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A Review Paper: Cohort Intelligence and Some Other Approaches in the CBAP and Healthcare System

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ABSTRACT

Human civilization is advancing at a breakneck pace. Each resource has its own value and significance in terms of consumption. We strive to make the most of every resource we have, regardless of field, in order to get greater outcomes. The Cycle Bottleneck Assignment Problem (CBAP) and Cohort Intelligence (CI) algorithm to reduce congestion in recovery units and cyclic scheduling in hospitals. Because it does not employ the cyclic approach to organize the number of patients in a week. The problem emerges while attempting to maintain the recovery unit as clear as feasible of congestion. Standard precaution measures are frequently disobeyed by service providers. Bottleneck analysis was also utilized in the study to determine the weakest link in standard precaution implementation and the challenges it presents in hospitals. There's cohort intelligence, a self supervised learning behavior in which other members of a cohort improves themselves by observing the behaviors of other members which can be used with this intelligence and basics about this algorithm to create a model which improves from time to time on real time data. This paper reviews many approaches of the healthcare system problem and its approaches with their upside and downside and diverse performance measures. We have received various articles, analyzed their technique and approach, major features of the algorithm utilized, and potential areas for improvement in that research work.

Keywords - Healthcare, CBAP, Heuristic, Cohort Intelligence, Matlab, STAR Method

I. Introduction

Human civilization is progressing at an incredible rate. In terms of consumption, each resource has its own worth and significance. In order to get better results, we endeavor to make the most of every resource we have, regardless of field[5], In 2013, Anand J. Kulkarni developed Cohort Intelligence (CI), an unique optimization approach based on artificial intelligence (AI)[1]. It seeks to model the behavior exhibited in self-organizing systems, in which candidates in a cohort engage and compete for similar goals. Each applicant strives to improve his or her own behavior by observing the actions of the other candidates in the cohort. A breakthrough Cohort Intelligence (CI) is a technique that is based on a cohort's self-supervised learning behavior[2]. The term "cohort" refers to a group of candidates who collaborate and compete to achieve a common goal. Every candidate in a cohort monitors the behavior of the other candidates in the cohort in order to improve their own performance. Every applicant may adopt a specific behavior in the cohort, which may lead to a change in their own behavior. When a candidate imitates a specific trait, it tries to adapt to the corresponding attributes[1].

