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WEB-BASED PROGRAMMING COURSE - CONCEPTS AND PERFORMANCE

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ABSTRACT

The rapid development of the information technologies gives opportunity and imposes the creation of new means, used in the process of education. Different platforms that allow the publication of educational courses on the Internet as well as directly accessible on the net electronic courses are being actively developed. This paper is dedicated to the problems that occur during the development of electronic educational courses. The main pedagogical requirements regarding the contents and the structuring of the electronic courses are concerned. An electronic educational course on structural programming on C++ is developed. Special attention is paid to the interactive educational approach that facilitates the understanding of more difficult rules in programming. The report contains review of the existing technologies that give opportunity for achieving interactivity during the mastering of the knowledge. A program system of Java applets is developed.

Some of the applets provide the students with the opportunity to view the execution of some of the rules in concrete examples. Other applets follow the step-by-step execution of the program code. Applets with the help of which the students can check the result of the execution of their programs are developed as well.

Keywords: programming, interactive education, Web-based course, Java applets.

INTRODUCTION

The development of information technologies and Internet provide opportunities for using new means and resources in the process of education. Various platforms for Internet courses publication and on-line education courses are being actively worked out. Web-based courses, directly accessible in the net are also available. Some of the courses are intended entirely for distant education, others can be used for both presentational and distant educational purposes. The mixed courses support the lecturer to hold the lecture and apart from that are available on-line in the Internet. The web-based educational courses compared to the conventional ones are widely spread in the net. They provide hypertext (links) use for reference to particular material and multimedia (sound, animation, video). Moreover, they give an opportunity for an interactive educational process thus overcoming the passive behaviour of the student. Some difficult for understanding concepts can be better clarified.

This article focuses on the main pedagogical and technical requirements concerning the development of electronic web-based educational courses. A web-based course for both presentational and distance education on C++ structure programming that meets all necessary requirements has been developed. Special attention is paid to the interactive educational approach that makes clearer the difficult rules in the programming language. Accordingly, a system of 24 Java applets has been developed.

Development of a web-based educational course on C++ structural programming

The pedagogical content of the on-line educational course is divided into three main parts:

• **Introduction** – it informs and motivates the students. This part contains information about the course's main topics, the preliminary knowledge needed for successful education, the educational purpose outlining the knowledge that is to be attained in the process of this course; the author of the course; the course plan; books for reference; computer system hardware and software requirements.

• **Main part** – contains the main pedagogical means for knowledge formation. This part consists of a sequence of similar educational modules that perform the main pedagogical educational concepts. Each module has a clearly structured theoretic part, examples that show the application of the theoretical part; problems that have to be solved by applying the theory; more difficult problems that acquire some background knowledge.

• **Conclusion** – this part of the course may contain some on-line tests for self-evaluation and some references for certain material repetition.

In order to develop a web-based educational course first of all one should structure appropriately the study material into similar average volume modules. Each module should be developed as a separate HTML-page, containing the title of the main topic and the subtopics, the content as well as a navigation part for connection to the other modules. The page formation is complied with the ergonomic requirements for font, font size and colour, page length and width, etc. For the course development it is important to find the appropriate way to navigate the information among the modules. They can be interconnected in linear, tree-like, star-like and mixed structure. The linear structure allows for a logical consecutive learning for the entire web course. Thus, the order of the modules is predefined. The tree-like structure is useful when presenting the hierarchical dependency of the material in each module. The star-like structure displays the general course plan thus allowing the direct access to either a neighboring module or a randomly chosen one. This structure is quite typical for Internet useage and allows the user freely to choose the study sequence of the material. This main advantage makes the star-like structure quite appropriate for web-courses and is realised in the developed course.

The module presentation in a concrete browser depends on the chosen hypertext marking language version (X) HTML. The need to have a unified standard for rendering hypertext information in Internet has lead to the introduction of international standards by W3C. These standards must be observed by all web browser developers. Consequently the use of the standardized (X) HTML language version is a prerequisite for excellent presentation of the developed web-course in Internet. The (X) HTML-code on-line check is made with a validator [5].

The developed course consists of a title page, introduction, course plan and 39 study modules. Special attention is paid to the interactive approach for attaining more complicated C++ language rules. For that purpose 24 interactive objects for Java teaching /Java applets/ are developed and used in the course.

Development of interactive learning objects

At present many new interactive objects for web-based education exist and are being actively developed. In [6] interactive objects for C++ and Java programming are created. The objects are developed as Java applets and objects, created in Macromedia (Flash, Shockwave) medium. In [7] a free graphic software medium JelSim for quick and easy Java applets development is presented. Minimal knowledge of Java is required. On this basis a series of JelSim Java applets that allow simulations in the field of chemistry are developed. As far as physics and genetics are concerned they are developed in [8-10], and can be found in other sources as well. The analysis of the modern technologies for development of interactive learning objects shows that they can be used as Java applets and objects developed in a multimedia medium Macromedia. For the purposes of this course the interactive teaching objects were chosen to be developed like Java applets.

The applet is a combined Java program that is implemented like an object in an ordinary web page and is executed from the web-browser when this page is browsed. The applets use almost the entire Java platform power. For security reasons some limitations to the computer memory are introduced. A main advantage of the Java applets is the free software and the comparatively small class-file volume. This makes them appropriate to work with, even if the Internet speed is slower.

A characteristic feature of all Java applets is that in Java medium the execution of a C++ program code is simulated. For that reason to the applets an additional code is added. Thus, the difference between the two languages is compensated. Since the applets are designed entirely for educational purposes most of them are limited for entering of input data. Thus, the concrete rules are shown more clearly. Because of that, the calculations are shown to the second sign after the decimal point.

