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Structural Writing, a Design Principle for Interactive Drama

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Abstract. Computer-based highly interactive drama involves different authoring approaches, compared to linear media. Underlying design principles needs to be understood in order to guide the authoring process, to teach authors and to design better systems. This paper identifies a fundamental design principle termed Structural Writing that underlies some of the most generative approaches in interactive drama. A theoretical description of this principle is proposed, which leads to a general architecture for interactive drama that may help authors and researchers to design systems that better exploit the principle of structural writing.

Keywords: interactive storytelling, interactive drama, authoring, creation process, design principle, structural writing, structuralism.

1 Introduction

A computer-based highly interactive drama (hereafter "interactive drama") is a system enabling an end-user to act within a narrative world as if he or she were the main character in a story. Being a character means more than executing a few choices within a story. It implies that the character has the same degree of freedom as other story characters [24]. The necessity for the system to take into account the end-user's action for modifying the story is one of the major challenges in the field.

The automatic generation of narrative events has the potential to provide a solution to this challenge. Several algorithmic tracks have been explored, such as autonomous agents simulations [1], narrative planing [26], narrative modeling [18, 22], and case-based reasoning [7]. However, these approaches have rarely gone beyond the stage of the "technical prototype" and have not produced many convincing playable stories [15]. The authoring issue may explain this situation [21]. Authoring such systems is quite difficult, not only because of a lack of user-friendly authoring tools, but also and more importantly because of inherent conceptual difficulties in handling the computational data needed to produce an interactive drama. The abstract nature of these data makes the authoring task particularly difficult [20, 23].

Tackling the authoring issue can take several routes. Our approach is based on the two following assumptions:

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- Instead of considering the authoring issue a constraint that guides the implementation of components that are added to an existing system, authoring should be taken into account from the outset and be at the heart of system design.
- Therefore, it is essential to identify as precisely as possible what makes authoring difficult, more precisely to identify which principles explicitly or implicitly lie behind the generative algorithms used by various systems.

The aim of this paper is to present a principle that appears relevant to interactive drama that we term Structural Writing. This principle is not new. It can be put into practice within existing systems but has not been explicitly presented to date. By clearly presenting the concept, we hope that existing systems may be either improved or used more appropriately, and that new systems may be implemented.

The paper is structured as follows: First, we present the notion of Authoring/Design Principle, a concept that helps understanding the authoring issue (Section 2). Then, we describe Structural Writing in reference to existing systems and approaches (Section 3). Section 4 explores algorithmic consequences of Structural Writing, to propose a general architecture for interactive drama, which in turn enables a refinement of the central concept of narrative structures (Section 5). Section 6 concludes the paper.

2 Authoring Principles

2.1 What Is an Authoring Principle?

In [20], it is claimed that what fundamentally distinguishes Interactive Storytelling from linear and multilinear (branching-based) forms of storytelling is the principle of conditional actions. For an author, writing a story with Interactive Storytelling systems such as Storytron, IDtension, Mimesis or Façade, requires understanding that a given event will happen only if some conditions are met. In several systems, such a condition is attached to an action by the author and is called a pre-condition. Post-conditions are conditions that are added whenever the action or event is executed and that can themselves serve as pre-conditions for other actions or events. These elementary Artificial Intelligence concepts constitute a major gap in terms of authoring.

The principle of conditional action does not suffice in supporting all authoring activity involved when writing an interactive drama. We claim that other principles exist in current interactive drama systems and we aim at identifying them. Beforehand, it is useful to characterize these authoring principles in general, with respect to the concept of abstraction

2.2 Abstractions

Abstraction has been identified as a key issue in authoring [20, 21, 23]. Although some forms of linear writing (such as screenwriting) involves a kind of abstract thinking, what characterizes generative writing is the fact that authors need to directly enter abstract data into the system. Abstraction is seen as a burden for authors, but from a computing point of view, abstraction is what makes the technology “powerful”. Abstraction is correlated with the degree of generativeness. The more abstract the data, the more generative the algorithm that uses these data, that is, the more story variations are possible with the same amount of information. This is schematically illustrated in Fig. 1.

To reach the goal defined in the introduction, it is necessary (but not sufficient) for an interactive drama technology to be able to generate such a high quantity of story variations. Hence the necessity of abstraction.

