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Adaptive System for Language Learning

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***Abstract*—This paper presents a system that combines NLP and hand-written rules for enhancing the text of authentic Web pages based on the needs of a specific language learner. It uses the Stanford CoreNLP system to process texts, and applies hand-written rules for retrieving language information that is relevant according to a given Common European Framework of Reference for Languages (CEFR) level. After the text content of the Web page is processed, it is presented to the user with enhancements of various language structure. These enhancements are meant to draw the user's attention to linguistic structures that are present on the text, so that the reading activity does not encompass only the meaning of the text, but also serves as a reinforcement to language learning activities.**

I. Introduction

Research on the field of second language acquisition (SLA) has already shown that the mere presentation of input to a language learner is not enough for ensuring that something will be learned [1]. This means that the language learner may process the input for its meaning alone, without noticing its linguistic structures, because there is no salient language information. Input is, therefore, understood as "potentially processible language data which are made available, by chance or by design, to the language learner" [2].

An input in its raw form has lower chances of being converted into intake by the learner, and may thus not bring any new linguistic information. In the early 90's, Schmidt [3] developed the hypothesis that, in order for a language learner to convert input into intake, he/she needs to notice the relevant information in the input. More recently, the author also stated that "people learn about the things that they attend to and do not learn much about the things they do not attend to" [4].

Raw input may not always present properties for drawing the learner's attention, especially when one deals with Web-based authentic texts, which are normally not meant as a language learning object. To solve the lack of salience in raw input, Smith [5] suggested the use of "input enhancements", so as to give prominence to the relevant linguistic information. Thus, some Computer-Assisted Language Learning (CALL) systems have begun to include enhancement of text structures as a means of attracting the user's attention to the form of language structures. This focus on form strategy [6] has provided a new way to assist language learners, and recent studies on CALL have shown that input enhancements represent a positive step in transforming input into intake [7], [8].

In this paper, we present SMILLE (short for Smart and Intelligent Language Learning Environment), an adaptive system that enhances authentic Web pages using available NLP tools. This type of system, according to Meurers [9], can be referred to as an Authentic Texts Intelligent Computer-Assisted Language Learning (ATICALL) system, because it deals with authentic texts and uses NLP for rendering a better presentation of linguistic information. SMILLE extracts the text content of a Web page chosen by the user (i.e., the language learner) and processes it, retrieving linguistic information that can be enhanced for the user based on his/her language learning needs. To ensure that the highlighted information is relevant, SMILLE is directly linked to the user's language level, as described by the Common European Framework of Reference for Languages (CEFR) [10].

We present information on related work on Section II, and then describe SMILLE and some of its features on Section III. On Section IV we present our final remarks.

II. Related Work

CALL systems have recently started to use NLP applications for aiding in reading activities [11]. Here, we describe a selection of applications developed for SLA.

A. The REAP Project

The REAP project [12] is a tutoring system for English that focuses on finding authentic, Web-based texts that are suitable for the user in terms of reading level. Information from the chosen texts further adapts the engine to the user's specific needs. The system highlights words that are supposedly not known by the user, who can click on them to pop up a definition from the Cambridge Advanced Learner's Dictionary.

B. WERTi

The WERTi system [1] allows for text enhancements of selected linguistic elements of English, Spanish and German. It also presents exercises corresponding to the selected category, such as clicking on relevant words, filling the gaps with multiple choice questions or writing the correct word in a gap. It accepts Web-based texts as input and highlights in the text (by means of color coding) the linguistic category that was selected by the user, or modifies the text for testing the user's skills based on the selected activity. WERTi uses NLP tools combined with rules and regular expressions to retrieve text information for each of seven linguistic subjects: articles, determiners, gerunds, noun countability, phrasal verbs, prepositions, wh-questions.

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C. SmartReader

SmartReader, developed by Azab et al. [11], [13], provides a reading assistant tool that uses the Stanford CoreNLP system [14] to process a text and show selected information to the user. Each word in the text can be clicked on to display semantic, syntactic and other information. The system presents definitions for content words and phrasal verbs, grammatical information for function words, and encyclopedic information for named entities. It also displays syntactic function of selected words in the given sentence and generates simple questions about named entities, provided the answers are in the near context.

