artificial neuron network modeling. Review of basic architectures of artificial neuron networks.

Practice (2 h.): Writing programmes to classify vectors by means of the simplest one-layer perceptron.

Unit 14. Fuzzy logical systems (4 h.)

Theory (2 h.): Elements of fuzzy set theory: fuzzy set, membership function, triangulated fuzzy numbers, α-level set. The systems of fuzzy inference. Field of application.

Practice (2 h.): Writing a programme to simulate the simplest system of fuzzy inference.

Unit 15. Presentation of final projects, review of results (2 h.)

Theory (2 h.): Presentation of project results with theory in PowerPoint format and practical results in the form of operating programme. Review of the course results.

Conclusion

The article suggests innovative general educational programmes for additional schoolchildren education, the distinguishing features of which are project-based technique and focus on mathematical modeling in engineering design. The work was performed in the frame of State Project of the RF Ministry of Education and Science to arrange and develop practice-oriented research clubs of engineering art. In curriculum development the representatives of Tver State University, Lobachevsky State University of Nizhniy Novgorod, Kazan National Research Technical University named after A. N. Tupolev and Ogarev Mordovia State University took part, it was presented at the seminars held in Moscow and Saint-Petersburg.

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Perspectives of Smart System Math-Bridge for Learning Array Sorting Methods

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The article proposes the use of Math-Bridge smart system as a tool to train and control knowledge of engineering students in the methods of sorting arrays.

Key words: Math-Bridge, sorting, exercise, direct exchange, algorithm.

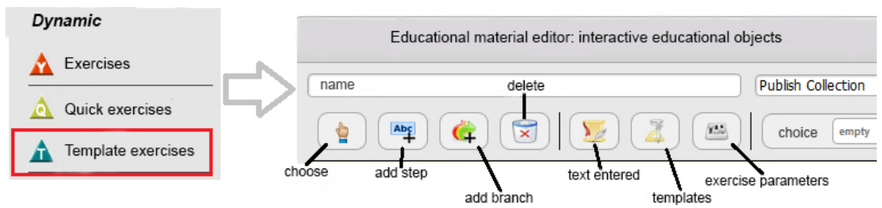
Application of training systems is one of the most advanced ways for educational information technology development. A training smart system Math-Bridge is a significant break-through made in this direction. It allows working with a wide scope of dynamic objects converted from usual graphic objects by means of a special editor [1]. A theoretical base for such systems was developed by Skinner B.F. and Crowder N.A. in the 1950-s of the 20th century. These systems are to take into account not only correct answers but also the ways that lead to the solutions [2]. Thus, the smart systems that provide a wide range of diverse objects and ready templates as tools are of special interest. The system is known to have been developed to train engineering students and students of natural science profile in the frame of MetaMath project [3, 4]. The course "Algebra and geometry" was developed in the frame of the project [5]. However, as practice shows, Math-Bridge toolkit can be successfully applied while training students from other majors [6].

This article studies the ways to use the system Math-Bridge to train and control the students of "Information and computer science" major on array sorting methods provided within the course "Algorithm and data structures". Specific features of creating dynamic training objects are used in this case [7]. Let us choose an Exercise as an object (fig. 1). This object can be directly used by making training algorithm via Educational material editor (fig. 1), or it is possible to choose one of the following (fig. 1, 2).

This approach is one of the easiest and fastest ways to create training and testing elements. The system includes six standard templates that allow designing exercises with one or two interactions with a trainee. The template types for exercise design are shown in fig. 2.

Besides, there is an opportunity to design dynamic objects by means of separate units, which allows implementing multi-level algorithms for further development of complex educational algorithms applied

