Leveraging Uncertainty Visualization to Enhance Multilingual Chat

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ABSTRACT

Machine translation offers much promise for improving workplace communication among colleagues situated in offices in different parts of the world. Many corporations use instant messaging chat as a means of facilitating communication, however current translation quality is too low to feasibly use it in a critical setting. Statistical translation systems generate a ranked list of hypotheses, but all but the first remain hidden. We describe a prototype multilingual visualization system for instant messaging conversations which reveals the uncertainty in the translation and provides alternative translations when available.

Categories and Subject Descriptors

H.5.3 [**Computers and Society**]: Group and Organization Interfaces—*Computer-supported cooperative work*; I.6.9 [**Computing Methodologies**]: Simulation, Modeling, and Visualization—*Visualization*

1. BACKGROUND

We present an instant messaging client which augments traditional translation using techniques for visualizing the uncertainty inherent in the text (see Figure 1). By understanding where a translation is suspect, participants in the conversation can explore the alternative hypotheses or ask their conversation partner for clarification. Uncertainty visualization is recently receiving increasing attention in the information visualization and visual analytics communities: data sets are more meaningful when the uncertainty within them is known. Our design is motivated by a collection of heuristics for the evaluation and design of visualization of uncertainty [4].

2. TRANSLATION ARCHITECTURE

We chose to work with instant messages as the data for uncertainty visualization in translation because they offer several advantages for this work. They tend to be short, keeping translation time low and providing an appropriate amount of data for a small-scale visualization. Our bidirectional instant messaging client performs translation on messages it receives using a beam search decoder for statistical phrase-based translation models. The decoder, Phramer [2], was trained using the English-Spanish portion of the Europarl corpus (approximately 1M sentences) [1]. The phrase-based translation is supported by a trigram language model trained on the same data [3]. The translation algorithm evaluates the input data and creates a set of hypotheses, assigning confidence scores to each word and phrase. Using this data, we populate a compact lattice with all alternatives with a score within a preset threshold of the best score. This graph, complete with scores for each node, is then used as the basis for visualization.

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Figure 1: Translation uncertainty visualization in a chat interface: upper panel records chat history in the language of the user, lower panel displays the visualization of the most recently received message.

3. VISUALIZATION DESIGN

The visualization is designed to reveal uncertainty in the data and support interactive exploration and modification of the translation alternatives while maintaining readability and maximizing screen real estate.

3.1 Layout

The graph produced by the translation subsystem is laid out on a grid, with the best scoring path along the bottom to facilitate reading. Node positioning is derived from the span of the original sentence covered by the node. The nodes are anchored by invisible springs to their grid positions, and to each other by springs represented visually as graph edges. Repellant forces are applied between nodes to prevent overlap and a force-directed energy minimization is run for several seconds to stabilize the layout. This hybrid layout allows any overlapping nodes to separate, balancing the need to keep nodes in the rigid layout for easy left-to-right reading, and the demand that nodes do not overlap (see Figure 3).

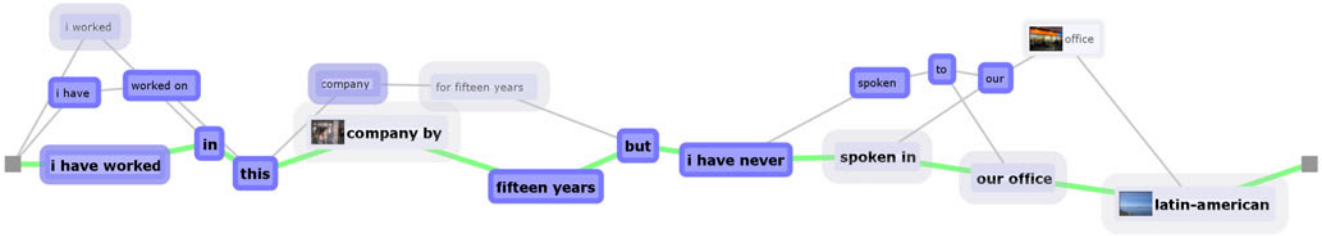

Figure 2: Lattice for which the statistically-identified best path is not the best translation. Note the increased uncertainty of the "company" and "fifteen" nodes.

