



Education and Economy in the Digital Age

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EDUCATION AND ECONOMY IN THE DIGITAL AGE

Monograph

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and Aleksander Ostenda*

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2.11. FEATURES OF USING ARTIFICIAL INTELLIGENCE TO ENHANCE THE QUALIFICATIONS OF WEB DEVELOPERS

Currently, large language models (LLMs) play a pivotal role in the development of artificial intelligence (AI), possessing the ability to generate text indistinguishable from human writing (Blank, 2024).

These models, such as GPT-4, are built on deep learning and neural networks and are trained using massive datasets. They exhibit a high capacity for contextual understanding and text generation across various subjects. High-quality AI algorithms require extensive data for training. For instance, the GPT-4 dataset was developed using 13 trillion tokens, comprising both textual data and code samples.

The application of large language models offers broad possibilities, particularly in automating text processing, translation, content creation, and analyzing large volumes of information. However, alongside these advantages, challenges arise concerning ethics, data privacy, and potential biases within the models (Naveeda, 2024).

The advancement of AI and large language models opens new avenues for research and the implementation of innovative solutions, necessitating further study and analysis to ensure their effective and safe use (Zeve, 2024).

The authors have explored how artificial intelligence can significantly optimize the recruitment process in IT companies, specifically by automating the analysis of resumes and candidate selection.

Machine learning algorithms can swiftly process large volumes of data, identifying key skills and experience required for specific programming positions. This reduces the burden on HR professionals and decreases the time spent searching for the ideal web developer candidate for an IT project.

For instance, GPT-4 can be utilized to develop and administer assessments for task evaluation. It can generate questions on various topics, analyze responses, and provide feedback. This ensures objective and standardized evaluation, which can be easily tailored to the specific needs of an IT company (Xu, 2024).

AI systems can individualize training programs for IT company employees by identifying their strengths and weaknesses.

Large language models (LLMs) assist in creating interactive learning materials and providing support in the form of virtual mentors. This contributes to the enhancement of IT personnel's qualifications and the development of their professional skills.

Artificial intelligence is capable of analyzing web developers' performance metrics, identifying trends and patterns that may go unnoticed in traditional analysis. This allows managers to respond promptly to issues and make informed decisions regarding the career advancement of web developers, including planning their career trajectories.

The application of artificial intelligence and large language models in IT personnel management offers significant opportunities to enhance the efficiency of HR departments, optimize the processes of evaluation, and develop programmers. These technologies not only facilitate the automation of routine tasks but also ensure more accurate and objective assessments, which are crucial for effective personnel management in modern IT companies.

LLMs can significantly simplify and accelerate routine tasks such as resume analysis, report preparation, and the creation of training materials. This allows HR professionals to focus on more strategic tasks.

LLMs provide standardized assessments of IT specialists' soft and hard skills, minimizing human bias and subjectivity. This promotes a fairer and more equitable selection and evaluation of personnel (Navarra, 2024).

Due to their ability to process large volumes of data, large language models (LLMs) can identify patterns and trends that enable more informed decisions regarding personnel management and career planning for employees.

They can create personalized training programs tailored to the specific needs and knowledge levels of web developers. This enhances the efficiency of training and supports their professional development.

LLMs hold significant potential for improving IT personnel management processes and assessing their soft and hard skills (Bhatnagar, 2024). However, it is essential to consider potential risks and limitations for their effective and ethical use.

Therefore, the value of using large language models lies in the automation of the evaluation processes for IT specialists' soft and hard skills, particularly for web developers. For instance, GPT-4 can be employed to automate the initial stages of technical interviews by posing questions to candidates and analyzing their responses. This reduces the workload on HR professionals and quickly filters out candidates who do not meet the basic requirements.

The large language model GPT-4 can generate standardized questions, ensuring a consistent level of difficulty for all potential candidates. This promotes objectivity in evaluation and helps avoid biases that may arise during manual interviews (Gartner, 2024).

GPT-4 is capable of analyzing candidates' responses to assess their technical competence and depth of knowledge.

The model can identify key terms and concepts used by candidates and compare them with the desired answers. GPT-4 can provide immediate feedback to candidates, highlighting their strengths and weaknesses. This allows candidates to gain valuable insights for further development and preparation for subsequent interview stages.

