Ontology–Based Visualization of Characters' Intentions

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Preface

This volume contains the proceedings of ICIDS 2014: The 7th International Conference on Interactive Digital Storytelling. ICIDS is the premier venue for researchers, practitioners, and theorists to present recent results, share novel techniques and insights, and exchange ideas about this new storytelling medium. Interactive digital storytelling is an exciting area in which narrative, computer science, and art converge to create new expressive forms. The combination of narrative and computation has considerable untapped potential, ranging from artistic projects to interactive documentaries, from assistive technologies and intelligent agents to serious games, education, and entertainment. In 2014, ICIDS took place in Singapore at the National University of Singapore, marking the conference's first venture to Asia.

This year the review process was extremely selective and many good papers could not be accepted for the final program. Altogether, we received 67 submissions (42 full papers, 20 short papers, and five demonstrations). Out of the 42 submitted full papers, the Program Committee selected only 12 submissions for presentation and publication as full papers, which corresponds to an acceptance rate of less than 29% for full papers. In addition, we accepted eight submissions as short papers, seven submissions as posters, and five submissions as demonstrations. In total, the ICIDS 2014 program featured contributions from 26 different institutions in 18 different countries worldwide.

The conference program also highlighted three invited speakers: Bruce Nesmith, Design Director, Bethesda Game Studios, and lead designer of Skyrim; Emily Short, narrative design consultant with a special interest in interactive dialogue, and author of over a dozen works of interactive fiction, including Galatea and Alabaster; and William Uricchio, Professor of Comparative Media Studies at MIT, and Principal Investigator of MIT's Open Documentary Lab and the MIT Game Lab (formerly the Singapore-MIT GAMBIT Game Lab). The titles of their talks were:

- Bruce Nesmith:
  The Story of Radiant Story
- Emily Short:
  Narrative and Simulation in Interactive Dialogue
- William Uricchio:
  Old Dogs—New Tricks: Lessons from the Interactive Documentary

In addition to paper and poster presentations, ICIDS 2014 featured five post-conference workshops: (1) An Introduction to Game Mastering: How to Use Tabletop Role-Playing Games to Collaboratively Produce and Create Stories, (2) Managing Informational Interactive Digital Storytelling Projects,

(3) Narrative Analysis of Interactive Digital Storytelling, (4) Future Perspectives for Interactive Digital Narrative, and (5) Story Modelling and Authoring.

In conjunction with the academic conference, an art exhibition was held at ArtScience Museum at Marina Bay Sands. The art exhibition featured a selection of 10 artworks selected from 39 submissions by an international jury.

We would like to express our sincere appreciation for the time and effort invested by our authors in preparing their submissions, the diligence of our Program Committee and art exhibition jurors in performing their reviews, the insight and inspiration offered by our invited speakers, and the thought and creativity provided by the organizers of our workshops. Special thanks are also due to our sponsors and supporting organizations, and to the ICIDS Steering Committee for granting us the opportunity to host ICIDS 2014. Thank you!

November 2014

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ArtScience Museum at Marina Bay Sands

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Ontology–Based Visualization of Characters' Intentions

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Abstract. The visualization of the characters' intentions in a drama is of great importance for scholars and professionals. The characters' intentions provide the motivations for the actions performed in a drama, and support its interpretation. This paper presents an interactive ontology–driven tool for the visualization of a drama analysis based on the mapping between the characters' actions and intentions, respectively. An automatic mapping establishes the correspondence between the actions, distributed on the linear timeline of the drama, and the intentions that motivate such actions, which form a forest of trees, one tree per character, spanning portions of the timeline. A tool provides a graphical representation of such correspondences and an immediate appraisal of the motivations of the actions in terms of tree projections. The system was tested on the analysis of a scene from *Hamlet* and has been employed in support of drama studies and didactics.

Keywords: Drama ontology, tree visualization, intelligent mapping.

1 Introduction

This paper presents a visual interface for improving the access to the drama content through a visualization of the content expressed in terms of the mapping between the characters' intentions and the linear unfolding of the story incidents on a timeline. In particular, the characters' intentions that motivate the incidents are represented by hierarchical plans arranged on trees, one tree per character; plans that commit to short–term goals are components (i.e., children in tree terminology) of plans that commit to longer–term goals.

