

NOOJ LOCAL GRAMMARS AND COGNITIVE SMALL WORLDS - THE CONCEPT OF DATE AND DURATION

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Abstract

Over the course of centuries, time has been and still is one of the concepts men have been long investigating, more specifically, the way in which time, in its flow, can be objectively managed and coped with. Scientists, philosophers, writers and artists have tried and still try to make their contribution to the conceptual definition of time, however discovering that it constantly seems to escape any form of definitive and immutable indication, especially as regards the classic tripartite but elusive subdivision of time conceived as past, present and future.

Consequently, the postulations regarding the concept of time have produced innumerable and extremely varied statements. To name just two of them, only apparently dissimilar, we will recall Albert Einstein's "Time is relative, its only value is given by what we do while it is passing" and Marcel Proust's "The days are perhaps the same for a watch, but not for a man."

The attempt to "dominate" time and its continuous and uninterrupted flow is present also in the morphosyntactic structures of natural languages, including Italian. Therefore, the aim of this paper is to assess how date and duration expressions are morphosyntactically built and can be formalised by means of specific NooJ local grammars, finite-state automata (FSA) and graphs.

Keywords: NooJ, NooJ Local Grammars, Date and Duration Italian Adverbs, Natural Language Processing, Finite State Automata, Graphs.

GRAMÁTICAS LOCALES DE NOOJ Y PEQUEÑOS MUNDOS COGNITIVOS: EL CONCEPTO DE FECHA Y DURACIÓN

Resumen

A lo largo de siglos, el tiempo ha sido -y continúa siendo- uno de los conceptos que más ha investigado y estudiado el hombre. Científicos, filósofos, escritores y artistas del pasado y del presente han intentado aportar su contribución para dar forma a una descripción conceptual del tiempo así como una evaluación objetiva del mismo. Sin embargo, estos intentos siguen sin poder dar con una definición lisa y llana, y en especial, una aún más adecuada para la elusiva subdivisión tripartita del tiempo en pasado, presente y futuro.

Como resultado, en esta búsqueda de la descripción más apropiada del tiempo encontramos una enorme diversidad de postulaciones. Por un lado, podemos referirnos a Albert Einstein con su cita "El tiempo es relativo, su valor dependerá de lo que hagamos con él"; y por otro lado a Marcel Proust con su cita "Los días pueden ser iguales para un reloj, pero no para un hombre" solo para converger en definiciones dispares.

En la búsqueda por "dominar" el tiempo y su flujo constante e ininterrumpido, también se refleja el desarrollo de estructuras morfosintácticas en las lenguas naturales, como el italiano, para su comprensión.

Por ello, el objetivo de este trabajo es determinar cómo están constituidas morfosintácticamente las expresiones que sitúan los predicados en fechas y duración de los mismos y cómo sería

posible formalizarlas mediante el uso específico de las gramáticas locales de NooJ, autómatas de estados finitos y gráficos.

Palabras clave: NooJ, gramáticas locales de NooJ, adverbios italianos de fechas y duración, procesamiento de lenguas naturales, autómata de estados finitos, gráficos.

1. Introduction: Time, Date, Duration and Natural Language

Over the course of centuries, time has been and still is one of the concepts men have been long investigating, more specifically, the way in which time, in its flow, can be objectively managed and coped with. Scientists, philosophers, writers and artists have tried and still try to make their contribution to the conceptual definition of time, however discovering that it constantly seems to escape any form of definitive and immutable indication, especially as regards the classic tripartite but elusive subdivision of time conceived as past, present and future.¹

Consequently, the postulations regarding the concept of time have produced innumerable and extremely varied statements. To name just two of them, only apparently dissimilar, we will recall Albert Einstein's "Time is relative, its only value is given by what we do while it is passing" and Marcel Proust's "The days are perhaps the same for a watch, but not for a man."

The attempt to "dominate" time and its continuous and uninterrupted flow is present also in the morphosyntactic structures of natural languages, including Italian. Therefore, as for this language, the aim of this paper is to assess how time passages are asserted, specifically by means of date and duration adverbs. We will see how these expressions are morphosyntactically built and can be formalised by means of specific NooJ local grammars, finite-state automata (FSA) and graphs.

1.1. Morphosyntax of Italian Time Expressions: A Brief Outline

In natural languages, hence also in Italian, time is the moment (present, past or future) in which the action indicated by a verb is placed. This notion, which alongside that of the verbal aspect represents the determination of the broader notion of process expressed by a verb, assumes grammatical importance in most languages, and is expressed through a system of forms that constitute the tenses. We may have:

- Absolute tenses, that is, tenses referring exclusively to the act of speaking (present, past, future);
- Relative tenses, referring to other tenses of the same syntactic period (future perfect, past perfect);
- Simple tenses, which consist of a single element, variable according to the number and the person;
- Compound tenses, provided with one or more auxiliaries, therefore also called periphrastic.

In the common Indo-European verb system, the temporal notion interferes with that of the aspect, which is predominant, as it is represented noticeably by the Greek verbal system. In it, the so-called present indicates the process in progress, the aorist the process itself (punctual action), and the perfect the result of a completed action. In particular, time finds its first grammatical

¹ As is well known, the idea of "past" and "future" are not objective and logical parts of time *per se*. Rather, they stand for the capacity of "remembering". Therefore, they are logical-organizational and adaptive functions of the human mind, aimed at connecting events already occurred to ongoing events, and in an attempt to predict or hypothesize events that have yet to occur.

affirmation in Indo-European in the present-past opposition.² Subsequently, it affirms itself in the history of the different linguistic systems, and becomes prevalent in some of them, as, for example, in the Romance languages, where the function of the aspect is purely accessory, while the temporal distinction is articulated in a rich complex of grammatical forms. For instance, as regards Italian verb inflections, we note that the forms expressing past actions are more numerous than those used for present and future ones. Actually, the present indicative (*io parlo*, I speak) and the present gerund (*io sto parlando*, I am speaking) are the only two forms with which it is possible to express contemporary actions. As for future actions, we only have two possible forms: the simple future *io parlerò* (I will speak), and the future perfect *io avrò parlato* (I will have spoken). On the contrary, the indicative forms usable for past actions are five: the present perfect *io ho parlato* (I have spoken), the imperfect *io parlavo* (I was speaking), the past tense *io parlai* (I spoke), the perfect past tense *io avevo parlato* (I had been speaking) and the remote past tense *io ebbi parlato* (I had spoken).

