

Italo Calvino's 'destini incrociati'. An experiment of semantic narrative modelling and visualisation

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Abstract

Il *castello dei destini incrociati*, thanks to its logical and combinatorial structure, lends itself to experiencing a formal ontology to achieve a semantic visualisation of the narrative created by the author using the tarot cards. Specifically, this research aims to investigate the work's *macchina narrativa combinatoria* ([1]: 124) using Semantic Web technologies to formalise and analyse the textual aspects that concern the collection's narrative and compositional structures. Data has been interpreted in the light of three main aspects: the semantics conveyed by the tarot cards, the text structure and the relations between cards. The result is ODI (Ontologia dei Destini incrociati di Italo Calvino) and its corresponding Knowledge Base (BACODI, *Base di Conoscenza dell'Ontologia dei Destini incrociati di Italo Calvino*) that formalise the description of tarot cards as artefacts and as narrative instances in the text. ODI and BACODI represent a new way to reflect on a non-conventional method to publish the edition of a literary work. All the contents can be browsed through MACODI (*Macchina Combinatoria dell'Ontologia dei Destini incrociati di Italo Calvino*), a web application for a multilayered view of the knowledge stored in BACODI.

Keywords: Semantic Web, Italo Calvino, Combinatorial Literature, Knowledge Graph, Semantic Narratives Visualisation, Digital Humanities.

Il castello dei destini incrociati, grazie alla sua struttura logica e combinatoria, si presta a sperimentare un'ontologia formale per una visualizzazione che sfrutta la semantica della narrazione creata dall'autore attraverso l'uso dei tarocchi. Nello specifico, la presente ricerca si propone di indagare la «macchina narrativa combinatoria» dell'opera ([1]: 124) utilizzando le tecnologie del Web Semantico per formalizzare e analizzare gli aspetti testuali che riguardano le strutture narrative e compositive della raccolta. I dati sono stati interpretati alla luce di tre aspetti principali: la semantica veicolata dalle carte dei tarocchi, la struttura del testo e le relazioni tra le carte. Il risultato è ODI (Ontologia dei Destini incrociati di Italo Calvino) e la sua corrispondente Base di Conoscenza (BACODI, Base di Conoscenza dell'Ontologia dei Destini incrociati di Italo Calvino) che formalizzano la descrizione dei tarocchi come artefatti e come istanze narrative nel testo. ODI e BACODI rappresentano un nuovo modo di riflettere su un metodo innovativo per pubblicare l'edizione di un'opera letteraria. Tutti i contenuti possono essere esplorati attraverso MACODI (Macchina Combinatoria dell'Ontologia dei Destini incrociati di Italo Calvino), un'applicazione web che permette una visualizzazione a più livelli della conoscenza conservata in BACODI.

Parole chiave: Web Semantico, Italo Calvino, Letteratura combinatoria, Grafo della conoscenza, Visualizzazione di una narrativa a base semantica, Informatica umanistica.

1. Introduction

Eccola ora apparecchiare una tavola per due, attendere il ritorno dello sposo, e spiare ogni muovere di fronda in questo bosco, ogni tirar di carte in questo mazzo di tarocchi, ogni colpo di scena in questo incastro di racconti, finché non si arriva alla fine del gioco. Allora le sue mani sparpagliano le carte, mescolano il mazzo, ricominciano da capo. ([1]: 48)

Il castello dei destini incrociati, the first collection of the homonymous work ([1]), is one of the most rigorous results of Italo Calvino's combinatorial literary production. It was conceived during his stay in Paris, thanks to the contact and collaboration with the *Ouvroir de Littérature Potentielle*, known as *Oulipo* ([2]), a group of mathematicians and literati born in 1960, experimenting the creative potentialities in literature using formal and structural rules (*contraintes*). The first edition of the collection dates back to 1969 when Calvino's stories originated as an accompanying text for the art volume *Tarocchi. Il mazzo visconteo di Bergamo e New York* edited by Franco Maria Ricci ([3]). The tarot deck Pierpont-Morgan Bergamo ([4]), used in the first collection of *Il castello*, helped indeed the author to build each story thanks to the reference to Ludovico Ariosto's *Orlando furioso*, of which Calvino was a great reader and scholar ([5]). The final edition was published in 1973, together with the addition of *La taverna dei destini incrociati*, which is based on a different tarot deck named Marseilles.

The challenge for Calvino was to see the tarot deck as a system of signs and an actual language ([6]: 8): the twelve stories of the collection arose from the combination of several cards that, placed in a row — in vertical or horizontal order — create a series of narrative sequences. The main plot relates to twelve travelers arriving at the castle, who use the specific tarot deck as a storytelling medium to tell their own story. The *oulipian contrainte* is double: all the travelers have lost their word, but they are nevertheless eager to narrate, and they cannot move tarot cards laid

down by the traveler who used them in the previous round but only place other cards alongside by drawing them from the deck. The result is the «quadrato magico»:

*Intorno, bastava lasciare che prendessero forma altre storie che s'incrociavano tra loro,
e ottenni così una specie di cruciverba fatto di figure anziché di lettere, in cui per di
più ogni sequenza si può leggere nei due sensi ([1]: 125).*

In the structure created by Calvino, each narrative sequence is crossed with another, as are the characters' destinies. Sequences can be read in any direction (e.g., from top to bottom or from left to right and vice versa) so that the meaning of each narrative story is given by how each card is combined with the other cards of the deck.

Although Digital Humanities research extensively covers knowledge representation of cultural heritage, i.e. Linked Open Data for publishing descriptive metadata in digital libraries and archives ([7]), there is a lack of formal representations for hermeneutic analysis of texts that consider formal expressions and narrative connections ([8]).

Il castello dei destini incrociati, because of its mechanical, geometric and combinatorial nature, lends itself to experiencing a formal ontology for a computational study, both critical and narratological, of the text. Specifically, ODI (*Ontologia dei Destini incrociati di Italo Calvino*) represents the combinatorial nature of Calvino's work. The corresponding Knowledge Base BACODI (*Base di Conoscenza dell'Ontologia dei Destini incrociati di Italo Calvino*) stores the first complete edition of the work, the description of tarot cards — both as artefacts and narrative instances — and the semantic links and narrative relations between different cards in each story, considering their coexistence in a single environment. BACODI contents can be browsed via MACODI (*Macchina Combinatoria dell'Ontologia dei Destini incrociati di Italo Calvino*), a web-based application for non-IT users.

