Agile Team Assembling Supporting High Cooperative Performance

Sylvia Encheva(✉)

Western Norway University of Applied Sciences, Bjørnsonsg. 45, 5528 Haugesund, Norway
sbe@hvl.no

Abstract. Modern organizations are repeatedly immersed in rapidly changing situations requiring a large variety of skills and expertise which more often than not implies bringing together new teams. In this paper, we present an approach that can significantly speed up team assembling processes where each required skill is possessed by more than one team member. Another important feature is providing automated information about members of other teams who possess specific currently requested skills when there is a need for it.

Keywords: Teams · Cooperation · Bipartite graphs

1 Introduction

Managers in service-providing organizations often face situations requiring urgent reassignment of employees to new tasks. Finding the right people at the right time can be a lot on the manager's plate while being in charge of a large number of employees or, e.g., being new in the job. Thus, the need for a quick screening procedure of up-to-date stuff skills and expertises is obvious.

Bipartite graphs were previously employed for solving assignment and transportation problems [2,16]. In most of the previous work, the main focus was on looking for an answer to problems where no changes were assumed. Thus, the well-known personal assignment problem referred to also as the Hungarian method is used to find an assignment of jobs to workers at a minimum cost [12]. Here, we are concerned with providing an approach that can handle dynamic changes while reassigning employees to new projects. Visualization of staff members grouped according to skills they possess is further illustrated based on n-dimensional hypercubes. Bipartite graphs can be factored as a product of two graphs one of which is a hypercube and the other is a complete graph [1].

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2 Related Work

Effective skills management is of vital importance to any organization. It is pointed in [13] that 'one of the big disasters in any company would be placing people in wrong roles and making failures of successful people.' The significance of assigning the right employees to the right projects as well as the need of up-to-date information about workers skills is discussed in [6,14].

The n-dimensional cube Q_n is the graph for which $V(Q_n)$ is the set of all 0–1 sequences of length n, with two vertices being adjacent if and only if they differ in exactly one position [1]. The authors investigate the problem of factoring Q_n as $Q_n = H \times K_2$. According to [5,10], Q_n can be presented as a direct product $Q_n = H \times K_2$ where H is a hypercube of dimension $n-1$ and K_2 is a complete graph. A bipartite graph is a graph whose vertices can be divided into two disjoint sets where every edge connects a vertex in one set to a vertex in the other set, [7]. For further reading on bipartite graphs, we refer to, e.g., [4,8,9].

Bipartite graphs have special value for running of iterative enhancement processes [3]. They have been employed in algorithm design [11,15] and used in social network analysis [17].

3 Team Assembling

Assume an organization where employees' skills or areas of expertise are used to gather teams contributing to high cooperative performance. The question we address here is how to organize the available and eventually non-available but possibly needed skills in way that supports efficient resource management.

In this scenario skills in an organization, or in each of its sections, are summarized in eight sets denoted by 'a, b, c, d, e, f, g, h.' A set can contain a single skill, several skills or being currently empty. These eight sets are further arranged in sixteen quadruples where:

- the first position is occupied by either a or e
- the second position is occupied by either b or f
- the third position is occupied by either c or g
- the forth position is occupied by either d or h

and any two quadruples differ in at least one position. The quadruples are $\{e,b,c,h\}$, $\{a,b,c,h\}$, $\{a,f,c,h\}$, $\{e,f,c,h\}$, $\{e,b,c,d\}$, $\{a,b,c,d\}$, $\{a,f,c,d\}$, $\{e,f,c,d\}$, $\{e,b,g,d\}$, $\{a,b,g,d\}$, $\{a,f,g,d\}$, $\{e,f,g,d\}$, $\{a,b,g,h\}$, $\{a,f,g,h\}$, $\{e,f,g,h\}$, $\{e,b,g,h\}$.

Each of these quadruples is, further on, associated with a vertex of the graph shown in Fig. 1 originally presented in [1] as graph H. Keep in mind that to the rest of this paper we are only interested in efficient representation of people and their skills and therefore not restricted by all requirements in graph theory.