III. System Description

SMILLE is being developed for English, but there will be an effort on porting it to other languages as well. Following the idea of WERTi [1] and the SmartReader [11], [13], SMILLE was designed in a way that the user has independence for choosing on-line reading materials in the foreign language, so that the freedom of choice should serve as an incentive for further developing his/her learning process. Using the selected, Web-based text, SMILLE provides a reading assistant tool that helps the user to notice linguistic content of the target language by highlighting (i.e., enhancing) language structures in context, while also offering the possibility of looking up meaning and word class.

In regard to the systems in Section II, SMILLE distinguishes itself in how the enhancements are selected. For instance, in WERTi [1], only a few grammatical structures are available for the user, while SmartReader [11], [13] presents information more relevant to the meaning of the words and lexical units. SMILLE links the displayed information to the guidelines of the CEFR, so that the enhancements are not limited to isolated linguistic structures, but covers the needs for a given language level and for specific linguistic knowledge that is required from the learner in proficiency tests (e.g., TOEFL and IELTS). As such, the user can read texts that are interesting according to his/her own preference, while keeping an eye on important information in terms of linguistic structures that are relevant for his/her process of acquiring a second language.

A. Reading Assistant

SMILLE is responsible for analyzing the text that was chosen by the user and for outputting an enhanced form of it. For example, if the user is currently studying phrasal verbs, the reading assistant can highlight phrasal verbs in the chosen text (provided there is any), so that the user's attention is more easily drawn to the in-context occurrence of this kind of syntactical construct of the English language.

For retrieving the relevant content in the chosen Web page, SMILLE crawls over the HTML structure and extracts its text content. This text content is then parsed for part-of-speech (PoS) and syntactic dependencies with the Stanford CoreNLP system [14]. Rules are then applied to the parser's output for creating new HTML tags for each relevant text content. The Web page text is then reconstructed. The output

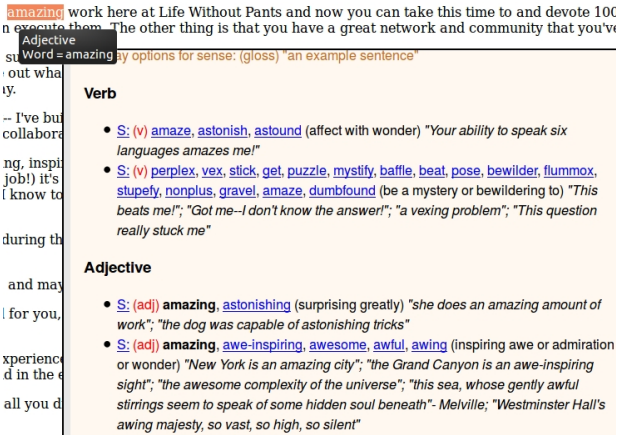

Fig. 1. SMILLE presents WordNet glosses for a given word on a CTRL+click. PoS and lemma are shown by hovering over a word.

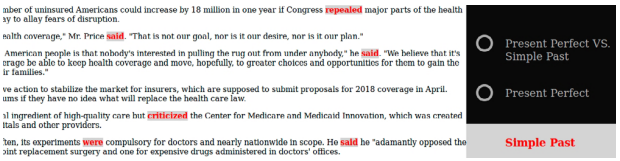

Fig. 2. Highlighting of simple past structures on the text.

of the reconstruction process is a Web page that can highlight relevant language structure information based on the user's language level. If the user wants to look up the meaning of a content word, an access to WordNet [15] glosses was implemented by CTRL+clicking on the desired word. By hovering the mouse over a word, SMILLE displays PoS and lemma information. Figure 1 shows an example of WordNet meaning retrieved by the reading assistant.

