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Coupling conceptual modeling and rules for the annotation of dramatic media

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Abstract. In this paper, we describe a semantic system for the representation and reasoning on drama features. The system builds upon an ontological module, used for representing the foundational structures of the drama and its characterizing features such as emotions and values, and is implemented as a rule layer operating, for reasoning purposes, on such module. The general goal of the system is to enrich the representation of drama in various ways, geared to specific tasks that range from emotion-based search of annotated drama corpora and retrieval to visualization of drama structures.

The paper describes the model of drama, encoded in the ontological model, and the rule models that form the reasoning layer. In order to validate the model and the enrichment operated by the rule layer, a well knows drama excerpt is employed as golden standard in a qualitative evaluation conducted by an expert to assess the expressiveness of the model for the drama domain, and to assess the validity of the enrichment.

Keywords: drama ontology, SWRL rules, semantic annotation

1. Introduction

The exponential spread of drama (and dramatic stories) in contemporary culture has led Esslin [32] to forge the definition of "dramatic media", i.e. media that display characters performing live actions, such as theatre, cinema and videogames. The notion of drama, traditionally acknowledged by studies in all disciplinary fields, ranging from literary criticism [40] and semiotics [77], to aesthetics [13] and psychology [11], has been boosted, over the last decade, by the advent of digitalization and new media, with dramatic media objects shared by the users of social networks. Drama permeates fan-fiction, amateur and traditional audiovisual production, docu-fiction, digitalized contents, etc., thus setting the need for indexing and search tools especially geared to dramatic contents. In addition, new forms of drama have leveraged a number of AI techniques, with the devise of machine readable representations of drama and the automation of a number of dramatic functions [61,75,90,79]. Finally, the quest for the massive access to digital (dramatic) media has spawned the issue of the metadata annotation, which is necessary for the indexing, retrieval, and presentation of media items, with the appearance of models and

applications in both the research and production communities [31,58,55]

The scenario depicted above advocates a carefully designed and theoretically sound model of drama, valid across different genres and media types. This paper addresses the application of ontological representation and reasoning to formalize the dramatic qualities of media objects. We describe a formal ontology of the drama domain and its integration with a rule layer (based on DL-safe SRWL rules), which provides further automatic reasoning over the conceptual structure encoded in the ontology. After a semi–automatic process of metadata annotation, realized through an annotation profile developed from the conceptual ontology, the rule layer augments the representation by introducing further dramatic qualities through reasoning. The process is realized through a framework, that is also implemented as a web–based platform for the annotation of dramatic media [58].

In particular, the rule layer addresses two specific tasks related with the analysis of drama, i.e., the representation of the actional structure underlying the plot, and the character's emotional states accompanying its unfolding. These two tasks, intrinsically relevant for drama indexing, manipulation and presentation, both rely on the drama model encoded in the ontology. They have been selected with the research goal of assessing the use of the ontology as the pivot of a modular framework where different rule sets are employed on annotated drama objects to enrich their representation.

As a running example, we employ a paradigmatic and well known drama (the so called "nunnery scene" of Shakespeare's Hamlet) throughout the paper to show how the framework components are integrated to provide a rich representation of drama features.

The structure of the paper is the following: Sections 2 and 3 survey the major facts about the domain of drama and the related work in drama formalization, respectively. In Section 4 we provide an overview of the whole framework, that includes the conceptual model of drama and the rule layer. Section 5 describes the conceptual ontology, with a thorough account of how its commitments are rooted in the literature on drama described in Section 2. Section 6 describes the rule layer, with Sections 6.1 and 6.2 devoted, respectively, to their two modules. The evaluation (Section 7) concludes the paper.

2. The Domain of Drama

Drama has been largely discussed as cultural object in its historical and stylistic development [12]. Here we discuss drama from the technical point of view; in other words, we pay attention to the craftsmanship behind the standard production of drama rather than the excellence of a specific author. Standard drama can be summarized as a group of specific features, that can be defined more or less precisely. These features refer to the identifiable elements in Shakespeare's *Romeo and Juliet* as well as in Tom Stoppard's *Rosencrantz and Guildenstern Are Dead*, in the HBO's *Sopranos* and even in some reality show, such as CBS's *Survivors*, and, finally, in some famous videogame such as Rockstar Games' *L.A. Noir* or Ubisoft's *Assassin Creeds*' series.

The fruition of drama mostly focuses on *enjoying* the *story* rather than appreciating the aesthetic features, although the latter are appraised by professionals and knowledgeable users. In fact, it is well known that in dramatic media the audience is engaged by the character's behavior rather than by the literary values. Almost all the repositories of drama and movies hold a synopsis of the story for each of the listed items (see, e.g., the Internet Movie Data Base[1]). The notion of "story" is widely acknowledged as the construction of an incident sequence [8], that, abstracting from the cinematographic properties, is motivated by the cause–effect chain [80]; this chain results from a complex interplay of agents, events, and environments, well known in playwriting techniques [25]. Elam names the notion of story as *fabula*, an abstraction of the *sujzet*/plot [29, p. 120]; Pfister concludes that

> a number of different dramatic texts can be based on one and the same story and also that the same story may even be presented as texts in different media [72, p. 197].

All these varieties of texts and shapes are defined by Ryan as the *avatars of story* [82, p. xviii].

[1] `http://www.imdb.com/`

Within this framework, drama scholars have developed a number of approaches to dramatic texts and theatrical plays [12]. The "technical point of view" relies on the so–called constructivist approach, which departs from the linguistic and literal forms to focus on the constitutive elements of drama. So, to explore the common story–based features that reconcile *Romeo and Juliet* and *Assassin Creeds*, we focus on: how the plot develops and is structurally organized, how characters are involved in the actions, what conflicts take place. In particular, the analyses of Lavandier [54], Ryngaert [83], Hatcher [46], and Spencer [86] distill the dramatic elements that the author has to handle in order to produce a well formed play, relying on the well known vocabulary of dramatic elements, e.g. character, plot, action, deliberation, emotion, conflict.

The Greek origin of the word *drama* is related to the notion of *do*, *act*, *performing*. Nowadays drama can be seen as a sequence of structured actions described in a text or in a score. Szondi has defined the drama as the action at the present time acted directly by characters. [89, pp 194-196] Nevertheless, this does not mean that the drama is the event enacted in front of the audience. As stated by Aristotle, a text, to be dramatic, does not need to be performed [3, 1453b 1-10] [2, p. xxxviii]. Therefore, we can say that drama is non dramatic because it is presented in front of an audience, but because of its specific tools of mimesis, hence its specific language of actions. Scholar has clearly stated that drama is made of characters' behaviors [10], and that a "dramatic action is not doing something" but "what a character wants" [86, p. 38]. The action has to spread out of the character's inner motivation and provide clue about its personality and intentions; most importantly, it must produce the higher level of conflicts and the consequent emotional appraisal. Action, intention, conflict are key terms in a computational perspective because links the drama to the design of behaviors. We can list the following dramatic elements that are commonly found in drama critics.

2.1. Action

Drama is a specific manner of organizing actions. This means that the action must have some qualities. *The Thirty Six Dramatic Situations* represents a seminal point because, from a large repository of plays, it extracts a list of situations that are perceived as dramatic [76]. Within each situation, and its subdivisions, Polti defines: the kind of action described (e.g. assassin, victim); the relations among agents (e.g. affinity, love, kinship, etc.); beliefs and goals that motivate the action (e.g. the agent's planning); the effects on the world; and the action's emotional charge.

2.2. Agent

Action involves at least one agent and must be the outcome of a deliberative process [2, p. xxiv]. Hence the action must involve agents with goals, deliberations and emotional states. Modern drama has overcome the notion of the character as a whole nucleus (e.g. the romantic hero), and has developed the idea of a character constituted by the sum of its actions [83]. Therefore the agent is a willing dynamic entity that constantly appraises the state of its world by means of rational deliberation and emotional charge.

2.3. Conflict

Not all the actions carried by an agent are dramatic. This quality spreads from a tension or an opposition among agents and/or the environment. The notion is ubiquitous in drama critics.

Leaving aside the opposition between the tragic hero and the fate in classical Greek plays, we can easily trace it back to 1758 with the seminal work of Diderot, who foresees a conflict based on the opposition between the character and the social environment [22]. Years later Lessing also wrote about an opposition driven by character's different moral values, therefore motivated by the inner feeling [56]. The notion is at the core of the drama for Hegel's *Aesthetics* in which

> drama is not a mere representation of an enterprise which peacefully runs its course. It has interest only from the animated strife between its personages and their struggle and perils. It gives us the final result of these conflicts [48, p. 287].

His whole perspective on drama is based upon the conflict as a core element that drives the character's creation and the storyline. From here onward, conflict became unmissable in the literature and was addressed in more detail. On the one side,

it has been seen as the main engine of the plot because it provides reasons to characters' change [25]; on the other side, it has been divided in types (e.g. inner, interpersonal, social)[63]. Nevertheless the main contribution on conflict is to represent the obstacle in a notion of drama as the struggle of an agent toward her/his desires[54].

2.4. Causal/Sequential Structure and Dramatic Arc

The agent's actions in conflict must be organized to give a sense of causality and wholeness, i.e in a plot. In other words, the single action is not only dramatic (as described by Polti's situations), but must be part of a sequence of actions that are ordered. The order is driven by the raising tension and is normally described as an arc along the temporal line. Therefore the sequence must be constructed according to a well established pace that goes from the introduction, to rising, climax and return [37].