Abstraction is not an authoring principles as such but it characterizes all authoring principles for interactive drama, to start with the principle of conditional actions. With conditional actions, authors do not know when an action will occur but rely on conditions on fictional states, which is remote from the concreteness of writing a drama as a mere chronology of actions.

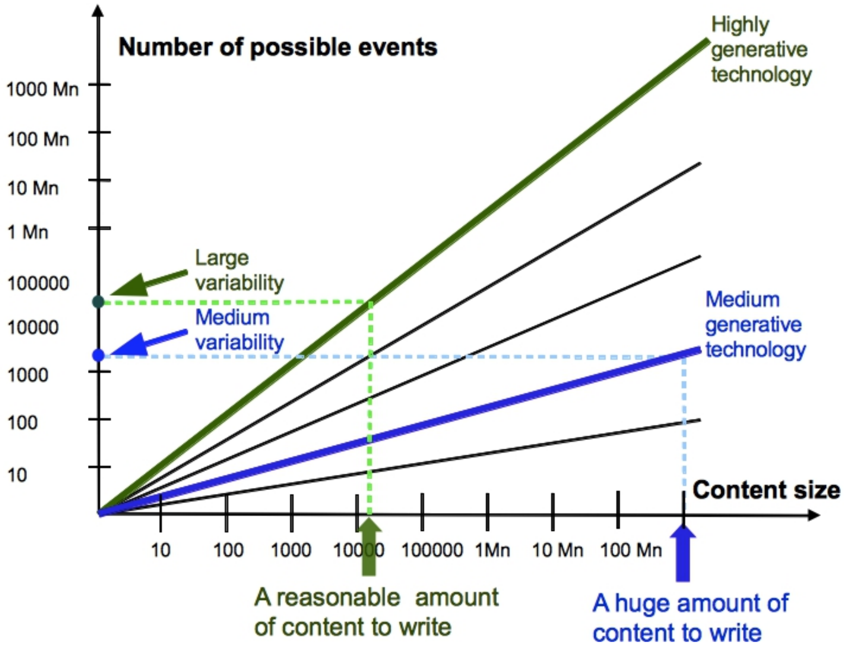

Fig. 1. The lines, drawn in an algorithmic scale, illustrate the exponential growth of the number of possible stories relative to the amount of data entered by an author. Each line corresponds to a system or approach, with the most generative ones represented by the steepest lines. This graph illustrates that with a given quantity of content, a more generative and abstract approach will lead to more variation (more possible events). Because human writing is limited highest levels of variation cannot be produced by less generative approaches.

Additional authoring principles involve a higher degree of abstraction, compared to the principle of conditional actions. As such, they add another degree of authoring difficulty to systems that only rely on conditional actions. The ability for an author to master these principles is crucial to the success of a system itself, hence the need to clearly identify them.

2.3 The Second Authoring Principle: Genericity

We can only present briefly a second authoring principle here. It will not be detailed in this paper, contrary to the third one that constitutes the core of our contribution (next Section).

Genericity is the principle that consists in including variables within actions (or other narrative elements). Such actions are called generic actions, in contrast to specific actions in which all variables are instantiated. A generic action is powerful in terms of quantity of possible generated instantiated actions. For example, the simple action of giving an object to someone can be represented as *give(?giver, ?object, ?receiver)*. With 6 characters and 5 objects, the number of possible giving actions is 150.

The principle of genericity is independent from the principle of conditional actions. For example, there exist AI-based systems for interactive drama that are conditional but not generic, as they represent actions and states as simple *propositions*.

The elementary programming concept of variables is fundamentally new as far as authoring is concerned. This raises several issues:

– First, authors themselves are rarely programmers, and they may need time to fully grasp the concept of generic actions.
– Second, it is difficult to anticipate all cases that may occur whenever an action's variable is instantiated. A typical case we encountered frequently in our authoring activities concerns "obvious" exclusions. For example, consider an author writing the action of giving an object that includes three variables: the giver, the object, and the receiver, which can be represented as *give(?giver, ?object, ?receiver)*. When writing rules and conditions to trigger such an action, the author will, at times, obtain the action *give(John, box, John)*, which is absurd. The author omitted to specify that the receiver cannot be the giver. In more complex situations, such errors can be very difficult to detect.
– Third, generic actions need to be not only instantiated but also rendered, visually and textually, which constitutes one dimension of abstraction [20]. Text generation becomes harder to master if deep structures contains variables. For example, textual surface forms need to vary according to the gender and spelling of the value that instantiates a variable.