Moreover, GPT-4 can generate realistic scenarios and tasks that simulate typical work situations, helping to evaluate candidates' practical skills in the context of real-world challenges they may encounter on the job.

Despite GPT-4's advanced capabilities, the model may have limitations in understanding complex contexts and specific technical details, which could lead to inaccuracies in evaluation.

The use of GPT-4 for conducting interviews also raises ethical concerns, particularly regarding the confidentiality of candidates' data. It is therefore essential to ensure proper data protection and algorithm transparency. However, full automation of technical interviews remains impossible without human oversight. HR professionals must review evaluation results and make final decisions regarding candidates.

GPT-4 can significantly enhance the process of conducting technical interviews in the IT sector by ensuring automation, standardization, and objectivity in evaluations.

However, for the effective use of this technology, it is crucial to consider potential limitations and risks, ensuring proper human oversight and adherence to ethical standards.

A critical aspect in developing solutions for the automated assessment of web developers' knowledge, skills, and abilities is the proper formulation of prompts.

Effective prompt management ensures objectivity and speed in evaluations within Learning Management Systems (LMS). Clearly articulated and structured prompts minimize the potential for bias and create equal conditions for all candidates. This is particularly important for making well-informed decisions regarding hiring or employee development.

The use of automated systems based on GPT-4 allows for the rapid processing of large volumes of data and the delivery of real-time results.

Properly formulated prompts facilitate the accurate assessment of candidates' knowledge and skills. Well-crafted questions and tasks enable a deeper understanding of the candidates' level of technical competence and coding creativity. This ensures a more detailed and justified analysis when evaluating the soft and hard skills of web developers.

Clear and structured prompts can motivate employees to develop their knowledge and skills.

Receiving feedback based on evaluation results helps identify areas that need improvement and fosters professional growth.

Proper prompt management enables the creation of tasks that accurately reflect business requirements and the specifics of a given position. This ensures that the competencies being

assessed align with the actual needs of the company, which contributes to the successful fulfillment of functional duties.

Effective prompt management allows for the easy adaptation of evaluation processes to changes in the business environment and technological landscape. This provides flexibility and scalability in the evaluation system, enabling quick responses to new challenges and demands.

Proper prompt management is critically important for ensuring objective, efficient, and accurate assessment of web developers' knowledge, skills, and abilities. A well-considered approach to formulating and managing prompts supports the successful achievement of business goals, personnel development, and the overall effectiveness of HR processes.

Prompt management for evaluating web developers begins with clearly defining the assessment goals. These goals may focus on evaluating the level of soft and hard skills, problem-solving abilities, or understanding of modern technologies. Defining specific goals enables the creation of effective prompts for assessment.

Effective prompts have a clear structure that includes understandable instructions, specific tasks, and evaluation criteria.

It is crucial that the tasks are realistic and correspond to actual work scenarios. This approach allows for the assessment of not only knowledge but also the ability to apply it in practice.

For a comprehensive evaluation of web developers' knowledge and skills, it is advisable to use various types of tasks, including theoretical questions, practical exercises, code reviews, and project work. This approach helps assess a wide range of competencies, from understanding fundamentals to implementing complex projects.

Prompts should be adaptive and take into account the candidates' level of preparation and specialization. This ensures a personalized approach to each candidate and allows for a more accurate assessment of their strengths and weaknesses.

When developing and using prompts, it is essential to consider ethical aspects such as candidates' data confidentiality, transparency of the evaluation process, and the avoidance of bias. This ensures fairness and trust in the evaluation results.

Prompt management is a key element in the process of evaluating the knowledge, skills, and abilities of web developers. Well-designed and implemented prompts contribute to objective and comprehensive candidate assessment, enhancing the efficiency and accuracy of selection and development processes.

For training GPT-4 in the context of evaluating web developers, it is critically important to select high-quality data. This process is illustrated in Figure 1.

All these data should encompass a wide range of questions and answers covering various aspects of web development, including frontend, backend, databases, cybersecurity, and modern information technologies. The volume of content ensures the effectiveness of training, while the quality of the data directly impacts the accuracy and relevance of the evaluation results.

The training data for GPT-4 is sourced from diverse origins such as technical documentation, educational materials, developer forums, and code repositories. The training content must be clearly structured and formatted. This provides the model with a broad context and allows it to better understand the different approaches and methodologies used in web development.

