'architecte
37	Şciusev	Şciusev
38	capitala	la capitale
39	R.S.S.M.	R.S.S.M.
40	această	cette
41	vechea	ancienne
42	aglomerație	agglomération

Rom-Franc		
nr	cuv rom	cuv franc
43	rurală	rurale
44	de la	de
45	calea	le chemin
46	ferată	de fer
47	au fost	a
48	pavate	pavé
49	străzile	les rues
50	înființată	a inauguré
51	presa	presse
52	locală	locale
53	se	s'
54	impune	Impose
55	eclectismului	l'éclectisme
56	urmează	Suit
57	tradițiile	les traditions
58	a cunoscut	a connu
59	evoluție	évolutiion
60	complexă	complexe
61	pînă	jusqu'
62	zilele	jours
63	noastre	nos

The analysis of Romanian words

nr	radacina	partea de vorb	gen	numar	pers	caz
1	ritmul	s	m	sg		N
2	se	v		pl	3	
3	realiza	v		pl	3	
4	în	s	m	sg		N
5	stil	pron	m	pl	3	
6	clasicist	v		pl	3	
7	clasic	prep				
8	mai	s	m	sg		N
9	ridica	adj	m	sg		N
10	clădire	adj	f	sg		N
11	Duma	adv				
12	şi	v		pl	3	
13	cea	s	f	sg		Ac
14	bancă	s	f	sg		Ac
15	a	conj				
16	stilizator	pron	f	sg		Ac
17	talentat	s	f	sg		Ac
18	neobizantin	adj	m	sg		N
19	unire	s	f	sg		N
20	Basarabia	s	f	sg		N
21	România	s	f	sg		N
22	cu	prep				
23	un	art				
24	puternic	adj	m	sg		N
25	centru	s	m	sg		N
26	efectua	v	f	pl	3	
27	lucrare de restaurare	s	f	pl		Ac
28	instala	v	f	sg	3	
29	opera	s	f	sg		Ac
30	sculptor	s	m	sg		G
31	Alexandru	s	m	sg		G
32	Plămădeală	s	m	sg		G
33	suferi	v		sg	3	

nr	radacina	partea de vorb	gen	numar	pers	caz
34	mare	adj	f	pl		Ac
35	distrugere	s	f	pl		Ac
36	arhitector	s	m	sg		n
37	Şciusev	s	m	sg		N
38	capitală	s	f	sg		Ac
39	R.S.S.M.	s	f	sg		Ac
40	aceasta	pron	f	sg		Ac
41	veche	adj	f	sg		N
42	aglomerație	s	f	sg		N
43	rural	adj	f	sg		N
44	de la	prep				
45	cale	s	f	sg		Ac
46	ferată	adj	f	sg		Ac
47	fi	v		pl	3	
48	pavat	v		pl	3	
49	stradă	s	f	pl		Ac
50	înființa	v		sg	3	
51	presă	s	f	sg		Ac
52	locală	adj	f	sg		Ac
53	se	pron		sg	3	
54	impune	v		sg	3	
55	eclectismul	s	m	sg		Ac
56	urma	v		sg	3	
57	tradiție	s	f	pl		Ac
58	cunoaşte	v		sg	3	
59	evoluție	s	f	sg		Ac
60	complex	adj	f	sg		Ac
61	pînă	prep				
62	zi	s	f	pl		Ac
63	noi	pron	f	pl		G