The visualization of the characters' intentions in a drama is of great importance for scholars and professionals, as the analysis of intentions is one of the most important differences between drama analysis and literary criticism. The system represents the drama elements in an ontological form and implements an automatic mapping between the characters' intentions and actions, respectively, and then visualizes the relationship between the story incidents and the characters' intentions in terms of tree projections. The system has been appraised in

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the analysis of a scene from *Hamlet* and has been employed in support of the drama analysis.

2 Background and Related Work

The applicative scenarios of the visualization of characters' intentions in a drama range from the media production industry, to the preservation of drama as intangible cultural heritage, to drama studies and teaching.

Though the visualization of story relations has been addressed by visual artists and amateurs to provide unique maps for orientation, especially in dramas that are difficult to grasp on behalf of the audience (see, e.g., the visualization of two Nolan's films *Memento*[1], 2000, and *Inception*[2], 2010), on a more productive side, a number of visual interfaces are provided with software tools that have been developed to assist the creation and production of dramas. For example, the writing assistant Dramatica Pro[3] visualizes the building blocks of a plot structure, with diagrams for plot progression and story points, that helps the writer in controlling and balancing the tension within the story development. Some works [14,13], propose the metadata annotation of dramatic heritage items, assuming an ontological approach (ontology called Drammar) to the representation of the drama elements, encoding the widely acknowledged relationship between the drama abstraction and one of the concrete shapes a drama can assume [19, p. xviii]. There exist other approaches that guide the annotation for the formal encoding of the drama elements. The Story Intention Graph [6] relies on the representation of the short–term characters' intentions to build an interpretive layer of a narrative text. This approach is very similar to what we propose in this paper, though missing the long–term relationships of the characters' intentions represented by the hierarchical nature of plans (see below), being oriented to the immediate interpretation of the actions. The Stories ontology[4], developed in collaboration with the BBC for the application in news, the storylines of *Doctor Who* episodes, and historical facts, is an event–(instead of character–) based description of the timeline of story incidents, with no interpretive intents. In both cases, we do not know of a visualization tool for presentation and analysis purposes.

Within the specific domain of drama, we recall a so–called constructivist approach, which departs from the linguistic and literal forms to focus on the constitutive elements of drama. The analyses of Lavandier [12], Ryngaert [20], Hatcher [10], and Spencer [21] distill the dramatic elements that the playwriter 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 [16].

[1] `http://visual.ly/memento-scene-timeline`
[2] `http://visual.ly/inception-timeline-visualisation`
[3] `http://www.writersstore.com/dramatica-pro-story-development-software/`
[4] `http://www.contextus.net/stories`

In this paper, we build on the Drammar approach: dramatic media are described by representing both the intentions of the characters and the timeline of story incident in a single formal representation. Here we use the word intentions to mean all the complex deliberative construct that guides the character's actions in the drama. With the word timeline, we summarize the temporal deployment of the executed action that will be experienced by the audience. Later in the paper, we show how, to be formally represented, these two notions forth a number of different features in our ontology. The challenges posed by the visualization concern the display of a timeline, with a fixed order of the component of incidents, and the superimposition of a number of trees that represent the characters' intentions. However, incidents and intentions should be aligned to reveal the structure of motivations that holds the plot.

3 Ontology Representation of Story Metadata

The notion of "story" is widely acknowledged to be a construction of an incident sequence that, abstracting from the mise–en–scène properties, is motivated by the cause–effect chain [18]; this chain results from a complex interplay among agents and events, well known in playwriting techniques [5]. In this section, we introduce the ontology Drammar, taking as a running example *Hamlet*. In particular, we address the "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 the Prince'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. 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.

