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LINGUISTIC TOOLS FOR NAVIGATION IN A VIRTUAL MUSEUM

1. Introduction

The digital and Virtual Reality technologies introduced in recent years in the world of museums have promoted the development of innovative products able to provide users and visitors with access modes very different from the traditional ones.

Basically, such products are constituted by interactive information units set up in the display rooms, or by digital devices (CDs, DVDs) simulating the path followed by the visitors; they are suitable for didactic purposes and can sell very well if supplied with multilingual audio guides available at the bookshops of the museums. However, if we consider the information available on the net and try to enter a museum of this type which either corresponds to a real one or reflects a typological set of objects actually housed in different and even geographically distant sites, we will certainly be unsatisfied for a number of reasons. Firstly, the few cases available can be looked upon as only partially virtual since the correlated information such as catalogue identification, inventory number, description, etc., has simply been converted into the new condition of digital format.

It is true that an artifact that a visitor can see in a low resolution icon catalogue simplifies the information retrieval operations, but it offers no innovative approach capable of justifying the considerable resources invested to produce the digitized objects consultable on-line.

Another problem we would like to face is represented by the possible interaction between digital objects and their linguistic captions which we think could contribute greatly to the development of a real virtual museum, as long as the environment of navigation and interaction with the user occurs with appropriate paradigms. A number of simple suggestions on this matter will be provided below.

The work described here[1] refers to an experiment that was carried out in order to make the visit to a painting gallery, represented by iconographical objects collected in an imaginary space, at the same time virtual and independent of cultural prejudices. Our virtual museum is thus considered as a series of undefined places, e.g. Internet sites or addresses relative to image files in .jpg format, eventually stored in directories available on one or more discs. For each painting it was necessary to produce a text format description of

[1] The ideas for this study were devised and set forth by Andrea Bozzi; Giuseppe Fedele carried out the experiment using and tailoring the neural network; Laura Cignoni was responsible for the lemmatization and the choice of examples provided in the paper.

about 400 words, therefore much longer than that of an ordinary caption, but shorter than a monographic essay. In particular, we wanted to check whether and to what extent the element represented by a text would make it possible to create a logical and conceptual association even among elements with no apparent relation (at least for users with a low or medium level of culture), as well as among those with evident relations that anybody could identify easily. The system, therefore, functions regardless of the cultural background of the visitor, with the result that anybody, experts and non-experts alike, can see the associations between the iconographic works and the "linguistic" reasons taken into account by the system for their realization.

Let us first anticipate that technology makes it possible nowadays to intervene automatically so that iconographic elements can be identified by digital image analysis; therefore, no linguistic description is actually necessary to associate paintings which have a number of elements in common. However, it should be pointed out that such methods can only highlight the similarities among chromatic elements, graphical patterns, well evident features in the foreground of the image, while many other aspects impossible to capture are missed, thus reducing the number of feasible associations. On the other hand, the associations carried out on linguistic grounds have sometimes shown to be excessive, owing to the considerable amount of information (in particular the profuse sequence of diversified adjectives) contained in historical and artistic works. This negative element which emerged from the experiment can however be exploited to find suitable solutions aimed at reducing the production of partially useless results.

2. The tool

The Self-Organizing Maps, also known by the acronym SOM, have appeared, in this phase of the project, the most suitable among the tools examined. However, at a later stage we intend to compare the results currently obtained with the ones deriving from a larger number of data and successively, it would be advisable to submit the same texts to different data mining systems so often employed nowadays in the Semantic Web[2]. Kohonen introduced

[2] The Self-Organizing Maps were implemented in the Eighties by Tuevo Kohonen at the *Neural Networks Research Centre* (University of Technology in Helsinki). The field in which he developed his theories includes associative memory, neural networks and identification patterns. SOMs represent the most common algorithm of artificial neural networks in the category of non-supervised learning and are able to interpret and visualize large amounts of data. With regard to other text mining techniques to be considered as a second step of the project, we shall first consider T2K (*Text to Knowledge*). T2K is a software module for the semi-automatic creation of thesauri of terms and ontologies of semantic metadata for the handling of documents. T2K was implemented jointly by the Department of Linguistics-Division of Computational Linguistics of the University of Pisa and the Institute of Computational Linguistics-CNR, in collaboration with Wbt.it, and successively experimented within the framework of the project "Traguardi" of FORMEZ-Dipartimento della Funzione Pubblica (Bartolini *et al*. 2004a).

