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## Multiple choice tests in VBA with on the fly question modification

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### Abstract

The paper presents the possibilities of dynamizing multiple choice tests prepared in the form of MS Word document managed by a VBA macro through the use of Word fields, especially IF fields

### 1. Introduction

Computer tests can be accessed in a network typically through HTML pages with both DHTML (HTML, JavaScript, CSS) and server-side scripts and technologies (Perl, ASP, php) (see e.g. [1, 2]). An alternative method is the use of LAN-characteristic techniques – in our case a VBA macro managing standard Word document and a file server – a NetWare 5 server. The tests are pointed at by the batch files which are NDS-objects through NAL (Novell Application Launcher). After being loaded from the server, the tests run solely on client stations (i.e. very fast), what is more, the main advantage of server-side authoring is maintained: student records are stored on the server.

The installation of tests on discless stations with the server-loaded operating system has been described in [3]. Here, the case of a locally installed Windows 2000 environment is used together with a NetWare 5 server. One of the disadvantages of this solution is that the test use is restricted to local networks<sup>1</sup>. On the other hand, a rich set of formatting and graphics MS Word tools and, at the same time, NetWare administrative tools for controlling access to the server resources at a specific time and for a specific duration and also user file and object rights can be used.

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<sup>1</sup> Accessing examination test from a public network requires an adequate authentication procedure just as in the case of distant paper examination, but different the self-assessment tests, when solving tests without the help of others is not required.

Currently, the following sets of 100-150 questions grouped into CAAMs (Computer Assisted Assessment Modules) directly connected to the most computer-oriented courses in our Faculty have been made available:

- operating systems;
- computer networks;
- MS Office;
- Internet applications;
- DBMS Oracle 8;
- expert systems;
- introduction to computer graphics.

The multiple-choice questions are displayed at random from a test bank according to the parameters controlled by the lecturer:

- the number of questions and the size of the bank;
- the number of points for each correct answer;
- the time limit.

After completing the test a summary is displayed. The final result is stored in a file with a unique name along with some comments.

## **2. Static multiple choice tests**

One of the principal weaknesses of multiple choice tests is their inflexibility – students become familiar with the contents of such tests very quickly. This is fostered by the ability of our system to give immediate feedback on incorrect answers and the support students receive in short context-oriented help (self-teaching aspect of the tests), and also by the promotion of active answer searching, including notes and the Web. Flicking through the complete tests with correct answers was not taken into account when the tests were first constructed. Unfortunately, these rather pathological forms of taking computer tests enjoyed unusual popularity among students. Not wanting to deprive the testees of the opportunity of active answer seeking and at the same time, not really seeing a working method of distinguishing standard notes from cribs, the following steps have been taken:

- the number of questions available for selection has been increased to at least 150 to make fair answer seeking more effective (if ‘ethical’ concerns proved insufficient) than thumbing through ready-made schemes. An additional effect is that students are more likely to have unique, never-seen-before tests;
- the answers to each question are displayed in a random sequence [4];
- the MS Word fields are used to involve a dynamical component to the tests.

### 3. Examples (I)

Most of the multiple evaluation questions, MEQ, represent first four levels of expected cognitive learning outcome according to the Bloom's taxonomy [5]: knowledge, comprehension, application, analysis.

**a) Knowledge** (*label, list, name, order, ...*)

The following:

*...could be a network with physical topology bus, star or ring. Communication is fast and inexpensive. The nodes are personal computers, sometimes more powerful machines...*

concerns:

[A] LAN [B] MAN [C] Internet [D] GAN [E] WAN

If the information is considered as the meaning of the message, then the meaning of the following two messages is different:

[A] Kielce 28km	<i>Kielce 28km</i>
[B] transfer 28Kb/s	transfer 28KB/s
[C] 13	1101 <sub>2</sub>
[D] 15 <sub>8</sub>	13
[E] 13	thirteen

**b) Comprehension** (*classify, describe, discuss, explain, identify, select, ...*)

Which of the following descriptions of real-time systems is incorrect:

- [A] The speed of real-time system is enforced by the speed of real processes controlled by the system
- [B] Universal operating systems belong to the category of the so called *hard real-time systems*
- [C] A real-time system responds to input 'immediately'
- [D] Military technology is one of typical fields of use for real-time systems
- [E] Most of the UNIX system versions follow the requirements characteristic of *soft real-time systems*

**c) Application** (*apply, operate, solve, use, ...*)

The result of the proportionality of nerve pulse frequency to the logarithm of stimulus (e.g. sound, light)  $S/S_0$ , where  $S_0$  is some threshold value is that if stimulus  $S_1/S_0=10$  generates the frequency  $f_1$ , and  $S_1/S_0$  stimulus the frequency  $f_2$ , then the  $f_2/f_1$  ratio is (show *incorrect* answer):

- [A] 2 when the intensity increases 10 times
- [B]  $\log_2 8$  when the distance to the source drops by the factor of 100
- [C] 2, when the intensity increases from  $S/S_0$  to  $(S/S_0)^2$
- [D]  $1+\ln 16/\ln 10$  when the distance from the source drops four times
- [E] dependent on the logarithm basis (2, 10, e, etc.)

**d) Analysis** (*analyze, calculate, categorize, compare, ...*)

- [1] the children of Mr Cogito are his descendants
- [2] the children of Mr Cogito's descendants are his descendants, too
- [3] Mr Cogito's descendants are exclusively the people fulfilling conditions [1] or [2]

The above definition should be called:  
[A] inductive [B] descendent [C] deductive [D] recursive [E] iterative

In all the cases above the answer is always on the screen in a direct form; no dynamic elements are involved in the presentation.