Together with verb forms and inflections, time adverbs are linguistic elements with which it is possible to refer to time in terms of past, present and future. From a semantic and lexical point of view, an adverb of time is such when it answers the question "when?", while the positioning in the temporal context of the response arises and is directly inherent in the adverb of time used.³ As we will see below, the expressions of date and duration that we will discuss here are in effect adverbs of time. For them we will present specific NooJ Italian local grammars, but while a date constitutes the answer only to the question "when?", a duration may be also the answer to other type of questions as for instance "for how long?", "in which period of time?", and so on.

From a logical point of view, distinguishing between date and duration is a rather intuitive but equally elusive process. The distinctions produced by the Classical Sciences and Philosophy seem today only partially precise. In fact, given a T axis of time⁴, we may affirm that when one event occupies one and only one point on T, we have a date; on the contrary, when one event occupies two or more subsequent points on T, we have a duration.

As for this definition, the conceptual and logical problem lays in the duration of a moment of T, which is the length (in terms of intervals of microseconds, seconds, hours, or days) in which we choose to enclose a point on T. In this sense, the expression "in that precise moment" is as well a date as "on 14 September 2020". On the contrary, it is more likely that a native English understand the expression "during the day 14 September 2020" as a duration, even if it shares most lexical elements with the date previously mentioned. Besides, it is appropriate also to state that a duration can contain a series of dates, or that a series of chronologically ordered dates constitute a duration. The opposite, however, is not logically demonstrable: considering a date a punctual event, the momentum of which has the beginning very close to the conclusion, it is not be possible to postulate that a date may include a duration. However, and again, also this statement seems as intuitive as elusive.

Fortunately, and in relation to the arguments to deal with here, we will see that the lexical elements used are of great help in making a more precise distinction between date and duration, even beyond the hypothetical or concrete length of a momentum on T. Indeed, the difference between "on 14 September 2020" and "during 14 September 2020" is established with a certain precision thanks to the two different introductory prepositions, namely "on" (punctual) and "during" (durative). While bringing to mind Z. Harris and M. Gross, it is in fact possible to affirm that within these two different adverbs of time, the two prepositions function as operators, helping to

² The historical forms of the future are independent innovations in the development of individual languages.

³ This is demonstrated by the fact that the Italian adverbs of time *oggi* (today), *ieri* (yesterday) and *domani* (tomorrow) all answer the question "when", but refer to different, if not opposite, time phases.

⁴ A time axis is a tool to represent, in chronological order, the succession of series of events concerning all fields of human activities.

address their different classification. We will also see that in Italian, the lexical elements, mostly prepositions, capable of fulfilling a similar task are different and distributionally equivalent.

2. Date, Duration, Small Worlds and NooJ Local Grammars

The theory of small world(s) or small world effect(s) is a mathematical and sociological theory holding that all complex networks present in nature are such that any two nodes can be connected by a path consisting of a relatively small number of links. Mathematically, this theory is studied as a branch of graph theory, particularly in computer science, with applications, for example, in Biology, Economics and Sociology. In our case, it is possible to extend the applications domains of this theory to lexica, lexical classification and linguistic analytical tools, such as NooJ local grammars and the formalization of syntactic patterns they allow.

For instance, let us consider knowledge domains, such as Psychoanalysis, Computer Science, or all the domains into which the investigative and research disciplines of human activities are divided. As is known, each of these domains has its own reference lexicon, which is a set of specific words whose meaning of use, in that specific domain, is non-polysemic and unambiguous. In this sense, we may have:

- Technical-scientific lexica, when the words used by a specific domain only pertain to it and to no other domain;
- Speciality lexica, when one or more scientific domains use words also pertaining to other domains, without altering in any case their non-polysemic and non-ambiguous meanings.

Speciality lexica are less rare than technical-scientific ones. For instance, it is often common and necessary for domains such as Jurisprudence and Law to use words that pertain to Biomedicine or Bioethics. Albeit less frequently, even hard sciences as Particle Physics can borrow terms from other domains, such as Quantum Mechanics, or Chemistry. However, in both cases, it is possible to affirm that a specific domain of knowledge is conceptually a small world, insofar as it is also defined in terms of discipline by the non-polysemic and non-ambiguous words it uses it, and by the concepts, which as such, these words express. Besides, their meanings, precisely because they are legitimate within a specific domain of knowledge, connect to each other, thus constituting a "network of knowledge", i.e. a small world.

