

GF Modern Greek Resource Grammar

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Abstract

The paper describes the Modern Greek (MG) Grammar, implemented in Grammatical Framework (GF) as part of the Grammatical Framework Resource Grammar Library (RGL). GF is a special-purpose language for multilingual grammar applications. The RGL is a reusable library for dealing with the morphology and syntax of a growing number of natural languages. It is based on the use of an abstract syntax, which is common for all languages, and different concrete syntaxes implemented in GF. Both GF itself and the RGL are open-source. RGL currently covers more than 30 languages. MG is the 35th language that is available in the RGL. For the purpose of the implementation, a morphology-driven approach was used, meaning a bottom-up method, starting from the formation of words before moving to larger units (sentences). We discuss briefly the main characteristics and grammatical features of MG, and present some of the major difficulties we encountered during the process of implementation and how these are handled in the MG grammar.

1 Introduction

Greek is a member of the Indo-European family of languages and constitutes by itself a separate branch of that family. Modern Greek (MG) can be easily traced back to Ancient Greek in the form of letters, word roots and structures, despite the fact that the language has undergone a series of transformations through the ages and has been a subject of considerable simplification. MG makes use of the Greek alphabet since the 8th century B.C. Today the language is spoken by approximately 13.1 million people worldwide. Some of the general characteristics of MG refer to the diversity of the morphology and the use of an extremely large number of morphological features in order to express grammatical notations. Words are in their majority declinable,

whilst each of the syntactic parts of the sentence (subject, object, predicate) is a carrier of a certain case, a fact that allows various word order structures. In addition, the language presents a dynamic syllable stress, whereas its position depends and alternates according to the morphological variations. Moreover, MG is one of the two Indo-European languages¹ that retain a productive synthetic passive formation. In order to realize passivization, verbs use a second set of morphological features for each tense.

2 Grammatical Framework

GF (Ranta, 2011) is a special purpose programming language for developing multilingual applications. It can be used for building translation systems, multilingual web gadgets, natural language interfaces, dialogue systems and natural language resources. GF is capable of parsing and generating texts, while working from a language-independent representation of meaning. The GF Grammar is based on two different modules. An abstract module provides category and function declarations, thus it constitutes a representation of a set of possible trees that reflect the semantically relevant structure of a language, and one or more concrete modules that contain linearization type definitions and rules, therefore managing to relate the tree structures with linear tree representations. The RGL contains the set of grammars of natural languages that are implemented in GF. The parallelism of the grammars is inevitable, given that their development is based on the same rules and functions that are defined in a common abstract syntax. At the moment RGL covers 34 languages² that originate not only from the European continent, but from all over the world. The common API defines around 60 hierarchical

¹ The other one being Albanian

² <http://www.grammaticalframework.org/lib/doc/status.html>

grammatical categories, and a large number of syntactic functions. MG constitutes the newest addition to the RGL and its implementation consists of 28 concrete modules.

3 Morphology

Morphology constitutes the most important aspect of the Greek Language. The words are in their majority declinable, produced via a combination of meta-linguistic elements, such as a stem and an ending. The endings are assigned proportionally with the part of speech and the type, and act as carriers of grammatical notations, indicating the gender, the number, the case or the person, or in the case of verbs the tense, the mood, the voice and the aspect as well. Appendix A presents the parameter types and operations that are defined in the grammar. The implementation of the GF MG morphology started from scratch. All declinable words needed to undergo a first simplistic categorization in order to create basic declension tables, before moving to sub-categorizations that allowed us to treat the various irregularities that govern the morphological structure of MG. One of the main aspects of MG is the presence of a dynamic syllable stress, a phenomenon that created additional difficulties in the implementation of the morphology. A stress can move from a stem to an ending but in many cases the movement is realized inside the stem. Such issues are handled in GF with the introduction of pattern matching functions and pattern macros. The MG grammar includes 25 pattern matching functions and macros that indentify stressed vowels, while at the same time they perform over a string, checking the matches, transforming the stressed vowels into their unstressed form, and assigning the stress to the correct character. They also serve to assigning the appropriate case ending or handle irregularities, such as the addition of extra consonants and reduplication cases.