In summary, this research aims to supersede the canonical representation of textual entities (i.e., tagging places, agents, and events of a text). It presents an example of a semantic narrative, starting with modelling the work's texture in all its narrative and compositional elements. The result is a new way to think about the concept of edition as a non-conventional approach to literature. This article is structured as follows: Section 1 provides an overview of the introduction to this work. Section 2 outlines the current state of the art, while Section 3 presents the study's methodology. Section 4 introduces the ODI model, accompanied by a case study from BACODI. Section 5 presents a preliminary data analysis conducted on the BACODI Knowledge Graph using a set of specifically designed SPARQL queries. Section 6 introduces the MACODI web application as a visualisation tool for a set of competency questions previously formulated. Section 7 concludes this work, summarising findings and highlighting potential future developments.

2. State of the art

The creation of semantic narrative visualisations has gained significant interest in recent years in the field of Digital Humanities ([9]; [10]) as an attempt to construct a “data storytelling” that could be sufficiently informative and appealing to users. Using semantics as a narrative methodology is crucial to overcome the print-digital dichotomy, especially in addressing

copyright concerns in contemporary literature¹. Employing a narrative network engages users to better understand the narrative texture and narratological phenomena in digital editions ([11]).

To the best of our knowledge, in the field of Digital Humanities, a relevant project regarding Italo Calvino's works is *Atlante Calvino: letteratura e visualizzazione* ([12]). This virtual environment explores Calvino's corpus through literature and information design. Despite the successful experimentation and the complexity of the analysis carried out by the project team, the web platform does not delve deeply into the textual aspects of the works. However, through an analysis of the textual elements, it could be feasible to decipher certain portions of the texts still safeguarded by copyright despite the inability to provide unrestricted access. A significant contribution specifically dedicated to *Il castello dei destini incrociati* is that of Renello ([13]), who experimented with the Petri net to formalise the work, which is also linked to the graph structure.

Even though there are theoretical studies on *Il castello dei destini incrociati* (including both collections), there is an absence of analyses for a closer understanding of the combinatorial and narrative relations between cards in the text. In other words, many scholars pause over: the multipurpose and symbolic nature of tarot cards for the generative process of the stories and their interweaving ([14]); the characters' relation with themselves and with others within a process of individual identity affirmation ([15]); the theoretical aspects of the combinatorial turning point in response to the complexity of reality ([16]) and the relationships between figure and writing, image and text ([17]). Researchers overlook the combinatorial mechanism of the tarot cards, called by the author *macchina narrativa combinatoria* ([1]: 124), whose mechanical and logical nature is suitable for computational studies. In this direction, new attention could be devoted to the operation of tarot cards as a combinatorial machine, through research focused on the text's narrative structure and its characteristics.

Regarding the study of narrative structures, scholars have actively attempted to identify theoretical models inherent to different ways and techniques of storytelling. In particular, see the study and analysis of characters, starting from Propp's famous scheme on character functions ([18]); the reflections on the "narrative voice" and the "point of view" ([19]); and the categories of space and time analysed by both Genette and Bakhtin ([20]; [21]). Recently, in the field of Digital Humanities, attention has turned toward using ontological methodologies and technologies for literary and narratological research purposes. Some projects have attempted to integrate Semantic Web technologies and narratological studies focusing on the role of the characters: SEBNET, a system able to analyse and generate fairy tales, and SEB, a semantic network application to analyse relations between characters in more complex narratives ([22];[23];[24]).

The Formal Ontology for Narrative ([25]) — an ontology focused on the concepts of character and narrative world/space — and the Narrative Ontology ([26]) — an extension of CIDOC

¹ The Italian Law on Copyright (L.633/1941) clarifies how the exclusive right to the publication and economic use of works of creative ingenuity belongs to the author and his heirs for the duration of seventy years from the author's death. In particular, Art. 70 specifies that: «Il riassunto, la citazione o la riproduzione di brani o di parti di opera e la loro comunicazione al pubblico sono liberi se effettuati per uso di critica o di discussione, nei limiti giustificati da tali fini e purché non costituiscano concorrenza all'utilizzazione economica dell'opera; se effettuati a fini di insegnamento o di ricerca scientifica l'utilizzo deve inoltre avvenire per finalità illustrative e per fini non commerciali.»

CRM, FRBRoo and OWL Time in the field of Digital Libraries — constitute some examples in reflecting on conceptual models for narratology.

As far as data visualisation is concerned, it serves a dual purpose: (i) as a practical tool to accurately express the peculiar characteristics of data content and (ii) as a method to clarify the associated semantic significance (also referred to as *knowledge*). Its goal is to offer a comprehensive perspective on the knowledge repository, potentially aiding domain experts in uncovering hidden information and connections addressing user interface design considerations. The projects mythLOD ([27]) and MELODY ([28]) exemplify efforts to provide specialised visualisation tools for Linked Open Data. On the one hand, mythLOD features visualisations such as a metadata catalogue and a data-storytelling section, revealing specific narratives within the data. On the other hand, MELODY offers a user-friendly interface for exploring Linked Open Data, enabling the creation of personalised, web-ready interactive data storytelling through its user-friendly and reusable software. In addition to these two projects, another significant one is Labyrinth ([29]), a 3D environment that uses semantic annotation to create exploratory paths between works of art by following the narrative relationships contained therein.

3. Methodology

Initially, the first six stories of *Il castello* were analysed according to the methodology proposed by Bowen ([30]: 33). This qualitative approach focuses on the text content and thematic analysis. It consists of three main phases:

- *skimming* (which includes a preliminary, superficial analysis of the text)
- *reading* (thorough and precise analysis of the same)
- *interpretation* (related to the moment of hermeneutic study of the work)

The analysis produced 19 requirements (competency questions) grouped into eight categories according to three main research aspects: semantics, text structure and relations between cards (e.g., ‘What are the meanings associated with cards that have suit wands?’ which concerns the category of the semiotics of suits in numeral cards regarding the semantics aspect, cf. section 5 (*Results*, a-h)).

Additionally, the analysis of source materials produced a series of conceptual maps representing the domain. Maps have then been refactored and translated into an OWL ontology called ODI. Data have been gathered from the text and saved in a set of tables. Tables have been then converted into the BACODI Knowledge Base, modelled on the ODI ontology.

