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RECURSIVE METHOD OF FORMING AN OPTIMAL SET OF TASKS ACCORDING TO THE CRITERION OF MAXIMIZING EARNINGS

Abstract. The work is devoted to the problem of a person's search in the current difficult times, when there is no work at all, or insufficient wages for normal living, the possibility of additional earnings. The analysis of the current state of the labor market and software systems with offers of vacant jobs showed that there are a sufficient number of such systems in general access and easy to use. One of their disadvantages is focusing only on vacancies that require full or partial employment (for example, the IT field) of a person. Such systems do not provide the possibility of hourly work, and then a person must independently search for offers on various advertising sites, in Telegram channels, Instagram, etc. Another and the most important problem is finding such additional income that would have the maximum impact on a person. The maximization criterion in this case for any person will be the maximum possible amount of earnings for a certain period of time. After all, each proposal has its own complexity and its own price, as well as the time of implementation. The object of research is the process of maximizing earnings. In view of the above-mentioned problems, it is proposed to develop a recursive method of forming an optimal set of tasks proposed for implementation, taking into account the criterion of maximizing earnings, which is **the subject of the research**. As a result of the implementation of this method, all tasks that will be in the time period specified by the user will be processed and added to the possible chains of tasks. The number of chains and tasks in them will depend on the "reachability" of a certain task for the user to implement, that is, whether the user will have time to physically reach the necessary place for its implementation. **Conclusion:** based on the results of working out this recursive method, prototypes of its implementation in practice with the formation of an optimal set of tasks and the laying of a route on Google-map are also illustrated.

Keywords: work; earnings; application; prototype; optimization problem; maximization criterion; recursive method; optimal set of tasks.

Introduction

Finding a job has always been and remains one of the most important tasks in the life of every person and, in turn, requires the involvement of a large amount of time and effort to obtain the desired result. In today's conditions, especially for Ukrainians who have not left their country, this task becomes even more important and difficult. The destruction of civil infrastructure, the destruction of cities led to the loss of jobs for thousands of citizens. Due to the continuation of military aggression, millions of people are forced to look for work outside their cities.

Currently, thanks to the rapid development of information technology, job search has become much easier and faster thanks to the use of Internet resources and mobile applications for job search. Such applications provide users with a convenient and effective tool for finding job vacancies based on various criteria, including location. For example, the application Job Search by ZipRecruiter [1], which is widely popular for job searching in the USA and Canada. One of the features of the application is filtering the search, for example, by job category, type of employment, salary level, as well as location. Another example of a job search application is Jooble [2], which works in many countries around the world, including in Ukraine. Jooble is a convenient and simple job search application that aggregates job vacancies from various sources such as employer websites, business directories and employment agencies. There is also a fairly powerful Ukrainian-made service for finding work and placing vacancies in the field of IT and other high-tech industries - DOU.ua [3]. With the help of this service, you can find work both in different industries and with different levels of experience and work format.

The service also provides useful advice on resume writing and interview preparation to improve candidates' chances.

In general, in Ukraine and the world today, there are a large number of job search applications - these are the ones mentioned above and LinkedIn, Indeed, Glassdoor, etc., but all of them offer jobs with permanent or long-term employment [4]. Services for finding temporary, so to speak, hourly part-time work either do not exist at all, or they are presented in an advertising format [5].

Statement for the task

Based on the results of the analysis of the current state of the labor market in Ukraine and the review of analogues of software job search systems, it was concluded that almost all existing services post offers of permanent earnings with a stable salary. Of course, this is not a disadvantage, but given the current situation in Ukraine, when demand outweighs supply, or the offered salary level is not sufficient for a normal standard of living, many people are looking for options for additional, so to speak, hourly earnings. However, in order to find such earnings, you need to spend a lot of time and it is not always effective to look at all sites with ads, certain groups in Telegram channels, ads in social chats, etc. And most importantly, you want to choose this type of income in order to maximize profit. Options for part-time work (hereinafter - tasks) can be different, for example, from walking a dog to a master of apartment repairs at certain hours, as well as the location of these tasks can be so far from each other that there will be no time to complete one task and have time for another .

Hence, the development of a method of forming an optimal set of tasks based on the criterion of maximizing earnings is relevant.

