EDUCATIONAL SOFTWARE FOR A COMPARATIVE STUDY OF DIRECT SORT METHODS

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ABSTRACT:

The informative society needs important changes in educational programs. The informational techniques needs a reconsideration of the learning process, of the programs, manuals structures, a reconsideration of the methods and organization forms of the didactic activities, taking into account the computer assisted instruction and self instruction. This paper presents a software package, which can be used as educational software.

This paper present a graphical user interface implement in Java useful for computer based training. It is made a comparative study of three sorting methods. There are many sort algorithms, because data-sorting problem is very important. The software application that is present here works with direct sorting algorithms.

KEYWORDS:
Educational software, informational techniques, data-sorting

1. INTRODUCTION

In the condition of informatics society whose principal source in the social–economic development is to produce and consumption the information, the complex and fast knowledge of the reality for rational, opportune, effective decisions is a desideratum which generate the necessity to form some superior level habituation in information manage for the whole population. The computers and their programs offer to the users powerful capabilities for the information manipulation: image and text visualize on the screen which can be manipulate later; memory storage of an important quantity of information, his accessing and selection of a part of them; possibility to realize a great volume of computation; possibility of equipment control and fast decisions; Computer Based Training.

This facilities offer to the microcomputers higher educational capabilities versus other technologies used in education and provide

learning controlled based on many parameters: intellectual aptitude, level of knowledge, abilities, rhythm of work.

2. COMPUTER BASED TRAINING AS A DIDACTIC METHOD

The informatics society makes sensitive modification in education programs. In this scope, the school must prepare programmers, maintenance technicians, etc. In the same time it is necessary that the teacher make ready to use the computer in education process.

These informational techniques impose to reorganize the contents of the education process, of the programs, course books and manuals, to reconsider the methods and organization forms of didactic activities, which follow to be center on individualization of the teaching process.

N. Crowder work out a new programming type: the branch programming which is characterized by: division of the content in small steps, his successive presentation according to the student needs and corrective feedback, use of author language.

The programmed teaching consist in information presentation in small units, logic structured, units that compose a program, the teaching program. The user will have possibility that after each sequence to have a knowledge about the measure of understanding the give information. The programmed teaching method organize the didactic action applying the cybernetic principles to the teaching-learning-evaluating activities level, considering like a complex and dynamic system, composed as an elements ensemble and inter-relations and develop his personal principles valid on the strategic level in any cybernetic organization form of teaching.

On the other hand, programmed teaching assume some principles which the teaching program must respect:

- The small steps principle consists in progressive penetration, from simple to complex, in a subject content which logic divided in simple units series lead to minimal knowledge, which later will form an ensemble. This principle regards the subject division in contents/information units that give to user the chance to succeed in his teaching activities;

- The principle of personal rhythm of study regard mannerism observance and capitalization of each user of the program which will be able to make the sequences of knowledge learning or control, in a personal rhythm appropriate to his psycho-intellectual development, without time limits. The user can progress in the program only if he accomplished the respective sequence requirement;

- The active participation principle, or active behavior, regard user effort trend into selection, understanding and applying the necessary information in elaboration of a correct answer. On each step the user is liable to an active participation to resolve the step job;

- The principle of inverse connection, regard positive or negative inputs of user competence, refer to the success or breakdown in task performed;

- The immediate and directly control of the task work precision with the possibility to progression to the next sequence, in case of success;

- The repetition principle, based to the fact that the programs are based on return to the users initial knowledge.

The combined programming interposes the linear and branch sequence according to teaching necessities.

After linear and branch programming the computer aided generative teaching has appear, where the exercises are gradually present, with different difficulty steps and answers on the students questions.

The expert system consists of self-teaching training programs, tutorial strategies, and the usage of natural language, mixed initiative and some complex representation of knowledge usage.

The simulation is a training computer programs onset characterized by the fact that the computer is like a lab witch contains typical interactive graphical programs.

The computer based programmed teaching realize learning process with a inputs flow – the command, an executive controlled system, an output flux – control and a control system functions which correct measure establish.