3.1 Declinable Parts of Speech

All nouns, proper nouns, adjectives, determiners, quantifiers, pronouns, participles, articles and verbs in MG are declinable and each category presents its own characteristics and irregularities. The implementation of the above categories follows a similar pattern: we first divide them into the main conjugations that grammars propose and then we make an exhaustive list of all the rules that specify their creation, as well as

all the specific features which may affect their formation. The creation of nouns includes 17 distinct functions that are categorized depending on the noun ending, the stress movement, whether the noun is parisyllabic or imparisyllabic, or whether the noun augments its syllables when inflected. These functions also handle specific phenomena of the MG language, such as the change of gender of a noun in the plural form, or nouns that originate from Ancient Greek, and are still used nowadays, retaining intact their form and endings. Similarly 6 functions create adjectives, where we also introduce the degree parameter that creates additional forms for all three adjective genders. The formation of the pronouns is of special interest, as MG makes use of two distinct types, the emphatic and the weak. The weak form³ occurs more often, whilst the use is always in close connection with verbs, nouns or adverbs. Our grammar introduces both forms of the pronoun, but it also alternates between them when the syntactic structure requires the use of a particular form. Greek proper nouns follow all the declension patterns and irregularities of common nouns morphology, meaning that they are primarily inflected for gender, case and number. Moreover, they present a major differentiation comparing to other languages, which refers to the introduction of the proper noun with a definite article that takes its form according to the grammatical features of the modified proper noun. The morphology of the verb in MG consists of a complex inflection system, as shown in Appendix B. Whilst in many languages, the grammatical notations are expressed with the use primarily of syntax, MG uses the combination of a stem and an inflectional ending to express grammatical categories such as person, number, tense, voice, aspect and mood. The fact that MG retains a productive synthetic passive formation increases drastically the number of possible forms of the verb, as most verbs have a second set of morphological forms for each tense in order to express passivization. Whilst Greek verbs are divided in two main categories, the second one subdivided into two smaller ones, (Holton et al ,1999; Iordanidou, 1999), the creation of the verb morphology in our grammar imposed the consideration of a number of specific parameters, among them the stress movement, the number of syllables which affects on the creation of the

³ Clitic pronoun

imperative forms, the active stem forms upon which we create the passive stems, the formation of the passive perfective participle, reduplication patterns, internal augmentation phenomena. In addition to the above, we needed to handle various irregularities, which referred mainly to the formation of the imperative or dependent forms, the passivization or not of the verb, the occurrence of a participle, the formation of the active or passive simple past with the use of ending forms borrowed from Ancient Greek. All the above parameters resulted in the creation of 26 main functions that handle the changes in the inflected endings of the verbs, and 39 smaller functions that are connected to the main functions and help us handle the modifications that the stem is subjected to, when conjugated. Moreover, we must emphasize on the necessity to create a series of pattern matching functions that form and alter stems, for the production of the passive perfective according to the active perfective or imperfective, the passive imperative and the participles. A separate concrete module was created in order to deal exclusively with the complex MG verb morphology. Finally, as in the case of personal pronouns, another alternation appears in the formation of the possessive pronouns. Weak and emphatic forms of the possessive pronoun are both used in order to express possession. The first one being the enclitic genitive form of the personal pronoun, while the latter one, expressed via a combination of the definite article, the adjective *δικός* *dikós* “own” and the enclitic genitive form of the personal pronoun. Both forms are assigned via two different functions, defined in the abstract syntax:

```
PossPron : Pron -> Quant ;
PossNP   : CN  -> NP  -> CN  ;
```

Table 1 presents an example of the main procedure, based on which we created the noun morphology and it is also representative of the process that was followed in order to handle the morphology of the main declinable parts of speech. The example concerns the creation of nouns of neuter gender, ending in *-ι*, such as the noun *αγόρι* *agóri* “boy”.

<i>Common abstract grammar : categories</i>
Cat N ;
<i>MG Resource grammar : Resource module</i>
Param
Number = Sg Pl ;
Case = Nom Gen Acc Vocative CPrep Prepos;
Gender = Masc Fem Neut Change;