The ontology Drammar (encoded in the OWL2 RL language) has been designed with the twofold goal of providing a formalized conceptual model of the dramatic elements [2,13,14], and an annotation schema for encoding the description of a dramatic item. So, along with classes that represent the domain of drama, it contains specific classes that are intended for interfacing the representation of drama with linguistic and common sense knowledge. The main classes of Drammar are: `DramaEntity`, grouping all the elements that belong to the drama domain, including the structural elements; `Description Template`, containing all the patterns for encoding linguistic schemata; `External Reference`, bridging the core elements of the ontology onto the external knowledge bases that allow the description of instantiated drama. Each class has then a number of subclasses; here we will describe the most relevant for the scope of this paper. The Drama Entity class is divided into three subclasses, each describing specific drama elements. `Drama Perdurant` and `Drama Endurant` represent, respectively, the processes that occur in drama, and the entities (characters and objects) that participate in them. `Drama Structure` subsumes specific classes for representing the structures of the story, which include sequential structures (`DramaList`), such as plans of the agents and timelines of incidents, and set structures (`DramaSet`), such as units, which group the incidents occurring in a specific story fragment. The `Timeline` class represents the indexing of units along time, while the `Plan` class encompasses the agents' intentions, and is organized hierarchically. The former accounts for the linear ordering of units as determined identifying intuitively the boundaries of the actions, the latter accounts for the intentions of the characters that motivate the actions occurring in the units. The `DramaEndurant` class subsumes the story entities participating in the unit, namely `Agent` (representing the characters that intentionally act in the incidents), and `Object` (any entity that is relevant to the action and does not have goals). The `Drama Perdurant` class provides the elements for the story dynamics, namely processes and states (subclasses `Process` and `State`, respectively), subdivided into *eventive* and *factual*, following a tradition dating back to 1927 [17]. The `EventiveProcess` class refers to what we have so far called incidents, and includes intentional and unintentional processes (`Action` and `UnintentionalEP` respectively) that occur in units or are committed in plans (`ActionInUnit` and `ActionInPlan`). The `EventiveState` class is divided into `StateOfAffairs`, `MentalState`, and `Done`; the latter class includes those states that represent the completions of processes. Mental states describe the intentional behavior of agents [7]; they encompass the following classes: `Belief`: the agent's subjective view of the world; `Emotion`: what the agent feels; `Goal`: the objectives that motivate the actions of the agents and help to describe the character's dramatic intention; `Value`: the moral values acknowledged by an agent; values can be put at stake by the unfolding of the story (specific class `ValueAtStake`).

The `Description Template` class has the purpose of binding a situation (e.g. either a process or a state) to its linguistic description. Each situation in Drammar is described by a template (linked to external knowledge repository - see next paragraph) that will provide an explicit shared pattern: for example, the process of *eating* will be univocally described as the relation between, at least, two entities (the eater and the eaten). The subclasses, namely `Schema` and `Role`, provide the primitives needed to realize this description. The `Schema` class represents the description of the situation in terms of the roles involved in it (i.e. the eating process[5]). In order to map the participant entities (i.e. the role eater and the role eaten), the class `Schema` is related to the `Role` class via the `hasRole` property.

The `ExternalReference` class is aimed at representing the qualities needed to describe specific drama entities. Following the paradigm of linked data [11], each different value of a quality is referred via an IRI (Internationalized Resource Identifiers)[6] pointing to some external common sense or domain

[5] See the Situation Description ontology pattern [8].

[6] The IRI is a generalization of the uniform resource identifier (URI), that extends the string of characters used to identify a name of a resource from ASCII to Unicode.