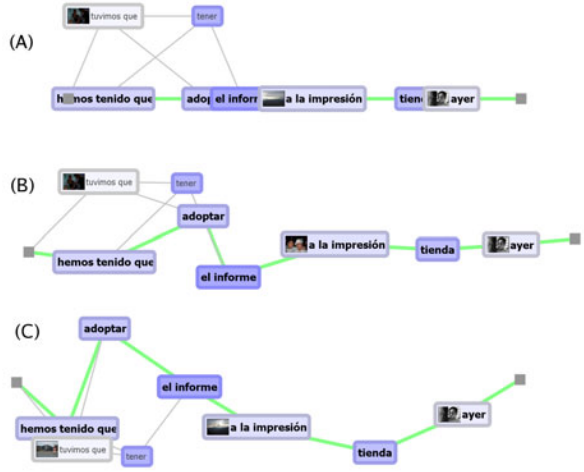

Figure 3: Graph layout construction: (A) rigid grid-based lattice, (B) hybrid layout, (C) force-directed layout. The hybrid layout provides the regularity benefit of the grid-based layout and the overlap avoidance of the force-directed layout.

3.2 Uncertainty Visualization

Uncertainty in the translation is most obviously visualized through the presence of alternative paths through the lattice. Confidence scores for nodes select the node fill hue, from saturated blue to desaturated gray (see Figure 2). To compensate for variations in colour perception [4], we redundantly encode the scores in the node border using size and transparency, varying from a tight solid blue, indicating high confidence, to a wide, transparent, gray border, indicating uncertainty. These techniques satisfy our goal: to coarsely indicate relative uncertainty, not provide specifics on the scores assigned to each node. In fact, the precise numbers are not very meaningful: they result from the settings of many variable parameters in the translation model.

The best path through the lattice is indicated by bright green edges. This path is recorded to the chat history when the next message is received. Nodes along the best path are drawn with a larger, stronger font. When out-of-vocabulary words are encountered, or the translation confidence is particularly low, photos are retrieved from Flickr [1] using the original (untranslated) words as a search query. In some cases, images may easily clarify the intended meaning.

3.3 Interaction

Several techniques to further explore and modify the graph are provided. Mouse-over of photo nodes provides an enlarged view of that node, revealing a set of four images about that node. To facilitate accurate chat logging, right-clicking nodes toggles their inclusion along the green "best path", which is used to produce the final translation that is recorded in the chat log.

4. CONCLUSIONS AND FUTURE WORK

By providing an easy to use interactive visualization of multiple translation hypotheses, we believe that, until translation quality improves, our technique can help coworkers converse through multi-lingual chat while minimizing confusion and misunderstanding. Extension of the prototype chat client to use the Jabber open source instant messaging protocols and evaluation of the usefulness and usability of the interface through user studies are logical next steps for this work.

5. ACKNOWLEDGMENTS

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6. REFERENCES

[1] KOEHN, P. European parliament proceedings parallel corpus 1996-2003. Available from: `http://people.csail.mit.edu/~koehn/publications/europarl.ps`.

[2] OLTEANU, M. Phramer: An open-source statistical phrase-based mt decoder. http://www.utdallas.edu/ mgo031000/phramer/, May 2006.

[3] STOLCKE, A. SRILM – an extensible language modeling toolkit. In *Proceedings of the International Conference on Spoken Language Processing (ICSLP)* (Denver, USA, 2002), vol. 2, pp. 901–904.

[4] ZUK, T., AND CARPENDALE, S. Theoretical analysis of uncertainty visualizations. In *Proceedings of SPIE-IS&T Electronic Imaging* (2006), R. F. Erbacher, J. C. Roberts, M. T. Gröhn, and K. Börner, Eds., vol. 6060, 606007.

[1] `http://www.flickr.com`