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AUTOMATION OF ELECTRONIC TESTING EXAMINATION IN ELNGLISH LANGUAGE USING DeTC

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Abstract. The recent paper describes carrying out computer-based testing examination in the English language at the Distributed e-Testing Cluster – DeTC. The aim of this work is finding solutions for the automatic generation of English language test questions, which are automatically assessed as well. Proposed is a method for parameterization of English language test questions of the types dichotomy and multiple-choice. An example of parameterization and the resulting automatic generation of a number of equivalent test questions is provided.

Key words: DeTC, English language e-testing, parameterization, automatic test generation, automatic assessment

Mathematics Subject Classification 2000: 97U50

1. Introduction

English language teaching is conducted at all levels of school education in Bulgaria (primary, secondary, high school), at universities and at different educational centers, specialized in language training. A large number of institutions in the field of education and business require a certificate for English language proficiency when applying for studying or employment [13]. At the same time, an increasing number of countries now require adult migrants to demonstrate proficiency in the language of the host country before granting residence, work permits or citizenship and a language test may be obligatory [12]. These considerations give perception of the large scale of English language education in

school, as well as during preparations for passing certificate exams, such as FCE (First Certificate in English), CAE (Certificate in Advanced English), CPE (Certificate of Proficiency in English), TOEFL (Test of English as a Foreign Language), SAT (Scholastic Assessment Test), IELTS (International English Language Testing System), etc.

Testing examination is one of the main instruments when evaluating various language skills in English and it can be applied at any stage of training – at entry level, for intermediate control and as a final test at the end of the training. Due to the large number of learners and the multiple testing of each of them, the preparation of a sufficient amount of different tests and their assessment is hard and time consuming work. This is a prerequisite for seeking possibilities for intensification of the process of testing and assessment.

The recent paper concerns the implementation of computer-based English language testing examination at the Distributed e-Testing Cluster – DeTC. The description of the architecture and functionality of DeTC is beyond of the scope of this paper and is discussed in a number of other publications [6, 8, 9]. The aim of this work is finding solutions for the automatic generation of English language test questions, which are automatically assessed as well. Proposed is a method for parameterization of English language test questions of the types dichotomy and multiple-choice. An example of parameterization and of the resulting automatic generation of a number of equivalent test questions is provided.

2. Automatic generation of English language test questions of the types of dichotomy and multiple-choice with one or more correct answers

A main requirement of testing examination is the availability of a large set of test questions in order to avoid cheating or the memorization of answers. Creating such a variety of test questions is a difficult and time consuming process which cannot be fully automated. A convenient facility for test authors is the developed in DeTC specialized editor for defining parameterized questions, which are automatically assessed.

Examples of parameterization of test questions in accounting and physics, as well as a description of the DeTC tools used for this purpose, is given in [7,11]. The approach applied in these cases comes down to the redefinition of a single-answer/multiple-choice question as a dynamic free-type question. The body of the parameterized question contains dynamic variables, whose values vary in a user-defined range. Dynamic answers are described with a type (integer or real), a formula for calculation and a method for comparison with the correct answer. The

formula can contain only the already defined dynamic variables, numeric constants and arithmetic functions. Examples of parameterization of test questions in SQL are presented in [10]. The questions are described by templates that contain dynamic variables for tables, fields and comparison operators. These templates define the text content of the question and the answer. In [1] and [4] are presented systems for automatic generation and evaluation of individualized exercises in programming languages – respectively QuizPACK for procedural programming in C and QuizJET for object-oriented programming in Java. In [2] is discussed the application of the system QuizMap in the context of self-assessment questions for Java programming. These systems are based on the parameterization of exercises and questions, so that each learner is provided with individualized programming code and a free-type question, which typically asks to predict the final value of a specific variable.

In this work we propose a method for parameterization of English language test questions of types dichotomy and multiple-choice with one or more correct answers. These are test questions connected with evaluating learners' knowledge of the lexical and grammatical structures that are met in the text. Examples of such questions are given below:

- ✓ Dichotomy:

  Peters and Tucker informed the applicants that it was necessary to enclose a photograph in their second letter. T/F

- ✓ Multiple-choice

  A multiple-choice/single-answer question for evaluation of learners' knowledge of the lexical structures met in the text:

  The statue of the Happy Prince was much admired because it ….

