

Computational system for narratives with a concern for truth

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Abstract

Narratives and interactive narratives have been investigated for the relationship with truth. This is especially relevant with non-fictional narrative and is crucial in knowledge transfer and historical research, where storyteller and expert roles interact (also within the same person) to deliver the truth to the reader/user. In a computational system for narrative, this account can be addressed formally with the tools provided by Semantic Web initiative, which promises an interconnected web of knowledge, with truthful facts expressed in logic terms and automatic reasoners that can contribute to the authoring and delivering of narratives.

In this paper, we propose a software architecture that implements a connection between the narrative and the knowledge components, the latter encoded in formal terms. As a proof of concept, we address narratives for historical research, with interconnected linear stories augmented with semantic labels that form a conceptual network. We eventually broaden our view by surveying approaches that have used knowledge representation in a storytelling architecture.

Keywords

Semantic Web, hypertextual narrative, narrative system

1. Introduction

The relationship of storytelling and truth has been acknowledged by narratology, especially on the investigation of the behavior of fictional narrative with respect to the so-called "factual" narrative [1]. Although we can assume that factual and fictional narratives exhibit different attitudes towards the story they report, being, on the one hand, truthful about some fact, and, on the other, fictional, i.e. invented by someone, respectively, we can also acknowledge, with narratologists, that "historians on occasion invent or arrange "intrigues", and novelists do on occasion draw inspiration from topical events" [1, p. 757]. Even, for some researchers, a text has never been a work of fiction, because in any case the novelist is actually simulating a factual narrative, whether just pretending to be believed or leaving traces to real sources (e.g., [2]).

Factual narratives, such as history essays and news articles, are acknowledged as a powerful tool for knowledge transfer and historical research; storytellers and disciplinary experts (also within a single person) interact to deliver the truth to the reader or user; storytelling usually requires a strong contribution of disciplinary experts to achieve credibility and convey correct messages. Knowledge transfer through storytelling spans across disciplines (such as, e.g., health, policy development, anthropology, technology research, ...) and addressing different purposes, theories, models, mechanisms, and outcomes [3]. For example, in decision making tasks for health (a major scope at all times), the transfer of the theoretical knowledge is followed by a modeling phase (development of methods for engaging the target audience in a behavior change), and an evaluation phase (about the achievement of intended effects). The storytelling techniques mostly contribute to the theory phase: for example, if we aim at smoking cessation, a narrative can fill the lack of knowledge of health effects of smoking, by discussing

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the health consequences of smoking versus quitting smoking, then to be connected to the goal "stop smoking" and then a mechanism of action.

Historical knowledge, in a time in which the public use of history is invasive, is transmitted through many social communication channels, with the danger of diffusion of stereotypes and apparently simplified paths. And the massive use of AI for creating narratives does not help with the relationship with truth, given its behavior that responds to some definition of bullshit [4]. Historians, in several disciplinary variants, have been engaging in a debate about the nature of historical research, with a bipolar distribution, ranging from positivism, that aims at a notion of "truth", to deconstructionism, that aims at a more or less structured narrative, until a pure linguistic construction [5]. Jerzy Topolski, who has proposed a synthesis of the two positions [6] has provided links between the historical fact and the many represented categories of historical writing (such as pragmatic, critical, erudite-genetic, structural, logical and dialectical writings), claiming that historical knowledge is a mix of source-based and non-source-based knowledge, to determine the selection of relevant information for the historical fact, with its hierarchical distribution and the formal construction of the narrative.

