# Modeling and Visualization of Drama Heritage

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**Abstract.** This paper presents a multimedia system for the modeling and visualization of drama heritage. The system consists of an ontology based annotation schema for the dramatic metadata of the cultural heritage artifacts (in textual or audiovisual form), a web–based platform for the introduction of the metadata, and a module for the visualization and exploration of such metadata. The system was tested on the cross–media studies of drama.

**Keywords:** narrative audiovisual, ontological representation, information visualization, film heritage.

## 1 Introduction

In the last decade, the notion of cultural heritage has been extending from the tangible to the intangible heritage, i.e. heritage that is "not closely linked to the physical consistency" [20]. Often this heritage presents artifacts that are digitized, although there is a general agreement about the lack of resources for "cataloguing" the collections and "make them accessible to the tradition bearers and the general public" [9]. Quite often the focus of cultural heritage cataloguing has been put on the audiovisual resources and the safeguarding activity has been coinciding with the preservation of the physical storage of the data, in both analogical and digital formats. Although there are a number of examples where the physical support (film and tape) has been augmented with metadata in order to preserve/represent information otherwise lost, yet there is not a shared system to represent the symbolic features. On the one hand, the efforts of digitisation of Cultural Heritage are providing common users with access to large amount of materials (see, e.g., Europeana[1]), on the other, the amount of metadata is very restricted, items come with very short descriptions and lack contextual information. Complying with the UNESCO *Convention for the Safeguarding of Intangible Cultural Heritage*, we can stress the "cultural" side, henceforth pointing at the social and symbolic values [16].

There are a number of approaches for enriching cultural heritage items with metadata. Some authors have resorted to Wikipedia, which offers in-depth descriptions and links to related articles, and is thus a natural target for the automatic enrichment of CH items (see, e.g., [1]). Other approaches come from the

[1] `http://www.europeana.eu/`

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field of video indexing, where semantic descriptors are automatically associated with videos. Semantic descriptors have been growing from a few tens of the first TRECVid conferences to a few thousands[2], and individual concepts are connected through the creation of semantic relations and ontological organization: for example, LSCOM is an ontology of concepts targetedly designed for a corpus of broadcast news [13] and the MediaMill dataset relies on a set of 101 semantic descriptors that are best suited for that repository [17]. Finally, a relevant source are the user–generated metadata, such as the tags that are freely inserted by users to annotate the items contained in public repositories. With reference to the audiovisual CH items, [10] report an informal survey carried out on the clips extracted from the feature film from *North by Northwest* (the famous 1959 MGM–Hitchcock's movie), contained in the YouTube repository. The survey reveals that of the 183 unique tags, split manually, into eleven different categories (Title, Actor, Director, Production, Editing, Publish, Genre, Character, Object, Environment, Action), following grounded–theory based analysis [18], only 32 could be interpreted as content metadata (such as, e.g., auction, boulevard), with most tags referring to characters ("Roger", "mother") or their qualities ("blonde", "dress"). The other tags all concern the resource itself (actors, director, ...) and could be retrieved from other sources, such as IMDB.

In this paper we address CH items that have a narrative form, i.e. they tell a story about characters who perform live actions. The fruition of this cultural heritage mostly focuses on *enjoying* the *story* rather than appreciating the aesthetic features, although the latter are appraised by professionals and knowledgeable users. The notion of "story" is widely acknowledged as the construction of an incident sequence [3], that, abstracting from the cinematographic properties, is motivated by the cause–effect chain [15]; this chain results from a complex interplay among agents, events, and environments, well known in playwriting techniques [6]. We propose an annotation relying on user tagging, driven by a narration model that is encoded in an ontology and an access that takes advantage of a visualization tool that reveals interesting properties of the item. Hence, the multimedia application we present is designed to model, annotate, and visualize the dramatic values of the narrative heritage (such as film, video and drama), and provides a cross–media, abstract representation of a narration sequence (a timeline of incidents) and of the complex interplay.