In such a system have tree stages of teacher perceive: teaching, evaluating and the feedback loop closing, the computer being present in all of tree stages.

3. THE COMPUTER BASED TEACHING ADVANTAGES

Based on W. Feuerzeig it is very possible that computer based teaching to produce students thinking modifications such as:

- Thinking disciplined increases, of mental precisions operation and their expression, of is precise need;

- Some general concepts early forming, such as: formal procedures, the variables, transform functions, hypothetic-deductive reasoning;

- Simplification of heuristic methods application in any kind problems solve, such as cause-effect analyze.

The intelligent tutorial programs being flexible and with capacity of each student word analyzes with explanations and motivates answer on questions, has human tutor nearly and therefore are in teaching individualization proposed.

Between computer-based training advantages it can be enumerate some phenomena animate simulation, states, and etc respective problem situation possibility.

The compute based training assure:
- The instructive individualization process;
- Pass through teaching-evaluating sequences in user personal rhythm;
- Eliminate the delays in instructive process;
- Some "drudgery" teacher release, which in classic lesson was perforce to accomplish;

-    Changing the relation between teacher and student, conducting to the modification wanted by the young student, to be treated not as a subject which only accept the information, but as an equal teacher partner in the own formation act.

4. PRACTICAL STUDY

From desire of improve the instructive educational process, using modern teaching methods, was realized an courseware on "*Data structures and algorithms*" discipline, where the subject "*Comparative study of some direct sort algorithms* " was especially developed.

In many real situation, when it is works with large set of dates, it is necessary to sort this dates by various criteria. By example, a names list must be alphabetic sorted. Date sorting may be an intermediary step to the searching operations.

There are many sorting algorithms, classified by their efficiency and by execution time. The efficiency of an algorithm is measure by some indicators. Such an indicator is represent by the number of the key comparison, C. Other indicator is the number of element assignation, respectively the number of the elements inversion, M. Both two indicators depend by the number of elements, n, which will be sorted.

A first class o algorithms characterized by simplicity are the direct sort methods for the indicators C and M are direct proportionally with n^2 that is from $O(n^2)$ type. There are also advanced sorting method, which are more complexity. For these algorithms the indicator C and M are from $O(n * \log_2 n)$ type.

It is very important to punctuate that the direct sorting methods are very appropriate for the major principles of data sorting. These principles are the minimum knowledge, which must have any person that will to learn programming computers.

In this application were analyzed three direct sorting methods: Bubblesort method, Selection sort method şi Insertion sort method.

A. Bubblesort method

It is based on the idea: it is compare repetitively two neighbor elements and it is interchange these elements if they're not in the desire order. The algorithm is present by follow:

```
public void bubbleSort()
    {  int out, in;
       do{                   // extern loop
             ok=1;
             for(in=0; in<out; in++)   // intern loop
             if( a[in] > a[in+1] )       // comparison
                   { swap(in, in+1);       // interchanging
         ok=0;
       }
    }
```

The algorithm time – profil leed to an estimative order $O(n^2)$ for the algorithm.

The temporal profile of the algorithm is $O(n^2)$.

B. Selection sort method

Selection sort algorithm improve the bubblesort algorithm performance by reducing the number of interchanging from $O(n^2)$ to $O(n)$. Unfortunately the number of comparisons remains $O(n^2)$. However, the selection sort method offer an semnificative improvement for the large records which must be move in memory. In this way the time for the movement is greather than the time for comparisons (In Java this disadvantage is avoid by references movement instead the objects).

The algorithm is present by follow:

```
 public void selectionSort()
{  int out, in, min;
for(out=0; out<nElems-1; out++)   // extern loop
  {
  min = out;                    // minim
  for(in=out+1; in<nElems; in++) // intern loop
    if(a[in] < a[min] )         //  comparison
       min = in;                // new minim
  swap(out, min);              // interchange
  }
}
```

The efficiency of selection sort method

The selection sort method performs the same number of comparison like bubblesort method, but less number of permutation. For a large number of elements the comparison time is predominant. Therefore, it is obviously that the selection sort algorithm order is $O(n^2)$, like bubblesort. For a small number of elements this method is better then bubblesort because the permutation times are less than the comparison times.

