

UDK 004.738.5

## A STUDY OF SOFTWARE DEVELOPMENT TOOLS THAT ARE REQUIRED IN THE JOB MARKET IN UKRAINE AND THE WORLD

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## ВИЯВЛЕННЯ ЗАТРЕБУВАНИХ НА РИНКУ ПРАЦІ ІНСТРУМЕНТІВ РОЗРОБКИ ПРОГРАМНОГО ЗАБЕЗПЕЧЕННЯ В УКРАЇНІ ТА СВІТІ

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## ВЫЯВЛЕНИЕ ВОСТРЕБОВАННЫХ НА РЫНКЕ ТРУДА ИНСТРУМЕНТОВ РАЗРАБОТКИ ПРОГРАММНОГО ОБЕСПЕЧЕНИЯ В УКРАИНЕ И МИРЕ

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**Abstract.** The article investigates the direction of modern web and software development. The works of domestic and foreign scientists devoted to the study of prospective directions of IT development are analyzed. It is revealed that the existing IT ratings detect global trends, but almost never highlight the specifics of the Ukrainian job market. That is why, as well as taking into account that the reviews of IT trends are rapidly becoming obsolete, the authors of the article set the goal to analyze the actual trends of network and software development in Ukraine and the world. Analysis of indices that was done by well-known consulting and IT companies (PYPL, TIOBE, GitHub and StackOverflow) has allowed the identification of the trends that will have the most significant impact on the IT industry in the future. Such trends include the use of cloud technologies, the use of large data, the introduction of visual and voice search services, the widespread use of artificial intelligence (AI) technologies and Internet of Things (IoT) technology. As a result of the monitoring of the modern job market, the authors of the article, taking into account the data obtained by other researchers, created a rating of used and demanded programming languages in Ukraine and worldwide. It has been found that JavaScript, Java, Python, C# and C++ are the most popular languages in the world today. Some differences between the tendencies in the use of programming languages in Ukraine and other countries are found. Thus, in Ukraine, development of web applications is more popular and in demand compared to the Western countries. That is why Ukrainian developers prefer JavaScript and PHP. At the same time, developers in other countries often use Java and Python programming languages. The most popular front-end frameworks for JavaScript are AngularJS, Node.js and React. These tools will be relevant in the nearest future.

**Key words:** software, IT trends, programming languages, JavaScript, Python, PHP, framework, job market.

**Анотація.** У статті досліджуються напрями розвитку сучасних веб-технологій і програмного забезпечення. Проаналізовано роботи вітчизняних та зарубіжних науковців, присвячених вивченню перспективних напрямів розвитку ІТ. З'ясовано, що наявні рейтинги у сфері ІТ виявляють загальносвітові тренди, але майже не висвітлюють специфіку українського ринку праці. Саме тому, а також зважаючи на те, що огляди трендів у сфері ІТ швидко стають застарілими, автори статті поставили мету провести аналіз актуальних трендів мережевого та програмного забезпечення в Україні та світі. Аналіз індексів, зроблених відомими консалтинговими та ІТ компаніями (PYPL, TIOBE, GitHub і StackOverflow), дозволяє визначити тенденції, які чинитимуть найбільш істотний вплив на ІТ-

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in the job market in Ukraine and the world**

галузь у майбутньому. Такими трендами є застосування хмарних технологій, використання великих даних, впровадження сервісів візуального та голосового пошуку, повсюдне поширення технологій штучного інтелекту (AI) та технологій інтернету речей (IoT). В результаті моніторингу сучасного ринку праці авторами статті, враховуючи результати, отримані іншими дослідниками, було створено рейтинг використовуваних і затребуваних у найближчому майбутньому мов програмування в Україні та в усьому світі. Виявлено, що найбільш популярними мовами у світі нині є JavaScript, Java, Python, C# та C++. З'ясовано певні відмінності між трендами у використанні мов програмування в Україні та в інших країнах. Так, в Україні, порівняно із західними країнами, більш популярний і затребуваний розвиток веб-додатків. Саме тому українські розробники надають перевагу мовам JavaScript та PHP. У той самий час розробники в інших країнах здебільшого використовують мови програмування Java та Python. Найбільш затребуваними фреймворками JavaScript нині є AngularJS, Node.js і React. Саме ці інформаційні технології та засоби розробки програмного забезпечення будуть актуальними в майбутньому.