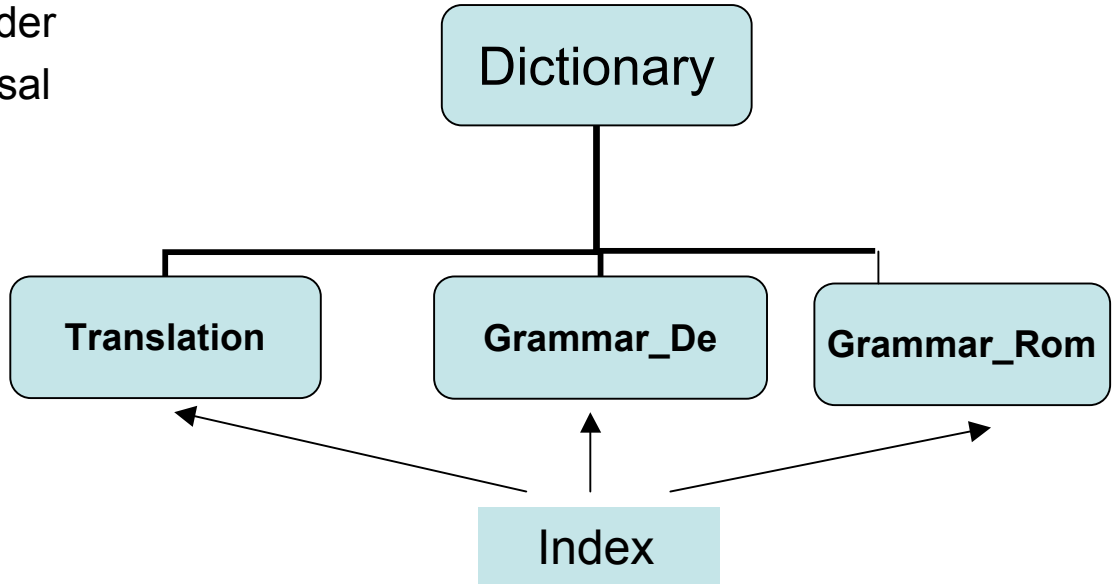
The analysis of French words

nr	radacina	partea de vorb	gen	numar	perso	caz
1	rytme	s	m	sg		N
2	étaient	v		pl	3	
3	réalisés	v		pl	3	
4	en	prep				
5	style	s	m	sg		N
6	classique	adj	m	sg		N
7	classique	adj	f	sg		N
8	plus	adv				
9	construire	v		pl	3	
10	batiment	s	f	sg		Ac
11	Duma	s	f	sg		Ac
12	et	conj				
13	de	pron	f	sg		Ac
14	banque	s	m	sg		Ac
15	la	prep				
16	stylisation	s	f	sg		N
17	très doué	adj	m	sg		N
18	néo-byzantin	adj	m	sg		N
19	union	s	f	sg		N
20	Bassarabie	s	f	sg		N
21	Roumanie	s	f	sg		N
22	avec	prep				
23	un	art				
24	puissant	adj	m	sg		N
25	centre	s	m	sg		N
26	effectuer	v	f	pl	3	
27	restauration	s	f	pl		Ac
28	installer	v	f	sg	3	
29	oeuvre	s	f	sg		Ac
30	sculpteur	s	m	sg		G
31	Alexandru	s	m	sg		G
32	Plămădeală	s	m	sg		G
33	etre	v		sg	3	

nr	radacina	partea de vorb	gen	numar	perso	caz
34	sévèrement	adv				
35	ravager	v		s	3	
36	architecte	s	m	sg		N
37	Şciusev	s	m	sg		N
38	capitale	s	f	sg		Ac
39	R.S.S.M.	s	f	sg		Ac
40	cette	pron	f	sg		Ac
41	ancienne	adj	f	sg		N
42	agglomération	s	f	sg		N
43	rurale	adj	f	sg		N
44	de	prep				
45	chemin	s	m	sg		Ac
46	fer	adj	m	sg		Ac
47	avoir	v		sg	3	
48	paver	v		sg	3	
49	rue	s	f	pl		Ac
50	inaugurer	v		sg	3	
51	presse	s	f	sg		Ac
52	locale	adj	f	sg		Ac
53	s'	pron		sg	3	
54	imposer	v		sg	3	
55	éclectisme	s	m	sg		Ac
56	suivre	v		sg	3	
57	tradition	s	f	pl		Ac
58	connaitre	v		sg	3	
59	évolutiion	s	f	sg		Ac
60	complexe	adj	f	sg		Ac
61	jusqu'	prep				
62	jour	s	f	pl		Ac
63	notre	pron	f	pl		G
64	pour	prep				
65	le	art	m	sg		
66	les	art	f	pl		

Example Based Machine Translator
Language Resource Group
Romanian-German

- Objectives
- Selecting the appropriate sentences
- Processing and conveying the meaning of the sentences
- Create a DB
- Select the sentences which transmit a relevant message to the reader
- Process a variety of 25 phrasal structures



Example Based Machine Translator
Language Resource Group
Romanian-German

- Results achieved
- We have selected and processed a variety of 30 phrasal structures as well as complete sentences
- A DB has been created
- The DB consists of four tables containing the data
- Rules of sentence formation have been set in order to be able to recombine the different chunks of sentences

Example Based Machine Translator
Language Resource Group
Romanian-German

Difficulties…

…este centrul Țării Secui…=… ist ein Zentrum des Szeklerlandes

V	S	S	V	Art	S	Art	S	

...este un centru al Țării Secui… ≠... ist ein Zentrum des Szeklerlandes

V	Art	S	Pron	S	V	Art	S	Art	S	

Example Based Machine Translator
Language Resource Group
Romanian-German

Other Problems…

Romanian:

Rîul a înghițit mărețul “Cheile-Bicazului”…

German:

Der Bach hat die gewaltige Bihaz-Schluch... gefressen

Example Based Machine Translator
Language Resource Group
Romanian-English

Main task

- Create the linguistic background of the project: a Romanian-English DB which would contain expressions/word combinations and their grammatical data.

Example Based Machine Translator
Recombination group
Romanian -English

- Task to be completed:

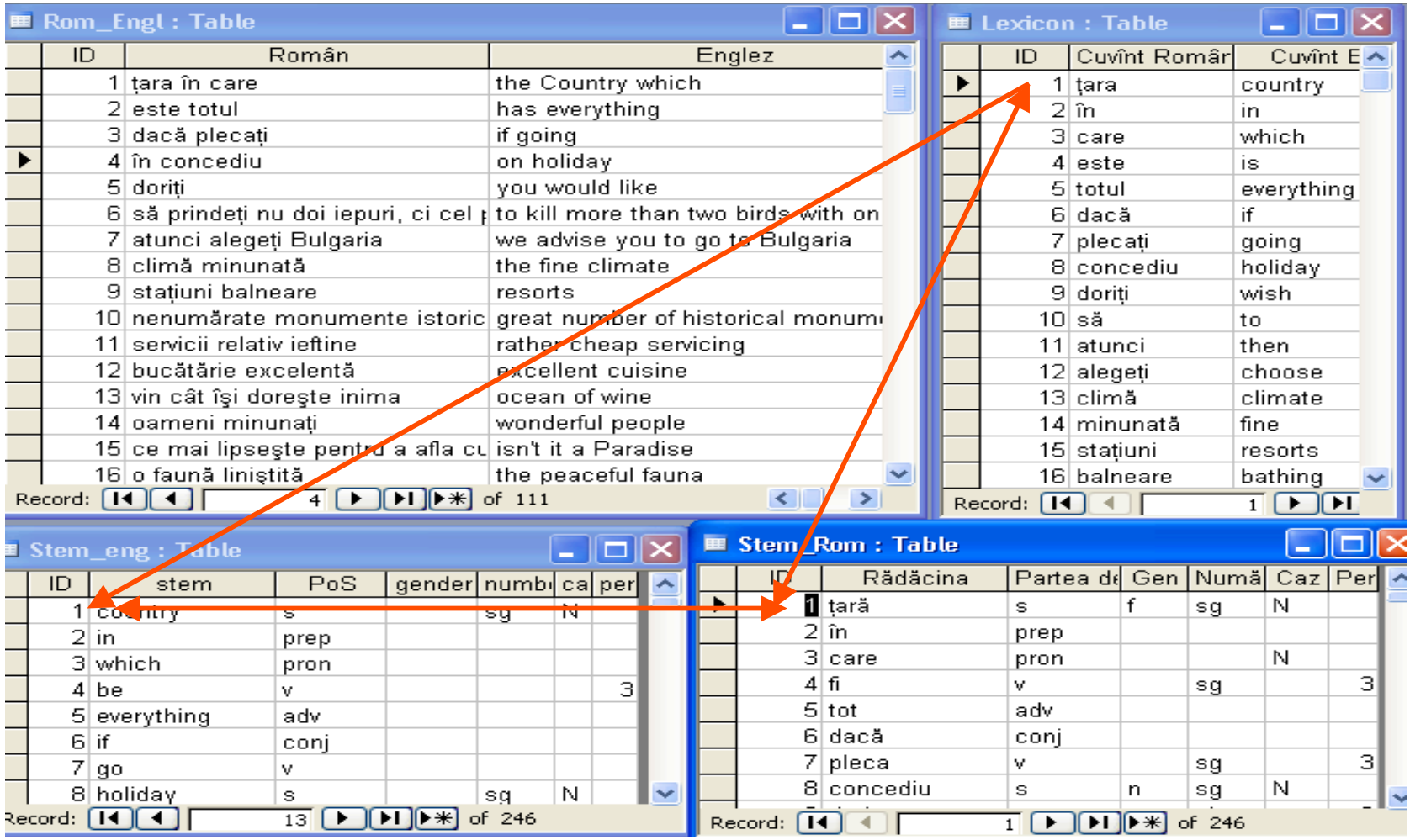
- To try to identify, for the retrieved chunks in the Source Language their corespondents in Target Language.
- To resolve parts with overlap.
- To put together the corespondent chunks.
- To define some simple combinatiuon rules.
- To use the syntactic information in the data base.

Example Based Machine Translator
Language Resource Group
Romanian-English

Actions taken

- Select the chunks in Romanian and find their equivalents in English
- Create the *lexicon*: Romanian words and their English translation of the given text
- Create 2 tables that contain grammatical data about each word of the lexicon (*stem, gender, number, case, person*), both Romanian and English
- Write the grammatical rules for the selected chunks.

Example Based Machine Translator
Language Resource Group
Romanian-English



Example Based Machine Translator
Language Resource Group
Romanian-English

The *grammatical rules* were created according to the selected chunks.

