A Discourse Representation Theory based analysis of the Russian perfective aspect

Bachelor Thesis

by

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Introduction

The aspectual system of natural languages is typically characterized by the interaction between the grammatical aspect and the lexical aspect categories (the latter are also called Aktionsarten) (Sasse, 2009). The aspectual system of Slavic languages differs from the aspectual system of languages of Western Europe: Slavic languages (among which is Russian) have an elaborate system of formal morphological aspectual markers (verbal prefixes and suffixes), which results in a big number of Aktionsarten. Numerous works on Slavic aspect distinguish from dozen to over hundred different Aktionsarten (Tatevosov, 2009; Khrakovsky, 1980; Mehlig, 1981; Maslov, 1981). The Western German languages lack the Slavic plurality of the morphological devices. Thus, the classification of Aktionsarten proposed by Vendler (1967), which is very influential in the Western aspectology, appears to be insufficient for the analysis of the aspect in Slavic languages. The Vendler's classification is based on purely semantic criteria and does not take in consideration the morphology. However, for the practical reasons it occurs to be useful to combine both classifications in order to create a more powerful representation of the Slavic Aktionsarten (Damova, 1999). In the present thesis I will propose the concept of the combination of both approaches and provide an analysis of the Russian perfective aspect while taking into consideration the peculiarities of the Russian morphology, the temporal and the aspectual system along with the Vendler's classification of Aktionsarten.

I chose the apparatus of Discourse Representation Theory (DRT) for the analysis of the perfective aspect in Russian, since it provides a suitable framework for the representation of the temporal/aspectual system of natural languages. DRT deals with – among other philosophical and linguistical questions – the temporal unfolding of a discourse considering its context and provides the possibility to represent the eventualities of the discourse in relation to each other and to the moment of speaking.

The thesis is organised as follows: Chapter 1 outlines the background on grammatical and lexical aspect as well as the special features of the aspect in Slavic languages. Chapter 2 presents the Discourse Representation Theory (DRT) and the representation of aspectual information within DRT. In Chapter 3 the grammatical and lexical features of the Perfective aspect in Russian are presented, and Chapter 4 gives the analysis of the Russian perfective aspect within DRT. The final part of the thesis provides conclusions supported by previous chapters and gives outlook on future research.

Chapter 1

Notion of Aspect and Aktionsarten in formal semantics

1.1 Grammatical Aspect

Carlota Smith (2004) compares the aspectual information in a sentence with the lens of the camera, which focuses on the described situation and makes the focused information visible, whereby only this "visible" information is available for the semantic interpretation (Smith, 2004). For example, consider the following sentences 1a – 1c:

(1) a. Mary was reading the book.
    b. Mary read the book.
    c. Mary used to read the book.

All these sentences describe the situation of *Mary reading the book* which lies in the past. However, the meaning of each sentence is different: while the first sentence describes an ongoing process of reading the book, the second one defines a completed action, and the third utterance shows a repetitive process. What distinguishes these sentences is the information about how the time in which this situation occurred is viewed: as complete, ongoing, consequential, planned, etc. Thus, these sentences differ with the respect to their aspectual information by sharing the same temporal content, i.e. expressing the past tense.

The concept of Aspect is closely related to the concept of Tense, since both grammatical categories convey information about time[1]. The difference between them lies in the art of defining the relation between the eventuality[2] and time. While Tense indicates the location of an eventuality in relation to the time of utterance, Aspect conveys information about the viewpoint, defining whether an eventuality is viewed from outside, as a completed whole, or from inside, as a progression. In other words, Tense answers the question "temporally when?" while the Aspect answers the question "temporally how?" (Mezhevich, 2008).

Tense and Aspect in languages like English and Russian are not isolated from each other but stand in compositional relation so that the aspectual interpretation of a tensed phrase (TP) can be generally derived from the combination of meanings of Tense and Aspect (Mezhevich, 2008). The idea of compositionality of Tense and Aspect in a TP is shown in (1.1): an eventuality expressed by the verb V and its arguments are combined to a verbal phrase (VP) which has an

[1] In this thesis I will use the notions Tense and Aspect to refer to grammatical categories, while the notions tense and aspect will refer to temporal and aspectual properties of example sentences.

[2] I will further use the term eventuality as a general term comprising events, states, processes, happenings, situations etc.

aspectual value and forms an aspectual phrase (AspP) which combines with Tense resulting in a TP:

(2) [$_{TP}$ Semantic Tense [$_{TP'}$ Morphological Tense [$_{AspP}$ Aspect [$_{VP}$ Eventuality]]]]

An example of the compositional relation between Tense and Aspect is the Past Progressive form in English, in which case the temporal-aspectual meaning of the TP represents the sum of the meanings of the past tense combined with the meaning of the progressive aspect (van Eynde, 1988):

(3) She was riding a bike.

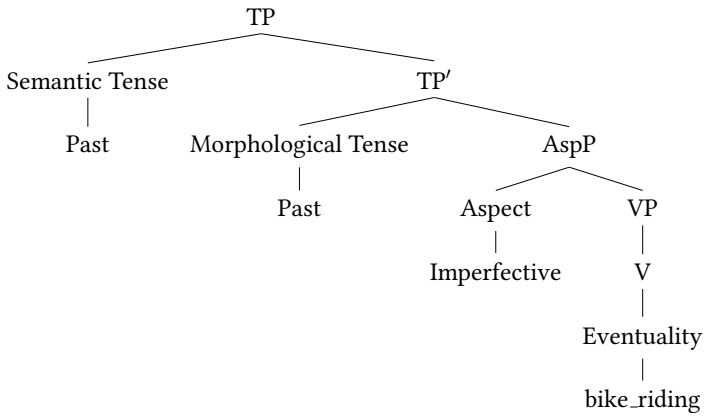


Figure 1.1: Compositionality of Tense and Aspect, after Paslawska and Stechow (2003)

A distinction between morphological and semantic Tense is necessary, since not every combination of morphological Tense and Aspect result in the sum of their meanings. There are cases in which a TP gets an interpretation which cannot be derived compositionally, and it can also be the case that a TP does not express the meaning which in theory should result from the combination of the morphological Tense and Aspect (van Eynde, 1988). For example, the combination of the verb in *present tense* with *perfective aspect* in Russian results not in the present perfective but in the future perfective reading of the TP. The future reading of the TP in 4 is the semantic Tense of the sentence (see Figure 4).

(4) On pro-čita-et knigu.
he PFV-read-PRS.3s book
'He will read a book.'

Tense and Aspect share their semantic content in terms of relating the eventuality to the coordinates on the timeline, which include the utterance time t_{ut} (the time when the utterance is made), the topic time t_{top} (the time about which an utterance is made), and the event time τ(e) (the time during which the eventuality obtains)[3]. While Tense indicates the relation of coincidence (or non-coincidence) of the utterance time t_{ut} and the topic time t_{top}, the Aspect shows the relation between the topic time t_{top} and the event time τ(e) (Mezhevich, 2008). For example, compare the following discourse, which contains four eventualities $e1$ – $e4$, with their representation on the timeline in Figure 1.3.

[3]I use the Klein's notions to refer to the coordinates on the timeline. Other notions can be also found in the literature, e.g. Kamp and Reyle (1993) uses the notion t_{loc} to refer to the location time of an eventuality, and Mezhevich (2008) uses T-Ast und T-Sit to define the Assertion Time and the Situation Time.

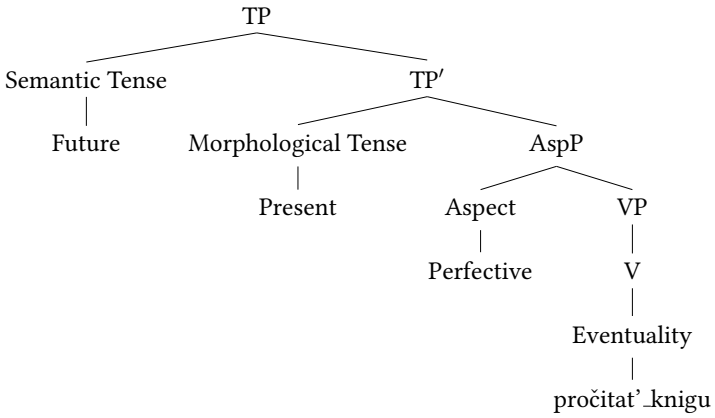


Figure 1.2: Interplay of aspect, morphological tense and semantic tense, after Paslawska and Stechow (2003)

(5) a. ($e1$) Mary turned the corner.
b. ($e2$) She was freshly bathed.
c. ($e3$) She was feeling calmed.
d. ($e4$) She crossed the street.

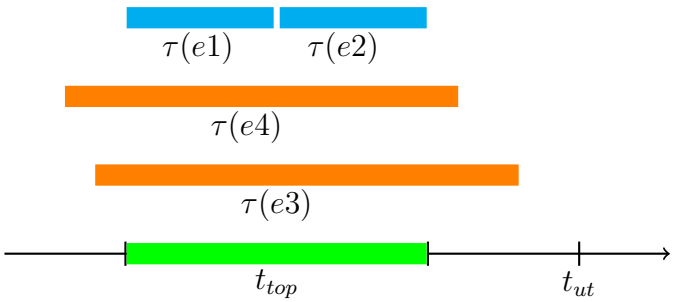


Figure 1.3: Representation of Tense and Aspect on the timeline, after Muskens (1995)

The eventualities of this discourse are represented as the time intervals on the timeline, every eventuality having its own event time $\tau(e1)$ to $\tau(e4)$. All eventualities of this discourse lie in the past, i.e. before the utterance time t_{ut}:

(6) $(\tau(e1) < t_{ut}) \wedge (\tau(e2) < t_{ut}) \wedge (\tau(e3) < t_{ut}) \wedge (\tau(e4) < t_{ut})$

The topic time t_{top} includes the eventualities of *turning the corner* (e1) and *crossing the street* ($e4$), which are represented as sequential completed activities:

(7) $(\tau(e1) \subseteq t_{top}) \wedge (\tau(e4) \subseteq t_{top}) \wedge (\tau(e1) < \tau(e4))$

The eventualities of *being freshly bathed* ($e2$) and *feeling calmed* ($e3$) represent ongoing overlapping situations and both exceed the topic time t_{top} (the symbol o stands for the overlapping relation):

(8) $(t_{top} \subset \tau(e2)) \wedge (t_{top} \subset \tau(e3)) \wedge (\tau(e2)\ o\ \tau(e3))$

While the formula in (6) represents the Tense of the eventualities, the examples (7) and (8) refer to the temporal flow of the situations in relation to the utterance time. Such kind of information about the temporal perspective is what comes from the grammatical Aspect[4]. As its name suggests, the grammatical Aspect appears grammaticalized in a large number of languages (including Germanic and Slavic languages) and refers to the morpho-syntactic properties of verbal phrases that describe the temporal flow of eventualities, for example as being ongoing, finished, about to start, focusing on result or experienced (Arche, 2014; Becker et al., 2013).

The two principal categories of grammatical aspect are the perfective and imperfective aspect. Whereas the imperfective aspect refers to the ongoing development of situations without including the endpoint of the eventuality, the perfective presents the situation as completed and collapsed to a "single unanalyzable whole" (Becker et al., 2013; van Eynde, 1988). The imperfective aspect can be formally represented as the binary relation $t_{top} \subseteq e$. There are two possibilities for an imperfective development of an eventuality as represented in Figure 1.4. The scheme on the left shows the topic time t_{top} of a punctual eventuality (for example, *Peter entered the room*) which is included in the eventuality time $\tau(e)$, while the figure on the right represents the topic time as a time interval of a certain duration (for example, *Peter called the taxi*), see also the examples (9) and (10).

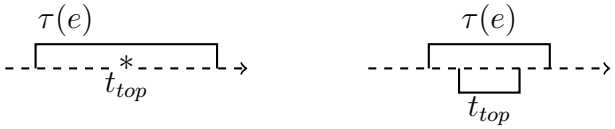


Figure 1.4: Imperfective aspect $t_{top} \subseteq \tau(e)$ (van Eynde, 1988)

(9) When Peter entered the room, Mary was talking to her friend.

(10) While Peter called the taxi, Mary was preparing the breakfast.

The following two overlap relations describe the temporal flow of either the perfective or the imperfective Aspect, depending on the semantics of the whole verbal phrase: $\tau(e) \gg t_{top}$ and $\tau(e) \ll t_{top}$. The first relation focuses on the beginning of an eventuality (as in (11)), whereas the second relation concentrates on the ending of a situation (see example in (12)), as represented in the Figure (1.5) below.

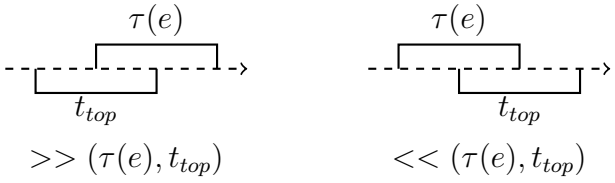


Figure 1.5: Overlap relations: $\tau(e) \gg t_{top}$ and $\tau(e) \ll t_{top}$ (van Eynde, 1988)

(11) While Peter called the taxi, Mary began preparing her breakfast.

(12) While Peter called the taxi, Mary finished reading the newspaper.

[4]Also called viewpoint aspect, outer aspect, perspective or viewpoint (Sasse, 2009).

The formal definition of the perfective aspect can be represented as the relation $e \subseteq t_{top}$. There are four possibilities for a perfective developing of an eventuality, which are represented in Figure (1.6). The first two examples show punctual eventualities (*sneezing, knocking*), while the duration of the topic time t_{top} varies from a time point to a period of certain duration. The last two examples show the non-punctual eventualities (*cooking the dinner*) which either coincide with the topic time or lie completely withing the topic time (see examples in (13) to (16)):

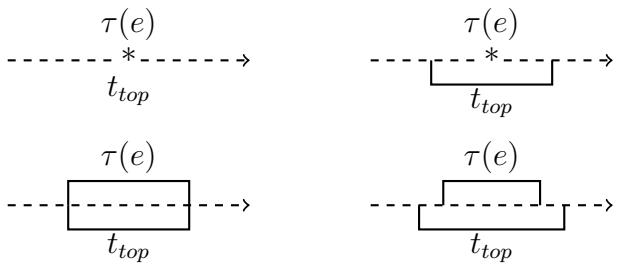


Figure 1.6: Perfective aspect $\tau(e) \subseteq t_{top}$ (van Eynde, 1988)

(13) Peter sneezed.

(14) While Peter was calling the taxi, somebody knocked on the window.

(15) Peter cooked the dinner and in the meantime Mary took the shower.

(16) Peter cooked the dinner while Mary was taking the shower.

Some authors distinguish between the perfect and the perfective aspects (Comrie, 1976; Lyons, 2012). The perfect aspect is expressed through the relation $e < t_{top}$, which defines a completed situation happened before the time of the reference point, and the relation $e > t_{top}$ for a completed eventuality about to happen after the topic time (see Figure 1.7):

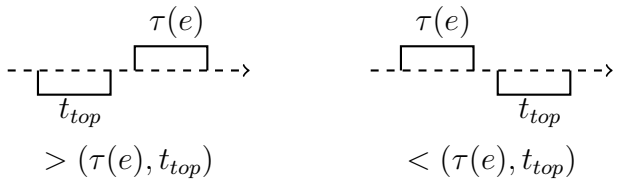


Figure 1.7: Perfect aspect $\tau(e) < t_{top}$ and $t_{top} < \tau(e)$ (van Eynde, 1988)

(17) Mary gave Peter a book, but Peter had already read it before.

(18) Mary will give Peter a book tomorrow, he will read it until next month.

The main difference between the perfective and the perfect aspect is that the perfective focuses on the completed event or its endpoint, whereas the perfect refers to the resultant state of the event (Becker et al., 2013; Klein, 1994; Paslawska and Stechow, 2003). In the present thesis I will contrast between the imperfective and the perfective aspects while regarding the perfect aspect as a sub-type of the perfective with completive reading.

The logical expressions corresponding to the perfective and imperfective aspects are summarized in the Table 1.1 below:

Perfective aspect	**Imperfective aspect**
PFV: $\lambda P \lambda t_{top} \exists$e[$\tau$(e) $\subseteq t_{top} \wedge$ P(e)]	IPF: $\lambda P \lambda t_{top} \exists$e[$t_{top} \subseteq \tau$(e) $\wedge$ P(e)]
PERF$_1$: λP$\lambda t_{top} \exists$e[$\tau(e) < t_{top} \wedge P(e)$]	
PERF$_2$: λP$\lambda t_{top} \exists$e[$t_{top} < \tau(e) \wedge P(e)$]	

Table 1.1: Perfective and imperfective aspectual operators, after Paslawska and Stechow (2003)

According to these formulas, the meaning of the Perfective Aspect is that there is an eventuality e and some (not yet defined) predicate P, as well as the topic time t_{top} for which the following holds: e is P and the time of the eventuality τ(e) includes the topic time t_{top}: (P(e) $\wedge$ τ(e) $\subseteq t_{top}$). The same properties hold for the PERF$_1$,PERF$_2$ and IPF operators as well – with the only difference, that in case of the PERF-operators, the time of eventuality τ(e) lies completely before (or completely after) the topic time t_{top}, and in case of the ipf operator t_{top} is included in τ(e).

1.2 Aktionsarten

1.2.1 Vendler's classification of Aktionsarten

The aspectual information in a discourse is not only expressed by means of grammatical aspect, but is also encoded semantically. For example, compare two sentences in (19), which share the same tense, grammatical aspect and argument structure:

(19) a. He listened to music.
b. He listened to a song.

The eventuality of *listening to music* in the first sentence defines an activity which endures indefinitely and has no natural temporal boundaries (like beginning or ending). In comparison, the phrase *listening to a song* describes an eventuality which typically takes several minutes and moves on toward a culmination point – the last note (Becker et al., 2013). The eventualities of the first type (without boundaries) are called atelic, and the second type (including endpoints) – telic eventualities. The phenomenon behind it is called *telicity* (from the Greek word *telos* which means *endpoint*). Telic events progress towards a specific goal or endpoint and are considered completed when the culmination point is reached, whereas atelic events do not have intrinsic endpoints and can continue indefinitely (Janda, 2007). Sharing the same grammatical aspect, these two eventualities differ in what is called *Aktionsart*, from German "manner of action" (also known as *situation type* or *lexical Aspect*) (Sasse, 2009).

Grammatical Aspect and Aktionsarten stand in complementary relation: grammatical Aspect gets a specific reading in a sentence through the interaction with the Aktionsarten. While the grammatical Aspect characterizes the phasal structure of the eventuality which it denotes, Aktionsarten focus on eventuality as a whole or parts of it (Sasse, 2009). Aktionsarten have the lexical nature and can be marked by lexical devices (like special particles or affixes) or not be marked at all. The differences between grammatical Aspect and Aktionsarten are summarized in Table 1.2.

Category / Criterium	Grammatical Aspect	Aktionsarten
Corresponding linguistic level	Grammar	Lexicon
Semantic meaning	Completion vs. incompletion	Manner of action (semantic verb/predicate classes)
Markers	Syntactically or inflectionally signalled	Lexically (specific particles) or derivationally signalled, if at all

Table 1.2: Difference between grammatical Aspect and Aktionsarten, after Kortmann (1991)

The most influential classification of Aktionsarten for the languages of the Western Europe was developed in 1967 by Zeno Vendler, who divided the verbs into four classes according to their semantics: States and Events (Activities, Accomplishments, and Achievements). The main characteristic of States is their static nature, i.e. the States do not involve a change. States describe situations which are static, durative and do not have temporal boundaries, for example *to know the answer*, *to lie on the bed*. Events are subdivided into three classes, i.e. Activities, Accomplishments, and Achievements, and describe dynamic unfolding situations which can be *durative*, *instantaneous*, *telic* or *atelic*. Activities describe continuous eventualities which do not have a final point, but can be decomposed to homogeneous parts, for example *to drive a car*, *to look for the key*. Accomplishments describe durative events with a final point: *to draw a circle, to build a house*. Achievements describe punctual telic eventualities: *to win a race*, *to lose the key*. The class of Achievements also includes the class of Semelfactives, i.e. punctual atelic events: *to cough*, *to sneeze*, *to knock* (Vendler, 1967; Smith, 2004).

The Vendler's Aktionsart classes can be defined through sets of aspectual properties, which address the following features: *dynamic/static*, *telic/atelic*, and *durative/ instantaneous* (see Table 1.3). The features *dynamicity/stativity* describe an eventuality with regard to whether it involves a change or not (for example, the eventuality of *noticing something* involves a change and is dynamic, while the eventuality of *being tall* is static). The labels *telic/atelic* show whether an eventuality has a culmination point or not (for example, the eventuality of *reaching the summit* involves the culmination and is telic, while the eventuality of *strolling in the park* is atelic). The features *durative/instantaneous* describe the duration of eventuality (for example, *running* or *playing* are durative eventualities while *recognizing* or *winning* are instantaneous):

Aktionsart	Dynamic	Durative	Telic	Examples
State	-	+	-	*know the answer, be glad, lie on the bed*
Accomplishment	+	+	+	*build a house, walk to school*
Activity	+	+	-	*laugh, push a cart, stroll in the park*
Achievement	+	-	+	*win the race, reach the top*
Semelfactive	+	-	-	*tap, knock, sneeze*

Table 1.3: A feature characterization of aspectual classes (Olsen, 1994, 1997)

1.2.2 Aktionsarten in Slavic languages

The Vendlerian classification described in Table 1.3, which is based on purely semantic criteria, is suitable for the languages of Western Europe, but does not suffice for Slavic languages. The system of Aktionsarten for Slavic languages is dependent on the morpho-syntactical markers and shows greater variety than the type-schemata described by Vendler (1967). The Aktionsarten in Slavic languages have more concrete meanings than the Vendler classification and depend on semantic effects resulting from prefixing and suffixing as well as on the lexical meaning of the stem verb itself (Kotsyba, 2014). There is no agreement between the semanticists on the final set of the Slavic Aktionsarten: numerous attempts to classify the Aktionsarten in Slavic languages distinguish from a dozen to over hundred different Slavic Aktionsarten (Ivanova, 1974; Khrakovsky, 1980; Maslov, 1981; Tatevosov, 2009). Table 1.4 below provides examples of several Slavic Aktionsarten in Russian Grammar (the list is not exhaustive):

Slavic Aktionsart	**Example**	**Translation**
attenuative	*poprivyknut'*	'get slightly used to something'
completive	*dopisat'*	'finish writing'
delimitative	*pocitat'*	'read for a while'
ingressive	*zacitat'*	'start reading'
perdurative	*prostoyat'*	'be standing for some while'
saturative	*nagulat'sa*	'get enough of walking'
terminative	*otrabotat'*	'finish working'

Table 1.4: Slavic Aktionsarten, after Tatevosov (2009)

There is also no agreement as to which criteria should form the basis for the classification of the Slavic Aktionsarten. The *lexicalist* theories classify the Aktionsarten according to the semantic characteristics of the affixes (i.e prefixes and suffixes). The Aktionsarten are viewed as the lexical category, and the prefixing and suffixing are seen as lexical process. The lexicalists label the prefixes after the most obvious type of modification which they trigger and name the corresponding Aktionsart after the verbal prefix. For example, if a verb has a delimitative or a saturative prefix it is classified under delimitative or saturative Aktionsart. The lexicalist theories result in classifications counting up to several dozens Aktionsarten (Ivanova, 1974; Mehlig, 1981). This is the main drawback of lexicalist approaches, namely, that the proposed classifications are not coherent due to the big number of criteria used (Damova, 1999).

Another attempt to classify the Slavic Aktionsarten is proposed by the *conceptualist approaches* (for example, (Isačenko, 1962; Maslov, 1981)). According to these approaches, the Aktionsarten are not the lexical categories and should not be classified according to the meaning of the affixes. Conceptualist approaches classify Aktionsarten according to abstract formal criteria regardless of their morphological constellation. The conceptualist theories see the Aktionsarten as semantic classes which share the similar features with regard to the development of an eventuality in the flow of time and come up with a relatively small set of Aktionsarten. For example, Maslov (1981) includes in his classification the following types: *stative, mutative, semelfactive, evolutive, multiplicative, iterative, resultative, inchoative and limited durative* (Isačenko, 1962; Maslov, 1981).

Conceptualist theories do not take into account the verbs with non-temporal semantics which may lead to a non-complete classification. For the purposes of the present thesis I will classify the Slavic Aktionsarten according to their ability to involve or exclude differ-

ent boundaries of eventualities on the timeline and distinguish between temporal and non-temporal Aktionsarten. Among the temporal Aktionsarten are the following six: *durative*, *ingressive*, *eggressive*, *delimitative*, *semelfactive*, and *repetitive* (Gerasymova and Spranger, 2012; Stoll, 2001):

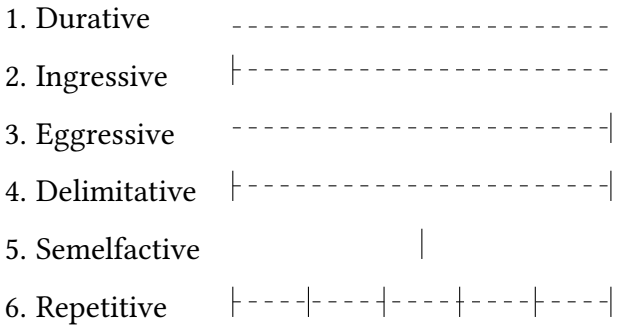


Figure 1.8: Temporal Slavic Aktionsarten, after Stoll (2001)

The durative Aktionsart describes stative eventualities without boundaries:

(20) On čitaet knigu.
He read.IPF-PRS.3s book.
'He is reading read a book.'

The ingressive Aktionsart focuses on the starting point of an eventuality:

(21) On zashagal esshe bystreje.
He pace.PFV-PRS.3s more faster.
'He started to pace even faster.'

The eggressive Aktionsart focuses on the ending point of an eventuality:

(22) On dočital knigu.
He read.PFV-PAST.3s book.
'He finished reading the book.'

The delimitative Aktionsart describes an eventuality of a certain duration, which had a starting and a final point:

(23) On pročitaet knigu.
he PFV-read-PRS.3s book
'He will read a book.'

The semelfactive Aktionsart refers to a punctual eventuality:

(24) On čikhnul.
He sneeze.PFV-PAST.3s
'He sneezed.'

The repetitive Aktionsart characterizes an eventuality which takes place several times:

(25) On perečityval poemu snova i snova.
He read.IPF-PAST.3s poem again and again.
'He read the poem again and again.'

The number of non-temporal Aktionsarten is bigger then the number of temporal ones and depends on the semantics of both affixes and the stem verb. The non-temporal Aktionsarten do not describe the temporal flow of the eventuality, but characterize other parameters, like spatial circumstances, orientation towards the aim or intensity (Ivanova, 1974). To the non-temporal Aktionsarten belong the following, among others: *cumulative*, *saturative*, *evolutive*, *attenuative* and *distributive* (Kunzmann-Muller, 1994).

The cumulative Aktionsart refers to the accumulation of objects in the evolving eventuality:

(26) Olga nakupila knig.
Olga buy.PFV-PAST.3s books.
'Olga bought a plenty of books.'

The saturative Aktionsart expresses that the eventuality evolved until the full saturation:

(27) Konstantin naplavalsja v ozere.
Konstantin swim.PFV-PAST.3s in lake.
'Konstantin swam in the lake to his heart's content.'

The evolutive expresses the initial state of eventuality and its increasing intensity:

(28) On raskričals'ja.
He shout.PFV-PAST.3s.
'He shouted louder and louder.'

The attenuative Aktionsart expresses the attenuation of an eventuality:

(29) On poprivyk k novoj kvartire.
He accustom.PFV-PAST.3s to new flat.
'He got slightly accustomed to the new flat.'

The distributive Aktionsart describes the eventualities which convey the sequence of events:

(30) Deti pobrosali igruski.
Children throw.PFV-PAST.3ol toys.
'The children threw the toys away one after another.'