The approach promoted by this paper is to couple the narratives, with an explicit representation of truth, that has a long standing tradition in formal logic. In particular, we refer to the accounts provided by the Semantic Web initiative [7]. The Semantic Web technologies provide methods and languages for the formal representation of the knowledge and can promote interoperability of platforms and the verification through automatic reasoning (see, e.g., [8]). Representations are based on ontologies, namely explicit representations of the conceptualization of some domain knowledge. Ontologies includes concepts and relationships between concepts that model knowledge graphs for states of affairs, actions, and persistent entities of the reference world. A conceptualization defines the major abstract concepts and relations in a domain, then specified in a logical language. Conceptualization applied to specific cases then forms the knowledge graph about some fact. Using a standard data modeling language for the Semantic Web such as RDF (Resource Description Framework), we express the facts through triples $\langle \textit{Subject}, \textit{Predicate}, \textit{Object} \rangle$. The web envisaged by the Semantic Web initiative is one of network nodes that work as competent for some limited domain, with an encoding of formal entities that represent objects and relations of the real world. Moreover, the encoding of the entities is expressed through the mechanism of the URI (Uniform Resource Identifier), which allows for the implementation of the Linked Data paradigm [9]. In this way, all the knowledge, segmented into limited domains, is represented in an interconnected network of nodes, which can invoke each other for the various competence areas.

The aim of this position paper is to propose a software architecture for computational models of narratives that represents the truth in formal terms and labels narratives with semantic entities and relationships, to form a knowledge graph. Narratives and knowledge entities also connect with the sources that provide evidence for their statements. In this initial development phase, we address logic representation of entities and relationships in their role of connecting narratives from diverse disciplines in realizing a shared factual truth, not always inaccessible when perspectives are different. We describe a system architecture and illustrate some case studies from our own experience and the literature as a proof of concept.

The paper is organized as follows. The next section introduces some basic tenets about narratives in their relationship with the historical truth. We do not know of systems that have addressed this issue beyond the narrative level. Then, we propose a knowledge informed approach to the software architecture for narrative models and formal representation. Finally, we list some approaches that rely on a semantic substratum, i.e. are knowledge-driven, to perceive how related works can actually reveal trends in this semantics-based direction. . Conclusions end the paper.

2. Background knowledge

In this section, we address a variety of projects that connect narration with some idea of knowledge and truth. Projects reveal features of this interaction.

The connection of narrative and truth has been addressed in the methods of knowledge transfer and scientific communication, with a long-lasting debate about the collaboration of storytellers and scientists, mostly for the so-called popularization of science. For example, Kirby has explored how scientists have contributed to incorporate science into entertainment programming through storytelling, in collaboration with television producers [10]. Unsurprisingly, this experience pointed out scientists' concerns for the accuracy of the reported scientific facts and TV producers' concerns for authenticity and plausibility of the story sometimes neglecting how science interacts with the story. So, the two realms of scientific facts and narrative incidents should be both kept in, though facing different concerns.

The distinction between science and narrative is sometimes blurred, because some qualitative methodologies (e.g., for ethnographic studies) involve the rigorous collection and construction of narratives to capture the specific manifestations of the phenomenon. In these contexts, narratives become instruments of scientific research. However, several scholars have pointed out that one major obstacle to the use of narrative in the production of scientific knowledge is the grounding on general statements for science and on specific instances for narrative. So, Dahlstrom has argued that for a narrative to be effective, its creation should be preceded by a conceptualization of knowledge, as suggested by research within communication and psychology [11]. With these insights in mind, narratives can lead to accurate knowledge gains; however, with the same readiness, narratives can promote the acceptance of inaccurate facts. Conceptualization can contribute to an effective cooperation between narrative and science but should be monitored for truthfulness of representation. In our approach, this task is left to the sharing of the conceptual knowledge between diverse disciplinary scientists, so to observe and describe the same facts from different perspectives.

This relationship between narration and the production of scientific knowledge is particularly evident in historiographic approaches, where (historical) truth is the target. Narratives establish a mapping to reality mainly through an interpretation effort that places the facts in a context and attempts to explain their significance. Jerzy Topolski has characterized the historiographic method by posing an ontological premise that supports an interpretation of the past and is independent of the scientist; the discovery of the historical truth proceeds from the historical sources through a transfer to a structured writing [6], that is the narrative that is fruitful for historical truth is not in any narrative format but in a licensed structure. Topolski's approach has followed the attention that historians have posed onto the linguistic medium, that has generated a debate with opposing arguments. On the one hand, "there are a number of respects in which [a historian] may be compared to a storyteller" [12]: possessing the knowledge about the historical inquiry, the historian can build the historical account in a narrative form, although the research path could have been different than linear. I.e., the exposition can actually be different from the real nature of the relationships in the research. On the other hand, Danto argues that historical research differs from exact sciences because it is a "narrative" and not an "explanation" of facts [13].

