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EVOLUTIONARY METHODS IN THE DEVELOPMENT OF WEB INTERFACES: THEORETICAL FOUNDATIONS AND AREAS OF APPLICATION

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Abstract
The article considers the basic definitions and principles of using evolutionary methods, in particular genetic programming, in the optimization and automated design of web interfaces. Existing approaches to the use of evolutionary algorithms to search for new options for the design of web pages are analyzed, and directions for further development of this area are described. Special attention is paid to local search methods and tree-like representation of HTML code as a chromosome. Based on the analysis, a conceptual hypothesis is formulated about the possibility of developing an information system that creates new layouts of web design using evolutionary methods.

Keywords: Local search methods, optimization, evolutionary algorithms, genetic programming, intelligent programming.

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Introduction

Modern approaches to the design of information systems are developing rapidly, shifting from control based on traditional software constructs toward intelligent programming technologies. One of the principal directions in the development of self-organizing and adaptive systems is represented by evolutionary methods, among which genetic programming occupies a distinct and significant position. Initially proposed by J. Fogel and later substantially refined by D. Koza, this method laid the foundation for contemporary evolutionary algorithms widely applied to a broad range of optimization problems.

In recent years, genetic algorithms have been actively employed to obtain optimal solutions to problems of varying levels of complexity. Their value lies in their ability to emulate the mechanisms of genetic inheritance and natural selection, thereby enabling the generation of novel solutions that are potentially more effective and robust.

Genetic algorithms are adaptive search methods grounded in the principles of biological evolution. Their primary function is to operate on a population of candidate solutions and to generate new solutions through the application of operators such as selection, mutation, and crossover.

Genetic programming, as a specific class of evolutionary methods, has proven to be an effective tool for solving practically significant optimization problems. A distinctive feature of this approach lies in its ability to automatically synthesize program structures, which makes it particularly promising for the development of complex interface solutions.

Evolutionary methods are generally understood as a class of computational algorithms that work with a population of potential solutions and iteratively transform it using specialized operators (selection, mutation, and crossover) in order to identify a global or near-optimal solution. The most widely recognized evolutionary methods include:

- genetic algorithms (GA);
- genetic programming (GP);
- evolutionary strategies (ES);
- evolutionary programming (EP);
- particle swarm optimization (PSO), among others.

These methods possess a universal character and can be applied to problems of optimization, modeling, forecasting, classification, and automated design.

Within the framework of evolutionary algorithms, the search for new solution variants is carried out using local search technologies. The most common types include:

- one-dimensional search methods (passive and sequential approaches),
- numerical methods,
- static optimization methods.

Each of these approaches has its own specific area of application and is distinguished by the characteristics of the optimization process it supports. In the context of web interface development, the combined use of one-dimensional search methods with tree-structured data representations is considered the most effective.

Evolutionary methods in web interface development. Information systems based on evolutionary methods make it possible to automate the process of finding solutions to problems related to user interface optimization. Web programming is a domain in which page design is determined by the arrangement of elements and the logic of their interaction, making it a suitable object for the application of evolutionary approaches.

Genetic algorithms are capable of generating a large number of alternative interface solutions and selecting those that best satisfy predefined quality criteria.

One of the most promising directions involves representing HTML code in the form of a tree-structured chromosome. This idea was initially proposed by Ye. A. Kolchugina and K. V. Zavarovskiy. The tree-based structure enables genetic operators to efficiently modify interface elements and generate new variants of web design.

Such an approach creates opportunities for the partial automation of web interface design, reduces the workload of designers, and provides new tools for generating non-standard and innovative solutions.

Research indicates that genetic programming can be applied as a tool for creating prototypes of web applications. By performing successive transformations on interface code, evolutionary

algorithms generate new layouts that can serve as a starting point in the development of information systems.

Although this field is relatively new, evolutionary prototyping in web design demonstrates significant potential and represents a promising direction for further scientific research.

Conclusion

An analysis of existing studies indicates that the application of evolutionary methods in web interface development constitutes a relevant and promising research direction. The use of genetic programming for optimizing interface structures enables the generation of a wide range of novel solutions, expands the possibilities of user system design, and facilitates the automation of prototyping processes.

Building on previous research, this study proposes the development of a conceptual model of an information system based on evolutionary algorithms that is capable of generating multiple web layout variants. The implementation of such an approach would significantly enhance the capabilities of web development and contribute to the automation of interface design processes.

References

1. Holland, J. H. Building Blocks, Cohort Genetic Algorithms, and Hyperplane-Defined Functions / J. H. Holland // Evolutionary Computations. – 2000. – Vol. 8 (4). – P. 373–391.

2. Панченко, Т. В. Генетические алгоритмы: учебно-методическое пособие / Т. В. Панченко, под ред. Ю. Ю. Тарасевича. – Астрахань: Издательский дом «Астраханский университет», 2007. – 6 с.

3. Пискулин, Д. Е. Применение интерактивного генетического алгоритма для поиска оптимального дизайна web-сайтов на основе CSS / // Молодой ученый. — 2020. — № 11 (301). — С. 24-29.

4. Саяпин, О. В., Тиханычев, О. В., Чискидов, С. В., Быстракова И. А. Разработка интерфейсов прикладных программ: макетирование или прототипирование / О. В. Саяпин // Прикладная информатика. — №1(85), 2020. — С. 49–56.

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