These difficulties are examples of how abstraction makes authoring interactive drama particularly difficult.

3 The Principle of Structural Description

3.1 Structures and Structures

The term "structure" needs to be clarified, because it can refer to two almost opposite concepts. On the one hand, "structure" refers to the set of main actions and events that give a story its core. For example, a well-known model to describe drama is the three-act structure [8]. In that case, a structure is a story's *skeleton*. On the other hand, a structure in structuralist narratology denotes a set of deep narrative elements that are related to each other and represent the meaning of the story. A common example of such a structure is the tabular description of myths proposed by Cl. Levi-Strauss [11]. In that sense, one also uses the term “deep structure”.

While these two meanings of structure refer to two different narrative theories, there is no simple match between structure type and underlying theory. For example, when the V. Propp theory [16], which originated in Structuralism, introduces its well-known succession of 31 elements, what it proposes is a skeleton. But when the same theory introduces the notions of roles and functions, it describes a deep or underlying structure. It is that second meaning of structure to which we refer here.

3.2 Structures in Drama

It is easy to spot (deep) structures in classical drama, as they correspond to dramatic situations. For example, a love triangle is a structure in which two persons are rivals intended on conquering the same third person. Several practical catalogs exist of such situations, such as Polti's “36 dramatic situations”. At a deeper level, all these situations express a conflict, i.e. an opposition between two potential actions. A situation without conflict would be a situation that leads to an obvious resolution, which by definition is not interesting from a dramatic point of view, especially in a love triangle.

Beyond the above mentioned ad-hoc catalogs, a more scientific investigation was conducted by E. Souriau in 1950 [19]. By analyzing a number of theater plays, Souriau isolated six fundamental roles that, when assigned to various characters in the play, can generate a situation[1]. Specifically, he describes a dramatic situation as a system of forces that are always “in tension” during the play. This mechanical analogy is interesting because it shows that structures cannot be reduced to actions. Structures are by nature *potential* (analogous to the notion of potential energy in mechanics). They can produce a dramatic movement (analog to the kinetic energy) but they are not themselves the movement.

Also, the potentiality of narrative structures makes them relevant by themselves, even if they do not generate any concrete action in the story. For example, the fact that two characters are rival might make them plan to hurt each other, hope that a “terrible accident” might occur, etc., even if none of these events actually occur. In other terms, narrative structures generate cognitive acts that contribute to the story quality. In the theory of Possible Worlds, these acts create possible world of various kinds (obligative, optative, conditional, hypothetical, pretend worlds, etc.) [17] in which the narrative structure generates different actions.

Finally, narrative structures play a fundamental role in the reader's activity. A good narrative structure stimulates many “inferential walks” [5], that is many anticipations of possible future events in the reader's mind.

3.3 Structures in Interactive Drama

Why are narrative structures interesting for Interactive Drama, and why now, after more than a decade of research in this area? The relevance of structuralist theory for interactive drama was highlighted more than a decade ago [25]. Since then, authors of

[1] The model was later reformulated by A. J. Greimas, as the actant model [9].

this paper have had the chance to proof test the validity and usefulness of the structuralist hypothesis for interactive drama, which sheds some new light on the issue.

The main argument for structural models for interactive drama is that a unique structure can unfold in a multitude of temporal paths. The author does not write those paths but the structure that can generate them. Recently, J. Murray reformulated this hypothesis by claiming that "to make a compelling narrative, we have to look for the underlying causal structure that motivates those actions" and by giving examples of story patterns that correspond to these structures [13].

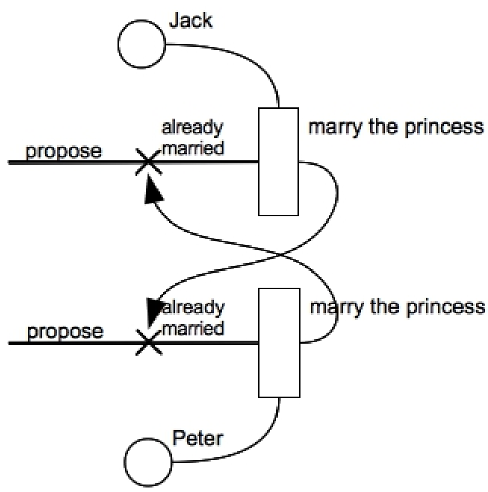

Fig. 2. Representation of a love triangle dramatic situation with goal-task structures. Two knights, Jack and Peter, have the same goal, to marry the princess (rectangles). To reach that goal they have to propose (tasks, horizontal lines) but their task is hindered by an obstacle (crosses) "already married", which is triggered whenever one of the knights reaches his goal, "marry the princess".