oper	
Noun : Type = {s : Number => Case => Str ; g : Gender} ;	
mkNoun_agori : (s: Str) -> Gender -> Noun = \agOri, g ->	
let	
agori = mkStemNouns agOri;	
in {	
s = table { Sg => table {	
Nom Acc Vocative CPrep P_se CPrep PNul =>	
agOri ;	
Gen CPrep P_Dat=> mkGenSg agori} ;	
Pl => table {	
Nom Acc Vocative CPrep P_se CPrep PNul =>	
mkNomPl agOri;	
Gen CPrep P_Dat=> mkGen agOri} ; g = g } ;	
mkStemNouns : Str -> Str = \s -> case s of {	
c + v@(#stressedVowel) + x@(_ _) =>c + unstress	
v + x } ;	
mkGenSg : Str -> Str = \s ->	
case s of	
{x + "ος" => x + "ους";	
x + ("ι" "υ") => x + "ιού"; } ;	
mkGen : Str -> Str = \s -> case s of {	
c + "άι" => c + "αγιών" ;	
c + v@(#stressedVowel) + x@(_ _) + ("ι" "υ")	
=>c + unstress v + x + "ιών" ;	
} ;	
stressedVowel : pattern Str = #("ά" "ό" "ί" "έ"	
"ή" "ύ" "ώ" "εύ");	
stress : Str -> Str = \x -> case x of {	
"α" => "ά" ;	
"ο" => "ό" ;	
} ;	
<i>MG Paradigms : Paradigms module</i>	
mkN = overload {	
mkN : (dentro : Str) -> N	
= \n -> lin N (regN n) ;	
mkN : (s : Str) -> Gender -> N	
= \n,g -> lin N (mkN1 n g) ;.....} ;	
mkN1 : Str -> Gender -> N = \x,g ->	
case x of {.....	
c + ("ι" "υ" "ό" "ά") => mkNoun_agori x g ;	
..... } ** {lock_N = <>} ;	
<i>Lexicon :abstract</i>	fun boy_N : N ;
<i>Lexicon MG</i>	lin boy_N = mkN "αγόρι"
	Neut;
<i>Lexicon English</i>	lin boy_N = mkN masculine
	(regN "boy") ;
<i>Parsing into the abstract categories</i>	
Lang> parse -cat=N -lang=Gre "αγοριών"	
boy_N	
Lang> parse -cat=N -lang=Eng "boys"	

boy_N
<i>Generating the full inflectional paradigms</i>
Lang> linearize -lang=Gre -table boy_N s Sg Nom : αγόρι s Sg Gen : αγοριού s Sg Acc : αγόρι s Sg Vocative : αγόρι s Sg (CPrep P_se) : αγόρι s Sg (CPrep PNul) : αγόρι s Sg (CPrep P_Dat) : αγοριού s Pl Nom : αγόρια s Pl Gen : αγοριών s Pl Acc : αγόρια s Pl Vocative : αγόρια s Pl (CPrep P_se) : αγόρια s Pl (CPrep PNul) : αγόρια s Pl (CPrep P_Dat) : αγοριών
Lang> linearize -lang=Eng -table boy_N s Sg Nom : boy s Sg Gen : boy's s Pl Nom : boys s Pl Gen : boys'

Table 1: The Noun Morphology

4 Syntax

The GF abstract syntax provides rules for all the common phrase structures: noun phrases (constructed of pronouns, proper nouns or common nouns and their modifiers), adjectival and verb phrases with their complements. The MG grammar covers all the above structures and successfully correlates the language with the various languages included in the RGL. Due to the fact that MG is a highly inflected language and given that the various morphological features express grammatical notations, the word order in a phrase is relatively free. Although all six logical permutations of the major clausal constituents are usually considered grammatically correct (Tzanidaki, 1995), SVO⁴ remains the predominant word order. The implemented rules in our grammar cover mainly the most common word order, unless the syntactic mechanisms of the phrase itself require otherwise.

4.1 Clauses

The formation of the clause relies on a number of parameters, namely the order, the tense, the polarity and the mood. In main indicative clauses the tense defines the point of time of the verb in relation to the time of speaking. MG has 8 tenses that are divided in three major categories: those that refer to the Present, the Past and the