**4. Dynamization of multiple choice tests**

We utilized the random number generator to differentiate successive runs of the test. Admittedly, **RND()** is absent in the rather modest set of functions available in the Word fields, but the other function on the **Paste Function** list, namely **INT()**, simply adds numerical values of hours, minutes and seconds displayed in the **Time** field (i.e. the “:” separator works here as the addition operator). After inserting the label: **Insert>Bookmark...** we set the current time with sec precision, say in the format: **HH:mm:ss** through the sequence of commands: **Insert>Field...>Categories (Date and Time)>Field names(Time)** . Similarly, to the field bookmarked **RND** we insert **INT(time)/144** through the sequence: **Insert>Field...>Categories(Equations and Formulas)>Field names(=Formula)** and additionally use **Formula...** button and **Paste Function, Paste Bookmark** drop lists. As a result, we have a convolution of three rectangular distributions, a poor imitation of a  $R[0,1]$  generator.

Table 1. Word fields examples

name	Code	Value
time	{TIME \@ “HH:mm:ss” \*MERGEFORMAT}	21:32:01
RND	{=INT(time)/144}	0.37
n0	{=INT(2*MOD(INT(RND*100);2))}	2

**5. Examples (II)**

The table above illustrates a method of generating pseudorandom numbers used for modifying the content and/or the suggested answers in multiple choice tests. It enables, for example, displaying drawings selected from a larger set:

The function fact() is called in a special manner, illustrated metaphorically by the picture (see Fig. 1):

```
var n=prompt(' read n,');  
function fact(n)
```

```
{if (n==0)
return 1
else
return(n*fact(n-1))}
```

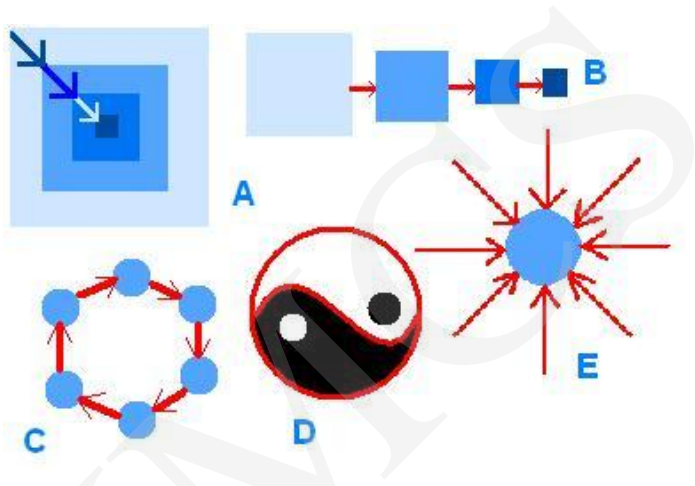


Fig. 1

or picture switching as in the example below (see Fig. 2):

Three files with identical initial size store the tie patterns. After the maximum lossless compression (elimination of redundancy) the file sizes differentiate. Which patterns have the smallest, medium and largest effective complexity [6], i.e. the length of compressed description of the regularities?

*Note: after the lossless compression the data may be recovered in the exact initial form*

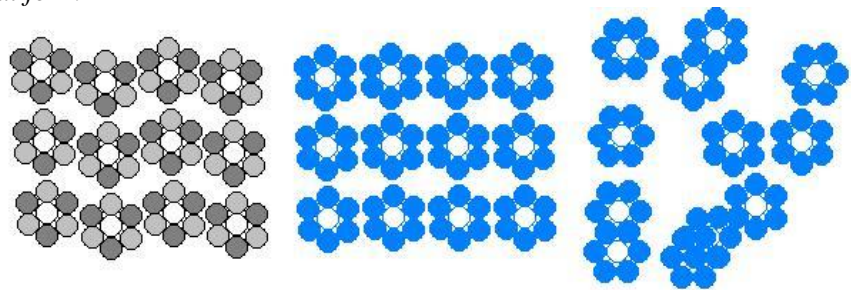


Fig. 2

[A] center, left, right [B] center, right, left [C] right, left, center [D] left, right, center [E] right, left, center

...or even splitting the task into diversified alternatives as in the last example (see below) when the source version contains  $n_0$  field:

The execution of the JavaScript-like code below gives:

```
function rec(n)
(IF n0=2 "{if(n<2)" "{if(n>0)" \* MERGEFORMAT }
{ write(n);
{ IF n0=2 "rec(n+1);" "rec(n-1);" \* MERGEFORMAT }
{ IF n0=2 "write(n+1)}" "write(n-1)}" \* MERGEFORMAT }
{ IF n0=2 "rec(0);" "rec(2);" \* MERGEFORMAT }
```

...after running displays different versions of the question depending on the value of the  $n_0$  parameter:

the version displayed for  $n_0=2$

```
function rec(n)
{if(n<2)
{ write(n);
rec(n+1);
write(n+1)}}
rec(0);
```

[A] 0121 [B] 012 [C] 01 [D] 210 [E] 2101

the version displayed for  $n_0=0$

```
function rec(n)
{if(n>0)
{ write(n);
rec(n-1);
write(n-1)}}
rec(2);
```

[A] 2101 [B] 210 [C] 21 [D] 01 [E] 0121

## 6. Summary

A dynamization of multiple choice tests has been presented. The sampled questions (together with the answers) are modified on the fly through MS Word fields. Thanks to this, the diversity of questions increases and, additionally, using ready-made notes to solve the MEPs is no longer as simple as it used to be.

## References

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