In addition, it is possible to state that a set of syntactic patterns likely to express specific similar meanings is, to all intents and purposes, a small world. From this point of view, this statement appears extremely natural if we consider the functional and applicative nature of NooJ local grammars, called local precisely because they account for just specific homogeneous sets of linguistic expressions, such as those of date and duration, in Italian and in any other natural language. As we will see, both date and duration expressions, to be formalized in two distinct NooJ local grammars, will all together have the purpose of producing sets of homogeneous meanings, or small worlds, the elements of which will be connected and functionally equivalent. It will therefore be possible with one grammar to formalize only the date expressions, while with another only the duration expressions. The two grammars will therefore be in a certain way conceptually in opposition to each other. It will therefore be possible with one grammar to formalize only the date expressions, while with another only the duration expressions. The two grammars will consequently be in a certain way conceptually in opposition to each other. However, the fact that these grammars are the expression of small worlds will facilitate the task of formalizing and automatically recognizing their meaning.⁵

⁵ This passage demonstrates how it is possible to obtain semantic descriptions starting from purely formal descriptions of natural language expressions. Thus, we produce what we can define an automatic procedure

3. Date and Duration NooJ Grammars for Italian

In order to process and formalise Italian date and duration expressions, we built a unique NooJ grammar, the structure of which is presented in Figure 1.

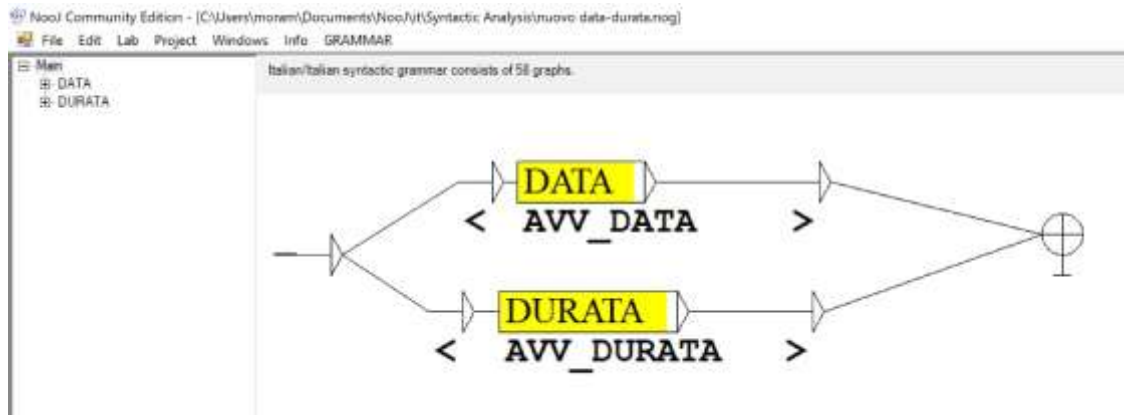


Figure 1. Date and Duration NooJ grammar for Italian main structure.

3.1. Date Syntactic Patterns

As we will see in the following pages, mainly the syntactic patterns of date expressions in Italian are composed mostly as follows (from left to right, but with interchangeable positions):

- Time adverbs as *ieri* (yesterday), *oggi* (today), *domani* (tomorrow), *dopodomani* or *dopo domani* (the day after tomorrow), *avanti* or *avanti ieri* (two days ago);
- Masculine/feminine determiners and articulated prepositions, and/or simple prepositions;
- The names of Days of the week;
- Time expressions, both pronounced and written according to the indications of a clock, and accompanied by adverbs for approximating time such as *pressappoco* (more or less), *all'incirca* (roughly) and so on;
- Propositions relating to the months of the year, both in their total and partial duration;
- Possible adjectives such as *scorso* (last), *passato* (past) or *precedente* (previous), both masculine and feminine.

3.2. Date Grammar

Due to these features, the main structure of our NooJ date grammar will be as follows:

of formal semantics recognition, in which each variation of (linguistic) form corresponds to a non-casual variation of (semantic) content.

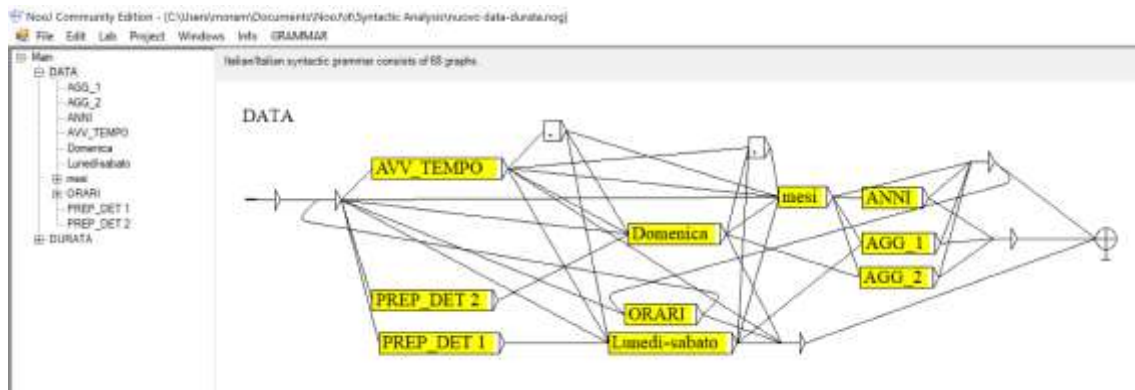


Figure 2. Date NooJ grammar for Italian, main structure.

As we can see in this figure, the structure of the grammar is very rich, as it uses a considerable amount of graphs (68). Hence, it does not currently seem possible to show it in full, as this operation would require a very high number of pages. Not even all the results of NooJ "Generation of Language" can be shown, as they would produce a very high-size NooJ dictionary, difficult to display and comment.

Therefore, we will show and comment below only one sub-parts of the grammar itself, that is, the graphs used to process the propositions including the months and their days, in both numbers and letters. We will also give examples of NooJ debug applications.