2.5. Units

The wholeness of drama springs from its parts. Although it is usual to describe drama in terms of acts and scene (or sequence for the movie), from Freytag onward it is clear that the subdivision of plot does not respond to practical reasons (such as characters' entrances or exits) but to dramatic reason. In other words the actions must be grouped according to theirs goal, conflicts and solutions; and each group can be further grouped as well, leading to the macro segmentation in three or five acts [54] [34]. These grouped actions are narrative blocks that may be seen as units that compose the dramatic arc. The units are the containers of the character's actions and may be graded according the quality of obstacles, conflicts, and changes that take place in it [72, p. 230 and p. 234]. Although the notion of unit is ubiquitous in drama critics, there is no shared opinion about the rules that define its boundaries. Beside the traditional narrative segmentation that follow the development of the story timeline [86], there are more complex approach that links directly the unit to the character's value at stake [63].

2.6. Emotion

Whatever point of view we adopt to define the units and their sequencing in the dramatic arc, it is clear that all is driven by conflict and the result has to lead to some emotional charge. Beside their importance in human behavior [18], emotions are one of the distinctive features of drama, as acknowledged since the Age of Enlightenment [23] and stated more recently by contemporary aesthetics [85,43]. The units can be described as emotional episodes [85, p.39], in which the agent feels some emotion as result of her/his appraisal of the situation at hand. Emotions represent the crucial aspect of the design of a dramatic action, because they are the glue of the elements of drama we have cited above (actions, conflict, and dramatic arc), that are all qualified by the emotion represented (e.g. the climax shows an action that spills out from (or causes) a stronger and deeper emotion, while the introduction can contain more descriptive events). But the emotions are also crucial because they allow the audience to fully appraise the action and its meaning in the plot. Characters are the primary medium by which a drama is conveyed to the audience and a character charged with the right emotion will secure the emotional bonding with the audience [42,14].

The dramatic elements mentioned here above are encoded in the Drammar ontology, which includes a linked conceptual model for Action, Agent, Conflict, and Units, and a rule layer for deducing the Causal/Sequential Structure of Actions (though Dramatic Arc requires further developments) and the Emotions. The ontology is employed in a toolsuite for the annotation of such elements in the metadata and their visualization, in order to support scholars and enthusiasts in drama analysis and didactics.

3. Related Work

The field of drama is relevant to several research lines, ranging from cultural heritage dissemination to the indexing and search of media repositories. Here we widen our perspective to include story ontologies, that also address the non dramatic narrative models. We are particularly oriented to the applicative paradigms of the mediation between

audience and cultural objects, aimed at stimulating the access to heritage items, and the metadata annotation of media repositories, aimed at the indexing and search of media items.

Story ontologies have been proposed with two main goals, namely the purpose of classifying story types and the purpose of providing an underlying model for narrative annotation [42,52,15,41]. A well known example of the first type of systems is the work in [42]. In this work, inspired by the work of Propp [77], an ontology of fairy tales, encoded in OWL, is exploited to model different plot types. The system uses the ontology to perform case-based reasoning: given a story plan, the system searches the ontology for a similar plot, measuring the semantic similarity of the given plot with the plots encoded in the ontology. A natural language module, then, generates a textual version of the obtained plot, adapted to the input parameters (characters, situations, etc.) provided by the user. In the same line, the work in [45] used automatic classification techniques to classify plot types; the Opiate system [33] relies on a Proppian model of story to create and populate story worlds. A formalization of Propp's model is described by [41]: in this work, a computational system exploits the formal model to generate new stories in the style of Russian fairy tales. Differently from previous attempts at formalizing Propp's theory, this proposal constitute a more rigorous description of the original model in computational terms. In recent years, the extention of Propp's theory as a general story model has been questioned by several authors, especially in relation with new media [16,91,41].

Overcoming the differences across media types and genres is one of the main challenges faced by the research on media annotation. In this field, story ontologies have been proposed as a way to provide a shared and inter-operable model for annotation scenarios which rely on the paradigm of crowd–sourcing and are characterized by the presence of different types of narrative contents. A media–independent model is provided by the OntoMedia ontology, exploited across different projects (such as the Contextus Project [52] and [55]) to annotate the narrative content of different media objects, ranging from written literature to comics and TV fiction. The OntoMedia ontology contains a very detailed model, tailored on story annotation, and mainly focused on the representation of events and the order in which they are exposed. In [], the ontology Stories, developed in collaboration with the BBC for the application in fields as news, drama, and historical facts, is employed to annotate plot elements across the episode storylines of the Dr. Who sci–fi TV series. OntoMedia lends itself to the comparison of cross-media versions of the same story (for example, a novel and its filmic adaptation); it is an event–(instead of character–) based description of the timeline of story incidents, with no interpretive intents, and so does not cover the description of characters in terms of intentions, goals, etc..

Complementary, the Story Intention Graph [31] relies on the representation of the short–term characters' intentions to build an interpretive layer of a narrative text, although it does not account for the whole causal sequence of the drama, motivated by long–term intentions.

The SUMO ontology, although not specifically tailored on story modelling, has been employed for the task of story annotation and story generation. In [17], the axiomatic definition of processes, in SUMO, is exploited to reason on stories and to generate plots. This approach, although not directly relevant for story models, reveals the relevance of an accurate representation of actions (processes, in SUMO terminology) for story description and annotation.

In the last decade, the use of ontologies (and story ontologies in particular) in online access to cultural heritage has been investigated by several projects. As reviewed by [49] and [24], computational ontologies are especially suitable to encode conceptual models for the access to digital archives, and to structure the interaction between the archive and the users.

A pioneering contribution in the use of ontologies for access to cultural heritage is given by the Culture Sampo project [51]. This project encompasses a set of domain ontologies, which provide the background against which cultural objects (artworks, artists, traditional practices, etc.) can be explored, tracking the underlying relations among them [50]. Concerning the story level, however, the system allows the exploration of the artifacts based on their connections with a reference story (the "Kalavala" Finnish saga), but the story representation is only functional to the access to cultural objects and is not intended as a standalone account of the story domain.

Narrative is the focus of the Bletchley Park Text system [65], a semantic system designed with the goal of supporting the users in the exploration of online museum collections. The system relies on an ontology of story, taken from the Story Fountain project [66]. Again, this system is strongly committed to the use of story to create narrative paths encompassing the museum's objects, rather then representing the story elements in a all-purposed fashion.

In general, the exponential growth of digitized media has called the attention on the problem of providing contextualized information about the data. Although most research on metadata annotation is not targeted at story or dramatic elements, some drama-based approaches have emerged, possibly in conjuction with tools for annotation.

The amount of user–generated metadata concerning dramatic media witnesses the interest of the general audience (see, e.g., the tags that are freely inserted by users in public repositories). However, as reported in [57] for the YouTube clips extracted from a classic feature film, most of the tags concern the resource (Title, Actor, Director, Production, Editing, Publish, Genre) and only a few (Character, Object, Environment, Action) the content.

Based on the user–generated tags, in the specific domain of the performing arts (which are related to drama), the tool MyStoryPlayer is a purposedly targeted interface for the semantic annotation of documents (such as video, audio, text, image, ..., encoded in RDF format) and the navigation of the annotations creating its own non–linear experience or path [6].

Although all the ontologies and systems reviewed here provide a (partial) formal view of the drama phenomenon, none has developed a consistent and comprehensive metadata system, based on a shared set of constructs, that can appropriately reflect the vocabulary of dramatic elements. This paper aims at bridging this gap. In the next sections we describe the Drammar ontology, with its conceptual model and the rule layer.

4. System Overview

Though the design of the drama encoding presented here has followed criteria of generality, it is useful to describe it in the context of the task that have triggered its creation and have inspired the realization of the tools that support the use of the ontology. The task of the metadata annotation of dramatic media items follows the workflow illustrated in Fig. 1. It employs the two components of the system, the ontology layer and the rule layer,in two different phases.

The ontology layer (see next section) describes the basic elements of drama and their organization in a model that abstracts from media, genres and ages. The system relies on external knowledge sources to account for the commonsense and the linguistic elements that are not intrinsic to drama itself, but are required when the manifestations of drama are annotated. The reference to external entities, like historical characters or place, and their linguistic descriptions, are mediated by a "meaning negotation" process by which external resources are linked to the annotated data. For a more accurate description and evaluation of the meaning negotiation process in drama annotation, see [15,57]. The ontology layer, which encodes the major components of drama described in Section 2, is the pivot on which other components hinge. The annotation of drama, carried out through the interface described in [58], takes as input an annotation schemata based on the ontology layer and returns as output an RDF graph, on which the reasoning process supported by the rule layer can be applied, with the goal of enriching the annotation with information inferred from the annotated data.