many innovative concepts in the field of artificial neural computing, which has proven particularly efficient as exploratory data mining system[3]. The structure of a map is constituted by a small network of processing units (the neurons), associated with a set of features (vectors) extracted from different types of data (textual or numerical). The map tries to represent all the observations available using a limited number of vectors. These are distributed along a bi-dimensional grid where similar vectors are placed physically close to one another while the dissimilar ones are distanced.

The SOMs represent a very flexible inferential engine: they have been used in natural language processing as morphological and syntactic analyzers and in speech recognition for the understanding of spoken language (KOHONEN 1995), providing a new non-traditional natural language processing method able to offer a qualitatively superior level for the visualization and organization of information contained in digitized archives (ONG *et al.* 1999). Kohonen himself proposes an application of the SOMs to natural language (HONKELA *et al.* 1995) through various experiments, one of which, conducted on the English translation of Grimm's fables, turned out to be particularly useful for our purposes. The material was represented by 200 fables; the entire text was included in a single file, where all the punctuation marks were suppressed, and the capital letters were replaced by non-capitals. Moreover, the articles "a", "an", "the" were eliminated, as they were irrelevant to the *text mining* operations. The remnant words (occurrences) in the text were about 250,000, while the corresponding lexical entries (lemmas) added up to 7,000.

In our experiment we used a considerably smaller amount of data: 12 captions from paintings by Henri de Toulouse-Lautrec[4], with a total of around 4,500 occurrences referred to a dictionary of 500 lexical entries (lemmas).

2.1 *The early phase*

The early phase of the work consisted in providing a uniform structure of the captions so that the system could operate consistently and the assessment of the results could be objective. To this purpose, the captions were constructed according to a simplification of the model suggested by PANOSFSKY (1955). The interpretative model is subdivided into five levels indicating the path followed by the visitor for his understanding of the work of art.

[3] Briefly, *data mining* is the extraction process of knowledge from large data banks, which occurs by the application of algorithms able to identify and visualize the meaning associations which exist among different types of information. When the methods of data mining are applied to textual documents, they assume the specific term of *text mining*. The data mining process implies the search, identification and extraction of patterns (vectors) by means of a multidisciplinary approach which combines statistical methods, information visualization and machine learning.

[4] The example of one textual description with lemmas is reported in the Appendix.

The first level is represented by the identification of the contents of the painting. This is the phase in which lines and colours are turned into objects, subjects or events. The second level consists in the identification of the scene represented; inferences are made to understand what the objects correspond to, who the subjects are, or better, the events portrayed in the facing work. The reference source is that of subjective historical-cultural knowledge. The third level allows an in-depth observation of the painting which identifies the intentions of the author. The fourth level witnesses the transition from the purely cognitive to the emotional activity of the viewer. The fifth and final level consists in his capacity of judgement and this can be of aesthetic, ethical or epistemological type. These operations are not actually so clear-cut, but represent a constant ongoing effort on the part of the viewer.

2.2 *The next phase*

In the next phase, the captions are integrated in a single file and tailored to the format requested by the lemmatization program which consists in the process of referencing the inflected forms present in a text to their lexical entries. This process can be manual, automatic or semi-automatic; in our case a semi-automatic system was used which assigns for example to the form "letto" both the entry "letto" (bed), singular masculine noun, and the entry "leggere" (to read), past participle of the verb. Disambiguation of the homographs present in the captions was performed manually. During this phase, punctuation marks as well as a-semantic words (articles, conjunctions, prepositions) were eliminated. At a later stage, the captions were separated individually, ready to be used in the following stages.