Ex: Țara în care → The country which

The rule: 1.s+prep+pron = 1.art+s+pron

Example Based Machine Translator
Language Resource Group
Romanian-English

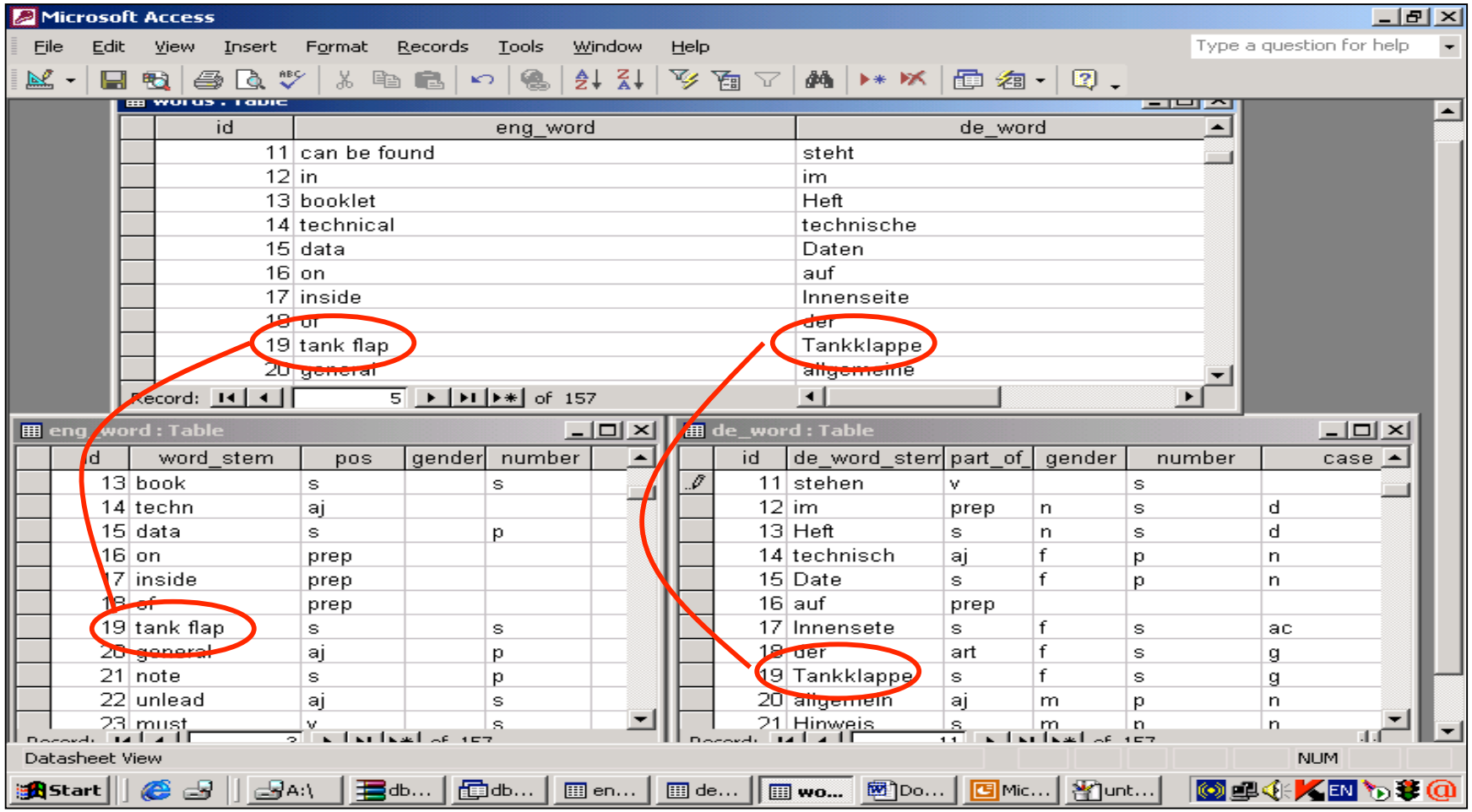
Outcomes

The created DB served as linguistic support for the Example Based Machine Translation project.

Example Based Machine Translator
Language Resource Group
English -German

- Task to be completed:
- Create a DB containing the linguistic resources
- Divide sentences into chunks and give their parallel translation
- Create a lexicon of all the words and their translation
- Create a tables containing the stems of the words in the lexicon with their partial morphological analysis and with an index which would point to the translation and the analysis of the word in the parallel table

Example Based Machine Translator
Language Resource Group
English -German



Example Based Machine Translator
Language Resource Group
English -German

- Intended Task

- Create a complete representative database containing ample linguistic information
- Organize the database in such a way that the information search and retrieval be optimal
- Set a number of grammar rules to guide the machine in the recombination phase
- Create a thesaurus for proper nouns and stable expressions, idioms etc.
- Create a separate database for representing grammar particularities such as inflection rules, peculiarities of German verbs, irregular as well as verbs with separable prefixes

Example Based Machine Translator
Language Resource Group
English -German

- Completed Task:

- Elaborated the Language resource database for English and German.
- Created bilingual lexicon covering a small part of the Volkswagen English German user's manual
- Created separate tables containing the stems of the words in the 2 languages and their partial morphological analysis
- The DB was organized in such way that the indexes of the words in the lexicon can point to their stems and respectively the morphological analysis in the other tables, thus making the access to the information faster
- Created rules of sentence formation based on the examples from the example database in the SL and linking them by means of index to the equivalent rules in the TL, in order to improve the functionality of the recombination module

Example Based Machine Translator
Matching Group

Task to be completed:

- **Using the input string and the string in the database find edit distance, ”Angle of Similarity” and semantic distance between these strings. The data will be used to detect the candidate most similar phrases in the database**
- **Compare each of the selected phrases by the edit distance with the input and extract the longest common sequence**

Example Based Machine Translator
Matching Group

Intended Task :

- **To implement the "Edit distance" algorithm in C++ Builder, which calculates the "Edit distance" value and the sequence of transformations required for matching the input string with the database string**
- **To use the values obtained to calculate the "Angle of similarity" and "Semantic distance"**
- **To implement the interface for connecting the module to the system**

Example Based Machine Translator
Matching Group

Intended Task:

- **Our task was also to elaborate an algorithm that would receive the results of the "Edit Distance" calculation for each string in the database , find the string in the database that matches the input string best and extract the longest common sequence of words for both sentences from it.**

Example Based Machine Translator
Matching Group
"Edit Distance" calculation

Basic Concept:

- **ED is defined as the minimal number of characters you have to replace, insert or delete to transform *one string* into another.**
- **Possible operations: insertion, deletion, substitution**

Implementation:

- **A commonly-used bottom-up dynamic programming algorithm for computing the edit distance involves the use of an (n + 1) × (m + 1) matrix, where n and m are the lengths of the two strings.**

Example Based Machine Translator
Matching Group

Step1: the matrix [length(s1)][length[s2] is constructed, the elements in the first row and first column are initialized

		The	**house**	**has**	**everything**
	0	**1**	**2**	**3**	**4**
The	**1**				
country	**2**				
which	**3**				
has	**4**				
everything	**5**				

Example Based Machine Translator
Matching Group

- **Step 2: Fill in each blank cell [row][column] according to the formula:**

cell[row][column]=*min*((cell[row-1][column-1]+cost), (cell[row][colunmn-1]+1), (cell[row-1][column])