Graphical representation of Cohort Intelligence Algorithm

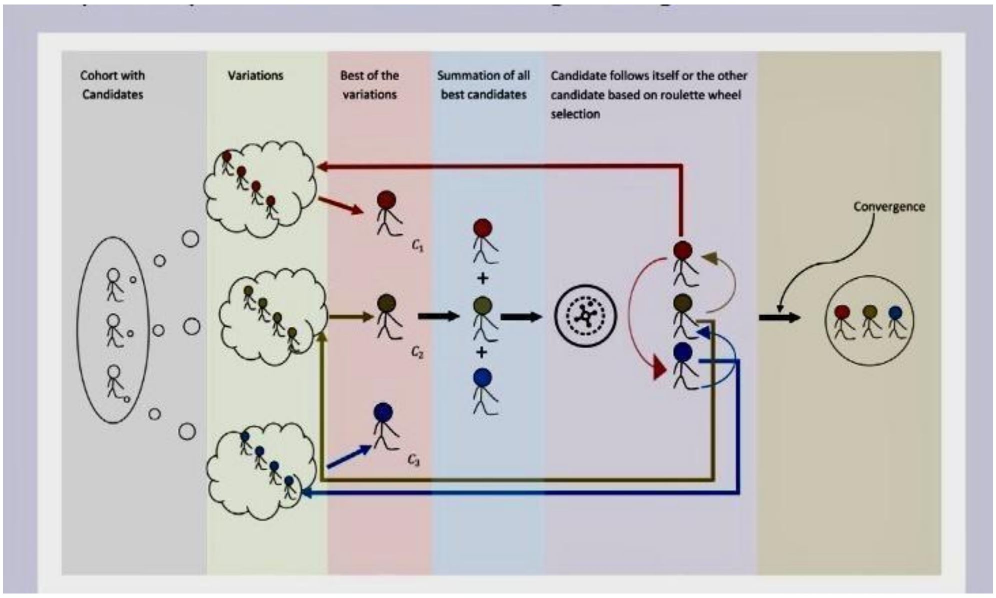

Fig 1

For years, academic research has focused on the examination of assembly line bottlenecks[9]. A bottleneck is defined as one of the workstations that limits the assembly line's overall output rate because demand exceeds the bottleneck's capacity, either temporarily or permanently [9, 11, 12]. It may result in situations where an upstream workstation has completed processing items but is unable to deliver them to a downstream workstation because it is still busy, or where a downstream workstation is idle and waiting for items to be delivered from an upstream workstation that is still processing [9, 13]. Furthermore, bottlenecks in a manufacturing process might cause two challenges. First, if the assembly line's capacity is insufficient to meet client demand, the company risks losing sales and goodwill. Second, extra inventory carrying costs are incurred if surplus inventory accumulates in front of bottleneck workstations. Controlling bottleneck workstations is well known for smoothing the flow of materials in an assembly line, improving customer satisfaction and lowering costs[9]. Because the presence of a bottleneck is a crucial determinant in assembly line performance and management [14, 15], bottlenecks are almost expected to exist [16]. As a result, it's critical to eliminate bottlenecks. By upgrading it, we mean raising the existing bottleneck's throughput capacity, allowing the entire assembly line to run more efficiently. Improvements at non-bottleneck workstations, on the other hand, do not boost system capacity. Models for controlling and managing bottleneck workstations have been developed by a number of researchers. However, locating a bottleneck is necessary before it can be remedied. In manufacturing operations, bottleneck analysis is very popular, and a lot of research has been done on bottleneck detection in recent years [17].

On discrete and mixed variable nonlinear constrained optimization problems, the performance of a novel socio-inspired metaheuristic optimization technique known as Cohort Intelligence (CI) algorithm is evaluated[9]. The problems studied are primarily from the disciplines of discrete structural optimization and mixed variable mechanical engineering design. A round off integer sampling strategy is provided for managing discrete solution variables. A penalty function approach is also included to deal with nonlinear restrictions. When compared to other known optimization strategies, such as the Multi Random Start Local Search algorithm, the acquired results are promising and computationally more efficient[9]. The accompanying benefits and drawbacks of the CI algorithm are also explored, with the effect of its two parameters, the number of candidates and the sample space reduction factor, being evaluated[9].

Bottleneck analysis is important for illustrating workflow in healthcare systems and identifying constraints in the execution of conventional precautions[2]. To alleviate the identified obstacles in standard precaution, institutional modifications like focused provider training, workload adjustments, and budget allocation are suggested options[2,13]. The CI approach is successfully proposed, and the cohort candidates' self-supervising nature, as well as their learning and improving qualities, are successfully exhibited, further improving their individual behavior[1,9]. Solving four test problems successfully validates the methodology. The findings revealed that the method is sufficiently resilient and has a low computing cost. The method is proven to be quite competitive, even better than some of the current methods[1].

