Integrating the Event Generation Mechanism in the Propp-based Story Generation Mechanism into the Integrated Narrative Generation System

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Abstract

In the Propp-based story generation mechanisms and the integrated narrative generation system which we have been developing, the former functions is a module in the latter. These systems have used respective event generation mechanisms to generated events which are the most important units in a narrative structural representation. A common event generation mechanism needs to be used in these two systems towards the complete blending. This paper will present the first tentative attempt as a prototype to be revised in the future.

Keywords: Narrative generation; Story generation; Integrated narrative generation system; Propp-based story generation mechanism; Event generation mechanism.

1. Introduction

One of the current major goals in our study is developing an integrated narrative generation system based on artificial intelligence, cognitive science and literary theories. The system aims to organically combine a variety of mechanisms or modules grounded on our previous fundamental and individual research results into one organic mechanism. We have described its ultimate philosophy and overall design[1], and introduced the current status of its actual implementation[2]. A significant characteristic of this system's research is the point that it adopts an interdisciplinary principle with such literary theories and narratology as Genette[3], Jauss[3] and inter-textuality. Propp's theory on "morphology of the folktales"[4] to be described in this paper is also equal to one of the literary theories relevant to some significant functions for the narrative generation. We have been considering the following two types of approaches for the literary theory by Propp: the first is developing a story generation mechanism using Propp's theory as comprehensively as possible ("Propp-based story generation mechanism") and the second approach is its introduction as one of the modules into the integrated narrative generation system[5].

As described above, the Propp-based story generation mechanism can function independently to generate stories with mainly the structural style of a Russian fairy tale which is the material of Propp's theory. On the other hand, we have been addressing the issue of its use as one module of the integrated narrative generation system[6]. For example, we have introduced the Propp-based mechanism into the integrated system as a set of techniques to generate macro structures of stories, and defined a story content grammar relating to the conceptual dictionaries based on our original interpretation and formalization of an essential part of Propp's theory. The event generation mechanism in the Propp-based mechanism, however, has not been connected fully organically to the integrated narrative generation system. An event means one of the most fundamental elements in each of the narrative structures to be generated by the Propp-based mechanism and the integrated narrative generation system.

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The event description forms in the two systems are basically same, but mechanisms for the respective event generation mechanisms are not unified formally since the Propp-based event generation mechanism has some special techniques to generate stories with the style of a Russian folk tales and is comparatively simplified. The Propp-based event generation mechanism, for example, has a function to set seven types of characters including hero, villain, victim, helper, dispatcher, donor and false hero in the Russian fairy tales into an agent in an event, while the event generation mechanism in the integrated system does not have the function. This paper considers the two event generation mechanisms in detail to synthesize them.

Gervás[7] describes that many of story generation systems using Propp's theory aim at general story generation mechanisms beyond the description of Propp even though the most important and essential part in story generation study using Propp's theory should be conducted on the basis of the valuable insight in accordance with the corpus of Propp. We have also been insisting that most of the systems using Propp' theory focus on only the element of the "function" to be mentioned below, but the theory includes many productive and theoretical ideas to contribute to story generation in various sides. One of our goals of the Propp-based story generation mechanism is implementing a story generation system introducing a variety of elements of Propp's theory as comprehensively as possible, while another goal is integrating this special approach into the framework of a more generalized architecture of the integrated narrative generation system. We simultaneously pursue specialty and generality.