2.3 *The clustering process*

The next phases are more directly involved in the clustering process performed by the neural system, the purpose of which is to create a map showing semantically-oriented nodes around which the system conglomerates semantically similar lexical entries. To this scope, lemmatization of the previous stage produced the "typical" dictionary of which only the most frequent entries are considered. The total of 100 lemmas represent – as already said – about 50% of all the words present in the captions.

An application carried out successfully by the SOMs was the creation of actual word-maps, in which the different lemmas – provided as input to the neural network underlying the Self Organizing Map – were organized in categories (clusters) according to some of their common features (identified and made pertinent by the neural system). At this point it was necessary to decide how to transform symbolic elements like the words (and the meanings

each of these words conveyed) into a metrical value reflecting their specificity and allowing an *automaton* (the artificial neural system) to establish degrees of similarity with other words. Basically, it was a matter of encoding a word and establishing the criteria according to which this was possible, so that the neural system could find regularities and statistical occurrences in a *corpus* of analysis (in our case, the text of the twelve descriptions). For instance, it is evident that we could not operate on the grounds of a hypothetical semanticity scale, according to which one should establish considerable grades of semantic vicinity or distance between two or more words. It follows that we could not refer to an inexistent semantic code by which the patterns to be inserted by the SOMs into a map could be encoded and represented vectorially. The only manner in which it was possible to assign a semantic value to the data was to encode the lemmatized word together with even a minimum part of the context in which it was found.

With this aim, a program operating on the lemmatized text of each description generates for each word ("key") a short context ("triplet") formed by the preceding ("predecessor") and following ("successor") word. Since the goal of the work is to investigate the similarities of the words whose contextual uses are similar, a numerical value is assigned to the keys in order to obtain a vector with the average of the vectors encoding the predecessors, with the vector encoding the key itself and with the average of the vectors encoding the successors. This encoding methodology does not assign an actual semantic representation of the word, which – as we have already said – would be impossible, but it consists in a codification that takes into account and evaluates the context-of-use of the word, in numerical form.

The neural network can now operate receiving as input a long string of three-element phrases, composed by the vectors representing the triplets as well as by the vectors associated with the different keys. The operations carried out by the neural system produce a distribution of the keys within a bi-dimensional map where the resulting clusters (groups of words defined as "nodes") can be checked. The "conceptual resolution", in other words the density of the semantic element, obviously depends on the size of the map: in a larger map the nodes will be able to identify more restricted concepts ("higher conceptual resolution"); in a smaller map, the semantic field of each node is larger ("lower conceptual resolution")[5].

[5] The size of the map also depends on the consistency of the vocabulary; it is related to the graphical interface required to visualize, in a clear and simple manner, the distribution of the words in the bi-dimensional space. In this respect, an excessively large map for a relatively small vocabulary, as in this case, would have the disadvantage of presenting the words of the single nodes excessively distanced one from the other, compromising the understanding of the bond or of the semantic-conceptual similarities identified by the neural system. In our experiment, we used a 40×30 semantic map, obtaining a total of 1200 conceptual nodes.

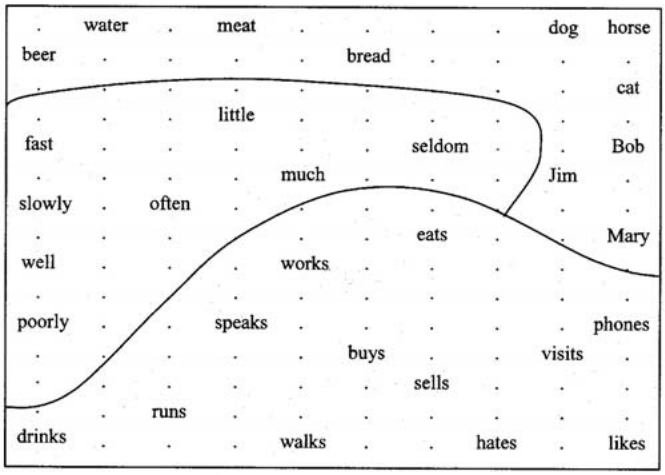

Fig. 1 – Example of a semantic map.

