

Human Resource Management Using World Competitive Contests Algorithm

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Abstract

Because of different relations between employees with different degrees, proper Human resource (HR) management is on the most challenging problems in organizations. In order to address this issue, we used from world competitive contests (WCC) optimization algorithm because this is an NP-hard problem. We considered a real world environment, and applied WCC and famous optimization algorithms on it. The results have been compared and approved by organization's managers and experts, and show that WCC leads to better results than others.

Keywords: WCC, Optimization Algorithm, Human Resource, Management.

Introduction

HR is designed to reduce of cost and time and to enhance of performance between employers (Foster, 2014). Different organizations have various policies with some employees who satisfy its requirements (Ulrich and et al, 1995). These organizations include several building with some floors which consist of several rooms that have special capacity of employees (Ahmadi & Mirsepassi 2010). Therefore, the managers face the problem that who employees must be roommate. This problem is an NP-hard problem, which the acceptable answer cannot be found in polynomial time order. Hence, managers use a traditional heuristic method without exploiting computational techniques for placement of them (Soliman & Spooner, 2000). As another performable method, they can use computational methods with optimization algorithms (Geem and et al, 2001). In this paper, we apply WCC algorithm (Masoudi-Sobhanzadeh & Motieghader, 2016). on this problem and compare it with other art-meta-heuristic optimization algorithms such as imperialist competitive algorithm (ICA) (Atashpaz-Gargari & Lucas 2007), genetic algorithm (GA) (Holland, 1992) and learning automata (LA) (Beigy & Meybodi, 2004).

Because of its applications and challenges, many researchers studies this problem that some of the recently carried out works are as follow: japan nuclear human resource management (Fujiwara, 2017), human resource development for regenerate medical products (Nishigaki and et al, 2017), review on human resource management emergence in china (Zhu & Warner, 2017), intellectual, capital and innovation of human resource management (Kianto ane et al, 2017), innovation on organizational and human resource management (Haneda & Ito, 2018).

This paper has been organized as follow: The second part describes WCC algorithm in details, problem formulation is expressed in the third section, experimental results are discussed in the fourth part, and finally, the fifth section is related to conclusion and future works.

The WCC

WCC consists of four main stages: 1- Teams population creating 2- Grouping operations 3- Group matches holding 4- Elimination

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matches holding. Flow chart of the WCC is depicted on fig.1.

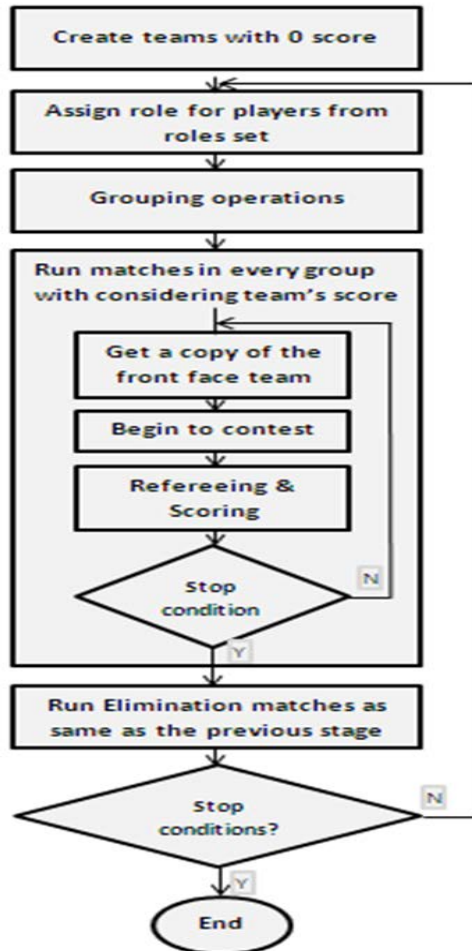


Fig. 1: Flowchart of WCC

WCC, like other evolutionary algorithms, starts with the first population. Population consists of teams and every team is set of players. Fig.2 shows an instance of team with 9 players. Each team that is considered as answer of a problem, in addition to variable values, has score value which is 0 at the first.