According to Damova (1999), the Vendler's Aktionsart classes and the Slavic Aktionsarten can be viewed as supplementary to each other. For practical reasons it appears to be useful to combine Vendler's approach with the existing Slavic Aktionsarten - in order to achieve an "adequate and more powerful semantic representation" of Slavic aspectual classes (Damova, 1999). For example, the prefixed verbs with resultative and saturative meaning correspond to Vendler's class of *Accomplishments* or the prefixed verbs with inchoative meaning are *Achievements* and the prefixed verbs with delimitative meaning are Activities. I will provide more details on the possible combination of both systems in the Chapter 3 when analyzing the Russian perfective aspect. But first, in Chapter 2 I will give an overview of Discourse Representation Theory (DRT) and the representation of the aspectual information by means of DRT.

Chapter 2

Representation of aspectual information in DRT

2.1 Discourse Representation Theory

Discourse Representation Theory (further – DRT), is a formal semantic framework which was designed to deal with the dynamics of discourse, understood as a sequence of sentences. The theory was presented by the Dutch philosopher and linguist Hans Kamp in 1981[1]. The basic idea of DRT is that a sentence in natural language discourse has to be interpreted in the context given by the preceding sentences (Kamp and Reyle, 1993). The importance of discourse context becomes specially visible on *anaphoric expressions* (i.e. expressions which refer back to some already given information) and *presuppositions* (implicit assumption about a commonly accepted world knowledge), since they are able to operate on the level between sentences. The classical non-dynamic truth-conditional semantic approaches faced problems while dealing with these phenomena, which set the starting point for several dynamic approaches in the 1980's, the so-called "dynamic turn"[2] (Altshuler, 2010).

For example, consider the following mini-discourse consisting of two sentences. This discourse can be represented by means of First Order Logic through the conjunction of two propositions and co-indexing in syntax:

(31) a. Mia$_i$ dances. She$_i$ smiles.
b. $dance(m) \wedge smile(x)$
c. $g(x) = m$
d. $dance(m) \wedge smile(m)$

However, a slight modification of the discourse from above, which contains an existentially quantified referent *a girl* (32a) appears to be problematic for the non-dynamic semantic approaches, since the referent *x* of the second sentence in (32a) is outside of the scope of the existential quantifier in the first sentence:

(32) a. A girl$_i$ dances. She$_i$ smiles.
b. $(\ \exists\, x[\ girl(x) \wedge dance(x)\ ]) \wedge (smile(x)\ )$

[1] A very similar theory was developed independently by Irene Heim in 1982, so that DRT is often referred to as the Kamp-Heim approach (Bos, 2003).

[2] Discourse Representation Theory (Kamp 1981), File Change Semantics (Heim 1982) and Dynamic Predicate Logic (Groenendijk and Stokhof 1991).

The unbounded variable makes the discourse being incorrectly interpreted as infelicitous. This results in the idea that the interpretation of the second sentence in (32a) is only possible within the context of the first sentence. The main idea of DRT is to map the fragments of the natural language discourse into discourse representation structures (DRSs) and to represent the content of these fragments by assigning them to a model-theoretic interpretation. The sentences in the discourse are represented by means of DRSs and every new DRS is interpreted relative to the previous DRS (Kamp and Reyle, 1993).

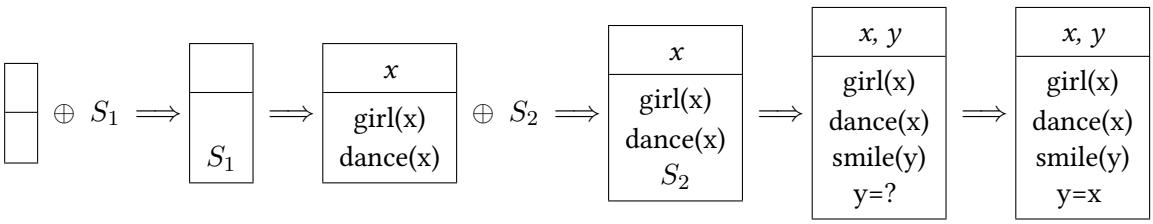
NL sentence $\rightsquigarrow$ DR structure $\mapsto$ First/second order model

The DRSs consist of a set of discourse referents (DRefs) and a set of conditions/statements. The DRefs refer to the participants of the evolving discourse and can serve as anchors for anaphoric expressions. The vocabulary of DRS languages includes the set of $DRefs$ (for example, x, y), the set of names $Name$ (for example, Mia, $Mary$) and the set of predicates $Pred$ (for example, $dance$, $smile$). A DRS K is formally defined as an ordered pair $\langle U(K), Con(K)\rangle$, where $U(K)$ stands for the universe of K consisting of the set of discourse referents ($U(K) \subseteq DRef$), and $Con(K)$ represents the set of conditions. The DRSs are usually given in the box notation, for example like the DRS below[3] (Kamp and Reyle, 1993).

(33) A girl dances. She smiles.

x, y
girl(x)
dance(x)
smile(y)
y=x

The processing of the discourse in (33) is given in the Figure below. In the first step, the empty DRS is merged with the contents of the first sentence $S1$ ($\oplus$ stands for the merging operation). The discourse referent x for *a girl* as well as the conditions *girl(x)*, and *dance(x)* are introduced. In the second step the DRS from the first step gets the content of the second sentence $S2$. The discourse referent x is introduced in the first sentence and refers to *a student*, while the representation of the second sentence shows that the discourse referent y refers back to the anchor x from the first sentence. The discourse referent y is *resolved* to the anchored discourse referent x (condition $y = x$)[4]. The resulting DRS contains information of both sentences in the discourse (Kamp and Reyle, 1993):



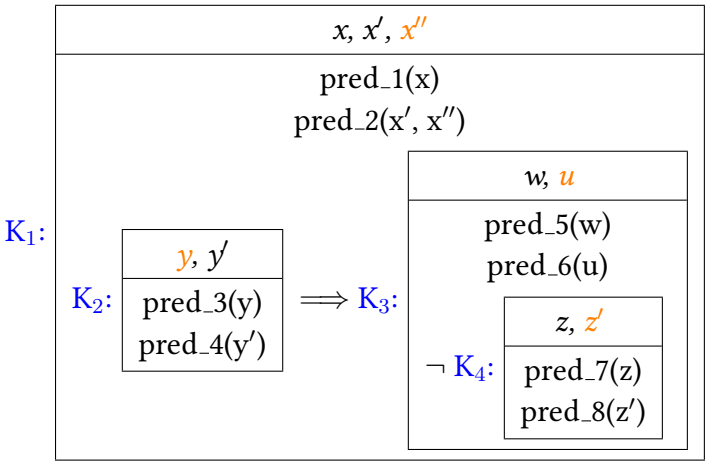
[3] A DRS can also be represented in a linear notation: ⟨ { x, y } { girl(x), dance(x), smile(y), y=x } ⟩. The box notation is used more frequently.

[4] This is a simplified representation of the processing algorithm which does not take into account temporal and aspectual information or other world knowledgee. I will provide the rules for representing temporal and aspectual information in the next section.

Another important phenomenon in DRT is the *accessibility* of the discourse referents. The rules of accessibility are crucial for anaphora resolution. For example, the accessibility conditions allow to rule out the following infelicitous discourse (34), which is a slight modification of the discourse in (32):

(34) Every girl$_i$ dances. #She$_i$ laughs.

The discourse in (34) is infelicitous in case when the universally quantified expression *every girl*$_i$ is interpreted as the anchor for the pronoun *she*$_i$ in the second sentence. The rules of accessibility in DRT prevent the processing of this infelicitous discourse. The accessibility constraints say that the universe of the DRS K is accessible from another DRS K if $K = K'$ or K subordinates K' (Kamp and Reyle, 1993). The following DRS shows the cases in which one DRS immediately subordinates another DRSs and provides examples of the accessible discourse referents:

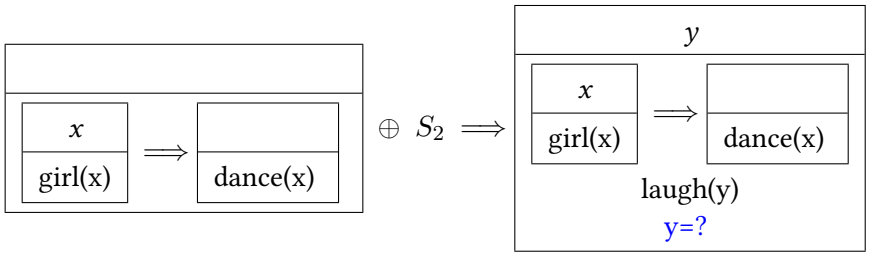


K_1 subordinates K_2, $K_3$and K_4
K_2 subordinates K_3 and K_4
K_3 subordinates K_4

Among the accessible variables are the following:
accessible to z' : x, x′, x″, y, y′, w, u, z
accessible to u : x, x′, x″, y, y′, w
accessible to x": x, x′
accessible to y : x, x′, x″, y′

Considering the rules of accessibilty, it can now be shown, how the infelicitous discourse in example (34) can be ruled out. Consider the representation of this discourse in (35):

(35)



The discourse referent y has to be mapped to some other referent of the given discourse, however there is no other referent accessible for y, which signals that the discourse in (34) is not possible. The universe of the main DRS is accessible for the embedded DRS (thus, the discourse referent y is accessible for x), but the reverse does not hold: x is not accessible for y. The domain of y is restrained by the scope of the universal quantifier. The discourse referent x is not defined in the universe of the main DRS and therefore not accessible for y to bind to.

2.2 Representation of temporal and aspectual information in DRT

2.2.1 Representation of Tenses in DRT

The discourse representation structures discussed in the previous section did not contain information on the Aspect or Tense. The temporal-aspectual representation of a sentence passes two stages in DRT. In the first stage, the information provided by temporal morphemes and temporal adverbials is represented and encoded in DRSs as discourse referents, their predicates and relations. In the second stage, the times and relations are interpreted in the context of the discourse (Smith, 2004). The temporal information is added to the DRS through introduction of the discourse referents for time points (t_{ut}, t_{top}, $\tau(e)$) and for eventualities (e for events or s for states). For example, consider the following sentence and its representation in a DRS below:

(36) John entered the White House.

e, x, y, t_{ut}, t_{top}
e $< t_{ut}$
e $\subseteq t_{top}$
enter(e, x, y)
John(x)
the_White_House(y)

In this DRS, e stands for the discourse referent of the eventuality of *entering the White House*, t_{top} refers to the discourse referent of the topic time, and t_{ut} represents the discourse referent related to the utterance time of the discourse. The expression $e \subseteq t_{top}$, states that the event e is temporally included within the topic time t_{top}, and $e < t_{ut}$ means that the eventuality e occurred before the utterance time t_{ut}.

The topic time in this sentence is not specified, which makes t_{top} to a time interval of certain duration lying before the utterance time t_{top}. The topic time t_{top} can also be expressed through the temporal adverbial phrases (AdvP), for example *on Saturday*:

(37) Mary read the book on Saturday.

e, x, y, t_{ut}, t_{top}
on Saturday(t_{top})
e $< t_{ut}$
e $\subseteq t_{top}$
read(e, x, y)
Mary(x)
book(y)

To represent the temporal information in DRT, the formulas in (38) can be used. Present tense is represented as an eventuality whose topic time t_{top} coincides with the utterance time t_{ut}, while the topic time of the past and future tense lie before or after the utterance time t_{ut}:

(38) a. PRESENT: $\lambda Q \left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} = t_{ut} \\ \hline \end{array} \oplus Q(t_{top}) \right)$

b. PAST: $\lambda Q \left(\dfrac{t_{top}, t_{ut}}{t_{top} < t_{ut}} \oplus Q(t_{top}) \right)$

c. FUTURE: $\lambda Q \left(\dfrac{t_{top}, t_{ut}}{t_{ut} < t_{top}} \oplus Q(t_{top}) \right)$

2.2.2 Representation of Aspects in DRT

As outlined in Chapter 1, perfective and imperfective eventualities behave differently with respect to the topic time[5] t_{top}. For example, consider the examples (39a) and (39b):

(39) a. Peter wrote a poem on Tuesday.
b. Peter was ill on Tuesday.

The utterance in (39a) is understood as a telic eventuality, i.e. an eventuality which has reached the culmination point within the given time interval – *on Tuesday*. This makes the following discourse infelicitous:

(40) Peter wrote a poem on Tuesday. # In fact, he began to write it on Monday and was still working on it on Wednesday.

The sentence in (39b) does not have natural boundaries, which allows the similar discourse:

(41) Peter was ill on Tuesday. In fact, he was ill on Monday and did not recover until Wednesday.

Thus, the topic time t_{top} of the imperfective eventualities exceeds the the time of the eventuality τ(e), while the τ(e) of perfective eventualities is fully included in t_{top} or lies completely before t_{top}. The formulas for the representation of perfective and imperfective aspect are given in (42) below. The formulas represent the idea that there is an eventuality e of a kind P (not yet specified), which takes a certain time τ(e), and there is also the topic time t_{top}. For each formula holds the following: if τ(e) is fully included in the topic time or lies completely before it, then the formula represents the perfective aspect (PFV), and if t_{top} is conveyed in the time of eventuality τ(e), then the formula represents the imperfective aspect (IPF).

(42) a. PFV: $\lambda P \lambda t_{top} \left(\dfrac{e}{\tau(e) \subseteq t_{top}} \oplus P(e) \right)$

b. IPF: $\lambda P \lambda t_{top} \left(\dfrac{e}{t_{top} \subseteq \tau(e)} \oplus P(e) \right)$

I will use the following formula to represent the eventualities within DRT. The schemata show the representation of proper names (e.g. *Mary*), substantives (e.g. *a book*), and intransitive and transitive verbs (e.g. *smile* or *read*), respectively:

(43) a. $\lambda P \lambda e \left(\dfrac{m}{\text{Mary(m)}} \oplus P(m)(e) \right)$

b. $\lambda P \lambda e \left(\dfrac{x}{\text{book(x)}} \oplus P(x)(e) \right)$

[5] My notion of the topic time t_{top} corresponds to the *location time* introduced by Kamp et al. (2011)

c. $\lambda x \lambda e \left[\begin{array}{|c} \\ \hline \text{smile(x)(e)} \end{array}\right]$

d. $\lambda R \lambda x \Big(R \Big(\lambda y \lambda e \left[\begin{array}{|c} \\ \hline \text{read(y)(x)(e)} \end{array}\right] \Big) \Big)$

To show how the temporal and aspectual representations interact with each other for a given eventuality, the temporal and aspectual information have to be combined. Consider the following sentences with the intransitive verb *smile* in past tense and perfective aspect:

(44) Mary smiled.

In the first step, the representation of the eventuality without the temporal or aspectual information is produced:

(45) $\Big(\lambda P \lambda e \Big(\left[\begin{array}{|c} m \\ \hline \text{Mary(m)} \end{array}\right] \oplus \text{P(m)(e)} \Big) \Big) \Big(\lambda x \lambda e' \left[\begin{array}{|c} \\ \hline \text{smile(x)(e')} \end{array}\right] \Big) =$

$\lambda e \Big(\left[\begin{array}{|c} m \\ \hline \text{Mary(m)} \end{array}\right] \oplus \Big(\lambda x \lambda e' \left[\begin{array}{|c} \\ \hline \text{smile(x)(e')} \end{array}\right] \Big) \text{(m)(e)} \Big) =$

$\lambda e \Big(\left[\begin{array}{|c} m \\ \hline \text{Mary(m)} \end{array}\right] \oplus \left[\begin{array}{|c} \\ \hline \text{smile(m)(e)} \end{array}\right] \Big) = \lambda e \left[\begin{array}{|c} m \\ \hline \text{Mary(m)} \\ \text{smile(m)(e)} \end{array}\right]$

In the second step, the temporal and aspectual information are combined:

(46) $\text{PAST(PFV}(\lambda e \left[\begin{array}{|c} m \\ \hline \text{Mary(m)} \\ \text{smile(m)(e)} \end{array}\right])) =$

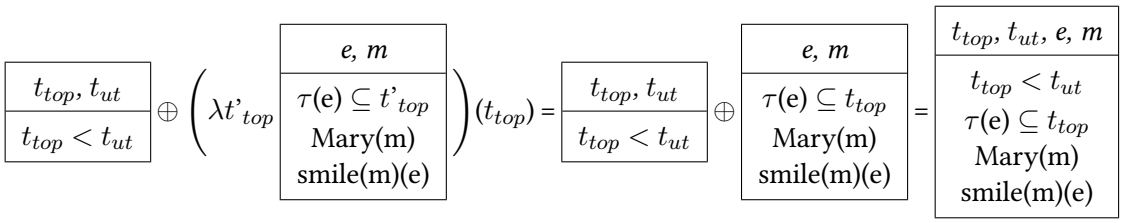
$\Big(\lambda Q \Big(\left[\begin{array}{|c} t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \end{array}\right] \oplus Q(t_{top}) \Big) \Big) \Big[\Big(\lambda P \lambda t'_{top} \Big(\left[\begin{array}{|c} e \\ \hline \tau(e) \subseteq t'_{top} \end{array}\right] \oplus P(e) \Big) \Big) \Big(\lambda e' \left[\begin{array}{|c} m \\ \hline \text{Mary(m)} \\ \text{smile(m)(e')} \end{array}\right] \Big) \Big]$

=

$\Big(\lambda Q \Big(\left[\begin{array}{|c} t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \end{array}\right] \oplus Q(t_{top}) \Big) \Big) \Big[\Big(\lambda t'_{top} \Big(\left[\begin{array}{|c} e \\ \hline \tau(e) \subseteq t'_{top} \end{array}\right] \oplus \Big(\lambda e' \left[\begin{array}{|c} m \\ \hline \text{Mary(m)} \\ \text{smile(m)(e')} \end{array}\right] \Big) (e) \Big) \Big) \Big] =$

$\Big(\lambda Q \Big(\left[\begin{array}{|c} t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \end{array}\right] \oplus Q(t_{top}) \Big) \Big) \Big[\Big(\lambda t'_{top} \Big(\left[\begin{array}{|c} e \\ \hline \tau(e) \subseteq t'_{top} \end{array}\right] \oplus \left[\begin{array}{|c} m \\ \hline \text{Mary(m)} \\ \text{smile(m)(e)} \end{array}\right] \Big) \Big) \Big] =$

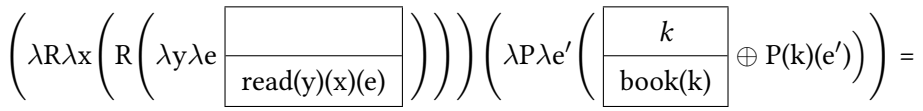
$\Big(\lambda Q \Big(\left[\begin{array}{|c} t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \end{array}\right] \oplus Q(t_{top}) \Big) \Big) \Big(\lambda t'_{top} \left[\begin{array}{|c} e, m \\ \hline \tau(e) \subseteq t'_{top} \\ \text{Mary(m)} \\ \text{smile(m)(e)} \end{array}\right] \Big) =$

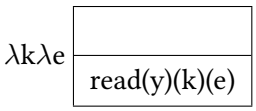


The processing of a sentence with a transitive verb *read* in (47) can be given in the similar way (see Annex 4.7 for the step-by-step processing):

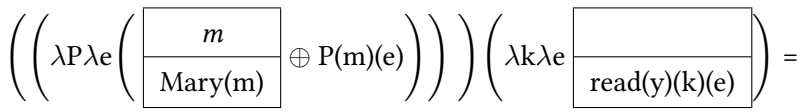
(47) Mary read a book.

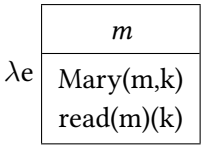
(48) a. *read a book:*

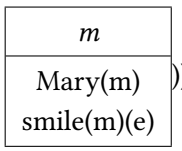


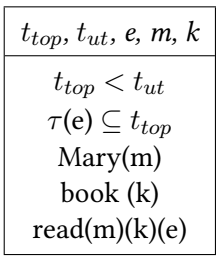


b. *Mary read a book:*





c. PAST(PFV(λe 

)) = 

2.2.3 Aspectual operators within DRT

The DRSs given in the previous section 2.2.2 still do not convey information about the Aktionsarten or different readings of the perfective/imperfective viewpoints (for example, the ingressive, eggressive, delimitative, habitual or other readings). The representation of the Aktionsarten in a DRS – especially Slavic Aktionsarten – is a quite challenging task. The difficulties result from both the heterogeneous nature of the Aktionsarten (temporal Aktionsarten and non-temporal Aktionsarten) and the big number of them (this statement concerns in particular the Slavic Aktionsarten).

The idea how to deal with the temporal Aktionsarten (i.e. Aktionsarten which map the eventuality to the coordinates on the timeline) comes from Kamp and Reyle (1993). The authors propose the notion of the Aspectual operators defining them as "*operators which transform the meaning of the underlying non-progressive or non-perfect verb, verb phrase or sentence into that of its progressive or perfect counterpart*". As an example, they introduce the aspectual operator PROG which transforms the perfective eventuality e into a progressive (i.e. imperfective) eventuality PROG(e) Kamp et al. (2011). The formal definition of the PROG says, that PROG is true for the eventuality e iff there is some eventuality e', e' is P and the eventuality e is a proper part[6] of e'

(49) PROG: λP.λe'.$\exists$e[e $\sqsubset$ e' $\wedge$ P(e')]

The following sentences show how the PROG-operator functions: the perfective eventuality of *pulling the gun* in (50a) is transformed into the progressive eventuality in (50b)

(50) a. The man pulled his gun.
b. The man was pulling his gun.

n, x, t1, e1
t1 $\prec$ n
e1 $\subseteq$ t1
e1: pull-gun(x)

n, x, t1, e1, s1
t1 $\prec$ n
e1 $\subseteq$ t1
s1:PROG(e1:pull-gun(x))

Figure 2.1: The PROG operator, after Kamp and Reyle (1993)

Kamp and Reyle (1993) and Kamp et al. (2011) only provide the example of the PROG operator. However, they also mention the possibility to define other aspectual operators. In particular, they mention the so-called *aspectual verbs* such as *start, continue, stop* or *finish*, which have the potential to become aspectual operators. According to the authors, these verbs "*map the meaning of the verb phrase to a corresponding compound phrase*" (Kamp and Reyle, 1993). For example, the phrase *started writing a letter* focuses on the beginning of the eventuality of *writing a letter* (thus, conveying ingressive meaning), while *stopped writing a letter* focuses on the ending of the eventuality (eggressive meaning).

Coming back to the six temporal Aktionsarten described in section 1.2.2, i.e. *duratives*, *ingressives*, *eggressives*, *delimitatives*, *semelfactives*, and *repetitive*, I propose the following aspectual operators: PROG, INGR, EGGR, DELM, SMFV and ITER.

The durative reading of the eventuality can be represented by applying the operator PROG, which says that there is an eventuality e' with the property e' is P and there is an eventuality e which is a proper part of e':

$$PROG = \lambda \text{P} \lambda \text{e}' \left(\begin{array}{|c|} \hline e \\ \hline \text{e} \sqsubset \text{e}' \\ \hline \end{array} \oplus \text{P(e}') \right)$$

Figure 2.2: Aspectual operator PROG, after Kamp and Reyle (1993)

The aspectual operator INGR triggers the ingressive reading of the eventuality, i.e. it focuses on its starting point. This operator is formalised as an eventuality e of kind P whose runtime

[6]The formal definition of the proper part is as follows: x is a proper part of y if (and only if) x is a part of y and x is not equal y: $x \sqsubset y$ iff x $\sqsubseteq$ y and $\neg(x = y)$, Hobbs and Moore (1985).

$\tau(e)$ is the initial bound (IB) of an interval t which is the runtime of the eventuality e'. The embedded DRS makes sure that there is no other eventuality e'' of the same type P, which fully includes the eventuality e', and thus prevents the possibility that there is another beginning point:

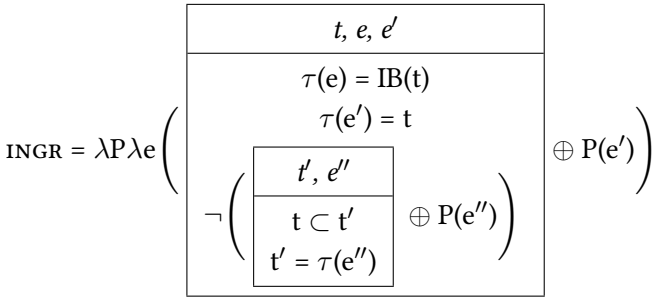


Figure 2.3: Aspectual operator INGR (Bary, 2009)

A similar operator can be used to describe the eggressive reading of eventuality, i.e. an eventuality with the emphasis on the final point. This operator has the same meaning as the INGR operator with the only difference being in focusing on the culmination point (CP) of the eventuality:

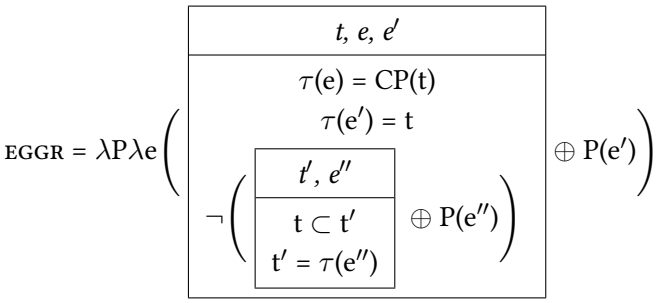


Figure 2.4: Aspectual operator EGGR, after Bary (2009)

The operator for semelfactive reading represents the punctual character of the eventuality, i.e. that the starting point $IB(t)$ coincides with the culmination $CP(t)$

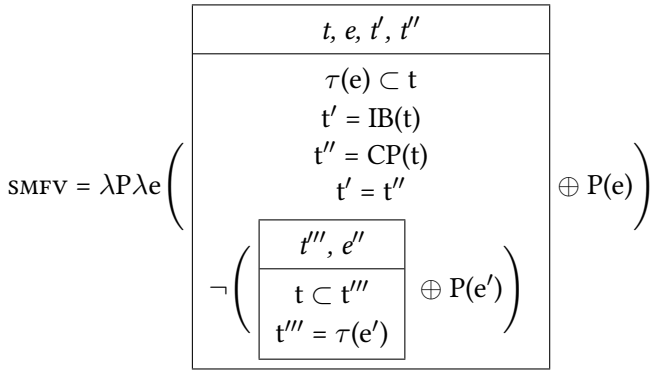


Figure 2.5: Aspectual operator SMFV (source: own representation)

To refer to the delimitative or perdurative readings, the following operator DELM is used. The meaning of this operator is to represent the maximal stage of an uninterrupted evolving

atelic eventuality with both initial and final boundaries[7]. The formula below represents the following conditions: for some eventuality e of the type P must hold, that if there is another eventuality e' and e is a proper part of e', then there is no eventuality e' of the same type P.