We shall now simulate what has been said so far, with the following example, also reported by KOHONEN (1995) in his work. Let us suppose that a text, obtained from a limited dictionary of thirty non-lemmatized words, is represented by a number of three-element phrases forming the contexts that will be mapped on the SOM:

Mary likes meat	Jim eats seldom	Jim speaks well
Bob buys meat	Mary likes John	cat walks slowly
Jim eats often	Jim hates bread	Mary buys meat
cat hates Jim	dog drinks fast	Bob sells beer
horse hates meat		

After having assigned the vectors according to the specifications given above and submitted them to the neural network in about 2000 *learning cycles*[6], the following result reported in a 150-node map (10×15) was obtained (Fig. 1).

The limited number of words did not allow the neural network to find elements of semantic contiguity, but grammatical ones instead: the nouns,

[6] For a neural network to be able to work, it is necessary to proceed to the so-called *training set* (learning phase) which envisions a certain number of "lessons" (learning cycles), during which statistical calculations are performed. There exist rules to understand the number of optimal cycles beyond which the network is no longer able to learn: there would be no qualitative advantage to continue the training set beyond this limit. In our experiment 1,000,000 learning cycles were performed.

verbs and adverbs were classified clearly (a separation line has been traced to facilitate the understanding of the results). Further distinctions are possible in the same set of words (for example proper nouns and common nouns or, still in the same category, human beings and objects).

For a tool of this type to be tailored to textual descriptions for navigation "by concepts" within the framework of a virtual museum, it is important to underline that these clusters of words are the result of an autonomous process and are not defined *a priori*. The context itself determines the relevance of the features and attributes of a single *item*: the resulting representation therefore emerges without the intervention of exogenous or extra-contextual parameters and categories.

Since the structure of the context influences the statistical results produced by the neural network, it is advisable to have the texts distributed in a regular manner, as in the experiment conducted on the twelve descriptions that were rendered structurally uniform according to a descriptive code.

3. Analysis of the results and concluding remarks

The study of the results obtained by the neural system was carried out on a bi-dimensional map displaying clusters of white spots within a grid of black ones (Fig. 2). Each white spot corresponds to a lemma, so that the semantic areas identified can be seen. Firstly, however, it is necessary to stress – as already pointed out – that the neural network acts by means of the statistical parameters deriving from the "triplet" structure by which the network has been trained. It is thus likely that clustering paradigms have been involved which are different from those we intend as "semantic".

For the neural network, even the forms ending with the same inflectional elements have a strong similarity value: many verbal forms in the infinite form tend to appear close to one another, unless they have been placed elsewhere owing to some stronger statistical reason. For example, in our experiment this was the case of the lemma "valorizzare" (to valorize) which we found surrounded by "dividere" (to divide), "circondare" (to surround), "diventare" (to become) and, at a slightly longer distance, by "ricondurre" (to reconduct). In the same way it comes as no surprise if proper names, like those of the painters Renoir and Van Gogh, etc., frequently quoted in all the texts next to names of people with whom they interacted at one time or another, are found close together.

Each lemma retains reference to the description in which it occurs, and for this reason one can easily check whether or not these clusters can be justified, not only from the point of view of morphological similarity, but also of comparison among the different contexts (parts of the descriptions) in which they appear. In this respect, we checked the possible reasons underlying a small