The rule layer (Section 6) currently includes two modules. The mapping model is in charge of augmenting the timeline of the drama incidents, grouped in units, with the story states that hold between adjacent units. Inspired by the Situation Calculus paradigm [62], the story states represent the development of a story through a series of snapshots, the solutions of continuity over units that are projected from the characters' intentions arranged on a hierarchy onto the timeline incidents. A graphical visualization of the alignment between the unit boundaries and the successes/failures of the plans display at a glance the motivations of the incidents unfolding in the timeline. The emotion assignment module is in charge of annotating the emotional states of the char-

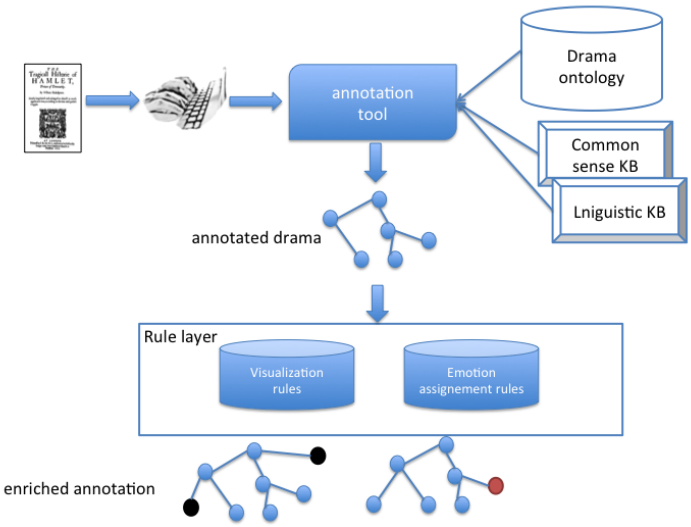

Fig. 1. Overview of the annotation framework.

acters based on their subjective appraisal of the drama incidents. Often disregarded by annotation projects, which tend to focus on the identification of actions and events (see for example [36]), characters' emotions provide an important way of indexing dramatic contents. A graphical visualization of the emotional change of the characters aligned with the timeline of incidents allows scholars and enthusiasts to easily track the evolution of the characters state.

5. Drama Ontology

In this section, we introduce the ontology Drammar, taking as a running example a scene from Shakespeare's *Hamlet*. In particular, we address the so–called "nunnery scene" in the Third Act, where Ophelia is sent to Hamlet by Polonius (her father) and Claudius (Hamlet's uncle) to confirm the assumption that Hamlet's madness is caused by his rejected love. According to the two conspirers, Ophelia should induce him to talk about his inner feelings. At the same time, Hamlet tries to convince Ophelia that the court is corrupted and she should go to a nunnery. In the middle of the scene Hamlet puts Ophelia on a test to verify her honesty (it is the so–called *climax* of the scene). Because he guesses (correctly) that the two conspirers are hidden behind the curtain, he asks the girl to reveal where her father Polonius is. She decides to lie and replies that he is at home. As a consequence, Hamlet becomes very angry in realizing that even Ophelia is corrupted and there is no hope to redeem the court.

Drammar ontology is encoded in the OWL 2 RL language. It is designed with the twofold goal of providing a formalized conceptual model of the dramatic elements as described in Section 2 and an annotation schema for the insertion of metadata about a dramatic item. Figure 2 shows the top level of Drammar classes: `Description Template`, containing all the patterns depending on linguistic schemata; `External Reference`, a bridge between the core elements of the ontology describing the drama domain and external knowledge bases to which such domain knowledge is connected; `Structure Element` representing how units are put together in a *Timeline* (the story evolution); `DramaEntity`, grouping all the elements (objects, processes, dramatic structures and dramatic units) belonging to the drama domain. Each class has then a number of subclasses; here we will describe the most relevant for our scope. An available version of the ontology can be downloaded at `http://www.di.unito.it/~vincenzo/FTP_SWJ/`.

The Drama Entity is divided in four subclasses each describing specific drama elements. The first two, `Drama Perdurant` and `Drama Endurant`, are explicitly inspired by the *Endurant* and *Perdurant* class of the DOLCE ontology [38], with the differ-

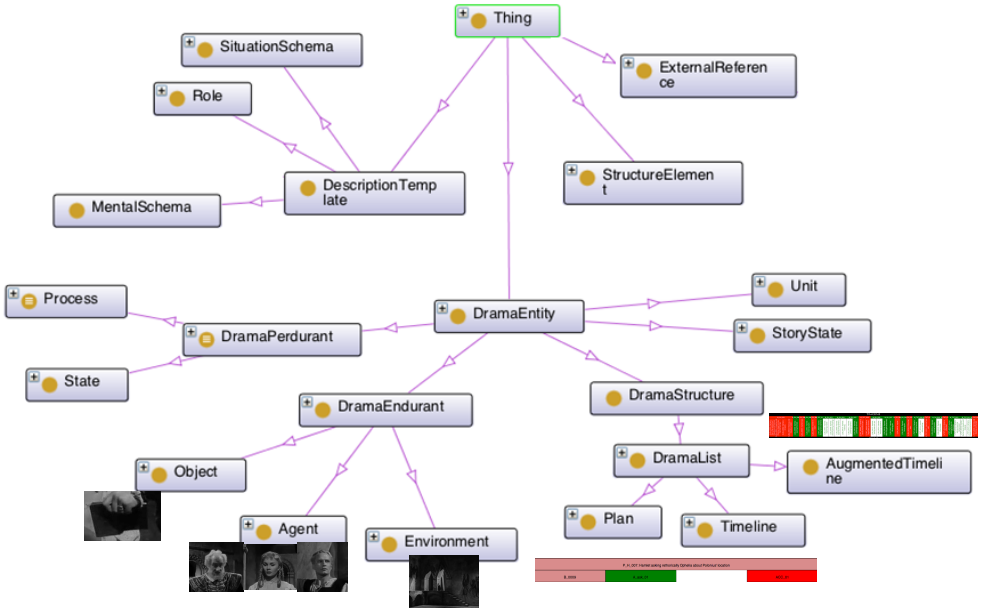

Fig. 2. Top level classes of the Drammar ontology.

ence that, as the name suggests, these are explicitly intended to represent the processes and the entities occurring in the drama domain. The other two subclasses are `Drama Structure` and `Unit` respectively. While the Drama Structure class represents the structures of the story, such as timeline and plans, the `Unit` represents a chunk of the story, identified by the annotator according to actional boundaries (i.e. characterized by the occurrence of some incidents, of which we can recognize beginning and end, see Section 2).

The class `DramaEndurant` (Fig. 2) models all the story elements participating in the unit, namely `Agent` (the elements who are characters that intentionally act in the incidents and referred to the *Agent* element in Section 2), `Object` (the elements that do not own intentions), and `Environment` (the locations where the incidents take place). The class `Drama Perdurant` (lower left of Figure 2) provides the elements for the story dynamics, namely processes and states, represented by the subclasses `Process` and `State`, respectively. The representation of processes and states is driven by the Time Indexed Situation design pattern developed in DOLCE [38]. On one hand, processes are further divided in `ActionInPlan` and `Incident`. Incident are actions that occur in a unit, they can be unintentional or intentional (`ActionInUnit` or `EventInUnit`). On the other hand, `State` are described in `StateInUnit`, `StateInPlan` and `MentalState` where the first two elements of the list allow to distinguish the different types of actional state occurring in Units or in Plans. Mental state is at the core of the description of the intentional behavior of agents. Agents, in fact, are the most complex entities (such a complexity is revealed by the number of properties having agents as domain). Agent representation in Drammar descends from the BDI theory [9], which has already seen some applications in the computational storytelling community [68] [71]. According to BDI, an agent is a tripartite function of Beliefs, Desires (or Goals), and Intentions (or Plans of actions, see below), where beliefs are the knowledge of the agent (what it knows or believes to be true), goals are the objectives to be achieved through the plans of actions. `Beliefs` and `Goals` are states; while `Plans` are actions surrounded by precondition and effect states; plans are hierarchically organized in sub-plans, until base plans that provide a context to individual actions. Beyond Beliefs and Goals, Drammar includes agents' `Emotions` and `Values`, who are credited to be relevant in characterizing drama in terms of emotional appraisal as described in Section 2. The agent's mental states concern one of the following classes:

- `Belief`: the agent's subjective view of the world (e.g., Hamlet believes "Ophelia is not loyal");
- `Emotion`: what the agent feels (e.g., Hamlet is in "Love" with Ophelia);
- `Value`: the moral qualities of an agent, that are put at stake along the narrated story (e.g., Hamlet's value put at stake is Honesty);
- `Goal`: objectives that motivate the actions of the agents; in accordance with agent theories, Drammar acknowledges different goal types (cf. [92]), depending upon their propositional content: perform goal (PG), that aims at the execution of a certain action; achievement goal (AG), that aims at the achievement of a certain state of the world; query goal (QG), a type of achievement goal, where the state to be achieved is a belief state of the agent itself; maintenance goal (MG), that aims at keeping or restoring a certain state in the story world.

All the entities of the drama domain feature qualities (e.g. speed or color), status (e.g., open/closed) etc. In general, all the different types of qualities are grouped into the `ExternalReference` class and, following the paradigm of linked data [47], each specific value of a quality (named *quale* in DOLCE) is referred via URI's to some external common sense or specific ontology. Each entity (as well as a DramaPerdurant) connects to its qualities through an individual of the ExternalReference class, that then connects to some external URI. For example, consider the "ExternalReference" individuals for all the entities in the "nunnery scene": the agents Hamlet, Ophelia and Polonius, the objects Polonius' room and the "nunnery scene" room (which also is an environment), the value Honesty (see Figure 3).