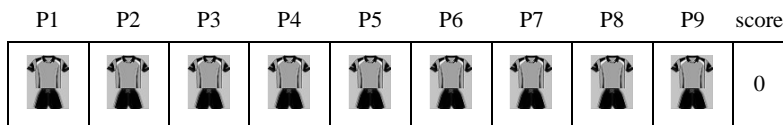


Fig. 2: An instance of a team

Where N is number of players and S is team's score, a team can be considered as an array such as eq.1 which its length is N+1.

$$\text{Team} = \{P_1, P_2, \dots, P_N, S\} \quad (1)$$

While improving current situation, teams score will enhance with 1 because there is no any constraint for teams score, also teams scores will change to 0 before new session start.

Grouping

Some teams according to their fitness values are selected as leaders of groups. Teams then are placed in groups based on eq.2, where d_{ki} is difference between i th group and k th team, m is number of i th group members, g is group number and n is number of players. More d_{ki} , more search space.

$$d_{ki} = \max_{i=1..g} \left(\sqrt{\frac{\sum_{r=1}^m \sum_{d=1}^n (T_{krd} - T_{ird})^2}{mn}} \right) \quad (2)$$

Besides seven groups and two teams, fig.3 shows edges that present difference between teams and groups. Bold arrows indicate that T1 places on G4 and T2 places on G1 because their differences are max.

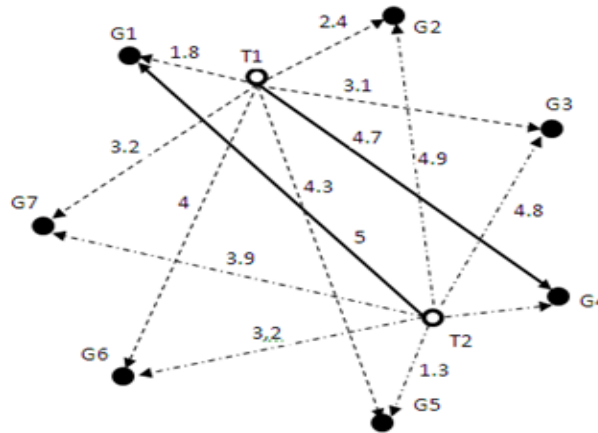


Fig. 3: Grouping in WCC

Task definition

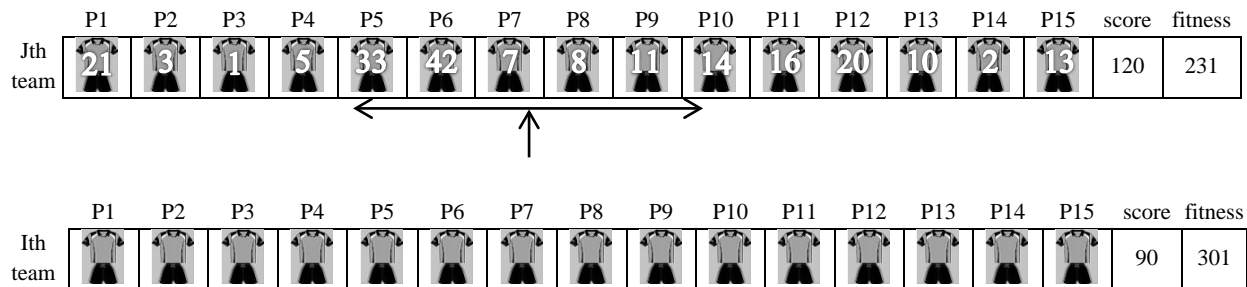
As it is mentioned, players’ tasks have main role on WCC performance. In a contest, every player has one or more than one task. Task definition depends on problem and it is different from one problem to another problem. Changing, replacing, inverting and so many other actions are tasks that players can apply to front face team. Players’ tasks, in begin of new session, are changed.

Holding group matches

Provide that a team has chance enough, it begins to contest with other teams on its group. while TH is threshold of playing chance for teams, c_i , s_i , s_j are sequentially: i th team’s playing chance, i th team’s score and j th team’s score in eq.3.

$$C_i = \frac{(s_i+1) \times TH}{s_i+s_j+2} \quad (3)$$

In a match, each team gets a copy of front face team and with considering c_i and according to players tasks tries to improve fitness. The team will update with copy values if it is successful in fitness improving. one supposed match is presented in fig.4.