Future and denoting whether the action expressed by the verb is viewed either as occurring repeatedly, as a completed event, or as an event completed in the past, whose completion is relevant to some other point in time. Noun phrases (NP) represent the subject of the sentence and thus, they appear in the nominative case, while agreement rules pass the grammatical features of the NP to the form of the verb. For the creation of the predication rule in our grammar, which forms a clause, we needed to take into consideration the presence of subject NPs that present a negative connotation (i.e. *κανένας* *kanénas* “nobody”) and impose the use of a negative polarity in the clause. Accordingly, we are making a distinction between the different moods, in order to assign the relevant particles that introduce the clause and which also vary depending on the polarity. Interrogative sentences do not defer from declarative sentences, in the sense that they use the exact same rules applied in declarations, while they are simply characterized by the addition of the question mark (;). *Wh*-questions are introduced with an interrogative word which may be indeclinable *τι* *ti* “what” or declinable for gender, number and case: *ποιός-ποιά-ποιό* *poiós-poiá-poió* “who”. The selection of the appropriate gender of the interrogative word in our grammar is a subject of interest. Whilst in most cases the masculine gender is used as an abstract gender when introducing *wh*-questions, in particular contexts, when the gender of the subject under question is known, the interrogative word should be labeled by the gender of the known subject, without that implying that the use of the masculine gender in such cases is considered semantically incorrect. Relative clauses on the other hand, present a more complex syntactic structure and a number of possible alternations, as they are introduced by two main types of relative markers: the indeclinable *που* *pou* “that, which” or the declinable relative pronoun *ο* *οποίος* *o opoíos* “which”. The MG grammar provides both forms and utilizes the two different relative markers, as the form alternates when its syntactic function in the relative clause requires a genitive, or when it appears in a prepositional or adverbial phrase. The antecedent of a relative sentence might appear in the form not only of a noun phrase but also of a sentence, as in the phrase “She sleeps, which is good”. When the antecedent is sentential, the relative clause can be introduced either with *που* *pou* “that” or with the relative pronoun *ο* *οποίος* *o opoíos* “which”,

⁴ Subject-Verb-Object

which appears mandatory in the neuter gender form. As Chatsiou (2010) notes, the use of the neuter gender is explained by the fact that the relative clause does not actually take a sentence as an antecedent, but it rather modifies an omitted or implied noun, such as *πράγμα* *prágma* “thing” or *γεγονός* *gegonós* “fact”.

4.2 Verb Phrases

Verb phrases are constructed from verbs by providing their complements, whilst GF provides one rule for each verb category. Appendix C presents examples of verb complementation. Appropriate agreement rules are specified for the complementation of verbs that take one or more arguments, namely the accusative case for direct objects and a prepositional phrase or a genitive for indirect objects. The lack of infinite in MG created additional difficulties in the construction of verb phrases. While in many languages the embedded clause is infinitival, the verbal complementation in MG is realized via the use of finite subjunctive forms, which implies that in all cases, the sentence should show a subject or object agreement. Phrases in English such as “*I want to buy an apple*”, that use the infinitive form of the verb *buy*, without any marking for person or number, can only be attributed in MG after considering the properties of the subject of the main clause, which becomes the subject of the verb of the subordinate clause. On the other hand, in order to achieve object agreement, it was necessary to create an extra record type that handles the object control complement. The creation of phrases such as “*I beg her to go*” is a typical case. The verb *beg* takes an NP complement, the direct object (*her*), which in MG has the form of a weak clitic pronoun, placed before the verb. In the subordinate clause, the NP complement becomes the subject of the verb *go*, and passes its number and person in the form of the embedded verb.

I beg her to go.

Εγώ την παρακαλώ να πάει.

Egō tin parakalāō na páei

I her-clit,acc,P3,Sg beg to go-P3,Sg,subj

I beg *her* (that *she* goes)

The same rule applies in cases of adjectival complementation, where, similarly, the NP complement should agree in gender and number with the adjective.

I paint them black

Εγώ τους βάφω μαύρους

Egō tous váphō maúrous

I them-clit,acc,Masc,Pl paint black-acc,Masc,Pl

4.3 Noun and Adjectival Phrases, Participles

As in most inflectional languages, where the constituents of the phrase are carriers of grammatical notations, MG noun phrases present a consistency in the phrase terms that is realized via the use of agreement rules: the gender, the number and the case of the noun or adjective should reflect in all the terms that define it. Moreover, the use of the definite article presents an extended necessity. Nouns are usually accompanied by a definite article, whilst this applies even in the case of proper nouns. The modification of NPs with participles is of special interest. In GF these constructions are assigned via functions that connect an NP and a transitive verb in order to create the participial NP (*the man tied*). Although MG makes wider use of a relative clause to express such structures, in the presence of a participle, the syntactic rules would suggest that it must be placed before the noun it is attributed to. Thus, it would be necessary to split the NP in its constituents, in order to introduce the participle before the noun and after the determiner. To handle this construction, the MG grammar creates polydefinite structures (Lekakou and Szendroi, 2012), where both the noun and the participle are each accompanied by their own determiner.

