A computational model of communication for automatically generating narratives

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Abstract

The collaborative generation of narratives is interesting for its potential to generate, utilising diverse knowledge bases, more interesting stories than those generated individually, and because it provides us with tools to analyze and understand how the creative communication occurs among computers and ultimately among human beings.

This research aims to prove that computer agents (computer programs that perform a specific task) with identical knowledge bases working together, cannot generate more interesting stories than those produced by any of them alone. Also, agents with completely different knowledge bases collaborating to generate stories, won't be able to communicate between them, thus, they won't produce interesting stories on a regular basis. Finally, we are particularly interested in identifying configuration spots of the agents where the communication collapses, and where the interestingness, coherence and novelty of the generated stories becomes optimal.

The narratives that we contemplate are defined as action sequences. These actions are written in a simple format: performer + action + receiver. Several studies have been presented concerning the evaluation of such narratives -see for instance (Pérez y Pérez and Ortiz 2013), (Ritchie 2007). For this work, we are particularly interested in the generation of collaborative narratives (Pérez y Pérez et al. 2010), those that cannot be generated by any of the agents by itself since they lack some of the knowledge structures utilized in the story.

There are several definitions of what communication means. Shannon (1948) defines it as the process by which a message is partially or totally reproduced in a different point from where it was originally produced. For this work, we rely on such definition and prupose that communication is the process by which an agent shares its internal representation of a situation with another agent. For our purposes, we state that the communication between two agents exists when one agent creates a partial story, shares it with another agent using a previously known code, and this second agent is capable of incorporating relevant knowledge to the story. We consider that the knowledge added by an agent is relevant when it was not present in the story. For this to happen, both agents should have similar internal representations of the story, otherwise, what is relevant for one agent it could be perceived differently by the other. This definition of communication has the drawback of considering random additions of knowledge originated from different internal representations as communications. Nevertheless, as the size of the knowledge bases grows, this type of collaboration becomes less probable.

To identify where the communication collapses in a collaborative generation of narratives, we calculate the similarity of the agents' knowledge bases, and from this value, we will be able to describe the configuration spots that originate the communication to break down. Additionally, we use the same similarity value to determine those configurations that generate the highest evaluated narratives.

Figure 1 shows a graph where the horizontal axis represents the similarity between two agents' knowledge bases, and the vertical axists represents the evaluation average of the stories generated by such agents. Point 'a' in the graph represents the evaluation of two knowledge bases with no common elements. Since there is no communication between them, collaborative stories cannot be generated and their evaluation is zero. Point 'b' represents the spot where communication begins to occur between the two agents. We are interested in finding the similarity value where this occurs. Point 'c' represents the maximum average evaluation of the stories. This point will be related to a similarity value, which represents the configuration that maximizes the story evaluation. Finally, point 'd' represents the evaluation of two knowledge bases with identical elements (highest similarity is 1). Since every story collaboratively generated can be developed by only one agent, those stories are not considered collaborative, and their evaluation is zero as well.

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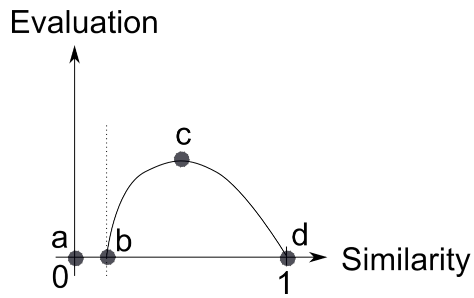

Figure 1: Similarity vs. Evaluation.
Point 'b' shows the communication rupture, and 'c' shows the maximal evaluation.

The collaborative process for the generation of narratives consists of two major tasks: story generation, and story interpretation (see figure 2). The story generation process initiates either with a partial story or can generate a new story from scratch. The story interpretation process receives a story written with the common code of both agents, and from it, an internal representation of the story is obtained. This representation serves as the starting point for an agent to progress the story.

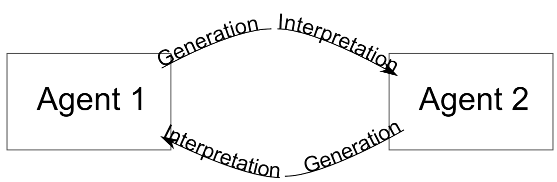

Figure 2: Narrative cycle generation

The knowledge base of a storyteller agent comprises diverse elements: an action repository (AR), a story generation knowledge repository (SGR), and a social knowledge repository (SR). AR stores the building blocks of a story. Every action contains a set of conditions to take place for it to be considered coherent, and a set of effects that will alter the story in case the action is added to it. SGR stores computational structures providing the system with mechanisms to select suitable actions (coherent, novel and interesting actions) to add into a story according to the current state of the story world (the known facts within the story). Finally, SR stores social regulations and structures that, in case of presence or absence, alter the action selection process, and modify or incorporate new facts to the story world.

These elements drive the knowledge base similarity evaluation process to a multidimensional scale, because instead of determining one single value for similarity, we will obtain multiple values (one per fact). We contemplate two different mechanisms to deal with multidimentionally. The first of them is related to the application of mechanisms for dimensionality reduction (such as eigenvectors), and the second is related to the generation of new metrics to determine the overall similarity between the knowledge bases (see (Pérez y Pérez 2014) for an example of such metrics).

Implementing the model

To test our model, we propose building a prototype utilizing Mexica-Impro (Pérez y Pérez et al. 2010), a collaborative storyteller based on the E-R creativity model, as our story engine. Additionally, we incorporate Social Mexica (Guerrero and Pérez y Pérez 2014), a computer model for social norms in narratives, which provides additional social information to the SR repository. Finally, we propose a set of metrics for similarity between each element of the knowledge base, and we extend a set metrics for evaluating the interestingness of the narratives proposed in (Pérez y Pérez 2014). We rely on Mexica-Impro as our storyteller because it can be configured to work with agents with independent knowledge bases. We consider relevant the incorporation of social knowledge because it provides with tools to prevent stories where social conflicts are overlooked, and incorporates social tensions that sometimes alter the climax and denouement of a story. Finally, we extend the metrics for evaluating the interestingness of a narrative because they don't incorporate measures for social structures and collaborative interaction.

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