# A Lattice Based Service Oriented Framework for an Effective Human Resource Management

Md Jakir Hossain Molla*
Aliah University , Kolkata, India.
Sandip Kumar Basak†
FAU Erlangen Nuremberg , Germany.
Sk Md Obaidullah1 ‡
Aliah University, Kolkata, India.
Narayan C. Debnath§
School of Computing and Information Technology, Eastern International University, Thu DauMot, Vietnam.
Narayan C. Debnath ¶
Eastern International University, Vietnam.
Soumya Sen ‖
A.K. Choudhury School of Information Technology, University of Calcutta, India.

**Abstract**

In modern day the success of majority of organizations depend on the efficiency of human resources. Measuring human resources and their performance are often challenging as there is no standard metric to measure how well a resource will fit in the organization. Moreover based on the job role the requirements of the skill-set of the candidates vary. For the newly joined candidates the requirements of most of the companies are same but different subset of skill are required as per the job role. As the number of subset of the skill set is high a standardized model is required to define a framework that will guide the recruitment process. The cost of recruitment goes high if a company organizes the recruitment from beginning to end phase. Generally the initial phases are same for a particular type of industry and this can be outsourced to a third party. A lattice based model named as Lattice-graph is proposed to manage the recruitment of newly joined candidates when the skill-set is static. However, when new skill(s) are added Lattice-graph can't incorporate these dynamic skills. Henceforth a new dynamic model is defined named as Hybrid-graph Skill Set Model (HGSSM) to incorporate the challenges of including new skill as per the requirement of the recruiter. Classification algorithms are also deployed to measure the accuracy of the newly joined candidate's recruitment based on the known skillset.

**Key Words**: Classification, Lattice, Hyper-lattice, Service-oriented model, Recruitment, Skill-set.

## 1 Introduction

Business organizations rely on their human resources for their growth and increasing profitability. Henceforth having the right person in the organization is now a key to success. Employees are hired in the organization through HR (Human Resource) department. Generally an organization recruits huge number of resources directly from the educational institutes. In this type of hiring, which is often termed as Fresher recruitment, candidates are evaluated with no previous working experience. Generally these candidates are recruited directly from a particular institute which is known as On- campus recruitment process. Another approach of recruiting fresher candidates is to call candidates from multiple institutes in one particular institute which is known as Pool-campus recruitment process. The benefit is that instead of visiting to multiple campuses recruitment is conducted in single campus and that is going to reduce the cost and timing drastically. An alternative to this is to invite the shortlisted candidates from different institutes based on the given criteria to a common place (May be the company owned premises), which is known as Off-Campus recruitment process. After getting the applications from the possible candidates a shortlisting process is followed. This is easy for the fresher candidates as they do not generally have special skills and they are evaluated based on their marks in the school / college / university level examinations and other parameters

*Aliah University , Kolkata, India. Email: jakirhossain20@gmail.com.
†FAU Erlangen Nuremberg , Germany.Email: sandipbasak14@gmail.com.
‡Aliah University , Kolkata, India. Email:sk.obaidullah@gmail.com.
§School of Computing and Information Technology, Eastern International University, Thu DauMot, Vietnam. Email: narayan.debnath@eiu.edu.vn
¶School of Computing and Information Technology, Eastern International University, Vietnam. Email: NdebnathC@gmail.com .
‖A.K. Choudhury School of Information Technology, University of Calcutta, India. Email: iamsoumyasen@gmail.com.