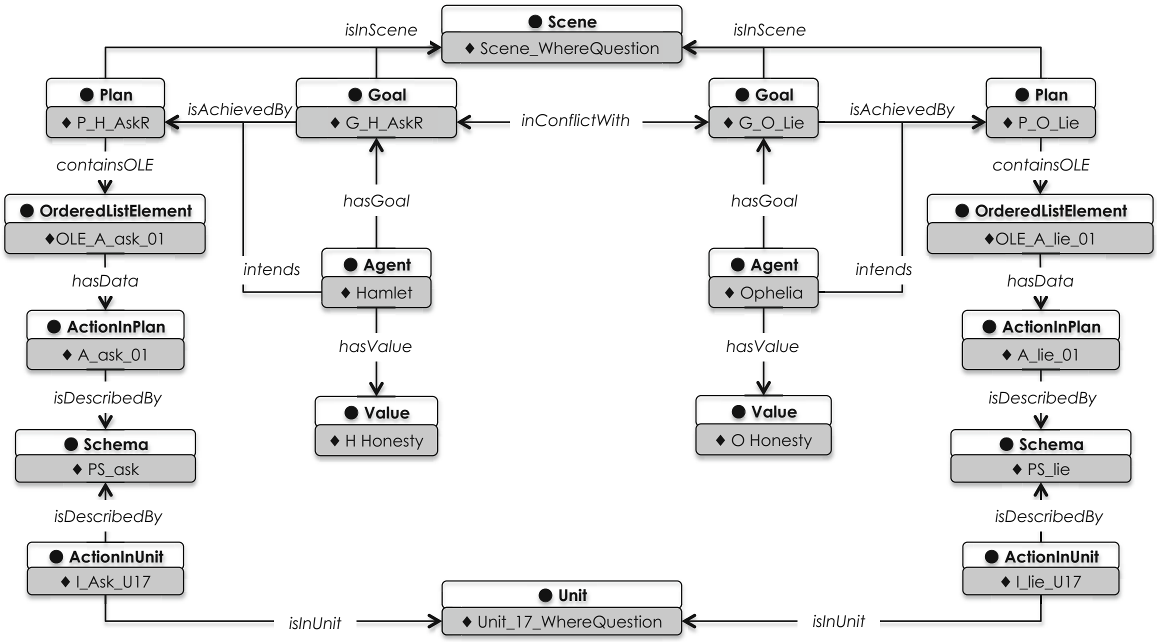

Fig. 1. The annotation of the example scene. Hamlet asks to Ophelia where her father is, and she answers with a lie.

specific ontology. [3] presents the linguistic interface for the annotation of linguistic schemata and commonsense knowledge information (involving the FrameNet roles and linguistic frames [1] and YAGO–SUMO commonsense ontology [4]). In Fig. 1, we illustrate how our running example, the "nunnery" scene, is represented in Drammar conceptual terms. The scene (Scene_WhereQuestion, see top of Fig. 1) encompasses the conflicting goals of `Hamlet` and `Ophelia` (`G_H_AskR` and `G_O_Lie` respectively), and the plans they have devised to achieve them (`P_H_AskR` and `P_O_Lie`), to which they are committed (i.e., that they intend, as expressed by the `intends` property). Both agents care for the value of honesty (`O_Honesty` and `H_Honesty`). Here, we show only the plan-related individuals that are relevant to the excerpt. Hamlet's plan contains the action of asking (`A_ask_01`, `OLE_A_ask_01`); Ophelia's plan contains the action of lying (`O_lie_01`, `OLE_O_lie_01`). The same schema, `PS_ask`, describes both Hamlet's action of asking in the unit and the corresponding action committed to by the plan; the same holds for Ophelia's planned and executed actions, both described by the schema `PS_lie`. Hamlet's and Ophelia's executed actions belong to the same unit (i.e., the basic container of the actions of the drama), `Unit_17_WhereQuestion`, to which they are linked through the `isInUnit` property. The unit (`Unit_WhereQuestion`) is positioned in the Timeline of the "nunnery" scene (`TL_Hamlet_Nunnery`). The ordering is provided by the `precedes` property: for example, the element that "stands for" the `Unit_WhereQuestion` is preceded by the recommendation that Hamlet provides to Ophelia to go to a nunnery and precedes Hamlet's outburst.

4 Mapping and Visualization

In this section, we focus on the core phases of mapping and visualization. Mapping is the intelligent phase that connects the plans and the incidents, by taking into account the coincident actions and the states that hold as preconditions and effects of the plans; visualization then takes into account the correspondences and provides a diagram that informs about the dramatic qualities.

4.1 Mapping

In the Drammar approach, the incidents in the units of the timeline are viewed as operators that carry on the story development from one state to the next one; states are projected from the plan structure onto the timeline, connecting the motivations (goals and plans intended by the characters) to the actions actually carried out. The projections of states onto the timeline and the connection of plans to incidents are yielded by if–then rules (encoded in SWRL language).[7] The rules aim at detecting the matching of the actions (incidents) occurring in the unit and the actions in plans, according to some shared properties of the linguistic schemata.[8] The automatization of the mapping corresponds to a workflow in which some scholar or enthusiast annotates a timeline of units and incidents and a drama scholar operates independently by identifying the characters' intentions, encoded in plans and goals; then, the SWRL rule finds what intentions match with what incidents, to augment the annotation and form the base for the visualization. In particular, the application of such rules aligns Plans and Units and augments the Timeline by interspersing units with precondition and effect states (called UnitStates).

