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VISUAL MONITORING OF STUDENTS' LEARNING IN THE AUTOMATED LEARNING INFORMATION SYSTEM BASED ON FRACTAL RECURSIVE ALGORITHMS

Abstract: It consists of developing a new visual assessment system based on fractal recursive algorithms and analyzing its effectiveness. Fractal systems are widespread in nature, and their modeling and visualization are important. The article analyzes the theory of fractals and recursive algorithms. A new visual assessment system has been developed. based on fractal-recursive algorithms. This system includes the following stages: selection of fractal models and determination of their parameters, development of recursive algorithms and analysis of their effectiveness, use of graphical programs to visualize the results obtained, evaluation of system performance and its improvement. A developed visual assessment system is natural. It can accurately and realistically describe phenomena, easily obtain and understand visual information, save time and resources, and explore complex phenomena.

Key words: Fractal, recursive algorithm, visual assessment system, recursion, modeling, graphics, natural phenomena, parameters, efficiency, research.

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ВИЗУАЛЬНЫЙ КОНТРОЛЬ ОБУЧЕНИЯ СТУДЕНТОВ В АВТОМАТИЗИРОВАННОЙ ИНФОРМАЦИОННОЙ СИСТЕМЕ ОБУЧЕНИЯ НА ОСНОВЕ ФРАКТАЛЬНО-РЕКУРСИВНЫХ АЛГОРИТМОВ

Аннотация: Фрактал рекурсив алгоритмлар асосида янги визуал баҳолаш тизимини ишлаб чиқиш ва унинг самарадорлигини таҳлил қилишдан иборат.Фрактал тизимлар табиатда кенг тарқалган бўлиб, уларни моделлаштириш ва визуаллаштириш муҳим аҳамиятга эга.Мақолада фрактал назарияси ва рекурсив алгоритмлар таҳлил қилинди.Фрактал рекурсив алгоритмлар асосида янги визуал баҳолаш тизими ишлаб чиқилди. Бу тизим қуйидаги босқичларни ўз ичига олади: фрактал моделларни танлаш ва

уларнинг параметрларини аниқлаш, рекурсив алгоритмларни ишлаб чиқиш ва уларнинг самарадорлигини таҳлил қилиш, олинган натижаларни визуаллаштириш учун графика дастурларидан фойдаланиш, тизимнинг ишлаш самарадорлигини баҳолаш ва уни такомиллаштириш.Ишлаб чиқилган визуал баҳолаш тизими табиий ҳодисаларни аниқ ва реалистик тасвирлаш, визуал маълумотларни осон қабул қилиш ва тушуниш, вақт ва ресурсларни тежаш, мураккаб ҳодисаларни тадқиқ қилиш имкониятларига эга.

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ФРАКТАЛ РЕКУРСИВ АЛГОРИТМЛАР АСОСИДА АВТОМАТЛАШТИРИЛГАН ЎҚУВ АХБОРОТ ТИЗИМИДА ТАЛАБАЛАР ЎЗЛАШТИРИШИНИ ВИЗУАЛ МОНИТОРИНГ ҚИЛИШ

Калит сўзлар: Фрактал, рекурсив алгоритм, визуал баҳолаш тизими, рекурсия, моделлаштириш, графика, табиий ҳодисалар, параметрлар, самарадорлик, тадқиқот.

Аннотация: Он заключается в разработке новой системы визуальной оценки на основе фрактальных рекурсивных алгоритмов и анализе ее эффективности. Фрактальные системы широко распространены в природе, а их моделирование и визуализация имеют важное значение. В статье проанализирована теория фракталов и рекурсивные алгоритмы. Разработана новая система визуальной оценки. на основе фрактально-рекурсивных алгоритмов. Данная система включает следующие этапы: выбор фрактальных моделей и определение их параметров, разработка рекурсивных алгоритмов и анализ их эффективности, использование графических программ для визуализации полученных результатов, оценка производительности системы и ее улучшение. Развитая система визуальной оценки естественна. Она способна точно и реалистично описывать явления, легко получать и понимать визуальную информацию, экономить время и ресурсы, исследовать сложные явления.

Ключевые слова: Фрактал, рекурсивный алгоритм, система визуальной оценки, рекурсия, моделирование, графика, явления природы, параметры, эффективность, исследование.

Introduction. The current age of information and digital technologies, the need to improve the quality and efficiency of methods for processing electronic document data (texts) is growing steadily. In the era of large amounts of data (big data), the process of processing unstructured text data poses new challenges and opportunities. This process mainly includes tasks such as information retrieval, text

filtering, document collection and sorting, finding answers to questions, automatic text annotation, searching for similar and duplicate texts, as well as text segmentation.

