

LIVING-LANG: Living digital entities by human language technologies

LIVING-LANG: Tecnologías del lenguaje humano para entidades digitales vivas

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Abstract

This project pursues the dynamic modeling at a spatial-temporal level of digital entities in social media for predicting their behavior. Firstly, digital entities are modelled by identifying the characteristics of individuals through their language and footprint on the network. Then, the extraction of relationships between digital entities is one of the nuclear challenges of the project. The proposal pursues this objective on a semantic level, structuring the information into representations of knowledge suitable for logical processing. Considering the heterogeneous nature of the sources to be dealt with, filtering of information is fundamental, using metrics and quality criteria. This spatial-temporal characterization, together with screening processes, will allow us to study high-performance predictive strategies in the evolution of digital entities. This project is coordinated by the SINAI and GPLSI research groups.

Keywords

Natural Language Processing, Sentiment Analysis, Emotion Mining, Sentiment Enrichment.

1. Introduction

Human language is the result of human social evolution, and thanks to it we can conceptualize reality, generating abstractions of it at different levels of complexity, which has given us a great capacity for reasoning. It has also enabled the organisation of complex social structures that have passed on culture and knowledge generation after generation through the use of a common language [1]. Language determines the way in which we relate to one another and, according to some authors, even how we think about and conceive the reality in which we live [2]. In this way, language becomes a very valuable resource for the cognitive modelling of an individual as studied in psycholinguistics [3], but also for understanding social interactions and com-


munities in what is known as Computational Social Sciences [4]. This emerging discipline is fuelled by the arrival of great volumes of information, primarily from the social web. We exchange a vast amount of information on the web. At the same time, our habits regarding information consumption are at a critical time of transformation. Digital media, as the preferred source of information, already threatens traditional written press. Young people choose social networks as their means of communication. Furthermore, this change in habit does not only affect the format or the means where the information is found, we are also changing the speed and type of content. According to Turkle [5], we have gone from “I think, therefore I am” to “I share, therefore I am”, reducing the quality of our “conversations” and, at the same time, creating the vague illusion of never being alone, referred to by the term “echo chamber”. Technology also implies changes in the way we act. An example would be the way in which we read [6] [7]. When we read digital media we “scan” rather than read. Short and simple content are almost the only element of consumption (titles, captions, highlighted sentences...) [8], and we are often carried away by our emotions when we decide what to read or where we read it. There are new challenges in this new digital paradigm that must be dealt with, derived from our inability to adapt to this new sce-

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nario and often resulting in the deterioration of our cognitive abilities [9] [10]. This enormous amount of information and digital connectivity entails the development of a technology capable of modelling the new paradigm, as well as determining the relationships that arise, their evolution in time and the ability to interfere with or predict their behaviour in the future.

Our previous project set out to identify digital entities, considered to be any entity in the real world (people, companies, organisations, tourist attractions...) with presence in the digital world and from which we can obtain a complete profile from their activity in such an environment. This profile is generated by processing unstructured content (web pages, articles, comments...) using human language technologies. However, the present “digital” situation requires us to go a step further and attempt to answer the following questions: a) How can we ensure the social contextualization of these entities, and model situations that change from day to day? b) How can we deduce new semantic relationships between entities? c) How can we guarantee that captured knowledge is real and contrasted by multiple sources? d) How can we guarantee the coexistence of knowledge in the long term?

This project aims to take these several steps further. In this way and thanks to these characteristics, we can establish relationships between the entities from a social and human perspective, improve the comprehension of the content exchanged, create new knowledge in the analysis of these relational structures and eventually, characterise and predict these networks between entities on a human language level by using temporal dimension, behaviours or phenomena.

This ability to understand language, model it and analyse its changes in time will allow us to face new challenges in the digital society in which we live. By measuring the veracity and credibility of the relationships extracted, we can confront phenomena such as fake news, defined as a deliberate distortion of a reality with the objective of creating and shaping public opinion and influencing social attitudes. Thanks to this project, tasks such as fact-checking, the automatic detection of ideological or confirmation bias, and the detection of clickbaits can be handled automatically, as well as other post-truth problems that are difficult to detect and treat because of their “viral” content. Furthermore, language modelling and new knowledge about these dynamic relationships and their evolution over time will allow us, through the application of diverse techniques, to identify new characteristics and make inferences that provide predictions of future

behaviours of digital entities. These predictions can be used for the early detection of problems associated with violence, mental health problems such as suicides, inappropriate behaviours and other security and health risks. Therefore, for example, a change in pattern of the type of language used in the communication between two people can help detect the start of practices such as sexual harassment, when language moves from a suggestive, captivating or friendly language to that of a coercive or threatening nature. As shown in Figure 1, the relationships between entities are dynamic and change with time as do their properties. By identifying these variations and their patterns based on human language, we can prepare these networks for the future by creating predictive models of peoples’ behaviour (risk detection, prevention of cyberbullying, terrorist warnings, etc.).

2. Objectives

The project started in 2018 and will be completed in 2022, and it involves a number of specific challenges and objectives of the overall project in the field of NLP research, which are detailed below:

OBJ1. *Generation of the human language models used by digital entities* through recognition of their primary characteristics (linguistic, cognitive, social, cultural and emotional) and independent of the domains and scenarios in which they act.

OBJ2. *Use of the knowledge generated by digital entities and discovery of the semantic relationships between them.* All available sources of information (unstructured, structured and open linked data), extraction mechanisms, identity enrichment, and other inference mechanisms will be taken into account. This will enable the integration of information related to an identity, determining the roles and properties associated to a space-time framework. It also enables the definition of relationships between identities using dynamic aspects such as context, temporary nature or importance.