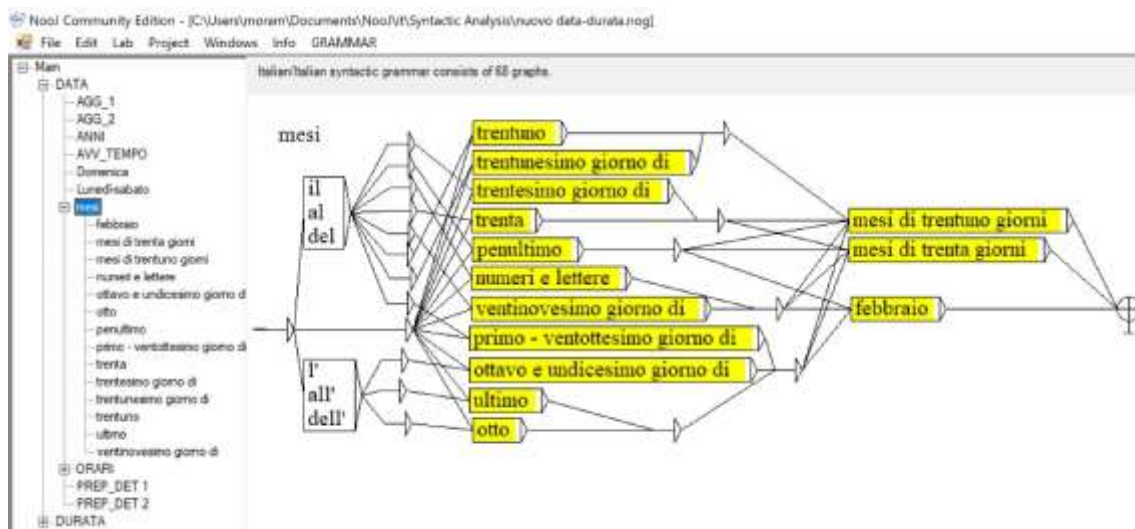


Figure 3. The graph "mesi", main structure.

As for the debug section, the following Figures 4 will show that the grammar correctly identifies as a date the proposition *l'ottavo giorno del mese di marzo 1915* (the eighth day of the month of March 1915).



Figure 4. Date recognition.

Besides, Figures 5 and 6 show that the grammar identifies correctly expressions as *l'otto marzo 1923 alle ore 23,32* (on March 8th, at 23h32) and their reverse forms as *alle ore 23,32 dell'otto marzo 1923*:



Figure 5. Reverse proposition recognition - 1.

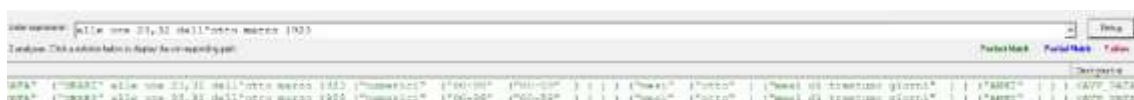


Figure 6. Reverse proposition recognition - 2

4. Duration Syntactic Patterns

Unlike those of dates, duration expressions have a less defined morphosyntactic profile, mainly due to the absence of numerical indications. Therefore, in terms of co-occurrence, duration expressions are freer and less predictable than dates. As well, in terms of word selection they use a set of time unit terms like *secondo* (second), *minute* (minute), *giorno* (day), *mese* (month), *anno* (year), and so on, preceded by or combined with composed preposition or simple prepositions as *in*, *tra* and *fra* (between), *durante* (during), *mentre* (while), and so on. Figure 7 shows the main structure of the NooJ grammar for duration:

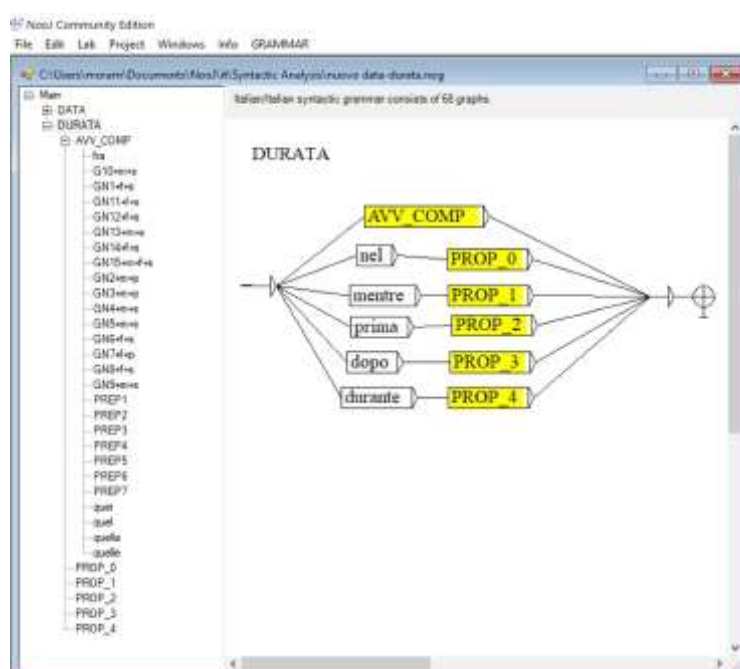


Figure 7. NooJ grammar for duration – main structure.

4.1. Duration Grammar

As we can evince from the structure column in Figure 7, due to morphosyntactic agreement restrictions, the creation of this grammar needed:

- Fifteen noun groups (GN), divided according to gender (masculine and feminine), number (singular and plural) and distributional structures;
- Seven prepositional groups (PREP), in which simple, compound and articulated propositions are inserted based on the gender(s) of the noun group(s) they precede;
- Five proposition types, which include different and non-factorizable patterns and contain phraseology elements.