Drammar refers to two external large–scale semantic resources for the description of the commonsense knowledge, namely the two ontologies Suggested Upper Merged Ontology (SUMO, [70]) and Yet Another Great Ontology (YAGO [88]), merged into YAGO–SUMO [20], which provide very detailed information about millions of situations, including entities (agents and objects), processes/actions, and events (see DramaPerdurant, for processes and events). Terms in YAGO–SUMO are accessed through a lexical resource, the WordNet lexical data base [64][2]; in particular, an interface supports the manual selection of concepts, extending the vocabulary to a multilingual setting (through the lexical data base MultiWordNet [73]), to increase the interoperability of the annotation data across languages.

The idea of adopting patterns from external, well known ontologies, is useful for the sake of interoperability. Entities participate in processes and states according to some Role (split into RoleInPlan and RoleInUnit), that is defined by a SituationSchema (split into ProcessSchema and StateSchema). All processes and states are described by (property isDescribedBy) a situation schema. Templates are described by the frames of Framenet [4], which depict situations, processes/actions, and/or events in terms of roles played by the elements that participate in it. Finally, other fundamental elements that are modelled into the Drammar ontology are the `Timeline` (representing the story evolution) and the `Plans` that can be hierarchically organized. These classes respond to the need of ordering sequence of states and actions in drama as defined by the causal sequence notion in Section 2. Timeline is the sequence of units (and, in turn, of incidents) while a plan is formed by a sequence of actions or subplans, with precondition and effect states following a STRIPS-like formalism, through which a character intends to achieve a goal. So, the timeline is the actual story development and the plans represent the cognitive deliberations of the agents that motivate that development.

In Fig. 6, we see how plans are mapped onto the timeline, to flesh out the motivations for the story evolution observed by the annotators, and to insert states into the timeline to form the AugmentedTimeline.

As an example, we see the annotation of the excerpt of *Hamlet* nunnery scene mentioned above (Figure 4). In this excerpt, Hamlet is testing Ophelia's honesty by asking rhetorically a question he knows the answer of, namely the current location of her father Polonius (actually, the same room where they are, behind a curtain), and Ophelia lies by reporting a false location, namely Polonius' home.

[2]See the portal http://www.ontologyportal.org/

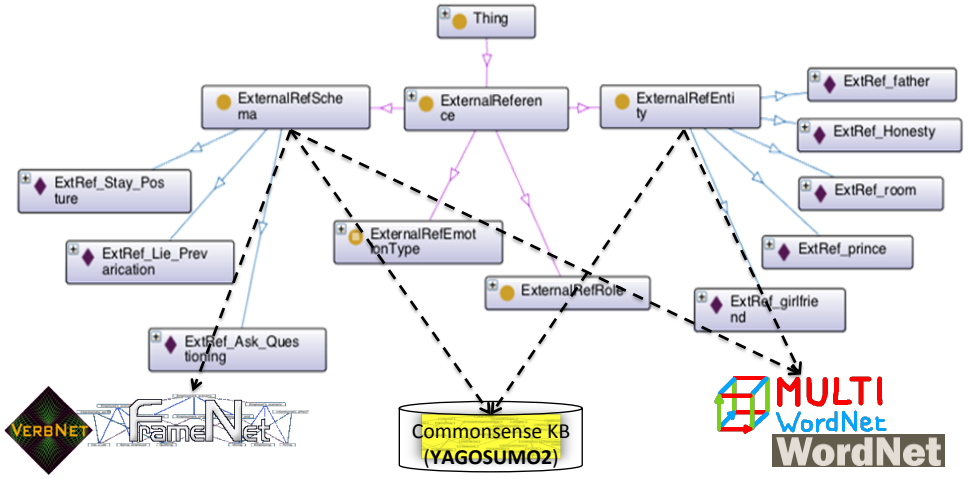

Fig. 3. The connection between the ontological elements of Drammar and the external resources through the individuals of the ExternalReference class. In particular, Entities are connected to YAGOSUMO through the Wordnet–based resources; Process Schemata are connected to YAGOSUMO through Wordnet and Framenet resources.

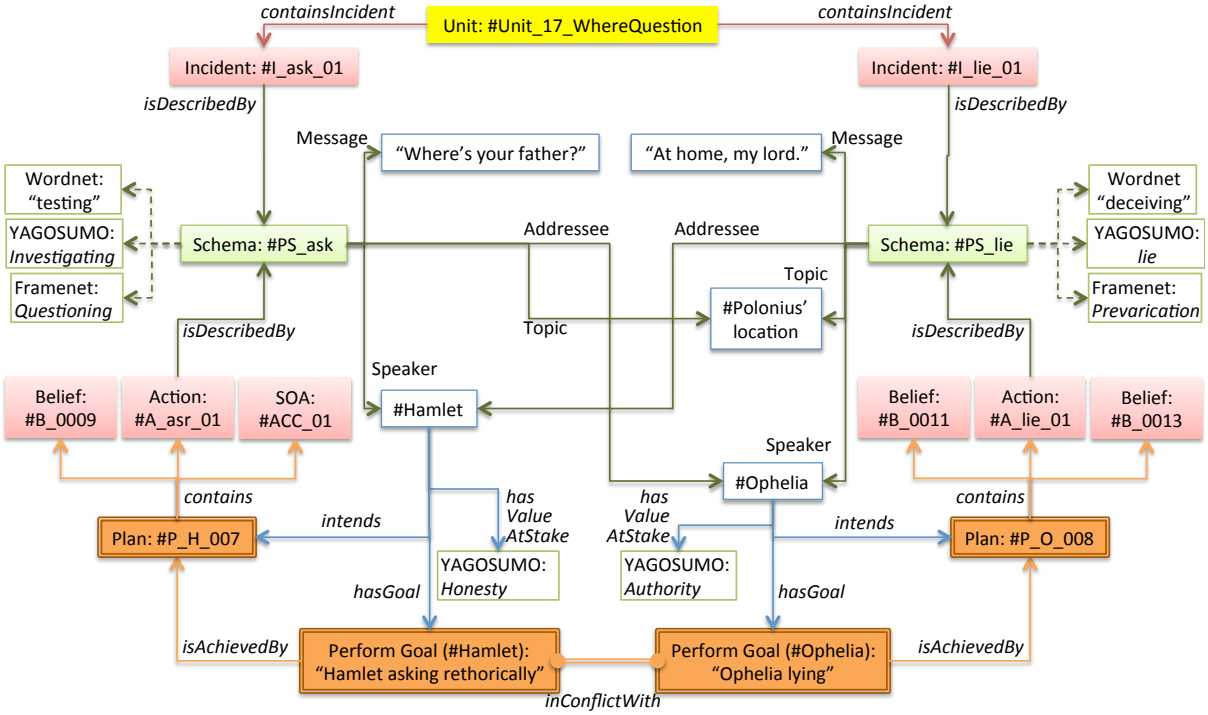

Fig. 4. The annotation of the Unit *#Unit1* where the Agent *#Hamlet* tests (concept *#Investigating*, frame *#Questioning*) the Agent *#Ophelia*'s honesty by asking about Polonius' location and she lies (concept *#lie*, frame *#Prevarication*) about it. The structure is built upon relations on roles and role fillers. Testing and lying are the two processes that describe the two incidents, respectively. Notice the conflict between the Hamlet's and Ophelia's goals, respectively.

Going from top to bottom in the figure, the unit contains two incidents. The incident on the left (*#I_ask_01*) is a process triggered by Hamlet's perform goal to ask rhetorically Ophelia about her father's location ("Where's your father?"). The schema that describes such incident is *#PS_ask*, that features the Wordnet sense "testing" and the YAGOSUMO concept "Investigating"; the associated frame in Framenet is "Questioning", which requires the roles Speaker (filled by *#Hamlet*), Addressee (filled by *#Ophelia*), Topic (filled by *#Polonius'* location), and Message (filled by the string "Where's your father?"), respectively. The schema *#PS_ask* is shared by the action *#A_asr_01* of Hamlet's plan *#P_H_007* (with the three elements described above) that achieves the perform goal of "asking rhetorically". The incident on the right (*#I_lie_01*) is a process triggered by Ophelia's perform goal to lie about her father's location ("At home, my lord."). The schema that describes such incident is *#PS_lie*, that features the Wordnet sense "deceiving" and the YAGOSUMO concept "Lie"; the associated frame in Framenet is "Prevarication", which requires the roles Speaker (filled by *#Ophelia*), Addressee (filled by *#Hamlet*), Topic (filled by *#Polonius'* location), and Message (filled by the string "At home, my lord."), respectively. The schema *#PS_lie* is shared by the action *#A_lie_01* of Ophelia's plan *#P_O_008* (with the three elements described above) that achieves the perform goal of "lying". The two goals, which are in conflict, are triggered by the two values that are put at stake in this unit: for Hamlet is Honesty to be put at stake, for Ophelia the Authority of her father.

6. Rule Layer

The rule layer accounts for the mapping and emotion appraisal operations, respectively. These operations (see Fig. 1) augment the annotations provided semi–automatically through the web interface to the ontological concepts by connecting the concepts of plan and unit, in the case of mapping, and the concepts of unit, plan and emotion, in the case of the appraisal. Properties that are defined over classes are instantiated on individuals. The rule layer overcomes some expressive limitations of the ontological language OWL 2 RL and produces some novel interesting knowledge.

The need for a combination of ontological representations, expressed in some standard ontological language, with some ontology-compliant rule languages is not new (see e.g. [1]).

In the literature, different integration strategies between the rule and the ontological layers have been proposed and several types of rule languages have been developed that are at least in principle suitable to be used in concrete ontology based application ([26]).