**Ключові слова:** програмне забезпечення, IT тренди, мови програмування, JavaScript, Python, PHP, фреймворк, ринок праці.

**Анотація.** В статье исследуются направления развития современных веб-технологий и программного обеспечения. Анализируются популярные запросы клиентов относительно программного обеспечения, рейтинг языков программирования и фреймворков. Установлено, что наиболее востребованы задачи связаны с машинным обучением и облачными технологиями. В результате мониторинга современного рынка труда авторами статьи, учитывая индексы, представленные известными IT компаниями (PYPL, TIOBE, GitHub и StackOverflow), и результаты, полученные другими исследователями, был создан рейтинг используемых и востребованных в ближайшем будущем языков программирования. Выявлено, что наиболее популярными языками являются JavaScript, Java, Python, C# и C++. Изучены различия между трендами в использовании языков программирования в Украине и в других странах. В Украине по сравнению с западными странами более популярно развитие веб-приложений. Поэтому украинские разработчики предпочитают использовать JavaScript и PHP. В то же время разработчики в других странах в основном используют Java и Python. Наиболее востребованными фреймворками JavaScript являются AngularJS, Node.js и React.

**Ключевые слова:** программное обеспечение, IT тренды, языки программирования, JavaScript, Python, PHP, фреймворк, рынок труда.

Any technology can become popular or fade away in no time. That is why people should always be on the lookout for new opportunities that can benefit business in the future. The problem of analyzing the perspectives for development of information technology (IT) is relevant. It is of particular importance for educational institutions specializing in computer and software engineering, computer science etc.

Ukrainian and foreign experts pay attention to the study of promising areas of IT development. For instance, economists T. Costunets and M. Zykova studied the prospects of its development in enterprise management [1]; O. Eliseeva and V. Belozertsev systematized modern information systems and technologies used in accounting processes [2]; L. Dovgan and A. Kozinets studied the status and problems of development of the IT-sphere in Ukraine [3]; M. Vereskun, O. Guseva and D. Lyashov investigated the tendencies of development of modern IT and their influence on the development of the theory and practice of enterprise management [4]. Programmers Daniel P. Delorey, Charles D. Knutson, and C. Giraud-Carrier studied the trends of programming languages in the development of open source [5]; Jayson DeMers considered the modern technological IT trends [6]; Andrei Neagoie studied technological trends for training [7]; E. Michael Maximilien and Pedro Campos investigated trends and challenges in the modern software development [8].

Monitoring the popularity rating of programming languages is important. Therefore, some companies regularly analyze it and publish the obtained indices. TIOBE Software (The Importance of Being Earnest) specializes in assessing and tracking the quality of software, monthly calculates the index of popularity of programming languages and identifies trends [9]. Another well-known index is PYPL (PopularitY of Programming Language) from developer Pierre Carbonnelle [10]. It represents the popularity index of programming languages and shows the tendency to increase or decrease the popularity of each position, as well as the top 10 IDE (Integrated Development

Environment), top 10 ODE (Open Dynamics Engine) and top 10 databases. The index is created by analyzing how often language tutorials are searched on Google.

IEEE Spectrum journal annually publishes the rating of programming languages [11]. The analysis of the popularity of technologies and programming languages is also published on the websites stackoverflow.com [12] and github.com [13]. Swedish developer Stefan Nielson investigated the structure of requests on the job site for technical specialists www.dice.com for the last 18 years and published obtained results in March 2018 [14].

All listed ratings cover the whole world and do not analyze the specifics of the Ukrainian job market. Reviews of trends in the IT sphere are rapidly becoming obsolete. Therefore, it is necessary to analyze the current web and software development trends in Ukraine as well as in the world.