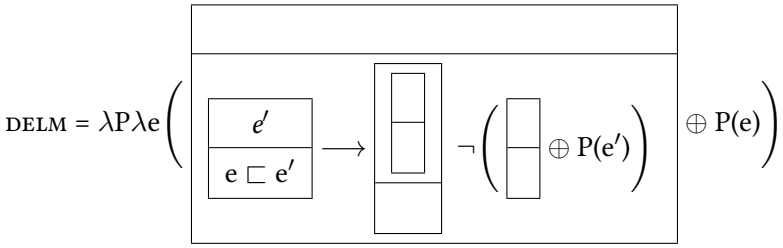


Figure 2.6: Aspectual operator DELM, after Bary (2009)

To represent the habitual reading, the operator ITER should be applied. Egg (2005) proposes the following definition of the ITER operator where $\cup E$ means a *convex closure* of eventualities e (i.e. the smallest set of eventualities which contain e) with the property that if an eventuality e' is a proper part of E, than it has the property P, the property $\neg\ P(e)$ means, that there is no single (i.e. no non-repeatable) eventuality e which has the property P:

(51) $\lambda P \lambda e. \exists E[\cup E{=}e \wedge \neg P(e) \wedge \forall e'[e' \sqsubset E \longrightarrow P(e')]\ ]$

The DRS below gives the formula (51) in the DRS notation:

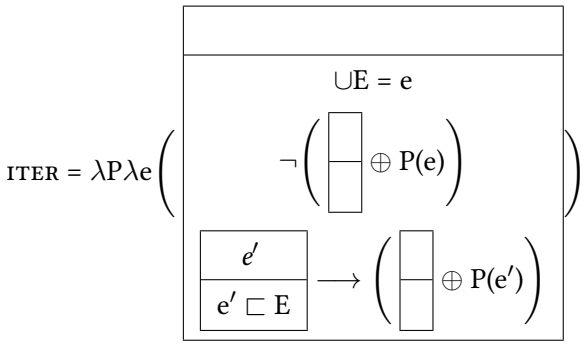


Figure 2.7: Aspectual operator ITER, after Egg (2005)

However, the problem is still not solved what to do with the Aktionsarten which does not have the temporal nature. Another challenging task – with regard to the Aspect in Slavic languages – is the necessity to to take into account the morphological properties of the Slavic verbal forms and the plurality of the Slavic Aktionsarten. A possible solution could be to store this information in the feature structure of the verb, and assign it to the Vendler's class on the level of the VP. I will discuss this idea in more detail in next Chapter 3, while giving the analysis of the Russian perfective aspect.

[7]My defintion of the DELM operator corresponds to the definition of the MAX operator introduced by Bary (2009) for the representation of atelic bounded eventualities.

Chapter 3

Perfective Aspect in Russian: meanings and interpretations

3.1 Aspectual system of Russian

The aspectual system of the Russian language includes two grammatical Aspect categories (perfective and imperfective) and several Aktionsarten, among which are five situational Aktionsarten in terms of Vendler classification (*states, activities, achievements, accomplishments and semelfactives*) and a list of Slavic Aktionsarten (among which are temporal and non-temporal, see section 1.2.2). The system of Tenses includes three values: *past*, *present* and *future*. Aspectual values are dependent on the morphology of Russian verbs, which is quite complex. The structure of Russian verbs consists of a lexical component (verb stem) and grammatical morphemes (also called inflections) (Smith, 1997):

(52) $[[\text{Prefix}[\text{Root}]\text{Suffix}]_{Stem}\ [\text{Inflection}]]_{Verbform}$

The components of the verb form belonging to the stem (root and affixes) convey information about the lexical meaning of the verb and its grammatical Aspect and Aktionsarten (Damova, 1999; Smith, 1997). The components of the verb belonging to the ending (inflexions) convey information about tense, mood, person, and number (see Figure 3.1).

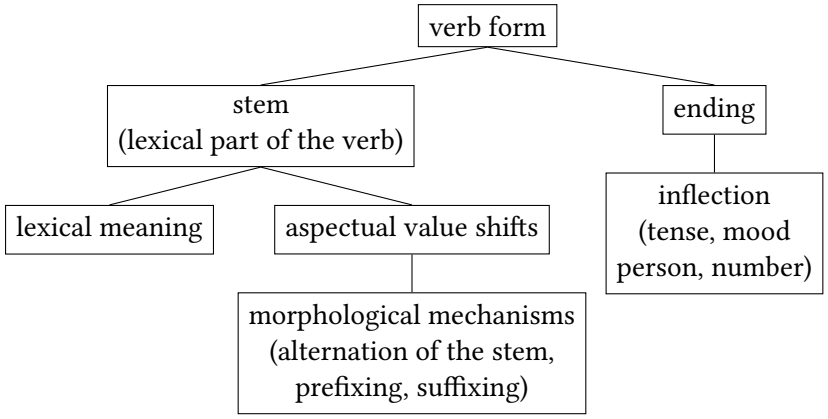


Figure 3.1: Morphological formation of Russian grammatical Aspect, after Damova (1999)

The lexical part of the verb, i.e. its stem, may affect the Aktionsart and the grammatical Aspect, while the ending represents tense, mood, person and number, as shown in example (53):

(53) Ona po-vy-tolk-a-l-a meški
She pref-pref-root-sfx-infl-infl bags
She distrib-out-throw-sfx-past-3.fem.sg bags
'She threw out bags one after another'

Since Tense is not isolated from Aspect in Russian and both categories are closely related to each other, conveying information about the temporal development of eventualities, I will argue, that Tense should be also included in the analysis of the Russian Aspect. These components are combined compositionally, which is represented in the architecture of the Russian Tense/Aspect system below:

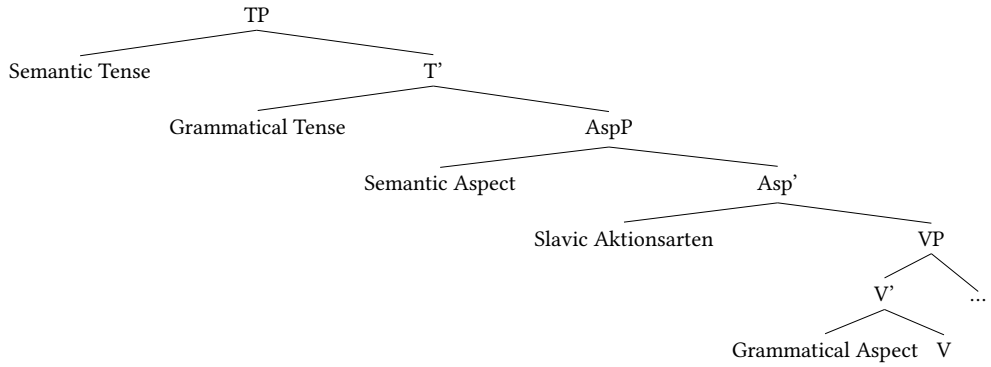


Figure 3.2: The tense/aspect architecture of Russian, after Paslawska and Stechow (2003) and Mezhevich (2008)

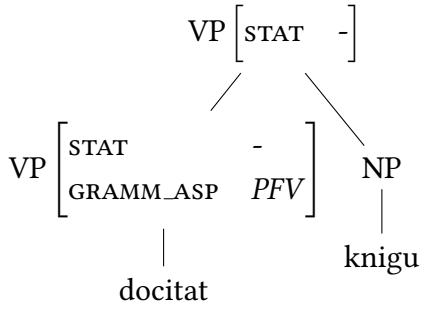
In the following sections 3.1.1 to 3.1.3, I will give an overview over these categories starting from the level of the grammatical Aspect and Slavic Aktionsarten up to the level of the semantic Tense and provide construction rules for the feature structures for each category.

3.1.1 Grammatical Aspect

The grammatical Aspect in Russian is a binary category which consists of imperfective and perfective Aspect. These two classes are expressed by morphological means throughout the verb paradigm: the category of Aspect is realized in Russian in every finite verb form and in many non-finite verb forms (i.e. the imperative, infinitive, and some participal forms), marking the verb form as being either perfective [PFV] or imperfective [IPF]:

pisat'	pisal	pishushij'
write.IPF-INF\	write.IPF-PAST.3s	write.IPF-PART-I.3s
'to write'	'he wrote'	'the writing person'
pishi'	napisat'	napisannyj'
write.IPF-IMP.s	write.PFV-INF	write.PFV-PART-II.3s
'write!'	'to write'	'the written text'

To represent the value of grammatical Aspect, the verb can be attributed by the features STAT with the values + or − (which means that the verb has stative nature or it has the dynamic nature) and GRAMM_ASP with the values PFV or IPF (for perfective and imperfective aspect):



The majority of Russian verbs have only one aspectual value, but there is a relatively small group of the biaspectual verbs whose perfective and imperfective forms are identical. These verbs behave like perfective or imperfective verbs dependent on the context (Janda and Lyashevskaya, 2011; Mezhevich, 2008; Zinova and Filip, 2015). Most of the biaspectual verbs are foreign borrowings ending in *-ovat'* (such as *reformirovat'*[PFV/IPF] 'to reform') with a relatively small group of verbs with historically Slavic roots (e.g. *ženit'sja*[PFV/IPF] 'to marry') (Zinova and Filip, 2015)[1]. The aspectual value of the biaspectual verbs becomes clear through the context:

(54) A on mezhdu tem zhenitsja na Lene!
but he between them marry.PFV-PRES.3s to Lena!
'But meanwhile he will marry Lena!'

(55) Primerno polovina molodyh ljudej zhenjatsja posle 25 let.
about half young people marry.IPF-PERS.3pl after 25 years.
'About half of young people marry in their late 20s.'

The Aspect in Russian is expressed by morphological means, through the prefixes and suffixes which have the potential to change the eventuality type and are thus called the *eventuality type modifiers* (Filip, 2000). One reason why the analysis of Russian Aspect is complicated is the absence of a single morphological feature that indicates the aspect of a given verb. Stoll (2001) comes up with the set of rules to define the aspectual value of verbs on the morphological level. However, all of these rules have exceptions.

- Rule 1: Unaffixed verbs are imperfective. Examples of imperfective simplex verbs are *rabotat'* 'to work', *pisat'* 'to write', *dumat'* 'to think' etc. This rule is true for the most unaffixed verbs, but there is a minor group of verbs for which this generalization does not hold, e.g. *brosit'* 'to throw', *koncit'* 'to finish', *dat'* 'to give', or *det'* 'put, which are perfective, but unaffixed.

- Rule 2: If a verb has one of the imperfectivizing/habitual suffixes *-iv*, *-a/-aj*, *-va/-vaj* or *-iva/-ivaj*, then the verb must be imperfective. This rule applies to most verbs. Among the exceptions are verbs with multiple prefixation, such as *po-vy-task-yv-at' 'pull out'*, which can be either perfective or imperfective.

- Rule 3: If a verb has a prefix, then the verb is perfective. This rule holds for most prefixed verbs without suffixes. Exceptions are a few loan-translations from other languages and

[1]For more discussion on the topic of biaspectual verbs see Zinova and Filip (2015); Janda and Lyashevskaya (2011); Mezhevich (2008).

some borrowings from Old Church Slavonic, e.g. *za-viset'* 'depend', *pred-videt'* 'foresee', *pred-custvovat'* 'have a presentiment' (Stoll, 2001). Further, the prefixed motion verbs like *pri-xodit'* 'to come' are imperfective as a rule.

- Rule 4: Verbs with the semelfactive suffix *-nu* are perfective. Rule 4 holds for the great majority of verbs with the suffix *-nu-* with a handful of exceptions (*gnut'* 'to bend', *l'nut'* 'to cling', *tonut'* 'to drown', *tjanut'* 'to pull' (Stoll, 2001).

Due to a rather big number of exceptions, the aspectual tests based on morphological pattern level are not really reliable, although they allow to draw some general morphological patterns of perfective and imperfective Aspect. The semantic tests provide a better solution. There are about a dozen of semantic aspectual tests for Russian language which can be found across the literature[2]. In the following paragraph I will briefly describe four of them (see Table 3.1). However, the weakness of these tests lies in the fact that no semantic test allows to positively identify the perfective verbs (Zinova and Filip, 2015).

Description of the test	**Imperfective**	**Perfective**
Compatibility with time point adverbials like *right now*	+	-
Future time reference in the present tense	?	+
Compatibility with the future auxiliary	+	-
Compatibility with phrasal verbs (*start, stop* etc.)	+	-

Table 3.1: Some tests for distinguishing perfective verb forms in Russian, after Filip (2000)

One possible test to determine the aspectual value of the verb is to combine it with time point adverbials like *sejchas* 'now' or *v etot moment* 'in this moment'. Imperfective verbs allow such combination, while perfective verbs show their incompatibility:

(56) a. Vanja v etot moment govorit s direktorom.
Vanja in this moment speak.IPF-PRESENT.3s to director.
'Vanja is speaking with the director right now.'

b. #Vanja v etot moment pogovorit s direktorom.
Vanja in this moment speak.PFV-PRESENT.3s to director.
'Vanja is speaking with the director right now.'

An imperfective verb in the present tense receives a present progressive reading, while a perfective verb gets the future interpretation:

(57) a. Vanja guljajet v parke.
Vanja stroll.IPF-PRESENT.3s in park.
'Vanja is strolling in the park.'

b. Vanja poguljajet v parke.
Vanja stroll.PFV-PRESENT.3s in park.
'Vanja will stroll in the park.'

This test is reliable for the most verb categories, but fails on the motion verbs, for example *priletet'/priletat'* 'to arrive by airplane':

[2]For more discussion on the semantic aspectual tests see Zinova and Filip (2015), Altshuler (2010), Romanova (2009), among others.

(58) a. Vanja priletajet v sredu.
Vanja fly.IPF-PRESENT.3s on Wednesday.
'Vanja will come on Wednesday.'

b. Vanja priletit v sredu.
Vanja fly.PFV-PRESENT.3s on Wednesday.
'Vanja will come on Wednesday.'

Only the imperfective verbs are compatible with the auxiliary verb *byt'* 'to be' in future tense:

(59) a. Vanja budet' guljat' v parke.
Vanja will stroll.IPF-INF in park.
'Vanja will be strolling in the park.'

b. #Vanja budet' poguljat' v parke.
Vanja will stroll.PFV-INF in park.
'Vanja will stroll in the park.'

The phrasal verbs like *nacat'* 'to start' or *zakoncit'* 'to finish' can be used only in combination with imperfective verbs:

(60) a. Vanja nacal/zakoncil pisat' pis'mo.
Vanja started/finished stroll.IPF-PAST.3s letter.
'Vanja started/finished writing the letter.'

b. #Vanja nacal/zakoncil napisat' pis'mo.
Vanja started/finished stroll.PFV-PAST.3s letter.
'Vanja started/finished writing the letter.'

3.1.2 Semantic Aspect: Vendler's and Slavic Aktionsarten

Among the Vendler's Aktionsarten applicable for the Russian language are all four Aktionsarten (states, activities, accomplishments, and achievements) described in section 1.2. The only difference is that in Russian the Semelfactives are recognized as a separate verbal class (and not as the sub-type of the Achievements). The reason for the separate status of the Semelfactives is that the verbs belonging to this Aktionsart share the same formal morphological device: the suffix *-nu* (Smith, 2004).

The grammatical Aspect can be combined with different situational Aktionsarten. While the imperfective Aspect can be combined with all kinds of Aktionsarten, the perfective Aspect cannot be combined with States, since States describe durative eventualities without endpoints and perfective development of eventuality involves a starting or a closing endpoint (or both) (Smith, 1997). The perfective aspect in Russian presents eventualities with initial or final endpoints. The perfective can be combined with all non-stative situational Aktionsarten (Smith, 1997):

(61) a. On po-sidel v parke.
He DELIM-sit.PFV-PST.3s in park.
'He sat for a while in the park.' (Activity)

b. On na-pisal pis'mo.
He COMP-write.PFV-PST.3s letter.
'He wrote a letter.' (Accomplishment)

c. On stuk-nu-l v okno.
He knock-SMFV.PFV-PST.3s in window.
'He knocked at the window.' (Semelfactive)

d. On vyigral igru.
He win.PFV-PST.3s game.
'He won the game.' (Achievement)

The imperfective Aspect can be combined with all Aktionsarten, including States (Smith, 1997):

(62) a. Vanja golodal.
Vanja starve.IPF-PST.3s.
'Vanja was starving.' (State)

b. Vanja pel v parke.
Vanja sing.IPF-PST.3s in park.
'Vanja sang in the park.' (Activity)

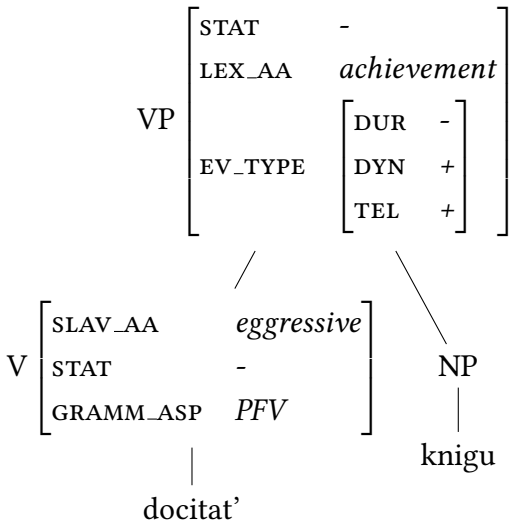
c. My pisali pis'mo.
We write.IPF-PST.3pl letter.
'We were writing a letter.' (Accomplishment)

d. On stucal v okno.
He knock.IPF-PST.3s in window.
'He was knocking at the window.' (Semelfactive)

e. On umiral.
He die.IPF-PST.3s.
'He was dying.' (Achievement)

The following features are introduced for semantic representation of the grammatical and semantic Aspect in the DRT: *Grammatical Aspect* with values PFV and IPF for perfective and imperfective verbs along with the feature STAT with the values + and − for static and non-static eventualities respectively. The feature *sem_aa* represents the Vendler's Aktionsart class and is supported by the features describing the eventuality type *DUR* (duration), *DYN* (dynamicity) and *TEL* (telicity), which have the values + or −. An example of the representation is shown in the feature structure of the following discourse:

(63) Docitat' knigu.
Read.PFV-INF book.
'To finish reading the book'



3.1.3 Grammatical and semantic Tense

The system of Tenses in Russian includes three values: *past*, *present* and *future*. The Aspect is expressed independently from Tense. Tenses in Russian do not interfere with the type of the eventualities: the sentences with a certain verb constellation in different tenses will describe the same situations with respect to their phases or object type. This holds because the Aktionsart of the described eventuality in Russian is referred to by the semantics of the verb, and not by the meaning of the tense itself, like in English (Damova, 1999).

Not every combination of Tense/Aspect is possible in Russian. While the imperfective Aspect can be combined with all three Tenses (Past, Present and Future), a combination of Perfective Aspect with the Future Tense is not grammatical. It should be noted as well that the combination of Perfective Aspect + Present Tense has the future reading and in some cases the repetitive/habitual reading. The table 3.2 summarizes the Russian Tense/Aspect system:

Grammatical Tense	**Imperfective**	**Perfective**
PAST	On (casto) cita-l knigu. He (often) read.IPF-PST.3s book 'He (often) read the book.'	On (*casto) pro-cita-l knigu. He (*often) PFV-read.PST.3s book 'He (*often) read the book.'
PRES	On (casto) cita-et knigu. He (often) read.IPF-PRS.3s book 'He is (often) reading the book.'	On (casto) pro-čita-et knigu. He PFV-read-PRS.3s book 'He will read a book. 'He would often read the book'
FUT	On budet (casto) cita-t' knigu. He will (often) read.IPF-PRS.3s book. 'He will be reading the book (often).'	

Table 3.2: Russian Tense/Aspect system (Altshuler, 2010)

To represent the Tense/Aspect system of Russian in DRT, the following features should be introduced:MORPH_TENSE with the values *past*, *present*, and *future* (for the representation of the grammatical tense), GRAMM_ASP with values *IPF* and *PFV* (for imperfective and perfective Aspect), the corresponding feature STAT with the values + and − (for static and non-static eventualities), SEM_TENSE with values *past*, *present*, and *future* (for the representation of the semantic tense). The following table represents the definition of Russian tenses through the available features (the blue marked rows indicate the attributes and values which are relevant

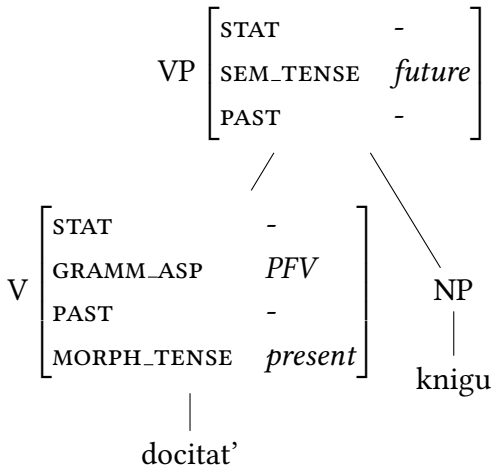
for the analysis of the perfective aspect in this thesis):

Grammatical Tense MORPH_TENSE	**Grammatical Aspect** GRAMM_ASP	STAT	PAST	**Semantic Tense** SEM_TENSE
past	IPF	+	+	*past*
past	PFV	+	-	*past*
present	IPF	-	+	*present*
present	PFV	-	-	*future*
present	PFV	-	-	*present*
future	IPF	-	+	*future*

Table 3.3: Russian Tense/Aspect system with corresponding features, after Damova (1999)

The feature structure in (64) gives the representation of Tense and Aspect for the following discourse (the information concerning the Aktionsart and the evenutality type is not included):

(64) Docitat' knigu.
Read.PFV-INF book.
'To finish reading the book'



3.2 Perfective aspect in Russian

3.2.1 Conventions of use

The use of the perfective Aspect in Russian depends on its property to relate the eventuality to its endpoints. The perfective Aspect has two direct and several augmented conventions of use. The direct conventions focus either on the culmination point or on the starting point of the eventuality. Most frequently the perfective Aspect is used to indicate the final point of the eventuality. Gilbert C. Rappaport (1997) calls this meaning of Russian perfective the *Final Emphasis*. If the verb is telic, the use of perfective aspect indicates that the eventuality reached the culmination point:

(65) On vstal ran'she vseh.
He get_up.PFV-PST.3s before everybody.
'He got up before everybody.' (Accomplishment)

(66) Ona prisla na rabotu za pjat' minut do nacala.
She come.PFV-PST.3s to work for five minutes until begin.
'She came to work five minutes early.' (Achievement)

If the verb is atelic, the perfective viewpoint emphasizes that the eventuality evolved to the final point and no longer continues:

(67) On mne pomog vo vremja mojej uceby.
He me help.PFV-PST.3s during time my studies.
'He helped me during my studies.' (Activity)

(68) Ona prozhila vsju zizn' v Moskve.
She live.PFV-PST.3s whole life in Moscow.
'She lived her entire life in Moscow.' (Activity)

The perfective Aspect is also used to emphasize the starting point of the eventuality:

(69) Ja zahodil po tamburu v strashnom volnenii.
I pace.PFV-PST.3s in vestibule in terrible agitation.
'I started to pace about in the vestibule in terrible agitation.' (Achievement)

Among the augmented interpretations of the perfective Aspect in Russian is the notion of the *Continuing Result*. In this case the perfective Aspect is used, when the speaker wants to emphasize that the eventuality terminated but the result of the eventuality still holds:

(70) K vam kto-to prisel.
To you somebody come.PFV-PST.3s.
'Somebody has come for you (and is still there).'

The perfective Aspect is also used to indicate the *Intention* of the speaker. For example, the choice of both perfective and imperfective Aspect is correct in the following sentences, but only the perfective Aspect – due to the focusing on the endpoints – has the meaning that the described activity was intended to occur:

(71) Ja pozvonil / zvonil direktoru.
I call.PFV-PST.3s / call.IPF-PST.3s director.
'I called the director.'

(72) Ty peredal / peredaval jemu moje soobschenije?
You convey.PFV-PST.3s / convey.IPF-PST.3s him my request?
'Did you convey my request to him?'

Perfective Aspect is also frequently used to express the *Sequentiality* of the happenings. For example, the eventualities in the following example are understood as a sequence of terminated events:

(73) Vcera prisel poctal'on. On posidel, popil s
Yesterday come.PFV-PST.3s postman. He sat.PFV-PST.3s, drink.PFV-PST.3s with
nami caj i usel.
us tea and leave.PFV-PST.3s

'Yesterday came the postman. Hes sat for a while, drank some tea with us, and then left.'

However, a sequence of perfective events in a sentence does not always mean that the eventualities occurred one after another:

(74) Nocju veter sorval krysu, razbil tri okna i
Night wind tore_off.PFV-PST.3s roof, break.PFV-PST.3s three windows and
razrubil jablonju.
bring_down.PFV-PST.3s apple-tree.
'During the night the wind tore off the roof, broke three windows and brought down the apple-tree.'

3.2.2 Combination with Aktionsarten and argument structures

As it was indicated in section 3.1.2, the perfective Aspect in Russian presents eventualities with both initial and final endpoints and includes four Aktionsarten: Activities, Accomplishments, Achievements and Semelfactives.

Activities

The Aktionsart Activities stands for dynamic atelic durative events (Smith, 1997). This Aktionsart includes mostly imperfective verbs. Among the perfective verbs belonging to this Aktionsart are verbs with SLPs perdurative *-pro* and delimitative *po-*. Both suffixes indicate eventualities of limited duration. These prefixes show that the situation has a starting point and an arbitrary final endpoint. Activities are compatible with expressions of duration and completion. The perfective verbs in this Aktionsart are compatible with NP complement, locative complement or can have no complement at all:

(75) a. Ona pro-stojala na uglu celyj čas
she stood.PFV-PAST.3s on corner entire for_an_hour
'She stood on the corner for an entire hour'

b. Igor' po-rabotal časok
Igor worked.PFV-PAST.3s for_an_hour
'Igor worked a bit for an hour'

Accomplishments

The Aktionsart Accomplishments refers to the durative telic eventualities. Accomplishments typically refer to specific, countable events. If the verb has nominal complements, they have to be specific, i.e. either accusative direct objects (instead of genitive) or demonstratives as well as quantifiers. Accomplishments are incompatible with expressions of simple duration (e.g. *for two hours*) and compatible with expressions of completion, including manner adverbials:

(76) a. Lev napisal roman
Lev wrote.PFV.PAST novel
'Lev wrote a novel'

b. Rebenok s"el jabloko
child ate.PFV.PAST apple

'The child ate an apple'

c. Kolja poexal v Moskvu
Kolja went.PFV.PAST to Moscow
'Kolja went to Moscow'

Accomplishments may also consist of a finite number of repetitions of a situation which is indicated by a cardinal or other adverbial:

(77) On povtoril etot zvuk tri raza
he repeat.PFV-PAST.3s this sound three times
'He repeated this sound three times'

The perfective states are not possible in Russian (Smith, 1997) due to the property of the perfective Aspect to emphasize the endpoints of the eventuality, while the States implicate the absence of boundaries. The only case when the Perfective Aspect may be used to described the continuing eventuality without boundaries is the habitual use of the Perfective. Very frequently the habitual use of the perfective Aspect is accompanied by specifying AdvPs like *vremja ot vremeni* – 'from time to time', *inogda* – 'every now and then', *casto* – 'frequently' or imperfectivizing particles like *byvalo* – 'it would happen that'. The habitual reading of the perfective aspect is only possible with the perfective verbs in presence:

(78) On, byvalo, otkrojet vam samyj slozhnyj zamok.
He, happend, open.PFV-PREs.3s you most complicated lock.
'It would happen that he would open the most complicated lock for you.'

(79) Izredka vdali pokazetsja korabl'.
Rarely far appear.PFV-PRES.3s ship.
'From time to time a ship would appear in the distance'

Achievements

Achievements describe an instantaneous change of state, they refer to dynamic punctual and telic events. Among the temporal Aktionsarten which belong to Achievements are ingressives, eggressives and some completives. Achievements do not allow the expressions of duration (e.g. *dva casa* – 'for two hours'):

(80) Maria do-čitala knigu.
Maria EGGR-read.PAST.3s book.
'Maria read the book to its end.'

(81) Pjanica razbil stakan.
Drunkard shatter.PFV-PAST.3s glass.
'The drunkard shattered the glass.'

(82) Ja za-krical, kogda uvidel ego.
I INGR-shout.PFV-PAST.3s, when saw him.
'I began shouting when I spotted him.'