like backlog history, year of gaps etc. After the shortlisting they are called for the evaluation process of the company. This evaluation process comprises of testing different parameters such as aptitude, soft skill etc. It is to be noted at the fresher level the criteria are more or less same for the Human resource based organizations. For example IT companies are looking for some common skills that reflect their requirements. Again Core companies look into some common criteria as per their requirements. This is to emphasize at fresher level many of the criteria are generally same such as soft skill, aptitude etc. and some are domain specific such as computer proficiency, domain knowledge etc. As mentioned earlier though Pool-campus, Off-campus recruitment reduces cost still it involves the time and huge manpower to complete the entire recruitment process. This cannot be managed by the HR department and therefore people from development teams, testing teams are requested to help the process. Now these people are generally billable resources (company earns money from the clients against the service of these resources) and they are being overburden for the additional responsibility of recruitment process. Henceforth minimizing the involvement of these resources is a priority for any organization to reduce the cost. This can be done by outsourcing some of the steps of recruitment process that are common for all the candidates across the industry. Once these preliminary steps are done then the people from the own organization would be involved to evaluate the company specific requirements to finalize the selection. This demands a business model [1] or framework to justify the hiring process by reducing the cost, time and eliminating the involvement of the resources of own organization. A third-party agency could play a crucial role here that will conduct the basic steps of examination based on the several parameters that are required to evaluate a candidate. Companies can choose the candidates based on their various skill-set requirements from the trusted third party agencies who have already conducted the baseline tests. This would be a service model [2] as the third party agencies already conducted tests on several skill set parameters and the recruiting company would choose any of the subset of the tested skill-set as per the business requirement [3] of the different job roles. This model is to be justified based on the historical data and suitable analytical models [4] are required to prove the robustness of the proposed model or framework [5]. As the requirement of the industry is changing rapidly sometimes it is not possible to give training even to these newly recruited candidates and henceforth they are being evaluated based on the customized skill-set of the specific project. In this case it is expected that these candidates had earn the required knowledge on the given skill-set. This requirement adds another challenge to the proposed service model. In this research work a lattice [6] based service oriented framework [7] is proposed to optimize the recruitment process of newly joined candidates with common skill-set and it is further extended using the concept of Hyper-lattice [8] to meet the requirement of the customized skill set of the newly joined candidates.

The rest of the paper is organized as follows. Section 2 presents a related work on the campus recruitment process and service modeling framework. Section 3 depicts the Objective and Contribution of this work. Section 4 presents the Dataset & System Configuration. In the next section (Section 5) the Lattice-graph Model and Hybrid-graph Skill Set Model (HGSSM) are proposed with Lemmas and Case Study. Finally, in section 6 the research work concluded.

## 2 Related Work

Campus placement of the student is a critical aspect of higher education, as it provides students with opportunities to join industry/corporate. In this way the students become professionals and they start to earn money, which is one of the dream aspects of every human being. Moreover placement of an Institute is one of the key parameter to judge the quality of the Institute. There are different types of jobs are available in the markets and the students have different proficiency levels on different skill parameters. Henceforth recommending the students for suitable type of jobs is a challenge for an Institute and also for the corresponding business organization to identify the suitable candidate for their specific job role. This is an analytical challenge and this is addressed in different researches. The employability prediction and recommender system for students were built using fuzzy logic to resolve the students employability [9]. In this research work fuzzy model performs a high predictive accuracy based on the calculated mean absolute error (MAE) and root-mean-square error (RMSE) scores. Soft skill is considered as one of the key attribute for getting job and this is addressed in [10] on Moroccan labor market by analyzing engineering job ads. A mixed content analysis method has been designed based on the sequential exploratory. In order to visually analyze the placement of students in a higher educational institution the Exploratory Data Analysis (EDA) [11] is used to generate inferences mathematical models. EDA is a detailed examination that helps in discovering the structure of the data. A framework for engineering employability skill was proposed [12] for Malaysia considering local and global expectations. The interactions among the various skills, measurement tools for employability skills are considered in this framework. In another research work data is collected from 41 Engineering professionals based in UAE using an anonymously survey and it helps to give the recommendations to educational institutions related to the essential workplace skills which are critical for Engineering graduates' employability [13]. A combined methodology [14] was proposed with exploratory data analysis and advanced predictive modeling particularly emphasizing the roles of gender, academic performance analysis, and Degree and MBA specialization in placement outcomes to forecast placement success of the students. An Adaptive Fuzzy Campus Placement Optimization Algorithm (AFCPOA) [15] was developed for solving unconfined optimization problems related to candidates seeking campus placement. The framework were considered to describe the written test and interview process by employer