For instance, GN10+m+s (Figure 8) recognizes and tags expressions like *da un momento all'altro* (any moment now):

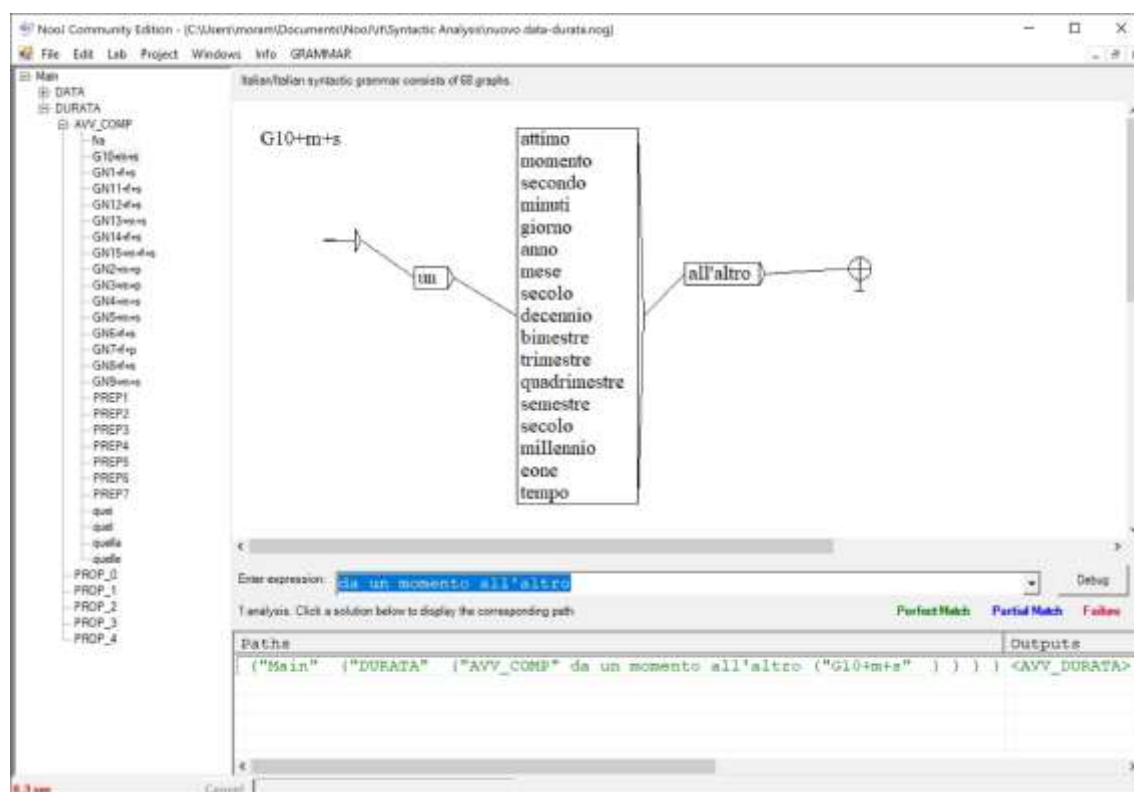


Figure 8. GN10+m+s.

At the same time, the graph GN15+m+f+s+p (Figure 9) is configured to process and tag duration adverbs which contain both singular/plural masculine and feminine time unit terms. In the debug window, we can observe that the grammar has correctly tagged the duration adverb *dopo alcune ore* (after some hours):

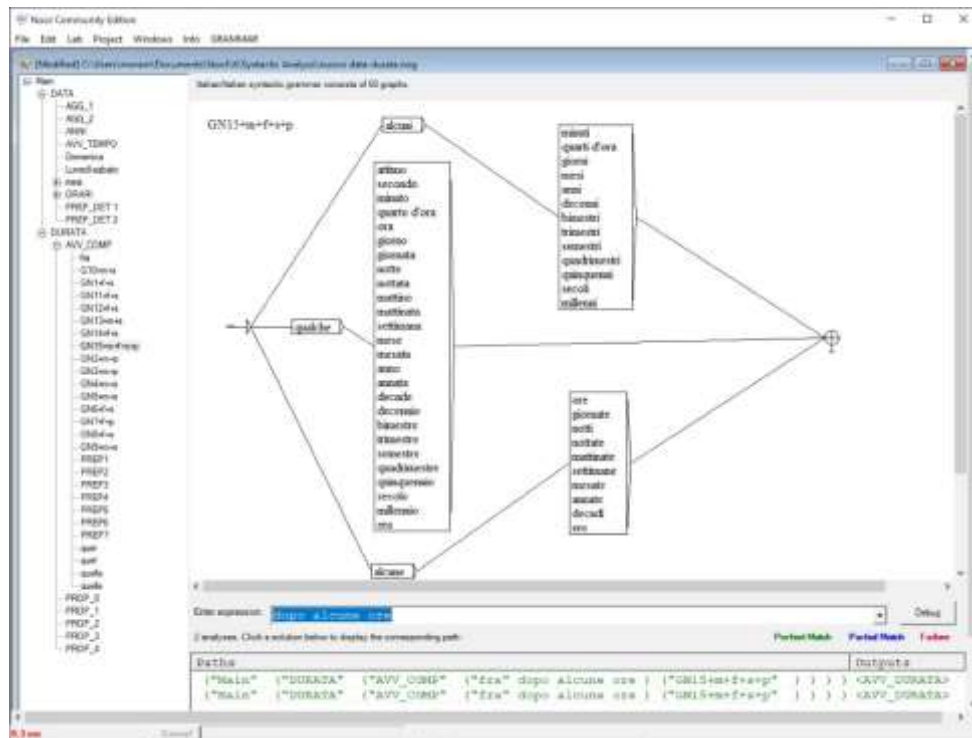


Figure 9. GN15+m+f+s+p.