		The	**house**	**has**	**everything**
	0	**1**	2	3	4
The	**1**	0			
country	2				
which	3				
has	4				
everything	5				

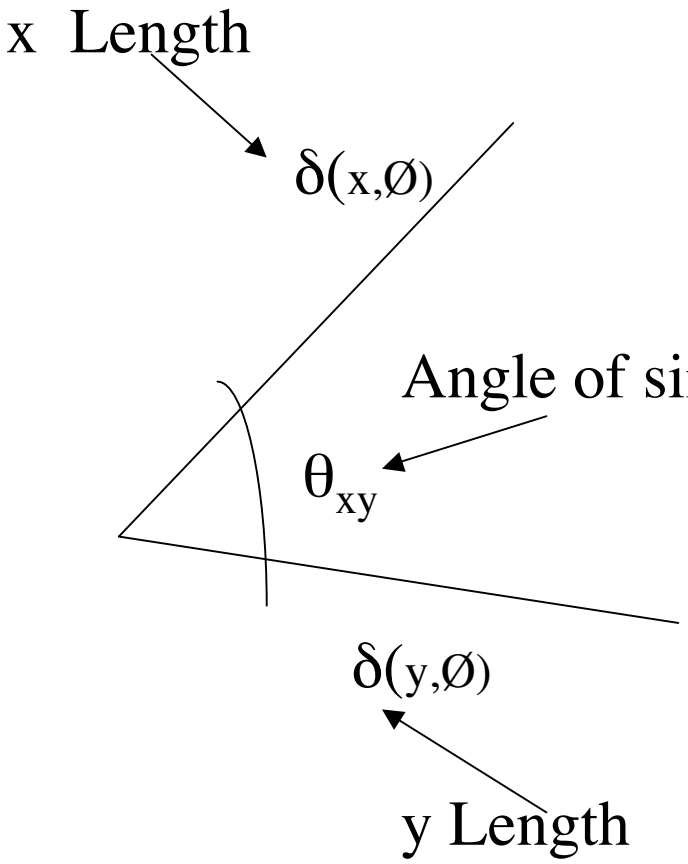
Example Based Machine Translator
Matching Group

- **Step 3:** When the matrix is complete, the "Edit distance" value corresponds to cell in the right lower corner and the path allows to reconstruct the order of transformations:

		The	**house**	**has**	**everything**
	0	1	2	3	4
The	1	**0**	1	2	3
country	2	**1**	1	2	3
which	3	2	**2**	2	3
has	4	3	3	**2**	3
everything	5	4	4	3	**2**

Example Based Machine Translator
Matching Group

Distance between sentence x and sentence y



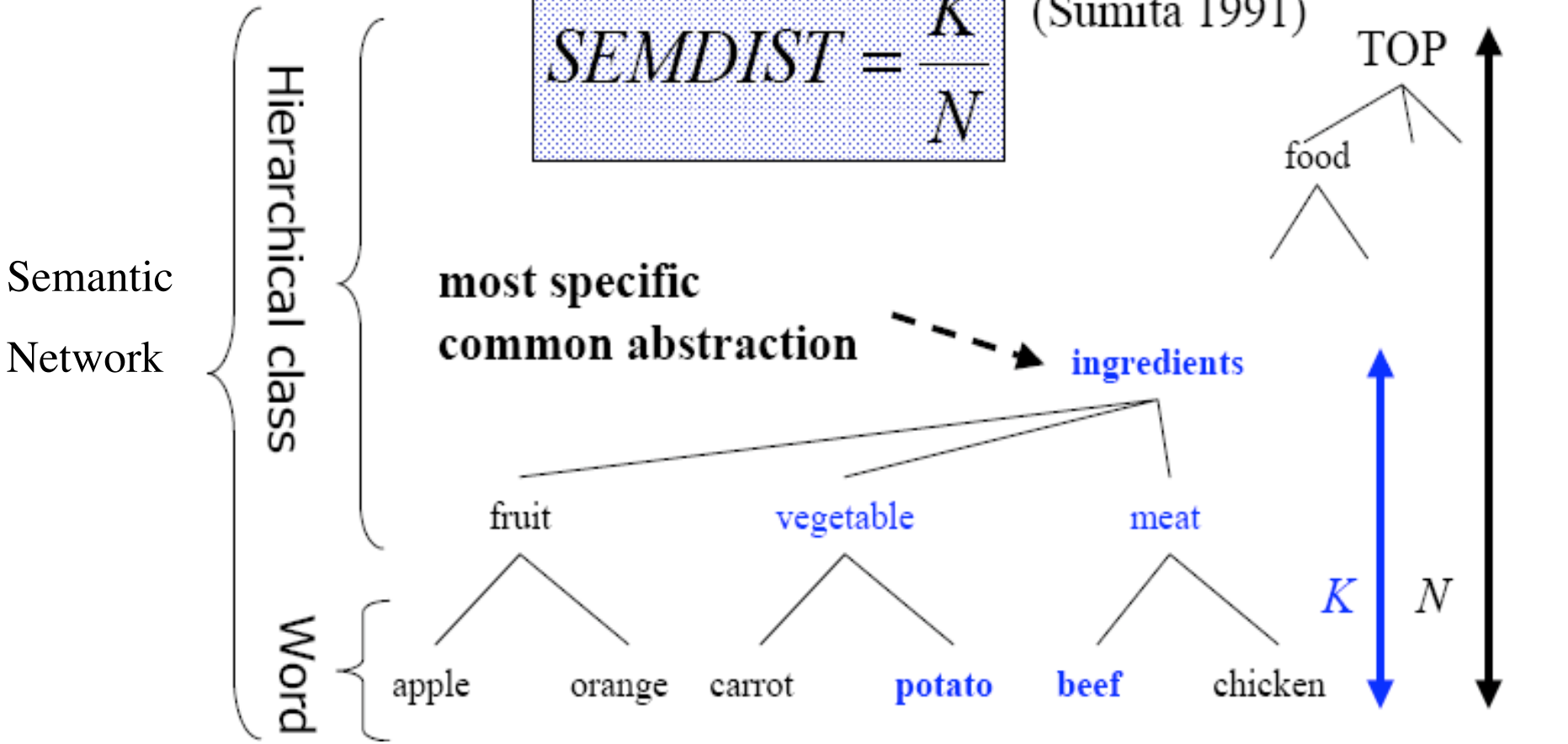
$$\sin\frac{\theta_{xy}}{2} = \frac{\delta(x,y) - \left|\delta(x,\varnothing) - \delta(y,\varnothing)\right|}{2 \times \min\left\{\delta(x,\varnothing), \delta(y,\varnothing)\right\}}$$