A: arrangement of two teams before match. Turn is for i th team. i th team fitness values is 19.8 and j th team fitness value is 18.4. We supposed that the less is the score value, the result is better.

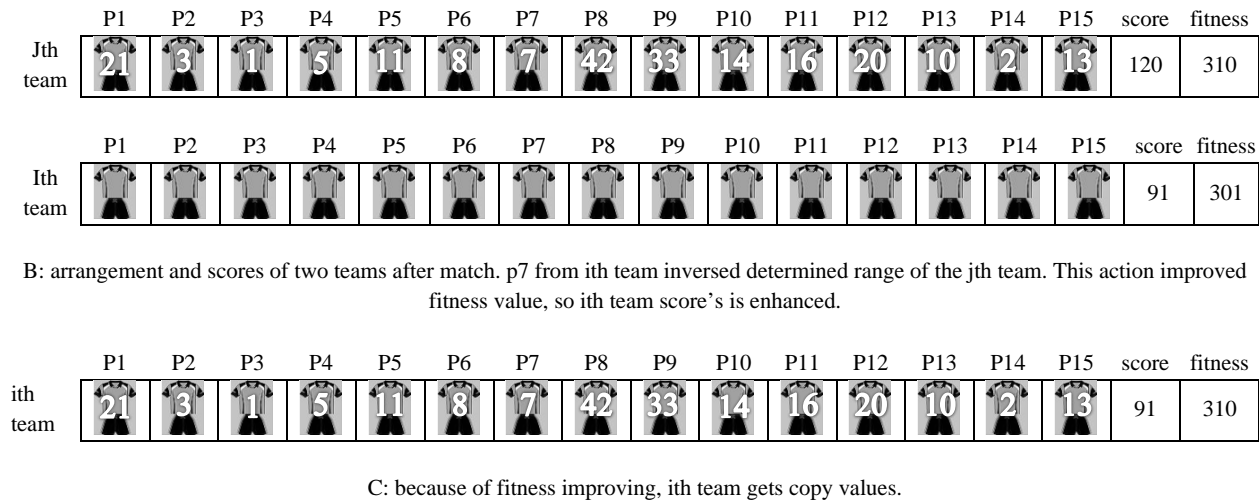


Fig.4: The WCC's operations

Elimination matches

Elimination matches will begin after group matches. In this stage, every team selects randomly its front face team from other groups, also each team has beat threshold, so a team will not able to keep the match after that and it will wait for new session.

Stop conditions

We can choose one of the follow options for end of the algorithm:

1. Predefined session number
2. Achieving to acceptable level of accuracy
3. When the best fitness value is constant for several sessions
4. Determined time finishing

The problem formulation and data used

An NP_hard problem, Human resource management is one of the most important problems and it can cause cost and energy wasting. In this section, we have considered building and human information such as distance between the buildings, number of floors in every building, number of rooms in every floor, number of vacant places in every room and relation percentage between employees. It is logical that individuals with related jobs be placed in the same room or in the near places. We apply the algorithms on a real world organization which its layout has been shown in fig.5.

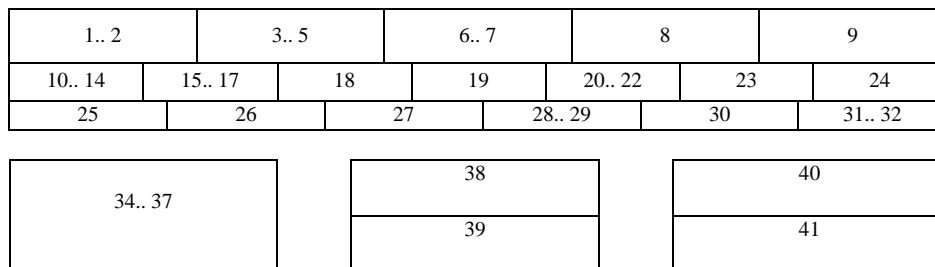


Fig.5. A practical example

Fig.5 shows a real world example of an organization with four building and some floors in each of them. The vacant places are numbered. The relation between employees has been presented by a graph in which every node of graph presents an employee and the edge between two nodes shows the relation rate between two employees. In our problem, every team is a potential answer for the

problem, and every player is tantamount for a node of graph. Also a value assigned to a player indicates the place which the employee must be placed in it. Fig.6 shows 41 employees who must be placed in 41 vacant places in the mentioned organization.