We can also see how the graph PROP_0 (Figure 10) is built to process and tag duration adverbs such as *nel bel mezzo della serata* (right in the middle of the soirée), which include the compound/phrasological preposition *nel bel mezzo di*:

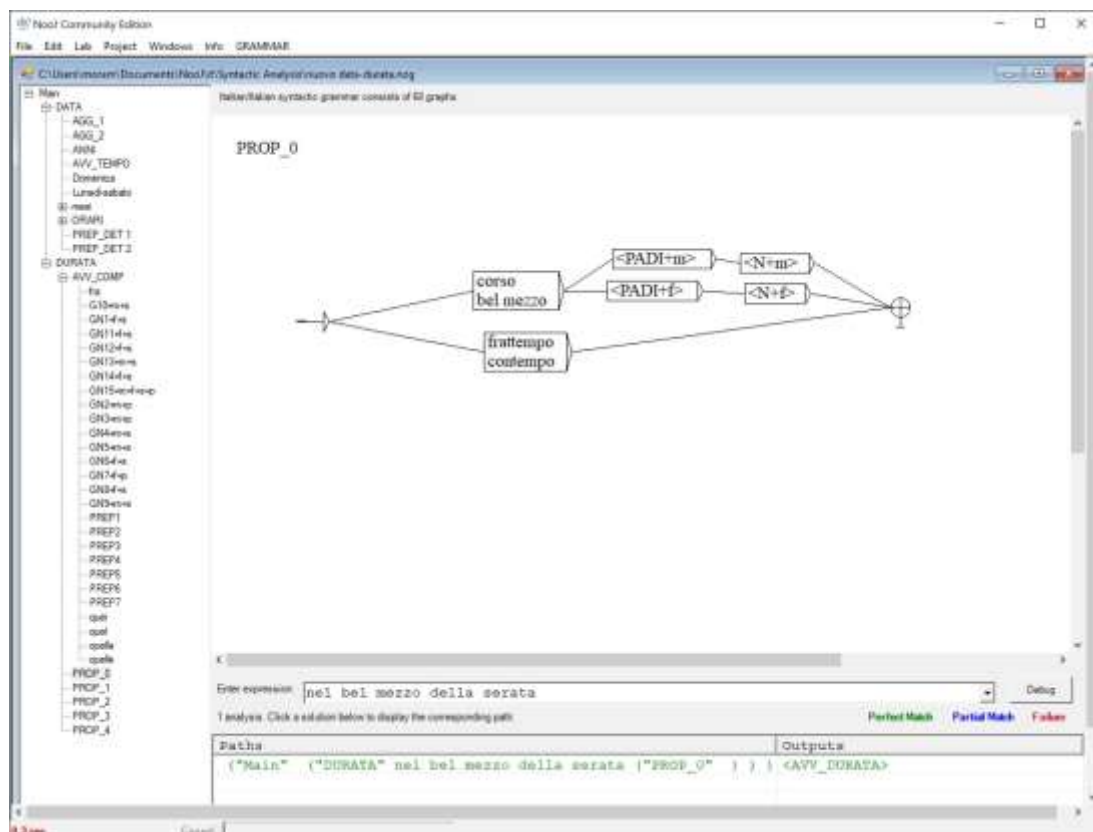


Figure 10. Graph PROP_0.

As a last example, we present the graph PROP_2 (Figure 11), useful to process among others expressions as *prima che il treno fosse arrivato nella loro stazione* (before the train had arrived at their station):

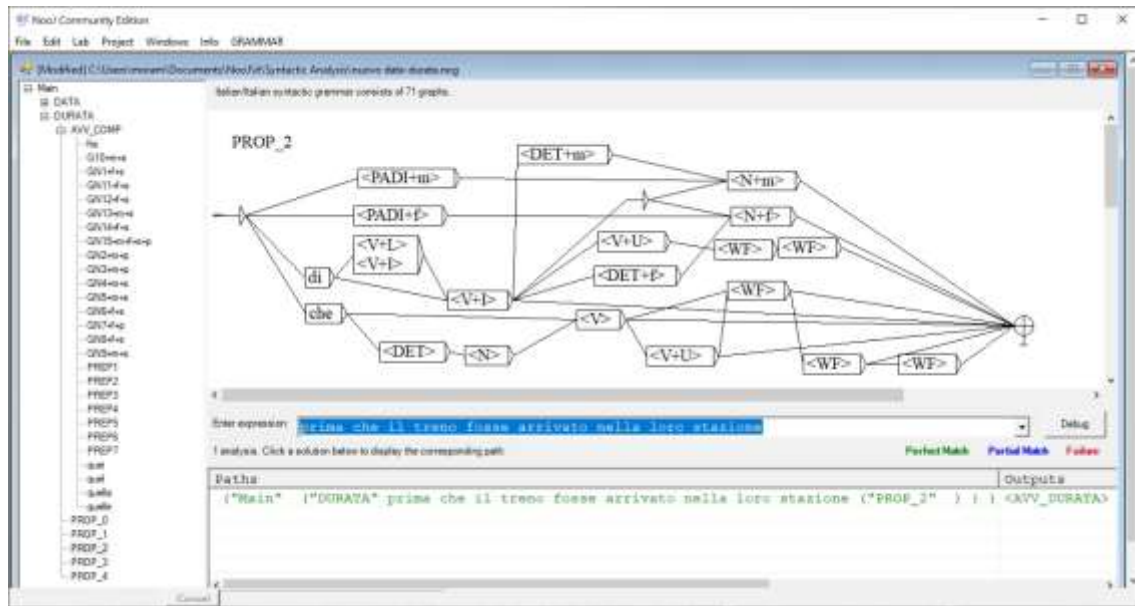


Figure 11. Graph PROP_2.