  A. looked like a weathercock.
  B. was very useful.
  C. was very beautiful.
  D. stood on a column.

  A multiple-choice/single-answer question for evaluating learners' knowledge of the grammatical structures met in the text:

  He was attracted by the Reed's slender figure and he stopped .... to her.

  A. to talk
  B. talking
  C. talk
  D. to talking.

The aim of parameterization is such that a multitude of equivalent, but different, specific questions with different dynamic answers can be generated from a

single parameterized question created in DeTC. The method we suggest consists of the following:

I. Stage one – input of the parameterized questions:

1) The sentence forming the body of the dynamic question is considered a combination of lexical and grammatical structures; each of those can be a subject of parameterization by replacing it with a dynamic variable while constructing the template of the parameterized question. The definition of dynamic variables is a decision the test author makes and it depends on the goals that are set to be achieved with these specific questions.

2) Defining the body of the dynamic question – a parameterized sentence is described in the form of a template; the dynamic variables are defined in the sentence by putting the '@' character before their names. During the generation of English language test questions there is also the option to use not only a single sentence for the body of the dynamic question, but a list of parameterized sentences, which use the same set of dynamic variables. With this the variety of generated dynamic questions is greatly increased while still keeping the questions in the same topic/subtopic, chosen by the test author. It is also possible to use only some of the defined dynamic variables with each sentence.

3) Defining the dynamic variables – each dynamic variable receives a name, a type (a character string in this case) and a list of values it can take. The exact value is determined at the time of generating the questions using a random number generator – as a result all the learners get unique questions. In our work up until now we distinguish between two types of dynamic variables:

- Variables, which define parts of the sentence by directly replacing the occurrence of the variable with its value.
- Variables, which, on one hand, define parts of the sentence by directly replacing the occurrence of the variable with its value (in dichotomy) or with a character string i.e. "…" (in multiple-choice), but, on the other, participate in forming the dynamic answers. The values of such variables are grouped in two lists – a list of correct and a list of incorrect answers.

II. Stage two – generating the test questions

1) Choosing the type of the question – a choice between type 1 (dichotomy) or type 2 (multiple-choice).

2) Defining the dynamic answers – the definition is made based on the chosen type. If the question is of type dichotomy there is no need to input additional information. If the question is of the multiple-choice type, the number of answers (and how many of them are to be correct) needs to be set. A random number generator is used to choose the correct answer and the needed amount of incorrect

answers from the lists of correct and incorrect answers without any duplicates. To ensure that the right answer will be in a different position in the list of answers of different dynamic questions, a random permutation of the already chosen answers is performed.

In the DeTC parameterization editor, the parameterized questions are defined in several sections – a section for defining dynamic variables, a section for defining dynamic answers, a section for defining the body of the question, a section for defining the dynamic form of the answer and a section for additional formatting of the question's screen [7,11].

The following example demonstrates parameterization for dynamically generating a set of questions of type 1 (dichotomy) and type 2 (multiple-choice/single-answer) based on the same input data – values for the dynamic variables and templates for the parameterized sentences. Figure 1 shows a table of parameterized sentences in the topic "English Language/Grammar Tenses/Present Simple Tense/3p. single". Topics and subtopics in DeTC are defined by the test author at his/her discretion. It is shown that the sentences can have whatever structure, without any limits as to where the dynamic variables can be placed.

List of parameterized sentences (templates)
My sister **@a** to the gym **@b**.
Tom **@a** to the park **@b** if it's not raining.

Figure 1. A list of sentence templates for dynamically generating the text of English language test questions

The tables in Figures 2 and 3 show the values for the dynamic variables @a and @b, which are used in the parameterized questions given in Figure 1.

Variable @a	
Correct answers	**Incorrect answers**
goes	go
runs	is going
walks	is gone
	run
	is running
	walk
	has walking
	is walking

Figure 2. Values for the dynamic variable @a

Variable @b
in the mornings before breakfast
every morning
on Saturdays

Figure 3. Values for the dynamic variable @b

In the given example the values for the dynamic variable @b are lexical structures with the same grammatical function (every morning, on Saturdatys e.t.c) and they define parts of the sentence by directly replacing @b with the value of the variable. The values for the dynamic variable @a are grammatical structures (go, goes, is going e.t.c.) which, on one hand, define parts of the sentence by directly replacing @a with the value of the variable (in dichotomy) or the "…" string (in multiple-choice), but, on the other, take part in forming the dynamic answers. As is seen here, the values of this variable are grouped into two lists – a list of correct answers and a list of incorrect answers.