Fig. 1. Dynamic objects and educational material editor



S.A. Fedosin

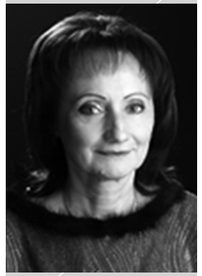


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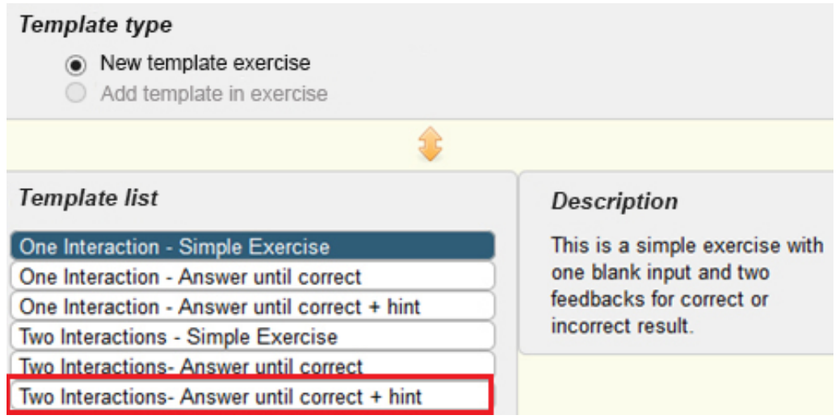
Fig. 2. Template types to design exercises



in training students from different majors. Separate units and templates used in algorithm design make it possible to model a trajectory of incremental problem solving with hints as an option in case of student's wrong answer. Such approach helps students to enrich and use their knowledge while working with dynamic objects of Math-Bridge system. These methods are particularly effective in training students on using different methods of array sorting: insertion sort, selection sort, and exchange sort (bubble sort).

The capacity of Math-Bridge system can be shown by the example of exchange sort, one of the simplest sort methods. The idea of the algorithm is to compare two adjacent elements. If their position does not comply with the set sorting conditions, they are interchanged. Then, the next two elements are examined until all the elements are sorted. In other words, it is necessary to develop the training trajectory that would allow testing and adjusting student's knowledge at each step of intermediate array formation.

Let us consider the training trajectory implementation via a dynamic element of Math-Bridge system. It is an exercise based on the template «Two Interactions – Answer until correct + hint» (fig. 2) and additional units (fig. 3)

As fig. 3 shows, the training trajectory has 4 interactions with a trainee, presented by units "Task1-Task4" that contain tasks for the next iteration of external srting cycle. The units "Interaction1-Interaction4" contain 4 options of the answers, one of which is the correct reflection of the array after each sorting stage. The next unit is available if a trainee chooses the correct option.

Fig. 4 shows an adjustment menu for branches. It enables an instructor to attribute a number of grades for a particular answer.

If a trainee chooses the correct option at each stage, he/she finally has an array correctely sorted. In this case, the next branch is switched to the ways shown by green arrows (fig. 3). If the trainee's choice is wrong, the system gives an error message and a hint, which is brief information about sort algorithm, it also offers to choose the corrct option (fig. 5).

Thus, the required skills are trained while studying the algorithm of exchange sort. The advantage of such exercise concept is the opprtunity for trainees to identify their errors, correct them, and avoid repeating them again, by revising theorerical base

Fig. 3. Training trajectory via template "Two Interactions – Answer until correct + hint" – 1 and additional units – 2