A detailed conception of narratological methodology for historical research has been provided by Ankersmith, according to whom, the narrative should be a subjective construction about the past, though based on individual facts acknowledged to be true [14]. The structure of the narrative contains, beyond the individual facts, the "narrative substances", that reflect a particular point of view of the historian (and storyteller). The structure of the historical tale relies on a conceptual idea provided by the historian, who does not "translate" the past, but produces a subjective narrative.

This paper proposes a software architecture for a computational model of factual narratives, that relies on an explicit representation of the individual facts that are known to be true, as witnessed by the related and referred sources. Such explicit representation is expressed in logical format. If conceptualization is a concrete help for the production of factual narratives, as stated by Ankersmith (see above), then we can consider the employment of a formal characterization of the conceptualization as an effective component of a narration model, in both the system design and implementation. Since the 1990's, the problem of building and sharing knowledge has been addressed through the artifact of the formal ontologies [15]. Formal ontologies, built for specific domains, are developed with objective design criteria and interconnection reference pointers. Later, they have evolved into the methods and languages of the Semantic Web initiative. The claim of this position paper is that such tools can be of support of narratives creation for addressing the relationship of narratives and truth.

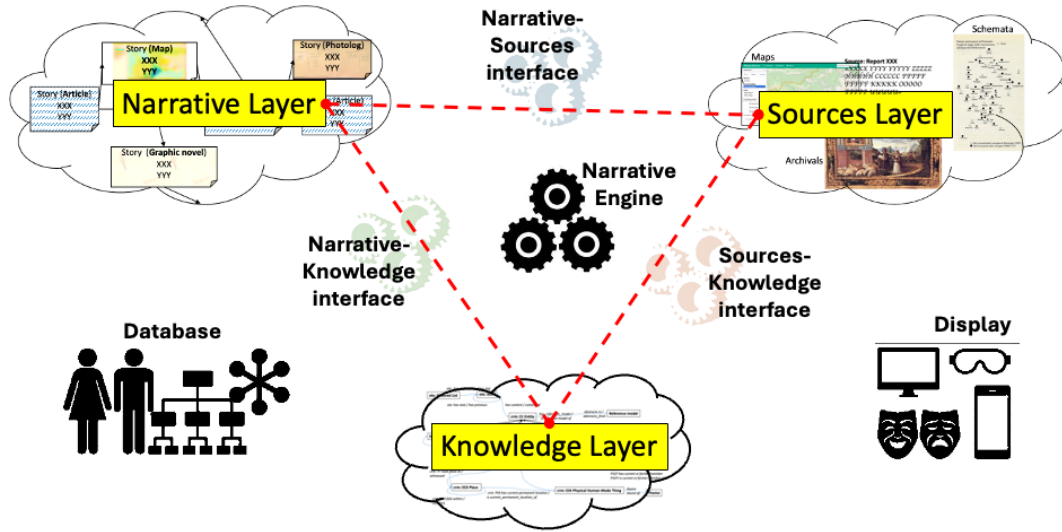


Figure 1: System layers: Narratives, Knowledge, Sources.

3. System for factual narrative

This section describes how a system for the relationship of narrative and truth can be designed from the principles above, concerning conceptualization of knowledge and truth and the relationship with narratives and sources. In the description, we refer to an application of the system design to the project Historygraphia¹, for hyperlinked narratives on historical facts centered upon cultural heritage items [16]. It works on the integration of narratives and sources (Figure 1) through a semantic annotation of the narratives and a knowledge graph representing the acknowledged truth: the layer of the narratives and the layer of sources are connected by identifying semantic entities, belonging to a reduced number of categories, that annotate the major entities mentioned in the narratives and the sources that support the arguments. The historical facts are represented by a knowledge graph in the Knowledge layer; entities in the Knowledge layer are connected to the linguistic expressions that identify them in the Narrative layer. Both narratives and entities are connected to the Sources that contain evidence about the facts represented in the Knowledge layer. All the three layers are reachable from each other, for a global navigation through the narratives and the access to sources and the knowledge graph.