The mapping works as follows (see Fig. 2):

– match plan actions and unit incidents through the equality of the description schema in the antecedent of the rule (see curved dotted line "mapping" in Fig. 2); in the antecedent the rule also identifies the individuals to be connected in the consequent part;
– project the states required by the plan as preconditions or effects, the plan states, onto the unit preconditions and effects, the unit states (see curved dotted lines "hasSetMember" and "spans" in Fig. 2) .

The ontology is initialized with the Timeline that includes empty unit states that precede and follow the units. Then, each application of the rule fills the

[7] If–then rules, combined with ontological description, allow the derivation of novel knowledge through the form of an implication between an antecedent (body) and consequent (head). In particular, the Semantic Web Rule Language (SWRL) is the language born form the merge of Rule ML and OWL DL, that integrates OWL with a rule layer built on top of it, adding the possibility to declare arbitrary Horn clauses expressed as if–then rules.

[8] The current implementation is based on simple operations, such as the exact equality of the linguistic frame, but it may potentially based on more complex algorithms for the computation of similarity indices.

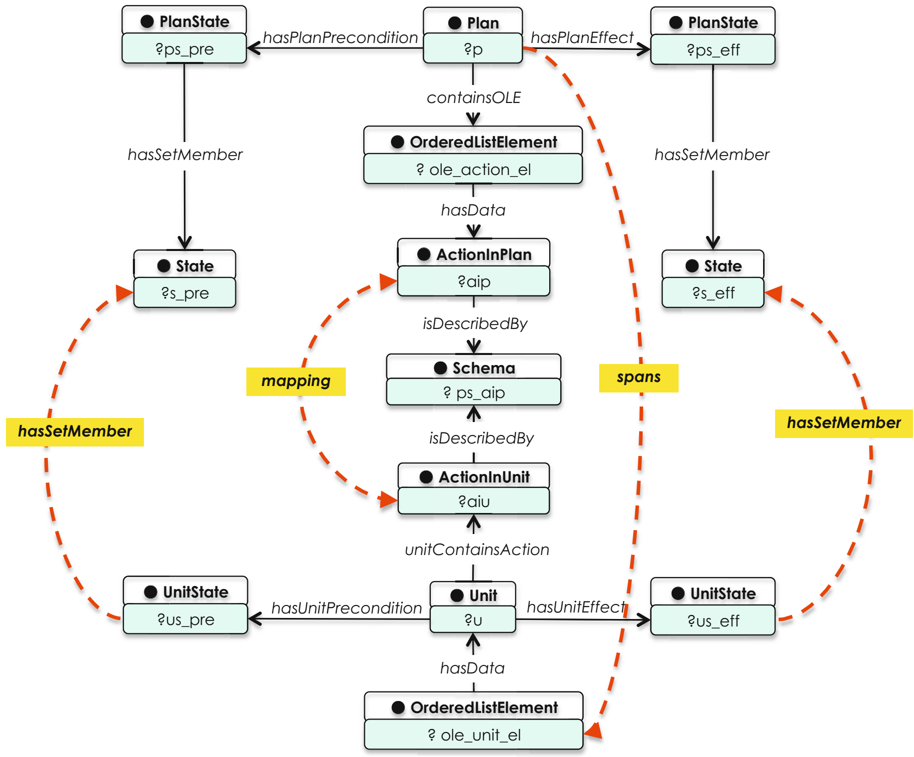

Fig. 2. The main mapping rule, that accounts for the spanning relation between plans and units. Another rule accounts for the spanning of hierarchically higher plans with a number of units.

unit states with states contained in the plans. In the excerpt of the "nunnery" scene, we have Hamlet's plan `P_H_AskR` and its action `A_ask_01` mapped onto the action `I_Ask_U17` (Hamlet asking Ophelia: "Where is your father?") of the `Unit_17_WhereQuestion`; the same happens for Ophelia's plan `P_O_Lie`, between the action `A_lie_01` and the unit action `I_lie_U17` (Ophelia lying about Polonius' location: "At home, my lord."). The higher plan `P_H_LearningHonesty` (Hamlet) is then triggered because of the mapping of the subplan `P_H_AskR`, though the latter fails in achieving its goal (see the visualization below).