The structure of the paper is the following. In the next section we sketch the CADMOS (Character-based Annotation of Dramatic Media Objects) suite, which, relying on the computational ontology Drammar, provides an interface for annotating the dramatic features of a narrative heritage item and visualizes the structure to the benefit of drama scholars and narration enthusiasts. Then we run a classic example, a scene extracted from Shakespeare's *Hamlet* to illustrate how the CADMOS suite works. Finally, we discuss the contribution of the representation in analyzing the differences between the original Shakespeare's screenplay and Olivier's film adaptation, a topic of much interest for drama scholars. Conclusions end the paper.

[2] http://www.lscom.org

## 2 CADMOS Suite for the Annotation of Metadata

CADMOS suite is a set of applications built around a computational ontology of the notion of story, called Drammar (see [4] for details). Based on the Drammar ontology, we have introduced an annotation schema, which is employed for the construction of a repository of drama items enriched with metadata, and a visualization tool, for the exploration of the metadata in the interest of scholars and enthusiasts. The Figure 1 illustrates the workflow of the CADMOS suite. Given an audiovisual item[3] the annotator, being her/him an expert or a visitor, splits the item into units (CADMOS segmentation phase), and defines a timeline of incidents as perceived from the movie. Then, he/she annotates the metadata for each unit, encoding the character's intentional behaviors in terms of goal, plans and achievement states, also with the support of the information from Shakespeare's text (CADMOS annotation phase). Timeline incidents, actions, goals, and plans are encoded according to the Drammar ontology. Finally, the encoding is displayed by matching the timeline incidents with the actions and plans assigned to the characters, to reveal the structure of the story plot (CADMOS vistool).

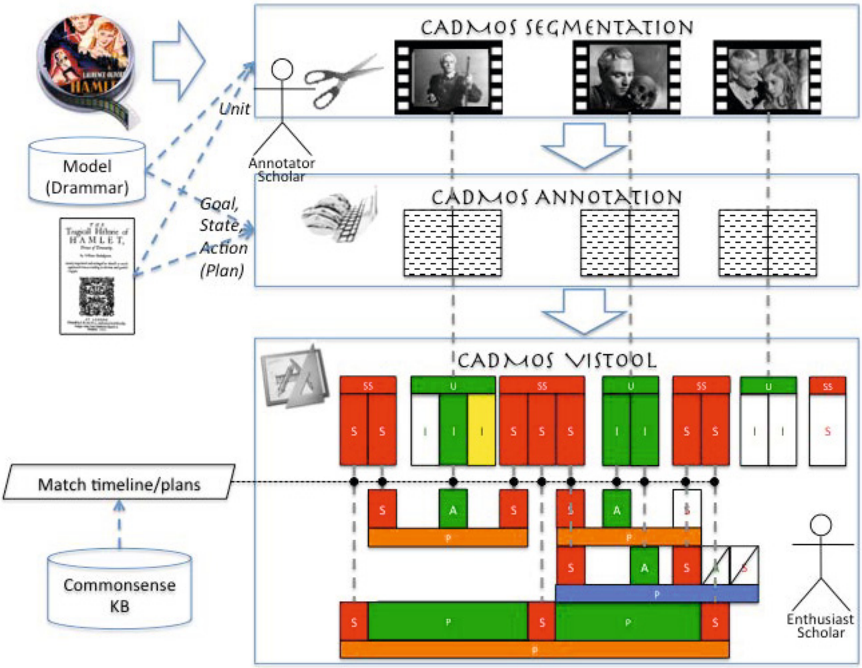


**Fig. 1.** The CADMOS suite workflow for metadata annotation and exploration

[3] In the figure, we have used the CH item *Hamlet*, the film directed by Laurence Olivier, UK, Two Cities Film production, 1948.

Now we introduce the ontology, the web–based application for annotating the metadata, and eventually the visualization tool.