C. Insertion sort method

In many cases the insertion sort method is the best directed sort method. The order of insertion sort algorithm is $O(n^2)$, like previously two methods, but, in normal situation,   is two time faster than bubblesort and faster than selection sort. The algorithm is present by follow:

```
public void insertionSort()
   {  int in, out;
    for(out=1; out<nElems; out++)
                // out is the marker
     {double temp = a[out];       // marker element
     in = out;                    // shift begin
     while(in>0 && a[in-1]>=temp)
       {
       a[in] = a[in-1];    // shift right
       --in;                 // back to left
       }
     a[in] = temp;      //  marker element insert
     }
   }
```

The efficiency of insertion method

In the first step it is perform maximum a comparison. In the next step it is perform maximum two comparisons, and etc. The maximum number of comparisons is:

$$1+2+3+...+(n-1)=n(n-1)/2.$$

However, a mean value can be considered $n(n-1)/4$.

The number of copying is approximate equal with the comparison number. Because a copying operation takes less time than a permutation operation, it can be considered that this algorithm is, for random values faster than bubblesort and selection sort.

Anyway, like two previously method, the insertion sort algorithm is performed in $O(n^2)$ time for random dates.

For dates that is already sorted or nearly sorted, the insertion sort algorithm offers better performance. If the elements are already sorted it is perform only a comparison by n-1 times. In this case the algorithm is performed in $O(n)$ time.

This application is realized in Java language. It is use the visual environment "Forte for Java 4.0".The "Forte for Java 4.0" environment offer a complete tools that avoid independent application development. The user can edit, compile, debug and design graphical user interface for application using these tools.

The main application window is an instance for the Swing class JFrame. This window allows, by a menu or a button, to select the sort method like is present in figure 1. After select sort method, a new window is opened. This window simulates the selected algorithm, and is present in figure 2 (for each sort method the window design is the same). For the simulation, was use an array with 20 elements. The elements are representing in this application by rectangles, which have heights proportionally with the value of the element.
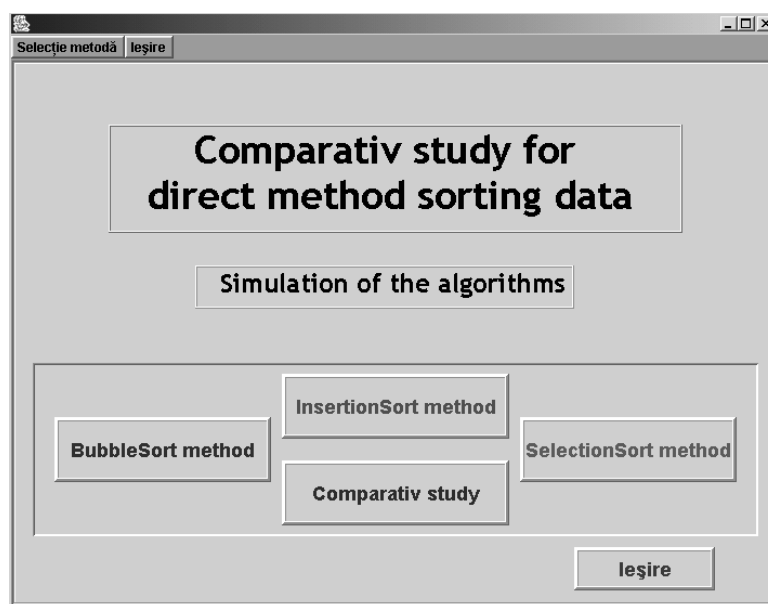

FIG. 1. THE MAIN WINDOW

The "Random" button allows 20 random values generating. This values are store in an array data structure, and the corresponding rectangles are draw in a panel.