Example Based Machine Translator
Matching Group

- **Semantic Distance**

$$dist = \frac{I + D + 2\sum semdist}{L_{input} + L_{example}}$$

$$SEMDIST = \frac{K}{N}$$ (Sumita 1991)



Example Based Machine Translator
Matching Group

Completed Task:

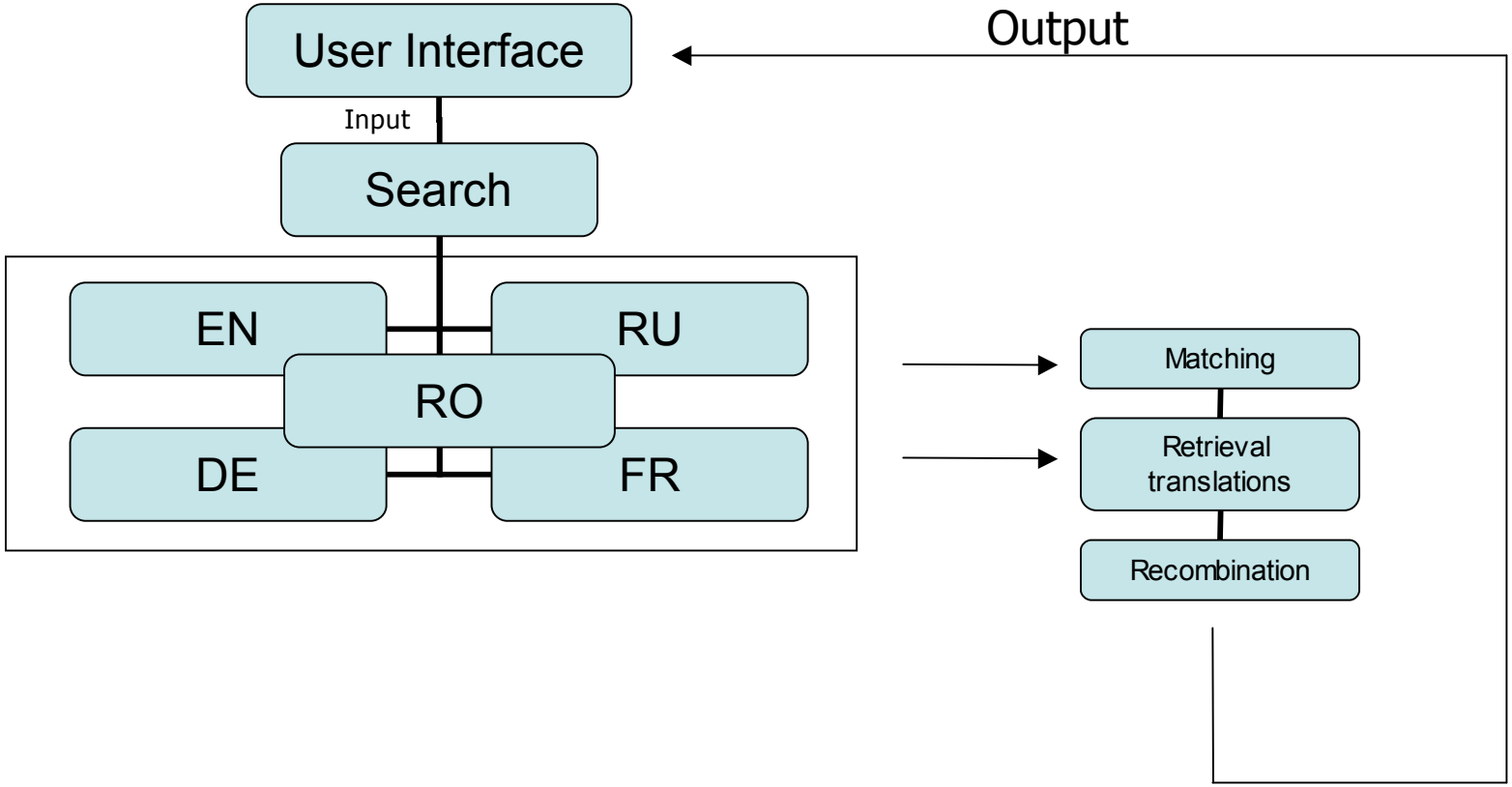
- ✓ **The algorithms for "Edit distance" and "Angle of similarity" calculation have been successfully encoded**
- ✓ **"Semantic distance" algorithm has been encoded. However, there are not enough parameters to perform the calculation (XML knowledge base was not created)**