Starting from the latter point a well known way to express rules comes from the Datalog and Answer Set tradition in logic programming. This solution allows to reason in a closed world assumption environment (differently from the ontological reasoning) and its non monotonic extensions allows to go beyond the classical ontological reasoning, which is focused on deduction. Another solution is that one pointed out by [44], showing that the intersection where the logic-programming and description-logic worlds coincides which they call DLP (Description Logic Programs). However, such an approach has the limit of leaving both the rule and ontology language with very restrictive expressivity. For such reason different extensions in the direction of logic programming and ASP on top of the DLP fragment have been proposed. This trend lead to the realization of the Web Rule Language (WRL), a W3C proposa,l that, however, did not received many attention both in the academic and application fields.

Another language, now a standard, for representing the rules is RIF (Rules Interchange Format), built on the basis of a strong effort made by the W3C in order to construct a common, portable, format for the interoperability of the rules in the field of Semantic Web. Such a language is composed of different dialects and is the common ground for the communication of different kinds of rule languages used in different system application. SWRL, finally, (Semantic Web Rule Language) is another language born form the fusion of Rule ML and OWL DL. It integrates OWL with a rule layer built on top of it. More specifically, SWRL adds the possibility to declare arbitrary Horn clauses expressed as IF THEN rules. A SWRL based system is therefore composed of ordinary OWL axioms plus SWRL rules. The antecedents and consequents of the rules consist of lists of atoms, which may be OWL class expressions, property definitions, or built-ins. Most of

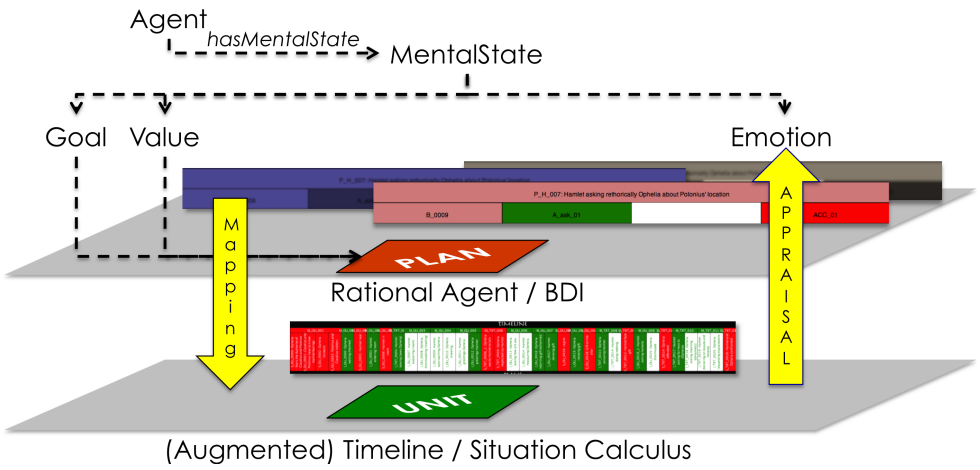

Fig. 5. Mapping layer module into ontology

the current available DL reasoners, such as Pellet or Hermit support inferences based on SWRL.

Concerning the integration strategies there are two main approaches known in literature. Each of them is strongly related to the languages used in real applications. A first approach is known as the "homogeneous approach" and assumes a tight semantic integration between the layers in which both ontologies and rules are embedded in a common underlyng semantics and where there is no distinction between rule predicates and ontology predicates. In such approach the rules extend ontological axioms to include arbitrary Horn-like clauses. This is the case, for example, of the above mentioned SWRL. The second approach is based, on the other hand, on the assumption of a strict semantic separation between the ontogical and the rule layers. Respectively, the ontology is used as a conceptualization of the domain and the rules can be used to build some application-specific relations. The communication between the layers is obtained via interface ([26]). A classical example of such approach regards the use of Answer Set Programming [27] . In this case, ontologies are dealt with as an external source of information whose semantics is treated separately. Nonmonotonic reasoning and rules are allowed in a decidable setting, as well as arbitrary mixing of closed and open world reasoning. In our system we adopted the homogeneous approach using as additional layer a set of rules based on SWRL. This choice was driven by many factors. First of all SWRL plugins are available in well known software package for ontology editiong such as Protegé. This allows, from a practical perspective, to directly use a unique package for the design and development of both the knowledge base and the rules. Then we found easier to ground both the ontological and the rule layer on a common underlyng sermantics and under a common reasoning assumption (namely the Open World Assumption). On the other hand the use of ASP or Datalog, despite their powerfulness and the possibility of using available of non monotonic extensions was beyond our application scope, since our aim was that of extending with simple additional reasoning capabilities the conceptual knowledge expressed in the ontology. In order to enhance the system with the support of such simple additional mechanimsms we used SWRL in their DL-safe modality. In fact, although SWRL provides a fairly minimal rule extension to OWL, this leads to undecidability. Thus, we posed the restriction which requires that individual variables in a rule bind only to individuals named explicitly in the underlying ontology. In such a way it was also possibile for us to test directly the use of standard DL reasoners. In the following sections some example regarding the application of the SWRL rules is provided. The first example regards the phase of mapping actions and plans for visualization purposes. The second one is related to the execution of rules related to the emotions of characters in the drama. The figure Fig. 5 synthetyzes the main functions of the rule layer: the mapping function (connectig actions in the unit and plans) and the appraisal one (assigning emotions to the characters in the drama).

6.1. Mapping Rules

As previously mentioned, the set of rules described in this section was built with the aim of allowing a support for drama scholars based on the visualization of character's intention according to the plans committed to them during the drama units. We will not focus here on the latter phase since it is beyond the scope of the paper (for the interested reader we remind at [58]). The focus is, instead, on the set of rules encoded in order to allow such a second step. The additional reasoning that we want to achieve by using this set of rules is that one of obtaining a recognition of equality between the actions (incidents), coming from an original timeline, and the action in plans, disposed on another plan timeline, according to some shared properties such as the fact that such actions are represented by the same Schema, have the same Roles and also the characters filling that roles in that shared schema are the same. This equality recognition of different action is what we call mapping. The result of such mechanisms is that the Augmented Timeline, is produced from the original Timeline and the Plans that mapped the incidents. The AugmentedTimeline is an OrderedList that contains all the units and the incidents of the Timeline, in the same partial order as in the Timeline, interspersed with precondition and effect states (agglomerated into StoryStates). Visually (see Figure 6), if a state S_1 is a precondition of the action A_2 in the plan P_{B1}(X), and the action A_2 is mapped onto the incident I_2 in the Timeline, then the state S_1 is inserted in the Timeline before I_2; the same applies to effect states. These states form storystates that interleave units. The AugmentedTimeline features a total order over incidents and states.

In detail, the mapping works as follows Fig. 7 :

- match plan actions and timeline incidents through the rule; this is useful for establishing the spatial alignment of the timeline incidents and the plan actions;
- point out successes and failures of characters' behaviors (i.e. plans can be fully realized, or failing): some plan actions are actually executed (as timeline incidents) and contribute to the plan success, and some plan actions result that are not executed and the plan fails to accomplish;

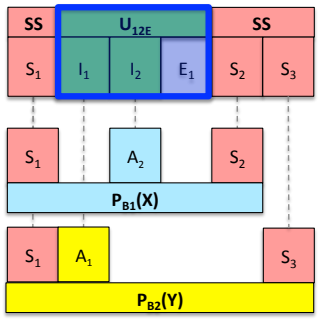

Fig. 6. How mapping works: the original annotated timeline is augmented with states projected from the plans; here are two basic plans, of two different agents, respectively providing different states to the representation. This schema is also a reference for the visualization phase.

- project the states required by the plan, as preconditions or effects of the plan actions, onto the timeline in the places preceding or following the incidents.

The SWRL rule is the following (syntax slightly adapted for readability issues):

IF

x is an instance of the class ActionInPlan (subclass of Dynamics) *AND*
x has an precondition (property $hasEffect$) state p *AND*
x has an effect (property $hasEffect$) state e *AND*
x has the same description schema of the incident y of the Unit U *AND*
U has a preceding StoryState SS_p and following StoryState SS_e in the AugmentedTimeline

THEN

p is inserted into the StoryState SS_p *AND*
e is inserted into the StoryState SS_e

The ontology is initialized with the AugmentedTimeline that is equal to the Timeline, but includes empty story states that precede and follow the units. Then, each application of the rule fills the story states with states contained in the plans.