……..
My sister runs to the gym on Saturdays. (T)
My sister walks to the gym in the mornings before breakfast. (T)
My sister walks to the gym every morning. (T)
My sister walks to the gym on Saturdays. (T)
My sister go to the gym in the mornings before breakfast (F)
My sister go to the gym every morning. (F)
Tom walks to the park on Saturdays if it's not raining. (T)
Tom go to the park in the mornings before breakfast if it's not raining.(F)
Tom go to the park every morning if it's not raining.(F)
…….

Figure 4. A sample of the generated dynamic questions of type dichotomy (the correct answer is in brackets)

In Figure 4 there is a random sample of the list of different equivalent questions, generated as a result of parameterization of test questions of type dichotomy, while in Figure 5 they are of the multiple-choice/single-answer type. All generated questions use the same input data for the values of the dynamic variables and the list of parameterized sentences. As is seen in the given example, we work with the following sets:

- A list of variants for the type of question – 2 elements (dichotomy and multiple-choice/single-answer);

- A list of templates of sentences, which use same dynamic variables – 2 elements;
- A list of values for the dynamic variable @a – 11 elements;
- A list of values for the dynamic variable @b – 3 elements,

which amounts to 66 generated questions for each type of question or a total of 132 questions. Raising the number of generated questions can be achieved by adding elements to any one of the above mentioned sets.

……..
My sister .... to the gym in the mornings before breakfast.
A. runs (correct)
B. is going
C. go
My sister .... to the gym on Saturdays.
A. is gone
B. go
C. walks (correct)
Tom .... to the park in the mornings before breakfast if it's not raining.
A. is gone
B. runs (correct)
C. is going
Tom .... to the park every morning if it's not raining.
A. is gone
B. goes (correct)
C. go
…….

Figure 5. A sample of the list of generated dynamic questions of the multiple-choice/single-answer type (the correct answer is marked with *correct*)

In Figure 4 at the end of each sentence is the right answer, automatically determined by the created algorithm for generating questions of type dichotomy. In Figure 5, after each question of the multiple-choice/single-answer type there is a random permutation of one correct and two incorrect answers (the correct answer is marked with ‘correct’). A random number generator is used to select both the correct and the incorrect answers; it is also ensured that the wrong answers are not duplicates for a given question.

3. Conclusions

Automatic generation of English language test questions with the tools of the Distributed e-Testing Cluster – DeTC provides significant intensification of the process of testing and assessment. The method proposed for the parameterization of English language test questions of the types dichotomy and multiple-choice makes it possible, on the base of a small amount of input values for dynamic variables and patterns for parameterized sentences, to generate a large set of equivalent dynamic questions of a certain topic/subtopic, chosen by the author. This results in achievements such as reduced time consumption during tests authoring, application of equal criteria, fair assessment and decreased influence of subjective factors. Our future work will be focused on developing and adding possibilities to DeTC for automatic generation of other various English language test questions [3, 5] - questions for determining the underlined option that contains a grammatical or spelling error; questions for providing a synonym (antonym or other); questions for matching; questions for adding prepositions; tasks for forming adjectives, nouns, adverbs, plurals, etc.

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АВТОМАТИЗАЦИЯ НА ЕЛЕКТРОННОТО ТЕСТОВО ИЗПИТВАНЕ ПО АНГЛИЙСКИ ЕЗИК ЧРЕЗ DeTC

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Резюме. Настоящата статия разглежда осъществяването на компютърно-базирано тестово изпитване по английски език в средата на разпределения клъстер за електронно тестване (Distributed e-Testing Cluster, DeTC). Целта на работата е намиране на решения за автоматично генериране на тестови въпроси по английски език, които и да се оценяват автоматично. Предложен е метод за параметризация на тестови въпроси по английски език със структуриран отговор от тип дихотомия и от тип множествен избор. Даден е пример за параметризация и автоматично генериране въз основа на нея на множество еквивалентни тестови въпроси.