Example Based Machine Translator
Matching Group

Completed Task:

- ✓ **Our program was successfully elaborated in C++ language. The subprogram finds the string in the database that matches the input string best and extracts the longest common sequence of words for both sentences from it.**

Example Based Machine Translator Recombination group



Example Based Machine Translator Recombination group

- Main Task
- Try to identify , for the retrieved chunks in the SL their correspondents in TL.
- Try to resolve parts with overlap.
- You have to obtain from the matching groups not only the chunks in the SL but also the order in which they appear in the input.
- Try to put together the correspondent chunks, first without any other information . Then define some simple combination rules.
- Try to use the syntactic information in the database.

Text Roman	Text Francez
ritmul a devenit mai rapid	le rythme devint plus rapide
se realizau în stil clasicist	étaient réqlisés en style classique
o biserica clasica de tip central	une église classique à plan central
a devenit mai rapid	devint plus rapide
au fost ridicate clădirea dumei orăşeneşti şi cea a băncii	on a construit le batiments de la douma,
stilizator talentat	trés doué pour la stylisation
stil neobizantin	style néo-byzantin
unirea Basarabiei cu România	l'union de la Bassarabie avec la Roumanie
un puternic centru economic	un puissant centre économique
sau efectuat lucrări de restaurare	on a effectué des restauration
a fost instalată în centru	on a installé au centre
este opera sculptorului Alexandru Plămădeală	est l'œuvre du sculpteur Alexandru Plămădeală
a suferit mari distrugeri	a été sévèrement ravagée
arhitectorul Şciusev	l'architecte Şciusev

Access DB received from the Matching group						
ID	**Rădăcina**	**Partead e vorbire**	**Gen**	**Număr**	**Persoana**	**Cazul**
1	oraş	s	m	sg		N
2	Chişinău	s	m			N
3	a fi	v		sg	3	
4	a amplasa	v		sg	3	
5	pe	prep				
6	şapte	num				
7	colină	s	f	pl		
8	din	prep				
9	epoca	s	f	sg		Ac
10	urmă	adj	f	sg		Ac
11	prima	num				
12	menţiune	s	f	sg		Ac
13	domnitor	s	m	sg		
14	Dimitrie Cantemir	s	m			Ac
15	avînt	s	m	sg		N
16	economic	adj	m	sg		N
17	a ilustra	v		sg	3	
18	de	prep				
19	descoperire	s	f	pl		N
20	monetar	adj	f	pl		G

DB transferred in XML

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Grup Rom.	Grup Fr.

S S Art V Prep S

orasul Chisinau ⇔ la ville de Chisinau

S + S ⇔ Art +V+Prep+S

Art Adj S Adj Art Adj S Adj

un puternic centru economic ⇔ un puissant centre economique

Art+Adj +S + Adj ⇔ Art +Adj+S + Adj

S Adj Adv Adj Prep Art S

stilizator talentat ⇔ tres doue pour la stylisation

S + Adj ⇔ Adv +Adj+Prep+Art+S

Example Based Machine Translator Recombination group

- Intended task:
- To organise a database with the chunks from the SL and their correspondents in TL.
- To look for parts with overlap.
- To define grammar rules to guide the machine.

Example Based Machine Translator Recombination group

- Completed task:
- We identified for the retrieved(regăsite) chunks in the Source Language their correspondents in Target Language.

for e.g.

1)obiceiurile bulgarilor de a umbla desculți =the manners of the bulgarians to go barefooted