Information about actual, requested software tools used in the software development world is very important, first of all, for IT specialists, since it has become necessary to coordinate the work of software modules in projects and projects among themselves. For universities that train IT professionals, it is equally important to track trends in employers' requirements for software developers. At the same time, the emphasis should be placed precisely on the requirements of the IT job market in Ukraine in order to provide qualified IT specialists for domestic enterprises and reduce the labor drain from the country.

**The goal of the article** is to investigate the top web and software development trends for people and businesses and to analyze the most popular programming languages in Ukraine and worldwide. The research is based on the listed above popularity indexes, on the Ukrainian and world job market sites and on interviews with developers from the leading Ukrainian software companies.

The finance industry tends to use big data, machine learning, and data science (data collection, visualization, analysis, and reporting) to run the processes automatically, without involving a developer and an administrator. It is becoming more and more important to have a system that can change its behavior for each user depending on his/her preferences, create new rules and behaviors based on the processed data, visualize statistics and provide reports in a convenient form.

There are several fields where machine learning is used in the fintech industry:

- Marketing, support, and sales needs. Customization and personalization in marketing, customer care and sales are the biggest trends currently. Machine learning can easily solve these tasks as it allows showing certain content to certain groups of people on every stage of the marketing funnel, setting up lead scoring, cross-sell and up-sell strategies based on user's behavior, analyzing and improving customer experience on the website, and so on.

- Risk scoring and security. AI allows detecting and preventing of fraudulent transactions.

- Credit scoring. Banks tend to use statistical methods and AI-based scoring models to determine the likelihood that a credit applicant will default on a loan.

The Table 1 contains the trends in marketing [15]. Top three positions, which total 75%, are all AI applications.

Developers say that fintech partners often request solutions that can be deployed in the “clouds” without downloading software on a physical computer. The user can access this app through their browser. In this case, clients do not need to buy expensive servers; it is possible to get data access from any device, which gives more freedom. Cloud-based providers offer automatic system upgrades, quick data recovery and reliable security.

Table 1 – The trends in marketing

| Trends                       | Popularity, % |
|------------------------------|---------------|
| Consumer Personalization     | 28,66         |
| Artificial Intelligence (AI) | 25,69         |

| Trends  | Popularity, % |
|---|---------------|
| Voice Search                                    | 21,23         |
| Mobile Optimization                             | 10,40         |
| IoT (Internet of Things) Marketing Applications | 3,61          |
| Blockchain                                      | 3,40          |
| VR  | 2,76          |
| FBM   | 2,34          |
| Other   | 1,91          |

Software customers' tasks and requests determine the trends in means for their implementation. **JavaScript** remains popular now. Being used by over eighty percent of developers and almost ninety-five percent of all websites for dynamic logic on respective pages. Various JavaScript interface frameworks, such as React and AngularJS, are important as IoT and mobile devices are becoming widespread. **Java** is one of the most popular programming languages. All Android apps work on Java and many companies use Java for backend development. C++ is used by big enterprises. **Python** is a regular purpose programming language for web development and generally used by developers. **C#** is greatly used in the video game development. PHP happens to be a scripting language used on server side and has improved its ranking. Most developers make use of PHP for web development [16].

We compared programming language ratings according to the PYPL, TIOBE, GitHub and StackOverflow indices (sorted on TIOBE index). The results of this comparison are shown in Fig. 1. SQL is not represented in the chart because two of the four indices do not have data on it. Significant difference in the popularity of languages is due to difference in approaches to defining indices, but there is no doubt that the leaders are JavaScript, Java and Python.