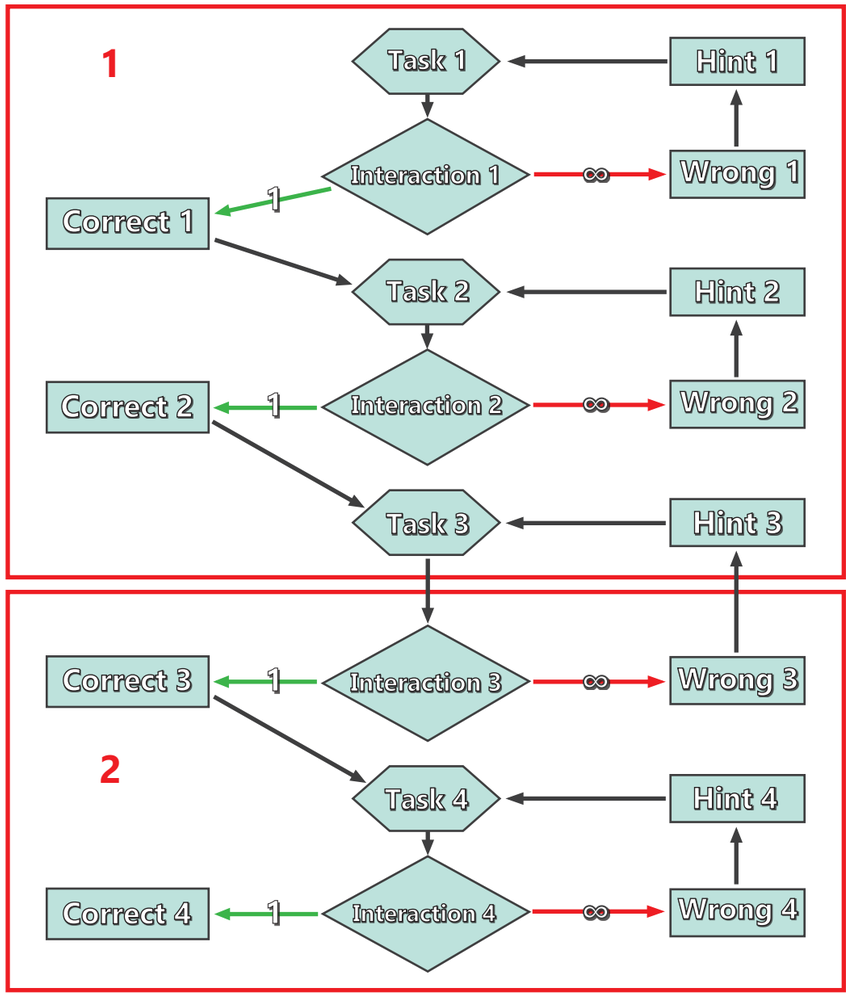
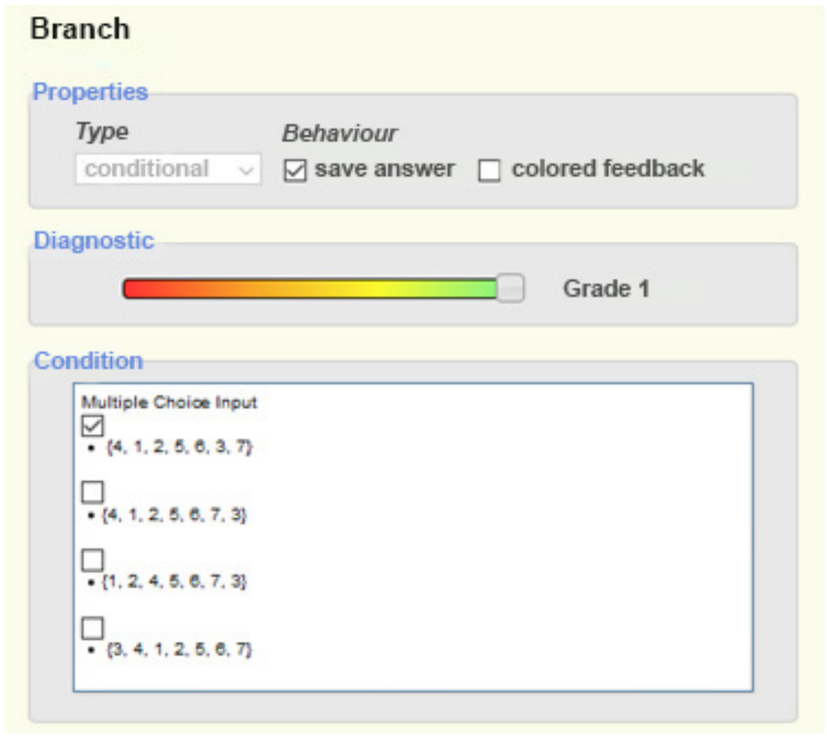


Fig. 4. Menu to adjust evaluation at the first training stage



provided by Math-Bridge system in the hint form.

The same exercise, without hints though, can be used only to control students' skills and knowldege. It is also possible to adjust the system to the mode prevents continuing the exerciseif the traineeo = has chosen a wrong option.

Fig. 6 shows a structure of a trajectory applied to control learning outcomes. Units "2" and "-2" cannot be distinguished, their contents are identical. They present the second sorting stage. The difference between them is that unit "2" is a link in the chain of correct answers, while unit "-2" belongs to the chain of wrong answers. There is no unconditional switch to the next interaction unit, which is a specific feature of the system. Thus, it is necessary to double the units of wrong answer branches, starting from unit "3".

Fig. 6 proves that the final correct answer can only be obtained by choosing the correct answer at each stage of the exercise. If a trainee makes a mistake at least in one unit, he/she is referred to the part of the algorithm with the units having the same content. However, there will be no shift to the branch of correct answers, no matter if the answer is right or wrong.

To sum up, it should be noted that versatility is an advantage of Math-Bridge system. This experience can be applied to sorting arrays of any size. The difference is in the number of units and content adjustment.