Semelfactives

Semelfactives are instantaneous events consisting of a single point. The semelfactive verbs may be transitive (Smith, 1997) *bodnut' kolxoznika* 'to butt a collective farmer' or have an

oblique (i.e. not-nominative) complement: *maxnut' rukoj* 'to wave one's hand'. Semelfactives do not allow the imperfective Aspect, they are also incompatible with expressions of completion or duration:

(83) a. Igor' stuknul v dver'
Igor knock.PFV-PAST.3s at door
'Igor knocked at the door'

b. Vdali kto-to maxnul rukoj
Far somebody wave.PFV-PAST.3s hand
'In the distance somebody waved his hand'

3.2.3 Lexical and superlexical prefixes

As indicated in section 3.1.1, the perfective Aspect in Russian is usually expressed by prefixed verbs (except for a minor group of unprefixed perfective verbs) and the verbs with the semelfactive suffix *-nu*. The amount of the verb prefixes vary across the literature. The most exhaustive list is provided by Švedova (1982), which includes 28 prefixes, 23 of which are productive (*v-/vo-, vz-/vzo-, voz-/vozo-, vy-, dis-, do-, za-, iz-/izo-, na-, nad-/nado-, nedo-, o-, ob-/obo-, ot-/oto-, pere-, po-, pod-/podo-, pred-/predo-, pri-, pro-, raz-/razo-, s-/so*$_1$-) and five are non-productive (*niz-* and *pre-*) or loaned and productive only in literary language (*re-*, *de-*, and *so*$_2$-).

When combined with the verb stem, the prefixes may behave in two ways. Some prefixes modify the meaning of the verb stem producing a whole new eventuality (e.g. *(č)itat'* 'to read' – *ot-(č)itat'* 'to lambast'). These prefixed are called *lexical prefixes* (LPs). There is also a group of verbal prefixes which do not interfere with the semantics of the verbs stem, but modify the stages or temporal limitation of an eventuality when combined with a verb stem. These prefixes are called the *superlexical prefixes* (SLPs) . The difference between the two types is that LPs add "*an identifiable extra bit of information relating to how the event progresses*" (Romanova, 2009), while SLPs describe perfective prefixes which specify the part of an action or modify an inherent temporal or aspectual characteristic of the eventuality described by the host verb (Romanova, 2009). A lexical prefix modifies the meaning of the verb. The superlexical prefix does not interfere with the semantics of the host verb but modify the verb in two ways: they can either pick out and delimite a subevent of the verb (e.g. *govorit'* – *za-govorit'* 'talk' – 'start talking') or they modify some inherent characteristics of the event (e.g. *myt' posudu* – *pere-myt' posudu* 'wash dishes' – 'wash all the dishes') (Romanova, 2009).

The lexical prefixes (LPs) are positioned inside the VP and are adjoined to the lexical head while the superlexical prefixes (SLPs) are placed outside of the VP and modify the whole verbal phrase (see Figure (3.3)) (Babko-Malaya, 1999; Svenonius, 2004):

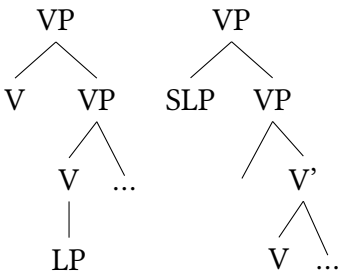


Figure 3.3: Difference between lexical and superlexical prefixes, after Romanova (2009)

An example of a verb with two prefixes, one of which is a LP and the other is a SLP is given in Figure (3.4). The verb *do-za-pis-yvat'* 'write to the end.PFV' contains a LPF *za-*, which is placed within the VP and a SLPF *do-* with the completive meaning which is placed outside of the VP:

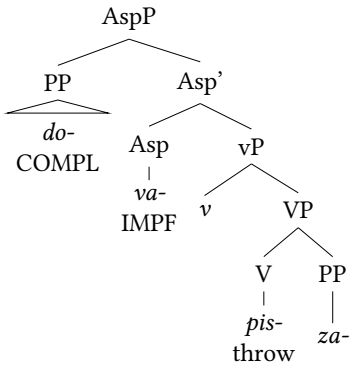


Figure 3.4: Verbal structure with a LP and a SLP (Romanova, 2009)

The semantic contribution of the LPs cannot be reduced to a uniform meaning component. The LPs *za-* and *po-* in the example below modify the semantic meaning of the stem verb *pisat'* in a rather unpredictable way (Tatevosov, 2009):

(84) a. za-pisat' 'write down, record'
za-ryt' 'dig in'
za-stroit' 'build up'

b. po-ljubit' 'fall in love'
po-stroit' 'build'
po-dvinut' 'move'

Thus, the Aktionsart of the verbs which were built by means of lexical prefixes cannot be derived from the meaning of the prefix and has to be derived from the lexical meaning of the whole verb, like this is the case with the unaffixed verbs.

The SLPs, on the other hand, combine with the verbal stem in a systematic and predictable way. In the example below the SLP *za-* provides the ingressive reading when combined with a verbal stem and the SLP *po-* has the delimitative meaning[3].

[3]According to Tatevosov (2009), the superlexical prefixes are not a homogenous class and could be devided into several types according they position on the verbal structure. For more discussion on the topic of superlexical prefixes see Tatevosov (2009); Zinova and Filip (2015); Romanova (2009); Isačenko (1962); Babko-Malaya (1999); Svenonius (2004); Ramchand (2004), among others. However, for the DRT-based analysis presented in this thesis only the difference on the semantiv level between the SLPs is sufficient: the details concerning the compositional properties of the SLPs go beyond the scope of the present thesis.

(85) a. za-pisat' 'start writing'
za-begat' 'start running'
za-pet' 'start singing'

b. po-pisat' 'write for a while'
po-begat' 'run for a while'
po-pet' 'sing for a while'

Due to systematic nature of the SLPs they can be combined with the Vendler's Aktionsarten for more feasible analysis of the aspect. However, it should be noted that some of SLPs are polysemic and can be combined with different Vendler's Aktionsarten. The following Table gives an overview of the SLPs with the corresponding Slavic Aktionsarten and the Vendler's Aktionsarten (the blue marked rows indicate the temporal Aktionsarten from the non-temporal ones):

Prefix	**Prefixed verb**	**Slavic Aktionsart (slavic_aa)**	**Vendler's Aktionsart (event_t)**
do-	*do-pisat'* 'finish writing'.PFV	completive/eggressive/ inceptive	achievement
iz-, izo- is-	*is-pisat'* 'cover sth. with writings'.PFV	eggressive-intensed	accomplishment
na-	*na-brat'* 'take a big amount of sth'.PFV	cumulative	accomplishment
na-	*na-gulat'sa* 'get enough of walking'.PFV	saturative/ completive	achievement
ot- oto-	*ot-rabotat'* 'finish working'.PFV	terminative	achievement
pere-	*pere-pisat'* 'rewrite'.PFV	repetitive	accomplishment
pere-	*pere-gulat'* 'get too much of walking'.PFV	excessive	achievement
pere-	*pere-lovit'* 'catch all items'.PFV	distributive	accomplishment
po-	*po-citat'* 'read for a while'.PFV	delimitative	activity
po-	*po-privyknut'* 'get slightly used to smth'.PFV	attenuative	accomplishment
po-	*po-brosat'* 'to throw smth. one after another'.PFV	distributive	accomplishment
pod- podo-	*pod-ustat'* 'to get slightly tired.PFV	attenuative	accomplishment
pri-	*pri-kryt'* 'slightly cover smth'.PFV	attenuative	achievement
pro-	*pro-stoyat'* 'stand for some while'.PFV	perdurative	activity
za-	*za-citat'* 'start reading'.PFV	ingressive/inceptive/ inchoative	achievement

Table 3.4: Superlexical prefixes and their meanings combined with the Aktionsarten, after (Tatevosov, 2009)

Chapter 4

DRT representation of the perfective aspect in Russian

Before I proceed to the analysis, I will briefly sum up the inventory I will use for the analysis. The following section provides the inventory for the analysis and in the sections 4.2 to 4.7 an analysis of the perfective Aspect used for a non-temporal and five temporal readings (delimitative, repetitive, ingressive, eggressive and semelfactive reading) will be given.

4.1 DRT-Analysis: Inventory

Among the Tense operators used for the analysis are the following formulas in (86), applied for present, past, and future tense, respectively. The formula for the present tense means that the the topic time t_{top} of the sentence coincides with the time of the utterance t_{ut}. In case of the past tense t_{top} lies before t_{ut}, and in case of the future tense t_{ut} lies before t_{top}:

(86) a. $PRESENT$: $\lambda Q\left(\boxed{\begin{array}{c} t_{top}, t_{ut} \\ \hline t_{top} = t_{ut} \end{array}} \oplus Q(t_{top})\right)$

b. $PAST$: $\lambda Q\left(\boxed{\begin{array}{c} t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \end{array}} \oplus Q(t_{top})\right)$

c. $FUTURE$: $\lambda Q\left(\boxed{\begin{array}{c} t_{top}, t_{ut} \\ \hline t_{ut} < t_{top} \end{array}} \oplus Q(t_{top})\right)$

The following DRS gives a representation of an eventuality with the perfective verb constellation (the time of the eventuality τ(e) is completely included into the topic time t_{top}):

(87) $\lambda P \lambda t_{top}\left(\boxed{\begin{array}{c} e \\ \hline \tau(e) \subseteq t_{top} \end{array}} \oplus P(e)\right)$

To represent the different temporal readings of the perfective Aspect the aspectual operators DELM (delimitative reading), ITER (repetitive reading), INGR (ingressive reading), EGGR (eggresive reading) and SMFV (semelfactive reading) will be used. The formal definitions of the operators are given in section 2.2.3. I will give the formal definition of each operator while giving the analysis of each temporal reading.

The following feature structure represents the aspectual characteristics of the verb, where STAT shows whether the verb has static nature or not, GRAMM_ASP refers to the grammatical Aspect of the verb, the attribute SLAV_AA gives the information about the Slavic Aktionsart of the verb, the feature MORPH_TENSE gives the value of the morphological Tense of the verb, and PAST shows whether the verb has the past form or not (value + or −, respectively).

(88)
$$\begin{bmatrix} \text{STAT} & - \\ \text{GRAMM\_ASP} & \textit{PFV} \\ \text{SLAV\_AA} & \textit{completive} \\ \text{MORPH\_TENSE} & \textit{present} \\ \text{PAST} & - \end{bmatrix}$$

Among the features describing the eventuality type of the VP are the following: LEX_AA stands for the semantic Aktionsart value (in terms of Vendler's classification), the feature STAT indicates whether the eventuality is stative or not and the attributes DUR , DYN and TEL describe the inherent properties of the eventuality, i.e. duration, dynamicity and telecity respectively:

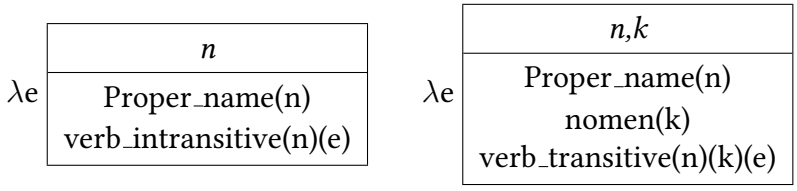
(89)
$$\begin{bmatrix} \text{LEX\_AA} & \textit{achievement} \\ \text{EV\_TYPE} & \begin{bmatrix} \text{DUR} & + \\ \text{DYN} & - \\ \text{TEL} & + \end{bmatrix} \end{bmatrix}$$

To represent the Tense of the TP, the following feature structure will be used, where PAST shows whether the whole tensed phrase (TP) has the past form or not (value +) or not (value −), and the attribute SEM_TENSE stands for the semantic (i.e. compositional) Tense of the whole TP:

(90)
$$\begin{bmatrix} \text{PAST} & - \\ \text{SEM\_TENSE} & \textit{future} \end{bmatrix}$$

I will use the DRSs given below to represent the eventualities before embedding the temporal and aspectual information (see examples in 91). The DRS on the left shows the eventuality with the intransitive verbal predicate and the DRS on the right represents the eventuality with a transitive verbal predicate. The steps for the processing of each DRS are given in section 2.2.2 and in the Annex 4.7:

(91)



4.2 Representation of non-temporal Aktionsarten

This section provides the analysis of the eventualities which do not have some specific temporal reading(for example, evolutive, saturative, attenutative or others). The analysis of the eventualities with temporal readings (for example, delimitative, repetitive, ingressive, eggressive or semelfactive) are given in the next sections 4.3 to 4.7.

I will provide the analysis of the perfective eventualities with non-temporal reading on the representative sentence in (92), which has the perfective attenuative reading:

(92) Maria pri-kryla dver'.
Maria ATT-close.PFV-PAST.3s door.
'Maria slightly closed the door.'

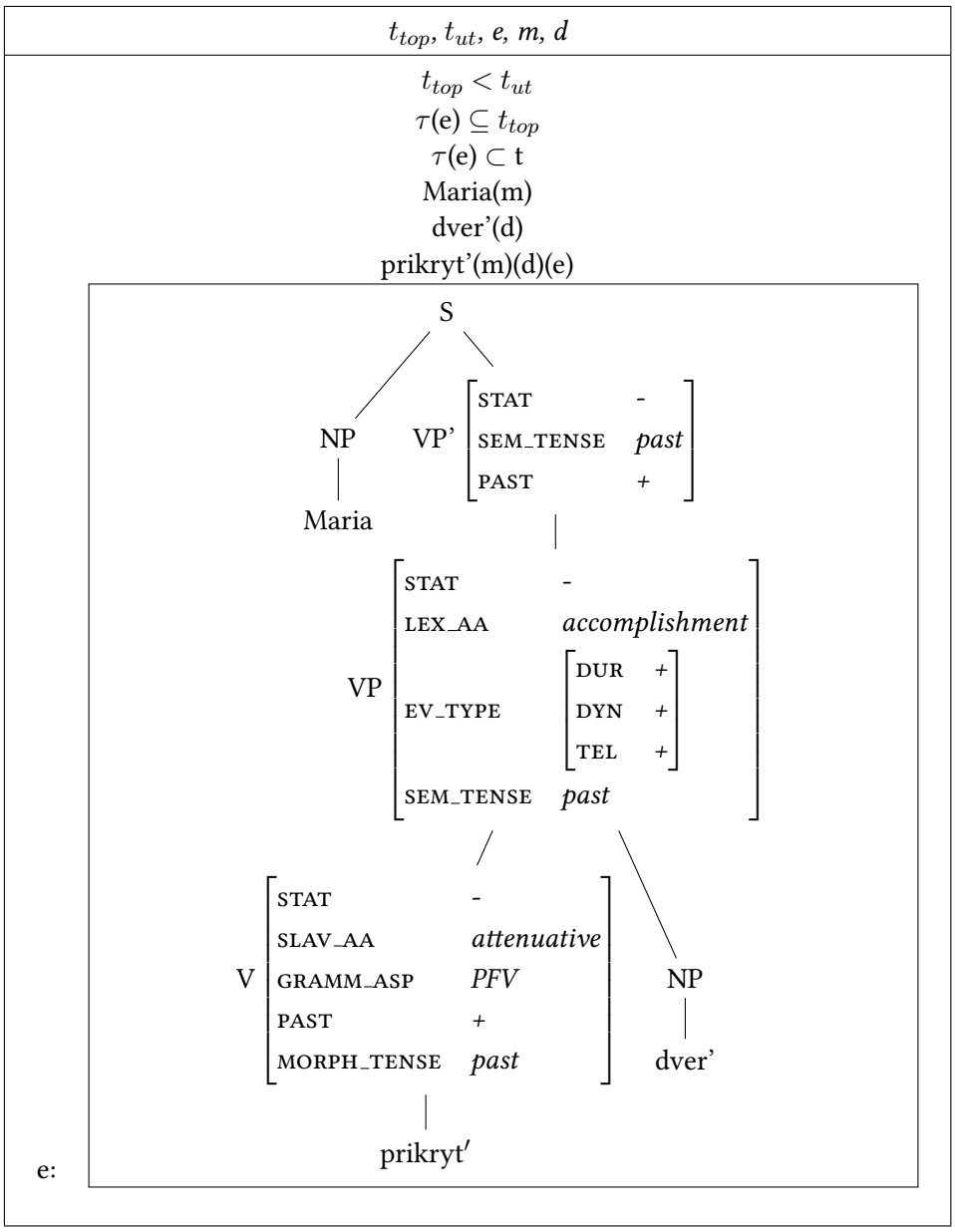
The representation of this sentence in DRS results from the combination of the past tense, perfective aspect and the attenuative Aktionsart. Since the attenuative Aktionsart does not have a special temporal reading, no aspectual operator will be used for the analysis. This results in the following combination:

$$\left(\text{PAST}\left(\text{PFV}\left(\lambda e \left|\begin{array}{c} m,d \\ \hline \text{Maria(m)} \\ \text{dver'(d)} \\ \text{prikryt'(m)(d)(e)} \end{array}\right|\right)\right)\right) =$$

$$\left(\lambda Q\left(\left|\begin{array}{c} t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \end{array}\right| \oplus Q(t_{top})\right)\right)\left[\left(\lambda P \lambda\, t_{top}\left(\left|\begin{array}{c} e \\ \hline \tau(e) \subseteq t_{top} \end{array}\right| \oplus P(e)\right)\right)\right.$$

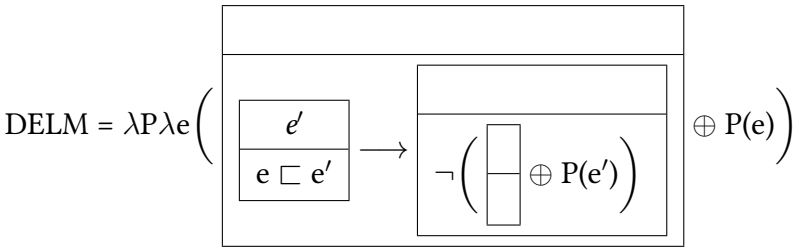
$$\left.\left(\lambda e \left|\begin{array}{c} m,d \\ \hline \text{Maria(m)} \\ \text{dver'(d)} \\ \text{prikryt'(m)(d)(e)} \end{array}\right|\right)\right)\Bigg]$$

The resulting DRS with the features describing the eventuality e is given in the Figure below (for the step-by-step processing of the λ-DRSs from above see section 4.7 in the Annexes):



4.3 Delimitative reading

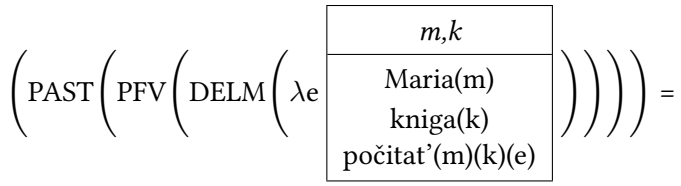
This section provides the representation of the delimitative reading of the perfective aspect. The delimitative modification focuses on the starting and ending point of an atelic eventuality. To represent the delimitative reading, I will use the aspectual operator DELM:

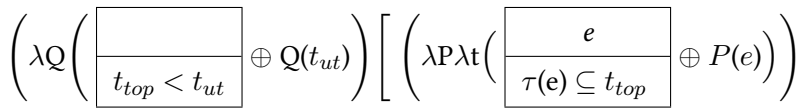


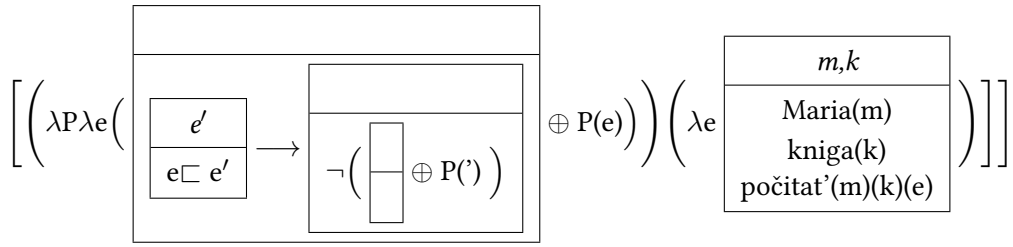
The following example provides the representative sentence for the perfective aspect with the delimitative reading:

(93) Maria po-čitala knigu.
Maria DLM-read.PFV-PAST.3s book
'Maria read the book for a while'

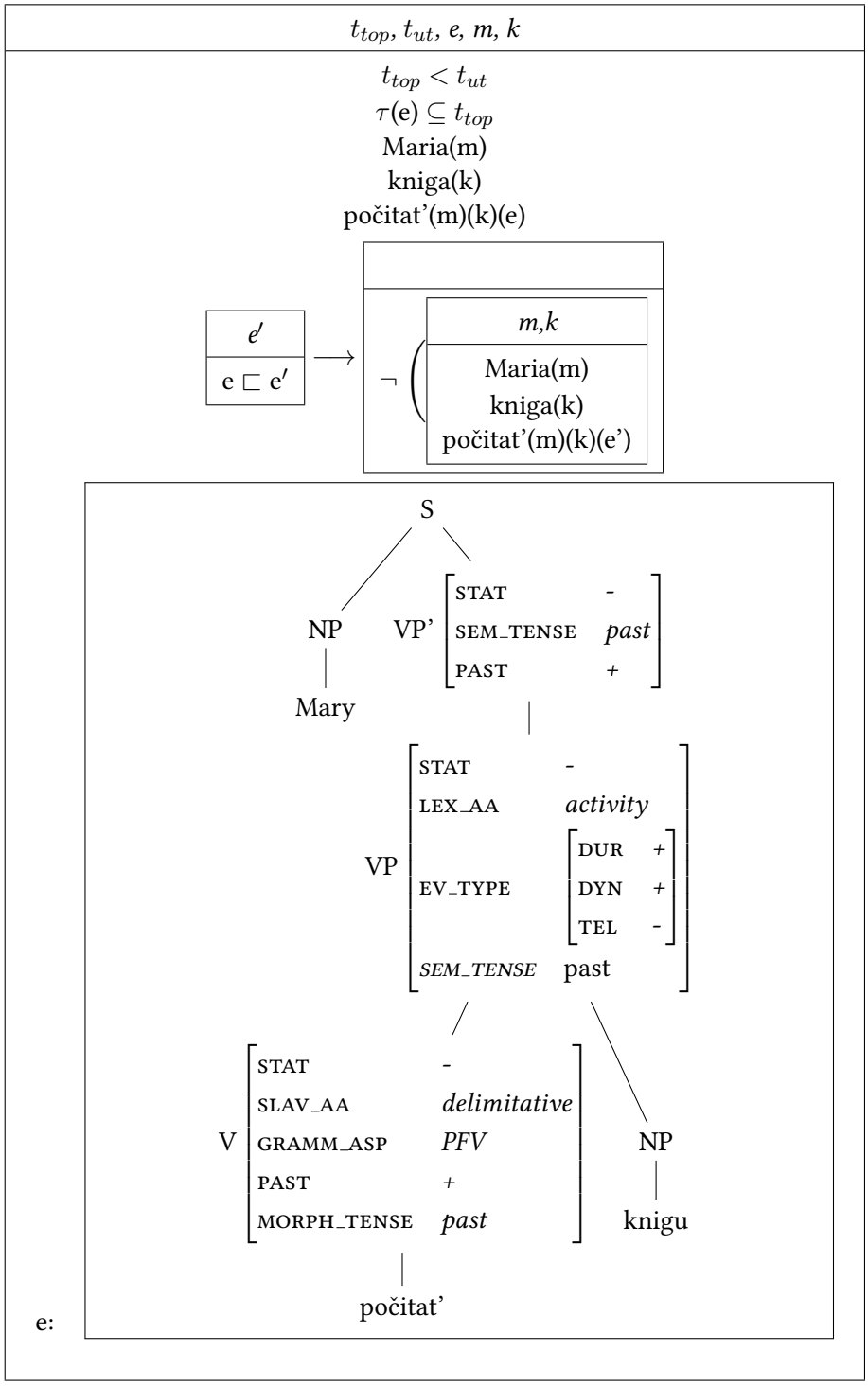
The representation of the delimitative reading results from the combination of the tense, perfective aspect and the delimitative operator DELM:





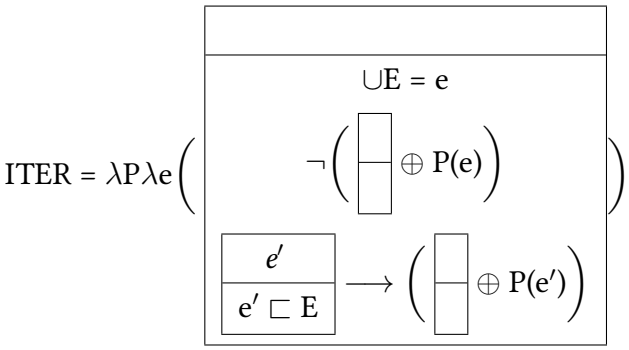


The processing of λ-DRSs results in the following discourse representation structure (for the step by step proceeding see the section 4.7 in the Annexes):



4.4 Repetitive reading

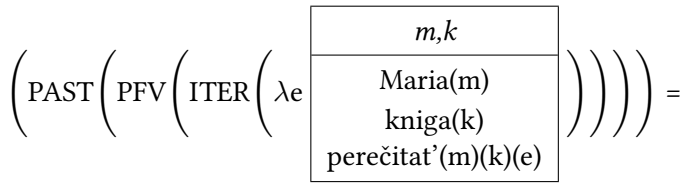
The repetitive reading of the perfective aspect focuses on the sequence of the repetitive eventualities. To represent the repetitive reading, I will use the aspectual operator ITER:

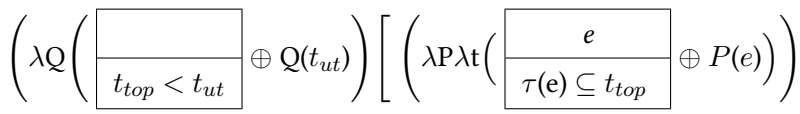


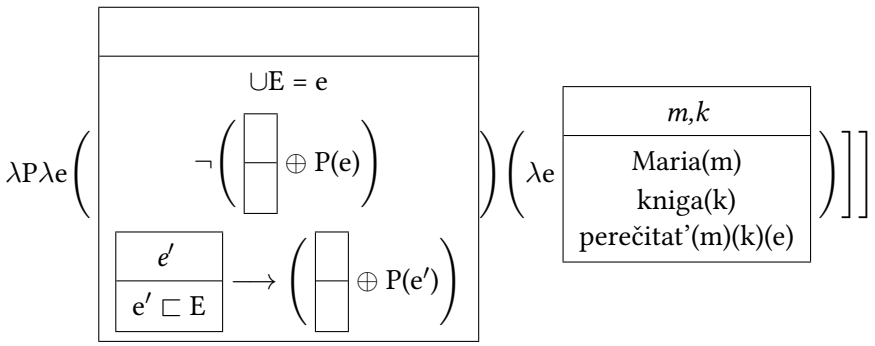
The following example provides the representative sentence for the perfective aspect with the repetitive reading:

(94) Maria pere-čitala knigu.
Maria ITER-read.PFV-PAST.3s book
'Maria re-read the book.'