### 2.1 Ontology Drammar

The Drammar ontology describes the content and structure of a story in terms of Units (the incidents of a story are grouped in segments), Entities (i.e., Agents, Objects and Environments of the story incidents), and Actions/States (that relate the entities one another). Drammar generalizes over the specific format by which a story is expressed ( novel, screenplay, etc.) and the medium through which it is conveyed. Following the paradigm of linked data[8], the ontology refers to external resources for the description of facts that are common to other domains: the large–scale commonsense ontologies SUMO (Suggested Upper Merged Ontology [14]) and YAGO (Yet Another Great Ontology [19]), merged into YAGO–SUMO [5], which provide very detailed information about millions of situations, including entities and process concepts; the lexical resources WordNet [12] and FrameNet [2], providing the means for an annotation interface based on linguistic terms and describing incidents and states through semantic templates expressed in terms of predicates and roles played by the participating elements; design patterns provided by other descriptive ontologies, such as DOLCE [7].

As an example of ontological encoding, we describe the annotation of a story incident (see Figure 2), driven by the Time Indexed Situation design pattern. This incident is extracted from the“nunnery scene” in the Third Act of Shakespeare's *Hamlet*. In this scene, Ophelia is sent to Hamlet by Polonius and Claudius to confirm the assumption that his madness is caused by his rejected love. According to the two conspirers, Ophelia should induce him to talk about his inner feelings. The girl is ready to return the love gift received by the prince, and hence hopes to induce him to confess his love and his suffering. Figure 2 shows the representation of the incident in which Ophelia is returning the gift to Hamlet.

The whole story is a sequence of incidents arranged on a timeline. Incidents are motivated by the achievement of agents' goal that are functional to the story advancement. Each agent features a library of plans that link the agents' goals with the actions they are committed to for the achievement of their goals. Actions then become actual incidents on the timeline, though some remain unrealized in favor of the realization of other agents' plans, who act in conflict with them. The plan structure is the following:

$P[Goal] = PreConditions(A)\ A\ Effects(A)$

$P[Goal] = +_{i=1}^{M} PreConditions(P)\ P_i\ Effects(P)$

A base plan for the achievement of some goal consists of an action $A$ and its Precondition and Effect states, respectively. States are ontological structures similar to processes (see Figure 2). A generic plans is then recursively defined as a sequence of (sub)plans, with Precondition and Effect states again (+ is the concatenation operator). Preconditions can be mental states, i.e. goals (G) and beliefs (B), and states of affairs in the story world (SOA). A base plan annotated for the agent Ophelia in the previous example is the following:

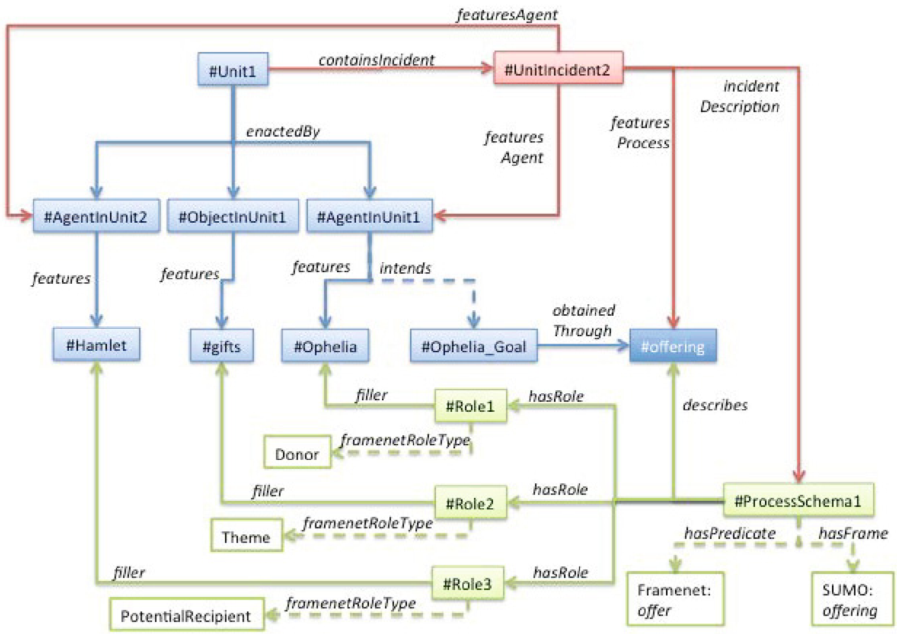


**Fig. 2.** The annotation of the incident where Ophelia offers the gift back to Hamlet, with instances (#) of Unit (*#Unit1*), Agent (*#Hamlet*, *#Ophelia*), and Object *#gift*). The action/process *#offering* (a SUMO concept) is connected to the role fillers (Framenet frame *offer*): *#Ophelia* is the *Donor*, *#Hamlet* the *PotentialRecipient*, gift the *Theme*.