The transformation from an author-defined atemporal structure to a variety of computer-generated temporal paths appears to be an elegant solution to the core issue of the field: how to provide an end-user with a large number of stories (depending of his or her choices) without writing all of them. From a computational viewpoint, such a transformation echoes the principle of generative systems. There already exist computational approaches that enable the generation of a series of actions, but the concept of narrative structure adds the constraint of narrativity to these algorithms.

At this stage, the argument remains theoretical. Let us examine two examples. First, the love triangle. In Fig. 2, this structure is represented with the help of IDtension [22] formalism: two characters (knights), have the same goal, marry the princess. If the first character reaches his goal, the second character cannot, and vice-versa. This is represented as an obstacle in our formalism. The same dramatic situation can be represented in various systems and formalisms, goal-tasks structures being chosen as an illustration. A hypothetical system using this structure would trigger a number of actions and events for exhibiting the structure, so as to "make the structure play". For example, each of knights will at some point adopt his goal, discover the other character's goal, try to reach his goal, influence the other to make him change his mind, ask advice from other characters, imagine/dream that he has gained the princess's love, etc. The order of these actions does not have to be defined in advance, as the system calculates these actions and their occurrence, based on the authored structures. As for conditional authoring (Section 2.1) there exist conditions for triggering one action rather than another. But these conditions are not written explicitly by story author. They are set dynamically by the engine, according to more general rules, that describe structures at a general level. For example, a (simplified) rule states that whenever a character has a goal, he or she will attempt to reach it. This is only defined once for all situations in which any character has a goal.

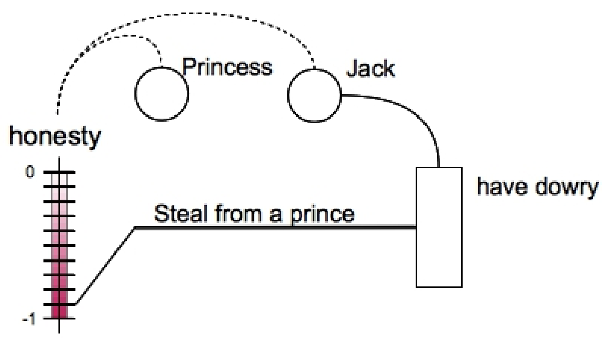

Fig. 3. Representation of an ethical conflict situation, with goal-task structures (see text). The gauge on the left represents the value of "honesty", to which both Jack and the princess are attached. The task "steal from a prince" is negatively scored according to this value.

Another example is the ethical conflict. In this case, the character wants to reach his goal of marrying the princess. But all attempts to propose her will fail unless he possesses a large dowry. One of the ways of overcoming this obstacle might be to rob a rich prince. However, this runs counter to the main character's, as well as the princess', values (see Fig. 3). Several characters can intervene in the story, to encourage or dissuade the knight to choose a course of action.

Following these examples, it is possible to provide a definition of a narrative structure for the purpose of interactive drama. A narrative structure is an author-readable and narratively meaningful set of fictional data (data from the fictional world), interconnected by relations, that do not directly describe events in the story but that are used by a derivation algorithm to indirectly calculate and generate a large amount of story events. This definition is author-oriented, as it includes the structures' readability as a fundamental criterion.