As a first testing activity, ODI was applied to the second section of Calvino’s work, *Tutte le altre storie* (the final chapter containing other six stories) and the model validity was confirmed. Subsequently, also the other six stories of the collection were added to BACODI. The representativeness of ODI and the correctness of the data in BACODI have been tested through the 19 competency questions previously defined via SPARQL queries.

Finally, BACODI data was studied to investigate the 8 main categories, mainly concerning the work’s semantics, the text structure, links and relations between cards. Each analysis refers to a specific category and has been carried out using a selection of competency questions run in SPARQL against BACODI. In analysing data, we have summarised our findings by providing four example analyses (the semiotics of suits in numeral cards, the narrative function of court

cards and triumphs, the miniature's dimension and the use of different cards for the same representation in the same story), that represent our *Query Paths*.

The whole work (ontology, RDF data, case studies and queries) is provided with technical documentation² to ensure reusability and reproducibility in a FAIR perspective.

Some of the *Query Paths* have been selected and have been presented in MACODI³, a web application for experimenting with the collection's semantic narrative. The application has been implemented through a Python environment (Jinja and Flask) serving BACODI and ODI contents in a Blazegraph triplestore to disseminate the BACODI contents to non-IT expert users.

4. Data and Data Model

ODI models the mentioned 19 requirements by formalising the work's edition, the cards' description — both as artefacts and narrative instances — and the semantic links and narrative relations between the different cards in each story.

This section presents the model with some examples from the text and a case study addressing the representation of the first card (*Cavaliere di Coppe*) mentioned in *Storia dell'ingrato punito* and its relationship with another card (*La Temperanza*).

² <https://odi-documentation.github.io/materials/>.

³ <https://projects.dharc.unibo.it/odi/>.

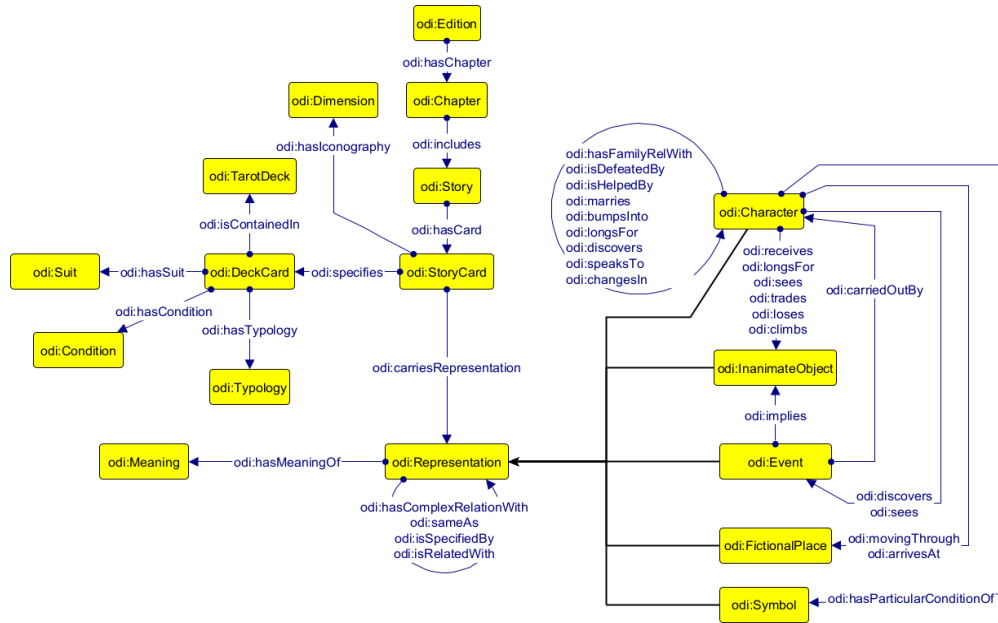


Figure 1: Main classes and object properties in ODI

The edition. It represents the literary edition (`odi:Edition`), including title, author, publication date, publisher, place of publication and chapters. In addition to that, the aim was to create a strong connection between the text and its critical reading made by the scholar ([31]). Furthermore, the modelling of the reference edition was designed with a view to future alignment with other ontologies.

Tarot cards as artefacts and narrative instances. Tarot cards (`odi:TarotCard`) are represented as cultural objects belonging to the tarot deck *Pierpont-Morgan Bergamo* (`odi:TarotDeck`) and as occurrences in the stories (`odi:Story`). Each card is represented by its name, the variant name in the collection (if present), suit, typology, number, current location, condition, miniature and artist who painted it. The connection between the card as a physical object (`odi:DeckCard`) and its narrative dimension (`odi:StoryCard`) is represented through the property `odi:specifies` indicating that the card takes on a particular meaning within a specific narrative context. In particular, cards (`odi:StoryCard`) are represented as narrative instances (`odi:Representation` and its subclasses, `odi:Meaning`) with additional information: the dimension of the reproduction's miniature in the margin of the text, the position in the narrative sequence of cards, the variant name in the text (if present) and the precise citation of the text⁴.

⁴ To make critical reading explicit, a property (`odi:hasTextualReference`) has been created to relate the given narrative function of each card with the author's description within the text. For instance, in the first story (*Storia dell'ingrato punito*) *Cavaliere di Coppe* represents (`odi:Representation`) a character (`odi:Character`), protagonist of the story (`odi:hasMeaningOf, odi:Meaning`), which has a textual reference (`odi:hasTextualReference`) that describes him as «un giovane roseo e biondo».

Semantics links and narrative relations between the cards in the stories. ODI models the network of narrative relations between each protagonist and the semantic links between two cards in the same story. Regarding the first case, properties are aimed at best expressing the narrative functions of the cards while taking the reference text into high consideration. Some properties describe actions (e.g. `odi:bumpsInto`, `odi:isDefeatedBy` and `odi:isHelpedBy`), while others are more descriptive (e.g. `odi:hasFamilyRelationWith`), and others still are used to begin with the narrative (e.g. `odi:longsFor`). Finally, there are properties for places (`odi:movingThrough` and `odi:arrivesAt`) and events to describe both the objects involved (`odi:implies`) and characters that performed them (`odi:carriedOutBy`). Generally, most cards have a direct relationship with the protagonist, while others have an indirect relationship with him/her. For this reason, a distinction has been made between ‘simple’ (i.e. direct) and ‘complex’ (i.e. indirect) relationships (`odi:hasComplexRelationWith`). In particular, cards that have a direct relationship can be specified (`odi:isSpecifiedBy`) or have a general relationship (`odi:isRelatedWith`) with the card that has an indirect relationship with the protagonist⁵. For instance, in *Storia dell'alchimista che vendette l'anima* ([1]: 15-20), the protagonist (*Re di Coppe*), looking for richness, obtains the transformation of the whole city into gold from the devil (*Il Diavolo*). The transformation involves three cards but their relationships with the protagonist are not the same: the triumph *La Ruota della Fortuna* (which represents the event of transformation of the city) has a direct relationship with the protagonist (he is involved in the event) whereas other two cards, *Nove di Coppe* and *Sei di Denari*, are used to specify the event (*Nove di Coppe* expresses the coins and *Sei di Denari* the gold city).