It is crucial to ensure the anonymization of data to protect developers' privacy. The data should be cleansed of personal information and metadata that could identify the authors. Adhering to ethical standards in data collection and usage is key to maintaining trust in the evaluation system.

The use of standard formats and tagging enables the model to better comprehend and process information. This includes the proper annotation of code snippets, explanations, and usage examples.

To ensure the relevance of the evaluation, up-to-date data reflecting the latest technologies and practices in web development is used.

Systematic updates of the data enable the model to adapt to new trends and meet the evolving demands of the IT industry.

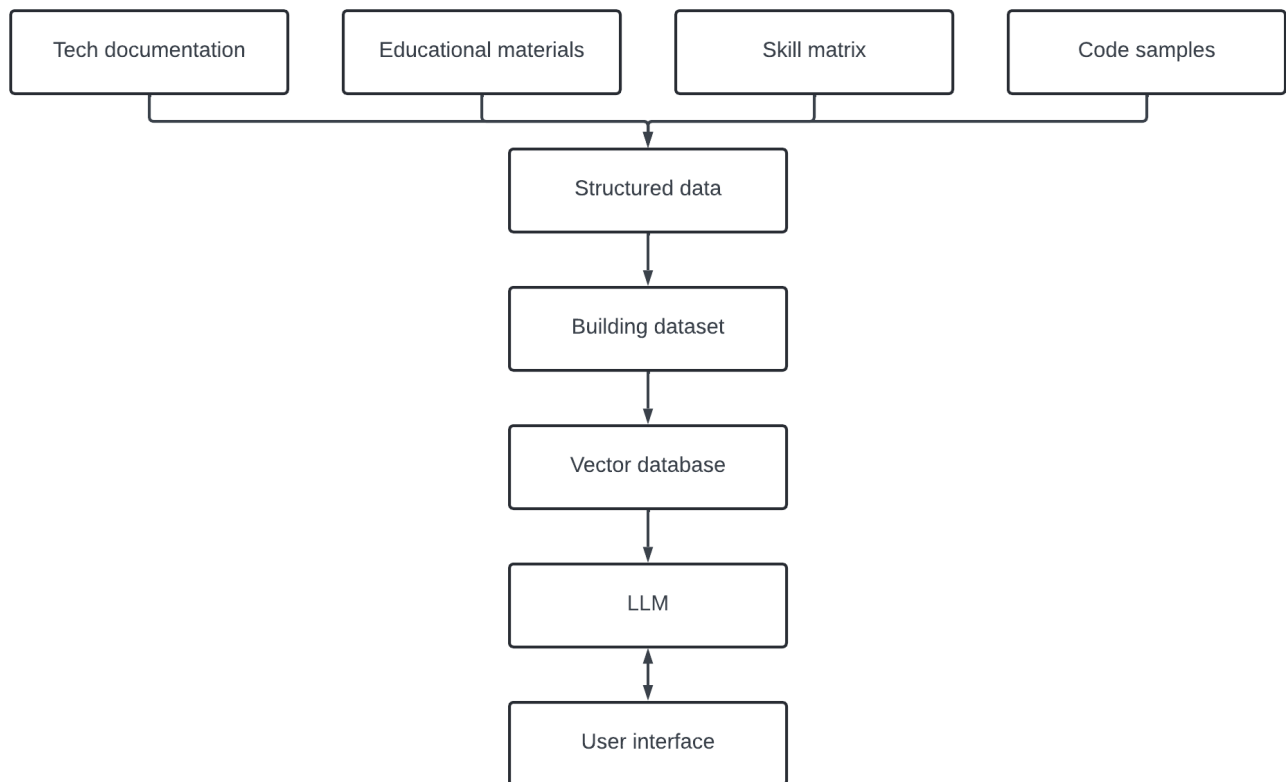


Fig. 1. The Structure of Dataset Formation in an LMS System

Before implementing GPT-4 for assessing the knowledge and skills of web developers in an IT company, the model was carefully validated and tested. This process included conducting test assessments and analyzing the results to identify potential errors and inaccuracies. Validation ensured the high accuracy and reliability of the evaluations.

The use of data for training GPT-4 in the context of evaluating web developers required careful selection and structuring of the training content. Ensuring quality, diversity, relevance, and ethical standards when handling the data contributes to the accurate and objective assessment of both soft and hard skills, which is critically important for the successful application of this technology.