2. An Overview of the Integrated Narrative Generation System

The integrated narrative generation system consists of the following three types of generation phases: story, discourse and expression. The system architecture, on the other hand, has the following parts from the type of processing: narrative techniques, knowledge bases, and conceptual dictionaries. For the conceptual dictionaries[8], we have been developing systems for verb concepts, noun concepts, adjective concepts and adjective verb concepts with the respective hierarchical structures from higher concepts to lower concepts according to a "is-a" relation. We differentiate a word's meaning or concept

from the word itself as the fundamental policy of developing the conceptual dictionaries. In particular, one or more meanings related to a noun are described in the noun conceptual dictionaries as one or more noun concepts, and the word to be used normally and the notations for these concepts are described in another linguistic dictionary. The noun conceptual dictionary contains 115765 terminal concepts and 5808 intermediate concepts in the current version. The verb conceptual dictionary similarly has 12174 terminal concepts and 36 intermediate concepts. A terminal verb concept in the hierarchical structure has the following information: a basic sentence pattern for natural language generation, one or more case structures and constraints for each of the cases. A case structure defines several cases for nouns required in the verb. In addition, knowledge for managing relations among events and mutual relationships between events & states are composed on the basis of the conceptual dictionaries for verb and noun concepts. The input information by a user to the first story generation phase is several parameters including length, unreality and repetition. The system selects one or more adequate story techniques according to the parameters in order to expand a story tree structure.

Although the Propp-based story generation mechanism can be used as an independent story generation system, its integration into the story generation phase in the integrated narrative generation system contributes to increase the diversity and flexibility in story generation. A story is described, in the story generation phase, as a conceptual representation form including a temporal sequence of events at the bottom level in a hierarchical tree structure with several types of relations as the intermediate nodes. Each of the events is described as a specific case structure which has a verb concept and the necessary instantiated noun concepts linked to the conceptual dictionaries. Fig. 1 shows a story structure and a case structure of an event within the story structure. The story generation mechanism generates story structures having a sequence of events according to structural operation techniques using the dictionaries and the other narrative knowledge. We call a procedure for expanding the tree structure of a story using the story knowledge base, which stores concrete narrative fragments or structures corresponded to the material for narrative generation for such various types of narrative relations as scripts and causal relations, a narrative technique for story generation or directly a story

technique. The input to a story technique is an event, the whole of a story structure or a sub-structure in a story structure and the output is chiefly the expanded story structure that is one of the possible various structures. They can treat from micro story structures to macro ones.
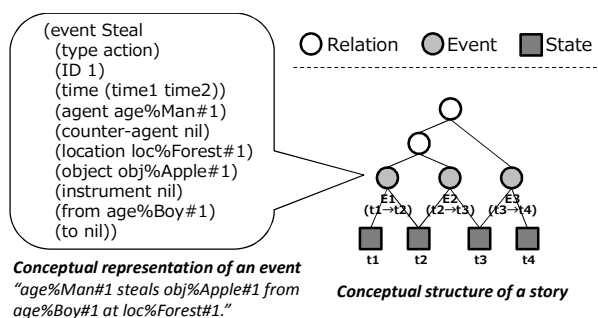

Conceptual representation of an event
"age%Man#1 steals obj%Apple#1 from age%Boy#1 at loc%Forest#1."

Conceptual structure of a story

Fig. 1. Structures of a story and an event

3. Propp-based Story Generation System

3.1. *The overview*

Propp's theory proposed the concept of a "function", which means an action seen from the result and the principle of the sequential arrangement of thirty one "functions" as the most important theoretical idea. The "function" of "villainy", for example, means that a character causes the damage of a different character through a concrete action. However, there is a variety of specific actions to actualize it since the "function" means a collective definition to abstractly define many concrete and real actions. We call more specified actions for actualizing each of the "functions" "sub-functions" on the basic of hierarchical concept. Propp described a variety of examples corresponded to the level of sub-functions. The "Propp-based story content grammar" based on the framework of Propp's theory with "functions" and sub-functions is the central part in our Propp-based story generation mechanism.