visiting campus for hiring students the suitable candidates. Another research work [16] has attempted to develop an automatic system to predict the placement of candidates in the early phase of their education and positively impact the institute's skill training program and hiring activities and the machine learning techniques such as Logistic Regression, Support Vector Machine, K-Nearest Neighbor, Decision Tree, Random Forest, and AdaBoost classifier were considered to compute the accuracy of the forecasting. [17] highlights the motives behind the developing need for Machine Learning centered campus placement assessment. The framework confirms the efficient talent matching, reducing costs, and saving time for the entire process. The study also highlights the benefits of remote and flexible assessments, revealing how technology can replace the old methods of campus placement process. The research work of [18] carried out to explore how it can reform university graduate student's employability skill. The proposed predictive models analyses attributes like student performance, interests, and career objective to identify the best-fit job opportunities for individual student. A campus placement predictor system [19] was proposed to predict the campus placement chance with estimated salary package range one can get from the University/College campus placements process based on his/her academic scores and pre-placement training assessment scores at the early stage. It has been observed from the above survey work that different type of requirements exist for different organizations. As these requirements are different for different job roles service based modeling may help to reduce the cost. Service identification [20] is a crucial phase to design any service-oriented application. Granularity of the services is important to achieve flexibility and reusability. Separation of decision modeling from the processes modeling gained significant importance in literature [21], as it incorporates both concerns into a single model incorporating scalability, maintainability, flexibility, and understandability. The introduction of the Decision Model and Notation (DMN) [22] standard provides a suitable solution for externalizing decisions from processes and automating decision enactments for processes. Web services [23] are the standard way to deploy service to any data /information sensitive system. Micro service architecture is getting popularity to deploy the web services. Deployment of the service model on the recruitment process will be cost effective and time saving if the requirements and skills are matched properly and this is going to be beneficiary for both the recruiter and the applicants.

## 3 Objective and Contribution

The success and the growth of any organization is dependent on the human resources of that organization as they define the business plans, monitor the execution and make crucial decision making and strategies. The roles of human resources are more crucial for the organizations like IT, ITES, Consultancies etc. These types of knowledge-driven organizations are fully dependent on the employability skill of their employees at every level. Henceforth the recruitment process should be robust to recruit the deserving candidates as per their job roles and corresponding skill-set. Measuring the competency level of the human resources is always challenging and therefore a model or framework is highly desirable to quantify the ability of the human resources. It should be fully customized and dynamic in nature to manage the recruitment of the resources across the industry as per the different job roles. Moreover these different subsets of skill levels should be tested to measure the accuracy. The contribution of this research work is listed below:

Contributions:

1. Differentiating basic skill set and specific skill set of recruitment to fit in a model for evaluation.
2. Developing a customized model that will provide all possible subset of skill set required for an organization.
3. A service layer that allow to access desired skill set of the candidate for an organization as and when required.
4. Extending the model to add one or more skill set dynamically as per the requirement.
5. Measuring the accuracy of predictions of different subset of skills based on historical data applying standard classification methodologies.

## 4 Dataset & System Configuration

In this research work a real life dataset [24] is used that comprises of 12864 student's placement assessment data. The dataset used in this analysis is prepared with the information of the students who already completed their respective courses. This dataset is prepared by taking information from the placement departments of several technical/engineering colleges who have passed technical degrees. This is an anonymous dataset as the name and other identity information of the students are not given. A snapshot of the database is given below in Fig. 1:

| Branch | Degree | Score/700 | Aptitude | English | Quantitative | Analytical | Domain | Computer Fundamental | Coding | Placement Status |
|---|---|---|---|---|---|---|---|---|---|---|
| Applied Electronics and Instrumentation | B. Tech. | 584 | 69 % | 87 % | 53 % | 67 % | 30 % | 20 % | 60 % | Placed |
| Mechanical Engineering | B. Tech. | 584 | 76 % | 80 % | 73 % | 73 % | 55 % | 40 % | 00 % | |
| Electronics and Communications Engineering | B. Tech. | 578 | 71 % | 73 % | 73 % | 67 % | 55 % | 47 % | 20 % | |
| Applied Electronics and Instrumentation | B. Tech. | 578 | 71 % | 93 % | 40 % | 80 % | 50 % | 33 % | 20 % | |
| Electronics and Communications Engineering | B. Tech. | 575 | 64 % | 73 % | 47 % | 73 % | 55 % | 53 % | 20 % | |
| Information Technology | B. Tech. | 572 | 76 % | 73 % | 80 % | 73 % | 30 % | 60 % | 20 % | |
| Electronics and Communications Engineering | B. Tech. | 566 | 64 % | 60 % | 53 % | 80 % | 60 % | 20 % | 58 % | |
| Computer Science Engineering | B. Tech. | 560 | 60 % | 73 % | 47 % | 60 % | 45 % | 40 % | 36 % | |
| Information Technology | B. Tech. | 560 | 69 % | 80 % | 47 % | 80 % | 25 % | 27 % | 20 % | |
| Mechanical Engineering | B. Tech. | 557 | 67 % | 80 % | 53 % | 67 % | 50 % | 20 % | 00 % | Placed |
| Mechanical Engineering | B. Tech. | 554 | 64 % | 67 % | 60 % | 67 % | 60 % | 27 % | 20 % | Placed |
| Mechanical Engineering | B. Tech. | 554 | 64 % | 73 % | 47 % | 73 % | 55 % | 20 % | 00 % | Placed |
| Electrical Engineering | B. Tech. | 554 | 64 % | 60 % | 73 % | 60 % | 55 % | 40 % | 20 % | Placed |
| Computer Science Engineering | B. Tech. | 551 | 60 % | 73 % | 47 % | 60 % | 50 % | 53 % | 20 % | Placed |
| Applied Electronics and Instrumentation | B. Tech. | 551 | 62 % | 67 % | 53 % | 67 % | 35 % | 33 % | 20 % | Placed |
| Mechanical Engineering | B. Tech. | 551 | 64 % | 87 % | 27 % | 80 % | 40 % | 13 % | 00 % | Placed |
| Mechanical Engineering | B. Tech. | 551 | 60 % | 67 % | 53 % | 60 % | 65 % | 33 % | 00 % | Placed |
| Computer Science Engineering | B. Tech. | 548 | 56 % | 60 % | 40 % | 67 % | 45 % | 47 % | 56 % | Placed |
| Applied Electronics and Instrumentation | B. Tech. | 548 | 58 % | 73 % | 40 % | 60 % | 40 % | 53 % | 20 % | Placed |
| Mechanical Engineering | B. Tech. | 548 | 62 % | 53 % | 87 % | 47 % | 60 % | 47 % | 00 % | |
| Electronics and Communications Engineering | B. Tech. | 545 | 60 % | 60 % | 60 % | 60 % | 35 % | 40 % | 20 % | Placed |
| Mechanical Engineering | B. Tech. | 545 | 64 % | 73 % | 40 % | 80 % | 40 % | 40 % | 00 % | Placed |
| Mechanical Engineering | B. Tech. | 545 | 64 % | 87 % | 40 % | 67 % | 30 % | 27 % | 00 % | Placed |
| Computer Science Engineering | B. Tech. | 542 | 56 % | 53 % | 47 % | 67 % | 65 % | 53 % | 20 % | |
| Computer Science Engineering | B. Tech. | 542 | 64 % | 73 % | 47 % | 73 % | 60 % | 40 % | 00 % | |
| Mechanical Engineering | B. Tech. | 542 | 67 % | 87 % | 53 % | 60 % | 60 % | 40 % | 00 % | Placed |
| Electronics and Communications Engineering | B. Tech. | 542 | 60 % | 67 % | 60 % | 53 % | 70 % | 33 % | 20 % | Placed |

Figure 1: Snapshot of the Dataset

### 4.1 Data Description

The dataset contains a set of attributes which are described below.

a) Branch: Mentions the specific department where the student is enrolled.

b) Course: The particular course a student is currently pursuing.

c) Score: Evaluation of students out of 700 in the 7 different subjects namely Aptitude (given in column no. 4), English (given in column no. 5), Quantitative (given in column no. 6), Analytical (given in column no. 7), Domain (given in column no. 8), Computer Fundamental (given in column no. 9), and Coding (given in column no. 10). It is to be noted that the marks from column 4 to 10 are given in the percentage format and the examination was conducted out of 700 based on the 7 subjects as given in column 4 to 10.

d) Placement Status: Whether the student has been placed or not.

### 4.2 System configuration

The following hardware and software environment has been used to carry out the experiment. The experimental set up is described below: Hardware: All the experiments are carried on using Intel Core i5 processor with a 12 GB of RAM and 1TB of hard disk drive.

Software: Jupyter Notebook is used to conduct the experiment. In Jupyter Notebook Python 3.8.1 is used to carry out the experiment. Moreover several libraries have been used during the experiment for different purpose. Those are, pandas to manipulate the data, numpy for accessing the multidimensional arrays, matplotlib to visualize data, and sklearn to access efficient tools for machine learning and statistical modeling.