Main part

The process of forming an optimal set of tasks from a set of possible tasks belongs to the type of optimization tasks, because the main idea and, so to speak, its goal is to find the best result that will bring the maximum profit, which is one of the goals of optimization tasks. This process relates, in a certain way, to mathematical programming, because it solves the problem of determining the distribution of limited resources (such as distance, time) necessary to achieve the set goal.

With a multitude of possible solutions, a criterion for optimizing such a process must be selected. The optimization criterion is a quantitative or ordinal indicator that expresses the ultimate measure of the economic, scientific-technical or other effect of the adopted decision for the comparative evaluation of possible solutions (alternatives) and the selection of the best one [4, 5].

To form a set of tasks that will provide the maximum possible earnings, the maximization criterion in the following form is best suited:

$$S(t) \xrightarrow{[t_k]} \max, \quad (1)$$

usually called the goal function or the objective function, where $S(t)$ is the sum of funds received for a certain set of sequential tasks in time, $[t_k]$, $k = 1..K$ is the k -th set of tasks, t – is one task.

When modeling a computational process, it is assumed that certain parameters are set for each element of the model – task :

$$t_i = \{time, location, price\}, \quad (2)$$

where *time* – is the hour at which the task should begin to be performed; *location* – is the address at which the executor must arrive to perform the task; *price* – is the amount of funds that will be provided to the executor for the performance of the task.

The sum of each possible chain of tasks is calculated according to the following formula:

$$S_k(t) = \sum_{i=1}^k t_i(price). \quad (3)$$

To find the optimal set of tasks that will ensure maximum profit, a recursive method [7] was developed, the algorithm of which is represented by block diagrams (Fig. 1 and 2).

A graphical representation of the recursive method [8,9] of finding the optimal set of tasks based on the profit maximization criterion is presented in Fig. 3.

This diagram shows how the recursive method of finding the optimal set of tasks works. According to the figure, there are 8 positions available for a certain user to perform tasks selected in a certain time range (in this case, those whose start is in the range from 9 to 12 o'clock inclusive). In order for a task to be added to the chain of an optimal set of tasks, the user must "get to it" after completing the previous one.

In this case, the algorithm checks the "achievability of the task" - whether the user can get from point A to

point B. "Unachievability of the task" in Fig. 3 is represented in red. That is, the user is geographically too far from the proposed task to have time to implement it.