This button can be use any time is need a new set of random dates.

The "Sorted" button display the rectangles ascending sorted after the selected algorithm is performed. In this case the user cannot observe the algorithm steps, only the final situation.

The "Sort" button performed a simulation for the selected algorithm. The simulation is performed slowly that the user can observe the algorithm steps. After each step, the process is put in stand by a few milliseconds, that the user can visual observe the algorithm.

The "Step by step" button allow analyzing the steps of algorithm, on each step. The button must be push on each step. As a matter of fact, the application rule with two different speeds by using the "Sort" and "Step by step" button.

The "Return" button is use for closing simulating window.

During simulation it is permanently displayed statistic dates, which offer information, refer to number of comparison, number of movements or number of interchanging elements. Also the principales elements of the analyzed algorithm are visual indicated, like in figure 2.

The application allow to the user to perform a comparative study for these three algorithms from the point of vue of efficienty. For this study, was 20000 random values generated. It is rule the three algorithms for the same set of dates. The result are represent in a comparative table in a other window, like in figure 3. It can be observe the algorithms performance also in marginal cases: with the dates already sorted, with the dates inverted sorted, and a normally set of dates.
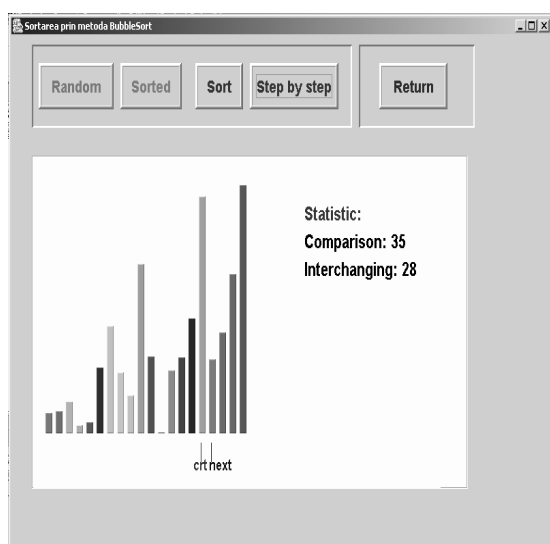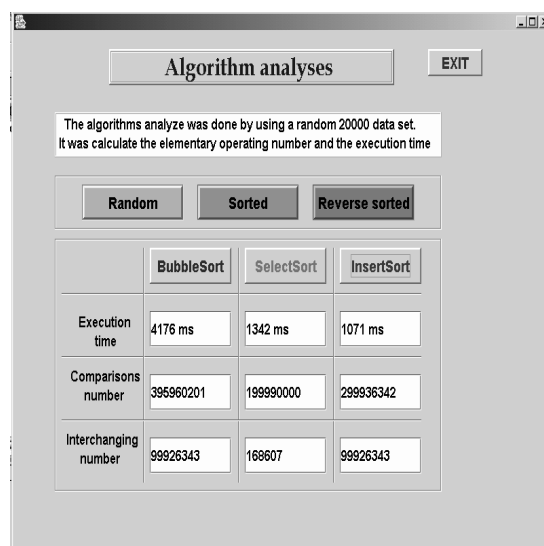

FIG. 2. ALGORITHM SIMULATION

FIG. 3. ALGORITHMS ANALYZE

5. CONCLUSIONS

On this application, authors take into consideration the condition, which must accomplish a courseware, being made necessary steps. So, in elaboration and utilization of this application must take into consideration next criteria:
- To follow up the curriculum for a specific domain;
- To accomplish some teaching and learning strategy. In this kind of self-instruction and evaluation program it must find basic notions and representation and scanning notions. Animation and graphical modeling must represent the graphical construction way and also scanning of them;
- To exist the possibility to use parameterized variable, in conditions in which users have the possibility to input the variables value;
- To present a method in which the user can be informed about how can use graphical module, i.e. an interaction user-computer exist.

The presented application accomplishes these criteria, and for this we consider that is a good example of how educational software must be realized.

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