The applets are protected from entering the inappropriate data for a certain problem and the mechanism for Java exceptions processing is used. For that purpose the try-catch construction is employed and errors of NumberFormatException class (because of entering inappropriate data) and of ArithmeticException class (errors in some arithmetic operation) are processed.

Java provides two models for processing events that have occured from components of the applet's graphic interface. If there are few graphic components (buttons and text fields) the event processing is done by redefining the action method of the class Component. If the interface is more complicated and there are more graphic components the new model, introduced by JDK 1.1 version, is used to process the events. For that purpose a class (applet) that implements a certain interface is created. The methods for events processing are declared there. In this class all methods declared in the implemented interface are realised. The applet becomes an action listener and the actions are automatically processed by the realised interface methods. The components, for example the buttons that are reacting to each action are registered as listeners using strictly defined methods. In most applets there are actions generated by several components – buttons, text fields, etc. The new Java model is used to process them.

The 24 interactive learning objects realised as Java applets are elaborated. They can be divided in three main groups. The first group includes applets that help the user to check by visual means and by concrete examples the execution of some general rules of the programming language. The user enters his own input data and consequently the result from the program code execution is drawn.

Example 1. The applet checks by use of concrete data the execution of the arithmetic operations with data of type int. The rule is as follows:

The multiplication /*/ and division / / / actions have higher priority than the addition / +/ and subtraction /-/ actions. This priority can be changed with the help of the round brackets:

2+3 / 3+2 equals 5

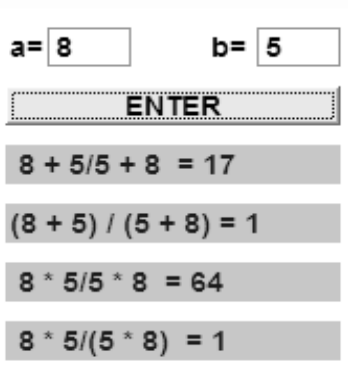
(2+3)/(3+2) equals 1

The binary actions * and / have equal priority. They are done consecutively from left to right:

2*3/ 3*2 equals 4

2*3/(3*2) equals 1

Check these rules with your data



Example 1.

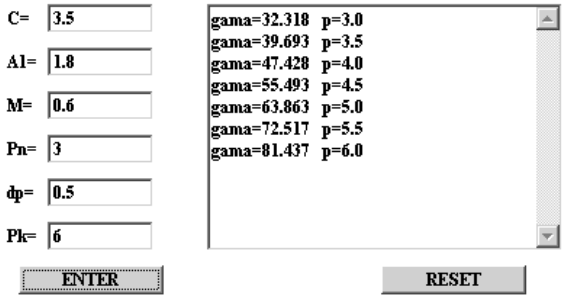
To the second group of applets /Example 2/ belong those that allow the user to check how the program he/she has developed works. Concrete input data are entered and the results are drawn with a hidden program code.

Example 2. The applet allows checking of the program developed by the user.

Make a program for calculating the γ coefficient according to the formulae:

$$\gamma = A_1.C.p \sqrt[3]{\frac{p}{M}}$$

The calculations have to be made for different values of p, which is changed from given initial value P_n to the given final value P_k with a step dp. Compare the results obtained with the applet:



Example 2.

In the third group of applets /examples 3-6/ apart from the already mentioned input – output actions we can also follow step by step the dynamics of the program code execution. The medial values of the variables in the execution process are also followed up.

Example 3. It shows the rule for the && action execution. The rule is as follows:

With && action the right operand is executed only if the left operand differs from 0.

```
#include <iostream.h>
int main ()
{
char x,  ch = 'A';
cin>>x;
int z =  x != 'N' &&  (ch = 'B') ;
return 0;
}
```

x= e STEP

ch= B RESET

Example 3.

Example 4. The applet shows the dynamics in the execution of the cycle.

To organize a cycle that should be executed until an /*/ sign is entered.

```
#include<iostream.h>
int main ( )   {
char star='*';
char ch=star+1;
while(ch != star )
  cin>>ch;
return 0 ;
}
```

STEP

star= *

ch= +

RESET

Example 4.

Example 5. Shows the dynamics in the sum calculation.

To calculate the sum of the numbers from 1 to 10:

```
#include <iostream.h>
int main ()
{
for( int i = 1, Sum = 0; i<= 10; i= i + 1)
   Sum = Sum + i;
return 0;
}
```

i= 4 STEP

Sum= 6 RESET

Example 5.

Example 6. Shows visually the data exchange between subprograms in C++.

The swap procedure exchanges the values of two whole numbers that have been entered. Follow up the execution with the help of the applet.

```
#include<iostream.h>
void swap(int *x, int *y)
  {
  int pom =  *x;
  *x  =  *y;
  *y  =  pom;
  }
int main( )  {
int a, b;
cout<<"Vavedete a: ";
cin>>a;
cout<<"Vavedete b: ";
cin>>b;
swap(&a, &b);
cout<<"a = "<<a<<"   b = "<<b;
return 0;
}
```

*x= 3 *y= 42 pom= 3

STEP

a= 3 b= 42

RESET

Vavedete a:
Vavedete b:

Example 6.

CONCLUSION

The web-based course is developed for presentation/distance education in structural programming of C++. Its capabilities can be further enlarged for entirely distance education after in the concluding part some on-line tests and recommendations for self-improving are added. The course is developed in accordance with contract No N 10196/2005 of the UCTM. The course was implemented and tested in the education of students from the "Industrial chemistry" speciality who were quite interested in the new educational approach. The web-based course is published on the website of the department [11].

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