The semantic annotation acknowledges a formal notion of truth of historical facts, by marking a few entities. Figure 2 features a fragment of a general ontology that have been used in project Historygraphia. Categories include Events and States of affairs, Objects, Time spans and Places, Actors, being single Persons or Groups, and finally some abstract concepts, such as Reference models and Themes, mostly related to the history of art and history of architecture. There exist relations between these semantic categories: an actor that participates in an event, an object collocated at some place, The knowledge graph of individuals (e.g., the Event of commissioning Object painting located in Place church to Actor artist, State of affairs toll gaining by Actor royal family because of the Event transit along some road, ...), that results from the connection of all entities through the relations is a representation of the historical facts. A suitable recommendation is to refer to entities and relations that have been encoded in shared ontologies: for example, the CIDOC-CRM model is widely employed in the representation of cultural heritage items and facts [17]. In this way, different projects can share the Knowledge layer and produce novel unpredicted connections.

Narratives, which mainly convey interpretation of the facts, are connected to the sources, to provide evidence for the historical facts. Sources are digitized materials stored by the platform or links to external

¹<https://historygraphia.unito.it/historygraphia>, visited on 19 March 2025.

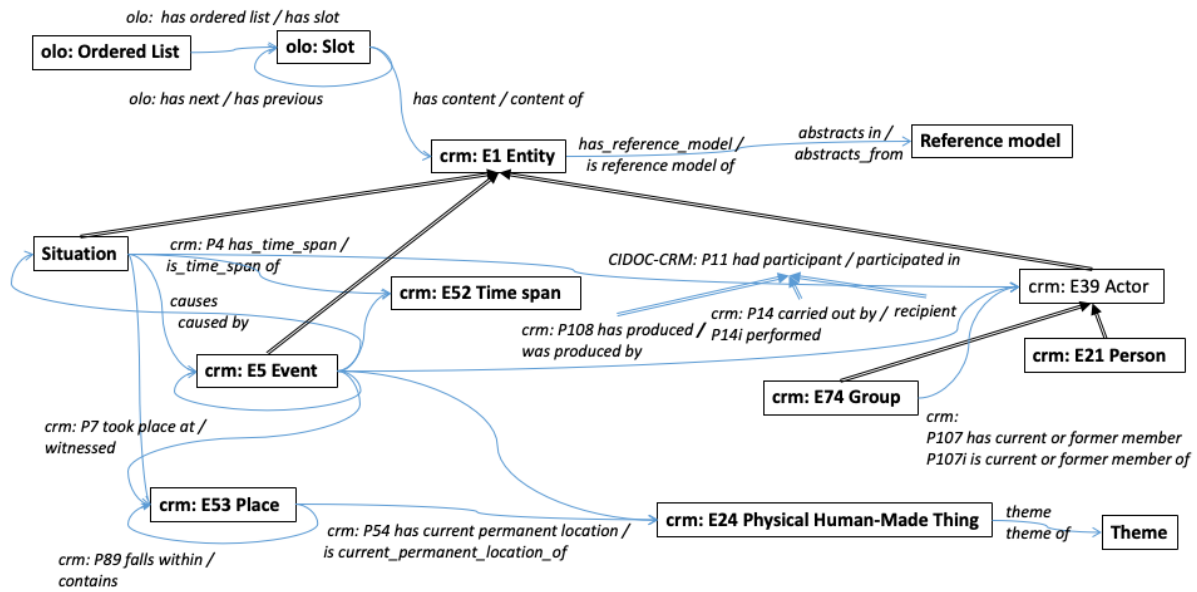


Figure 2: Ontology used in labeling individual narratives in Historygraphia project.

materials and consist of original documents, images, essays on historical facts, digitized collections of objects, The references to sources are also connected to the entities and relations in the knowledge graph, that works as a repository of the encoded historical facts. In Figure 3, we show an example of a narrative, again taken from the Historygraphia project, with its connections to the related sources and to the entities that correspond to the fact encoding in the knowledge graph. The narrative tells of a commissioning that the breeders' brotherhood has entrusted a painter for a cycle of 12 canvases; the choice of the painter depends on the painter's origins in a land that has an intense commerce with the local community. The knowledge graph represents the main entities that participate to this event. The two sources reported in the figure are a manuscript, that supports the news of the intense commerce of cattle, and the digital collection of ex-voto paintings, that display a relevant presence of herds.