La ruota dell'Arcano Decimo rappresenterebbe allora letteralmente gli ingranaggi all'opera nel Gran Mulino dell'Oro, il meccanismo gigantesco che avrebbe innalzato la Metropoli Tutta Quanta di Metallo Prezioso [...]. Quest'interpretazione non rendeva conto di tutti i particolari della miniatura (per esempio, le orecchie e code bestiali che ornavano alcuni degli esseri umani rotanti) ma costituiva una base per leggere le successive carte di coppe e denari come il Regno dell'Abbondanza in cui nuotavano gli abitanti della Città dell'Oro ([1]: 19).

As far as the semantic links are concerned, two cards can be used to express an identity (`odi:sameAs`) or an evolution (`odi:changesIn`) of the same representation in the same story (cf. Section 5.3).

⁵ For a complete overview of the relationships between cards in each story, please refer to the documentation: <https://odi-documentation.github.io/materials/> (Query paths > Relations between cards).

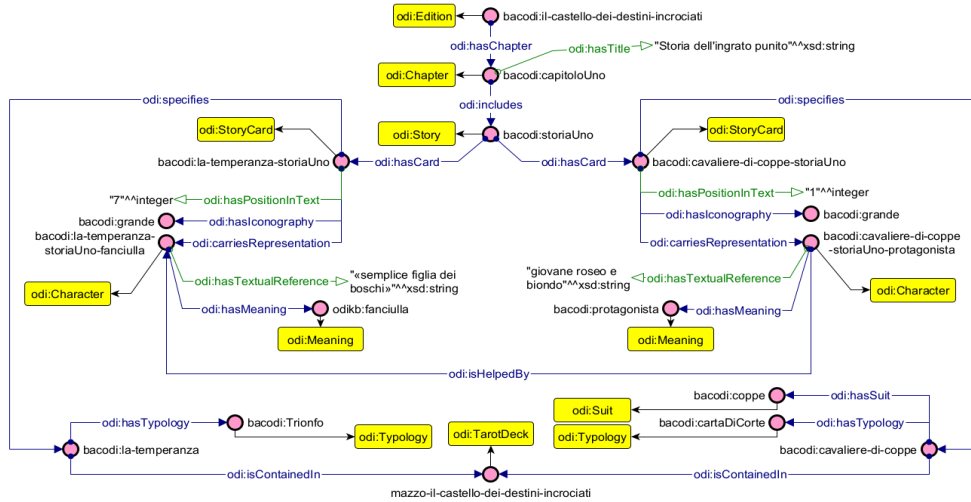


Figure 2: Representation in BACODI of the interaction (**odi:isHelpedBy**) between the cards *Cavaliere di Coppe* and *La Temperanza* in the first story

Figure 2 exemplifies the formal representation of *Cavaliere di Coppe* as the protagonist and its relation with *La Temperanza* in *Storia dell'ingrato punito* (**odi:Story**). After introducing himself, the protagonist arranges 18 tarot cards gradually in a vertical row. The narrative depicts, in summary, a knight who is robbed and hanged from a tree branch by a brigand but subsequently rescued by a maiden. In turn, the maiden resolves to avenge the knight when he forsakes her to wed a woman of greater affluence. At the end of the story, the knight meets his demise at the hands of Cybele and her adherents.

The maiden who initially helps the knight is represented by the triumph *La Temperanza* and in BACODI the property which describes the interaction between the two characters is **odi:isHelpedBy**. As shown in figure 2, both cards are represented in relation to the tarot deck (**odi:TarotDeck**) and the story (**odi:Story**). In the first case, they are represented as artefacts belonging to the tarot deck (**odi:TarotCard**) with their protagonist (e.g. *Cavaliere di Coppe* is a court card (**odi:Typology**) and its suit is cups (**odi:Suit**)). In the second case, they are represented as narrative instances (**odi:StoryCard**) describing the interaction of the two characters in the story (**odi:Character**) with a specific meaning (respectively the protagonist and the maiden, **odi:Meaning**).

5. Data Analysis

The network of narrative occurrences preserved in BACODI and modelled using ODI⁶ suggests a more comprehensive analysis of *Il castello*, considering the tarot cards as a privileged means of

⁶ The complete documentation of the work can be found, as already stated, at <https://odi-documentation.github.io/materials/>. In particular, in *The semantics* section are the three examples

communication and storytelling. The analysis was on the whole carried out on three main aspects, recalling the categories of requirements (cf. section 3, *Methodology*): the tarot cards semantics, investigated through (a) the semiotics of suits in numeral cards, (b) the narrative function of court cards and triumphs, (c) the usage of the same cards with the same meaning in different stories, and (d) the use of two different cards for the same representation in the same story (semantic links, cf. section 4, *Model*); the text structure, investigated through (e) the position of the cards in each story, (f) recurring patterns of cards through the stories, and (g) the dimension of the miniature reproductions along the margin of the edition; finally, relations between cards have been analysed under the light of (h) simple relations (direct relations between each protagonist's card and other cards in the same story) and complex relations (indirect relations between each protagonist's card and other cards in the same story through the presence of a card which links them).

Here are four examples: three come from the analysis's first central aspect (the tarot cards semantics), whereas the last one is from the second one (the text structure). They demonstrate that the author's narratology remains structured despite presenting it as a seemingly chaotic narrative game.

