MALT - a Multi-lingual Adaptive Language Tutor

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Abstract. We describe a "Multi-lingual Adaptive Language Tutor" (MALT) that uses natural language parsing and text generation to create various kinds of grammar exercises for learners of any language. These exercises can be restricted to specific topics by the instructor such as transformation of verb tenses. MALT generates novel exercises focusing on the specific difficulties of language learners as determined from their past mistakes, helping them overcome individual difficulties faster. We also present the first preliminary results from employing MALT in the foreign language classroom at Notre Dame.

Keywords. intelligent tutoring system, computer assisted language learning, Italian

1. Introduction

We propose a *Multi-lingual Adaptive Language Tutor* (MALT), which (1) addresses the problem of producing targeted individual exercises and producing feedback, and (2) has been successfully employed in a real language course at the University of Notre Dame. MALT consists of an automatic exercise generator that uses natural language processing methods to generate exercises dynamically and adaptively focus on the weaknesses of the language learner. MALT allows instructors to select a set of exercise types that focus on a particular grammar topic (e.g., transformation of verb tenses). MALT will initially present students with exercises generated from a random distribution of types from the set and record correct and incorrect answers. Based on the answers, it will quickly focus on "problem cases" and dynamically create appropriate exercises for them, thus providing learners with targeted exercises in areas, in which they are most likely to make mistakes. Hence, MALT avoids context-dependent learning effects where students learn only examplars, but not rules (such as learning the ending of a particular verb only in the context of a particular sentence with salient features). MALT provides detailed information to language instructors regarding the individual weaknesses and the learning trajectories of their students, which instructors can use as (one form of) feedback to complement their own written assessments and to help them adjust the content, pace, and sequence of materials in a given course. Finally, MALT can save both instructors and students time; the former by helping to produce different kinds of exercises for different students, the latter by focusing on problem cases without producing exercises on problem types, in which students have already demonstrated mastery. MALT currently has preliminary language modules for English, Italian, and Japanese.

2. A Brief Overview of the MALT System

MALT consists of *language-independent* modules (i.e., the syntactic parser, semantic representation and manipulation, text generation, question type selection, user interface) and *language-specific modules* (e.g., grammar rules, morphological rules including conjugation and declination tables, lexicon, etc.). This modular design allows for easy addition of new language modules as well as for adaptation of the user-interface to different teaching environments without having to change language-independent parts.

A top-down parser exercises are generated by based on initial non-terminal grammar symbols passed to the parser. The parser uses an *augmented context-free* grammar, where each terminal or non-terminal symbol may have one or more parameters attached to it. Augmented grammars allow for complex context-sensitive rules (e.g., as required for general formulations of subject-verb agreement) to be specified with relatively few grammar rules. Subject-verb agreement, for example, can be implemented by creating the following rule that specifies that the *number* parameter of the SUBJECT has to agree with that of the VERB: INTRANSITIVES→SUBJECT(NUMBER=?N)VERB(NUMBER=?N).

MALT targets question types according to past results stored in a simple *student model*. The model explicitly keeps track of the number of correctly and incorrectly answered questions for each category. For an exercise selection heuristic in these tests, types were selected based on which had been answered correctly the least number of times.

3. Experiments with MALT in Intermediate Advanced Italian

We conducted preliminary tests of MALT as part of the ROIT 215 *Intensive Intermediate Italian* course at Notre Dame in Spring 2005. Early in this course, students review the present tense subjunctive forms of regular and irregular Italian verbs for the three conjugations "-are", "-ere", and "-ire". These reviews typically include some more mechanical focus/practice for accuracy of forms with fill-in or transformation questions, where students are presented with a sentence containing the main verb in present tense indicative form, which they then have to transform into the present tense subjunctive form. We configured MALT to provide this kind of transformation exercise grouped into five question types (one for each conjugations, one for deviant "-ire", and one for irregular verbs). Moreover, MALT was embedded as an applet on a page in WebCT, a web-based teaching environment used in many classes at Notre Dame (but not in ROIT 215) [1].

We conducted a pre-test consisting of 20 transformation questions in WebCT before the in-class review of the material, after which students had one week to use the tutor voluntarily (instead of just practicing transformations using the workbook) before an in-class post-test again measured their performance.

The results show that 6 out of the 7 students using MALT improved on the post-test (Post) based on the pre-test (Pre), while only 2 out of 5 students not using MALT showed improvement, indicating the utility of MALT as practice tool for verb transformations in

	without MALT					with MALT						
Pre	13	11	15	15	18	17	18	17	7	18	18	11
Post	11	20	17	14	15	14	19	18	14	19	20	16
Impr	0.85	1.82	1.13	0.93	0.83	0.82	1.06	1.06	2.00	1.06	1.11	1.45
Corr	-	-	-	-	-	19	57	79	177	60	170	20
Tot	-	-	-	-	-	24	65	115	267	67	185	30

Italian.[1] The lower part also shows the total number (Tot) and correct number (Corr) of practice transformations.

We also conducted an anonymous survey asking students to rate various categories, from "5–strongly agree" to "1-strongly disagree":

SURVEY QUESTIONS:
MALT was overall useful.
MALT covered all conjugations and irregular verbs.
MALT produced a great variety of sentences.
MALT was helpful in practicing verb transformation.
MALT was easy to use.
MALT was easy to access.
MALT was well integrated into WebCT.
MALT should be used on a regular basis in Italian courses.
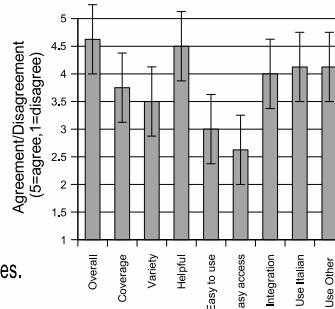
The overall results confirmed that students found MALT very useful and would like to see it integrated in Italian and other language courses.

4. Conclusion

The goal of MALT was to create an intelligent CALL system for realistic use in the foreign language classroom. Results from preliminary in-class tests of MALT with American undergraduate learners of Italian as a second language are very encouraging and justify a larger scale deployment, which is planned for Fall 2005 in the beginning Italian language courses. Future versions of MALT will provide a graphical interface that will allow instructors to customize MALT (e.g., by adding or deleting lexical items, grammatical rules, question types, etc.–currently this is only possible via text files and requires knowledge of specific data structures in MALT).

References

[1] WebCT, HTTP://WWW.WEBCT.COM/
[2] J. Gamper, J. Knapp. "A Review of Intelligent CALL Systems." *Computer Assisted Language Learning* 2002 Vol. 15, No. 4 , pp. 329-342. Swets and ZeitLinger.

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[1] A t-test comparing the average improvements $Impr$ (given by the fraction Post/Pre) of the two groups (1.22 with and 1.11 without MALT) is not statistically significant ($p = 0.65$), which is partly due to one's student large improvement and also to the small sample size (we expect the difference to become significant with a larger group).