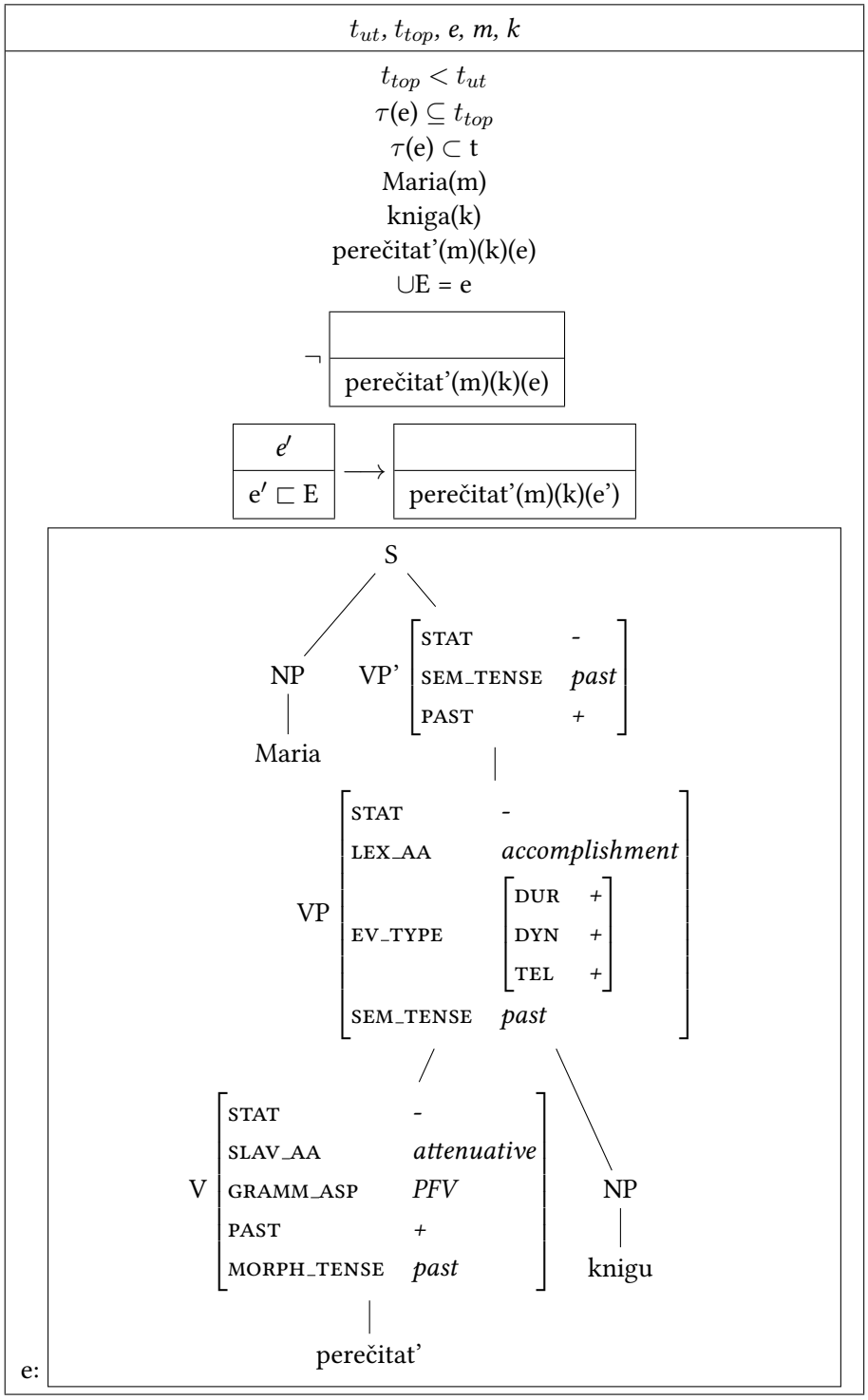
The representation of the repetitive reading results from the combination of the tense, perfective aspect and the repetitive operator ITER:







The processing of λ-DRSs results in the following discourse representation structure (for the step by step proceeding see the section 4.7 in the Annexes):



4.5 Ingressive reading

The ingressive reading focuses on the beginning of the eventuality. The following aspectual operator INGR will be used for the analysis:

$$\text{INGR} = \lambda P \lambda e \Big(\boxed{\begin{array}{c} t,\ e,\ e' \\ \hline \tau(e) = IB(t) \\ \tau(e') = t \\ \neg \Big(\boxed{\begin{array}{c} t',\ e'' \\ \hline t \subset t' \\ t' = \tau(e'') \end{array}} \oplus P(e'') \Big) \end{array}} \oplus P(e') \Big)$$

I will show the representation of the ingressive reading of the perfective aspect in DRT on the analysis of the following utterance:

(95) Maria za-čitala knigu.
Maria INGR-read.PAST.3s book.
'Maria started to read the book.'

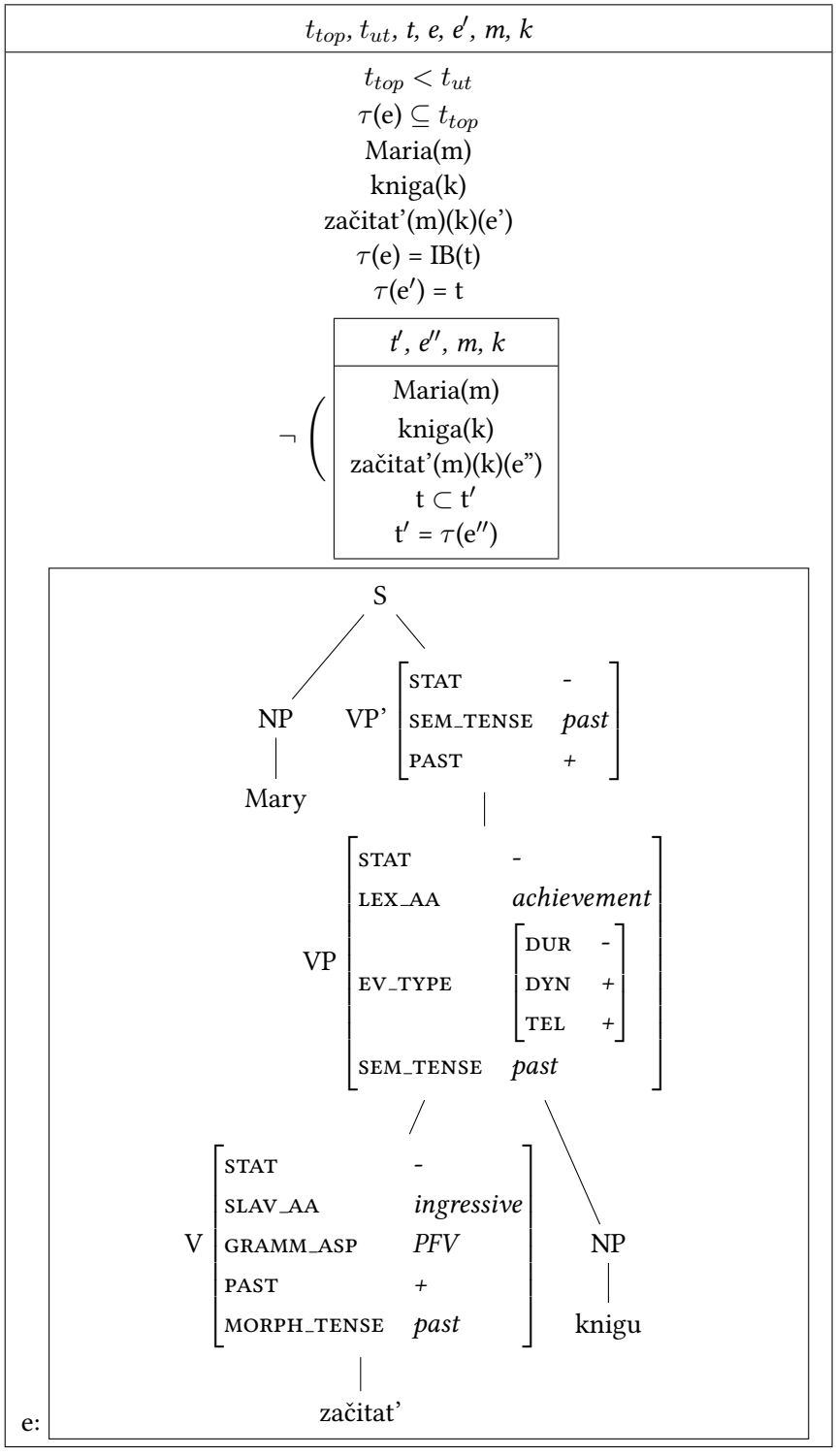
The representation of the ingressive reading results from the combination of the tense, perfective aspect and the ingressive operator INGR:

$$\Big(\text{PAST} \Big(\text{PFV} \Big(\text{INGR} \Big(\lambda e \boxed{\begin{array}{c} m,k \\ \hline \text{Maria}(m) \\ \text{kniga}(k) \\ \text{začitat'}(m)(k)(e) \end{array}} \Big) \Big) \Big) \Big) =$$

$$\Big(\lambda Q \Big(\boxed{\begin{array}{c} \\ \hline t_{top} < t_{ut} \end{array}} \oplus Q(t_{ut}) \Big) \Big[\Big(\lambda P \lambda t \Big(\boxed{\begin{array}{c} e \\ \hline \tau(e) \subseteq t_{top} \end{array}} \oplus P(e) \Big) \Big)$$

$$\lambda P \lambda e \Big(\boxed{\begin{array}{c} t,\ e,\ e' \\ \hline \tau(e) = IB(t) \\ \tau(e') = t \\ \neg \Big(\boxed{\begin{array}{c} t',\ e'' \\ \hline t \subset t' \\ t' = \tau(e'') \end{array}} \oplus P(e'') \Big) \end{array}} \oplus P(e') \Big) \Big(\lambda e \boxed{\begin{array}{c} m,k \\ \hline \text{Maria}(m) \\ \text{kniga}(k) \\ \text{začitat'}(m)(k)(e) \end{array}} \Big) \Big] \Big]$$

The DRS below provides the analysis of the eggressive reading of the perfective aspect (for the step-by-step proceeding see the section 4.7 in the Annexes):



4.6 Eggressive reading

The eggressive reading focuses on the ending of the eventuality. The following aspectual operator EGGR will be used for the analysis:

$$\text{EGGR} = \lambda P \lambda e \Big(\boxed{\begin{array}{c} t,\ e,\ e' \\ \hline \tau(e) = CP(t) \\ \tau(e') = t \\ \neg \Big(\boxed{\begin{array}{c} t'',\ e'' \\ \hline t \subset t' \\ t' = \tau(e'') \end{array}} \oplus P(e'') \Big) \end{array}} \oplus P(e') \Big)$$

I will show the representation of the eggressive reading of the perfective aspect in DRT on the analysis of the following utterance:

(96) Maria do-čitala knigu.
Maria EGGR-read.PAST.3s book.
'Maria stopped reading the book.'

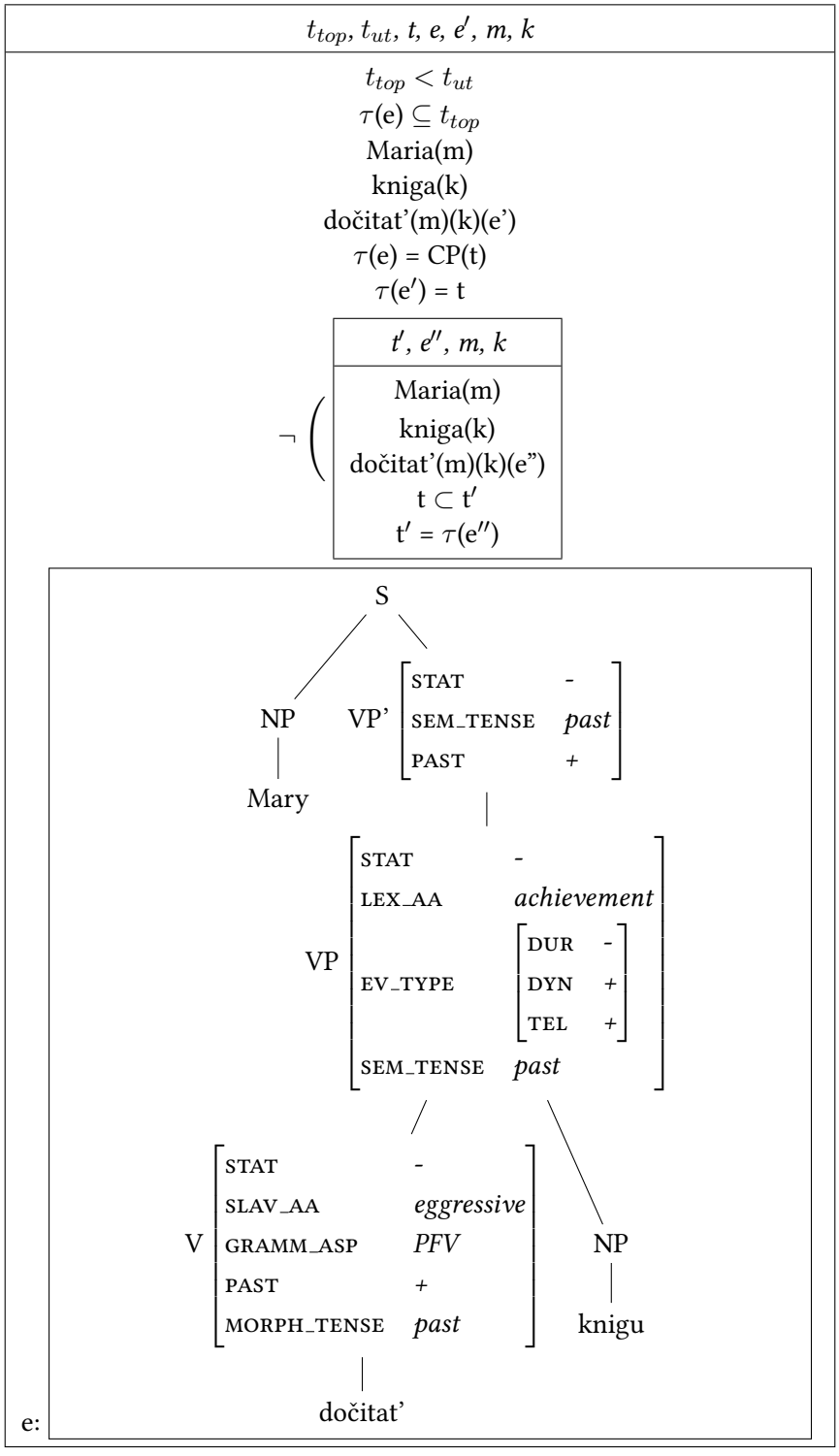
The representation of the eggressive reading results from the combination of the tense, perfective aspect and the eggressive operator EGGR:

$$\Big(\text{PAST} \Big(\text{PFV} \Big(\text{EGGR} \Big(\lambda e \boxed{\begin{array}{c} m,k \\ \hline \text{Maria}(m) \\ \text{kniga}(k) \\ \text{dočitat'}(m)(k)(e) \end{array}} \Big) \Big) \Big) \Big) =$$

$$\Big(\lambda Q \Big(\boxed{\begin{array}{c} \\ \hline t_{top} < t_{ut} \end{array}} \oplus Q(t_{ut}) \Big) \Big[\Big(\lambda P \lambda t \Big(\boxed{\begin{array}{c} e \\ \hline \tau(e) \subseteq t_{top} \end{array}} \oplus P(e) \Big) \Big)$$

$$\lambda P \lambda e \Big(\boxed{\begin{array}{c} t,\ e,\ e' \\ \hline \tau(e) = CP(t) \\ \tau(e') = t \\ \neg \Big(\boxed{\begin{array}{c} t'',\ e'' \\ \hline t \subset t' \\ t' = \tau(e'') \end{array}} \oplus P(e'') \Big) \end{array}} \oplus P(e') \Big) \Big(\lambda e \boxed{\begin{array}{c} m,k \\ \hline \text{Maria}(m) \\ \text{kniga}(k) \\ \text{dočitat'}(m)(k)(e) \end{array}} \Big) \Big] \Big]$$

The DRS below provides the analysis of the eggressive reading of the perfective aspect (for the step-by-step proceeding see the section 4.7 in the Annexes):



4.7 Semelfactive reading

The semelfactive reading focuses on the punctual atelic eventualities. The following aspectual operator SMFV will be used for the analysis:

$$\text{SMFV} = \lambda P \lambda e \Big(\boxed{\begin{array}{c} t, e, t', t'' \\ \hline \tau(e) \subset t \\ t' = \text{IB}(t) \\ t'' = \text{CP}(t) \\ t' = t'' \\ \neg \Big(\boxed{\begin{array}{c} t''', e' \\ \hline t \subset t''' \\ t''' = \tau(e') \end{array}} \oplus P(e') \Big) \end{array}} \oplus P(e) \Big)$$

I will show the representation of the semelfactive reading of the perfective aspect in DRT on the analysis of the following utterance:

(97) Igor' čikhnul
Igor sneeze.PFV-PAST.3s at door
'Igor sneezed'

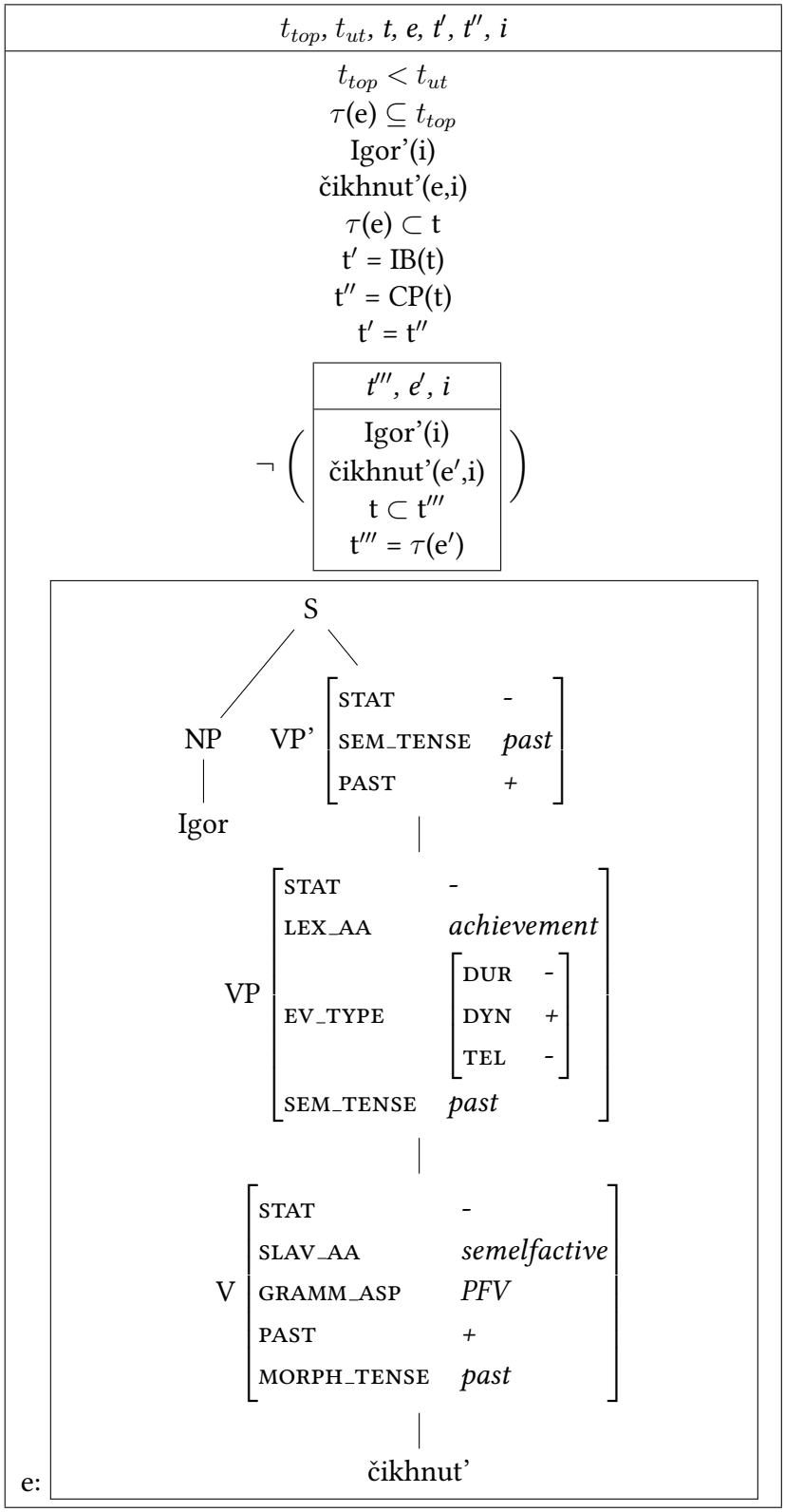
The representation of the semelfactive reading results from the combination of the tense, perfective aspect and the semelfactive operator SMFV:

$$\Big(\text{PAST} \Big(\text{PFV} \Big(\text{SMFV} \Big(\lambda e. \Big(\boxed{\begin{array}{c} i \\ \hline \text{Igor'}(i) \\ \text{čikhnut'}(i) \end{array}} \Big) \Big) \Big) \Big) \Big) =$$

$$\Big(\lambda Q \Big(\boxed{\begin{array}{c} \\ \hline t_{top} < t_{ut} \end{array}} \oplus Q(t_{ut}) \Big) \Big[\Big(\lambda P \lambda t \Big(\boxed{\begin{array}{c} e \\ \hline \tau(e) \subseteq t_{top} \end{array}} \oplus P(e) \Big) \Big)$$

$$\Big[\lambda P \lambda e \Big(\boxed{\begin{array}{c} t, e, t', t'' \\ \hline \tau(e) \subset t \\ t' = \text{IB}(t) \\ t'' = \text{CP}(t) \\ t' = t'' \\ \neg \Big(\boxed{\begin{array}{c} t''', e' \\ \hline t \subset t''' \\ t''' = \tau(e') \end{array}} \oplus P(e') \Big) \end{array}} \oplus P(e) \Big) \Big(\lambda e \Big(\boxed{\begin{array}{c} i \\ \hline \text{Igor'}(i) \\ \text{čikhnut'}(i) \end{array}} \Big) \Big) \Big] \Big]$$

The DRS below provides the analysis of the semelfactive reading (for the step-by-step proceeding see the section 4.7 in the Annexes):



Conclusions and outlook

In the present thesis I carried out the analysis of the Russian perfective Aspect by means of Discourse Representation Theory (DRT). The Aspect in Russian is expressed by morphological means, and the verbal affixes are frequently polysemous, which leads to the bigger complexity of the possible readings of the sentence and to the high number of Aktionsarten. The Vendler's classification of the Aktionsarten (including States, Activities, Accomplishments, Achievements, and Semelefactives), which is very influental for the Western Germanic languages, does not suffice to describe the plurality of the Aktionsarten in the Russian language. In order to achieve an adequate and more powerful semantic representation of Slavic aspectual classes it appears to be useful to combine the Aktionsarten classification proposed by Vendler with the existing Slavic Aktionsarten.

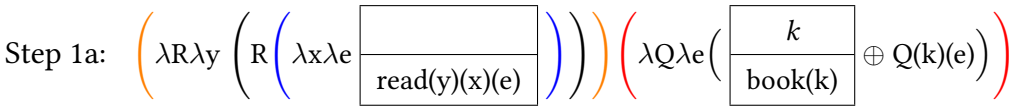
Discourse Representation Theory was chosen as a formal semantic framework which allows to deal with aspectual and temporal information of the discourses. DRT introduces discourse referents for time points and eventualities and also offers an extendable system of aspectual operators for the representation of the eventualities. The analysis has shown, that the Aktionsarten in Russian can be divided into two major classes: temporal Aktionsarten (among which are durative, inchoative, eggressive, delimitative, semelfactive, and repetitive), which involve or exclude different boundaries of the eventualities, and the non-temporal ones (for example, saturative and distributive). In order to represent the temporal readings of the perfective Aspect in Russian by means of DRT, a combination of four components is needed: representation of the Tense, representation of the perfective Aspect, aspectual operator, and the representation of the eventuality itself. In order to represent the non-temporal readings of the perfective Aspect, only three components are used: representation of the Tense, representation of the perfective Aspect, and the representation of the eventuality.

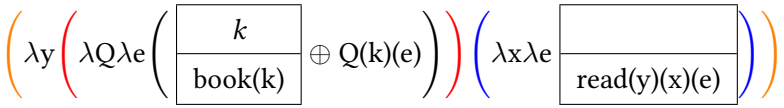
For the sake of taking into account the complex morphological system of Russian verbs, I proposed the concept of analysis of the Russian aspectual system through combination of feature structures and Discourse Representation Structures (DRSs). The grammatical and lexical content of Tense, Aspect and Aktionsarten in Russian can be described through features connected with the tensed phrase (TP), the aspectual phrase (AspP), the verbal phrase (VP), and the verb (V). These features can be represented within the DRSs conveying the additional characteristics for the eventuality. The advantage of combining the apparatus of DRT with feature structures is that it makes possible to account for cases where different temporal or aspectual meanings are conveyed by the same verbal form.

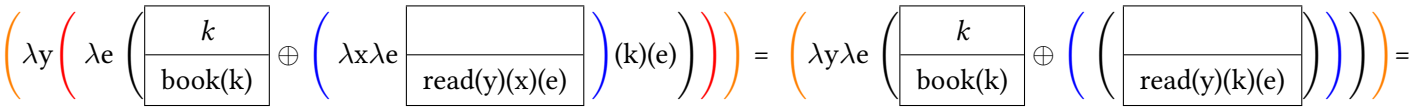
The present thesis has a theoretical perspective. Among the possible outlooks on the research of the Russian perfective Aspect could be the practical implementation of the given analysis, for example, in the programming language Prolog. Another possibility for the future research might be the analysis of the negative perfective sentences in Russian – a topic which employs the notion of the presupposition. Another potential topic could be a more detailed analysis of the temporal markers in Russian language (for example, adverbials, adverbial phrases or temporal anaphora) and their influence on the readings of the perfective Aspect.

