

Computational Narratology

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1 Definition

Computational narratology is the study of narrative from the point of view of computation and information processing. It focuses on the algorithmic processes involved in creating and interpreting narratives, modeling narrative structure in terms of formal, computable representations. Its scope includes the approaches to storytelling in artificial intelligence systems and computer (and video) games, the automatic interpretation and generation of stories, and the exploration and testing of literary hypotheses through mining of narrative structure from corpora.

The use of the term ‘Computational Narratology’ covers several senses: (i) a ‘humanities narratology’ sense, used in Meister (2003) to designate a methodological instrument in the construction of narratological theories, from the standpoint of automatically extending narratological models to larger bodies of text, providing empirical testing of their predictions in actual corpora, and precise and consistent explication of concepts; (ii) a ‘cognitive computing’ sense, used as a title for a course (Goguen 2004) covering artefacts such as narrative texts, video games, and computational artworks, and integrating insights from semiotics, sociolinguistics and cognitive linguistics. Fox Harrell has characterized it further, as providing “techniques from computer science to provide a language to describe cognitive insights and to implement narrative effects of the type analyzed in discourse narratology” (Harrell 2007: 7); (iii) a ‘computational implementation of narratology’ sense (cf. Cavazza & Pizzi [2006] and many others), referring to the importation of constructs from humanities narratology for implementation in computer systems that carry out storytelling, along the lines of computational linguistics, where formalisms from linguistic theories are implemented in systems.

2 Explication

As “a humanities discipline dedicated to the study of the logic, principles, and practices of narrative representation” (Meister → Narratology [1]), narratology has a natural and substantial overlap with the (scientific and engineering) disciplines involved in the development of artificial intelligence systems aiming for human-like

narrative behavior, as well as the (engineering and aesthetic) practices involved in the design of intelligent computer-based interfaces and game environments for interacting with narratives. In the course of developing such systems, researchers have mapped narratological constructs to computational ones and elucidated interactions among them, formulating (sometimes implicitly) theoretical and empirical approaches to narrative. Computational narratology has also been strongly influenced by linguistic theories.

Computational narratology is a fast-evolving field, motivated in part by the surge in popular interest in interactive games and entertainment and their promise of offering engaging narratives with life-like characters. The pervasiveness of computer technology and digital media in everyday life and cultural activity has substantially raised expectations about their future involvement. The advent of the new millennium has accordingly seen a spate of books, journal articles and conferences on topics related to this subject.

3 History of the Concept and its Study

3.1 Influences from Humanities Narratology

Research in computational narratology has absorbed and instantiated approaches from humanities narratology that specify formal and/or logical structure. The narratological differentiation of *fabula* versus *sujet* (Šklovskij [1917] 1965; Tomaševskij [1925] 1971) has provided a scaffolding for much of the computational narratology work in story generation, where the *fabula* is usually implemented—as in Genette ([1972] 1980)—as the events of the entire narrative in chronological and causal order prior to any verbalization thereof, and where the *sujet* is the final generated output. Here *events* (Hühn → Event and Eventfulness [2]) like other narratological constructs, are given a precise and specific computational representation, involving their participants, places and times, and in some cases their causes and effects. Focusing on *fabula*, algorithms to generate story have incorporated the narrative functions of Propp ([1928] 1968), e.g., Grasbon & Braun (2001); Peinado & Gervás (2006) as well as those of Bremond (1970), e.g., Schäfer et al. (2004); Cavazza & Charles (2005). More coarse-grained accounts of the roles of characters in plot (Jannidis → Character [3]), such as the narrative arc of Freytag (1900) and the heroic quest of Campbell ([1949] 1990), have also inspired the design of many interactive narrative systems (Mateas & Stern 2005; Gervás et al. 2006). In relation to the *sujet*, text information extraction systems (Mani et al. 2006; Mani 2010a) have been able to infer Genette's ([1972] 1980) temporal orderings (Scheffel, Weixler & Werner → Time [4]) by having the computer learn from annotated corpora, while sentence generators such as Montfort (2011) have used

rules that can express any of Genette's orderings with a felicitous use of narrative voice, tense, and aspect.

3.1 Influences from Linguistics

Constructs which have emerged from linguistics, such as *story grammars*, (e.g., Rumelhart 1980), have been widely elaborated and applied in computational narratology, as in Bringsjord & Ferrucci (2000) and Lang (2003). These notions, along with others arising independently out of AI, such as *scripts* (Schank & Abelson 1977), have also (despite their computational brittleness) influenced humanities narratology (Emmott & Alexander → Schemata [5] and Herman → Cognitive Narratology [6]). The contributions of corpus linguistics to narratology are also well-recognized (Salway & Herman 2008), and in recent years, more advanced text mining techniques have allowed for large-scale empirical tests of literary hypotheses. For example, Elson et al. (2010) have been able to automatically extract conversational social networks from the dialogues between characters in 19th-century novels, disproving a claim by the literary critic Moretti (1999) that urban novels reflect the looser ties of city life, resulting in more characters sharing fewer conversations.