OBJ3. *Use of knowledge of relationships to determine the coherence, quality and contrast of the semantic relationships extracted.* For this, we will use veracity assessment techniques, emotion analysis and subjectivity, as well as the detection of bias in the information to guarantee and contrast the information that arises from the relationship.

OBJ4. *Prediction of future behaviour of digital entities* by discovering potential future semantic relationships between them, through the analysis of pre-existing networks and based on previously detected relationships.

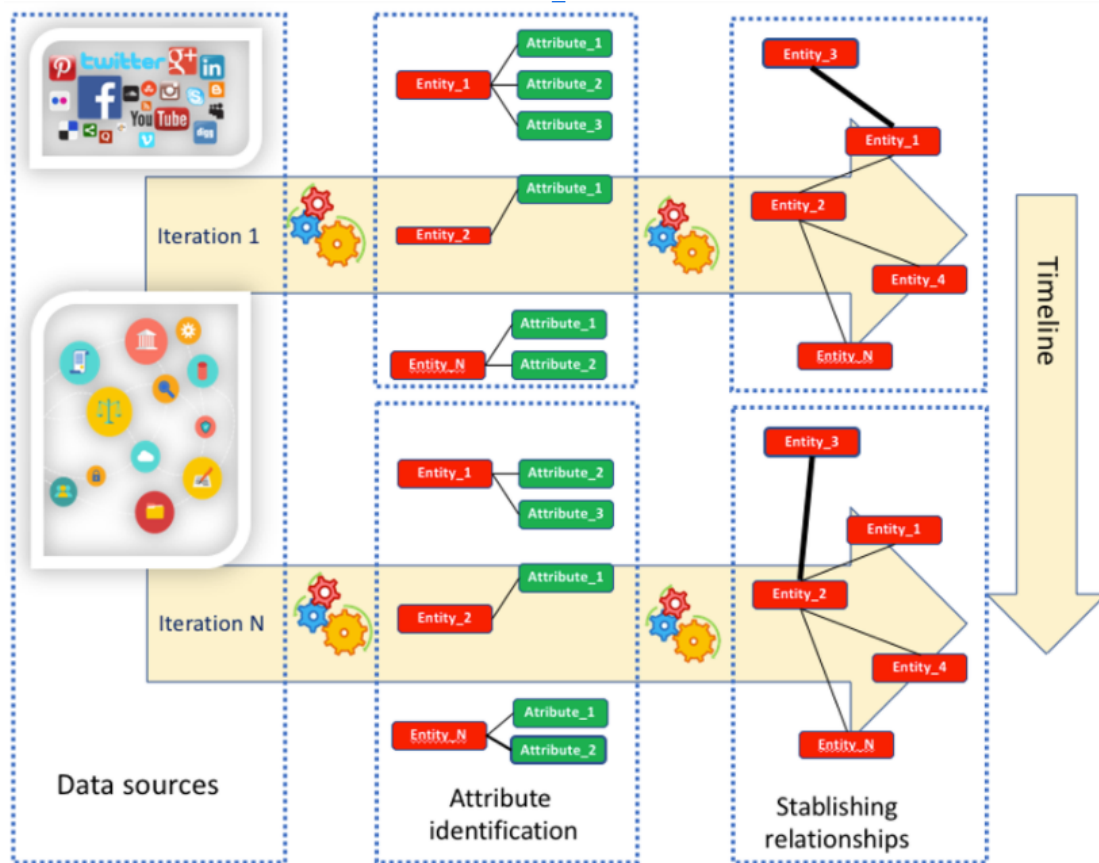


Figure 1: Detection and monitoring of digital entities – Representation of an evolving environment over time

In summary, this project contributes to the Spanish national Plan for the Promotion of Human Language Technologies, which has aimed to promote the development of natural language processing since 2015.

To achieve the above global objective and the specific objectives of the global project, the coordination of two complementary sub-projects is proposed, whose specific objectives will cover the global objectives proposed, and whose reunification will provide the added value sought by the coordination.

3. Results and conclusions

This section describes the most significant results of the project.

Results regarding OBJ1: In this project, the domains to be worked on are mainly health and education, as well as the following scenarios: fake news, knowledge extraction, violence and hate speech

[11, 12], studying the characteristics of the different scenarios in order to model the language in each of them. Resources associated with the different scenarios and domains defined have been created and used to train machine learning systems.

Results regarding OBJ2: The project has worked on various techniques for knowledge extraction in the different domains and scenarios defined, as well as on the organisation of workshops such as eHealth-KD 2020 to model human language in health documents in Spanish [13]. In addition, knowledge discovery techniques are being applied to the health domain [14, 15]. In addition, work has been done on the discovery of temporal information to enrich the entities by automatically extracting timelines from the documents and generating summaries from these timelines [16].

Results regarding OBJ3: In relation to this objective, a systematic study of the state of the art in this matter has been carried out [17] and, based on this study, work has been done to determine both

the veracity of the news and its parts and to study the detection of satire, achieving an architecture capable of determining 74% accuracy [18]. Within this task, progress has been made in the detection of incongruent headlines as well as in fact-checking tasks, as part of the disinformation detection architecture [19]. In addition, work has been done on emotion detection [20] [21] and negation [22].

Results regarding OBJ4: Regarding this objective, the project focused on the discovery of virality patterns, applying opinion mining techniques that enable us to structure the information based on the polarity of the messages and the emotions they contain [23]. After transforming the information from an unstructured textual representation to a structured one, association rules mining were used, concluding that messages with a high-negative polarity and a very high emotional charge, especially emotions that have intensified with the COVID-19 pandemic, such as fear, sadness, anger and surprise are more likely to go viral in social media.

All publications related to the project can be found on the project website¹.

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¹<https://livinglang.gplsi.es/>

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