Fig. 5. Error message and brief explanation

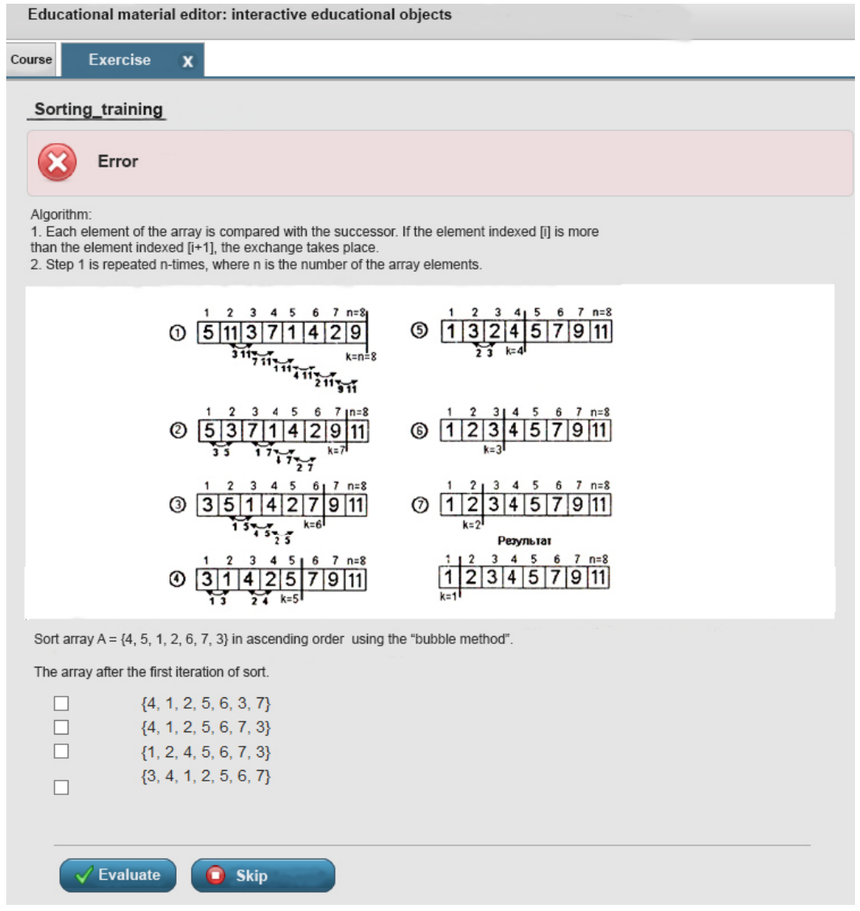
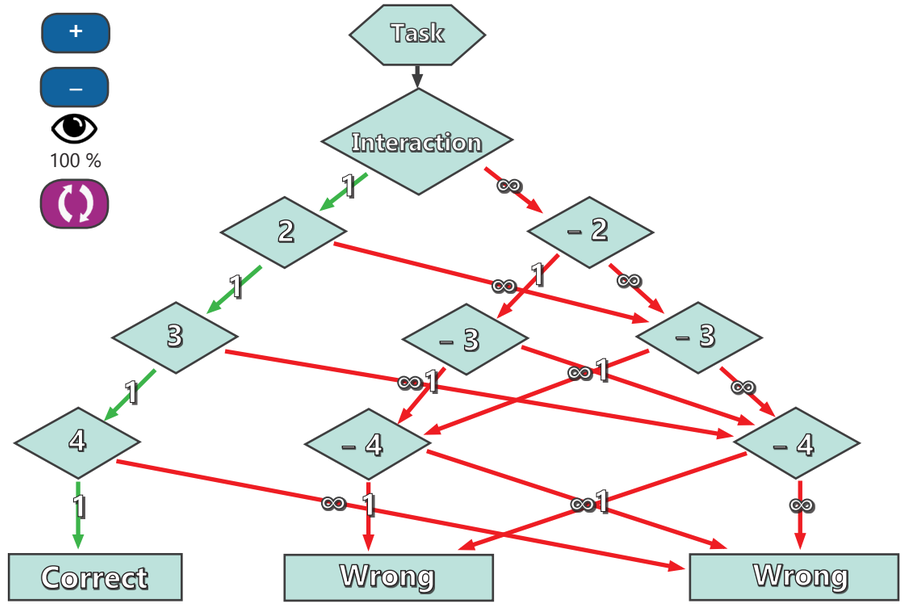


Fig. 6. Trajectory of learning outcomes control via units



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