## 5 Proposed Methodology

In this section we will apply an algebraic model to formalize the recruitment process in terms of the given skill-set. The seven different types of skill (Aptitude, English, Quantitative, Analytical, Domain, Computer Fundamental, and Coding) that has been described in the Section-4 are the basic requirements of the majority of the organization. If we look at these skill-set more carefully we will find that four skill 'Aptitude', 'English', 'Quantitative', and 'Analytical' are almost always required by any organization. These four skills are represented by a set P=Aptitude, English, Quantitative, Analytical. Remaining skills are also required by the majority of the organization but all are not necessary for every job role. Henceforth all possible combination of the skill-set can play significant role in the selection process. It is found as per the job role, organizations can choose a resource based on any one of the given skill set or any combination of the given skill set. The requirement of all possible combination of the members of the set can be represented using lattice which is effectively used in data warehouse cuboids or in association rule mining [25].

A lattice is a partially ordered set (poset) in which every pair of elements has a unique Least Upper Bound (LUB) and Greatest Lower Bound (GLB). This algebraic model can represent all possible combinations of the skill set and they are closely connected to each other and can be traversed easily between different combinations of the skill-set.

### 5.1 Lattice-graph

The lattice model is going to be formed with 4 skill set parameters. Hereon we will refer to each skill-set parameter as dimension.

i) $P = \{\text{Aptitude, English, Quantitative, Analytical}\}$
ii) $D = \{\text{Domain}\}$
iii) $CF = \{\text{Computer Fundamental}\}$
iv) $C = \{\text{Coding}\}$

Here the proposed model is referred to as Lattice-graph. Initially this algebraic graph model will start with NULL value and that will be at level 0 and represented in the form of a node. Over the time new dimension(s) will be added at level 1 and every dimension is represented as node. In next level (level-2) two of the dimension will be added and that will form all the dimension pairs and each of these will be represented in the form of a node. This process will be continued to level n, where n is the number of skill set or dimensions.

The process of merging the dimensions is referred to as Integration. The reverse operation where we want to get back the unmerged dimensions are referred to as Discretization. In the Fig. 2 a Lattice- graph is formed with the four skill parameters P, D, CF and C as described above.

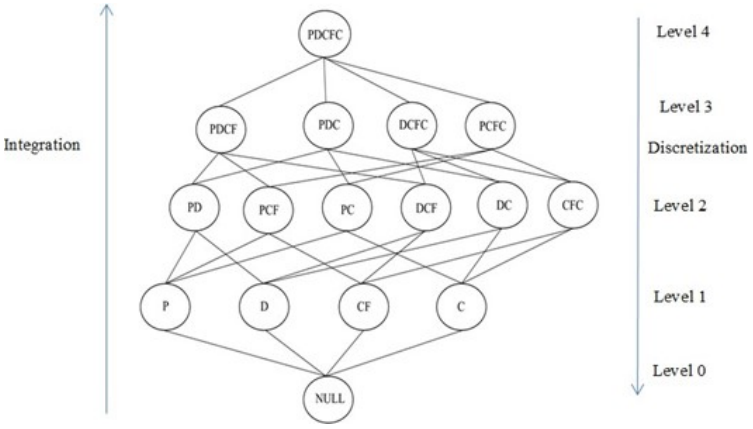


Figure 2: Lattice-Graph with Four Dimensions of Skill-set Parameters

The company that is conducting the assessment test is going to be referred to as Assessment Test Organizing Company (ATOC). ATOC maintains the database of different skill set of all the students and their marks. Now they can form the score sheet for each of the node of the Lattice-graph and can rank them. Any organization that wants to recruit candidates will go to the ATOC and tell about the required skill set for their different job roles and can also specify how many candidates

(say M number of candidates) they want to allow for the further round of selections. As per this specification ATOC will provide the top M candidates from the given node of Lattice-graph. In every node they will store the information of every candidate by sorting the marks in descending order.

For example a company wants 200 candidates having the knowledge of set P and domain (D) and 100 candidates of set P, computer fundamental (CF) and coding (C) for the further round of selection. Now based on this specification ATOC will access node PD for top 200 candidates and node PCFC for top 100 candidates.

### 5.2 Lemmas on Proposed Lattice-graph Model:

Lemma 1: Number of nodes in each level $n >= 1$ is ${}^nC_r$where n is the number of dimensions and r ($r >= 1$) is the level number in Lattice-graph.