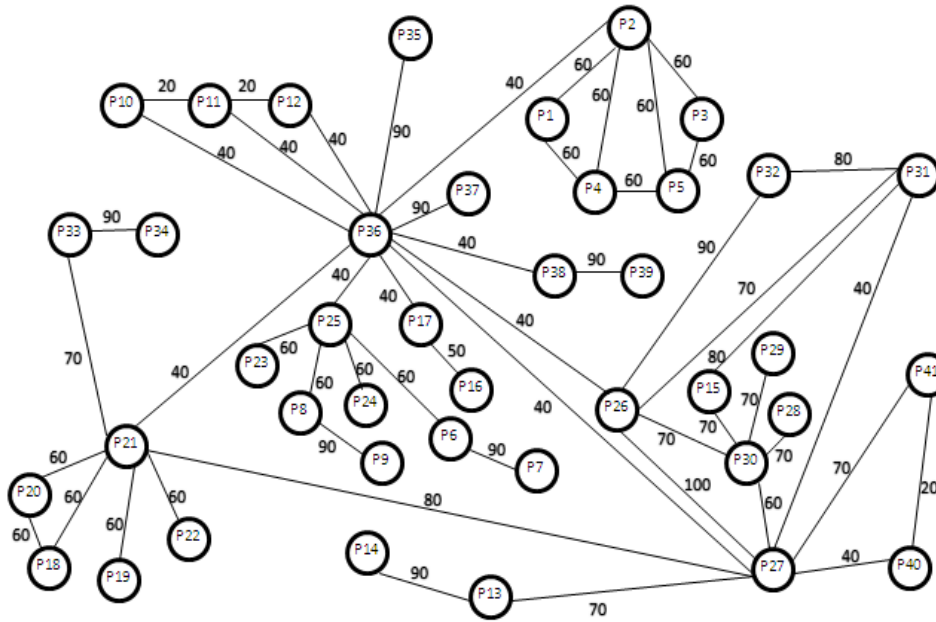


Fig. 6. the employees of real world example

Experimental Results

We evaluate the performance of WCC against GA, ICA and combination of genetic algorithm and learning automata (LAGA) Goldberg & Holland 1988). in terms of convergence and stability. This problem can be considered as an array, where array's index is staff number and content of each index shows the location which employee must be placed in it. Fitness value is evaluated for each team as eq.4.

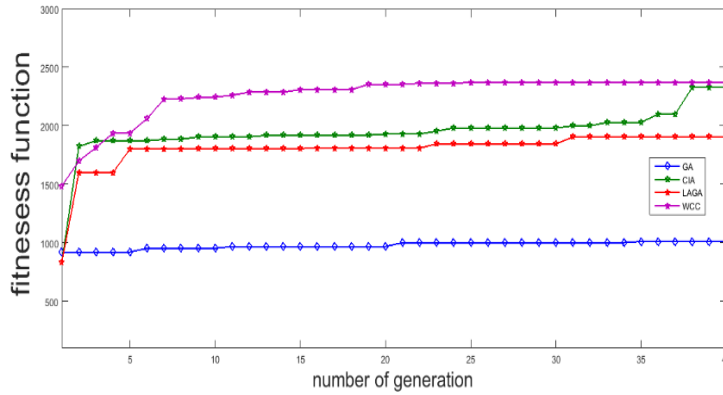
$$\text{Fit} = \sum_{i=1}^n \sum_{j=i+1}^n \frac{R_{ij}}{D_{ij}} \quad (4)$$

In eq.4, R_{ij} is relation percentage between i th staff and j th staff, and D_{ij} is distance between the two employees. It will be 1 if the two employees are located in the same room. Fitness function or score function can be considered as either minimization or maximization problem. Eq.4 is maximization problem, so the higher is the score value, the proper is the results. LAGA, ICA and WCC which their parameters are showed in table.1 have been implemented on a system with 2.2 GH of CPU, 1 GB of RAM, WIN7 (64 bit) operating system.