4 Algorithmic Considerations

The derivation algorithm that was mentioned above is a key component in a system based on structures. It comprises two distinct parts:

- First, the algorithm needs to be able to derive which narrative actions are possible at a given time, based on the narrative structure and the current state. These narrative actions encompass both the performative actions that can be directly derived from the structures, and other more complex types of actions: influences, transmissions of information, help/hindrance, or more specifically jealousy, revenge, self-destruction, etc. In terms of classical logical representation, rules and action descriptions often need to be of higher order. To take an extreme example from classical drama, in Marivaux' "Les Fausses Confidences" (1737), we encounter the following situation between the two lovers A (the man) and D (the woman): "He knows that she believes he does not know that she knows that he loves her", with "believing" meaning "having a wrong knowledge" while "knowing" meaning "having the correct knowledge". If, to simplify matters, everything is coded as beliefs, one represents this knowledge as follows: *believes(D,believes(A,not believes(D,believes(A,loves(D,A)))))*
- Second, the algorithm needs to be able to produce one action after the other so that these actions chain in a way that builds an interesting *Interactive Narrative Experience* for the end-user. Planning algorithms for example, ensure that narrative actions follow each other until a specific goal is reached, either a character's goal [3][1] or a more global goal [26][4]. Qualifying essential qualities of an Interactive Narrative Experience is a very difficult task. Not only should the story move forward, but pacing, plot clarity, end-user's emotions, connotative aspects, etc. are qualities that cannot be ignored.

We refer to the first part of the algorithm as the *Action Generator*, and to the second part as the *Narrative Sequencer*. If one applies these algorithms to the structure depicted in Figure 3, one observes that the story remains too basic to be interesting because there are only a few concrete actions that can happen in the storyworld. The obvious solution is to make the structure more complex, by adding specific narrative elements. For example, in the above-mentioned example (love triangle, Fig. 2 & 3), one could invent actions that will hinder the other suitor, such as spreading rumors about him, making him miss an encounter with the princess, fail to rob the prince, etc. However, this would result in a complex structure in which the fundamental elements that need to be expressed are lost within less important elements. Furthermore, the algorithms for calculating actions are not the same for "core" structural elements and for additional ones. Therefore, we introduce a fundamental distinction between two kinds of elements, those that create the core narrative structure from which one or more narrative paths are calculated and those that enrich each path. We call the former *core elements* and the later *support elements*. This distinction is analogous to the distinction made by Roland Barthes in 1966 between "nuclear functions" and "catalysts" [2], the nuclear functions covering the key events in a story, the catalyses covering actions which complete these key events[2]. The difference is that Barthes' nuclear functions are story events while our core elements are structural atemporal elements and their relations.

[2] More precisely, the above-defined support elements correspond to Barthes' catalysts, indices and informants combined.

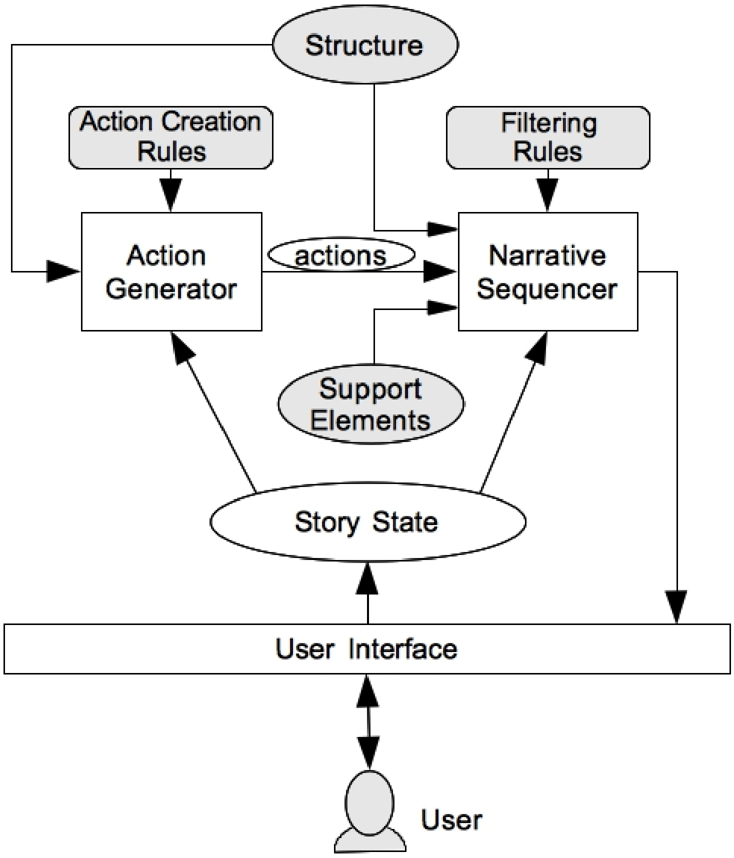

Fig. 4. An general architecture that supports Structural Writing. Authored elements are in grey.