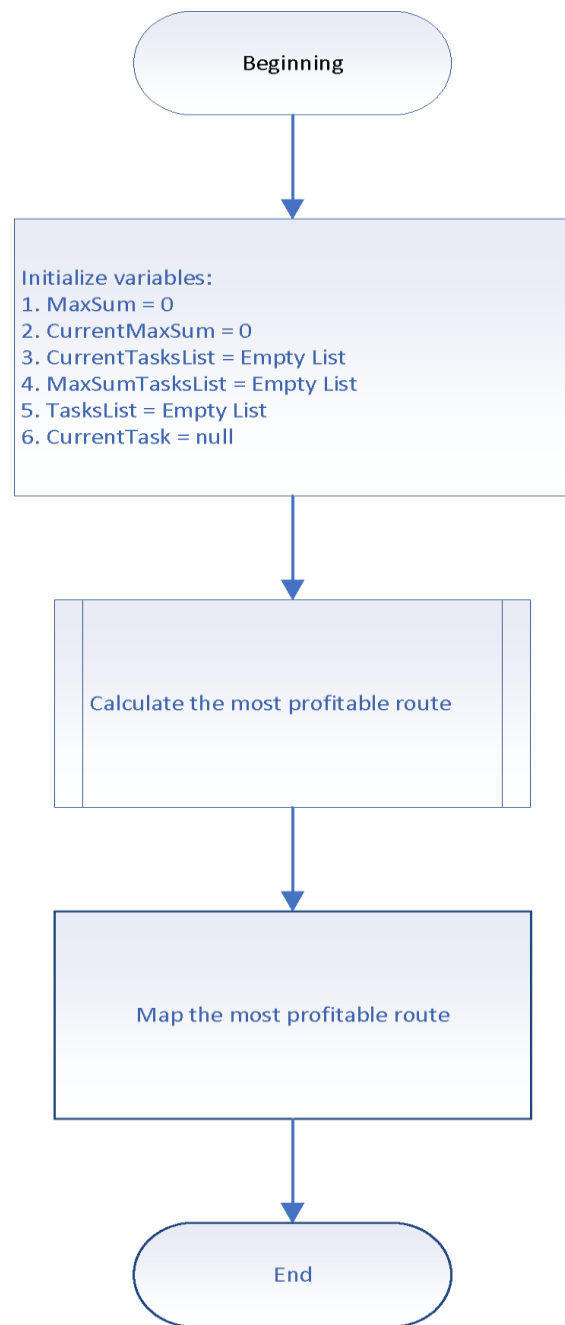


Fig. 1. Block diagram of the recursive method of finding the optimal set of tasks

Thus, during the execution of the recursive method of finding the optimal set of tasks based on the criterion of profit maximization, 8 possible sets of tasks (green chains) will be considered, which, as the algorithm is executed, will be compared with each other according to the indicator calculated according to formula (3), in order to ensure the objective function (1).

Fig. 4 shows a prototype of the implementation of the indicated method, in particular, a generated list of tasks for the user in the time range selected by him, and Fig. 5 shows a view of the map with a route along the list of tasks.