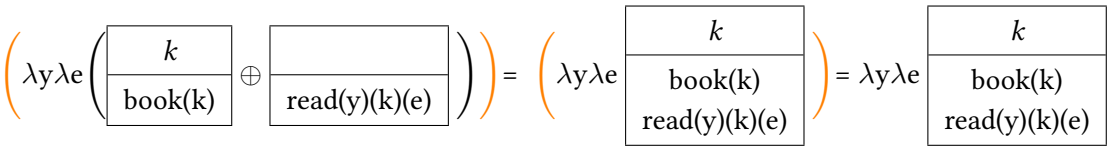
Annexes

Annex 1: Example from Section 2.2.2 (eventuality with the transitive verb)

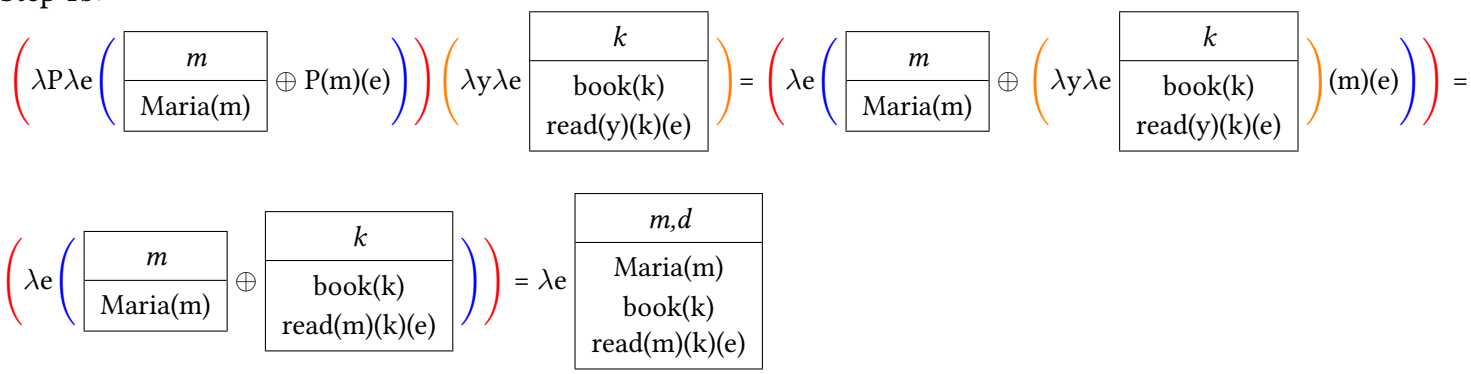
Step 1a: 







Step 1b:


λPλe (m | Maria(m) ⊕ P(m)(e)) (λyλe k | book(k) read(y)(k)(e)) = (λe (m | Maria(m) ⊕ (λyλe k | book(k) read(y)(k)(e)) (m)(e))) =
(λe (m | Maria(m) ⊕ k | book(k) read(m)(k)(e))) = λe m,d | Maria(m) book(k) read(m)(k)(e)

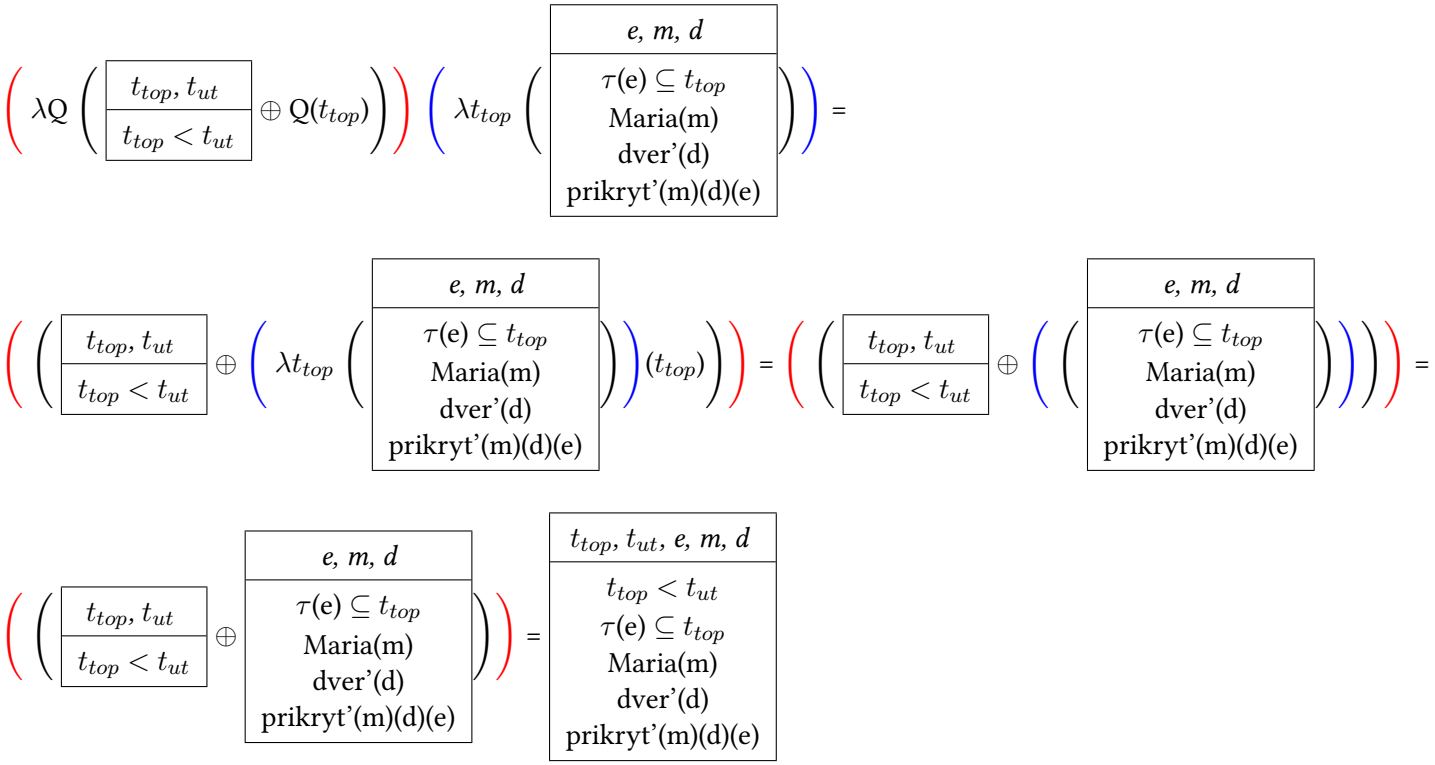
Annex 2: Example from Section 4.2 (eventuality with the non-temporal reading)

$$\text{PAST}\left(\text{PFV}\left(\lambda e\left[\begin{array}{c} m,d \\ \hline \text{Maria(m)} \\ \text{dver'(d)} \\ \text{prikryt'(e,m,d)}\end{array}\right)\right)\right) = \left(\lambda\, Q\left(\left[\begin{array}{c} t_{top},\, t_{ut} \\ \hline t_{top} < t_{ut}\end{array}\right) \oplus Q(t_{top})\right)\right)\left(\lambda P \lambda\, t_{top}\left(\left[\begin{array}{c} e \\ \hline \tau(e) \subseteq t_{top}\end{array}\right) \oplus P(e)\right)\right)\left(\lambda e\left(\left[\begin{array}{c} m,d \\ \hline \text{Maria(m)} \\ \text{dver'(d)} \\ \text{prikryt'(m)(d)(e)}\end{array}\right)\right)\right) =$$

$$\left(\lambda Q\left(\left[\begin{array}{c} t_{top},\, t_{ut} \\ \hline t_{top} < t_{ut}\end{array}\right) \oplus Q(t_{top})\right)\right)\left(\lambda t_{top}\left(\left[\begin{array}{c} e \\ \hline \tau(e) \subseteq t_{top}\end{array}\right) \oplus \left(\lambda e\left[\begin{array}{c} m,d \\ \hline \text{Maria(m)} \\ \text{dver'(d)} \\ \text{prikryt'(m)(d)(e)}\end{array}\right)(e)\right)\right) =$$

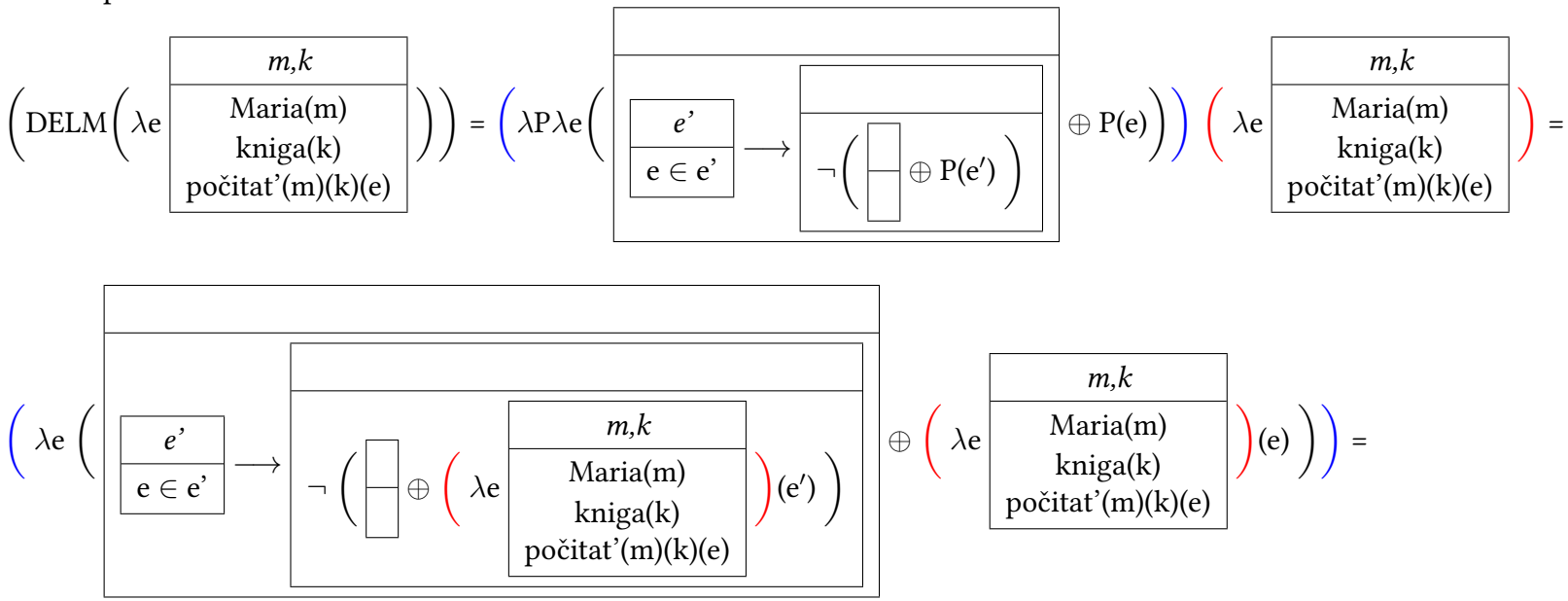
$$\left(\lambda Q\left(\left[\begin{array}{c} t_{top},\, t_{ut} \\ \hline t_{top} < t_{ut}\end{array}\right) \oplus Q(t_{top})\right)\right)\left(\lambda t_{top}\left(\left[\begin{array}{c} e \\ \hline \tau(e) \subseteq t_{top}\end{array}\right) \oplus \left(\left(\left[\begin{array}{c} m,d \\ \hline \text{Maria(m)} \\ \text{dver'(d)} \\ \text{prikryt'(m)(d)(e)}\end{array}\right)\right)\right)\right) =$$

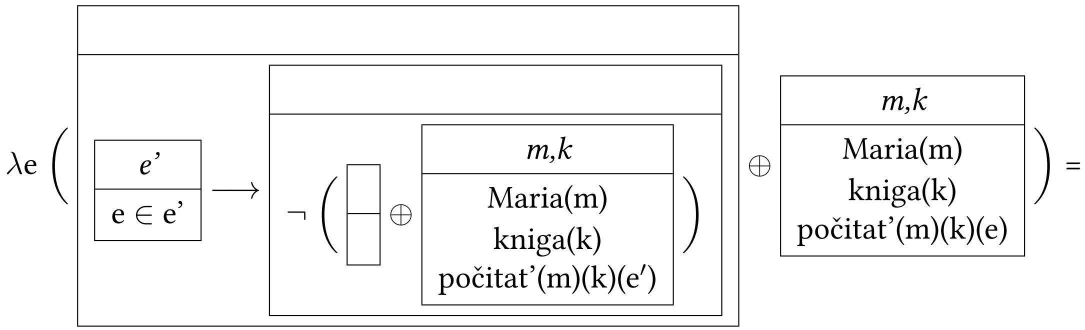
$$\left(\lambda Q\left(\left[\begin{array}{c} t_{top},\, t_{ut} \\ \hline t_{top} < t_{ut}\end{array}\right) \oplus Q(t_{top})\right)\right)\left(\lambda t_{top}\left(\left[\begin{array}{c} e \\ \hline \tau(e) \subseteq t_{top}\end{array}\right) \oplus \left[\begin{array}{c} m,d \\ \hline \text{Maria(m)} \\ \text{dver'(d)} \\ \text{prikryt'(m)(d)(e)}\end{array}\right)\right) =$$

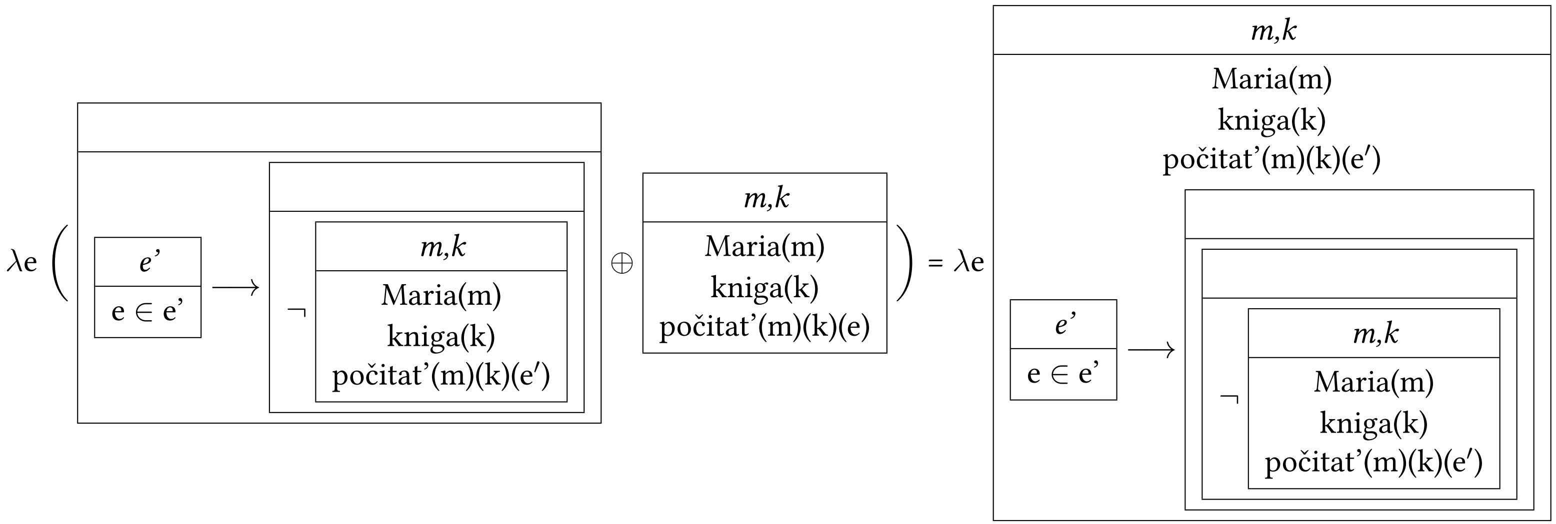

λQ
t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕ Q(t_{top})
λt_{top}
e, m, d
τ(e) ⊆ t_{top}
Maria(m)
dver'(d)
prikryt'(m)(d)(e)
=
(t_{top})
⊕

Annex 3: Example from Section 4.3 (eventuality with the delimitative reading)

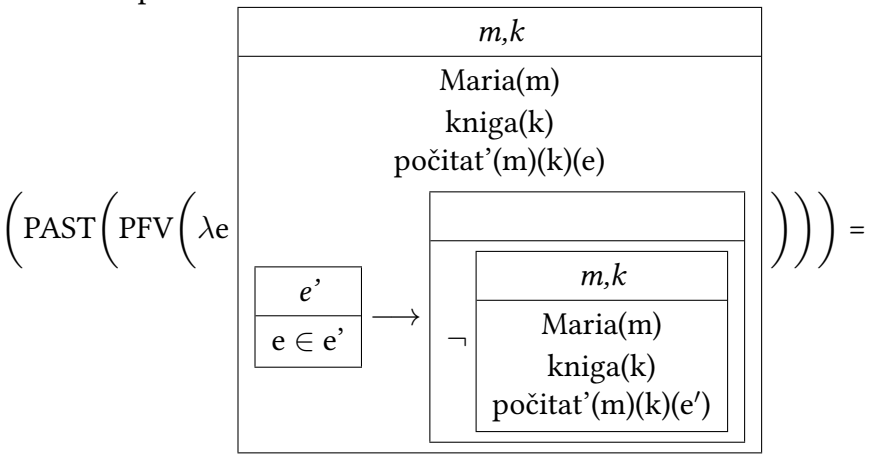
First step:

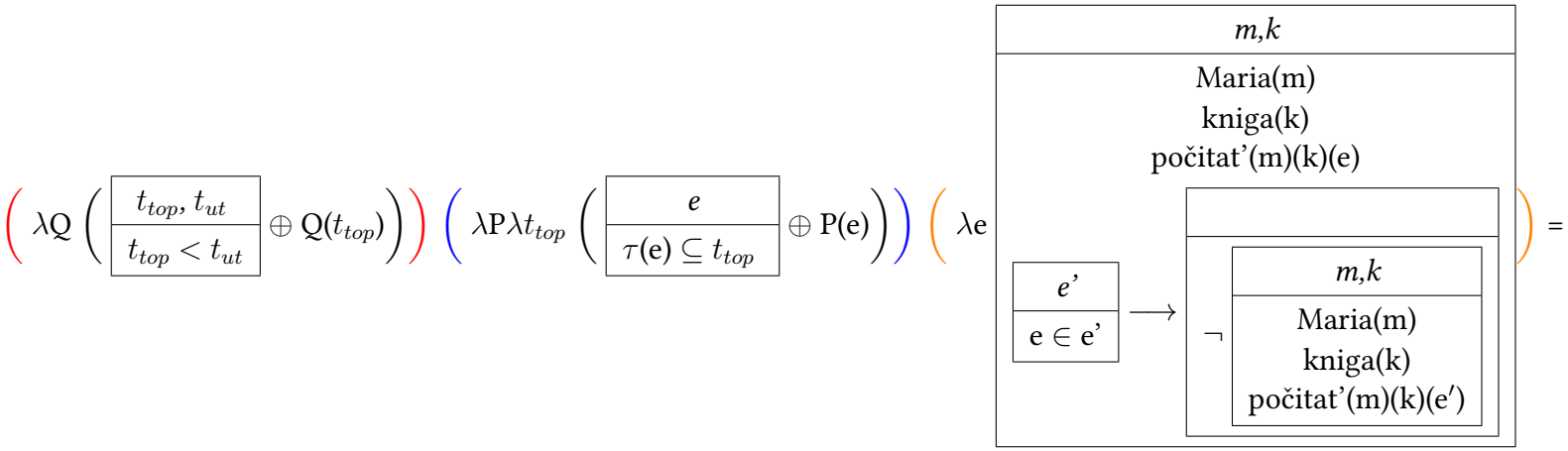



λe
e'
e ∈ e'
¬
m,k
Maria(m)
kniga(k)
počitat'(m)(k)(e')
⊕
m,k
Maria(m)
kniga(k)
počitat'(m)(k)(e)
=


λe
e'
e ∈ e'
¬
m,k
Maria(m)
kniga(k)
počitat'(m)(k)(e')
⊕
m,k
Maria(m)
kniga(k)
počitat'(m)(k)(e)
= λe
m,k
Maria(m)
kniga(k)
počitat'(m)(k)(e')
e'
e ∈ e'
¬
m,k
Maria(m)
kniga(k)
počitat'(m)(k)(e')

Second step:


m,k
Maria(m)
kniga(k)
počitat'(m)(k)(e)
PAST
PFV
λe
e'
e ∈ e'
¬
m,k
Maria(m)
kniga(k)
počitat'(m)(k)(e')
=


λQ
t_top, t_ut
t_top < t_ut
⊕ Q(t_top)
λPλt_top
e
τ(e) ⊆ t_top
⊕ P(e)
λe
m,k
Maria(m)
kniga(k)
počitat'(m)(k)(e)
e'
e ∈ e'
¬
m,k
Maria(m)
kniga(k)
počitat'(m)(k)(e')
=

$$\left(\lambda Q \left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline \end{array} \oplus Q(t_{top}) \right)\right) \left(\lambda t_{top} \left(\begin{array}{|c|}\hline e \\ \hline \tau(\text{e}) \subseteq t_{top} \\ \hline \end{array} \oplus \left(\lambda \text{e} \begin{array}{|c|}\hline m,k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{počitat'(m)(k)(e)} \\ \begin{array}{|c|}\hline e' \\ \hline \text{e} \in \text{e'} \\ \hline \end{array} \longrightarrow \begin{array}{|c|}\hline \\ \hline \neg \begin{array}{|c|}\hline m,k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{počitat'(m)(k)(e}'\text{)} \\ \hline \end{array} \\ \hline \end{array} \\ \hline \end{array} \right)(\text{e}) \right)\right) =$$

$$\left(\lambda Q \left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline \end{array} \oplus Q(t_{top}) \right)\right) \left(\lambda t_{top} \left(\begin{array}{|c|}\hline e \\ \hline \tau(\text{e}) \subseteq t_{top} \\ \hline \end{array} \oplus \begin{array}{|c|}\hline m,k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{počitat'(m)(k)(e)} \\ \begin{array}{|c|}\hline e' \\ \hline \text{e} \in \text{e'} \\ \hline \end{array} \longrightarrow \begin{array}{|c|}\hline \\ \hline \neg \begin{array}{|c|}\hline m,k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{počitat'(m)(k)(e}'\text{)} \\ \hline \end{array} \\ \hline \end{array} \\ \hline \end{array} \right)\right) =$$

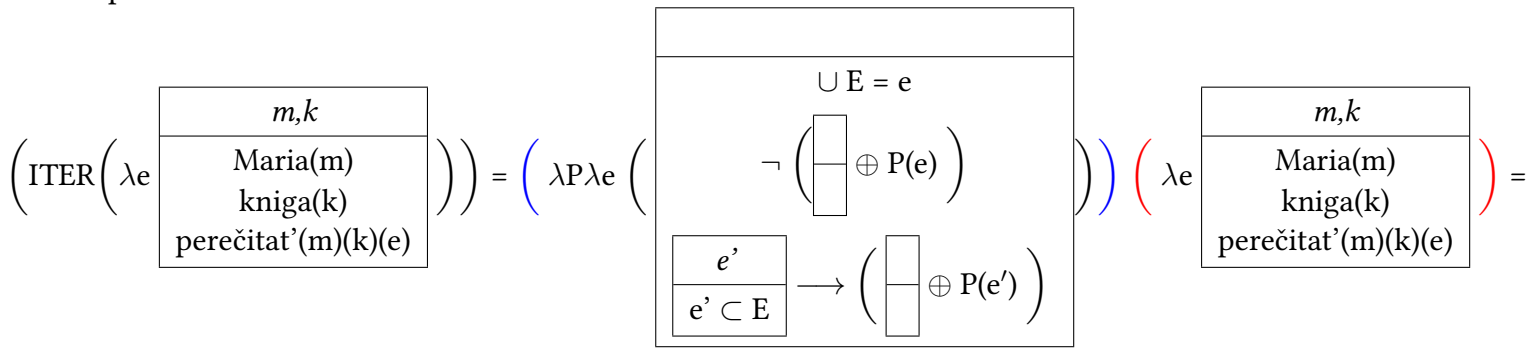
$$\left(\lambda Q\left(\begin{array}{|c|}\hline t_{top}, t_{ut}\\\hline t_{top} < t_{ut}\\\hline\end{array} \oplus Q(t_{top})\right)\right)\left(\lambda t_{top} \begin{array}{|c|}\hline \textit{e, m, k} \\\hline \tau(\text{e}) \subseteq t_{top} \\ \text{Maria(m)} \\ \text{kniga(k)} \\ \text{počitat'(m)(k)(e)} \\ \begin{array}{|c|}\hline \textit{e'} \\\hline \text{e} \in \text{e'} \\\hline\end{array} \longrightarrow \begin{array}{|c|}\hline \\\hline \neg \begin{array}{|c|}\hline \textit{m,k}\\\hline \text{Maria(m)}\\ \text{kniga(k)}\\ \text{počitat'(m)(k)(e')}\\\hline\end{array}\\\hline\end{array} \\\hline\end{array}\right) =$$

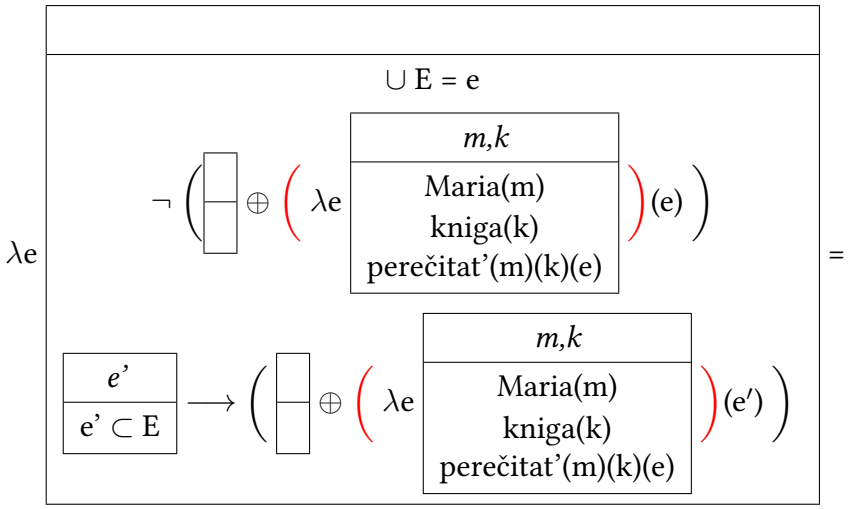
$$\left(\begin{array}{|c|}\hline t_{top}, t_{ut}\\\hline t_{top} < t_{ut}\\\hline\end{array} \oplus \left(\lambda t_{top} \begin{array}{|c|}\hline \textit{e, m, k} \\\hline \tau(\text{e}) \subseteq t_{top} \\ \text{Maria(m)} \\ \text{kniga(k)} \\ \text{počitat'(m)(k)(e)} \\ \begin{array}{|c|}\hline \textit{e'} \\\hline \text{e} \in \text{e'} \\\hline\end{array} \longrightarrow \begin{array}{|c|}\hline \\\hline \neg \begin{array}{|c|}\hline \textit{m,k}\\\hline \text{Maria(m)}\\ \text{kniga(k)}\\ \text{počitat'(m)(k)(e')}\\\hline\end{array}\\\hline\end{array} \\\hline\end{array} (t_{top})\right)\right) =$$

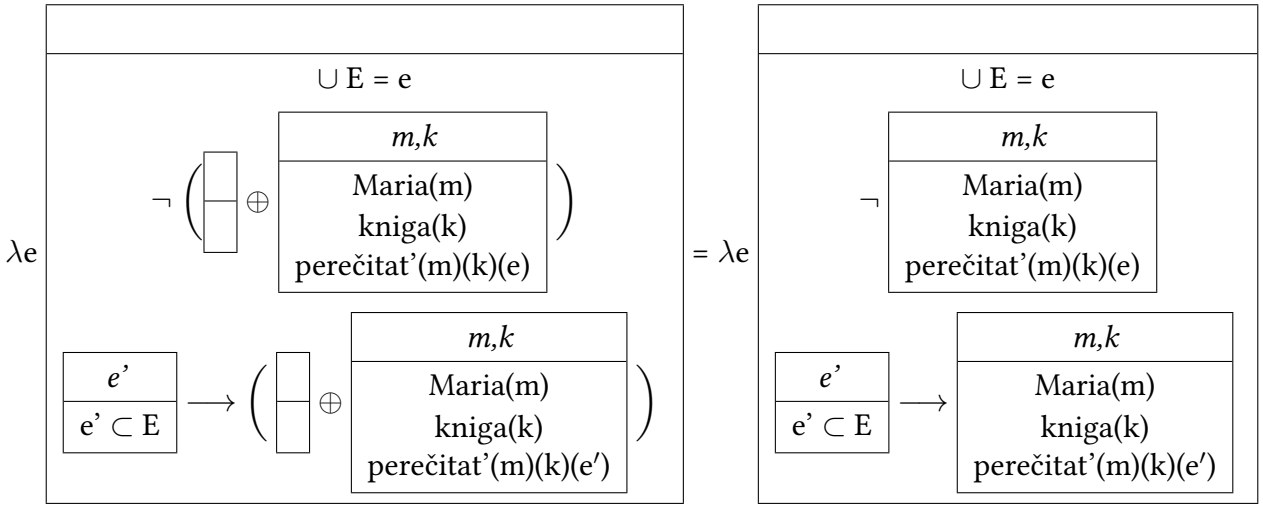
$$\left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline \end{array} \oplus \begin{array}{|c|}\hline e,\ m,\ k \\ \hline \tau(\text{e}) \subseteq t_{top} \\ \text{Maria(m)} \\ \text{kniga(k)} \\ \text{počitat'(m)(k)(e)} \\ \begin{array}{|c|}\hline e' \\ \hline \text{e} \in \text{e'} \\ \hline \end{array} \longrightarrow \begin{array}{|c|}\hline \\ \hline \neg \begin{array}{|c|}\hline m,k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{počitat'(m)(k)(e}') \\ \hline \end{array} \\ \hline \end{array} \\ \hline \end{array} \right) = \begin{array}{|c|}\hline t_{top},\ t_{ut},\ e,\ m,\ k \\ \hline t_{top} < t_{ut} \\ \tau(\text{e}) \subseteq t_{top} \\ \text{Maria(m)} \\ \text{kniga(k)} \\ \text{počitat'(m)(k)(e)} \\ \begin{array}{|c|}\hline e' \\ \hline \text{e} \in \text{e'} \\ \hline \end{array} \longrightarrow \begin{array}{|c|}\hline \\ \hline \neg \begin{array}{|c|}\hline m,k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{počitat'(m)(k)(e}') \\ \hline \end{array} \\ \hline \end{array} \\ \hline \end{array}$$

Annex 4: Example from Section 4.4 (eventuality with the repetitive reading)

First step:






λe
∪ E = e
¬
⊕
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e)
e'
e' ⊂ E
⟶
⊕
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e′)
= λe
∪ E = e
¬
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e)
e'
e' ⊂ E
⟶
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e′)

Second step:

$$\Big(\text{PAST}\Big(\text{PERF}\Big(\lambda e$$

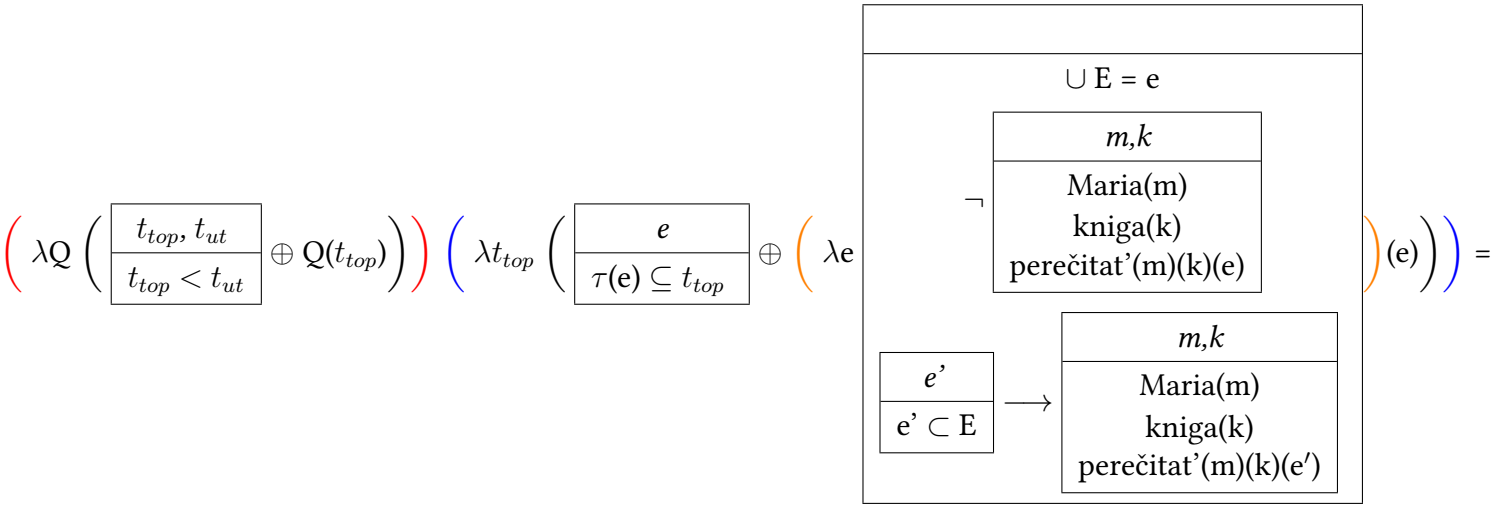
$\cup$ E = e
¬ [*m,k* | Maria(m), kniga(k), perečitat'(m)(k)(e)]
[*e'* | e' $\subset$ E] $\longrightarrow$ [*m,k* | Maria(m), kniga(k), perečitat'(m)(k)(e′)]

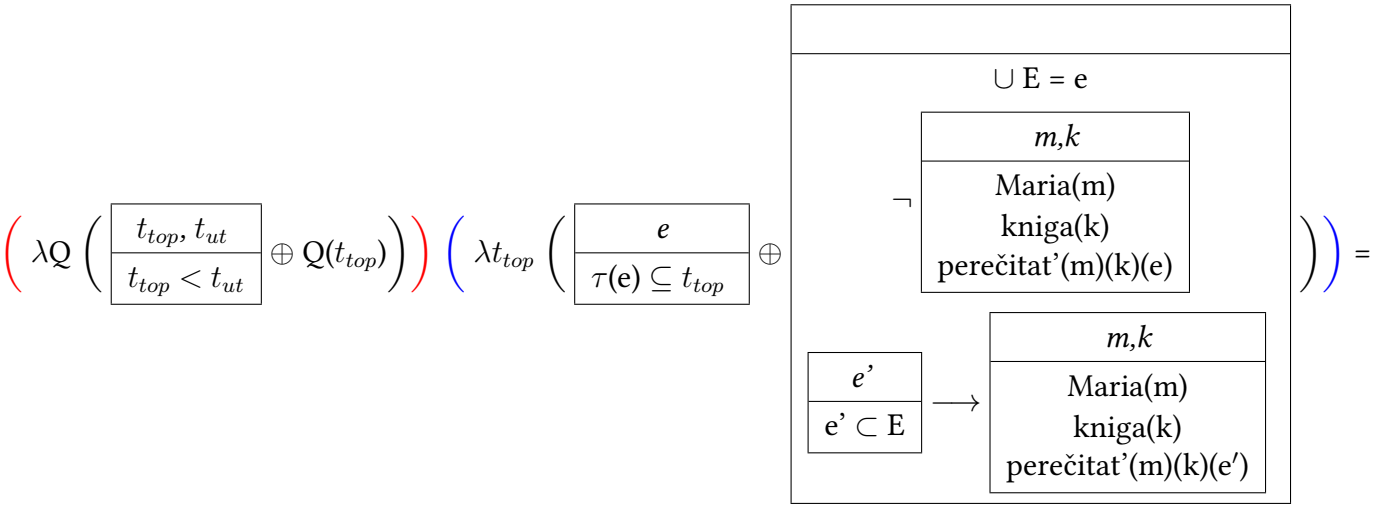
$$\Big)\Big)\Big) =$$

$$\Big(\lambda Q\Big(\boxed{t_{top},\, t_{ut} \mid t_{top} < t_{ut}} \oplus Q(t_{top})\Big)\Big)\Big(\lambda P \lambda t_{top}\Big(\boxed{e \mid \tau(e) \subseteq t_{top}} \oplus P(e)\Big)\Big)\Big(\lambda e$$

$\cup$ E = e
¬ [*m,k* | Maria(m), kniga(k), perečitat'(m)(k)(e)]
[*e'* | e' $\subset$ E] $\longrightarrow$ [*m,k* | Maria(m), kniga(k), perečitat'(m)(k)(e′)]

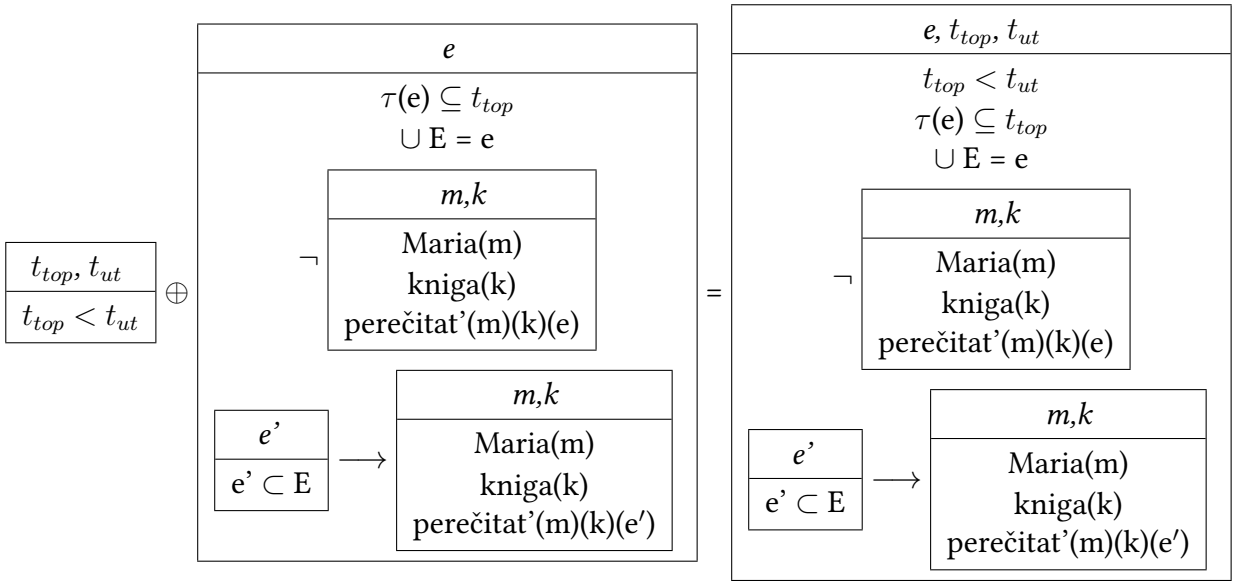
$$\Big) =$$


λQ
t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕ Q(t_{top})
λt_{top}
e
τ(e) ⊆ t_{top}
⊕
λe
∪ E = e
¬
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e)
e'
e' ⊂ E
⟶
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e′)
(e)
=


λQ
t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕ Q(t_{top})
λt_{top}
e
τ(e) ⊆ t_{top}
⊕
∪ E = e
¬
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e)
e'
e' ⊂ E
⟶
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e′)
=

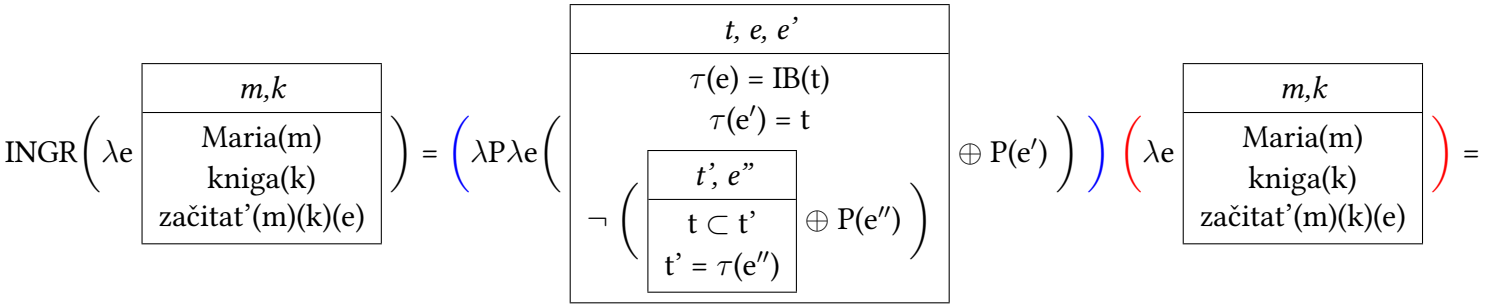
$$\lambda Q \left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline \end{array} \oplus Q(t_{top}) \right) \left(\lambda t_{top} \begin{array}{|c|}\hline e \\ \hline \tau(e) \subseteq t_{top} \\ \bigcup E = e \\ \neg \begin{array}{|c|}\hline m,k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{perečitat'(m)(k)(e)} \\ \hline \end{array} \\ \begin{array}{|c|}\hline e' \\ \hline e' \subset E \\ \hline \end{array} \longrightarrow \begin{array}{|c|}\hline m,k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{perečitat'(m)(k)(e')} \\ \hline \end{array} \\ \hline \end{array} \right) =$$

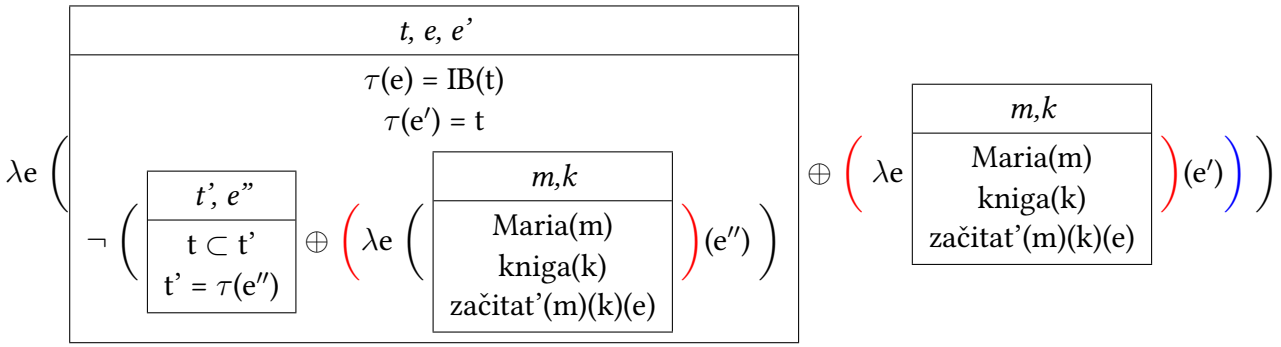
$$\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline \end{array} \oplus \left(\lambda t_{top} \begin{array}{|c|}\hline e \\ \hline \tau(e) \subseteq t_{top} \\ \bigcup E = e \\ \neg \begin{array}{|c|}\hline m,k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{perečitat'(m)(k)(e)} \\ \hline \end{array} \\ \begin{array}{|c|}\hline e' \\ \hline e' \subset E \\ \hline \end{array} \longrightarrow \begin{array}{|c|}\hline m,k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{perečitat'(m)(k)(e')} \\ \hline \end{array} \\ \hline \end{array} (t_{top}) \right) =$$

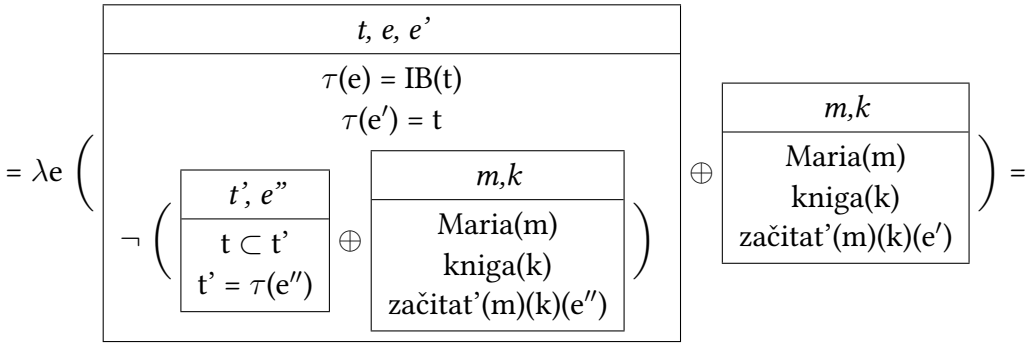

t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕
e
τ(e) ⊆ t_{top}
∪ E = e
¬
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e)
e'
e' ⊂ E
⟶
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e')
=
e, t_{top}, t_{ut}
$t_{top} < t_{ut}$
τ(e) ⊆ t_{top}
∪ E = e
¬
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e)
e'
e' ⊂ E
⟶
m,k
Maria(m)
kniga(k)
perečitat'(m)(k)(e')

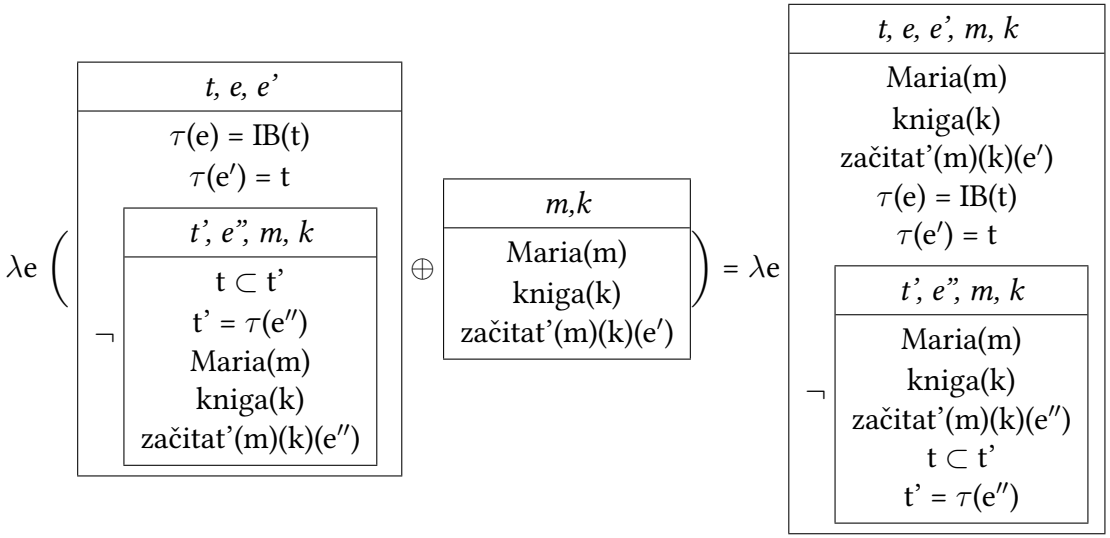
Annex 5: Example from Section 4.5 (eventuality with the ingressive reading)

First step:








t, e, e'
τ(e) = IB(t)
τ(e′) = t
t', e", m, k
t ⊂ t'
t' = τ(e″)
Maria(m)
kniga(k)
začitat'(m)(k)(e″)
m,k
Maria(m)
kniga(k)
začitat'(m)(k)(e′)
t, e, e', m, k
Maria(m)
kniga(k)
začitat'(m)(k)(e′)
τ(e) = IB(t)
τ(e′) = t
t', e", m, k
Maria(m)
kniga(k)
začitat'(m)(k)(e″)
t ⊂ t'
t' = τ(e″)

Second step:

$$\Big(\text{PAST}\ \Big(\text{PERF}\ \Big(\ \lambda e\ \Big|\ t, e, e', m, k\ \Big|\ \text{Maria(m)},\ \text{kniga(k)},\ \text{začitat'(m)(k)}(e'),\ \tau(e) = \text{IB(t)},\ \tau(e') = t,\ \neg\ \Big|\ t', e'', m, k\ \Big|\ \text{Maria(m)},\ \text{kniga(k)},\ \text{začitat'(m)(k)}(e''),\ t \subset t',\ t' = \tau(e'')\ \Big)\Big)\Big) =$$

$$\Big(\ \lambda Q\ \Big(\ \Big|\ t_{top}, t_{ut}\ \Big|\ t_{top} < t_{ut}\ \Big)\ \oplus\ Q(t_{top})\Big)\Big)\ \Big(\ \lambda P \lambda t_{top}\ \Big(\ \Big|\ e\ \Big|\ \tau(e) \subseteq t_{top}\ \Big)\ \oplus\ P(e)\Big)\Big)\ \Big(\ \lambda e\ \Big|\ t, e, e', m, k\ \Big|\ \text{Maria(m)},\ \text{kniga(k)},\ \text{začitat'(m)(k)}(e'),\ \tau(e) = \text{IB(t)},\ \tau(e') = t,\ \neg\ \Big|\ t', e'', m, k\ \Big|\ \text{Maria(m)},\ \text{kniga(k)},\ \text{začitat'(m)(k)}(e''),\ t \subset t',\ t' = \tau(e'')\ \Big)\ =$$

$$\left(\lambda Q \left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline \end{array} \oplus Q(t_{top}) \right)\right) \left(\lambda t_{top} \left(\begin{array}{|c|}\hline e \\ \hline \tau(\text{e}) \subseteq t_{top} \\ \hline \end{array} \oplus \left(\lambda \text{e} \begin{array}{|c|}\hline t, e, e', m, k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{začitat'(m)(k)(e}') \\ \tau(\text{e}) = \text{IB(t)} \\ \tau(\text{e}') = \text{t} \\ \neg \begin{array}{|c|}\hline t', e'', m, k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{začitat'(m)(k)(e}'') \\ \text{t} \subset \text{t'} \\ \text{t'} = \tau(\text{e}'') \\ \hline \end{array} \\ \hline \end{array} \right)(\text{e}) \right)\right) =$$

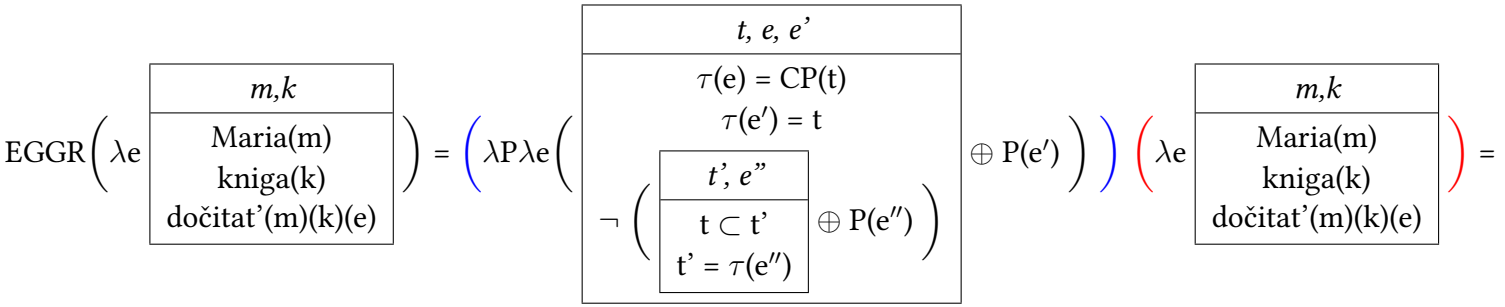
$$\left(\lambda Q \left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline \end{array} \oplus Q(t_{top}) \right)\right) \left(\lambda t_{top} \left(\begin{array}{|c|}\hline e \\ \hline \tau(\text{e}) \subseteq t_{top} \\ \hline \end{array} \oplus \begin{array}{|c|}\hline t, e, e', m, k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{začitat'(m)(k)(e}') \\ \tau(\text{e}) = \text{IB(t)} \\ \tau(\text{e}') = \text{t} \\ \neg \begin{array}{|c|}\hline t', e'', m, k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{začitat'(m)(k)(e}'') \\ \text{t} \subset \text{t'} \\ \text{t'} = \tau(\text{e}'') \\ \hline \end{array} \\ \hline \end{array} \right)\right) =$$

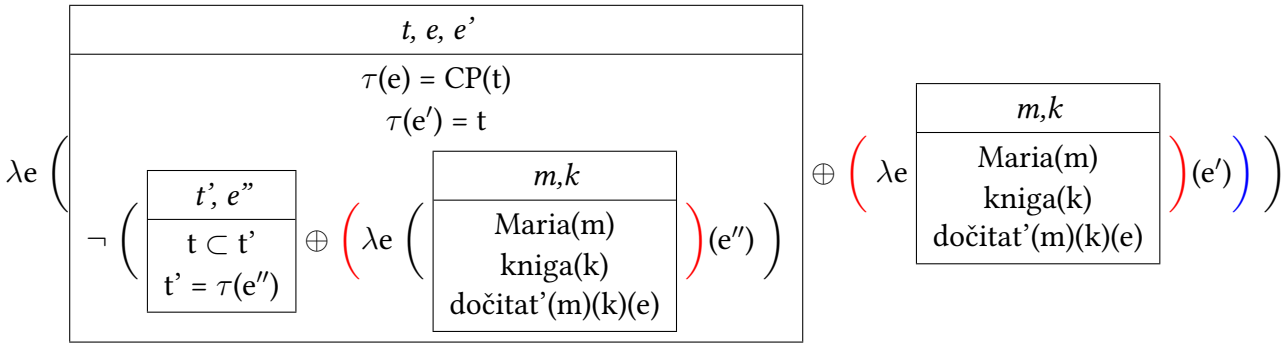
$$\left(\lambda Q\left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline\end{array} \oplus Q(t_{top})\right)\right)\left(\lambda t_{top}\ \begin{array}{|c|}\hline t, e, e', m, k \\ \hline \tau(e) \subseteq t_{top} \\ \text{Maria}(m) \\ \text{kniga}(k) \\ \text{začitat'}(m)(k)(e') \\ \tau(e) = \text{IB}(t) \\ \tau(e') = t \\ \neg \begin{array}{|c|}\hline t', e'', m, k \\ \hline \text{Maria}(m) \\ \text{kniga}(k) \\ \text{začitat'}(m)(k)(e'') \\ t \subset t' \\ t' = \tau(e'') \\ \hline\end{array} \\ \hline\end{array}\right) = \left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline\end{array} \oplus \left(\lambda t_{top}\ \begin{array}{|c|}\hline t, e, e', m, k \\ \hline \tau(e) \subseteq t_{top} \\ \text{Maria}(m) \\ \text{kniga}(k) \\ \text{začitat'}(m)(k)(e') \\ \tau(e) = \text{IB}(t) \\ \tau(e') = t \\ \neg \begin{array}{|c|}\hline t', e'', m, k \\ \hline \text{Maria}(m) \\ \text{kniga}(k) \\ \text{začitat'}(m)(k)(e'') \\ t \subset t' \\ t' = \tau(e'') \\ \hline\end{array} \\ \hline\end{array}\right)(t_{top})\right) =$$

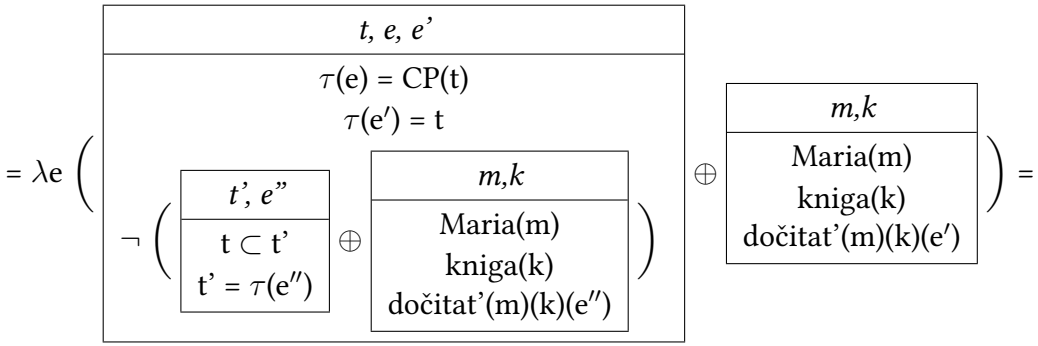
$$\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline\end{array} \oplus \begin{array}{|c|}\hline t, e, e', m, k \\ \hline \tau(e) \subseteq t_{top} \\ \text{Maria}(m) \\ \text{kniga}(k) \\ \text{začitat'}(m)(k)(e') \\ \tau(e) = \text{IB}(t) \\ \tau(e') = t \\ \neg \begin{array}{|c|}\hline t', e'', m, k \\ \hline \text{Maria}(m) \\ \text{kniga}(k) \\ \text{začitat'}(m)(k)(e'') \\ t \subset t' \\ t' = \tau(e'') \\ \hline\end{array} \\ \hline\end{array} = \begin{array}{|c|}\hline t_{top}, t_{ut}, t, e, e', m, k \\ \hline t_{top} < t_{ut} \\ \tau(e) \subseteq t_{top} \\ \text{Maria}(m) \\ \text{kniga}(k) \\ \text{začitat'}(m)(k)(e') \\ \tau(e) = \text{IB}(t) \\ \tau(e') = t \\ \neg \begin{array}{|c|}\hline t', e'', m, k \\ \hline \text{Maria}(m) \\ \text{kniga}(k) \\ \text{začitat'}(m)(k)(e'') \\ t \subset t' \\ t' = \tau(e'') \\ \hline\end{array} \\ \hline\end{array}$$