A vertex belonging to any of the four squares

- $\{e,b,c,h\}$, $\{a,b,c,h\}$, $\{a,f,c,h\}$, $\{e,f,c,h\}$

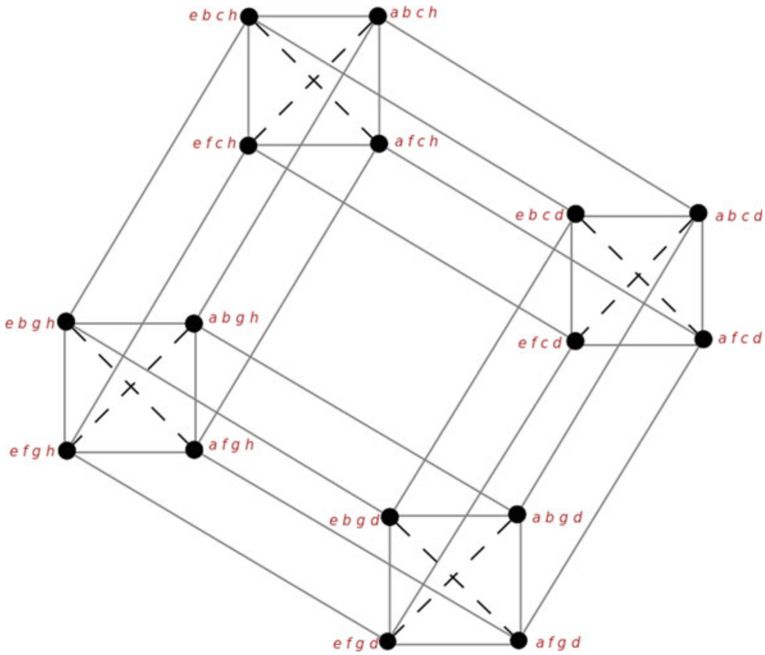

Fig. 1. Skills representation

- $\{e, b, c, d\}$, $\{a, b, c, d\}$, $\{a, f, c, d\}$, $\{e, f, c, d\}$
- $\{e, b, g, d\}$, $\{a, b, g, d\}$, $\{a, f, g, d\}$, $\{e, f, g, d\}$
- $\{e, b, g, h\}$, $\{a, b, g, h\}$, $\{a, f, g, h\}$, $\{e, f, g, h\}$,

is connected to any of the other three vertices in the same square and to two vertices belonging to two other squares. Thus, two vertices connected by an edge which is not a diagonal in a square differ in one position only, while two vertices connected by an edge which is a diagonal in a square differ in two positions. Interpretation: Two persons placed in two vertices which differ in one position only can assist or substitute each other in case any of the three skills they share are required. If however they are placed in two vertices which differ in two positions, they can assist or substitute each other in case any of the two skills they share are required.

There are two diagonals in each of the above-mentioned four squares in Fig. 1. This indicates that smaller teams consisting of two groups associated with each square can be assembled when two sets of skills are required only. A dashed line is used to emphasize connections between vertices which differ in exactly two positions.

The representation in Fig. 1 allows assembling of different teams. We are now looking at the cases where all members of a team share exactly two of the eight skills 'a, b, c, d, e, f, g, h.' This is visually illustrated by parallelograms with vertices associated with quadruples sharing two skills, e.g., quadruples $\{a, b, c, h\}$,

$\{a, b, c, d\}$, $\{a, b, g, d\}$, $\{a, b, g, h\}$ share skills $\{a, b\}$ (highlighted in blue) while quadruples $\{e, b, c, d\}$, $\{e, f, c, d\}$, $\{e, f, g, d\}$, $\{e, b, g, d\}$ share skills $\{e, d\}$ (highlighted in read), Fig. 2. These are only two out the 28 parallelograms in Fig. 1. This demonstrates excellent potentials for interactivity, i.e., whenever a new team is needed in a way that its members share specific skills a manager can straight away call on the corresponding people, placed in the vertices of above-described parallelograms.

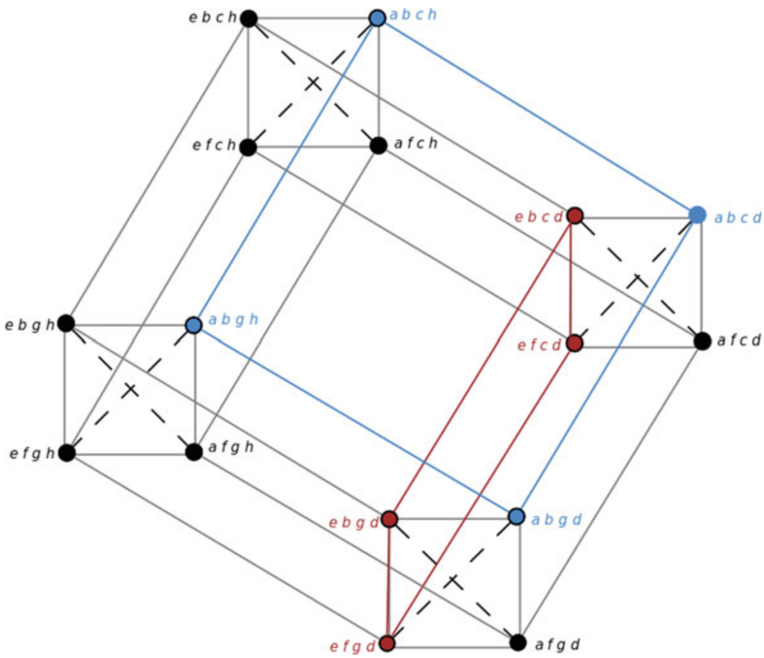

Fig. 2. Quadruples sharing skills a, b and e, d, respectively

Such representation of available skills and areas of expertise can be used to monitor market demands of a particular work force and subsequently extend the competence level of current staff members and or employ new appropriate personel. Visibility of available and non-available skills can be emphasized by different coloring of vertices and edges as, e.g., in Fig. 2.

Remark: If we think about a quadruple as a vector with four coordinates with values 0 or 1, then the binary sum of two such vectors will vary from 1 to 4. Such types of presentations turn out to be very handy in the process of programming an app using the above-described approach for reassignment of employees.

4 Conclusion

The main idea in this work is to provide assistance to managers and project leaders in cases when they quickly have to assemble a team with necessary skills and competences for completing a new task or being able to find a substitute for a member who is currently involved in other projects or for some other reason is unavailable. In addition, the presented approach can be used for developing a mobile application facilitating efficient restructuring of a workforce.

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