3.2 Computational Elaborations of Narratological Concepts

Computational narratology has also developed its own accounts of key narratological concepts. An example is the fine-grained notion of *plot* based on plot units (Lehnert 1981), which is derived, much as in Bremond's account, from a representation of events that involves characterizing the motivations behind the actions of characters as well as their emotional outcomes. While systems use such models of plot in story generation, the inferential challenges involved in imputing motives to characters in narrative understanding are substantial enough to limit the ability of systems to fully extract a plot representation. However, Goyal et al. (2010) have developed, based on a corpus, a text understanding system that can infer characters' emotions (or affect states) associated with events, identifying which outcomes are beneficial, harmful, or neutral for particular characters. More nuanced models of characters' *emotions* have also been explored. For example, the interactive storytelling system of Pizzi (2011) is driven by plans that exploit an inventory of characters' feelings listed in Flaubert's preliminary studies for *Madame Bovary*; such a framework allows for a variety of sentiment-driven interactive retellings of the novel. Another interesting reformulation of a narratological construct is that of *suspense*. Cheong (2007) generates stories judged to be suspenseful by modeling the *reader's* reasoning about limitations and conflicts involving a protagonist's goals (Prince → Reader [7]), based on narratological

insights from Gerrig & Bernado (1994).

For computational accounts to be made more relevant to humanities narratology, two issues need to be confronted: (a) the challenge of interdisciplinary communication across substantial methodological divides, especially given the shift in interest of post-classical narratology away from the precise analyses that characterized its structuralist phase; (b) the fact that computational representations and techniques for story generation are not general enough to concoct anything other than very short, relatively simple stories (such as fairy tales), let alone epics or novels (Gervás et al. 2006). The availability of multimillion-word narrative corpora and advanced machine learning algorithms used for training computational approaches can partially alleviate this problem, though annotating narratological information can be expensive.

4 Trends in the Field

The search for generic computational methods that could be used across narratives focused attention in the 1970s on *planning* formalisms. The spotlight has remained there ever since, although the planning techniques have evolved to accommodate ever-wider narratological concerns. In planning terms, to understand a story requires inferring, based on the Aristotelian notion of *mythos*, the causes of the events in the story and the goals of the characters involved—in effect, reconstructing from the sentences in the *sujet* a plan that corresponds to a causal chain of events (or operators) that can transform the initial state of the storyworld into the final state. The inferred events in the chain can include mental states and actions that may or may not be explicitly mentioned in the *sujet*. *Story understanding* systems (e.g. Wilensky 1978) never got very far, since (i) inferring characters' goals involves a large search space and the inferences may need to be revised during processing and (ii) humans use a great deal of knowledge to interpret even simple stories. Given Forster's exemplifying sentence "The king died and the queen died of grief," a child has no difficulty figuring out why the queen was upset, but imparting a body of such commonsense knowledge to a computer is difficult; (iii) aspects of language that are hard to formalize but that are important for story interpretation, such as humor, irony, and subtle lexical associations, have by and large eluded computational approaches.

However, planning of *fabulae* for *story generation*, where the author can limit the system considerably, has proved more viable (Gervás → Story Generator Algorithms [8]).

In recent years, interactive narrative has been the major driver in the field,

promising new varieties of aesthetic experience, aided by game engines and vivid animations. One of the challenges here (Mateas & Stern 2005) is retaining authorial control over the plot while granting some freedom to the user (who may act as an animated protagonist) in shaping the evolution of the narrative. Empowering the user can lead to aesthetically unsatisfying outcomes, but restricting her through constraints from the plot can limit engagement. The need for generation of text snippets and dialogue rather than full stories (Fludernik → Conversational Narration – Oral Narration [9]) to accompany storyworld animations has also spurred a trend of increased use of text generation based on templates that map non-linguistic input directly to the linguistic output form, sacrificing linguistic generalization for rapid prototyping. Overall, key issues include the modeling of narrative progression and the invention of suitable metrics for aesthetic satisfaction (Mani 2010a, 2010b).

5 Topics for Further Investigation

- (1) As a hybrid of game and narrative that spans multiple media, interactive narrative represents a new and evolving genre. What novel constructs from computational narratology are applicable here, and which old ones need refinement?
- (2) The computer-assisted annotation of large-scale corpora with narratological information bearing on time, place, plot, character, emotion, point-of-view, narrative embedding, metalepsis, etc. is feasible when carried out as collaborative projects. In this respect the “crowd-sourcing” of narratological markup aims to serve human readers by providing more comprehensive narratological descriptions of narratives across an entire corpus, while at the same time facilitating computer-based research into their narratological patterns (cf. Meister 2012). Assuming that such efforts can advance computational narratology and also test more foundational theories, which models should be elaborated for corpus-level annotation efforts by the community?
- (3) How should an empirical theory of aesthetic response be formulated, and can this be exploited computationally?

6 Bibliography

6.1 Works Cited

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6.4 Web Resources

- [AAAI Symposia <http://www.aaai.org/Press/Reports/reports.php>] [13]
- [13][Computational Linguistics for Literature <http://sites.google.com/site/clfl2012/> [14]]
- [ICIDS — Interactive Storytelling <http://www.icids.org/> [15]]
- [Intelligent Narrative Technologies <http://www.aaai.org/Library/Workshops/ws11-18.php>] [16]
- [16][Computational Models of Narrative <http://narrative.csail.mit.edu/ws13/> [17]]

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