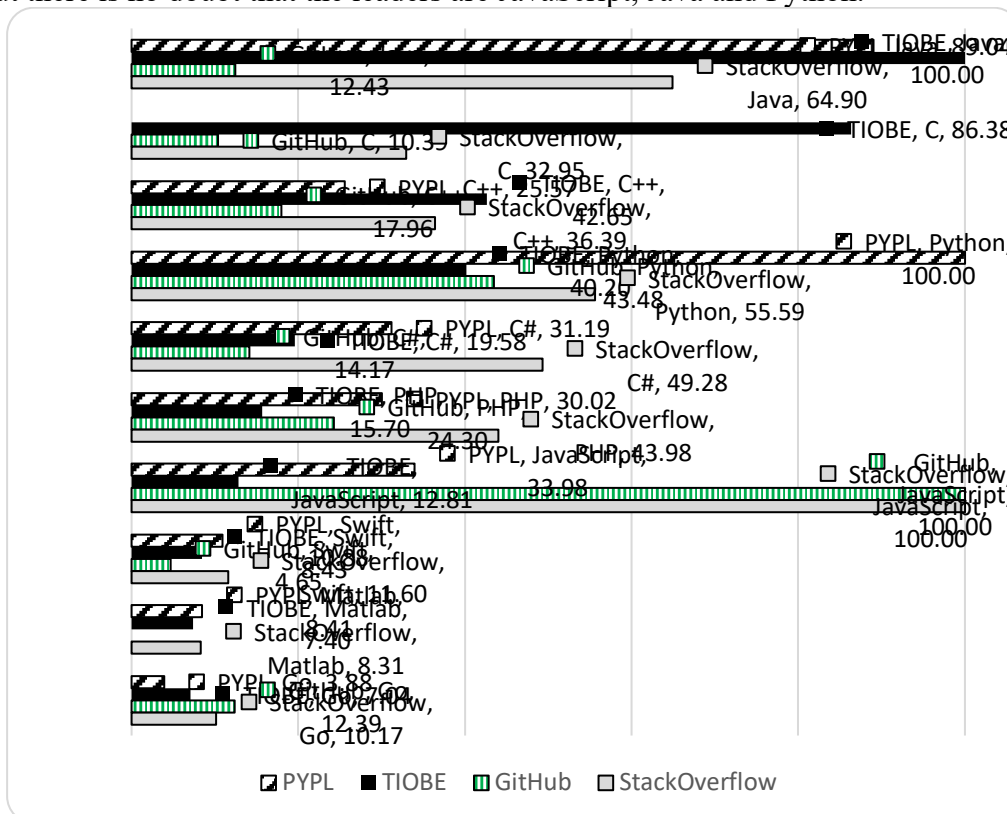


Figure 1 – Top 10 of programming languages

According to research [17], there is some difference in the trends of programming languages in Ukraine and other countries. The development of web applications in Ukraine is more popular, it is proven by the higher level of use of the JavaScript and PHP languages.

Our analysis of the job market in Ukraine (site rabota.ua) and results of similar researches

[14, 18] in other countries (based on sites dice.com, indeed.com) place the priorities of programming languages differently (Fig. 2). The chart demonstrates the distinction between domestic and foreign job markets.