The authors implemented the integration of the large language model GPT-4 as a key component of an intelligent information system for training and evaluating the soft and hard skills of web developers. This integration has created an effective tool for automating the evaluation processes and providing feedback, as illustrated in Figure 2.

The system consists of several key modules: the prompt generation module, the response analysis module, the feedback provision module, and the learning materials management module. GPT-4 has been integrated into both the prompt generation and response analysis modules, enabling the automation of these processes.

Using GPT-4, a mechanism for generating prompts covering various aspects of web development has been developed. The model generates questions and tasks that take into account the level of difficulty and the specific competencies being assessed, aligned with the rank and job descriptions of IT personnel. This allows for the creation of personalized tests for each candidate applying for a position or for an employee recommended for skill enhancement and rank advancement.

GPT-4 is employed for the automatic analysis of responses to the generated questions. The model is capable of recognizing key terms, assessing the correctness and completeness of the answers, and identifying errors. This ensures objective and accurate evaluation of the knowledge and skills of web developers.

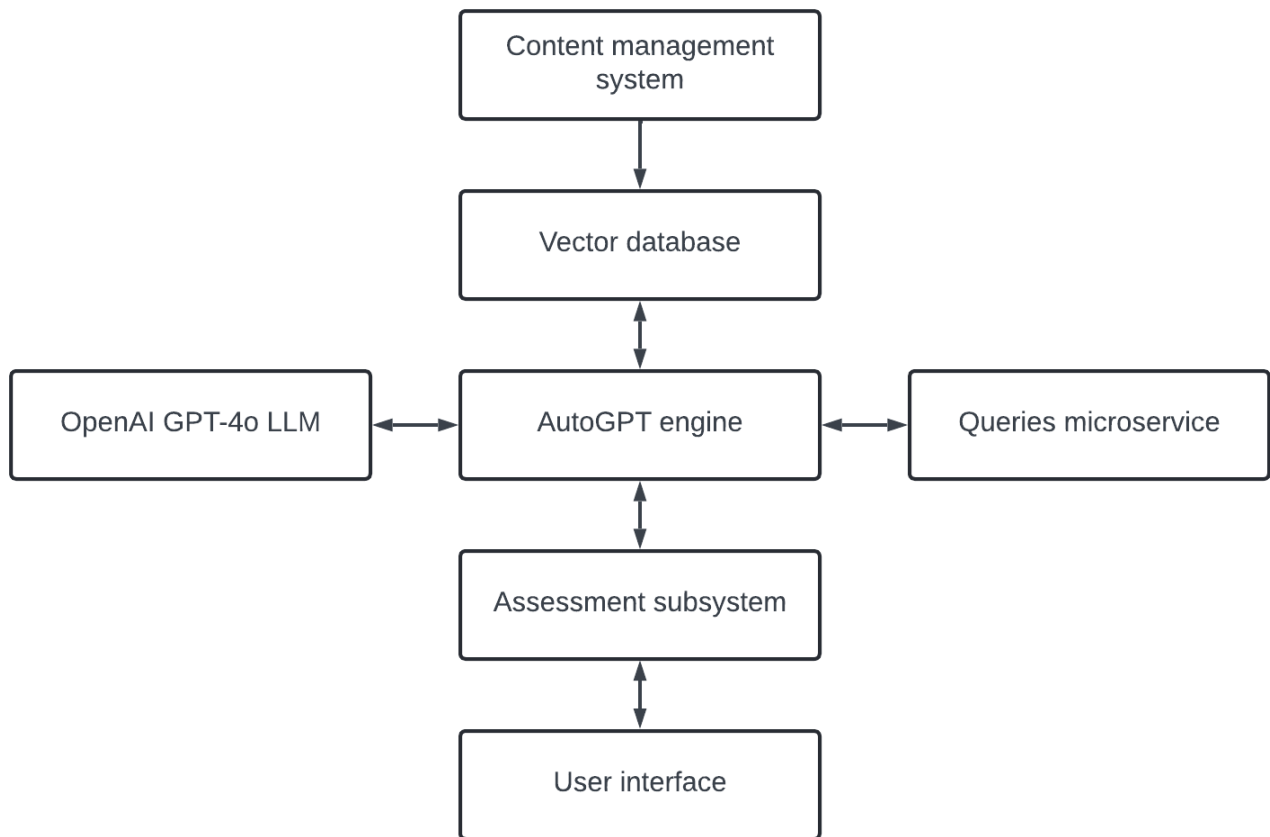


Fig. 2. System-Level Architecture of the LMS System

The intelligent system based on GPT-4 provides detailed feedback, including comments on the strengths and weaknesses of the responses, recommendations for improvement, and additional learning resources. This feedback facilitates the professional development and skill enhancement of web developers.