We describe the Propp-based story generation mechanism. A story as the output information is equivalent to a sequence of events bound hierarchically using "story relations" including "causal relation", "continuation relation", etc. The form of an event as one of the basic components in a story takes a frame representation, which is formed by a verb concept and the corresponding case elements for such noun concepts as agent, object and location. The verb concepts and noun concepts are associated with each of the corresponding

elements in the conceptual dictionaries. The structure generation mechanism and the event concept generation mechanism are respectively corresponded to generative mechanisms, while the Propp-based story content grammar and the conceptual dictionaries are equivalent to the knowledge parts to be referred by the generative mechanisms. Since these generative parts and the parts to be referred by them are mutually independent, the redundancy of processing lessens.

3.2. *Propp-based Story Content Grammar*

The story content grammar[5, 6] that is a new style of the reorganization of Propp's theory, which gradually generates a macro story with the structure of the style of a Russian fairy tale from the highest level to the lowest level, consists of the following five hierarchical levels. The actual description by Common Lisp is shown in Fig. 2. The elements including "reserve portion", "beginning", etc. in the level 1 and 2 are defined based on the description of structures of Russian fairy tales in Propp[4]. The levels of "functions" and sub-functions were faithfully defined from the description of the analysis of 100 tales. The role of these hierarchical levels is to make the structural part of a story which is a tree structure with relations as the intermediate nodes. Events in the level 5, on the other hand, are generated by the event generation mechanism associating with the above structure generation mechanism. An event particularly forms a case structure including a verb concept and the corresponding noun concepts as noted above. We have defined by hand patterns of these case structures based on examples corresponded to sub-functions in Propp[4]. For example, we have formally defined a case structure of "(interdict 1 (agent human) (object outgo@out) (to !hero))" based on an example in the sub-functions under "interdiction (γl)" as "If Baba Jaga comes, don't you say anything, and be silent." There is a asset of "Pair of sub-functions" as another significant elements. This was defined according to the description on mutual relations between two sub-functions in Propp's theory.

```
(setq *Propp-level1-list*
'   ((Russian folktale
      (00_Preliminary-part P-Problem P-Trial P-Solution))))
(setq *Propp-level2-list*
'   ((P-Problem (Reserve-portion Beginning))
    (P-Trial (OR (Reserve-trial Battle-and-victory)
                 (Reserve-trial Task-and-solution))) …))
(setq *Propp-level3-list*
'   ((Reserve-portion (OR (01_Absentation 02_Interdiction
                          03_Violation) …))
(setq *Propp-level4-list*
'   ((01_Absentation (OR bet-1_Going-out1 bet-2_Death
                         bet-3_Going-out2))
    (02_Interdiction (OR gam-1_Interdiction
                        gam-2_Command-or-proposal)) …))
(setq *Propp-level5-list*
'   ((alp-1_Preliminary-part ((Preliminary-part (1))))
    (bet-1_Going-out1 ((Go-out (agent Parents)
                               (object Business))))
(bet-2_Death ((Dead (agent Parents)))) …))
```

Fig. 2. A part of the description of the Propp-based story content grammar

4. Combining the Event Generation Mechanism with the Integrated Narrative Generation System

In the Propp-based story generation mechanism, when the structure generation mechanism reaches to the lowest level in the story content grammar, the event generation mechanism is executed to make the event structure based on the format of the case structure described in the story content grammar. On the other hand, in a story generation mechanism in the integrated narrative generation system, when a story technique refers to the corresponding unit in the story content knowledge base, the generation mechanism is executed to make the event structure based on the format of the case structure described in the story content knowledge base. The story knowledge base in the integrated narrative generation system stores concrete knowledge for story generation, in particular a variety of sequences of events described in the form of case structure corresponded to the types of relations such as "cause-effect" and "script". The story content grammar in the Propp-based story generation mechanism will be also a part of the story knowledge base in the future. Two types of event generation mechanism have been independently prepared for the Propp-based mechanism and the integrated system since both of the description forms are different each other. To develop a common event generation mechanism is the goal for incorporating the Propp-based mechanism into the integrated system completely. We will describe previous four types of procedures according to the different types of case structure's description in the Propp-based mechanism and

the tentative revision in the integrated narrative generation system.