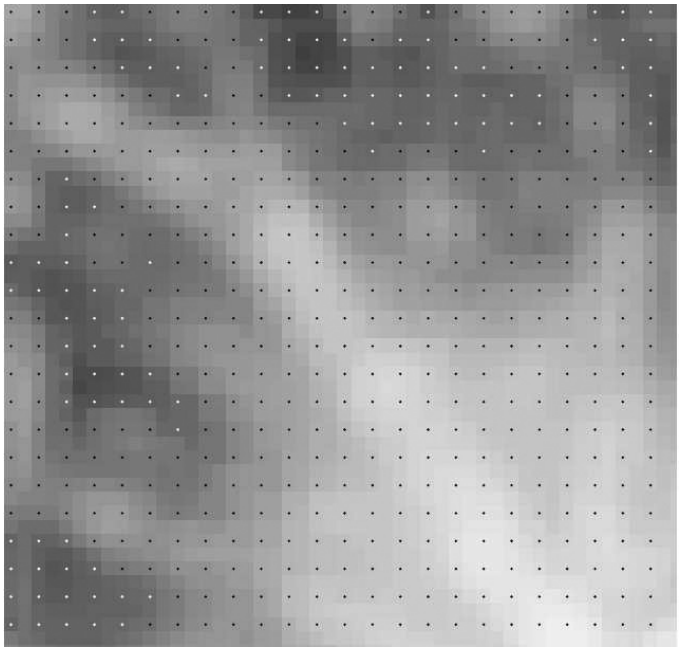

Fig. 2 – Representation of some node groups on the map. A word (lemma) corresponds to each white spot. The nodes selected by the mouse show the associated lemmas. An appropriate graphical interface, not realized in this phase, makes it possible to convert these groups in text files which can be consulted easily for operations aimed at checking the performance of the network and to apply any necessary correction to the system. The examples examined in section 3 have been drawn from the white-node clusters of lemmas.

grouping which contained words like "nudo" (naked), "vestito" (dressed), "modella" (model), "prostituta" (prostitute), "volume" (volume) and "realistico" (realistic). The passage containing the lemma "nudo" (text n. 9: «La donna, completamente nuda, siede in piena luce su di una poltrona …»)[7] has quite a satisfactory and antithetic correspondence with another passage containing the lemma "vestito" (again in text n. 9: «in una posizione simile a quella di Marie, anche se più pudicamente vestita»)[8].

Furthermore, what the two descriptions have in common is the fact that they refer to female subjects who are both performing the function of models. It is worth mentioning that in the same area of the map we find a

[7] Translation: the woman, totally naked, is sitting on an arm-chair in full light.
[8] Translation: in a position similar to that of Marie, although more chastely dressed.

series of lemmas which fit with the previous ones, for example “prostituta” (prostitute), “modella” (model) and “realistico” (realistic).

Another interesting match is that of “pudico” (chaste) with “delicato” (delicate), if we consider the two contexts: (text n. 9 «anche se più pudicamente vestita»[9], and text n. 10: «I toni delicati del viso e dei capelli castano chiari»)[10].

A case worth mentioning is found in a rather vast area containing the two adjectives “splendido” (splendid) and “diafano” (diaphanous). The former is referred to a passage contained in description n. 8: «… per dare maggiore risalto alla sua splendida chioma …»[11], while the latter appears in description n. 10: «Sotto un aspetto diafano…»[12]: in this case the reason for the matching produced by the neural system is more subtle than the belonging of the two elements to the same part of speech. These two qualifying adjectives are in fact positioned one next to the other because the contexts in which they appear are semantically similar.

The examples are many both for the matches which are acceptable but, unfortunately, also for those that are not.

We may conclude by asserting that the method which has been followed could provide even more significant results if the *corpus* of texts were extended and the relation between amount of data (intended as number of different lemmas) and size of the map were better assessed. What seems to emerge is the fact that it is not always possible to apply the same criterion, whatever the size of the main vocabulary used in the texts analyzed. This means, for example, that for a very long text, in which the percentage of semantically significant words is low and the percentage of a-semantic terms is high, the neural network will provide a classification which cannot be used for our purpose.

Instead, the results will be reliable only in the presence of fairly large texts containing a rich lexicon, and only in this case will it be possible for the size of the map to be balanced for an optimal conceptual resolution which will stimulate the curiosity of the visitor looking for digital artifacts displayed in a virtual museum.

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[9] Translation: even if more chastely dressed.
[10] Translation: the delicate tones of the face and of the light brown hair.
[11] Translation: to give prominence to her magnificent hair.
[12] Translation: under a diaphanous appearance.