From the above considerations, a tentative architecture based on structural writing has been sketched in Figure 4. This architecture is not a system description – Its various components are not enough specified for that purpose. Rather, our motivation is (1) to extend as much as possible theoretical considerations about structural writing to the algorithmic side and (2) to illustrate the algorithmic components visually so that they become more explicit. The architecture visualizes the fact that narrative structures contains abstract data that need to be processed, by the Action Generator (see above), based on *Action Creation Rules*, to yield to possible actions to be displayed to the user. These possible actions are then processed by the Narrative Sequencer (see above), based on another set of rules, the *Filtering Rules*. The Narrative Sequencer sends to the *User Interface* either NPC actions or a set of actions possibly played by the end-user. The User Interface is responsible of visualizing the executed actions and capturing the end-user's intervention in the story.

These components are not totally new in the field of interactive narrative. For example, the Action Generator corresponds to the *narrative logic* in IDtension, while the Action Creation Rules correspond to the respective *rules* [22]. In a different type of system, the *double appraisal* mechanism [12] corresponds to a part of the narrative sequencer, the filtering rule being: select the action that maximizes the emotional impact on other characters. The content of each component is voluntary left open, the above architecture being more an illustration of our theoretical considerations rather than a system description.

Fig. 4 also depicts the levels at which authoring should occur: Narrative Structures, Support Elements, Action Creation Rules, and Filtering Rules. Asking the author to write at the level of these two sets of rules is problematic, as it requires a level of procedural literacy that many authors do not have. From our authoring experience with IDtension, in which this level is typically hidden from the author [22], we observed that the author needs to have control over these rules, in order to be able to write structures that fully exploit the engine possibilities. A solution consists in pre-writing these two sets of rules so that the author only has to configure/tune the rules. Such pre-writing is possible because these rules are relatively stable from one scenario to the other.

5 Refining the Concept of Structure

We observed that connecting structural elements together does not, in many cases, produce the expected large amount of possible events. For example, instead of having two competing goals, as illustrated in Figure 2, we can arrange goals in a sequence so that one goal is triggered once the previous one has been reached. The derived story events would naturally create a rather linear story. Therefore, there is a need to further qualify structures in terms of potentiality to produce large amounts of events.

Structuralist narratology has largely developed the concept of structure, but often in an abstract manner that is difficult to use for our purpose. Souriau's approach, however, is certainly useful, with the mechanical analogy mentioned above. Dramatic situations are seen as “a system of forces in internal tension” ([19] p.42 our translation), which evokes a psycho-social system in which various motivations to act (or acts) go in opposite directions, which corresponds to the concepts of conflicts [6, 8, 10], obstacles [10], dilemma, paradox [14], etc. Such a tension corresponds to cycles in the topology of interconnection between narrative elements. For example, Figure 3 represents such a cycle, with a character who wants to reach a goal, which is reachable by a task, which is (negatively) attached to a value, which is attached to the same character. The “degree of circularity” that occurs within such a structure can be formalized in the future, with a formalism that depends on the language used for representing narrative structures. Such a formalization would provide indicators on the quality of the structures and help authors to write interesting structures.

6 Conclusion

We introduced the concept of Structural Writing, a fundamental and independent design principle that can be at work in computer-based interactive drama. This principle, as other authoring principles, is independent of a particular system. It is shared, for example, by both character-based interactive drama and centralized drama managers. With its high degree of abstraction, Structural Writing is believed to provide a powerful solution for interactive drama, although by no mean it is the one and only design principle.

The identification of the design principle of Structural Writing enables us to better understand existing systems, and improve future implemented systems. In particular, the resulting architecture (Fig. 4) is a tool for both analyzing some existing systems and designing new systems for interactive drama.

An important feature that has been largely overlooked in the field is the a priori assessment of dramatic structures, based on their topology. Existing approaches rely on authors to design "good" structures. However, "bad" structures can simply ruin the particular advantage of structural writing, by merely implementing the principle of conditionality. An ideal system should not only allow authors to express their creativity with the available narrative elements, but also prevent them from writing structures that do not have suitable structural generative properties.

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