A Cycle of Learning: Human & Artificial Contextual Vocabulary Acquisition

Karen Ehrlich (ehrlich@cs.fredonia.edu)
Computer Science Department, Fredonia State University, SUNY
234 Fenton Hall, Fredonia, NY 14063, USA

William J. Rapaport (rapaport@cse.buffalo.edu)
Department of Computer Science and Engineering, University at Bufflalo, SUNY
201 Bell Hall, Buffalo NY 14260-2000, USA

Introduction

We are developing a system, Cassie, that defines unknown words from their linguistic context combined with background knowledge [Ehrlich & Rapaport, 1997; Rapaport & Ehrlich, 2000]. This work is of significance for cognitive science, education, computational linguistics and philosophy of mind.

Cassie is built on SNePS, a semantic-network-based knowledge representation and reasoning system developed by Stuart C. Shapiro and the SNePS Research Group [1999], with facilities for parsing and generating English and for belief revision. SNePS has been and is being used for several natural language research projects.

Cassie Learns as Humans Learn

When asked to define of a word, Cassie reports relevant aspects of her experience with that word. Which aspects are chosen depends upon the type and quantity of her exposure to the word, and the contexts in which it occurs, as well as what background knowledge she has.

Our algorithms for selecting information salient to a good definition have been drawn, in large part, from observation of humans with very strong verbal skills. These humans were asked to reason aloud as they read a series of passages containing an unfamiliar word, or a familiar word used in a new sense. It was observed that certain types of information were almost always regarded as salient, while other items would be reported when the preferred data was lacking, but would be dropped from the definition (even if still believed) once the more important information could be observed or inferred.

Though monotonic reasoning is preferred where possible [Ehrlich, 2004], it is at times necessary to withdraw or modify previously held beliefs. Therefore, Cassie has been given an ability to analyze her beliefs, and to select (from among the beliefs supporting a conclusion shown to be erroneous) a belief most likely to be at fault. Cassie then withdraws or modifies the belief according to pre-defined algorithm. This allows her to revise an incorrect definition (as opposed to the more typical case of an incomplete definition).

Cassie's ability to define nouns, verbs, and adjectives has been developed and refined through work on a number of examples, following protocols taken from several readers. Current work includes the further development of a rudimentary discourse analysis for finding the effects of verbs and further development of case-based reasoning.

Humans Learn as Cassie Learns

Meanwhile, the algorithms we have developed and tested on Cassie are being used to formulate an educational curriculum [Rapaport & Kibby, 2002]. It is well-known that the majority of a person's vocabulary is obtained from context, but to date there has been little in the way of instruction in methods of acquiring vocabulary from context. The explicitly formulated algorithms needed to allow Cassie to learn word meanings, however, provide what appear to be a useful set of techniques that can be explicitly taught to secondary school and college students. Investigation is ongoing into how helpful these techniques may be in improving reading comprehension, especially in reading scientific or technical materials that may include a variety of new terms.

References

Ehrlich, K. (2004). Default Reasoning Using Monotonic Logic: Nutter's modest proposal revisited, revised and implemented, *Proceedings of the 15 th Midwest ArtificialIntelligence and Cognitive Science Conference (MAICS2004, Roosevelt University)*: 48–54

Ehrlich, K., & Rapaport, W. J. (1997). A Computational Theory of Vocabulary Expansion, *Proceedings of the 19th Annual Conference of the Cognitive Science Society (Stanford University).* (Mahwah, NJ: Lawrence Erlbaum Associates): 205–210.

Rapaport, W. J., & Ehrlich, K. (2000). A Computational Theory of Vocabulary Acquisition, in Iwanska, L. & Shapiro, S. C. (eds.), *Natural Language Processing and Knowledge Representation: Language for Knowledge and Knowledge for Language* (Menlo Park, CA/ Cambridge, MA: AAAI Press/MIT Press).

Rapaport, W. J., & Kibby, M. W. (2002). Contextual Vocabulary Acquisition: A Computational Theory and Educational Curriculum, *Proceedings of the 6th World Multiconference on Systemics, Cybernetics and Informatics (SCI 2002; Orlando, FL)*

Shapiro, S. C., & the SNePS Implementation Group, (1999). SNePS-2.5 User's Manual, *SNeRG Technical Note* (Buffalo, NY: SUNY Buffalo Department of Computer Science and Engineering).