4.2 Visualization

The visualization module addresses the representation of multiple trees of characters' plans, arranged hierarchically on a tree that spans a timeline of events. Tree layout, especially in the case of multiple trees spanning the same set of basic elements (usually the leaves of a tree) has been the object of several approaches of information visualization (see the survey in [9] on single and multiple trees); each approach brings specific advantages and disadvantages, depending on the task at hand. We have implemented a form of containment (or nested) approach, which has the advantage of a bounded space; this approach typically leaves no room for node content, but in our system this content is retrievable through mouse interaction on the node.

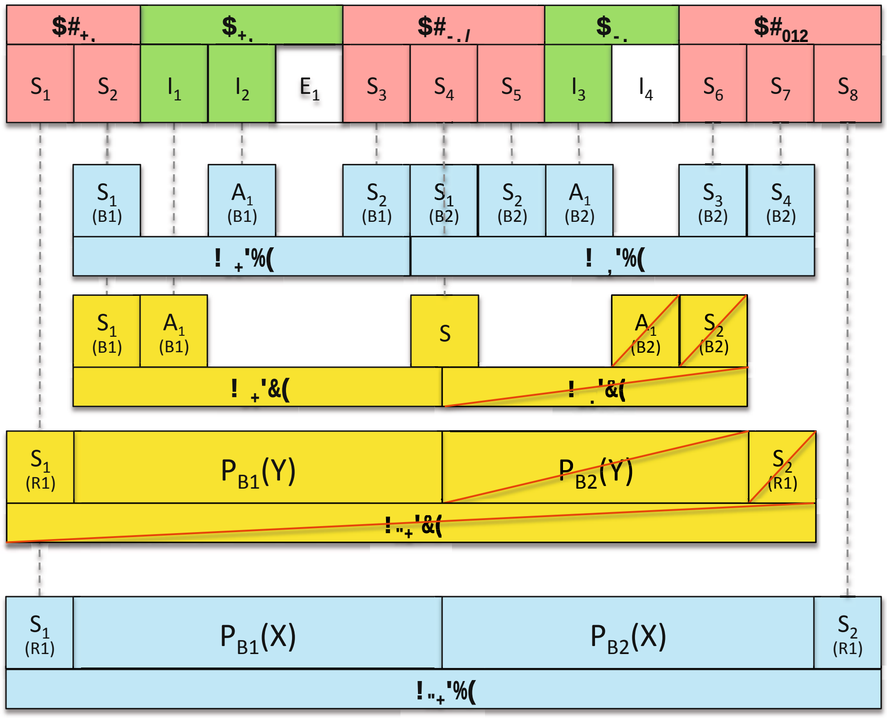

Fig. 3. General schema of the visualization: top) timeline, made of units U (made of incidents I and E) and unit states US (made of states S projected from plans P); bottom) agents' plans, made of actions A and states S aligned with unit incidents I and states S, respectively. Notice that two incidents were not matched by the plans actions.

The multiplicity of trees is visualized as different layers. The abstract structure of visualization is in Fig. 3. In the top row there is the Timeline, consisting of units (`U`) and unit states (`US`). Units are made of incidents, which can be either intentional actions (`I`), so mapped to actions in agents' plans, or unintentional events (`E`). Unit states are collections of single states, which are retrieved from the agents' plans and projected onto the timeline. Unintentional events and unmapped intentional incidents are filled in white. In the lower part of the figure we visualize the plans of the agents, arranged hierarchically (root at the bottom). X and Y are the agents that commit to the plans; `S` is a state and `A` is an action. Plans closer to the timeline consist of an action bordered by precondition and effect states, respectively; plans higher in the hierarchy consists of a sequence of subplans bordered again by precondition and effect states. All actions and states are mapped onto the timeline (dotted lines in the figure). Each incident or state is represented by a box; boxes filled with white color and barred diagonally indicates elements that have not been realized in the timeline, thus the plan failed.