In the excerpt of the "nunnery scene" and the plan #P_H_007 (Hamlet), the timeline contains the actional incident, #I_OLI_0027 (Hamlet asking Ophelia "Where is your father"), which is mapped onto the action #A_ask_01. The same happens for the plan P_O_008 (Ophelia), between the timeline incident #I_OLI_0028 (Ophelia lying about Polonius' location "At home, my lord") and the action #A_men_03. The recursive plan

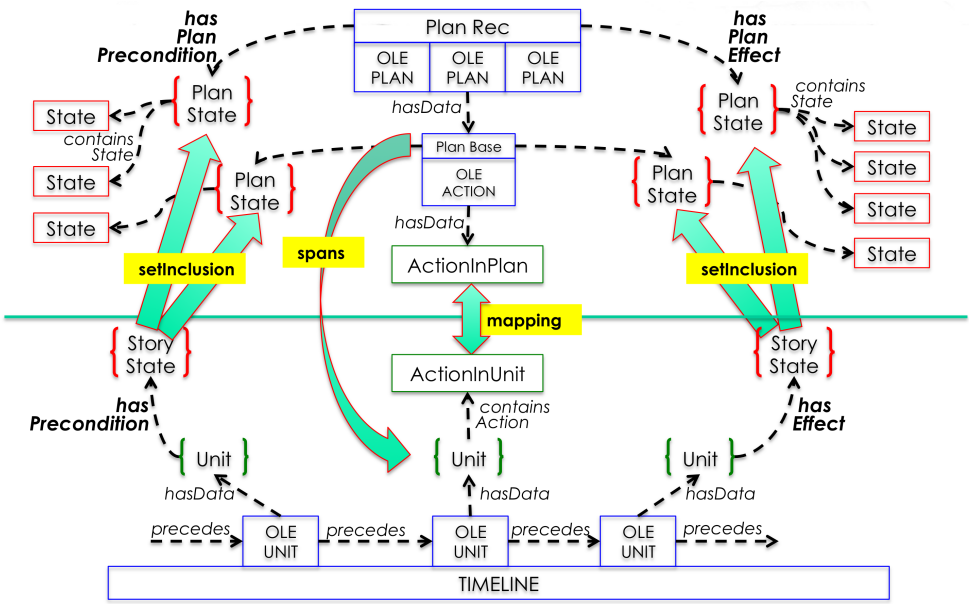

Fig. 7. The fragment of Drammar Ontology used by mapping rules for plans.

P_H_01_1 (Hamlet) is then triggered because of the mapping of the subplan #P_H_007 (Hamlet).

6.2. Emotion and SWRL Rules

Since the pioneering work of [30], computational models of emotions have been proposed in order to endow intelligent agents with emotional states [39,74,78,59,28]. These models rely on cognitive theories, since they explain emotions in terms of the agent's mental states (beliefs, goals, etc.), similarly to the mentalistic models of behavior which characterize intelligent agents. As describe in Section 5, in Drammar, characters are described as augmented BDI agents, i.e., in terms of belief, goals, intentions and values. The rule module for emotion assignment is inspired by the cognitive model of emotions by [69] that has been successfully applied to computational models of characters [19,71,21]. When rules are applied to the story annotation, they result in the assignment of emotional states to characters. Cognitive theories of emotions rely on the "appraisal" of the situations in which the person who experiences the emotion is involved. Appraisal happens through the different dimensions that characterize the person-environment relation (i.e. desires, moral values, etc.). For example, a situation may be *desirable* with respect to the person goals, or it may be appraised as *immoral* because it contains an immoral action with respect to the moral dimension of the person, etc. The appraisal process, then, results in the elicitation of emotions, whose type varies according to the appraisal theory of reference: so, for example, a situation appraised as desirable will elicit a joy emotion, while the execution of an immoral action will elicit a reproach emotion. According to [60], in order to encode an appraisal

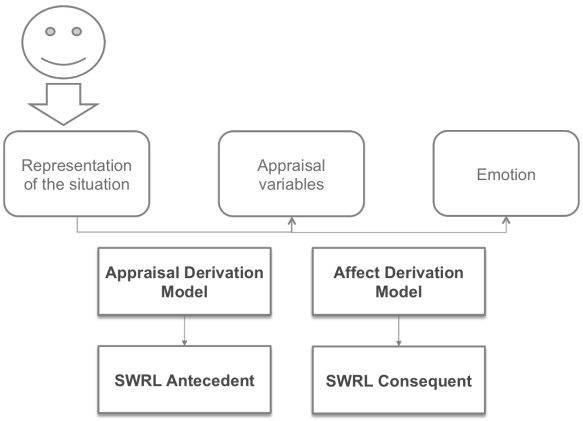

Fig. 8. A component model view of computational appraisal models from [60].

theory into a computational model, we need to define the *Appraisal Derivation Model* and the *Affect Derivation Model*. The *Appraisal Derivation*

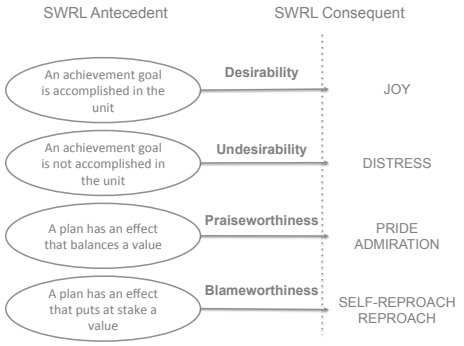

Fig. 9. Appraisal and Affect Derivation model with SWRL rules.

Model defines how the set of appraisal variables is derived from the *Representation of the Situation*. For example, if an agent desire is not achieved in a situation, the appraisal derivation model should be able to derive that the situation is undesirable for the agent. The set of appraisal variables is defined by the appraisal theory (e.g. desirability and likelihood of events, praiseworthiness of actions, attractions of objects, etc.).
Taking as input the set of appraisal variables, the *Affect Derivation Model* generates the corresponding affective state according to the referred appraisal theory.
The most challenging part in defining a computational model of emotions is the domain-independent specification of the Appraisal Derivation Model. Our work relies on the computational model of emotions proposed by [4,5], which is based on the OCC (Ortony Clore Collins) appraisal theory [69]. In OCC theory, emotions arise from the appraisal of events, actions and objects. The SWRL rule antecedent encodes the Appraisal Derivation model, while the SWRL rule consequent asserts the emotion type felt by the agent, encoding the Affect Derivation Model (see Fig. 8). The set of SWRL rules for emotion annotation infers the emotional state of the agents in a given unit (i.e. AgentInUnit in Drammar), depending on the consequences of the unit incidents on the agent's goals and values. In [4,5], the Appraisal Derivation model and the Affect Derivation model are both defined with a domain independent approach (Fig. 9). The Appraisal Derivation model (i.e, the antecedent of rules) generates the following appraisal variables: Desirability, Undesirability, Praiseworthiness and Blameworthiness. These variables depend on the character's mental state in the given units and on the incidents occurring in the unit. Desirability/undesirability depends on the success/failure in reaching an agent's goal. Praiseworthiness/Blameworthiness depends on agent's value rebalanced/put at stake. The Affect Derivation Model, following OCC theory, distinguish emotion types based on the appraisal variables involved: desiderability/undesirability variables elicit Joy/Distress emotion (Well-being emotion category), praiseworthiness/blameworthiness variables elicit Pride/Self-reproach or Admiration/Reproach emotion (Attribution emotion category). According to OCC model [69], when both appraisal variable regarding actions and goals are generated, the *Affect Derivation Model* generates the following compound emotions: *Gratification* (*Joy* and *Pride*), *Gratitude* (*Joy* and *Admiration*), *Remorse* (*Distress* and *Self-Reproach*), *Anger* (*Distress* and *Reproach*). For example, the SWRL rule for the *Reproach* emotion asserts that Hamlet feels an emotion of type Reproach towards Ophelia, who is a layer because performed the blameworthy action lying in the unit incident, putting at stake the value "Honesty".

The antecedent of the SWRL rules for generating Well-being emotions is based on the goal achievement in the unit. The consequent infers the emotion type and the target of the emotion. In the following, we describe the set of SWRL rules with a readable syntax[3].The SWRL rules for generating Well-being emotions are SWRL Joy and SWRL Distress.

SWRL Joy rule fires if an agent has achieved a goal in the unit.

IF

an agent ag has a goal g of type "Achievement" *AND* there exist a unit u that features the agent ag *AND* the goal g is achieved

THEN

the agent ag feels Joy towards her/himself

SWRL Distress rule fires if an agent has not achieved a goal in the unit.

IF

[3]Note that, for the sake of brevity, we report only the most relevant element in order to show the logic with which emotions are generated by the rule module.

an agent *ag* has a goal *g* of type "Achievement" *AND*
there exist a unit *u* that features the agent *ag AND*
the goal *g* is not achieved

THEN

the agent *ag* feels *Distress* towards her/himself

The SWRL rules for Attribution emotions are based on the appraisal of plans as praiseworthy or blameworthy with respect to the consequences on values. If a plan puts at stake a value the plan is blameworthy, otherwise if the plan brings a value at stake in a balanced state the plan is praiseworthy. Note that, the attribution of blame or credit is made by the agent that felt the emotion towards another agent. The SWRL rules for generating Attribution emotions are defined in the following way:

SWRL Pride rule fires if an agent performed a plan that re-established a value put at stake in the unit.

IF

an agent *ag* intends an accomplished plan *p AND*
there exist a unit *u* that spans the plan *p* and features the agent *ag AND*
the Plan *p* includes in the effect states a balanced value *v*

THEN

the agent *ag* feels *Pride* towards her/himself

SWRL Shame rule fires if an agent performed a plan that put at stake a value in the unit.

IF

an an agent *ag* intends an accomplished plan *p AND*
there exist a unit *u* that spans the plan *p* and features the agent *ag AND*
the Plan *p* includes in the effect states a value put at stake *v*

THEN

the agent *ag* feels *Shame* towards her/himself

SWRL Admiration rule fires if an agent wants to re-establish a value and another agent performed a plan that re-established the value in the unit.