Proof : In level-1 for every dimension is represented in its own form, hence it is represented in terms of that dimension only. In level-1 the value of r=1. Hence for level-1 for every dimension it is represented in 1 form only. Thus ${}^nC_1$ is the number of representation in level -1. In the next level, r=2 and every node is represented by 2 dimensions by combining the nodes of level-1. Hence it is represented as ${}^nC_2$. In the next level, r=2 and every node is represented by 2 dimensions by combining the nodes of level-1. Hence it is represented as ${}^nC_2$. This process is continued till level = (n-1) where r=(n-1).In this level number of node is ${}^nC_n - 1$ and this is same as ${}^nC_r$ as r=(n-1) in this level. Finally for level n number of nodes are ${}^nC_n$ where r=n. Hence we can say number of nodes is nCr for level r. Hence it is proved for all the levels $n \geq 1$.

Lemma 2: The number of dimensions d for a node of Lattice-graph in level r is r for $r \geq 1$.

Proof : In level-1 (r=1) number of dimension is 1 (d=1). In every upward level (r+1) number of dimension are increased by 1. Hence in level-2 (r=2) number of dimension are 2 (d=2). This is continued till level-n (r=n) and number of dimensions at that level are n (d=n).

Lemma 3: Number of nodes to be generated in Lattice-graph at level (r+1) from each node of level r using Integration operation is (n-r) for $r \geq 1$ and $r \leq n-1$.

Proof : In level-1(r=1) every node is combined with remaining of the node of level-1. As per lemma-2 number of dimensions of a node in level-1 (r=1) is 1. So a node in level-1 is combined with n-1 nodes (where r=1). In next immediate level each nodes has 2 dimensions and that can be combined with remaining of the (n-2) dimensions. In lemma-2 it is proved that numbers of dimensions of a node in level-2 (r=2) is 2. Since (n-2) holds for n=2. We continue this upto level r=n- 2. Finally for r=n-1 we get (n-(n-1)) = 1 which is the number of node to be generated at level n from the level (n-1).

Lemma 4: Number of nodes generated in Lattice-graph at level (r-1) from each node at level r using Discretization operation is ${}^rC_{r-1}$ where $r \geq 2$. Proof: In lemma-2 it is proved that number of dimensions in each node at level r is r. In every lower level nodes are generated with 1 less dimension of the previous level. As r is the number of dimension is current level and (r-1) is the number of dimension in the immediate lower level total number of nodes is represented by rCr-1. As the nodes are generated up to level-1 r is considered as $r \geq 2$.

### 5.3 Accuracy of Each Node based on Classification Algorithms

When a company wants to recruit candidates and they are taking the help of ATOC they might be interested to know how authentic this data set is. This authenticity problem can be framed by considering the historical data of their performance along with the placement record (whether placed or not). In order to ensure the authenticity different classification algorithms are applied on the given dataset. The five algorithms that are applied listed below.

a) SVM (Support Vector Machined)
b) Random Forest Classifier
c) KNN (K-nearest-neighbour)
d) Kernel-SVM
e) Decision Tree Classifier

For every node of the Lattice-graph classification algorithms are applied and for each of these 75% of data used for training and 25% for testing. We show the top two algorithms based on their accuracy in table 1

| Combinations | Best accuracy with algo name | 2nd best accuracy with algo name |
|---|---|---|
| 1) PDCFC | 97.57% (Random Forest) | 97.41% (Decision Tree) |
| 2) PDCF | 97.35% (Decision Tree) | 96.61% (Random Forest) |
| 3) PDC | 96.67% (Random Forest) | 96.48% (Decision Tree) |
| 4) DCFC | 95.11% (Decision Tree) | 95.08% (Random Forest) |
| 5) PCFC | 97.51% (Random Forest) | 97.20% (Decision Tree) |
| 6) PD | 95.80% (Decision Tree) | 95.42% (Random Forest) |
| 7) PCF | 96.26% (Decision Tree) | 96.11% (Random Forest) |
| 8) PC | 96.23% (Random Forest) | 95.95% (Decision Tree) |
| 9) DCF | 94.49% (SVM) | 94.15% (Decision Tree) |
| 10) DC | 94.74% (Random Forest) | 94.71% (Kernel SVM) |
| 11)CFC | 94.86% (Kernel SVM) | 94.83% (Random Forest) |
| 12) P | 94.93% (Decision Tree) | 94.74% (Random Forest) |
| 13) D | 94.49% (SVM) | 94.49% (Kernel SVM) |
| 14) CF | 94.49% (SVM) | 94.49% (Kernel SVM) |
| 15)C | 94.71% (Kernel SVM) | 94.65% (Random Forest) |

Table 1: Accuracy of Classification Algorithms for each node of Lattice-graph

The above table will give the idea on the quality of the student's data that a recruiting company will get from ATOC.