The system effectively manages learning materials by automatically updating them in line with the latest technologies and practices in web development. GPT-4 aids in creating new educational courses and adapting existing ones to meet the users' needs.

It has been found that the integration of GPT-4 into the intelligent information system significantly enhanced the efficiency of training and assessment processes. Testing of the system demonstrated high accuracy and objectivity in evaluations, as well as a positive impact on the motivation and development of web developers.

The integration of the large language model GPT-4 as part of the intelligent information system for training and evaluating web developers has shown significant potential for improving the efficiency and accuracy of these processes. This approach facilitates the creation of adaptive and personalized solutions for skill enhancement and career advancement of web developers.

The use of large language models like GPT-4 in the processes of training and evaluating soft and hard skills allows for the optimization of routine tasks by providing standardized and objective assessments.

These models automate many aspects of learning and evaluation, including task generation, response analysis, and feedback provision. This automation enables instructors and evaluators to focus on more strategic tasks, such as the individual development of candidates.

GPT-4 models ensure the objectivity of evaluations by reducing the influence of human factors and potential biases.

This contributes to the fairness and transparency of selection and training processes, which is critically important for providing equal opportunities for all candidates.

GPT-4 is capable of assisting in the updating and creation of modern educational materials that align with the latest trends and industry demands. This ensures the relevance of knowledge and the preparation of professionals who possess the necessary competencies to work in today's technological environment.

The further development of large language models and their integration into educational systems opens up prospects for the creation of intelligent learning environments that support continuous learning and development for higher education students, novice programmers, and professional web developers in IT companies. The use of AI to analyze large volumes of data allows for the optimization of skill enhancement processes for web developers within IT companies and suggests pathways for their professional development and career advancement.

The use of large language models in the training and assessment of soft and hard skills is an important step toward increasing the efficiency and quality of educational processes. This approach promotes the objectivity of assessments, adaptability of learning programs, and relevance of knowledge, ultimately ensuring the preparation of highly qualified web developers.

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2.10. Leonid Taraniuk, Renata Korsakiene, Karina Taraniuk. RESEARCH OF MARKETING INNOVATIONS OF COUNTRIES IN THE CONTEXT OF THE IMPLEMENTATION OF THE SUSTAINABLE DEVELOPMENT GOALS

The main objective of the research is to assess the marketing of innovations by business entities in various countries in the context of implementing the Sustainable Development Goals. In this scientific study, a bibliometric analysis of scholarly works on the marketing of innovations by companies within the sustainable business system was conducted. The study highlighted the key positive and negative factors that influence the effectiveness of marketing activities for innovative products within the sustainable business framework. An analysis of the competitiveness of the components of innovation marketing in countries with developed and developing economic systems was carried out to identify the leaders and laggards. Ranges of the integral indicator of the competitiveness level of the innovation marketing components in different countries under the conditions of achieving the Sustainable Development Goals were established.

2.11. Valentyna Yuskovych-Zhukovska, Oleg Bogut. FEATURES OF USING ARTIFICIAL INTELLIGENCE TO ENHANCE THE QUALIFICATIONS OF WEB DEVELOPERS

The modern development of artificial intelligence (AI) demonstrates significant potential across virtually all areas of human activity. It is anticipated that shortly, AI will automate and surpass human cognitive abilities, potentially replacing certain job positions. Already today, AI can compete with human decision-making processes. In IT companies, AI functions assist in enhancing the qualifications of web developers by evaluating their soft and hard skills. Future programmers, specifically those pursuing the first (bachelor's) level of higher education, have the opportunity to rapidly master the process of developing and testing websites and web applications with the help of an intelligent system developed by the authors. Professional web developers can also use this system to enhance their qualifications and advance to a new, higher level.