II. Related Work

In this paper they have solved 3 optimization problems with cohort intelligence out of which one is that of healthcare only one which we are interested in but they have not considered any exceptions while solving this problem for eg. In case of an emergency how should the resources be allocated is something on which we could work on [1]. The CI algorithm could be explored with multi-criteria and multi objective CI algorithm. Similarly a generic probability based constraint handling technique could be used [2]. The impact of other features such as direct waiting time (patients' waiting time at the clinic) and patient-to-provider ratio. the performance of the proposed variants of OSACI algorithm can be investigated on other datasets and problem domains. Furthermore, it is also interesting to examine the impact of employing other OBL types, such as Center-based Sampling, and Quasi-Reflection OBL, for initialization and cohort update on the convergence speed, especially with highly-dimensional datasets [3]. In this work, eight different dominance relations are employed and their performances are evaluated against the proposed strong dominance relation. However, when this algorithm is set to perform within limited number of iterations, it does not perform well. There is a strong need to design an algorithm that could fetch desired number of NDS within the provided number of iterations such as combining it with ANN to avoid overfitting [4]. This paper explains about the cohort intelligence a self supervised learning behaviour in which other members of cohort improves themselves by observing the behaviours of other members. We can use this intelligence and basics about this algorithm to create a model which improves from time to time on a real time data and can solve the cyclic bottleneck problem for a large number of dataset as well [5].

Literature Review

S. No.	Title	Authors	Publisher (Conference / Journal)	Methodology	Conclusion / Research Gap
1	Application of the cohort-intelligence optimization method to three selected combinatorial optimization problems	Anand J. Kulkarni, M. F. Baki, Ben A. Chaouch	Elsevier	Cohort Intelligence and MRSLS	In this paper they have solved 3 optimization problems with cohort intelligence out of which one is that of healthcare only one which we are interested in but they have not considered any exceptions while solving this problem for eg. In case of an emergency how should the resources be allocated is something on which we could work on.
2	Cohort intelligence algorithm for discrete and mixed variable Engineering problems	Ishaan R. Kale and Anand J. Kulkarni	International journal of parallel, Emergent and distributed systems	Cohort Intelligence	The CI algorithm could be explored with multi-criteria and multi objective CI algorithm. Similarly a generic probability based constraint handling technique could be used.
3	New feature selection methods based on opposition-based learning and self-adaptive cohort intelligence for predicting patient no-shows	M. Aladeemy, L. Adwan, A. Booth, M. khasawneh and S. Poranki	Applied soft computing journal	Cohort intelligence	the impact of other features such as direct waiting time (patients' waiting time at the clinic) and patient-to-provider ratio. The performance of the proposed variants of OSACI algorithm can be investigated on other datasets and problem domains. Furthermore, it is also interesting to examine the impact of employing other OBL types, such as Center-based Sampling, and Quasi-Reflection OBL, for initialization and cohort update on the

					convergence speed, especially with highly-dimensional datasets.
4	Pareto Dominance based Multiobjective Cohort Intelligence Algorithm	Mukundraj V. Patil , Anand J. Kulkarni	Elsevier	Cohort Intelligence	In this work, eight different dominance relations are employed and their performances are evaluated against the proposed strong dominance relation. However, when this algorithm is set to perform within limited number of iterations, it does not perform well. There is a strong need to design an algorithm that
					could fetch desired number of NDS within the provided number of iterations such as combining it with ANN to avoid overfitting.

5	Cohort Intelligence: A Self Supervised Learning Behavior	Anand J Kulkarni, Ishan P. Durugkar, Mrinal Kumar	IEEE	Cohort Intelligence	This paper explains about the cohort intelligence a self supervised learning behaviour in which other members of cohort improves themselves by observing the behaviours of other members. We can use this intelligence and basics about this algorithm to create a model which improves from time to time on a real time data and can solve the cyclic bottleneck problem for a large number of dataset as well.
6	Tabu Search and Iterated Local Search for the Cyclic Bottleneck Assignment Problem	Xiangyong Li, Lanjian Zhu, Fazle Baki, A.B. Chaouch	Elsevier	Tabu Search and Iterated Local Search	In this paper, they have studied the cyclic bottleneck assignment problem (CBAP).Consequently, they present two algorithms that can be used to solve the problem efficiently.One algorithm is based on the Tabu search method, and the

					other follows an iterated local search scheme.Their algorithms outperforms existing approaches. But they also have not condired any exceptions like emergency entry of a patient in a hospital which we could work on.