### 5.4 Hybrid-graph: Inclusion of New Skill for Assessment

The Lattice-graph model is conceptualized based on the defined skill-set. However in real life different business organizations may require human resources for some job roles based on some specific skill(s). This dynamic requirement of

skill(s) can't be included in the lattice-graph as it is static in nature. Henceforth a new model is required that can overcome this limitation of Lattice- graph. Data warehouse and OLAP tools are based on lattice of cuboids [20] which is relevant to the concept of Lattice-graph. The limitations of lattice of cuboids were mitigated using Hyper-lattice, which supports the inclusion of new dimension.

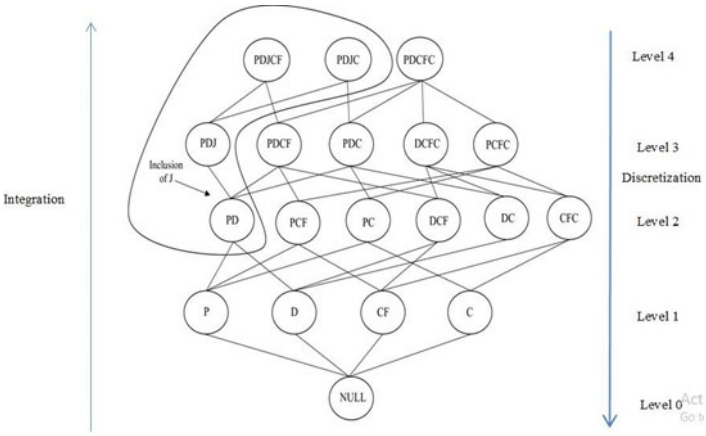


Figure 3: Inclusion of new skill (Japanese Language (J)) at level 2

In this research work we used the concept of Hyper-lattice to extend the proposed Lattice-graph to apply in the area of fresher recruitment based on pre- defined and new skill set. We consider that an organization wants to recruit employees based on the requirement of skill set P Aptitude, English, Quantitative, Analytical, skill D (Domain) and also with a new skill Japanese language (J). This is depicted in Fig. 3.

As we look into this structure we can find this is the merging of more than one lattice structure. However this structure degenerate the lattice structure as there are multiple Least Upper Bound (LUB) and Greatest Lower Bound (GLB). This structure is referred to as Hybrid-graph Skill Set Model (HGSSM). It may be possible more than one skill may be added in the different level of the graph.

This proposed HGSSM structure can be conceptualized as a composition of multiple Lattice- Graphs. This view is depicted in Fig. 4 where three Lattice-graphs are forming a HGSSM.

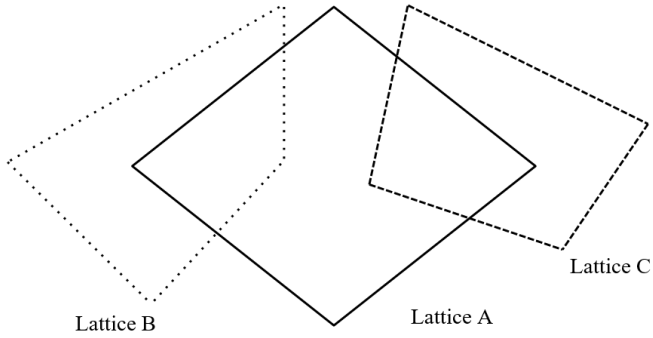


Figure 4: :
Hybrid-graph Skill Set Model (HGSSM) by merging three Lattice-graphs

HGSSM is a new structure and henceforth the properties of this new structure are to be defined. These are defined below.

### 5.5 Properties of Hybrid-graph Skill Set Model (HGSSM)

1. HGSSM consists of more than one Lattice-graph: HGSSM is a complex structure with more than one Lattice-graph.

2. Any number of dimensions could be added in the HGSSM: There is no restriction on how many dimension(s) could be added in the HGSSM.

3. New dimension may be added between level-1 to level (n-1): It is permissible to add new dimensions between level 1 to level (n-1). If added in level-0 then it will expand the Lattice-graph only. New dimension can't be added beyond level-(n-1) because over that it will exceed the existing level of HGSSM.

4. A new dimension may be added more than once in the HGSSM: This mode is flexible enough to add new dimension multiple times to reflect the business need.