IF

there exist two agents *x* and *y*, each intending respectively the plans *px* and *py* which include in the effect states the same value *v AND*
there exist a unit *u* that features the same two agents *x* and *y AND*
the unit *u* is spanned by the two plans above *AND*
the value *v* is not re-balanced by the plan *px* because *p* fails *AND*
the value *v* is re-balanced by the plan *py*

THEN

the agent *x* feels *Admiration* emotion towards the agent *y*

SWRL Reproach rule fires when an agent wants to re-establish a value and another agent performed a plan that puts at stake the value in the unit.

IF

there exist two agents *x* and *y*, each intending respectively Plan *px* and *py* which include in the effect states the same value *v AND*
there exist a unit *u* that features the same two agents *x* and *y AND*
the unit is spanned by the two plans above *AND*
the value *v* is not rebalanced by the plan *px* because *p* fails *AND*
the value *v* is put at stake by the plan *py*

THEN

the agent *x* feels *Reproach* emotion towards the agent *y*

SWRL rules for Compound emotions fire when an agent feel an emotion of different type. For example, the **SWRL Remorse** rule fires if an agent feels a shame emotion and a distress emotion. In the following we describe the activation of the Reproach and Shame SWRL rules for the characters Hamlet and Ophelia. In figure Fig. 10, we report an excerpt of the semantic annotation in Drammar of the `Unit` *#Unit17_WhereQuestion* extracted from the "nunnery scene" in which Hamlet puts Ophelia on a test to verify her honesty and Ophelia decides to lie about the location of her father. We only report the salient points needed to illustrate the activation of the Reproach and Shame SWRL rules. The Unit "Unit17_ WhereQuestion" has two `AgentInUnit`: *#Hamlet_17* and *Ophelia_17*. The AgentInUnit #Hamlet_17 feels the `Emotion` *Emo_Hamlet_17* and features the `Agent` *#Hamlet*. The Agent #Hamlet features the `AgentInPlan` *#Hamlet_P_H_01_1* who intends to execute the `Plan` *#P_H_01_1* in order to achieve the `Goal` *Goal_Hamlet_LearningHonesty* of type "Query" not reported in Fig. 10 (i.e. Hamlet wants to know if Ophelia will tell the truth or a lie). The Plan #P_H_01_1 is not accomplished and has the `PlanState` *#Pstate_Eff_P_H_01_1* which contains

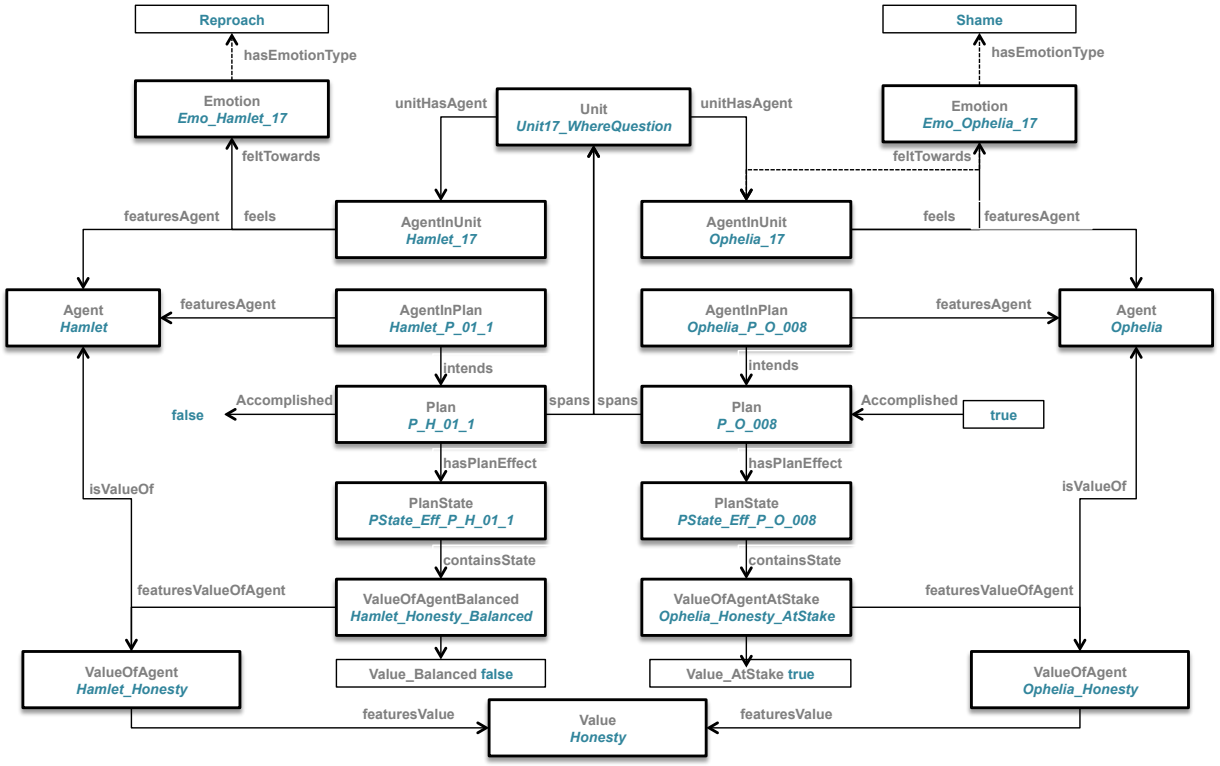

Fig. 10. The semantic annotation of the "nunnery scene" used by the emotion rule module. The property `hasEmotionType` and `feltTowards` are inferred by the rules for Reproach and Shame emotions.

```
Unit(?u) ∧ unitHasAgent(?u, ?agInUnitX) ∧ unitHasAgent(?u,?agInUnitY) ∧
AgentInUnit(?agInUnitX) ∧ AgentInUnit(?agInUnitY) ∧ Emotion(?e), feels(?
agInUnitX, ?e) ∧ spans(?planX, ?u) ∧ spans(?planX, ?u) ∧

Agent(?ag) ∧ Agent(?agY) ∧ featuresAgent(?agInPlanX, ?agX) ∧ featuresAgent(?
agInPlanY, ?agY) ∧ featuresAgent(?agInUnitX, ?agX) ∧ featuresAgent(?agInUnitY, ?
agY) ∧

AgentInPlan(?agInPlanX) ∧ AgentInPlan(?agInPlanY) ∧ intends(?agInPlanX, ?planX) ∧
intends(?agInPlanY, ?planY) ∧ accomplished(?planX, false) ∧ accomplished(?planY,
true) ∧ hasPlanEffect(?planX, ?planStateX) ∧ hasPlanEffect(?planY, ?planStateY) ∧
containsState(?planStateX,?valueOfAgentXBalanced) ∧ containsState(?planStateY,?
valueOfAgentYAtStake) ∧ featuresValueOfAgent(?valueOfAgentXBalanced,?
valueOfAgentX) ∧ featuresValueOfAgent(?valueOfAgentYAtStake, ?valueOfAgentY) ∧
featuresValue(?valueOfAgentX, ?value) ∧ featuresValue(?valueOfAgentY, ?value) ∧
Value_Balanced(?valueOfAgentXBalanced, false) ∧ Value_atStake(?
valueOfAgentYAtStake, true)

->

feltTowards(?e, ?agInUnitY) ∧ hasEmotionType(?e, Reproach)
```

Fig. 11. Complete Reproach SWRL rule in the Drammar Ontology.

the `ValueOfAgentBalanced` *#Hamlet_Honesty_Balanced* with data property `Value_Balanced` set to *false*. Summarizing, the goal *#Goal_Hamlet_LearningHonesty* is not achieved and the value *#Hamlet_Honesty_Balanced* is not balanced by the Plan *#P_H_01_1*.

The `AgentInUnit` *#Ophelia_17* feels the `Emotion` *#Emo_Ophelia_17* and features the `Agent` *#Ophelia*. The Agent #Ophelia features the `AgentInPlan` *#Ophelia_P_O_008* who intends to execute the

`Plan` *#P_O_008* in order to achieve the perform goal *#Goal_Ophelia_Lying* not reported in Fig. 10 (i.e. Ophelia intends to tell a lie). The Plan *#P_O_008* is accomplished and has the `PlanState` *#Pstate_Eff_P_0_008* which contains the `ValueOfAgentAtStake` *#Ophelia_Honesty_AtStake* with data property `Value_atStake` set to *true*. Summarizing, the goal *#Goal_Ophelia_Lying* is achieved and the value *#Ophelia_Honesty_AtStake* is put at stake by the Plan *#P_O_008*.
The Reproach rule, reported in Fig. 11, fires for the agent #Hamlet_17, because the plan perfomed by Ophelia is appraised as blameworthy: it put at stake the value Honesty. The Reproach rule consequent asserts the emotion type *Reproach* felt by the AgentInUnit #Hamlet_17 with the AgentInUnit #Ophelia_17 as target (property `feltTowards`). The Shame rule fires for the agent #Ophelia_17, because the plan perfomed by Ophelia is appraised as blameworthy: it put at stake the value honesty. The Shame rule consequent asserts the emotion type *Shame* felt by the AgentInUnit #Ophelia_17 with the AgentInUnit #Ophelia_17 as target.