A sidebar menu displays all information retrieved from the text that is relevant for the user's language level. There, the user can choose up to five elements to be highlighted at the same time. So far, SMILLE was designed with a B1-level student in mind, so that it presents relevant information for this specific language level (according to the CEFR). It can highlight adverbs, adjectives (in normal, comparative and superlative forms), various verb tenses (simple past, past continuous, present perfect, present perfect continuous, simple future, future continuous, future constructed with "going to", as well as a contrast between verb tenses that may pose problems for non-natives, like the difference between present perfect and simple past, or the difference in the use of simple future and future with "going to"), modal verbs, passive voice, question tag structures, wh-questions, and phrasal verbs. Figures 2 and 3 exemplify a few of the structures that can be highlighted by SMILLE's reading assistant.

Some of the information that is highlighted by SMILLE require only that the parser correctly analyzes the word or structure in question. Such is the case, for instance, of adverbs, adjectives and simple verb tenses. Other structures require some rules for retrieving more complex word structures, such as compound verb tenses, phrasal verbs and passive voice, but

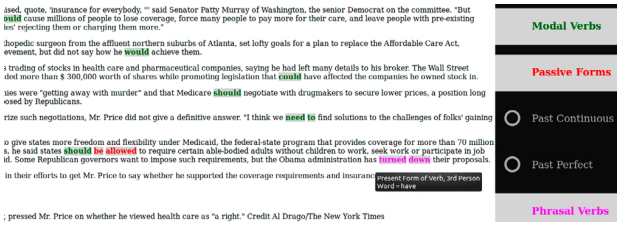

Fig. 3. Highlighting of modal verbs, phrasal verbs, and passive voice.

the information is mostly retrieved from the dependency and PoS tags. Still other structures though, such as WH-questions and question tags, are retrieved based on rules specifically written for them. As such, SMILLE combines the analysis done by the Stanford CoreNLP parser with hand-written rules to extract text information that would not be easily identified, and would not be salient, in a raw input.

B. System Development

So far, SMILLE presents a reading assistant for B1-level language learners that wish to read authentic texts in English. An extension for the Chrome web browser was developed and is currently being tested. With this extension, the user can simply click on a button to process the entire page and have all the information he/she needs in a matter of seconds.

Further developments on SMILLE shall implement information on other language levels and also other languages, so that it can be adapted to the different users' needs. It will also be further enhanced by an interaction with a teaching assistant module, which should keep track of user progress in the second language, so that it can make automatic suggestions in terms of language content that should be highlighted and of texts that would be interesting based on user-specific information. As such, the reading assistant will draw information from the teaching assistant, rendering the text analysis and the information presented to the user compatible with his/her language learning needs. The teaching assistant shall be constantly evolving, by registering data that were already shown to the user in the reading assistant. In this way, the teaching assistant will learn the user preferences, and his/her strengths and weaknesses in terms of foreign language comprehension.

IV. Conclusion

This paper presented a system that combines available NLP resources for enhancing language learning. SMILLE extracts raw text from a Web page chosen by the user and enhances its contents by providing the user with the tools needed for understanding a text based on the user's previously acquired knowledge. The text analysis is carried out by Stanford CoreNLP system [14] and a set of rules specific for the linguistic structures associated to a language level.

SMILLE is currently under development. The reading assistant presents information for an English learner that aims to achieve level B1. By combining text processing with NLP tools and hand-written rules, the system presents a series of linguistic information, aiding the user to notice in-context grammatical structures and providing access to glosses for words that are present in the text.

SMILLE allows the user to select up to five types of structures to be shown at a time. This arbitrary restriction was a way to avoid that too many linguistic structures are highlighted at the same time. Unfortunately, we do not know of any studies that address the question of how much highlighted information is too much. We are currently studying the possibility of passing from an arbitrary number of text structures to a percentage of the text in terms of words, but it would still require some research to determine how much highlight is effective for the user to pay attention to the relevant structures.

Further developments have to be implemented, so as to cover other levels and languages, and to create a database for keeping track of user information. With these in place, SMILLE will be able to provide more user-oriented suggestions based on relevant information from each individual user.

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