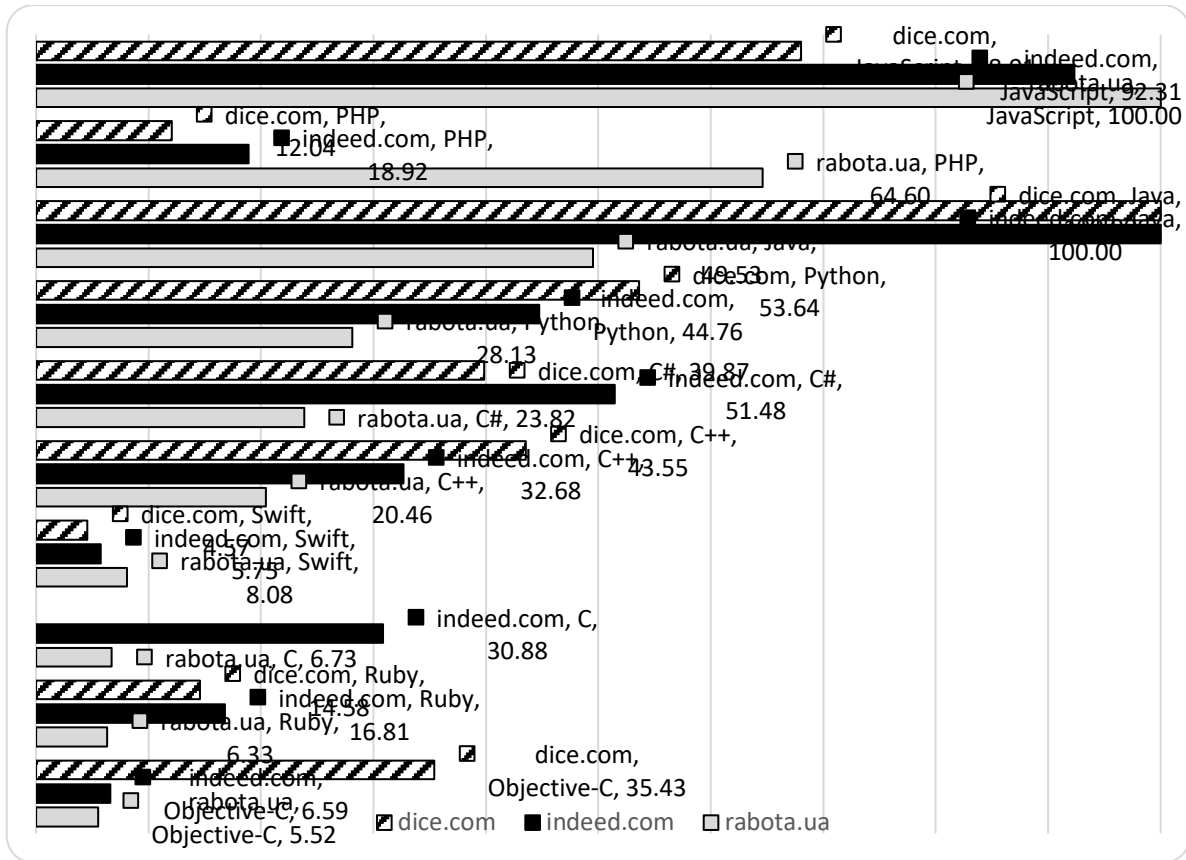


Figure 2 – Comparative rating of programming languages in the job market of Ukraine (according to the website rabota.ua) and other countries

The diagram in Fig. 2 does not contain data on SQL-based languages, although their popularity in Ukraine is higher than in other countries.

Libraries and frameworks are one of the intense competitiveness on front-end development [19]. Hackerrank.com published research in which its authors among other compared employers' need and developers' knowledge in JavaScript frameworks. It is shown that the needs of employers in AngularJS, Node.js and React frameworks are significantly higher than the knowledge and capabilities of developers. React has the biggest gap between what developers know and what employers want [20]. This is a signal that in the near future, the attention of students who plan to be engaged in web programming should be attracted to the study of these frameworks.

Based on the job market in Ukraine (site rabota.ua) and in other countries (site dice.com), we analyzed the popularity of various JavaScript frameworks. The results of this analysis, as well as the rating of the frameworks published on StackOverflow.com, are shown in Fig. 3. AngularJS and React are the undisputed leaders in Ukraine. Popular in the world Node.js framework takes 4th place in Ukraine after Django.