7. Evaluation

In this section, we propose an evaluation of our ontology in terms of the support it can give to drama studies and didactics. This evaluation is in the context of a toolsuite that includes a graphical interface for the annotation of the conceptual classes and properties and a visualization module that displays the result of the application of the mapping and appraisal rule–based operations [58]. Because of the increasing production of fiction as Film, Tv, and New Media industry, drama studies are leaving the realm of literature to became a structured format for reproduction. In the last decades, in schools and universities the focus of the drama courses has switched from literary to structural and actional qualities. This means that the text is more and more intended both as an incident design (either on stage or on screen) and as a network of relations over agents' intentions. For example, [63] guides the author through the scene splitting beat according to the character actional goal, and its value change. This leads to focus on the actions intended by characters in a drama and represented as a shared behaviors in the sequence of units that form the so called timeline. The cultural object that we commonly call drama is the audience's cognitive appraisal of both the character's intentions and the events that take place. The experience of reading a drama is quite different from reading a novel [84]. The reader has to make sense of a sequence of character's individual lines or action briefly described in the stage direction.

In the famous example by M. Forster, the phrase "The king died and then the queen died" is a chronicle while "The king died, and then queen died of grief" is a plot because the latter builds upon cause and effect nexus. [35, p. 130]. Bringing the example further, and following the rules of drama as stated in the Section 2, we could also say that a dramatization of the same content would be:

"The servant: (*Entering the room*) Her majesty, the King is dead. The Queen: (*Falling on the floor*) Argh!".

Understanding the dramatic text is a complex operation that implies, for example, to fill such a gaps like the missing of an explicit relation between the two events (the queen dies because of the news), matching the nexus between a verbal expression and an action (the servant's communication and the Queen's falling), attribute emotions and values to the situation and reconstruct the metal state of the agents (the Queen dies of grief because she loved the King). Thus, also in this oversimple example, we see that the dramatic text, and moreover the dramatic performance, plays upon an interwoven relation between the timeline of actions and the mental behaviors that we infer from it.

In the "Nunnery scene" excerpt we have used in this paper, Hamlet's questioning plays upon a complex mental process. Here the reader has to consider it as a part of a plan to test Ophelia's honesty. Otherwise, if the reader focuses only on the timeline, the asking "Where is your father?" could be read just as a meaningless lunatic behavior. The character must show a comprehensible behavior, in which the reader sees some mental state such as desires and intentions; thus the reader conducts some inferences and deductions based on them. The cognitive construct we call "character" is the outcome of the reader's interpretation based not only upon the mere represented action (the timeline) but also upon its "enrichment" with the motivations we can deduce. The character does not

coincide with the agent in the narration and is bigger than its narrative container [67]. Our appraisal of Hamlet's action in this excerpt depends upon our interpretation of his behaviors and mental states. There is a vast literature upon this line ("Where is your father") that can be summarized in two main approaches: those who believe that he doesn't know the answer (and tend toward an inner psychological interpretation of the two lovers' loneliness), and those who think he knows he's being spied (and put the accent on the Elsinor's intrigue) [81] [87] [93] [53]. This proliferation is possible because of the great gap that exists between the mere action and the intention the readers recognize behind it, or, in other words, between the actions Hamlet is planning and the action he actually shows. Be aware that the character results comprehensible and believable only if this gap can be filled by the reader through a cause-effect chain, and that is why the simple lunatic behavior would not fit into the scene, and is not taken in consideration by our interpretative process. The interpretative process is the field where drama studies has proliferated, and has been conducted mainly by means of re-narration. For example, the seminal work of Harold Bloom on Shakespearian character's is mainly a new personal narrative of the plays [7]. Our system succeeds in giving a formal representation of this operation providing an explicit automatic mapping between the actions in the plans and the action in the timeline.

As shown in Figure 6 the augmented timeline accounts for the execution of two conflicting plans and, moreover, shows the states that holds before and after the unit. From a literary point of view the reader of a drama can be focused on the quality of the verse, on the rhythm of the prose, even on the specific style of event design. From the storytelling point of view it is important to measure the cognitive and emotional appraisal of actions and events. To appreciate the actional qualities of a drama the reader must learn to focus on the precondition and effects they hold before and after the unit. Thanks to those, the reader is able measure the character's change, and the final results of the conflicts (see 2.3). Therefore the states in the augmented timeline represent the key elements that allows the reader to build his/her cognitive representation of drama. Specifically, character's mental states cannot be represented onto the augmented timeline if not a result of characters' deliberation, therefore using the mapping among plans and incidents.

Hence the mapping accounts also for the emotional charge of the scene. In fact the lines displayed in the unit we are using as example ("Where is your father?","At home, my Lord") could produce the characters' intense emotional charge as usually described in the traditional *misè en scene* only if we focus on the conflict laying between the two plans. Hamlet wants to learn about Ophelia's honesty hence he put her on a test. Ophelia needs to comply with the Father and King's authority therefore has to avoid to disclose the plot, hence she lies. Given the two plans and the given value at stake (honesty) the system succeeds in calculate the resulting characters' emotional charge. Following OCC rules, as stated in Section 6.2, the system produces Hamlet's reproach and Ophelia's shame as emotions triggered in the timeline's unit. This evidence would have otherwise gone lost or at least attributed to the reader's free interpretation. This doesn't means that the scene can have only one emotional interpretation, but rather that our system formally shows that the emotions have a direct link to the characters' deliberative process and that the way we describe the latter gives shape to the the former. The relation among action and emotion is crucial in understanding drama and is the seminal step to grasp the difference between a play and a novel. While in novel the character's emotional charge is often the object of detailed descriptions at length, in drama it must be contained within the character's line[4].

Nevertheless, this relation is also the basilar feature to develop a performance as direct representation of the text.

In general, in learning about drama structure and meaning, our system helps to bridge the gap among the description of the script and the description of the performance, and shows the interventions of the latter in terms of dramaturgy. In a postgraduate dissertation project, we have asked the candidate to analyze different versions of the "Nunnery scene" from three movies based on *Hamlet*, respectively the ones directed by Olivier, Zeffirelli, and Branagh. Once the student has an-

[4]This is particularly true in Shapespears's play where the text doesn't contain long stage direction

	Length in mins	N. of units	N. of conflicts	%
Olivier	235	33	9	27,2
Zeffirelli	168	35	8	22,8
Branagh	306	43	11	25,6

Table 1
Number of units and conflicts in the Nunnery scene.

Olivier		Zeffirelli		Branagh	
Hamlet	Ophelia	Hamlet	Ophelia	Hamlet	Ophelia
Love	Distress	Distress	Distress	Happy-for	Happy-for
Distress	Happy-for	Anger	Hope	Love	Love
Pride	Pride	Reproach	Reproach	Distress	Distress
Reproach	Disappoint.	Love	Disappoint.	Anger	Disappoint.
Hope	Reproach	Fear	Anger	Reproach	Reproach
Anger	Hope		Pride	Disappoint.	Fear
	Fear		Fear	Hope	Pity
	Pity			Resentment	
	Dislike				

Table 2
From top to bottom, the sequence of Hamlet and Ophelia's emotions in the Nunnery scene.

notated the three clips according to the Drammar ontology we have analyzed the results. As shown in Table 1, if we compare Olivier's movie to Zeffirelli's we note that the latter exhibits a considerable higher number of units (given its shorter length) and has a lower presence on conflict. This tells that Zeffirelli has carried out an tightened pace *Hamlet*, where the Prince of Denmark is performed by Mel Gibson (famous for his action movies), and described as determined, athletic, dynamic. On the contrary, Olivier's version focuses on the inner feelings of the character, leading to a slower pace and focusing on a higher level of interpersonal conflicts. Finally Branagh's scene seems to take a balance with respect to the other two. It is the longest scene shot, and this allows Branagh to show both a fast action pace and an attention to the characters' conflicts. Olivier's focus on the inner psychological implication of the scene emerges also from the analysis of the emotions annotated (see Table 2), in which the shortest scene has the highest number of emotions and the highest diversification between the two agents..

Drammar ontology and the SWRL rules reveal their effectiveness in bringing upfront the dramatic qualities that would otherwise be hidden within the author's craftsmanship, or revealed in the highly subjective process of interpretation by means of narration in the drama critic. Therefore it helps the production process because helps the pipeline in checkin the consistency of the deliberative processes and emotional charges in the plot. It is also useful in the analysis and teaching of drama because helps to visualize the logic behind the play and highlight the interchange among the dramatic qualities.

8. Conclusions

This paper has presented an ontological approach to the domain of drama. The importance of the domain of drama is witnessed by its cross-cultural presence and the amount of media items classified as drama that require significant metadata to improve access and retrievability. The ontology, called Drammar, consists of two layers, encoding the conceptual model and the mapping/appraisal rules, respectively. The paper focuses in particular on the rule layer, that imple-

ments respectively the mapping operation, for projecting the motivations of the drama agents on the timeline of incidents, and the appraisal of emotions, for computing the emotional states of the agents in the units from the plans they are committed to and the conflicts in which they are involved. The results of the applications of the rules are of great importance for drama scholars, in both their research activity and the teaching activity. The prototype experiment carried out on Hamlet nunnery scene has revealed a number of issues that significantly characterize the drama and support the potentiality of the encoding in teaching.

We are going to carry out extensive experiments on a corpus of dramatic media items that have been annotated with the conceptual model, with the goal to check the width of the rule format and of the particular rule structure devised for the emotion appraisal. Also, we are going to develop a further module of rules for the formulation of goals in response to values that are at stake: these tasks, as well as the selection of the plan to be committed, are the typical realm of rules in the development of applications of interactive storytelling. The long term aim is to see the convergence of annotation and production applications based upon a common core conceptual modeling and rule layering as demonstrated in this paper.

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