Research and technological advances in these areas are helping to make text processing processes more efficient and faster. Existing algorithms and artificial intelligence-based methods are creating innovative solutions that allow you to analyze texts and quickly obtain the necessary information. As a result, the demand for information in scientific research, business processes, and everyday life is increasing. Also, through these processes, opportunities are emerging for the discovery of new knowledge in various fields, which has a positive impact on the development of information technologies.

Effective scientific research is being conducted in the field of education in the direction of widespread application of such a creative approach as fractal pedagogy. In this regard, training based on the principles of fractal pedagogy in the training of future specialists based on advanced foreign experience is of particular importance. The main links in the educational process are the teacher, the student, the subject and the applied methodology. It should be noted that the skill of teaching a subject depends on the teacher. An important factor is that the tools used by the teacher meet modern requirements, as the knowledge base within his subject. Because specialized subjects are considered as a set of knowledge in a special field of information technologies and are being improved every day with new technologies, tools, software, etc. Integrally with these processes, there is a need for fractal-like growth of the teacher's professional skills. On the other hand, students should have basic concepts in the subjects, be aware of the latest updated knowledge, be able to apply the acquired knowledge in their future professional life, develop new information, etc., which is described as a clear manifestation of fractal harmony. In this regard, monitoring these processes is important to offer effective ways to assess and manage the activity of teachers and students in the learning process.

The main goal of improving the efficiency of the educational process automation system is to monitor the quality of students' learning activities and mastery indicators, as well as diagnose the effectiveness of teachers' management activities. Educational quality assessment involves identifying mechanisms for developing the educational process, increasing the effectiveness of the use of new pedagogical technologies, and implementing development trends in the educational process.

The main indicators of mastering educational materials in specialized areas of education are computers, mathematics, computer science (programming), physics, special disciplines, such as increasing the mastery of the subject, and the time spent on solving problems. Therefore, in diagnosing the quality of teaching and managing the educational process, studies include such indicators as the level of mastery of knowledge or the automation coefficient. This indicator characterizes the qualification as the ability to master the mastered methods of activity. As a result of each educational process, the acquisition of knowledge and practical skills

in the subject by the student is considered an important indicator, and the use of the acquired knowledge in other related specialized disciplines is the basis for the formation of a specialist.

The developed automated educational information system for monitoring the process of students' mastering based on fractal features includes the following components:

- Information model of education based on the educational thesaurus in accordance with the modular curriculum;
- Fractal model of analyzing student mastering indicators;
- Pedagogical control materials;
- Fractal harmony of visualization of the stages of the educational process;
- Fractal nature of student mastering indicators.

The basis for developing the block for monitoring the process of students' mastering of the automated educational information system is the thesaurus collection of the subject module. It was carried out using the main features of fractals. Increasing interdisciplinary connections in the education of students studying in various educational areas is carried out through fractalization of the organization of educational materials of the subject. The information model of the block of materials of the automated educational information system is built on the basis of the modules of the subject, their interdisciplinary connections, connection with the field of specialization and scientific field.

Fractal systems are an integral part of mathematics, and their frequent occurrence in nature and widespread use in various fields is a very interesting phenomenon. It is important to create a visual assessment system based on fractal recursive algorithms, study and improve the effectiveness of this system. The visual assessment system allows you to describe complex natural phenomena using fractal theory. Based on this system, you can obtain a visualized model of natural phenomena. For this, fractal recursive algorithms are used. Recursive algorithms repeat themselves and form a fractal structure.

The development of a visual evaluation system based on the fractal recursive algorithm includes the following steps:

- Choosing fractal models and determining their parameters;
- Development of recursive algorithms and analysis of their effectiveness;
- Using graphic programs to visualize the obtained results;
- Evaluating the performance of the system and improving it.

The visual assessment system created on the basis of fractal recursive algorithms has the following advantages:

- Ability to accurately and realistically describe natural phenomena;
- Easy acceptance and understanding of visual information;
- Saving time and resources;
- Ability to research complex phenomena.

The visual assessment system, created on the basis of fractal recursive algorithms, plays an important role in the study of natural phenomena, their mathematical modeling and visualization. The creation and improvement of this

system is of not only scientific, but also practical importance. Using the unique properties of fractals, it becomes possible to conveniently and effectively mathematically model natural phenomena and their processes.
Fractals are structural elements that have the property of self-similarity, through their influence it is possible to make complex systems look simple. In this system, the representation of the structural elements of science by stochastic fractals, reflecting the property of self-similarity of fractals, and these are considered self-similar parts, is considered.

As part of the automated educational information system, the possibilities of improving the system for monitoring user mastery indicators are considered. This process is carried out using a visual representation based on fractal properties, which allows for more effective control of students' activities in the learning process.

In addition, the control system is built on the principles of fractal self-similarity and conservation of change. The use of fractals makes it possible to determine the level and depth of interdisciplinary connections between the modules of the subjects being studied. In this case, each fractal module can contain many other modules, which allows for a clear view of their mutual relationships.