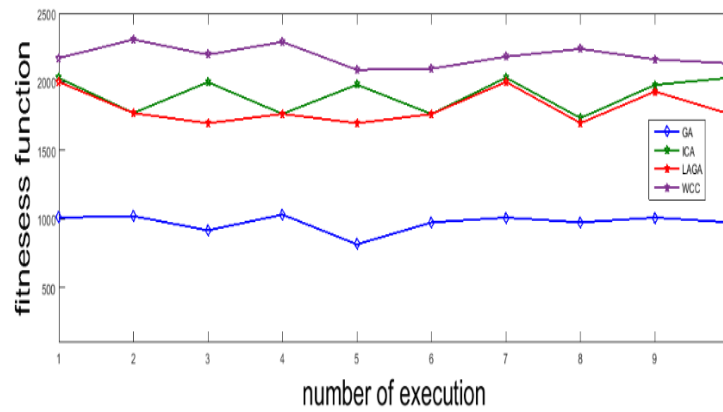
Table 1- The algorithms' parameters

Algorithm name	Parameters
WCC	Number of roles=2, number of groups=4, number of teams=20, number of session=40
ICA	Number of countries=1000, evolution rate= 40%, number of generation=40
GA	Number of the first population=1000, pm=0.1, pc=0.8, number of generation=40
LAGA	Number of the first population=200, pm=0.1, pc=0.8, number of generation=40

Inversing copy's values and changing copy's values from front face team as randomly are roles that are defined for players. We carried out these algorithms over 10 individual runs. Then we depicted them. There results in terms of convergence and stability are available in fig.7. In each generation, every algorithm calls fitness function 900 times. Also, reaching to the latest generation has been considered as stop condition.



a. Comparison of the algorithms based on convergence criterion



b. Comparison of the algorithms based on stability criterion

Fig 7: comparison of the algorithms

In fig.7, WCC, GA, ICA, LAGA are depicted by purple, blue, green and red diagrams respectively. These results indicate that WCC is suitable than to three other methods in terms of convergence and stability. From convergence point of view, it is observable that WCC's slope is sharper than three others. Because optimization algorithms operate randomly, their final results are different in individual executions. An algorithm which its results are closer to each other is proper than other algorithms. From this point of view, we observe that WCC has minimum fluctuate, so its stability is proper than three others. Table.2 compares algorithms over 10 separate runs. This table includes: algorithm name, the worst and the best acquired value, average of the acquired values, elapsed time for finding best value (second) and standard deviation. Standard deviation, one of the most important criteria, is calculated by eq.5 (Deviation, 1973).

$$S.D = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2} \quad (5)$$

In reaching to acceptable answer, GA was unsuccessful, but it has minimum of elapsed time and standard deviation. LAGA performance is almost acceptable, but it is not better than ICA and WCC. As it can be found, WCC is better than others. The latest record of table is related to existing layout. The acquired results had been discussed with the real word organizations' human resource management, and he approved obtained layout can enhance the organization's performance.

Table 2- Comparison of the algorithms

Algorithm	Worst	Best	AVG	e. time	S. D
WCC	1844	2172	2029.9	10.4511	99.936
ICA	1737	2031	1909	11.0054	129.3505
LAGA	1699	2000	1829.3	11.3701	112.199
GA	816	1033	975.1	9.6341	65.038
current layout	809	1010	~980	-----	-----

Conclusion

In this paper, we applied WCC algorithm on human resource management problem. We considered a real world organization and evaluate the performance of WCC and three famous optimization algorithms and methods on it. The experimental results showed that WCC is suitable than others in terms of convergence, stability and final layout. Also, the results showed that WCC has acceptable execution time and standard deviation. In addition to mentioned points, we discussed about results of the algorithms with expertise, and they approved that the algorithms' results can enhance the organization's performance. As future works, we can examine algorithms' functionality on various organizations, and compare and analysis their results. In addition to, we can apply recently introduced optimization algorithms or other methods to this problem, and scrutinize its results against results obtained by this paper.

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