In the preliminary testing of the Historygraphia prototype, we noticed that the development of a narrative can proceed from the knowledge graph or the narrative. Historians perform an interplay between the two layers, building up an interpretation of historical facts through 1) the selection of the individual events/objects/agents and relationships between them, which are encoded in the formal representation, and 2) inserting references to the sources from both narration paragraphs and semantic entities. Both the knowledge graph and the semantic labeling of narratives are inserted into a database of narrative units as well as of entities of the (hi)story world; the labeling allows for the connection of narratives through the shared entities and the system proposes a navigation over the universe of narratives. Also, the system reveals clusters of narratives about topics on maps of a territory or on networks of entities connected by relationships.

The Historygraphia system has been implemented as a webapp that is built on a database that stores both narratives and knowledge, and indexes sources. The system relies on CMS Omeka-S for the narrative-knowledge interface, by exposing an API that allows the visualization of the data with a GIS mapping on a territory map.

4. Discussion of knowledge-driven models of narratives

The software architecture proposed above is a general proposal for the connection between true facts and narratives about the facts. There are a number of approaches that employ semantic techniques, in

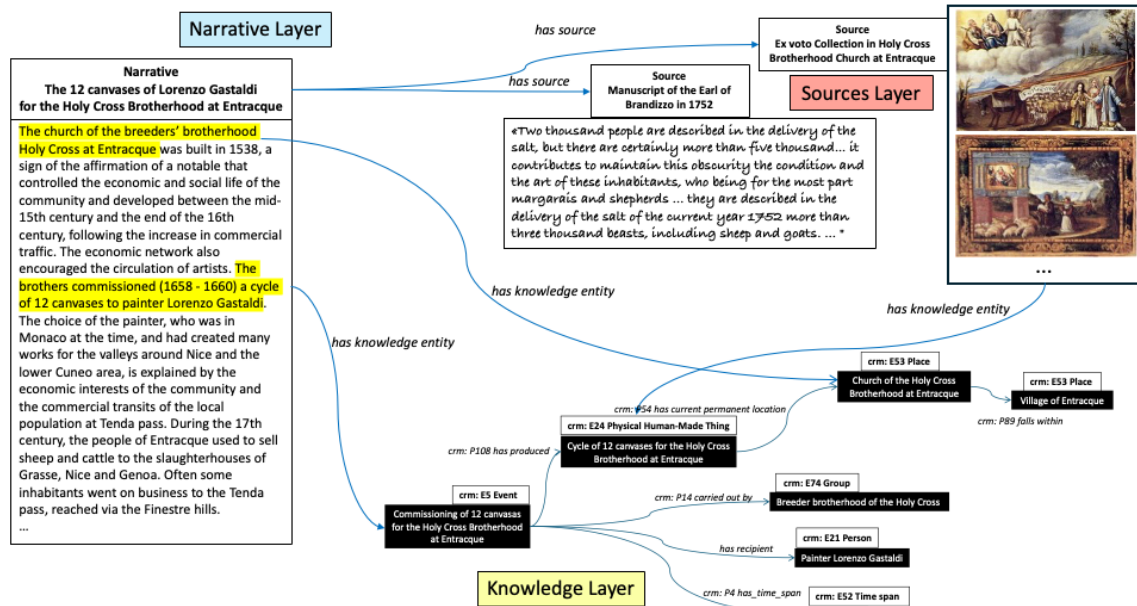


Figure 3: A snapshot of an example narrative with the connections to sources and knowledge graph.

general, the systems are designed by having a semantic resource in mind, with the author exploiting the knowledge conceptualization. In some cases there can be a use of inference engines in order to test the consistency of the resource and possibly extend the relationship with the truth encompassing many narratives. In our testing, we have worked on a mutual check of truthful facts on behalf of the participant to the experiment, belonging to several historical disciplines. Here we discuss a few cases of systems and architecture proposals that are driven by a representation of knowledge and facts, with the goal of providing different perspectives and no claim of comprehensiveness.