Fig. 3 – *Alphonse de Toulouse-Lautrec conduisant son mail coach*.

APPENDIX

The texts relative to the descriptions of the twelve works by Henri de Toulouse-Lautrec examined were the following: *Alphonse de Toulouse Lautrec conduisant son mail coach* (Fig. 3); *Cheval blanc*; *Princeteau dans son atelier*; *Autoportrait*; *Le jeune Routy*; *La comtesse Adèle de Toulouse-Lautrec*; *Etude académique*: *polisseur de marbre*; *Carmen Gaudin*; *La grosse Marie*; *Emile Bernard*; *Vincent Van Gogh*; *Lily Grenier*. Below we can see the description of the first work, in which the forms of the text are followed by the specification of the lemma, in brackets. Grammatical tagging of the lemmas provided by the automatic system was discarded to avoid the increase of possible associations among lemmas belonging to the same part of speech.

ALPHONSE (ALPHONSE) DE (DE) TOULOUSE (TOULOUSE) – LAUTREC (LAUTREC) ALLA (A) GUIDA (GUIDA) DELLA (DI) SUA (SUO) CARROZZA (CARROZZA)

Henri (HENRI) assimila (ASSIMILARE) i (IL) gusti (GUSTO) familiari (FAMILIARE) e (E) il (IL) clima (CLIMA) aristocratico (ARISTOCRATICO) del (DI) suo (SUO) ambiente (AMBIENTE). Soprattutto (SOPRATTUTTO) i (IL) soggetti (SOGGETTO) equestri (EQUESTRE) sono (ESSERE) al (A) centro (CENTRO) della (DI) sua (SUO) attenzione (ATTENZIONE) e (E), dipingendo (DIPINGERE) il (IL) tiro (TIRO) a (A) quattro (QUATTRO) guidato (GUIDARE) da (DA) suo (SUO) padre (PADRE), Lautrec (LAUTREC) dimostra (DIMOSTRARE) di (DI) aver (AVERE) attentamente (ATTENTO) studiato (STUDIARE) il (IL) movimento (MOVIMENTO) dei (DI) cavalli (CAVALLO) al (A) galoppo (GALOPPO) durante (DURANTE) le (IL) battute