4.4 Idiomatic Expressions

The GF grammar deals with idiomatic expressions in a special module and manages to handle constructions that are formed in fixed ways, such as generic and impersonal clauses. The copula verb *είμαι* *eímai* “to be” used in the third person of singular accompanied by an adverb in the comparative form or by a neuter adjective used adverbially, can form impersonal clauses:

ImpersCl vp=predVP [] (Ag Neut Sg P3)vp ;

Although MG makes use of two main moods, the indicative and the subjunctive, the latter one introduced with the particle *να* *na* “to” in sentences with positive polarity and *μην* *min* “not” in cases of negation, our grammar required the addition of an extra mood form, the Hortative, in order to form imperative sentences where the speaker makes a suggestion or a wish i.e. the English sentences “let’s go” or “let John go”, which in MG, according to Chondrogianni (2011) are introduced with the hortative particle *ας* *as* “let”.

5 Evaluation

The purpose of the evaluation of the grammar was not only to assess the correctness of the grammar but also to provide a proof-reading and verify the coverage of the resource library. The evaluation was conducted with the use of a test set, which includes 440 automatically – generated test examples, utilized in the Synopsis of the RGL⁵ as well as 27 test definitions used in Khagai (2006). The test set provides linearization of trees, as seen in Appendix D, both in English and in MG, in order to assess the correctness of the MG translations, and it is organized in such way that it includes all the rules in the grammar and all possible combinations of the categories. The evaluation revealed a number of interesting findings. Some examples were indicative of the way a term can have a different lexical linearization, depending on the context in which it appears. Such is the adjective old (*παλιός/paliós*), which was, initially, translated in our concrete Lexicon bearing the sense of something that is not new. That resulted in sentences such as *αυτός ο παλιός άνδρας* *αυτός ο paliós ándras* “this old man”, that, although syntactically correct, they fail in a semantic level, as the term *παλιός* is attributed to inanimate objects, whilst the sense of something that has lived for a long time requires a different lexical approach. Another observation refers to the use of the definite article, mainly with the presence of the mass noun or in apposition constructions. Whilst mass nouns are marked by the absence of the article, certain constructions in MG require its use in order to render a phrase grammatically correct. In addition, the test showed that some constructions predetermined in the abstract syntax, although they do not generate ungrammatical instances, they fail to produce outcomes that would constitute the predominant syntactic structure. Such is the case of the use of a relative clause, instead of a participial construction, when the semantic function of the verb requires it. The above findings concerned 15 of the sample sentences, out of which 9 referred to the use of the adjective old (*παλιός/paliós*). With the exception of cases that are associated mainly with semantic and pragmatic connotations, which nonetheless are not the focus of the resource grammar, not major

⁵<http://www.grammaticalframework.org/lib/doc/synopsis.html>

obstacles were encountered in the application of the MG resource grammar.

6 Related Work

Not many available computational grammars are noted for MG. One of the available grammars refers to MG Resource Grammar (Poulis et al 2005), built upon the theoretical framework of Head Driven Phrase Structure Grammar (Pollard and Sag, 1994). The implementation of the grammar is realized in the LKB grammar development system (Copestake, 2002), whilst the writing and testing makes use of LinGo Grammar Matrix tool (Bender et al, 2002) in order to implement quickly as many phenomena of the language as possible. The grammar concentrates on the implementation of a number of phenomena, such as locative alternation, word order, cliticization, politeness constructions and clitic left dislocation and it comes with a test suite, whilst the system provides a syntactic analysis for the test items. Another attempt refers to the large-scale systemic functional grammar of MG, developed by Dimitromanolaki et al (2001), in the context of M-PIRO, a multilingual natural language generation project, and based on descriptions of museum exhibits, generated automatically in three languages from a single database source. The grammar follows the approach of systemic grammars that are primarily concerned with the functions of the language, and with the way that these functions are mapped into surface forms.

7 Conclusion and Future Work

The result of the current work is the development and implementation of MG in GF. The grammar manages to correlate MG with the various other languages in the RGL. The current work consists of 28 concrete modules, covering orthographical, morphological and syntactic variations of the language. The testing and evaluation of the MG grammar revealed a high percentage of accuracy in the translation of English sentences to MG. At the same time it verified the complexity of MG and the challenges in the implementation. Future work refers mainly to providing a number of possible alternations in some constructions, namely the various word order structures or the different structures related to participial NPs. In addition, the coverage of language specific features is desirable, namely phenomena of clitic doubling and left dislocation, as well as fronted/focal constructions.