$$P_{b1}^{Ophelia}[G : Ophelia\ wants\ Ophelia\ interact\ with(Hamlet)] =$$

$$SOA : \ Ophelia\ neglected$$
$$A : \ Ophelia\ returning\ gift\ to(Hamlet)$$
$$SOA : \ Hamlet\ have\ gift$$

In this example, Ophelia, convinced by Claudius and Polonius, tries to induce Hamlet to reveal his deeper feelings. She use the gift once received as love signs as a means to provoke the prince. Thus, the action of returning gift is motivated by Ophelia's goal of having an interaction with Hamlet and because of the pre-conditional state of affairs that she is neglected; the effect should be that Hamlet is in possess of the gift (but this state will remain unrealized).

### 2.2 CADMOS Annotation and Mapping

Within the CADMOS project we have developed a web based interface and annotation tool (see Figure 3), that was designed to carry out the annotation without the load of formality on the annotator. The annotation process starts by identifying the meaningful units of the item, by marking its boundaries through a video player interface (Figure 3, above right); then, selecting the appropriate tabs, the annotator introduces the metadata for the story entities (agents, objects, environments); finally, the annotator retrieves the incident templates (a similar template concerns actions, events, and states), with roles that are filled with the story elements (the M–e–s tab concerns the mise–en–scène properties of the scene, i.e. camera movements, camera angle, type of shot, staging of actors). The annotation of actions also include their motivations, namely goals and plans, with precondition and effect states. The appropriate metadata are identified through natural language words that are used to retrieve the formal terms in the lexical and commonsense knowledge ontologies.

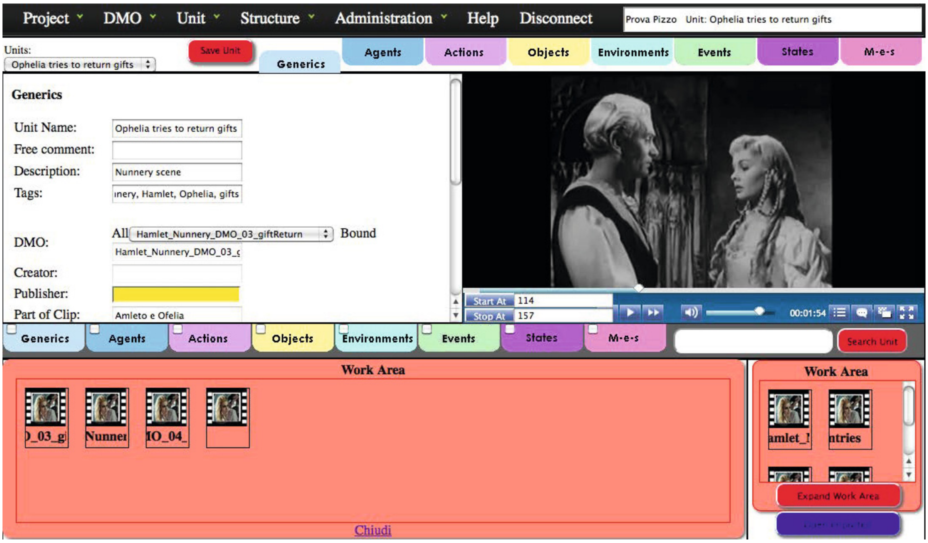


**Fig. 3.** The Cadmos Web Application for the segmentation and the annotation phases

The mapping of plan actions over timeline incidents is useful to visualize the motivations underlying agents' actions. First, we analyze the plans, and discover the actions that match (i.e., motivate) the incidents of the timeline; then, we point out successes and failures of characters' behaviors, i.e. we evaluate what plans can be fully realized or what plans fail; finally, we project the states required by the plan, as preconditions or effects of the plan actions, onto the timeline incidents.