When the generation of a story structure according to the story content grammar in the Propp-based story generation mechanism reaches to the level of event generation, the event generation mechanism is executed to make the case structure. The mechanism inserts specified instances into each of the cases based on the difference of the second term in each element of the case structure. Fig.3 shows an original case structure and a transformed instance by the following techniques in the event generation mechanism.
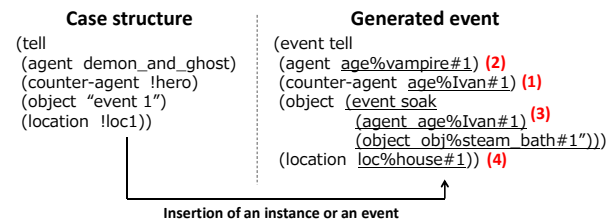
Case structure   **Generated event**

```
(tell                       (event tell
 (agent demon_and_ghost)     (agent age%vampire#1) (2)
 (counter-agent !hero)       (counter-agent age%Ivan#1) (1)
 (object "event 1")          (object (event soak
 (location !loc1))                   (agent_age%Ivan#1) (3)
                                     (object_obj%steam_bath#1")))
                             (location loc%house#1)) (4)
```

Insertion of an instance or an event

Fig. 3. The correspondence between a case structure and the actgually generated event

(1) When one of the seven types of roles of actors is described in the second term of a case such as "!hero", the event generation mechanism sets the instance of the actor, we call "agent" in the system, based on the predefined or inputted correspondence knowledge such as "Ivan: hero", "Baba-Yaga: donar", etc. For incorporating it into the integrated narrative generation system, when an agent as a Propp-based agent including hero, heroin etc. appears in a story generation process, the system describes the label such as "hero" in the attribute frame. An attribute frame is a data set associated with a noun concept and the noun concept is embodied by inserting instances or the other various labels into it.

(2) When the value of a case in an event is a name of a noun concept in which a specified instance of an agent, an object or a location should be inserted, the event generation mechanism sets an instance made from a noun concept in the noun conceptual dictionary selected within the range of the constraint. The name of the noun concept specifies the constraint in the current design. For example, if the name is "demon_and_ghost", the values to be inserted is selected in the range under the name in the noun conceptual dictionary. On the other hand, when the name is described in the style such as "horse@beast", it will be used as the value directly.

(3) When an event concept itself should be the value of a case (object case in particular) in an event recursively, the event generation mechanism expands the description such as "event 1" to a case structure different from the case structure in which the expanded event is included. The previous mechanism has used predefined sets of case structures to be inserted in the position based on examples described by Propp's theory. The examples have not three or more nests. The integrated narrative generation system uses a recursive function for dealing with this type of processing based on a predefined list of nested events. To achieve more general recursive processing will be a future issue.

(4) When one or more events have a mutual-dependence relation, the mechanism processes a special operation. In particular, when the value of the agent, object or location in a case structure must be equal to the value of the other case structure for the consistency among events, the mechanism uses a same value for the one or more elements and designates the range which the values can take in the noun conceptual dictionary. This is related to the "pairs of sub-functions". The integrated narrative generation system prepares a procedure for treat this processing with reference to the story knowledge base in section II. Each of many data stored in the story knowledge base is a set with two or more events and the elements in the events need to have a mutual-dependence relation. One of the issues is that the number in the Propp-based mechanism is not many, while the number in the story knowledge base will be very many.

5. Conclusion

This paper described both of the overviews of our Propp-based story generation system and an integrated narrative generation system, and presented ways for incorporating the Propp-based system in the level of event generation mechanism into the integrated system towards the complete blending. The basic policy was that we incorporate the special mechanisms in the Propp-based system into more generalized mechanisms in the integrated system, however a part of the mechanisms such as actors' roles in the Propp-based system will be considered to be arranged in the integrated system too.

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