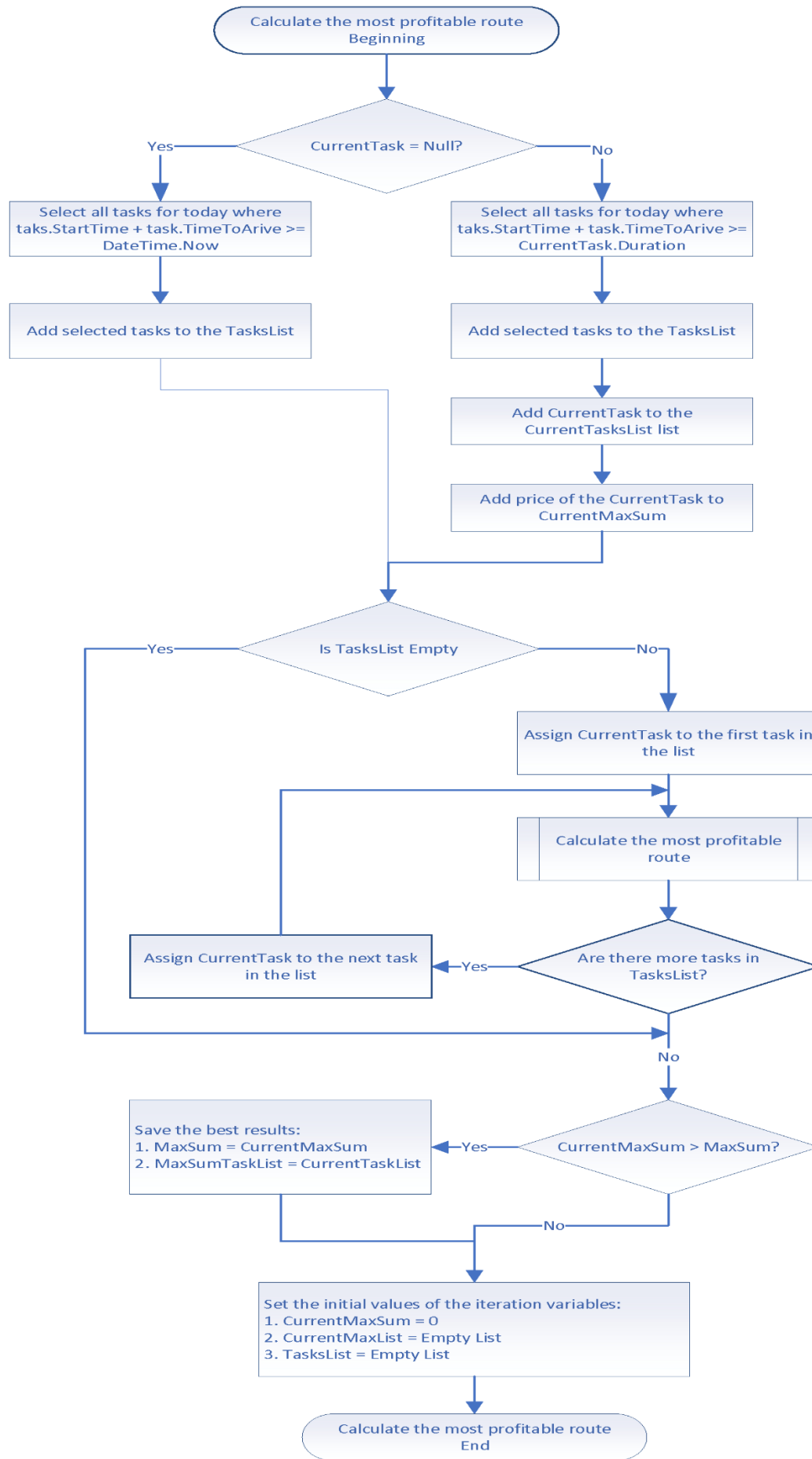


Fig. 2. Block diagram of the iteration of the recursive method

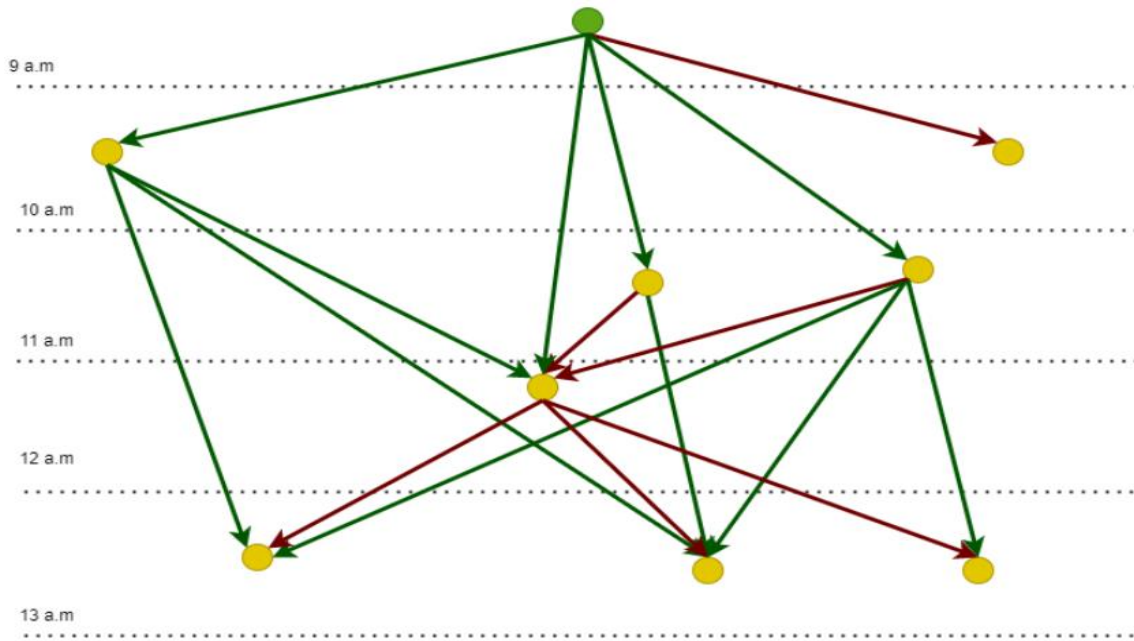


Fig. 3. Graphic representation of search routes for an optimal set of tasks

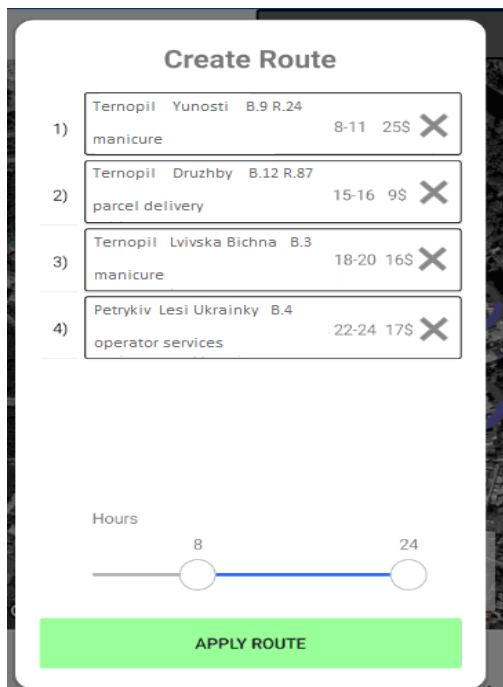


Fig. 4. Prototype of the formed list of tasks for the user

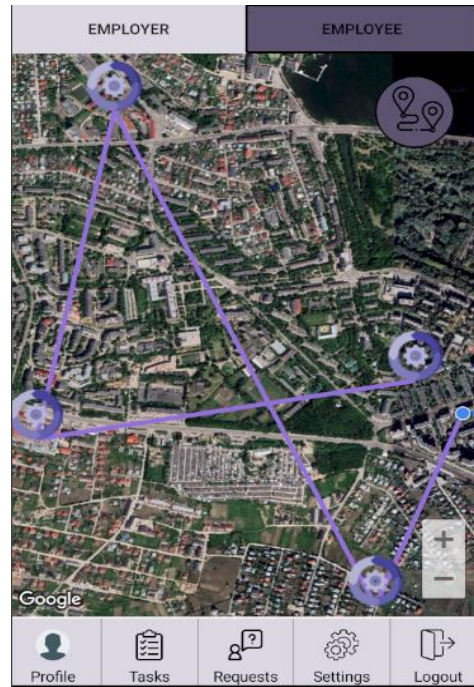


Fig. 5. Prototype window with route

Conclusions

The work explores an important issue for all adults, namely, finding a job for the possibility of a normal existence and support for oneself and one's relatives. It is outlined that at the moment most of the Internet resources are focused on job offers only for permanent employment and not very high salary levels.

Hence, the issue of finding additional hourly earnings is relevant. Also, in addition to finding offers of such earnings, it is necessary to analyze their "profitability"

for an individual user. Therefore, the optimization task of finding additional earnings based on the criterion of profit maximization was formed, because this is the main criterion for every user. To solve the optimization problem, a recursive method of forming an optimal set of tasks based on the criterion of maximizing earnings was developed.

Prototypes of the implementation of the proposed method are provided for practically obtaining a clear list of tasks for the time period selected by the user with maximum earnings for the selected time.

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Рекурсивний метод формування оптимального набору завдань за критерієм максимізації заробітку