The visualization algorithm proceeds left to right by following the mapping between incidents and plan actions. It assumes the timeline distribution of the states and incidents over the x axis as fixed and aligns the plan actions and consequently the precondition and effect states as a consequence. The plan hierarchy

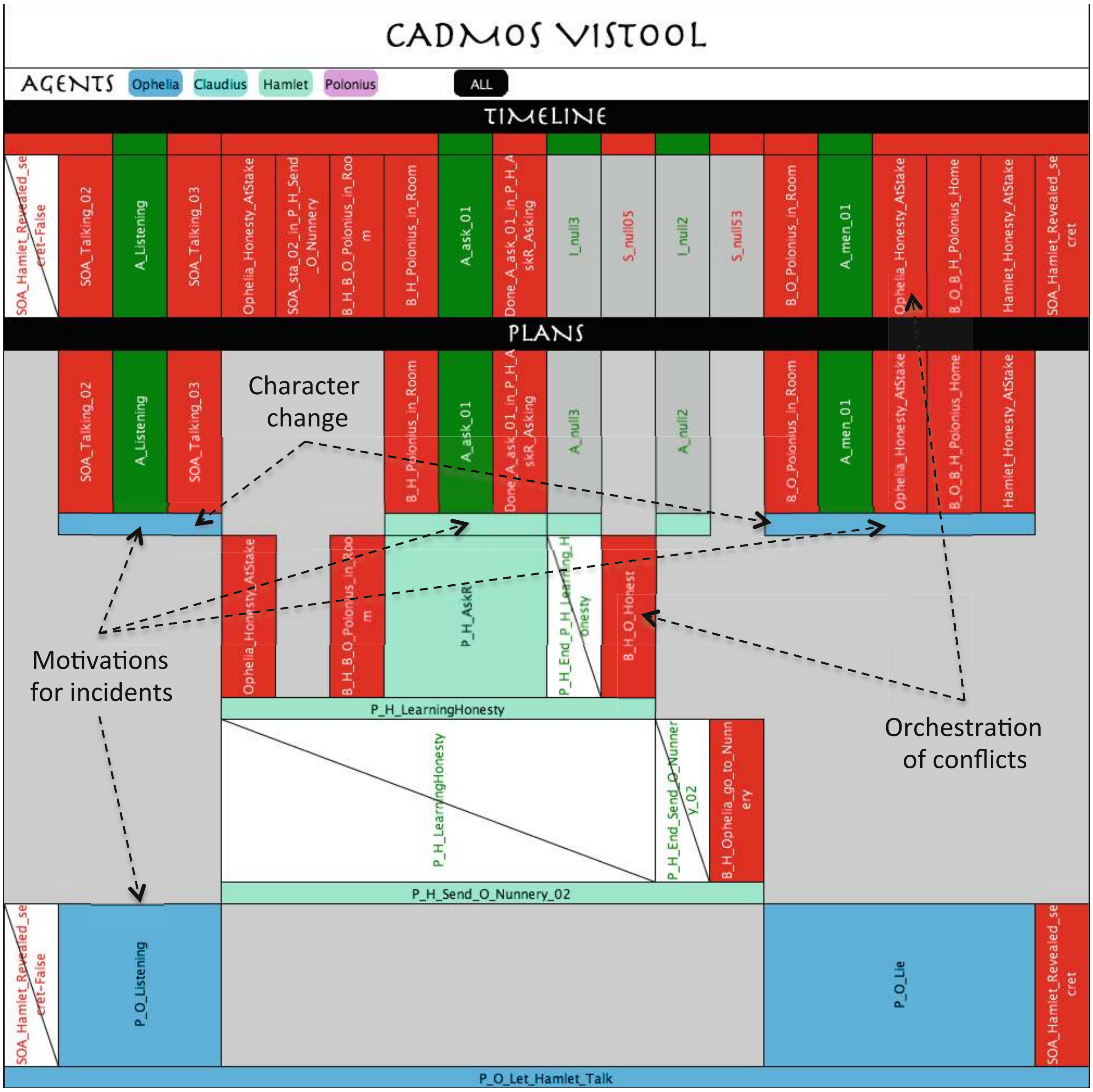

Fig. 4. Screenshot of the visualization - excerpt of *Hamlet* "nunnery" scene incident represented in Fig. 1. In overlay, the characterizations of different interesting phenomena for drama visualization (see text).

is built downwards, so higher layers will be lower in the visualization. Each agent features a color, which is declared in the agents' area with a clickable button. All the plans of an agent are displayed with the agent's color. 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 fill the unit states between adjacent units. The plan is a horizontal box that spans all the states and actions that belong to it. Fig. 4 shows the visualization of the motivations of the excerpt of the "nunnery" scene incident represented in Fig. 1. The content of a box appears in a text within a balloon when the mouse goes over the box. The current working implementation of the visualization tool is in D3[9], after a preprocessing phase made in Processing[10], which also produces a static image. These double implementation and exit was adopted after we realized that the visualization was very slow when the diagram had a relevant size (e.g., the whole "nunnery" scene). The current D3 visualization adapts to our case the "zoomable icicle" solution[11] that provides some interesting interactivity features for zooming on a specific area of the scene and displaying tooltips for having a synoptic view while accessing the content.