5. Grammar Application and Results

In order to test our grammar, we applied it to an Italian translation of *Lof der Zotheid* by Erasmus of Rotterdam.⁶ We give hereby the concordance results, which are reasonably definite in terms of both adverb tagging and noise as for recall and precision:

⁶ This file is freely downloadable from <https://www.liberliber.it/online/autori/autori-e/desiderius-erasmus-erasmo-da-rotterdam/>.

Noo! Community Edition - [Concordance]

File Edit Lab Project Windows Info TEXT CONCORDANCE

Reset Display: 5 characters before and 5 after Display: ☒ Matches ☒ Outputs
☒ word forms

Text	Before	Seq.	After
la tua Moria. dalla campagna,		9 giugno 1508/<AVV_DATA>	.Elogio della Follia Parla la
la tua Moria. dalla campagna,		9 giugno/<AVV_DATA>	1508. Elogio della Follia Parla la
D'altra parte quale donna		dopo la prima/<AVV_DURATA>	esperienza vorrebbe riprovarci, se non
tempo, essere chiamato uomo? Infine,		dopo la resurrezione/<AVV_DURATA>	, potremo mangiare e bere? Della
secondo loro, è peccato, salvo		dopo una bevuta/<AVV_DURATA>	, quando vogliono dilettersi di qualche
Dèi alla fine del banchetto		dopo una buona/<AVV_DURATA>	bevuta? Follie tali che io
cipiglio. Se per caso capiterà		durante una conversazione/<AVV_DURATA>	, sarà come il lupo della
essere esposti a mo-rire		in giornata/<AVV_DURATA>	, se hanno visto il simulacro
dalla croce? e poteva Cristo,		in quel medesimo tempo/<AVV_DURATA>	, essere chiamato uomo? Infine, dopo
a bere la cicuta? Infatti		mentre andava/<AVV_DURATA>	filosofando di idee e di
tornava a dire quelle parole,		mentre erano in parecchi/<AVV_DURATA>	a chiedersi che cosa mai
tornava a dire quelle parole,		mentre erano/<AVV_DURATA>	in parecchi a chiedersi che
di idee e di nuvole,		mentre misurava/<AVV_DURATA>	il salto delle pulci, mentre
se non nelle rughe e		negli anni/<AVV_DURATA>	che nel vecchio sono di
solito ne viene. Se però		nel frattempo/<AVV_DURATA>	qualche odioso sag-gio si
così poveri e addirittura sordidi.		Nel frattempo/<AVV_DURATA>	, però, gli altri rimangono pieni
che si guarderanno a vicenda?		Nel frattempo/<AVV_DURATA>	si beano della loro speranza
cortigiane, i giochi, le insulsaggini		Nel frattempo/<AVV_DURATA>	un alternarsi di merende. Di
la scarpa di un povero		nel giorno del Signore/<AVV_DURATA>	è delitto più grave che
la scarpa di un povero		nel giorno/<AVV_DURATA>	del Signore è delitto più
la delicatezza delle orecchie d'		oggi/<AVV_DATA>	, che riescono a sopportare ormai
poi io sia venuta qui		oggi/<AVV_DATA>	, e vestita in modo così
quei sofisti, ben inteso, che		oggi/<AVV_DATA>	riempiono la testa dei ragazzi
dove sono nata, visto che		oggi/<AVV_DATA>	nel valutare il grado di
infatti, specialmente come viene esercitata		oggi/<AVV_DATA>	dai più, si riduce, come
proprio Mes-sia, e ancor		oggi/<AVV_DATA>	si tengono aggrappati al loro
di Scoto. Al giorno d'		oggi/<AVV_DATA>	, qual mai pagano, qual mai
aveva faticato tanto, che anche		oggi/<AVV_DATA>	è più cieco di una
altro, si tratta di adulazione.		Oggi/<AVV_DATA>	, però, l'adulazione non gode
comitato che ha buona memoria'		Oggi/<AVV_DATA>	ce n'è un altro
o un bue potrà aggiudicarsi		prima del sapiente/<AVV_DURATA>	. Se è il piacere che
macilento, cagionevole; invecchiato e incanutito		prima del tempo/<AVV_DURATA>	, colto da morte prematu-ra
passatempo a cui già molto		prima delle nozze/<AVV_DURATA>	si dedicava la sua verginella
in genere sono già vecchi		prima di essere stati davvero giovani/<AVV_DURATA>	, e questo per le preoccupazioni
in genere sono già vecchi		prima di essere stati/<AVV_DURATA>	davvero giovani, e questo per
		prima di essere/<AVV_DURATA>	stati davvero giovani, e questo

Figure 12. Concordance results from *Elogio della Follia (Lof der Zotheid)* by Erasmus of Rotterdam).

A very similar result quality came from the analysis of the Italian Wikipedia entry on Aldo Moro⁷, of which we present part of the concordance in Figure 13:

⁷ https://it.wikipedia.org/wiki/Aldo_Moro.