(BATTUTA) di (DI) caccia (CACCIA) o (O) alle (A) corse (CORSA), riuscendo (RIUSCIRE) poi (POI) a (A) tradurre (TRADURRE) pittoricamente (PITTORICO) con (CON) grande (GRANDE) abilità (ABILITÀ) il (IL) ritmo (RITMO) sincronizzato (SINCRONIZZATO) delle (DI) zampe (ZAMPE) degli (DI) animali (ANIMALE) lanciati (LANCIATO) nella (IN) corsa (CORSA). Il (IL) quadro (QUADRO) mostra (MOSTRARE) una (UN) corsa (CORSA) in (IN) carrozza (CARROZZA) tirata (TIRATO) da (DA) quattro (QUATTRO) cavalli (CAVALLO). La (IL) descrizione (DESCRIZIONE) minuziosa (MINUZIOSO) della (DI) forza (FORZA) e (E) possanza (POSSANZA) dei (DI) cavalli (CAVALLO) traspare (TRASPARIRE) dalla (DA) tensione (TENSIONE) delle (DI) linee (LINEA) con (CON) cui (CUI) Loutrec (LOUTREC) disegna (DISEGNARE) gli (GLI) animali (ANIMALE); la (IL) loro (LORO) irruenza (IRRUENZA) è (ESSERE) grande (GRANDE) quanto (QUANTO) la (IL) fermezza (FERMEZZA) del (DI) soggetto (SOGGETTO). La (IL) posizione (POSIZIONE) del (DI) soggetto (SOGGETTO) così (COSÌ) tesa (TESO) in (IN) avanti (AVANTI) evidenzia (EVIDENZIARE) un' (UN) attenzione (ATTENZIONE) particolare (PARTICOLARE) alla (A) guida (GUIDA): entrambe (ENTRAMBE) le (IL) mani (MANO) sono (ESSERE) poste (POSTO) sulle (SU) redini (REDINE), il (IL) corpo (CORPO) leggermente (LEGGERMENTE) flesso (FLETTERE) in (IN) avanti (AVANTI) non (NON) adagiato (ADAGIARE) al (A) cassetto (CASSETTO) mostra (MOSTRARE) una (UN) figura (FIGURA) alta (ALTO) e (E) slanciata (SLANCIATO). La (IL) postura (POSTURA) del (DI) soggetto (SOGGETTO) indica (INDICARE) un (UN) temperamento (TEMPERAMENTO) eccentrico (ECCENTRICO) e (E) stravagante (STRAVAGANTE); in (IN_EFFETTI), si (SI) tratta (TRATTARE) del (DI) conte (CONTA) Alphonse (ALPHONSE), grande (GRANDE) amante (AMANTE) della (DI) libertà (LIBERTÀ) e (E) della (DI) vita (VITA) attiva (ATTIVO), personalità (PERSONALITÀ) fuori (FUORI) dai (DA) rigidi (RIGIDO) schemi (SCHEMA) tradizionali (TRADIZIONALE) della (DI) casata (CASATA) a (A) cui (CUI) appartiene (APPARTENERE); per (PER) il (IL) giovane (GIOVANE) Henri (HENRI), piccolo (PICCOLO), dalle (DA) ossa (OSSO) fragili (FRAGILE) e (E) costretto (COSTRINGERE) all' (A) immobilità (IMMOBILITÀ) per (PER) lunghi (LUNGO) periodi (PERIODO) della (DI) sua (SUO) adolescenza (ADOLESCENZA), è (ESSERE) certamente (CERTO) un (UN) mito (MITO) irraggiungibile (IRRAGGIUNGIBILE). Lautrec (LAUTREC) trascorre (TRASCORRERE) diversi (DIVERSO) periodi (PERIODO) di (DI) vacanza (VACANZA) a (A) Nizza (NIZZA), dove (DOVE) esegue (ESEGUIRE) proprio (PROPRIO) quest' (QUESTO) immagine (IMMAGINE) del (DI) padre (PADRE), riconoscibile (RICONOSCIBILE) più (PIU') che (CHE) per (PER) i (IL) tratti (TRATTO) del (DI) volto (VOLTO), per (PER) la (IL) barba (BARBA) irsuta (IRSUTO) e (E) l' (IL) atteggiamento (ATTEGGIAMENTO) agile (AGILE) e (E) autorevole (AUTOREVOLE) al (A) tempo (TEMPO) stesso (STESSO). Nel (IN) quadro (QUADRO), la (IL) mano (MANO) ferma (FERMO) con (CON) cui (CUI) il (IL) conte (CONTE) Alphonse (ALPHONSE) guida (GUIDARE) e (E) controlla (CONTROLLARE) la (IL) carrozza (CARROZZA), tradisce (TRADIRE) l' (IL) ammirazione (AMMIRAZIONE) del (DI) giovane (GIOVANE) Henri (HENRI) nei (IN) confronti (CONFRONTO) del (DI) padre (PADRE), uomo (UOMO) di (DI) grande (GRANDE) vigoria (VIGORIA) fisica (FISICO), sportivo (SPORTIVO) e (E) abile (ABILE) cacciatore (CACCIATORE). La (IL) caccia (CACCIA), infatti (INFATTI), è (ESSERE) la (IL) passione (PASSIONE) di (DI) famiglia (FAMIGLIA) al (A) punto (PUNTO) che (CHE) il (IL) nonno (NONNO) di (DI) Henri (HENRI), Raymond (RAYMOND) de (DE) Toulouse (TOULOUSE)-Lautrec (LAUTREC), soprannominato (SOPRANNOMINATO) "principe (PRINCIPE) nero (NERO)", è (ESSERE) descritto (DESCRIVERE) come (COME) un (UN) "cacciatore (CACCIATORE) forsennato (FORSENNATO)". La (IL) tecnica (TECNICA) utilizzata (UTILIZZARE) è (ESSERE) quella (QUELLO) dell' (DI) olio (OLIO) su (SU) tela (TELA) Lautrec (LAUTREC) è (ESSERE) ancora (ANCORA) molto (MOLTO) lontano (LONTANO) dal (DA) voler (VOLERE) sperimentare (SPERIMENTARE) tecniche (TECNICA) nuove (NUOVO), ricordiamo (RICORDARE) che (CHE) è (ESSERE) ancora (ANCORA) un (UN) fanciullo (FANCIULLO) sente (SENTIRE) il (IL) bisogno (BISOGNO) di (DI) dipingere (DIPINGERE) ma (MA) segue (SEGUIRE) strade (STRADA) già (GIÀ) battute (BATTERE) per (PER) quanto (QUANTO) riguarda (RIGUARDARE) le (IL) tecniche (TECNICA) usate (USATO). Per (PER) quanto (QUANTO) riguarda (RIGUARDARE) lo (IL) stile (STILE) ci (CI) troviamo (TROVARE) di (DI) fronte (FRONTE) ad (AD) un (UN) periodo (PERIODO) con (CON) un' (UN) influenza (INFLUENZA) lievemente (LIEVE) impressionista (IMPRESSIONISTA); ciò (CIÒ)