5 Effectiveness of the Interface

Now we address the use of the interface in the experience of teaching drama to students by quickly fleshing out interesting aspects of the drama. In the last decades, the drama courses focus moved 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, McKee [15] guides the author through the scene splitting into beats according to the characters' goals and value changes. This leads to a larger use of visualization systems to clearly stress the structural elements in the dramatic text, and to map the connection with the performance, i.e., to show the continuity between event design and event performance. For example the drama map provided by the ReadWriteThink website allows the students to focus on the elements of the drama posing key questions about the conflict's structure.[12]

Our visualization helps the class to understand how the text of the dramatic medium is bound to the character's deliberation, and thus how to read the *characters' behaviors*. For example, the more successful the mappings, the more the narrative text of the dramatic medium is bound to characters' deliberation (i.e. the performance is consistent with the play). Therefore, our system can be used as a qualitative evaluation tool both in teaching drama authoring and in drama analysis. In Fig. 4 we propose a schema of how to interpret the actual visualization of an annotated example, and we highlight three examples of how our system can visualize some key features of drama.

Motivation for Incidents. In drama, it is important that the character's plans show some consistency with the incidents that occur in the sequence of events. This is the fundamental feature that gives to the audience the perception of a logical sequencing of action, thus helps to create the believability of the story in terms of consistent list of incidents within the units. In our visualization, the list of incidents is grounded on the perceived behaviors of the agents involved. In other words, it is graphically clear how the action of asking (where Polonius is) is motivated by Hamlet's plan of learning about Ophelia'shonesty.

9 `http://d3js.org/`
10 `http://processing.org/`
11 `http://bl.ocks.org/mbostock/1005873`
12 `http://www.readwritethink.org/classroom-resources/student-interactives/drama-30012.html?tab=2#tabs`

Orchestration of Conflicts. Normally the units listed in the timeline are the results of the synchronous occurrence of two agents' plans (such as the ones by Hamlet and Ophelia in the "nunnery" scene). We adopt a visualization that shows a layer of parallel plans that map onto the same chunk of the timeline. When the two plans have a similar goal, they both aim at the same effect: thus, they map the same final state onto the timeline, and are described as a shared plan. Our visualization piles up different plans with opposite goals. When this occurs, very often it means that only one plan will achieve its goal and thus only one state is mapped onto the timeline. In Fig. 4, we see that plan `P_H_LearningHonesty` and plan `P_O_Lie` lead to conflicting states, Ophelia honesty at stake and Hamlet believes Ophelia is honest (`B_H_B_O`), but the latter state is not realized (null box in the Timeline).

Change. Drama is not reality but the essence of reality [5]; hence the actions are selected to give the sense of intensity and meaningfulness. Within this framework, any kind of failure bears some sort of change in the character (beside other opportunities in the story development). For example, in the "nunnery" scene, the failure of the Hamlet's plan is a clear indication of the *characters' change*. The sequence of null states and actions in the timeline in the Fig. 4 is a clear visualization of Hamlet's plans failures.

6 Conclusion

This paper has presented an approach to the mapping of the characters' intentions onto actions and the visualization of such information. Character's intentions form multiple trees that span a timeline of incidents. The system is able to build the mapping between a library of plans and the timeline of incidents, and to visualize the contributions of the several characters' intentions to the whole plot.

The system relies on an ontology of drama and builds upon the unrestricted annotation provided by narrative enthusiasts and media students. The system was tested on the analysis and exposition of the case of a short classical scene in *Hamlet* in drama studies teaching and analysis. Though oriented and tested to the didactics of drama structure, our system can be applied to the analysis of news stories, blog entries, or the fruition of cultural heritage. Other significant features should be added to the visualization, namely the Dramatic Arc and a dynamic/interactive construction of the mapping.

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