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A Method of Student's Capability Evaluation by Error Correction Problem

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Abstract We defined the data structure of error correction problem and considered a method of student's capability evaluation to automate the examination evaluation of the problems for the error correction in computer assisted test system.

Key words test system, correction problem, examination evaluation

Introduction

The previous computer assisted test systems evaluate student's capability with yes/no type, filling-in-blank(or sentence) type, choice(single or multi) problem type, pairing problem, sequence problem, execution step problem etc [3, 4].

In this case computer assisted test system evaluates according to the degree that system's correct answer matches with the student's answer, so it cannot evaluate to the wrong answer and it is not appropriate in the evaluation of error correction problem.

In this paper we considered a method of student's capability evaluation to automate the examination evaluation of error correction problem in computer assisted test system.

1. An Extraction Algorithm of Error Correction Information

In order to evaluate student's answer on error correction problem, we must find error's position in the answer sentence and must modify the contents.

The data structure of error correction problem to realize this is defined as equation (1).

$$\text{Problem}=\{\text{id, problem, mod\_cnt, pos\_set, txt\_set, answer}\} \quad (1)$$

where id is a number of the error correction problem, problem is a problem of the error correction, mod_cnt is the number of the error correction, pos_set is the position set of the error in the error correction sentence, txt_set is a correction string set of the error position in the error correction sentence and answer is the answer sentence of student.

After dividing inflected words in error correction problem, in order to give yes or no of the error, position and modified content information in inflected words we define the data structure of the registration information having inflected words as follows.

$$\text{Typeword}=\{\text{typeword}|\text{typeword}=(\text{flag, pos, txt})\} \quad (2)$$

where flag is a flag expressing yes or no of the error, pos is the number of inflected word, txt is content of inflected word.

The data structure of the error correction information in the registration information of inflected word is defined as follows.

$$\text{Set}=\{\text{mod\_no},\ \text{pos0\_set},\ \text{txt0\_set}\} \tag{3}$$

where mod_no is number of error correction, pos0_set is position set of the error in the answer sentence and txt0_set is a correction string of the error position in the answer sentence. This is obtained from the data structure of equation(2) that derives the error correction problem from analysis of the morpheme by maximum length agreement method.

On the basis of this data structure, we discriminate inflected words from the exam problem and we make an algorithm extracting filed values of the data structure's equation (3) on every word as follows.

① We set pos=1 and m_cnt(inflected word's number)=0.

② We obtain a string from the position of pointer(pos) with space as separator.

③ We split root and particle by inflected word process of the string.

④ We set txt[pos]=root of a word and flag[pos]=error information state.

⑤ If answer sentence is ended go to ⑦.

⑥ pos++, m_cmt++ and go to ②.

⑦ We set up mod_no=1 and i=1.

⑧ If flag[i] is one, we set pos0_set[mod_no]=pos[i] and txt0_set[mod_no]=txt[i].

⑨ We set up i++ and mod_no++.

⑩ If i≤m_cnt, go to ⑧.

⑪ Finally, we save the error correction information.

By this algorithm we discriminate inflected word's information of equation (2). Then we extract error correction information equation (3) of inflected words with error flag set.

2. A Method of Student's Capability Evaluation by *M* Function

The student may find error's position exactly in the answering process on the error correction problem and then he can modify properly that contents or may not find even the position of error[1, 2].

And though the student may find the position of error, he cannot correct it. To resolve these problems we make an evaluation function satisfying following terms.

Term desired 1: The bigger the share of the student's answer set in correct answer set of system is, the higher the evaluation value is.

From this requirement, the evaluation value X_1 is calculated as follows.

$$X_1 = \frac{|S \cap U|}{|S|} \tag{4}$$

where S is the set of correct answer set offered by system, U is student's answer set and $|\cdot|$ is a number of the set. At this time X_1 has a value in [0, 1].

Term desired 2: The more the correct part in student's answer sets, the more the evaluation value is.

From this requirement, the evaluation value X_2 is as follows.

$$X_2 = \frac{|S \cap U|}{|U|} \tag{5}$$

The evaluation value satisfying the such terms desired simultaneously is as follows.

$$X = X_1 \bullet X_2 = \frac{|S \cap U|^2}{(|S| \bullet |U|)} \tag{6}$$

In this paper we establish a non-linear relationship between evaluation value and marks and create the mark function $M(X)$ with S function that is typical membership function of fuzzy theory as follows.

$$M(X) = \begin{cases} \alpha X^2, & 0 \le X \le 0.5 \\ \beta + \beta(1 - \gamma(X-1)^2), & 0.5 < X \le 1 \end{cases} \tag{7}$$

where we set $\alpha = 5,\ \beta = 2.5,\ \gamma = 4$ by experiment planned law.

On the other hand, we determine the evaluation value on the error correction information and the sum average, and then we evaluate the student's capability on error correction problems.

3. Experimental Results

We carry out exams of error correction problems related to the programming languages C, C++ and VC.

On an error correction problem "*operator is a monomial operator which returns a value of an address of the variable that operand points", when a student corrects this sentence into "*operator is a monomial operator which returns a value of an operand of the address that operand points", if we process in accordance with above algorithm, we may get inflected word's registration information and error correction information as follows (table 1, 2).

Table 1. Inflected word's registration information

flag	pos	txt	flag	pos	txt	flag	pos	txt
0	1	*연산자	1	4	변수	0	7	값
0	2	연산수	0	5	놓여있	0	8	돌려주
0	3	가리키	1	6	주소	0	9	단항연산자

If the answer sentence of the examination papers two errors position were corrected and one correction content was wrong, evaluation value is as follows.

$$X = \frac{1 + 0.5}{2} = 0.75$$

Table 2. Error correction information

mod_no	pos0_set	txt0_set
1	4	주소
2	6	연산수

Since $X > 0.5$, the student get mark as following

$$M(x) = 2.5 + 2.5[1 - 4(0.75 - 1)^2] = 4.375.$$

Conclusion

We proposed a method of student's capability evaluation to automate the examination evaluation of the problems for the error correction in computer assisted test system.

First, we proposed an algorithm to extract error correction information (position of the errors and the correction contents) of the error correction problems.

Second, we defined a new evaluation function which can evaluate error correction problems from the desire of the evaluation function and verified its effectiveness with experiment.

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