The visual assessment system based on fractal recursive algorithms is also able to present complex information in a simple and understandable form during the learning process. This, in turn, is of great importance for students' understanding and assimilation of the text. The system allows teachers and students to visually display complex information using fractal structures, which increases the effectiveness of the learning process.

The use of fractals also allows teachers to individualize the learning process. Taking into account the specific characteristics of each student, it is possible to provide them with educational materials adapted to them through fractal systems. In this process, the self-similarity of fractal models helps to improve the level of student learning, since each student perceives information in a way that is convenient for him.

As a result, the visual assessment system created on the basis of fractal recursive algorithms not only creates new opportunities for scientific research, but also makes the learning process more effective and interesting. The system's ability to present complex information in a simple form, monitor student learning performance, and identify cross-disciplinary connections makes it an important part of the modern education system.

Thus, the visual assessment system created using fractal recursive algorithms will continue to create new opportunities in the field of education and research in the future, and further research is needed in this area. Simplifying the complexities of the learning process can be achieved through the use of fractal structures, which will further expand students' knowledge and make their learning more effective.

REFERENCES

1. Anarova Sh.A., Sadullayeva Sh.A., Azamov V.F. Murakkab fraktal tuzilishdagi dizaynlarni arxitekturada qo‘llash. “Рақамли иқтисодиётни шакллантиришда илм-фан ва инновацион ютуқларни амалиётга жорий этишнинг долзарб муаммолари” мавзусидаги ёш олимларнинг XVII республика илмий-амалий online конференцияси.Самарқанд.2020 йил 3 июн. 19-23 б.
2. Қаюмова Г.А. HURST кўрсаткичига асосланган билим чуқурлиги ва ўқув когнитив фаолиятининг синергетик таъсири ҳажмини аниқлаш алгоритми. ЎзМУ хабарлари Мирзо Улуғбек номидаги Ўзбекистон Миллий Университети илмий журнали. №1/11/1. Тошкент-2022. -Б.116-119
3. Маджуга А.Г. Концептуально-теоретические основы фракталной педагогики как новой области социально-гуманитарного знания/А.Г. Маджуга, И.А. Синицина, Э.В.Филипенко // Научный диалог. 2015. №12(48). С.450–459.
4. Шредер М. Фракталы, хаос, степенные законы. М., Ижевск: Регулярная и хаотическая динамика. 2001. 527 с.
5. Nazirov Sh.A., Anarova Sh.A., Nuraliyev F.M. Fraktallar nazariyasi asoslari. – Tashkent: Navro‘z. Monografiya. 2017. - 128 b.
6. Anarova Sh.A., Narzulloyev O.M., Ibragimova Z.E. Development of Fractal Equations of National Design Patterns based on the Method of R-Function // International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-4, February 2020. –Pp. 134-137.
7. Kalandarov, A., Kalandarov, A., Abduraimov, D., & Anorbayev, M. (2024, November). Mathematical model of the coupled problem of thermoelasticity in stresses. In AIP Conference Proceedings (Vol. 3244, No. 1). AIP Publishing.
8. Abduraimov, D. E. (2024). UNVEILING THE STAGES AND PERSPECTIVES OF INTEGRATING ARTIFICIAL INTELLIGENCE SYSTEMS INTO THE EDUCATIONAL PROCESS. Экономика и социум, (4-1 (119)), 102-106.
9. Abduraimov, D., & Monasipova, R. (2024). AUTOMATING ECONOMIC ISSUES: THE EXAMPLE OF AUTOMATING WAREHOUSE PRODUCT STORAGE ACCOUNTING AND ITS SOFTWARE. DIGITAL TRANSFORMATION AND ARTIFICIAL INTELLIGENCE, 2(5), 12-17.
10. Samandarov, E., & Abduraimov, D. (2025, September). Classification the level of knowledge of students at school using the Naive Bayes machine learning algorithm. In AIP Conference Proceedings (Vol. 3356, No. 1, p. 030001). AIP Publishing LLC.
11. Samandarov, E., Abduraimov, D., Xudayberdiyev, A., Normatova, M., Butaboyev, A., To‘ychiyeva, Z., & Taniberdiyev, A. (2025, June). Comprehensive review of educational platform for assessing and classifying students’ knowledge levels utilizing machine learning. In Fourth International

Conference on Digital Technologies, Optics, and Materials Science (DTIEE 2025) (Vol. 13662, pp. 232-242). SPIE.
12. Ziyadullaev, D., Mukhamedieva, D., Teshaboyev, M., Abdurakhimov, D., Bakhodirov, M., Ziyodullaeva, G., & Abduraimov, D. (2023). Application of the neuro-fuzzy approach to solving problems of soil phases evaluation. In BIO Web of Conferences (Vol. 67, p. 02009). EDP Sciences.