7	A robust block-chain based tabu search algorithm for the dynamic lot sizing	Xiangyong Li,Fazle Baki ,Peng Tian,Ben A. Chaouch	Elsevier	Tabu Search algorithm	In this paper, they have studied the dynamic lot sizing problem (DLRR).Consequently, they present an algorithm to solve this problem efficiently called as the Tabu Search algorithm. The same algorithm that was used in the previous paper to solve the cbap. This paper helped us understand this algorithm even furthur.
8	Iterated Local Search: Framework and Applications	Helena R. Lourenc¸o , Olivier C. Martin and Thomas Stutzle	Springer	Iterated Local Search	This paper explains the Framework and applications of Iterated Local Search algorithm used to solve cbap in the paper-6. This helped use get a good understanding of this method.
9	A Bottleneck Detection Algorithm for Complex Product Assembly Line Based on Maximum Operation Capacity	Dongping Zhao, Xitian Tian, and Junhao Geng	Hindawi Publishing Corporation - Mathematical Problems in Engineering	A novel algorithm of bottlenecks detection in complex production assembly line based on maximum operation capacity	Could Extend the methods to detect bottlenecks in assembly networks with varying operation capacity is a complex mathematical challenge.
10	Using Bottleneck Analysis to Examine the Implementation of Standard	Chunqing Lin,a,* Li Li,a Liang Chen,b Yunjiao Pan,b and	AJIC Journal	Bottleneck analysis	There are a few gaps to this study that should be mentioned. First, the research was limited to a single Chinese province. The findings may not be

	Precautions in Hospitals	Jihui Guanb			applicable to other locations where changing economic circumstances may have an impact on the implementation of conventional precautions in hospitals.

III. The implemented methods

A. Tabus and Tabu List

Tabus are a type of short-term memory that is used to record the properties of visited solutions in order to avoid cycling when moving away from local optima via non-improving steps (Gendreau and Potvin 2010). Tabus can also help the search move away from previously explored portions of the search space, allowing for more thorough exploration. To do so, we declare tabu movements, which have the effect of reversing recent moves. The tabu list keeps tabus organized. In the TS-CBAP technique, the definition of tabus is determined by which nearby operator vis is employed. We employ numerous tabu lists at the same time, and each type of nearby operator has its own tabu list.

B. Iterated Local Search for the CBAP

The CBAP is then given an iterated local search (ILS). The ILS is a straightforward and effective stochastic local search method. It's been used to solve certain difficult combinatorial optimization problems, such as the traveling salesman problem and vehicle routing issues (Gendreau and Potvin 2010). Rather than sampling the space of all potential candidate solutions, the ILS does a biased, randomized walk in the space of locally optimal solutions. This walk is implemented by applying a perturbation to a locally optimal solution iteratively, then using a local search strategy, and finally using an acceptance criterion to choose which locally optimal solution the next perturbation should be applied to.

C. Bottleneck analysis

Bottleneck analysis is a step-by-step method for identifying restrictions that prevent a health system from attaining the desired effect of an intervention, in this case routine precautions. 20-22 The method begins by visualizing the process steps from beginning to end, determining a target value (e.g., throughput rate, waiting time, difficulty level) for each process step, identifying process steps where workflow is constrained, and locating and resolving the root causes of those constraints. Between August 2016 and June 2017, bottleneck analysis was carried out in 12 hospitals in Fujian Province, China. A stratified sampling approach was used to choose the hospitals.

D. Cohort Intelligence

Cohort Intelligence (CI) is a novel Artificial Intelligence (AI) technique that has recently been developed. It is based on the social inclination of cohort candidates to learn through interaction and competition with one another. Every applicant may adopt a specific conduct in the cohort, which, in turn, may lead to an improvement in their own behavior.

IV. Conclusion

In this paper, we have received various articles, analyzed their methods and approaches, and major features of the algorithm utilized. We have majorly discussed algorithms like Tabus and Tabu List, Iterated Local Search for the CBAP, Bottleneck Analysis, and Cohort Intelligence. Then we discussed the related research work done in the same.

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