5.1 The semiotics of suits in numeral cards

Each suit in *Il castello* has its miniature referring to a specific semantic field, which differs from the traditional cartomantic bibliography ([32]). The occurrences of tarot cards featuring the suit of wands depict the wooden environment of *Il castello* (e.g., 'log', 'wood'). However, in rare cases, the card number defines their meaning. For example, *Due di Bastoni* can express duality or a choice between two situations (in *Storia della sposa dannata* and the fourth story of *Tutte le altre storie*) regardless of the suit. In contrast, tarot cards with the suit of coins refer to two distinctly contrasting semantic domains: firstly, earthly power, wealth and materiality (e.g., 'richness', 'inheritance', 'money'); secondly, heaven, the divine and the immaterial (e.g., 'light', 'moon', 'state of beatitude'). Between the two semantic fields, however, the former stands out over the latter. Most of the findings regarding the symbolism of numerals in the suit of swords refer to themes of warfare (e.g., 'war', 'duel', 'dispute'); sometimes, it refers explicitly to defence (e.g., 'barrier', 'guards'). Finally, the semantic meaning associated with the suit of Cups is less clearly defined than the other suits. From the results, it is possible to note a large percentage that refers to banqueting and refreshment (e.g., 'banquet', 'wedding banquet', 'tavern'); there are, however, other references such as those related to wealth (e.g., 'the source of life', 'world peace') or to love (e.g., 'love encounter'). In most cases, the meanings of tarot cards are determined by their respective suits, with the type of suit significantly impacting the meaning of numbered cards (unlike triumphs and court cards, analysed in their narrative function (b)). Additionally, not all four suits refer to a single and defined semantic field: the suit of wands recalls, in fact, a narrow semantic field, whereas the suit of cups indicates broader semantics.

shown (i.e. *The semiotics of suits in numeral cards*; *The narrative function of court cards and triumphs*; *Using different cards for the same representation in the same story*) while the fourth example is documented in *The text structure > The miniatures' dimension*.

5.2 *The narrative function of court cards and triumphs*

Court cards express each protagonist of the stories (e.g. the *Cavaliere di Coppe* in *Storia dell'ingrato punito*). For this reason, querying BACODI to find out all court cards' representations was useful for two reasons: firstly, because the existence of court cards that don't represent the protagonist underlined the non-exclusivity of this representation for the typology of card (e.g. the *Fante di Bastoni* in *Storia dell'Orlando pazzo per amore* which represents the character Medoro instead of the main one Orlando); secondly, because queries showed court cards' representation almost always as characters of the stories (**odi:Character**, 12 occurrences) except for one occurrence in which the court card refers to an inanimate object (i.e. 'Trojan horse' in the first story of *Tutte le altre storie*) and two occurrences concerning an event (i.e. 'removal of a leader' in the last story of *Tutte le altre storie*; 'unforeseen' in *Storia dell'ingrato punito*). It is therefore clear that Calvino prefers court cards to represent characters in the stories. Triumphs have more complex miniatures and this complexity stimulates the author's imagination, enriching multiple possibilities of interpretation for the narrative plots. The results of the seventh query are, indeed, diversified: some triumphs represent characters (e.g., 'brigand', 'maiden'), others inanimate objects (e.g., 'prediction', 'soul'), still other events (e.g., 'violence', 'transformation of everything into gold') or fictional places in the sense of narrative world ([33]; [34]) (e.g., 'grave', 'moon' but also «Città del Tutto e delle Parti»); finally, some refer to symbols (e.g., 'inner harmony', 'justice').

5.3 *Using different cards for the same representation in the same story*

Two cards may have a semantic link to express an identity (**odi:sameAs**) or an evolution of the same representation (**odi:changesIn**) in the same story.

The results of the two queries show six occurrences where two cards represent the same entity within a story and ten occurrences where two cards represent an evolution of the same entity within a story. In the first case, the entity of the two cards is almost always a character (5 occurrences vs. 6 total occurrences), except for one occurrence where it is a symbol (i.e., 'richness'). Thus, one notes an almost exclusive propensity to delineate a character's identity by using two different cards in the same story. In the second case, the evolution expressed between the two cards always occurs for a character without exception (thus excluding inanimate objects, events, places and symbols). Therefore, the evolution turns out to be an exclusive property of characters. Both cards are mostly triumphs (6 occurrences out of 10). However, there are times when the evolution involves court cards. In three occurrences the court card is the first card (e.g., from the *Cavaliere di Coppe* to *Il Penduto*) and occurs only once as the second card (from *La Stella* to the *Regina di Spade*). Therefore, triumphs are more effective for the writer to represent the evolution of a character in the story and court cards compete with triumphs to represent a character's condition — physical or intellectual — at the beginning, but not to express its evolution.

5.4 *The miniatures' dimension*

A key element of Calvino's work is the cards' miniature reproductions in the text margins, corresponding to each card quotation. The presence of various dimensions (if present, the miniature can have big or small dimensions) led to querying BACODI to understand whether miniature dimensions, seemingly purposeful rather than arbitrary, serve a storytelling function.

A total of 118 miniature reproductions appear in the text margins (61 big and 57 small). While numerals and triumphs do not present any relevant pattern, miniature reproductions depicting court cards are predominantly big (primarily when representing the protagonist), with three

exceptions in the final chapter. However, these exceptions serve to convey additional layers of meaning compared to their initial representations of the protagonist in the story. Specifically, in the last chapter, the miniatures represent the protagonists (*Il Bagatto*, *La Temperanza*, and *La Giustizia*) having a small dimensions. However, the author utilises these instances to express nuances beyond the original depictions with different tarot cards. For instance, in the fifth story of *Tutte le altre storie* the protagonist is initially represented with the court card *Fante di Coppe* ([1]: 46). Later in the text, the protagonist is represented by the triumph of *Il Bagatto*, which expresses the protagonist's desire to become emperor ([1]: 47). Both cards' miniatures are printed in the margin of the page in correspondence with their citation: the first card presents a big dimension, whereas the second one presents a small dimension. Whether a miniature reproduction has a big or small dimension depends on its context: the first reproduction of the protagonist always requires a big dimension, emphasising its importance in the story, while subsequent reproductions may vary based on the nuanced expressions they convey within the storyline.

6. Visualisation

MACODI (*Macchina Combinatoria dell'Ontologia dei Destini incrociati di Italo Calvino*) is a web application which has been designed and implemented to browse all BACODI contents. A SPARQL endpoint⁷ is provided for IT experts to investigate all possible relations between entities in BACODI. However, the SPARQL endpoint is not so accessible to non-IT-expert users. The examination of data by domain experts (i.e. literature experts and scholars) is crucial for verifying its accuracy and, more importantly, the expressive potential of BACODI. Data visualisation thus becomes a tool dedicated to representing the specific nature of the data and explicitly conveying its associated semantic meaning (referred to as knowledge). It also addresses user interface design requirements while simultaneously aiming for a multilayered view of the knowledge stored in BACODI. This view can reveal implicit information and connections that can stimulate new knowledge of the work ([27]).