This mapping is realized in the ontology by 1) modeling the timeline and the plans as sketched above, 2) defining the incident mapping through SWRL (Semantic Web Rule Language) IF–THEN rules, and 3) augment the timeline with states through an off–line algorithm. Both Timeline and Plan classes modeling relies on the generic class *OrderedList*, that represents the incidents' positions. An instance of Process or State refers to some position (relation *refersToTimeline*) in the Timeline or in a Plan, respectively. Based on the representation above, the reasoner infers that some ordered list of incidents in the timeline belongs to some plan. The reasoner works with inferences of an ontological nature and with a SWRL rule that validates the mapping of some incident to some plan action. Finally, the timeline of the incidents is augmented through an off–line algorithm that takes as inputs the timeline, the plans, and the incident mapping, and returns as output an OrderedList named Augmented Timeline that contains the incidents of the Timeline, in the same partial order as in the Timeline, interspersed with states (agglomerated into story world states) as projected from the plans. So, if a state S is a precondition of the action A in the plan P, and the action A is mapped the incident I in the Timeline, then a state S', that is the same as S is inserted in the Timeline before I (and after the incident preceding I in the Timeline). The augmented timeline OrderedList features a total order over incidents and states.

### 2.3 CADMOS Visualization Tool

In this section we describe the design, both interface and interaction, and the implementation of the visualization tool. The visualization concerns multiple trees of characters' intentions (or plans), possibly arranged hierarchically on a tree that spans a timeline of events.

The whole visualization space is split into three areas (refer to Figure 4): the Agents area (top), where the characters involved are listed and the Timeline area, where the augmented timeline is displayed with the incidents and the states, the Plans area, where the plans are displayed in hierarchical order. Each narrative incident or state is represented by a box (green for actions, yeller for events, red for states). White boxes in the Plans area are actions not mapped in the timeline, but the plan is activated because some of it's actions or states have been mapped. Finally, the boxes filled with white color and barred diagonally means have not been realized in the Timeline, thus the plan failed.

All the incidents or states in the timeline have occurred in the plot realization. The timeline incidents pivot the horizontal alignment: each realized plan action is aligned with the matching timeline incident; at the same time states of the plans are projected onto the timeline to represent the story world state between adjacent units. The incidents that occur in a unit are considered in parallel, though we decided to assign them an individual position to allow for a visible alignment with the plan action. The plan label is an horizontal box that spans all the states and actions that belong to it.

In figure 4 there is the visualization of the excerpt of "nunnery scene" described above. As an example of mapping, consider the actional incident I_OLI_0016 ("Ophelia returning gift to(Hamlet)"), mapped onto the plan action A_0005 ("Ophelia returning gift to(Hamlet)"). A plan participates to the mapping and the augmentation of a timeline when the order of the incidents on the timeline respects the order of the mapped actions in the plan. In our example, since we have the mapping I_OLI_0016–$A\_0005$, and the subsequent mapping I_OLI_0017 (Hamlet denying gift)–$A\_1112$(Hamlet refuse gift), the plan $P\_P\_0003^{Ophelia}$ can participate to mapping (notice that the last part of the plan

