

## The structure and functions of ETS GRAD

Ildar Galeev, Larisa Tararina, Sergey Sosnovsky  
Kazan State Technological University

The urgency of computer-assisted technologies for teaching natural languages (NL), and first of all foreign languages, is constantly growing. To denote computer-assisted teaching NL a special term – CALL (Computer Assisted Languages Learning) has appeared and is widely used now. The chief disadvantage of the currently available systems of teaching NL is their moderate adaptivity to the learner's individual characteristic features. To overcome the mentioned drawback, it is necessary to develop expert tutoring systems (ETS) which dynamically form a tutoring program in accordance with the learner's being-trained level, in contrast to traditional computer systems functioning in conformity with a strict, preset scenario.

The importance of mastering the grammar of the German language in the part of adjective declensions is conditioned by the fact that the knowledge about adjectives is used both for the synthesis, and for the analysis of a sentence in German. When a sentence in German is synthesized, the main task at studying an adjective is to determine its ending correctly. In case of analyzing (understanding) a sentence in German, the knowledge about adjectives may play the most important role when a large variety of analysis problems are being solved:

- the subject recognition;
- the number distinction;
- the extended sentence identification, etc.

So, solving the synthesis problems, the learner acquires some sort of knowledge, which can be also used when analyzing a sentence in German. In this connection it is worthwhile to design ETS GRAD (GR- Grammatik, AD - Adjektive) in which a tutorial task represents a set of sentences in German with the roots of adjectives. The learner has to put the necessary endings in a correct way. A fragment of a tutorial problem can appear as:

*Das klein... Kind trinkt warm... Milch.*

The formalization of the tutorial task structure has been carried out on the basis of the German language syntax analysis. A tutorial task shows up as a random symbol line containing several sub-lines, and each of the latter is described by a specially fixed frame.

As the result of analyzing the morphology of the noun being determined, the structure of the dictionary of the determined nouns (the file DICTIONARY) as a necessary component of the information base ETS GRAD has been formalized, and its formation mechanism has been established. The article morphology analysis has resulted in defining the body of knowledge about the article, which is included into the ETS GRAD information base as a component of the knowledge about the German language grammar. On the basis of the adjective morphology analysis and taking into consideration the results of analyzing the determined noun and articles morphology, a general approach to algorithmic directive formation has been formulated. The algorithmic directives in question are aimed at the determination of adjective endings, are organized as a set of rules (operations) like "IF (condition), THEN (action)" and realize the external form of representing the expert-teacher's knowledge about the German language grammar in the part of adjective declension.

It is evident that a whole class of such algorithmic directives can be formed in NL. In this case the algorithmic directives of the mentioned class may differ considerably from each other. The following basic differences are possible:

- according to the types of the assigned operations included into the algorithmic directive;
- according to the detail degree of the assigned operations included into the algorithmic directive;
- according to the sequence of the assigned operations set forth by the expert-teacher;
- according to the NL form of representing the algorithmic directive stemming from both the NL ambiguity, and its synonymy.

As an example illustrating a potential diversity of algorithmic directives in the learning subject domain (SD) under consideration, a number of operations describing this or that subset of adjective declension rules in a weak form has been offered:

- IF there is a definite article *der* or one of the pronounse, *dieser, jener, solcher, jeder, welcher*, before the adjective and the noun, and the noun being attributed is of the masculine gender, THEN the adjective ending is *-e*;
- IF there is a definite article *der* before the adjective and the noun, and the noun being attributed is of the masculine gender, THEN the adjective ending is *-e*;

- IF there is a definite article *der* before the adjective and the noun, and the noun being attributed is of the masculine gender, or there is definite article *das* or a definite article *die* , and the noun being attributed is of the feminine gender, THEN the adjective ending is *-e*.

Within the framework of the formulated general approach, a particular algorithmic directive has been worked out, the file ALGORITHM being used for storing it.

The expert-teacher is able to work out his own algorithmic directive which differs from the one proposed and adequately (both in the NL representation form, and in the content) reflects his knowledge scope in the learning SD being analyzed. ETS GRAD software supports such an opportunity.

Alongside the external form of representing the knowledge about adjective declension, the internal form of the mentioned knowledge presentation has been developed. This form is realized as the file GRAMMAR. Provision has been made for a mechanism supporting semantic adequacy of the named form of representing knowledge, used for the learner's error diagnostics and explanation display. The algorithm of the learner's errors diagnostics provides for localizing and counting the errors made. The proposed algorithm is invariant to particular realizations of the external and internal forms of presenting the knowledge about the German language grammar.

The following structures of subject-oriented ETS GRAD subsystems have been defined. The subsystem of tutoring task formation constitutes a set of the tutorial problems bank (the file Bank of tutorial problems), means for its creation and maintenance and a corresponding program for representing the problem, the properties of the latter being governed by the teaching model subsystem in accordance with the learner's current knowledge.

The teaching model subsystem has been realized via software design tools MONAP-PLUS (Galeev, I., Ivanov, V. and Akhmadullin, M. 1994; Galeev, I., Ivanov, V. and Akhmadullin, M. 1996). There is no problem – “solver” subsystem in connection with the decision not to construct the problem generator.

The diagnostics subsystem comprises a set of the files DICTIONARY and GRAMMAR, means for their creation and maintenance and a corresponding program, providing:

- the learner's answer input;
- the learner's answer analysis;
- diagnostic message output;
- assistance representation to the learner;
- identification of the type and number of the errors made;

- feedback formation and control return.

The explanation subsystem is defined as the diagnostics subsystem expansion due to including the file ALGORITM into its structure. The file is used to form the answers to the learner's questions "WHY?". The answer is formulated in a natural language way as "IF..., THEN...".

In line with the previously elaborated ETS architecture, designed with the MONAP-PLUS software tools, the subject-oriented expansion of the educational environment ETS GRAD includes the following files: Bank of tutorial problems, DICTIONARY, GRAMMAR. Software has been developed, which ensure the creation and maintenance of the subject-oriented expansion of the educational environment ETS GRAD. The indicated software supports the ETS openness level preassigned by the MONAP-PLUS software design tools. A subject-oriented component of the tutoring dialogue has been worked out. This component is carried out by the corresponding subject-oriented subsystems ETS GRAD performing their basic functions. Moreover, the process of the dialogue contemplates analyzing the logical integrity (completeness and consistency) of the ETS GRAD information base. If the integrity is broken, the expert-teacher receives emergency message.

ETS GRAD, ensuring an adequate process of mastering the German language grammar in the part of adjective declension, represents an open-type flexible system able to expand and change in accordance with the expert-teacher's demand. Using the software at his disposal the expert-teacher is able:

- to alter the existing (supplied) ETS;
- to build up a set of independent and essentially different ETS in the considered learning SD for different learners' categories;
- to build up an ETS family in the considered learning SD, having a network architecture, i.e. using common components of information bases.

## REFERENCES

- Galeev, I., Ivanov, V., Akhmadullin, M. (1994) MONAP-PLUS: the Development of ETS Design Technology. *East-West International Conference on Human-Computer Interaction. EWHCI'94.* (Proceedings Volume 2. Saint Petersburg, Russia, August, 2 - 6, 1994) - P. 188-204.
- Galeev, I., Ivanov, V., Akhmadullin, M. (1996) Teaching Model in MONAP-PLUS. *Human-Computer Interaction. The 6th International Conference. EWHCI'96.* (Moscow, Russia, August 12-16, 1996) - P. 320-323.