2) pentru poporul slav = for slavic people

3) cea mai frumoasă farfurie = the most beautiful plate

ro-en : Table

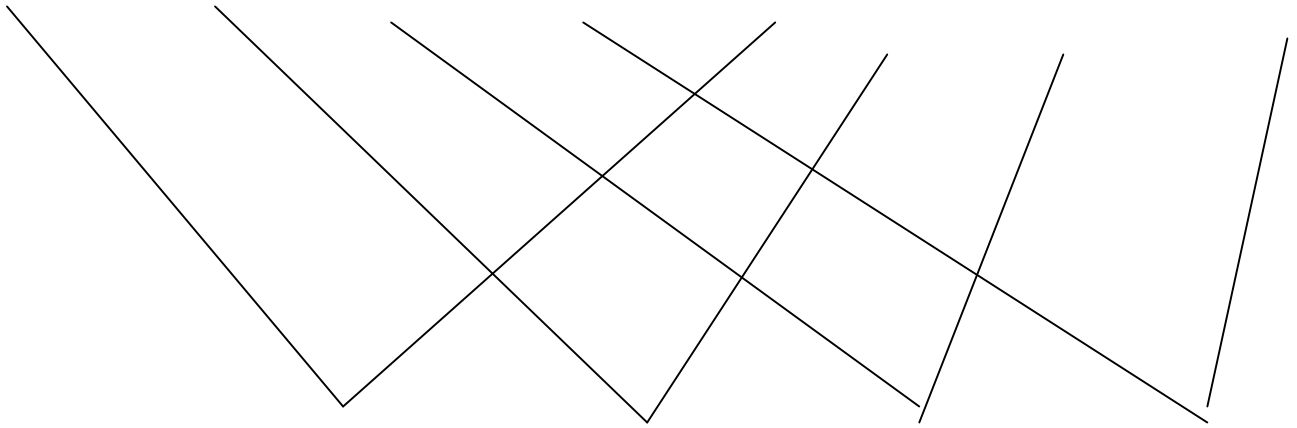
romîn	englez
să vă dea ceva la drum	put some dainty in your bag
fără a urmări un scop anume	disinterestedly
acum cîțiva ani	several zears ago
un cunoscut	an acquaitance
au hotărît să facă o călătorie prin Bulgaria	decided to make a trip across Bulgaria
bilete de călătorie	return tickets
sătui şi mulţumiţi de viaţă	very full and extremely pleased with his life
Bulgăroaicele sunt prieteni devotaţi şi familiste	Bulgarian women are excellent friends and perfect housekeepers
harnice şi rezistente deşi cu caracter	enduring and hardworking though capricious
sunt cel mai bun lucru pe care-l putea crea natura	is the best being nature could create
locuitorii ţării	local inhabitants
lor li se dea cea mai bună bucată de masă	they give them the best pieces of meat for dinner
cel mai comod scaun	the strongest chair
cea mai frumoasă farfurie	the most beautiful plate
adevăraţii bulgari	true bulgarian
conştienţi de propria frumuseţe şi originalitate	aware of his own beautz and exclusiveness
trăiesc cu acest gînd	fuss over this idea
priviţi-l pe Filipp Bredrosovici	look at Filipp Bredrosovici
ochi de catifea	velvet dark eyes
păr negru	thick dark hair
cu o căsătorie	with a mariage
succesul acestei afaceri	the success of this entreprise
depinde de faptul dacă doamna	depend on whether the woman
să accepte ideea că bulgarul este cea mai bună creaţie a naturii	agree that the Bulgarian man is the best Creature in the world

Record: 20 of 97

Example Based Machine Translator Recombination group

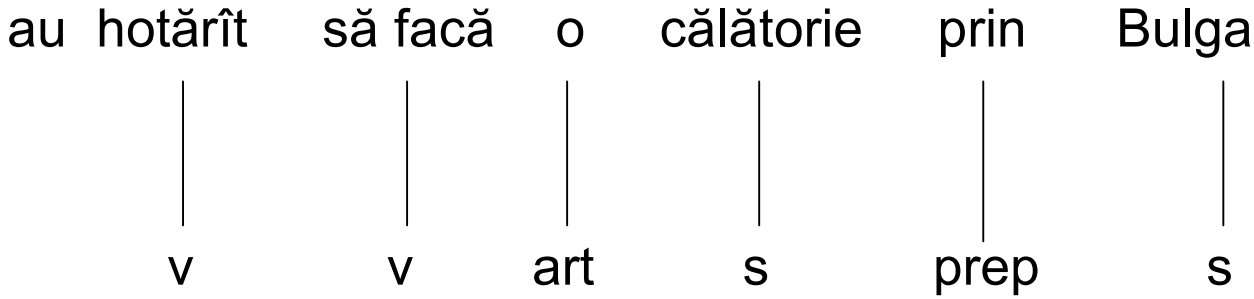
- **we resolved parts with overlap(care coincid)**

Vinurile sunt relativ ieftine= wines are quite cheap

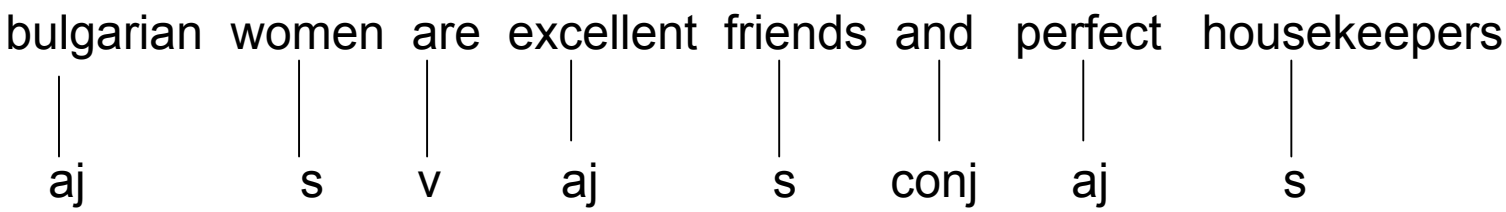


Example Based Machine Translator Recombination group

We didn't obtaited only the chunks in the Source Language but also the order in which they appear in the input.



After that we obtained the chanks in the Target Language and also the order in which they appear in the output.



Example Based Machine Translator Recombination group

We defined some simple combination rules:

In Romanian Language the adjective is usually placed after the noun which is vice versa in English,where it has its place in front of the noun **.**

e.g.

păr negru = black hair

triburi turcice = turkic tribes

In English the definite articles is placed in front of the noun but in romanian it misses.

e.g.

ro: **obiceiurile** bilgarilor de a umbla desculți

eng: **the manners** of the bulgarians to go barefooted

Example Based Machine Translator
Recombination group

The construction noun1+noun2,in romanian , when:

noun1 – the possessed object

noun2 - the possessor

differ in English where:

noun1 is preceded by the article the

noun2 is preceded by the preposition of and article the

e.g

malurile Mării Negre = the coasts of the Black Sea

Example Based Machine Translator
User Interface Group
Results

Example Based Machine Translator
User Interface Group
Results