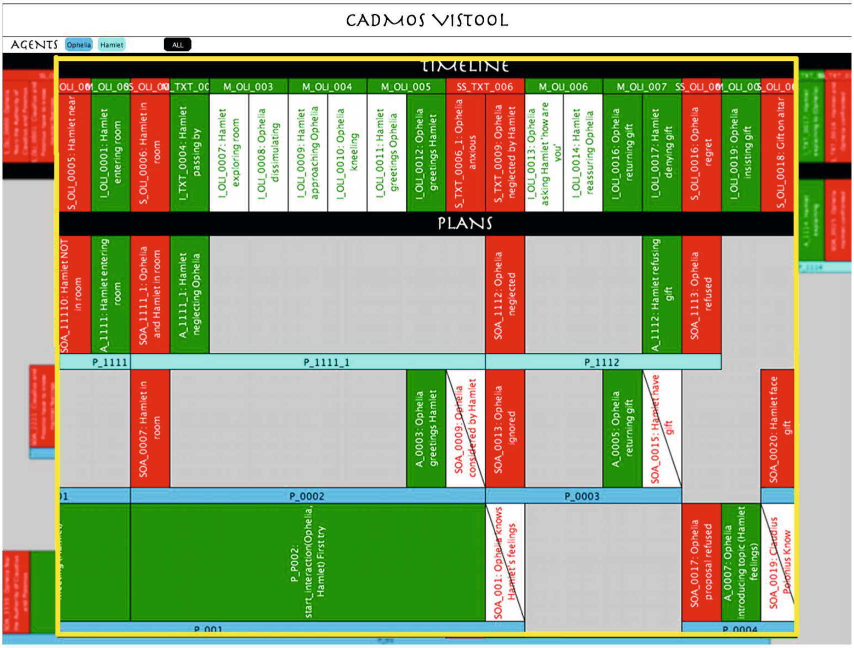


**Fig. 4.** Augmenting timeline with states projected from plans, with an enlargement in the middle area

is not mapped then). If the sequence of incidents does not respect the order exhibited by the mapping actions in some plan, that plan is not activated for contribution to mapping.

We augment the timeline with the states that hold between adjacent incidents on the timeline. States are taken from the preconditions and effects that are associated with the actions in the plans. So, in the case of A_0005 ("Ophelia returning gift to(Hamlet)"), we will have $SOA: \ Ophelia\ neglected$ as precondition, and $SOA: \ Hamlet\ have\ gift$ as effect.

## 3 Discussion and Conclusion

In order to validate our approach, we tested the differences between the original text and one specific mise-en-scène, a much appreciated topic for drama scholars. The matching of the plans over the augmented timeline shows the relation between the description of the agents' behaviors and intentions, as implied by the text *Hamlet* and the factual representation of those behaviors in the mise-en-scène (i.e. the actors' displayed actions). The latter can be considered a sort of translation that converts the information provided by the written text into the performance, transcoding the "dramatic text" into the "performance text" [11]. In a drama, the most important aspects of the translation are the dramatic features of the text (e.g. characters, intentions, conflicts, emotions). These features can be considered as the intangible heritage of a dramatic item. The visualization helps to measure the degree of equivalence between this intangible cultural heritage and a specific form of representation. In our example, the beginning of the so called "nunnery scene" in Olivier's movie shows a high grade of conformity with the drama, albeit there is a clear discrepancy regarding the Hamlet's plan P_1111_1 for which we have to resume to the text, I_TXT_0004, as well as in the plan P_1114 that can be matched only with I_TXT_0017 (I_TXT are facts stated in the text timeline; I_OLI are facts stated in the movie timeline). This means that the movie fails to fully represent the content of the drama, i.e. the artist provides a specific personal interpretation of the intangible heritage called *Hamlet*, the Shakespeare's play. The differences among such heritage and its numerous mise-en-scène's can be considered quite common in the case of the intangibility, as in traditional folk fable where there is a flourishing of versions (for example the story of *Cinderella* from oral tale to Perrault's or Disney's versions). In the case of drama, we have not only a written text to preserve, but also, and most importantly, the dramatic features that shape the specific story. The representation of such features must go beyond the mere philological approach (that would undermine the quality of the performance), and can take into account the core structure of the heritage. In other words, the artist (Olivier, in our case) can neglect to display all the lines of the play as well as each action described in the text, and, in the same moment, he can comply with the drama. For example, Olivier's rendering of Hamlet's character seems to add actions that weren't clearly stated in the text (the white boxes in the timeline representation - Figure 4), but nevertheless they fulfill the plan as devised in the original behaviors in the play.

In this paper, we have presented a tool for acquiring the metadata of intangible cultural heritage, specifically drama heritage. Our proposal relies on a computational ontology that encodes the major facts about drama and provides a web-based application for annotators to contribute. After computed the mapping between the agents' intentions and the actions they carry out, the alignment is displayed through a visualization tool for study and access purposes. The approach has been tested on a study of the text/mise-en-scène differences on Hamlet's nunnery scene.