The home page provides an interactive reproduction of the «quadrato magico» ([1]: 125) giving each story-s title according to the corresponding card sequences (cf. Figure 3). The image serves as a visual aid to provide users with an overview of the combinatorial nature and structure of Calvino's work. Through the image, it is possible to directly access the in-depth analysis of each card and each story within MACODI. A clarification accompanies the numeral *Sei di Bastoni* due to the unclear identification within the fourth story of *Tutte le altre storie*.⁸

⁷ <https://projects.dharc.unibo.it/odi/sparql>.

⁸ A complete explanation of this occurrence and a set of interpretations can be read by clicking on the card.

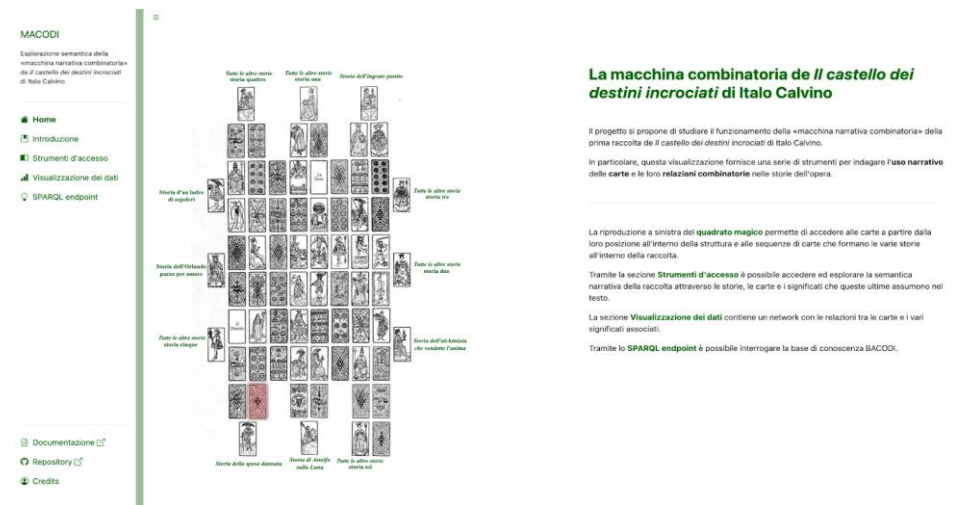


Figure 3: Home with the browsable *quadrato magico*

After a brief introduction which explains the genetics of the collection, the combinatorial work and the project (i.e. *Introduzione*), users can access BACODI contents⁹ through three main indexes (i.e. *Strumenti di accesso*), as shown in Figure 4: (1) *Le storie* contains all the stories of the collection grouped by their relative chapter. (2) *Le carte* contains all tarot cards of the tarot deck sorted alphabetically or by frequency. Cards can also be filtered according to their characteristics: suits (*Bastoni, Coppe, Denari, Spade*) or typology (*Trionfi, Carte di Corte, Numerali*). (3) *I significati* contains all the meanings expressed by the different cards filtered by classes (i.e., symbol, inanimate object, character, event and fictional place) and can be sorted alphabetically or by frequency.

⁹ <https://projects.dharc.unibo.it/odi/indici/>.

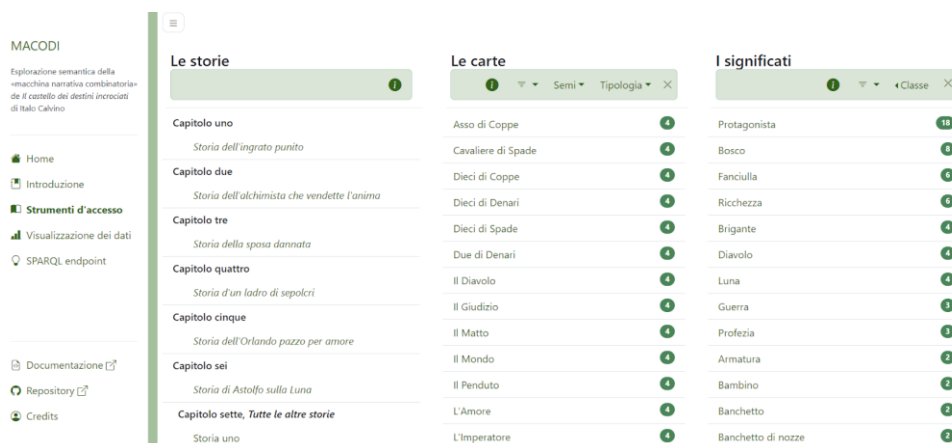


Figure 4: Browsable indexes in MACODI visualisation

The three indexes showcase the set of interpretive analyses performed on the original text to extract the related terminology, conceptual categories, and their relations.

Each item in the indexes leads to a dedicated page which exposes the description of the item itself and its related set of textual interpretations. Such interpretations focus on the occurrences of the cards in the text. A sequence of cards chosen from the tarot deck forms the stories' narrative sequence, revealing the work's combinatorial nature. The following information, therefore, constitutes each interpretation:

- The position (e.g. *Posizione 1*) shows a card's occurrence within a story's narrative sequence
- The instance corresponds to the narrative instance of each card within its story
- The text provides the textual reference in the text
- The miniature of each card may or may not be reproduced in the margin of the text at the quotation of its corresponding card. When it is present, the reproduction is shown in its original dimensions (i.e. big or small) as in the text ([1]). For instance, as shown in Figure 4, the reproduction associated with the court card *Cavaliere di Coppe* has a big dimension. This visualisation ought to resemble the analysis outlined in section 5.4.

Each story is accessible with a brief description and its related interpretations. For instance, as shown in Figure 5, *Storia dell'Ingrato Punito*¹⁰ is presented with a summary (*Sinossi della storia*). The first card (*Posizione 1*) forming the story's narrative sequence is *Cavaliere di Coppe* which represents the protagonist (instance) described in the text as «un giovane roseo e biondo che sfoggiava un mantello raggianti di ricami a forma di sole, [...] mosso [...] più dal desiderio d'apparire che da una vera vocazione cavalleresca» (text) and correlated with a big reproduction of the card miniature (miniature). The same pattern is presented for each card in the story (18 interpretations in total). The visualisation offers a comprehensive overview of the narrative sequence and its combinatorial attributes.