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Appendix A. Parameter Types and Operation Definitions

```
param
Case = Nom| Gen| Acc| Vocative| CPrep
Prepos;
Gender = Masc | Fem | Neut | Change;
Agr = Ag Gender Number Person ;
Mood = Ind | Con | Hortative;
TTense =TPres | TPast| TFut | TCond |TImperf;
CardOrd = NCard Gender Case| NCardX |NOrd
Gender Number Case ;
DForm = unit | teen | ten | hundr isVowel ;
isVowel = Is | isNot ;
Aspect = Perf | Imperf ;
Order = Main | Inv ;
Form = Weak |Emphatic ;
VForm =
VPres Mood Number Person Voice Aspect|
VPast Mood Number Person Voice Aspect|
VNonFinite Voice|
VImperative Aspect Number Voice|
Gerund |
Participle Degree Gender Number Case;
Voice = Active | Passive;
Prepos = P_se | PNul | P_Dat;

oper

AAgr : Type = {g : Gender ; n : Number} ;
VP = { v : Verb ; clit,clit2 : Str ; comp
: Agr => Str ; isNeg : Bool ; voice :
Voice ; aspect :Aspect};
NounPhrase = { s : Case => {c1,c2,comp :
Str ; isClit : Bool } ; a : Agr;
isNeg:Bool};
Noun : Type = {s : Number => Case => Str ;
g : Gender} ;
Adj : Type = {s : Degree => Gender =>
Number => Case => Str ; adv : Degree =>
Str } ;
Adv : Type = {s : Str } ;
Verb : Type = {s : VForm => Str } ;
Det : Type = {s : Gender => Case => Str ;
n : Number};
PName : Type = {s : Number => Case => Str ;
g : Gender} ;
Pronoun : Type = { s : Case => {c1,c2,comp:
Str ; isClit : Bool } ; a : Agr; poss :
Str } ;
Preposition = {s : Str ; c : Case} ;
Quantifier = {s : Bool => Gender => Number
=> Case => Str ; sp : Gender => Number
=> Case => Str ; isNeg:Bool } ;
Compl : Type ={s : Str ; c : Case ; isDir :
Bool} ;
```