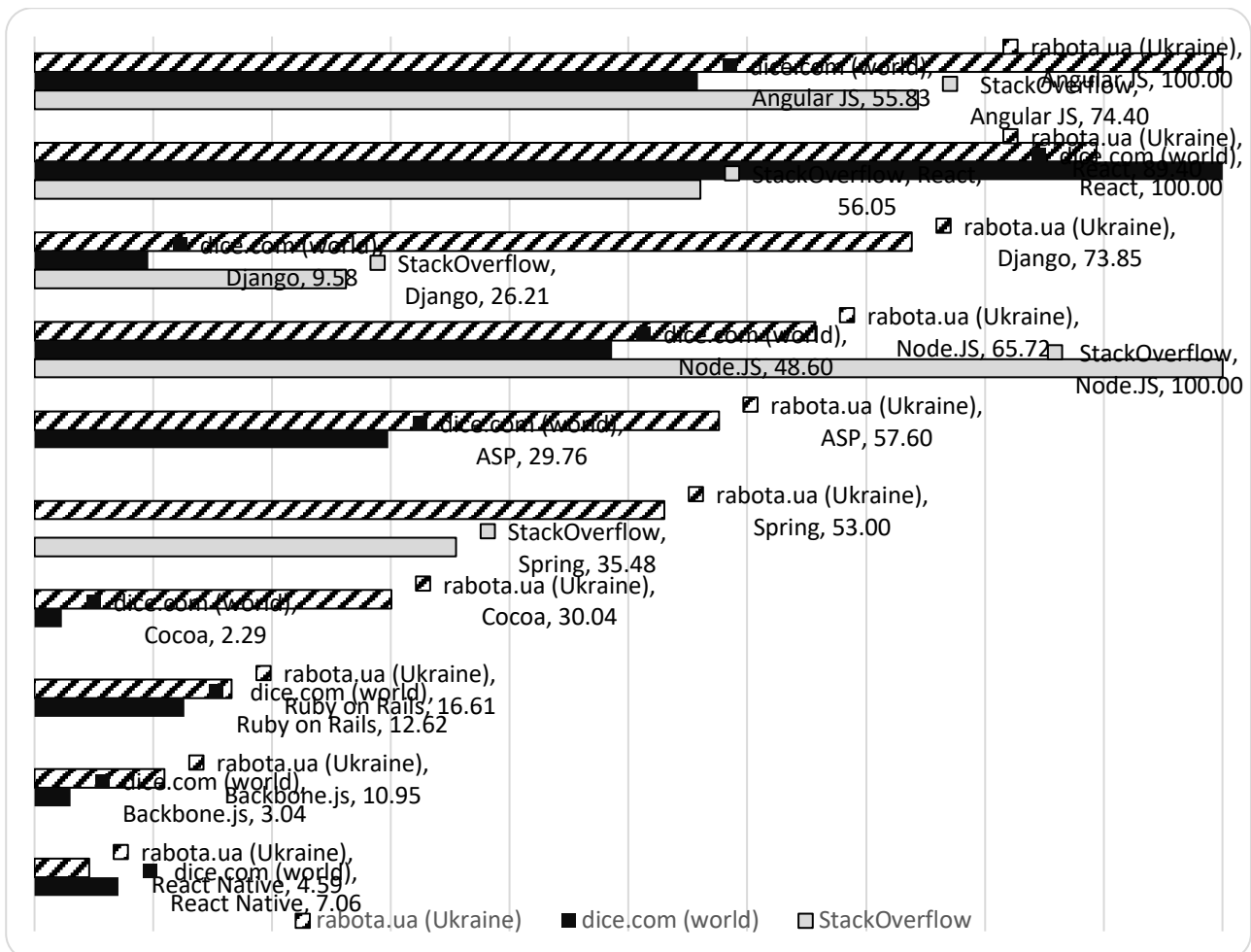


Figure 3 – Top 10 of the JavaScript frameworks based on the job market (sites rabota.ua in Ukraine and dice.com worldwide) and StackOverflow index

Today there is a great demand for information systems that can change their behavior for each user according to their preferences and create new rules and behavior based on processed data, visualize statistics and submit reports in a convenient form. Deploying cloud information systems allows customers to use software without downloading it to physical computers or spending on expensive servers and to have free access to software applications from any device (PC, tablet, phone) connected to the Internet. The top web and software development trends are machine learning and clouds technologies.

The analysis carried out in the work showed that the most popular programming languages in Ukraine and worldwide are JavaScript, Java, Python, PHP, C# and C++. JavaScript frameworks AngularJS, Node.js and React will be relevant in the nearest future. The results of the research in the domestic IT job market are correlated with the requirements of the IT job market in other countries of the world. At the same time, it was revealed that in Ukraine, IT specialists in the field of web applications development with knowledge of the corresponding software tools are more in demand.

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DOI 10.33243/2518-7139-2018-1-2-101-108