Text	Before	Seq	After
direttore della rivista Azione Futura[1].	Dopo qualche anno di carriera accademica<AVV_DURATA>		fondò nel 1943 a Bari, con
Democrazia Cristiana. Morì e sepolture	Dopo una prigionia<AVV_DURATA>		di 55 giorni nel covo di
di professore di diritto penale	Durante gli anni universitari partecipò ai dibattiti della rivista e della		sen. Nel 1942 entrò a far
nel consiglio nazionale del partito	durante il VI congresso nazionale della DC<AVV_DURATA>		Ministro della Pubblica Istruzione nel
citato nelle lettere della sinistra	durante la prigionia<AVV_DURATA>		alcune fotografie di lui a
vennero pubblicati alcuni documenti realizzati	durante la sua attività politica<AVV_DURATA>		[24][25][26][27]. Opere Aldo Moro si occupò
giorni a settimana (sabato, mercoledì,	giovedì<AVV_DATA>		, venerdì e sabato)[31], ogni puntata
della Democrazia Cristiana. Fu rapito	il 16 marzo 1978<AVV_DATA>		e ucciso il 9 maggio successivo
Presidente Moro sequestrato dalla BR.	il 16 marzo 1978<AVV_DATA>		giorni della presentazione del nuovo
Patrizio Schifano, presentato a Palermo	il 18 marzo 2008<AVV_DATA>		Il divo, figlio di Paolo
infamata misericordia, che perdono tutti[22].	il 20 settembre 2012<AVV_DATA>		il presidente del tribunale diocesano
Nati nel 1916. Morì nel 1978. Nati	il 23 settembre<AVV_DATA>		Morì il 9 maggio. Nati a
pubblicata dalla Gazzetta del Mezzogiorno	il 24 settembre<AVV_DATA>		del 2012. da la Repubblica.it
nel settimanale L'Espresso. Riconoscimenti ufficiali	il 4 maggio 2007<AVV_DATA>		il Parlamento ha votato e
Agencia Progetto, 1971. Prima e dopo	il 7 maggio<AVV_DATA>		Roma, Agencia Progetto, 1972. Per una
«No al processo in piazza»	il 7 marzo 1977<AVV_DATA>		condanna in Parlamento il dibattito
Nella notte tra l'8 e	il 9 giugno 2007<AVV_DATA>		giorni della visita del Presidente
capito il 16 marzo 1978 e ucciso	il 9 maggio<AVV_DATA>		successivo da alcuni terroristi delle
di Aldo Moro fu ritrovato	il 9 maggio<AVV_DATA>		nel portabagagli di un'automobile
con il quale si sostituisce	il 9 maggio<AVV_DATA>		il "Giorno della memoria" in
nel 1978. Nati il 23 settembre. Morì	il 9 maggio<AVV_DATA>		Nati a Maglie. Morì a
chiedendo le dimissioni del Presidente.	il 9 maggio<AVV_DATA>		prese la parola Moro. Il
Battista Morini, di cui, proprio	in quegli anni<AVV_DURATA>		divenne amico, come presidente del
per cinque giorni a settimana (	lunedì<AVV_DATA>		mercoledì, giovedì, venerdì e sabato
cinque giorni a settimana (sabato,	mercoledì<AVV_DATA>		giorni, venerdì e sabato)[31], ogni
Note. ^ Sala viceversa di Moro	negli anni della FUCI si vide Renato Moro<AVV_DURATA>		Aldo Moro negli anni della
veda Renato Moro, Aldo Moro	negli anni della FUCI<AVV_DURATA>		Studiati, 2008 e Tiziano Torricelli
Moro, 2004. Renato Moro, Aldo Moro	negli anni della FUCI<AVV_DURATA>		2008. Roberto Pastorelli, Annunziata Moro, 1987. Paolo
PCI sta apparendo una strada autonoma.	Negli anni settanta e soprattutto dopo le elezioni del<AVV_DURATA>		1978, che vide un aumento del
a due anni col scoppio	nei giorni immediatamente precedenti il sequestro<AVV_DURATA>		Bolognese, notte fra il 4 e il 5
di palazzo Marini in Roma	nel corso della presentazione<AVV_DURATA>		del libro di Corrado Vivanti
lo statista scrive di Dio[23].	Nel giorno del<AVV_DURATA>		30° anniversario della sua morte
presso l'Università di Bari	nell'anno accademico<AVV_DURATA>		1942-43, raccolte a cura e per
la R. Università di Bari	nell'anno accademico<AVV_DURATA>		1944-45, raccolte a cura e per
presso l'Università di Bari	nell'anno accademico<AVV_DURATA>		1946-1947, Bari, L.U.C.E.
Mosca. ^ Marcello Veneziani, Ma è	oggi<AVV_DATA>		che viene in Italia la
Cattolici, Roma, Critica, 1969. Una politica	per i tempi nuovi<AVV_DURATA>		Roma, Agencia Progetto, 1969. Per la
avvenne all'inizio del 1978 (gioco	prima del rapimento<AVV_DURATA>		), quando iniziò a cominciare la
(sabato, mercoledì, giovedì, venerdì e	sabato<AVV_DATA>		[31], ogni puntata durava circa una
a settimana (sabato, mercoledì, giovedì,	venerdì<AVV_DATA>		e sabato)[31], ogni puntata durava

Figure 13. Concordance results of the Italian Wikipedia entry on Aldo Moro.

The two results highlighted in blue are the only errors in the concordance, as they show the processing of partial patterns, ending with two articulated preposition. This partial pattern processing comes from the use of the regular expressions <WF>.⁸

6. Conclusions

As seen in Figure 12, our date and duration grammar seems to be very effective. It is very probable that its accurate results depend on the fact that date and duration adverbs, as already stated, are expressions concerning a cognitive and semantic small world, in which patterns and words to use are mostly predefined and not very numerous. This helps in predicting these same expressions, also restricting the occurrences of possible ambiguous propositions or adverbs.

Nonetheless, despite the comforting results, both in terms of text application and debugging, this grammar is far from being exhaustive and complete. As for future research and applications, the possible interventions to improve it are mainly two, namely:

- The creation of a specific lexical set for time unit terms time, both simple and compound. This would allow using, inside graph nodes, not the terms but the tag that identifies them.
- A more accurate morphosyntactic study of the right contexts of both date and duration adverbs, in order to reduce the use of the regular expression <WF>, as seen in Figure 11. This regular expression is very powerful but also too generic if placed at the end of a proposition. In this case, especially if used as a loop, it is not easy in a graph to calculate

⁸ See Figure 11.

either the length or the morphosyntactic type the ending pattern. Therefore, a more accurate contextualization of date and duration adverbs is needed.

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