¹⁰ <https://projects.dharc.unibo.it/odi/storie/storiaUno>.

MACODI
Esplorazione semantica della «macchina narrativa combinatoria» di Italo Calvino

Home
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Credits

Capitolo uno
Storia dell'ingrato punito

Sinossi della storia
Un giovane cavaliere, dopo aver ereditato una grossa somma dal padre, si mette in cammino nel bosco. Sorpreso e derubato da un brigante, viene salvato da una fanciulla di ritorno da una fonte. I due giovani si innamorano, ma presto il cavaliere abbandona la fanciulla per sposare una donna d'alto rango. Durante il banchetto nuziale, lo sposo vede correre un bambino con in mano il suo mantello dimenticato nel bosco. Il giovane decide di rincorrerlo, ma viene fermato dalla fanciulla abbandonata adesso nascosta in un'armatura da cavaliere. La fanciulla rivela al giovane che quel bambino è loro figlio e decide di vendicarsi sguainando la spada e gettando a terra il cavaliere sanguinante. Una volta rinsavito, il giovane viene finito dalle seguaci di Cibele.

Approfondimento: Network delle relazioni ↓

Interpretazioni

Posizione	Istanza	Testo	Miniatura
1	Carta: Cavaliere di Coppe Significato: Protagonista	«un giovane roseo e biondo che sfoggiava un mantello raggianti di ricami a forma di sole, [...] mosso [...] più dal desiderio d'apparire che da una vera vocazione cavalleresca»	
2	Carta: Re di Denari Significato: Padre	«un personaggio leggermente più anziano degli altri e dall'aspetto posato e prospero»	
3	Carta: Dieci di Denari Significato: Eredità	«borsa colma di monete d'oro»	

Figure 5: *Storia dell'ingrato punito* visualisation

Additionally, each story is correlated with a network visualisation which shows the semantic links and narrative relations between the representations of the cards within the story. The network reflects ODI modelling choices, where the protagonist has been chosen as the preferred point of view. For instance, as shown in Figure 6, the protagonist presents 12 links with other representations, in particular, 'is defeated' (*è sconfitto da*, 3 occurrences), 'moves through' (*si muove per*, 2 occurrences), 'bumps into' (*si imbatte in*, 2 occurrences), 'changes into' (*cambia in*, 1 occurrence), 'is helped by' (*è aiutato da*, 1 occurrence), 'has a family relation with' (*ha una relazione familiare con*, 1 occurrence), 'receives' (*riceve*, 1 occurrence), 'marries' (*sposa*, 1 occurrence). Each meaning of the story is linked with the card which represents it. For instance, *Cavaliere di Coppe* represents the protagonist and it is coloured concerning the class it belongs to (e.g. The protagonist is a character (*personaggio*)). The list of interpretations shown in Figure 5 is sorted by the occurrence of the card in the text, which is grouped under the category of "position". This arrangement imitates the narrative sequence of the story. On the other hand, the network emulates the fine-grained modelling activity that ODI performs. It enables users to explore the narrative interplay constituted by the cards, their meanings, and the protagonist in greater depth.

MACODI

Esplorazione semantica della «macchina narrativa combinatoria» de *Il castello dei destini incrociati* di Italo Calvino

- Home
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- SPARQL endpoint

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- Repository
- Credits

Cavaliere di Coppe

Descrizione



fonte Wikimedia

Artista: Bonifacio Bembo

È contenuta in: Pierpont-Morgan Bergamo

È attualmente conservata: Morgan Library

Ha seme: Coppe

Ha tipologia: Carta di corte

Interpretazioni

Posizione	Istanza	Testo	Miniatura
1	Compare in: <i>Storia dell'ingrato punito</i> Significato: Protagonista	«un giovane roseo e biondo che sfoggiava un mantello raggiante di ricami a forma di sole. [...] mosso [...] più dal desiderio d'apparire che da una vera vocazione cavalleresca»	
11	Compare in: <i>Tutte le altre storie</i> , Storia sei Significato: Allontanamento del condottiero	«Appena lo sposo dovette ripartire»	

Figure 7: *Cavaliere di Coppe* card visualisation

Further exploration of the semantics of the suit (as described in section 5.1) and the narrative function of the typology (as described in section 5.2) can be explored with the dedicated visualisations, which enables the examination of all instances of a specific typology (e.g., tarot card¹²) or suit (e.g., cups¹³) within the text. The addition of barcharts for both suit and typology also provide a visualisation of the number of occurrences of the suit or typology with a specific class (i.e. symbol, inanimate object, event, ideal place and character). For instance, as shown in Figure 8, the suit of cups is almost always used to express an event (cf. section 5.1).

¹² <https://projects.dharc.unibo.it/odi/tipologia/carta-di-corte>.

¹³ <https://projects.dharc.unibo.it/odi/semi/coppe>.



Figure 8: Barchart of suit of cups

Similarly to the visualisation of stories, cards, suits and typologies, each meaning is accompanied by its distinct visualisation. For instance, the meaning attributed to the protagonist is shown with all its narrative instances in the text. As shown in Figure 9, the protagonist¹⁴ appears predominantly as the first meaning to be introduced (*Posizione 1*) in all the stories, with different cards (e.g. *Cavaliere di Coppe*, *Cavaliere di Bastoni*, *Fante di Coppe*) and mostly reproduced with a big dimension.

This functionality lends itself to a more comprehensive understanding of the interaction between the narrative elements. For instance, when seeking out all occurrences of the primary character (i.e., the protagonist) across all narratives, it becomes evident that a significant majority of these instances (12 out of 17 total occurrences) are situated at the outset of the stories. As discussed in section 5.4, the smaller reproductions of miniature are almost always peculiar to the protagonist who has already been introduced earlier in the storytelling by another card which has a big reproduction in the margin of the text.

¹⁴ <https://projects.dharc.unibo.it/odi/significati/protagonista>.