5. The structure may have multiple upper bounds but unique lower bound that is NULL: As NULL is the starting point of the structure there is only one lower bound.

### 5.6 Case Study

In this case study we are considering the same company as defined in Section 5.1 is looking for resources having the skill set P Aptitude, English, Quantitative, Analytical, skill C (Coding) and also with a new skill Japanese language (J). The HGSSM of Figure 2 will be changed to a new HGSSM as given in Fig. 5.

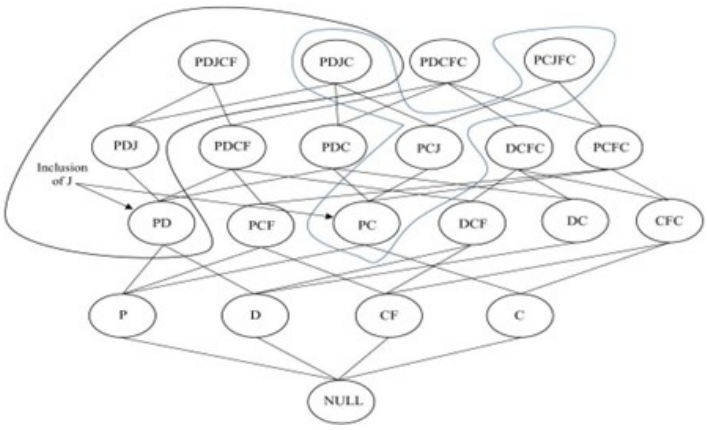


Figure 5: Modified HGSSM over a Figure 2, after inclusion of dimension J in PC node

## 6 Conclusion

This research work aims to develop a service based model to reduce the cost and time associated with the fresher recruitment. The model is based on the required skill set of the fresher candidates. The model is curated in a way so that any subset of the skill set could be selected based on the requirement of the any organization. An organization want to conduct the recruitment of fresher candidate do not need to start the process from scratch, rather they can take this service from Assessment Test Organizing Company (ATOC). This is going to significantly reduce the time and cost of the recruitment process. The proposed model termed as Lattice-graph gives the option to the recruiter to choose the required skill set as a service from the ATOC. Moreover this Lattice-graph model is extended to Hybrid-graph Skill Set Model (HGSSM) to adapt the requirement of customized skill-set of the candidates. The novelty of the framework is that once it is upgraded from Lattice- graph to HGSSM it has the capability to integrate customized requirement(s) of the skill-set of any organization as and when required. The limitation of the Lattice-graph is that it assumes few known skill-set to begin the construction of the structure. In order to use Lattice-graph in other applications the basic dimensions should be known at the beginning. However it will able to add new skill-set over the time dynamically to form Hybrid-graph Skill Set Model (HGSSM).

This framework could be improvised further to cater the requirement of the recruitment of the experienced resources. Specially, HGSSM will be suitable as it able to integrate new dimensions (skill parameters) as per the business / project specific requirement(s). The roles of experienced resources are often very much customized and HGSSM is fully scalable to any level of customization.

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## Author Biographies

**Md Jakir Hossain Molla** is a Training and Placement Officer in Aliah University and also a Ph.D. scholar in the Department of Computer Science & Engineering, Aliah University, Kolkata, India. His main research interests include Data Science, Machine Learning, and Data Mining.

**Sandip Kumar Basak** is pursuing his Master's of Science from FAU Erlangen Nuremberg, Germany. He received his B.Tech in Information Technology from A.K.Choudhury School of Information Technology under University of Calcutta, Kolkata. His research areas are Data Warehouse, Big Data, Machine Learning, and Data Mining.

**Sk. Md Obaidullah** is an Associate Professor and former Head in the Dept. of Computer Science & Engineering, Aliah University. He obtained his Ph.D. (Engg.) from Jadavpur University, Kolkata in 2017. His research interests include Machine Learning, Deep Learning, Medical Image Analysis, and more.

**Professor Dr. Narayan C. Debnath** is the Founding Dean of the School of Computing and Information Technology at Eastern International University, Vietnam. He earned both D.Sc. in Computer Science and Ph.D. in Physics.

**Dr. Soumya Sen** is an assistant professor at A.K. Choudhury School of Information Technology, University of Calcutta. He received his Ph.D. in Computer Science & Engineering in 2016. His research areas include Machine Learning, Blockchain, and Data Warehouse & OLAP Tools.