Appendix B. Verbs of First Conjugation

```
mkVerb1 :
(x1,x2,x3,x4,x5,x6,x7,x8,x9,x10,x11,x12,x13,x
14,x15 : Str) -> Verb = \paIzw, paIksw,
Epeksa, Epeza, paIz,paIks, Epeks, Epez, De,
p, pl, Imp, Imp2, Imp3 ,part->
{
s = table {
VPres Ind Sg P1 Active _ => paIzw ;
VPres Ind Sg P2 Active _ => paIz + "εις" ;
VPres Ind Sg P3 Active _ => paIz + "ει" ;
```

```

VPres Ind Pl P1 Active _ => paIz+ "ουμε" ;
VPres Ind Pl P2 Active _ => paIz + "ετε" ;
VPres Ind Pl P3 Active _ => paIz + "ουν" ;
VPres Ind Sg P1 Passive _ => paIz + "ομαι" ;
VPres Ind Sg P2 Passive _ => paIz + "εσαι" ;
VPres Ind Sg P3 Passive _ => paIz + "ειται" ;
VPres Ind Pl P1 Passive _ => p + "όμαστε" ;
VPres Ind Pl P2 Passive _ => paIz + "εστε" ;
VPres Ind Pl P3 Passive _ => paIz + "ονται" ;
VPres _ Sg P1 Active _ => paIksw ;
VPres _ Sg P2 Active _ => paIks + "εις" ;
VPres _ Sg P3 Active _ => paIks + "ει" ;
VPres _ Pl P1 Active _ => paIks + "ουμε" ;
VPres _ Pl P2 Active _ => paIks + "ετε" ;
VPres _ Pl P3 Active _ => paIks + "ουν" ;
VPres _ Sg P1 Passive _ => p1 + "ώ" ;
VPres _ Sg P2 Passive _ => p1 + "είς" ;
VPres _ Sg P3 Passive _ => p1 + "εί" ;
VPres _ Pl P1 Passive _ => p1 + "ούμε" ;
VPres _ Pl P2 Passive _ => p1 + "είτε" ;
VPres _ Pl P3 Passive _ => p1 + "ούν" ;
VPast _ Sg P1 Active Perf => Epeksa ;
VPast _ Sg P2 Active Perf=> Epeks + "εξ" ;
VPast _ Sg P3 Active Perf => Epeks + "ε" ;
VPast _ Pl P1 Active Perf =>paIks+"αμε" ;
VPast _ Pl P2 Active Perf =>paIks+"ατε" ;
VPast _ Pl P3 Active Perf => Epeks+"αν" ;
VPast _ Sg P1 Passive Perf => De + "ηκα" ;
VPast _ Sg P2 Passive Perf => De+"ηκες" ;
VPast _ Sg P3 Passive Perf => De + "ηκε" ;
VPast _ Pl P1 Passive Perf =>p1+"ήκαμε" ;
VPast _ Pl P2 Passive Perf=> p1+"ήκατε" ;
VPast _ Pl P3 Passive Perf => De+"ηκαν" ;
VPast _ Sg P1 Active Imperf => Epeza ;
VPast _ Sg P2 Active Imperf =>Epez+ "εξ";
VPast _ Sg P3 Active Imperf => Epez + "ε";
VPast _ Pl P1 Active Imperf =>paIz+"αμε";
VPast _ Pl P2 Active Imperf =>paIz+"ατε";
VPast _ Pl P3 Active Imperf => Epez+"αν";
VPast _ Sg P1 Passive Imperf=>p+"όμουν";
VPast _ Sg P2 Passive Imperf=>p+"όσους";
VPast _ Sg P3 Passive Imperf =>p+"όταν";
VPast _ Pl P1 Passive Imperf=>p+"όμασταν";
VPast _ Pl P2 Passive Imperf=>p+"όσασταν";
VPast _ Pl P3 Passive Imperf=>p+"όντισαν";
VNonFinite Active => paIks + "ει";
VNonFinite Passive => p1 + "ει";
VImperative Perf Sg Active=> Imp2 ;
VImperative Perf Pl Active => Imp ;
VImperative Imperf Sg Active => Imp3 ;
VImperative Imperf Pl Active =>paIz+"ετε";
VImperative _ Sg Passive = mkImperPassive
    paIks + "ου";
VImperative _ Pl Passive => p1 + "είτε" ;
Gerund => paIz + "οντας" ;
Participle d g n c => (regAdj part).s !d!
    g !n !c});

```

```

as = vp.aspect
in
v.c3.s ++ "να" ++ vp.clit ++ vp.clit2
++ vp.v.s ! VPres Con agr.n agr.p vo
as ++ vp.comp! a ;
c2 = v.c2
} ;

```

```

ComplSlash vp np = insertObject vp.c2 np
(insertComplement (\\a => vp.c2.s ++
vp.n3 ! np.a ) vp ) ;

```

Appendix D. Example of the Test Set

```

mkUtt (mkNP (mkNP john_PN) (mkRS (mkRC1
which_RP (mkVP walk_V))))
John , who walks
ο Γιάννης , που περπατά

```

```

mkUtt (mkNP or_Conj (mkNP this_Det woman_N)
(mkNP john_PN))
this woman or John
αυτή η γυναίκα ή ο Γιάννης

```

```

mkUtt (mkNP or_Conj (mkListNP (mkNP this_Det
woman_N) (mkListNP (mkNP john_PN) i_NP)))
this woman , John or I
αυτή η γυναίκα , ο Γιάννης ή εγώ

```

```

mkUtt (mkCN big_A house_N )
big house
μεγάλο σπίτι

```

```

mkUtt (mkCN big_A (mkCN blue_A house_N))
big blue house
μεγάλο μπλέ σπίτι

```

```

mkUtt (mkCN (mkAP very_AdA big_A) house_N )
very big house
πολύ μεγάλο σπίτι

```

```

mkUtt (mkCN (mkAP very_AdA big_A) (mkCN
blue_A house_N) )
very big blue house
πολύ μεγάλο μπλέ σπίτι

```

Appendix C. Verb Complementation Examples

```

ComplVV v vp =
    insertComplement (\\a => case a of {
    Ag _ n p => let
        vo= vp.voice ;
        as = vp.aspect in
    "να" ++ vp.clit ++ vp.clit2 ++ vp.v.s !
VPres Con n p vo as ++ vp.comp ! a})
(predV v) ;

SlashV2V v vp = mkVPSlash v.c2 (predV v)
** { n3 = \\a =>
    let agr = clitAgr a ;
    vo = vp.voice ;

```