è (ESSERE) comprovabile (COMPROVABILE) dalla (DA) presenza (PRESENZA) di (DI) una (UN) caratteristica (CARATTERISTICA) comune (COMUNE) ai (A) quadri (QUADRO) di (DI) questo (QUESTO) periodo (PERIODO), e (E) cioè (CIOÈ) la (IL) contrapposizione (CONTRAPPOSIZIONE) tra (TRA) alcuni (ALCUNO) punti (PUNTO) focali (FOCALE), sui (SU) quali (QUALE) si (SI) concentra (CONCENTRARE) l' (IL) attenzione (ATTENZIONE) (in (IN) questo (QUESTO) caso (CASO) il (IL) padre (PADRE) e (E) i (IL) cavalli (CAVALLO) in (IN) corsa (CORSA)), e (E) vaste (VASTO) zone (ZONE) neutre (NEUTRO) che (CHE) fungono (FUNGERE) da (DA) connettivo (CONNETTIVO) o (O) da (DA) sfondo (SFONDO), il (IL) cocchiere (COCCHIERE) dietro (DIETRO) il (IL) conte (CONTE) Alphonse (ALPHONSE) e (E) gli (GLI) alberi (ALBERO) sul (SU) fondale (FONDALE). È (ESSERE) il (IL) caso (CASO) di (DI) notare (NOTARE) come (COME) questo (QUESTO) trattamento (TRATTAMENTO) discontinuo (DISCONTINUO) e (E) dinamico (DINAMICO) della (DI) superficie (SUPERFICIE), che (CHE) invita (INVITARE) lo (IL) sguardo (SGUARDO) a (A) saltare (SALTARE) da (DA) un (UN) punto (PUNTO) all' (A) altro (ALTRO) sia (ESSERE) esattamente (ESATTO) una (UN) rielaborazione (RIELABORAZIONE) delle (DI) tecniche (TECNICA) impressioniste (IMPRESSIONISTA) che (CHE) ottiene (OTTENERE) il (IL) risultato (RISULTATO) opposto (OPPOSTO).

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ABSTRACT

The advances of digital technology to the museum world have led to the development of computational tools for the classification of information as well as consultation of semantically correlated documents. The work presented here consists in an experiment, organizing the textual descriptions relative to iconographic works by means of SOM (Self-Organizing Maps), which represent the most common algorithm of artificial neural networks in the category of non-supervised learning, i.e. without the control and contribution of knowledge on the part of the human operator. The system produces a bi-dimensional map in which the words, represented graphically by means of semantically correlated nodes, are contiguous and form agglomerates. Therefore, the visit to a virtual museum containing works located in different sites can take place following pathways which are "conceptually-oriented", independent of the learner's cultural background.