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Анотація. Робота присвячена проблемі пошуку людиною в теперішні скрутні часи, коли роботи або взагалі нема, або недостатня оплата праці для нормального проживання, можливості додаткового заробітку. Проведений аналіз поточного стану ринку праці та програмних систем з пропозиціями вакантних робочих місць показав, що таких систем є достатня кількість досить в загальному доступі та зручними в користуванні. Одним їх мінусом є орієнтація лише на вакансії, які потребують повної або часткової зайнятості (наприклад, ІТ сфера) людини. Можливості погодинної роботи такі системи не надають і тоді людина повинна самостійно шукати собі пропозиції на різних рекламних сайтах, в телеграм-каналах, інстаграмі тощо. Іншою і найбільш головнішою постає проблема пошуку такого додаткового заробітку, який мав би максимальний вплив на людину. Критерієм максимізації в даному випадку для будь-якої людини буде максимально можлива сума заробітку за певний період часу. Адже кожна пропозиція має свою складність і свою ціну, а також час реалізації. **Об’єктом дослідження** виступає саме процес максимізації заробітку. З огляду на вище вказані проблеми запропоновано розробити рекурсивний метод формування оптимального набору пропонованих для реалізації завдань із врахуванням критерію максимізації заробітку, що і є **предметом дослідження**. В результаті реалізації даного методу всі завдання, які будуть знаходитись в часовому проміжку вказаним користувачем, будуть опрацьовані і додані в можливі ланцюжки завдань. Кількість ланцюжків та завдань у них буде залежати від «досяжності» певного завдання для реалізації користувачем, тобто чи встигне фізично користувач добратись до необхідного місця для його реалізації. **Висновок:** за результатами опрацювання даного рекурсивного методу також проілюстровані прототипи його реалізації на практиці з формуванням оптимального набору завдань та прокладання маршруту на Google-map.

Ключові слова: робота; заробіток; додаток; прототип; оптимізаційна задача; критерій максимізації; рекурсивний метод; оптимальний набір завдань.