## References


1. Agirre, E., Barrena, A., de Lacalle, O.L., Soroa, A., Fernando, S., Stevenson, M.: Matching cultural heritage items to wikipedia. In: Calzolari, N., Choukri, K., Declerck, T., Doğan, M.U., Maegaard, B., Mariani, J., Odijk, J., Piperidis, S. (eds.) Proceedings of the Eight International Conference on Language Resources and Evaluation (LREC 2012). European Language Resources Association (ELRA), Istanbul (2012)
2. Baker, C., Fillmore, C., Lowe, J.: The berkeley framenet project. In: Proceedings of the 36th Annual Meeting of the Association for Computational Linguistics and 17th International Conference on Computational Linguistics, vol. 1, pp. 86–90. Association for Computational Linguistics (1998)

3. Bordwell, D., Thompson, K.: Film art: An introduction. McGraw Hill, Boston (2006)
4. Cataldi, M., Damiano, R., Lombardo, V., Pizzo, A., Sergi, D.: Integrating commonsense knowledge into the semantic annotation of narrative media objects. In: Pirrone, R., Sorbello, F. (eds.) AI*IA 2011. LNCS, vol. 6934, pp. 312–323. Springer, Heidelberg (2011)
5. De Melo, G., Suchanek, F., Pease, A.: Integrating yago into the suggested upper merged ontology. In: 20th IEEE International Conference on Tools with Artificial Intelligence, ICTAI 2008, vol. 1, pp. 190–193. IEEE (2008)
6. Egri, L.: The Art of Dramatic Writing. Simon and Schuster, New York (1946)
7. Gangemi, A., Presutti, V.: Ontology design patterns. In: Handbook on Ontologies, pp. 221–243 (2009)
8. Heath, T., Bizer, C.: Linked data: Evolving the web into a global data space. Synthesis Lectures on the Semantic Web: Theory and Technology, pp. 1–136 (2011)
9. Kurin, R.: Safeguarding intangible cultural heritage in the 2003 UNESCO convention: A critical appraisal. Museum International 56(1/2), 66–77 (2004)
10. Lombardo, V., Damiano, R.: Commonsense knowledge for the collection of ground truth data on semantic descriptors. In: Proceedings of the 2012 IEEE International Symposium on Multimedia (ISM 2012), pp. 78–83. IEEE Computer Society (2012)
11. Marinis, M.D.: The Semiotics of Performance. Indiana University Press (1993)
12. Miller, G.: Wordnet: a lexical database for english. Communications of the ACM 38(11), 39–41 (1995)
13. Naphade, M., Smith, J.R., Tesic, J., Chang, S.F., Hsu, W., Kennedy, L., Hauptmann, A., Curtis, J.: Large-scale concept ontology for multimedia. IEEE MultiMedia 13, 86–91 (2006)
14. Pease, A., Niles, I., Li, J.: The suggested upper merged ontology: A large ontology for the semantic web and its applications. In: Working Notes of the AAAI-2002 Workshop on Ontologies and the Semantic Web (2002)
15. Rimmon-Kenan, S.: Narrative Fiction: Contemporary Poetics. Routledge (1983)
16. Smith, L., Akagawa, N.: Intangible Heritage. Key Issues in Cultural Heritage. Taylor & Francis (2008), `http://books.google.it/books?id=voan0ESUzgAC`
17. Snoek, C.G., Worring, M., van Gemert, J.C., Geusebroek, J.M., Smeulders, A.W.: The challenge problem for automated detection of 101 semantic concepts in multimedia. In: Proceedings of ACM Multimedia, Santa Barbara, USA, pp. 421–430 (October 2006)
18. Strauss, A., Corbin, J.: Basics of qualitative research: grounded theory procedures and techniques. Sage Publications, Newbury Park (1990)
19. Suchanek, F., Kasneci, G., Weikum, G.: Yago: a core of semantic knowledge. In: Proceedings of the 16th International Conference on World Wide Web, pp. 697–706. ACM (2007)
20. Vecco, M.: A definition of cultural heritage: From the tangible to the intangible. Journal of Cultural Heritage 11(3), 321–324 (2010), `http://www.sciencedirect.com/science/article/pii/S1296207410000361`