Dramatour is a project for the development of an interactive guide for a historical site [18], an animated character (the guide) delivered on a mobile device while visiting a site. An animated character shares the anecdotes about the historic inhabitants of the site, the historical information on the building, the details on the artworks/objects. The representation of facts is reduced to a labeling for constraining the sequencing of narratives in a consistent delivery, and labels are organized according to five taxonomical dimensions, namely topological, chronological, historical, object, and symbolic, listing all the concepts that are mentioned in the narratives. Two dimensions, the topological and the historical ones, guide the navigation over the universe of the narratives. So, in this case, the formal representation of facts reduces to a semantic labeling of narratives for purposes of sequential exposition of the narratives. The topological dimension organizes the knowledge about the structure of the location (palace, rooms, walls and ceilings of each room, objects contained in a room, with entities mainly related by mereological, i.e. *part of*, relations); the historical dimension organizes the historical figures who lived in the site and those who worked in it, subdivided into painters, architects, and craftsmen.

More similar to Historygraphia is the system in [19], where the formal representation, actually DBpedia [20] and other datasets, is used offline for the detection of paths between pairs of concepts during the creation phase of the narratives. This demo tool is an example of what the authors call "algorithmic storytelling", that is a particular type of query response, actually a story that explicitly relates the query context with a path that encodes some semantic relation. It could be employed in several cases of storytelling, such as e.g. the scientific communication analyzed above.

Paths are discovered within DBpedia and other linked datasets (e.g. Facebook, WordNet, CIA Factbook, ..., a closed list). Standard software modules of Named Entity Recognition and Disambiguation (NERD) are used to link the output from the Open Graph Protocol representation² to the related DBpedia

²<https://ogp.me>, visited on 28 July 2025.

resource.

The system described in [21] employs Semantic Web technologies to alleviate the task of the author to create a story world from scratch. In particular, the system, queries DBpedia to extract the information about the characters and the places that populate the story and also about the simple actions (e.g., riding a bike from some place to another). The tool takes as input a story generating grammar in addition to generic keywords for people, places and other various metrics in order to control the output text. The generated text contains new information, descriptions of characters and locations that is not written by the author.

The Semantic Storytelling vision and approach [22] proposes an architecture to (semi-)automatically extract or generate different plot lines for supporting "knowledge workers" (e.g., journalists, ghost writers) in their daily work, by performing Semantic Analysis (processes that enrich documents through Named Entity Recognition and Named Entity Linking), Text Genre-specific Story Knowledge (identification of the abstract structures of different types of stories) and Semantic Generation (dynamic and interactive recomposition of the information extracted in the Semantic Analysis).

5. Conclusions

This paper has explored the relationship of narrative and truth through the proposal of a three-layered software architecture that related narratives, formal knowledge and sources. The paper has also broadened the analysis with other proposals in the literature, that address how to connect narrative and conceptual knowledge representation, with contribution in navigation of a universe of narratives, discovery of knowledge paths between entities mentioned in narratives, identifying entities to be connected in shared databases (e.g., DBpedia), and enriching stories with information taken in external sources after a provided story structure.

The formal approach to conceptualization and the notion of knowledge sharing can become modules of a narrative system, in both the design and implementation phases. Although such systems do not currently employ the reasoning capabilities, we believe that this approach is worth pursuing, given the similarities of the methodological approaches between authoring and semantic modeling. Software modules can ease the contribution of the semantic modeling to the authoring process, by identifying elements of the storytelling design and their relationships with other entities in the story world. These modules should be part of the authoring tools to expose the authors an access to knowledge that is not mediated by other storytelling-based transfers.

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Declaration on Generative AI

The author(s) have not employed any Generative AI tools.

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