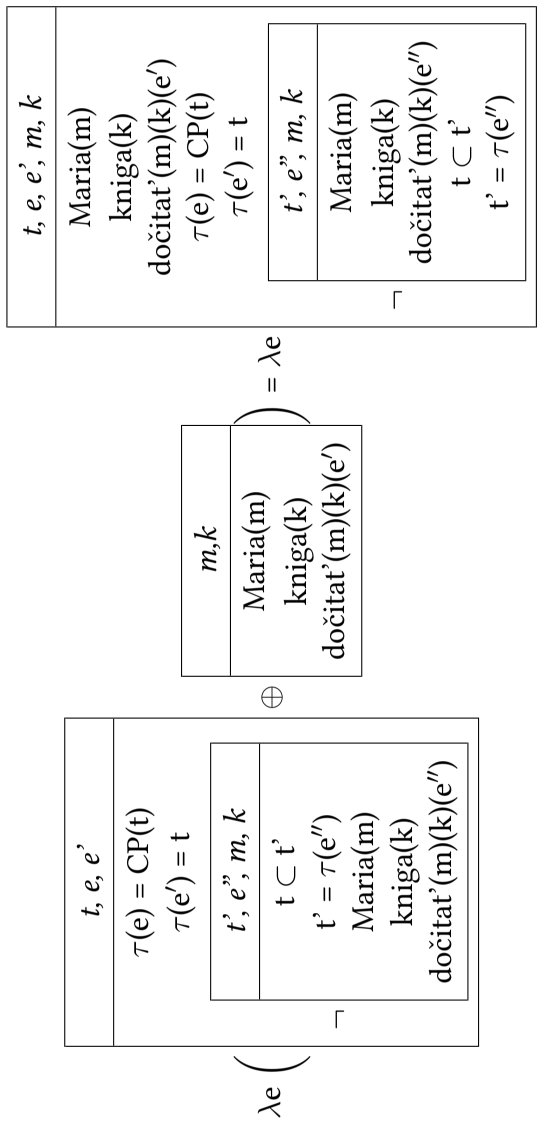
Annex 6: Example from Section 4.6 (eventuality with the eggressive reading)

First step:








λe
t, e, e'
τ(e) = CP(t)
τ(e') = t
t', e'', m, k
t ⊂ t'
t' = τ(e'')
Maria(m)
kniga(k)
dočitat'(m)(k)(e'')
⊕
m,k
Maria(m)
kniga(k)
dočitat'(m)(k)(e')
= λe
t, e, e', m, k
Maria(m)
kniga(k)
dočitat'(m)(k)(e')
τ(e) = CP(t)
τ(e') = t
t', e'', m, k
Maria(m)
kniga(k)
dočitat'(m)(k)(e'')
t ⊂ t'
t' = τ(e'')

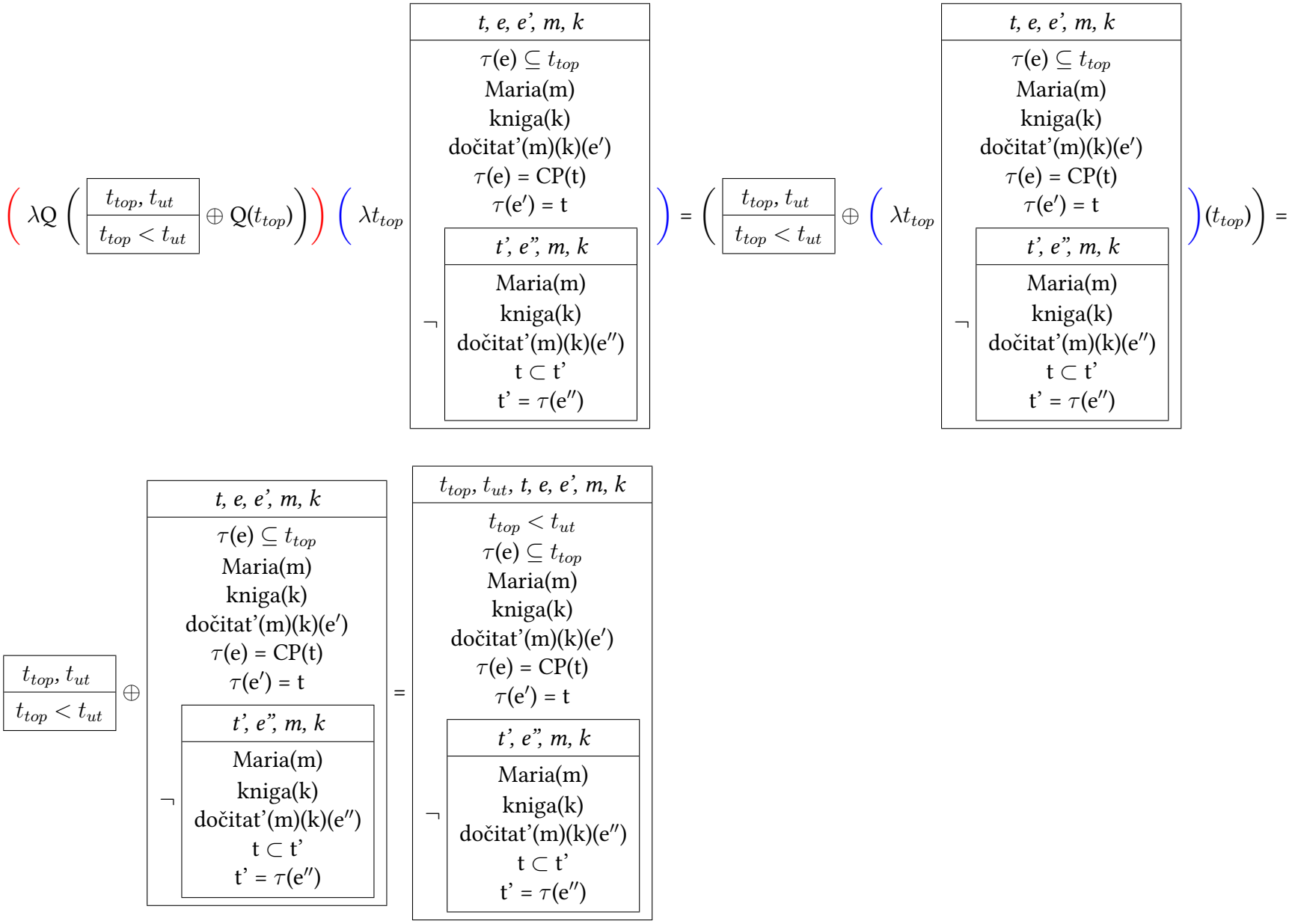
Second step:

$$\left(\text{PAST}\left(\text{PERF}\left(\lambda e \;\boxed{\begin{array}{c} t,\ e,\ e',\ m,\ k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{dočitat'(m)(k)(e')} \\ \tau(e) = \text{CP(t)} \\ \tau(e') = t \\ \neg\ \boxed{\begin{array}{c} t',\ e'',\ m,\ k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{dočitat'(m)(k)(e'')} \\ t \subset t' \\ t' = \tau(e'') \end{array}} \end{array}}\right)\right)\right) =$$

$$\left(\lambda Q\left(\boxed{\begin{array}{c} t_{top},\ t_{ut} \\ \hline t_{top} < t_{ut} \end{array}} \oplus Q(t_{top})\right)\right)\left(\lambda P \lambda t_{top}\left(\boxed{\begin{array}{c} e \\ \hline \tau(e) \subseteq t_{top} \end{array}} \oplus P(e)\right)\right)\left(\lambda e \;\boxed{\begin{array}{c} t,\ e,\ e',\ m,\ k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{dočitat'(m)(k)(e')} \\ \tau(e) = \text{CP(t)} \\ \tau(e') = t \\ \neg\ \boxed{\begin{array}{c} t',\ e'',\ m,\ k \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{dočitat'(m)(k)(e'')} \\ t \subset t' \\ t' = \tau(e'') \end{array}} \end{array}}\right) =$$

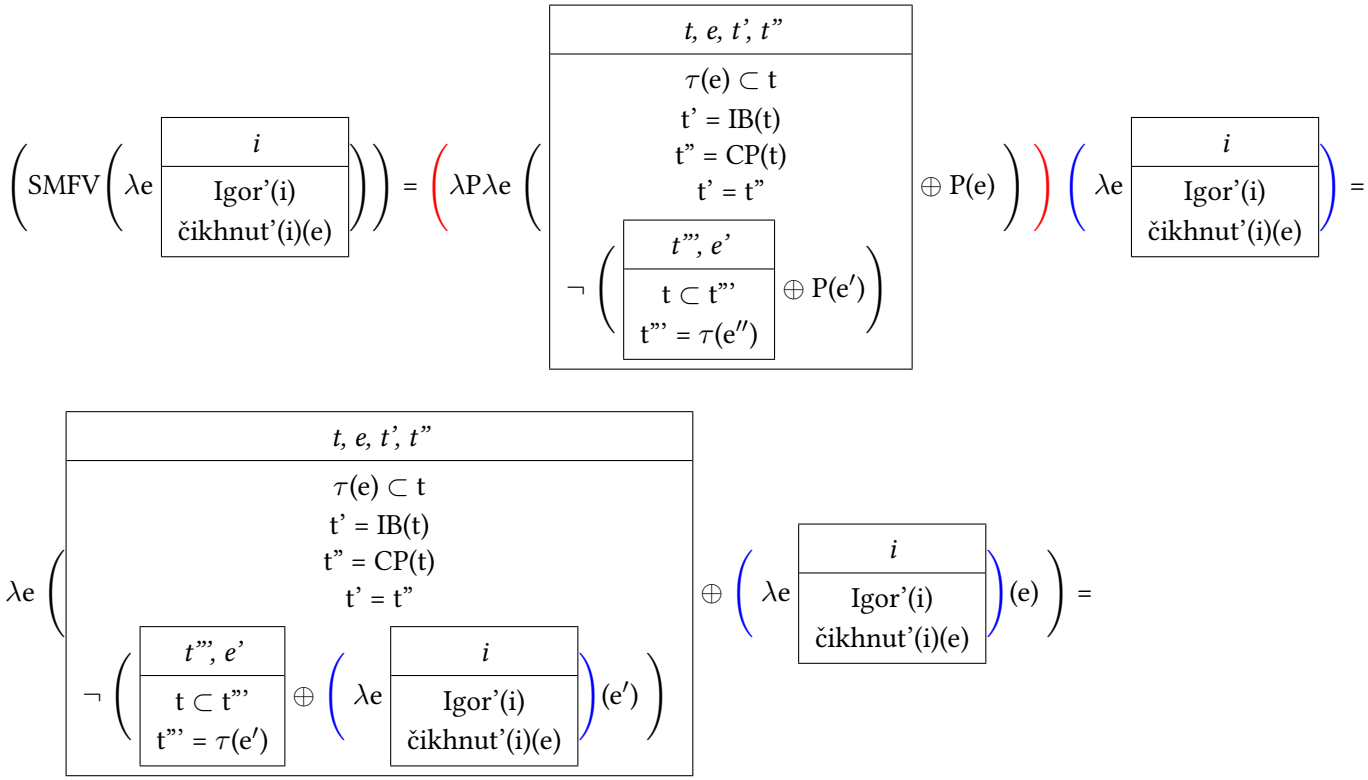
$$\left(\lambda Q\left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline\end{array} \oplus Q(t_{top})\right)\right)\left(\lambda t_{top}\left(\begin{array}{|c|}\hline e \\ \hline \tau(\text{e}) \subseteq t_{top} \\ \hline\end{array} \oplus \left(\lambda \text{e} \begin{array}{|c|}\hline \textit{t, e, e', m, k} \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{dočitat'(m)(k)(e}'\text{)} \\ \tau(\text{e}) = \text{CP(t)} \\ \tau(\text{e}') = \text{t} \\ \neg \begin{array}{|c|}\hline \textit{t', e'', m, k} \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{dočitat'(m)(k)(e}''\text{)} \\ \text{t} \subset \text{t'} \\ \text{t'} = \tau(\text{e}'') \\ \hline\end{array} \\ \hline\end{array}\right)(\text{e})\right)\right) =$$

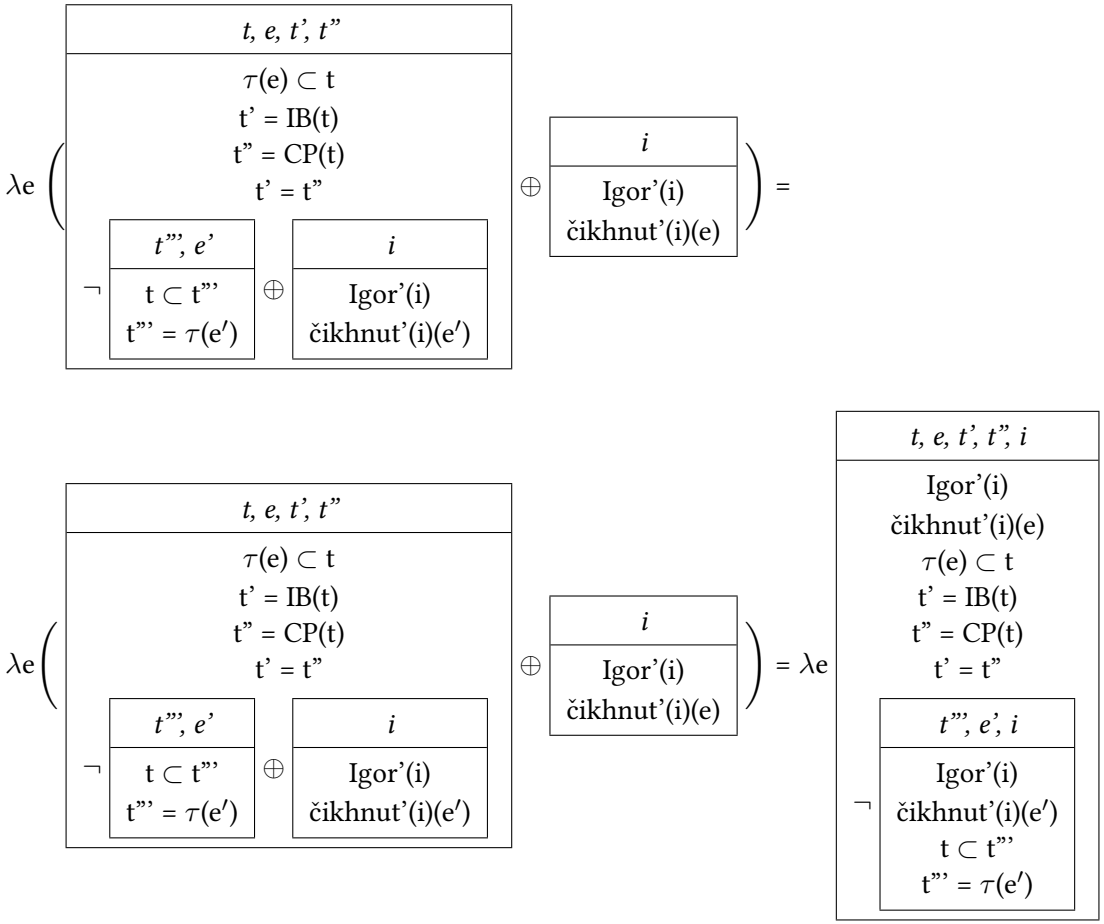
$$\left(\lambda Q\left(\begin{array}{|c|}\hline t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \\ \hline\end{array} \oplus Q(t_{top})\right)\right)\left(\lambda t_{top}\left(\begin{array}{|c|}\hline e \\ \hline \tau(\text{e}) \subseteq t_{top} \\ \hline\end{array} \oplus \begin{array}{|c|}\hline \textit{t, e, e', m, k} \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{dočitat'(m)(k)(e}'\text{)} \\ \tau(\text{e}) = \text{CP(t)} \\ \tau(\text{e}') = \text{t} \\ \neg \begin{array}{|c|}\hline \textit{t', e'', m, k} \\ \hline \text{Maria(m)} \\ \text{kniga(k)} \\ \text{dočitat'(m)(k)(e}''\text{)} \\ \text{t} \subset \text{t'} \\ \text{t'} = \tau(\text{e}'') \\ \hline\end{array} \\ \hline\end{array}\right)\right) =$$


λQ
t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕ Q(t_{top})
λt_{top}
t, e, e', m, k
τ(e) ⊆ t_{top}
Maria(m)
kniga(k)
dočitat'(m)(k)(e′)
τ(e) = CP(t)
τ(e′) = t
¬
t', e", m, k
Maria(m)
kniga(k)
dočitat'(m)(k)(e″)
t ⊂ t'
t' = τ(e″)
=
t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕
λt_{top}
t, e, e', m, k
τ(e) ⊆ t_{top}
Maria(m)
kniga(k)
dočitat'(m)(k)(e′)
τ(e) = CP(t)
τ(e′) = t
¬
t', e", m, k
Maria(m)
kniga(k)
dočitat'(m)(k)(e″)
t ⊂ t'
t' = τ(e″)
(t_{top}) =
t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕
t, e, e', m, k
τ(e) ⊆ t_{top}
Maria(m)
kniga(k)
dočitat'(m)(k)(e′)
τ(e) = CP(t)
τ(e′) = t
¬
t', e", m, k
Maria(m)
kniga(k)
dočitat'(m)(k)(e″)
t ⊂ t'
t' = τ(e″)
=
t_{top}, t_{ut}, t, e, e', m, k
$t_{top} < t_{ut}$
τ(e) ⊆ t_{top}
Maria(m)
kniga(k)
dočitat'(m)(k)(e′)
τ(e) = CP(t)
τ(e′) = t
¬
t', e", m, k
Maria(m)
kniga(k)
dočitat'(m)(k)(e″)
t ⊂ t'
t' = τ(e″)

Annex 7: Example from Section 4.7 (eventuality with the semelfactive reading)

Step 1



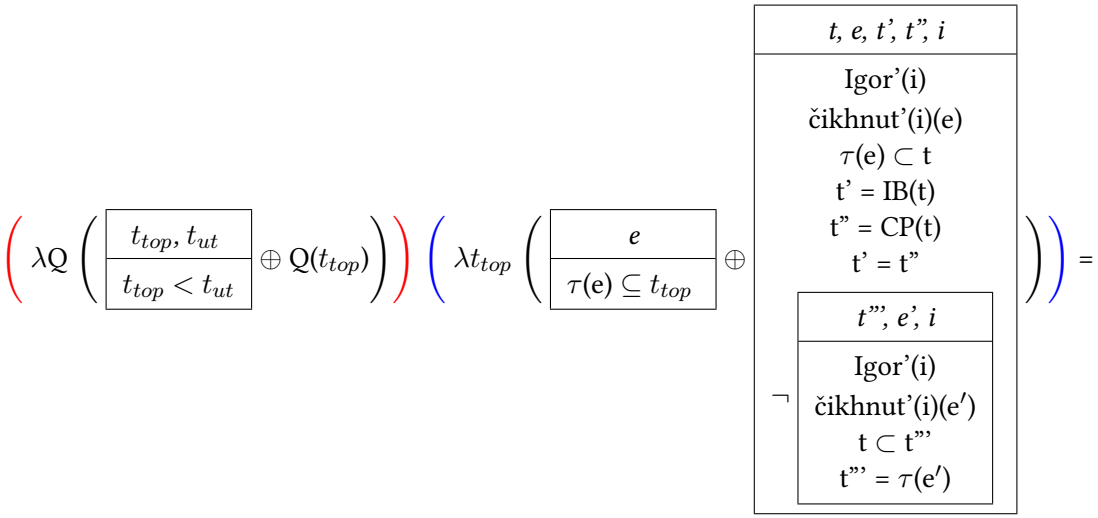

t, e, t', t''
τ(e) ⊂ t
t' = IB(t)
t'' = CP(t)
t' = t''
t''', e'
t ⊂ t'''
t''' = τ(e')
i
Igor'(i)
čikhnut'(i)(e')
i
Igor'(i)
čikhnut'(i)(e)
λe
⊕
¬
=
t, e, t', t'', i
Igor'(i)
čikhnut'(i)(e)
τ(e) ⊂ t
t' = IB(t)
t'' = CP(t)
t' = t''
t''', e', i
Igor'(i)
čikhnut'(i)(e')
t ⊂ t'''
t''' = τ(e')

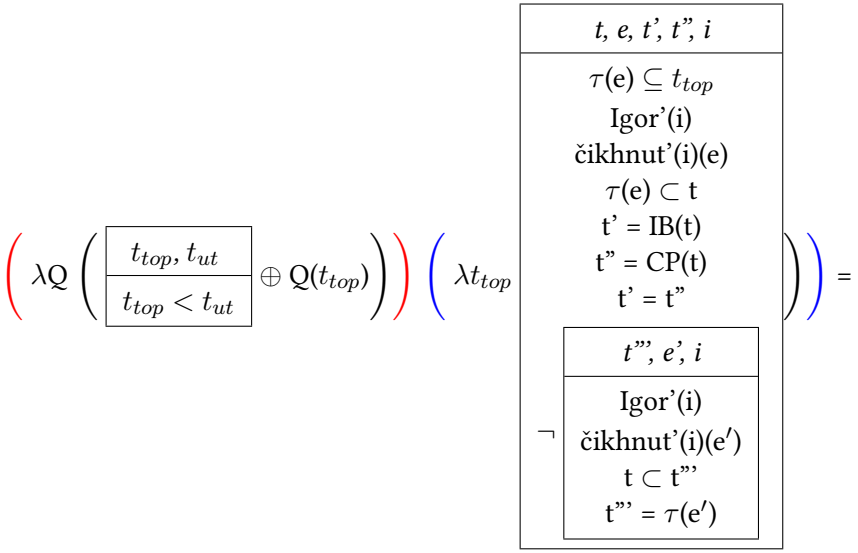
Step 2

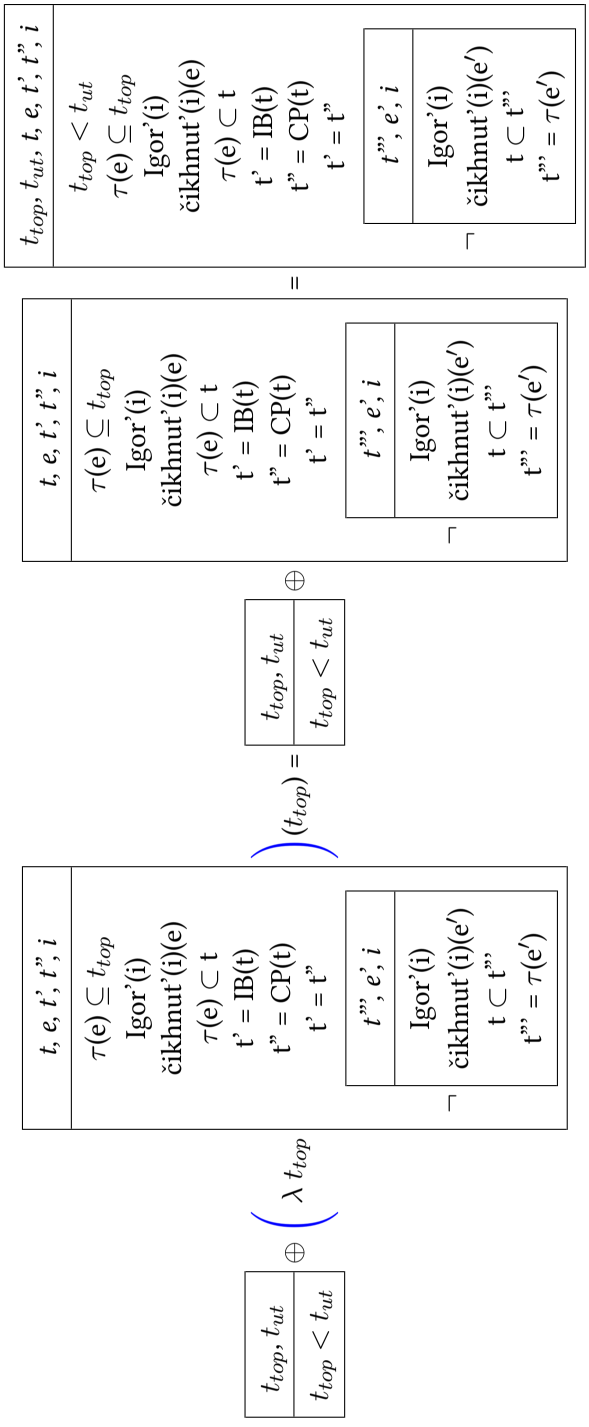
$$\left(\text{PAST}\left(\text{PFV}\left(\lambda e\ \boxed{\begin{array}{l} t, e, t', t'', i \\ \hline \text{Igor'(i)} \\ \text{čikhnut'(i)(e)} \\ \tau(e) \subset t \\ t' = \text{IB}(t) \\ t'' = \text{CP}(t) \\ t' = t'' \\ \hline \neg\ \boxed{\begin{array}{l} t''', e', i \\ \hline \text{Igor'(i)} \\ \text{čikhnut'(i)}(e') \\ t \subset t''' \\ t''' = \tau(e') \end{array}} \end{array}}\right)\right)\right) = \left(\lambda Q\left(\boxed{\begin{array}{l} t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \end{array}} \oplus Q(t_{top})\right)\right)\left(\lambda P \lambda t_{top}\left(\boxed{\begin{array}{l} e \\ \hline \tau(e) \subseteq t_{top} \end{array}} \oplus P(e)\right)\right)\left(\lambda e\ \boxed{\begin{array}{l} t, e, t', t'', i \\ \hline \text{Igor'(i)} \\ \text{čikhnut'(i)(e)} \\ \tau(e) \subset t \\ t' = \text{IB}(t) \\ t'' = \text{CP}(t) \\ t' = t'' \\ \hline \neg\ \boxed{\begin{array}{l} t''', e', i \\ \hline \text{Igor'(i)} \\ \text{čikhnut'(i)}(e') \\ t \subset t''' \\ t''' = \tau(e') \end{array}} \end{array}}\right)$$

=

$$\left(\lambda Q\left(\boxed{\begin{array}{l} t_{top}, t_{ut} \\ \hline t_{top} < t_{ut} \end{array}} \oplus Q(t_{top})\right)\right)\left(\lambda\, t_{top}\left(\boxed{\begin{array}{l} e \\ \hline \tau(e) \subseteq t_{top} \end{array}} \oplus \left(\lambda e\ \boxed{\begin{array}{l} t, e, t', t'', i \\ \hline \text{Igor'(i)} \\ \text{čikhnut'(i)(e)} \\ \tau(e) \subset t \\ t' = \text{IB}(t) \\ t'' = \text{CP}(t) \\ t' = t'' \\ \hline \neg\ \boxed{\begin{array}{l} t''', e', i \\ \hline \text{Igor'(i)} \\ \text{čikhnut'(i)}(e') \\ t \subset t''' \\ t''' = \tau(e') \end{array}} \end{array}}\right)(e)\right)\right) =$$


λQ
t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕ Q(t_{top})
λt_{top}
e
τ(e) ⊆ t_{top}
⊕
t, e, t', t'', i
Igor'(i)
čikhnut'(i)(e)
τ(e) ⊂ t
t' = IB(t)
t'' = CP(t)
t' = t''
¬
t''', e', i
Igor'(i)
čikhnut'(i)(e′)
t ⊂ t'''
t''' = τ(e′)
=


λQ
t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕ Q(t_{top})
λt_{top}
t, e, t', t'', i
τ(e) ⊆ t_{top}
Igor'(i)
čikhnut'(i)(e)
τ(e) ⊂ t
t' = IB(t)
t'' = CP(t)
t' = t''
¬
t''', e', i
Igor'(i)
čikhnut'(i)(e′)
t ⊂ t'''
t''' = τ(e′)
=


t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕
λ t_{top}
t, e, t', t'', i
τ(e) ⊆ t_{top}
Igor'(i)
čikhnut'(i)(e)
τ(e) ⊂ t
t' = IB(t)
t'' = CP(t)
t' = t''
t''', e', i
Igor'(i)
čikhnut'(i)(e′)
t ⊂ t'''
t''' = τ(e′)
(t_{top}) =
t_{top}, t_{ut}
$t_{top} < t_{ut}$
⊕
t, e, t', t'', i
τ(e) ⊆ t_{top}
Igor'(i)
čikhnut'(i)(e)
τ(e) ⊂ t
t' = IB(t)
t'' = CP(t)
t' = t''
t''', e', i
Igor'(i)
čikhnut'(i)(e′)
t ⊂ t'''
t''' = τ(e′)
=
t_{top}, t_{ut}, t, e, t', t'', i
$t_{top} < t_{ut}$
τ(e) ⊆ t_{top}
Igor'(i)
čikhnut'(i)(e)
τ(e) ⊂ t
t' = IB(t)
t'' = CP(t)
t' = t''
t''', e', i
Igor'(i)
čikhnut'(i)(e′)
t ⊂ t'''
t''' = τ(e′)

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Düsseldorf, 25.05.2016