Posizione	Istanza	Testo	Miniatura
1	Compare in: <i>Storia di Astolfo sulla Luna</i> Carta: Cavaliere di Bastoni	«cavaliere inglese»/«un tipo leggero come un fantino o un fioletto»	
1	Compare in: <i>Storia dell'ingrato punito</i> Carta: Cavaliere di Coppe	«un giovane roseo e biondo che sfoggiava un mantello raggiante di ricami a forma di sole, [...] mosso [...] più dal desiderio d'apparire che da una vera vocazione cavalleresca»	
1	Compare in: <i>Tutte le altre storie, Storia quattro</i> Carta: Cavaliere di Denari	«un altro convitato che si presentava sotto le mentite spoglie»	
1	Compare in: <i>Tutte le altre storie, Storia cinque</i>	«castellano-locandiere»	

Figure 9: The *Protagonist* card visualisation

The collections of interpretations within the semantic narrative framework serve as a valuable instrument for highlighting the combinatorial aspects of Italo Calvino's work. Notably, owing to copyright constraints on Calvino's works, this semantic narrative experiment is presented with a curated selection of text excerpts, comprising less than 20% of the total content of the original work. This approach allows users to engage interactively with Calvino's narrative textures, affording them an opportunity to appreciate the combinatorial essence of his writing while maintaining a meaningful connection with the textual richness of the original work.

The three indexes function as entry points to access the data within BACODI, and the hyperlinks embedded in the visualisation enable users to explore BACODI contents from various viewpoints, allowing them to construct personalised pathways ([27]).

In addition to the access points offered by the indexes, BACODI is navigable through a network visualisation. This network can be explored with the aid of interactive tools designed to assist users in examining the connections between tarot cards and their associated meanings. Within the network, the connections between the cards are depicted based on the meanings they convey within the collection. Tarot cards are symbolised by green squares, while the associated meanings are represented as grey circles, as shown in Figure 10. The thickness of each link between them corresponds to the frequency of co-occurrences of the card-meaning pairs found in Calvino's work ¹⁵.

The analysis of the network is incorporated within the network's description, serving the purpose of assisting users in their exploration of the connections between tarot cards and their associated meanings.

Data visualisation serves as an illustration of how to employ targeted procedures to enhance the role of the end user in resource access. It falls within the realm of research activities seeking to

¹⁵ A detailed interpretation of the network can be found at <https://projects.dharc.unibo.it/odi/visualizzazioni/>.

view Linked Open Data (LOD) and graph databases as a new mode, not only for publication but also for the semantic enrichment of Cultural Heritage. This approach aims to enrich the user's access experience by developing novel forms of knowledge organisation and, consequently, knowledge consumption (*ibid.*).

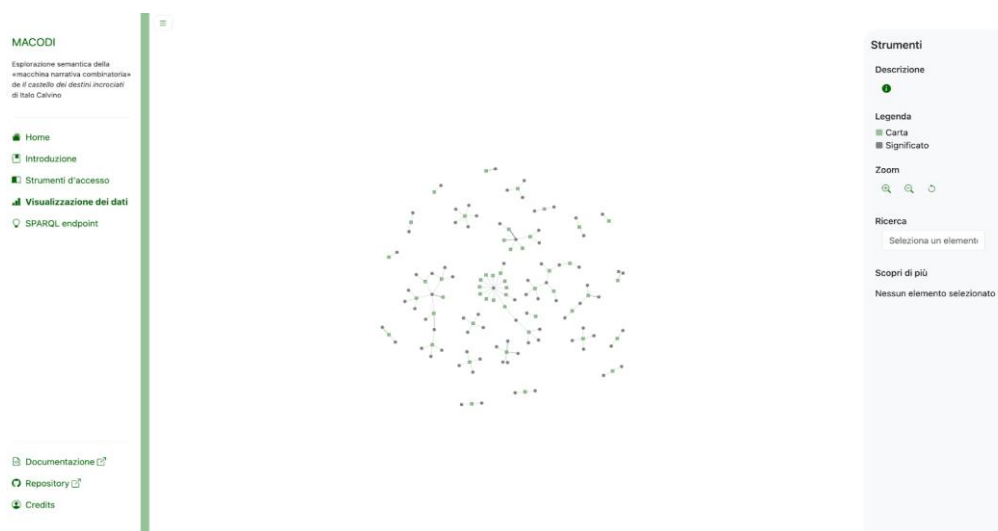


Figure 10: Network representing all relations between cards and meanings

7. Conclusion and future works

This study explores how to exploit Semantic Web technologies to represent aspects of interpretative analysis in the humanities on literary texts. Specifically, this research aims to provide a semantic visualisation of the narrative within the first collection of Italo Calvino's *Il castello dei destini incrociati*.

ODI and BACODI represent the formalisation of textual elements on which narratives are built (description of the cards — both about the deck and to the stories in the collection) and their relations (the semantic links and narrative relations present in each story between the different cards) considering their coexistence in a single environment (the edition of the work). The web application MACODI aims to supersede the canonical representation of textual entities (i.e., tagging places, agents and events of a text) by illustrating the narrative brought forward by the combinatorial use of the tarot cards.

In the future, we aim to go beyond the approach that considers each protagonist as a privileged point of observation, to formalise a more complex network of relations between all the cards in the deck. Additionally, we plan to align ODI with existing ontologies to ensure interoperability with other models (e.g., FRBRoo, CIDOC CRM). We also aim to expand our work to the second collection of the work, *La taverna dei destini incrociati*. Another goal will be to provide more context to the content of data to cover the copyright issue. In particular, we aim to enrich the description and detailed metadata of each meaning represented by the cards. Finally, the addition of *provenance*

information on the mining process ([8]) will strengthen the *trust* in the dataset produced and the overall work carried out ([35]).

This project represents the need to go beyond the canonical digital scholarly editions, even those based on Semantic Web technologies, to demonstrate how semantics can be used to create new interpretational paths, explore the content of literary works and expand the users' knowledge on our textual tradition. MACODI, constituting less than 20% of the original content, engages users with Calvino's intricate storytelling. This allows them to grasp the combinatorial essence of his writing while staying connected to the textual richness of the original work.

To conclude with Calvino's words:

Smontato e rimontato il processo della composizione letteraria, il momento decisivo della vita letteraria sarà la lettura. In questo senso, anche affidata alla macchina, la letteratura continuerà a essere un luogo privilegiato della coscienza umana, un'esplicitazione delle potenzialità contenute nel sistema dei segni d'ogni società e d'ogni epoca: l'opera continuerà a nascere, a essere giudicata, a essere distrutta o continuamente rinnovata al contatto dell'occhio che legge ([36]: 211-212)

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