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SHIFTTING BOTTLENECK ALGORITHM FOR JOB SHOP SCHEDULING PROBLEM

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Abstract
The job shop scheduling is typical task which can optimize the utilization facilities in this paper scheduling problem for 5 jobs on 5 machine is presented to determine the optimal priority sequence of the jobs shifting bottleneck algorithm is considered the make span obtained from the algorithm is compare with lekin software.
Keywords*: job shop scheduling; make span time bottleneck heuristic algorithms, lekin soft ware.*
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1. Introduction

To minimize the make span in a job shop by using Shifting bottle neck is one of the efficient procedures. It follows the pre-defined machines sequence always in one machine with bottleneck processing sequences. Through iterative method the heuristic algorithm is used to minimize the bottleneck process by finding maximum make span time (Cmax) and maximum lateness time (Lmax).
Many researches is focus on this area. By Jilcha Kassu & Berhan Eshetie (2015) [2] - with Shifting Heuristic Bottleneck, Job Shop Scheduling Problem for Machine Shop. By Jinliang Cheng Yoshiyuki Karuno Hiroshi Kise(2001)- Shifting bottle neck approach for flow shop scheduling problem . Mohd Salleh Abdul Rahim (2011)[3] – consider 3 machine flow shop problem using bottleneck heuristic algorithms to given optimum solution. Riza A. Rahman, Budi Santosa, and Stefanus E. Wiratno (2014)[5]: This paper combines the differential algorithm with bottleneck heuristic for two-objective Minimization makes span time. Salleh Ahmad BAREDUAN, Sulaiman HASAN (2010), using bottleneck-based algorithms, effective make span & heuristic developed to solve for near-optimal scheduling sequence. . In this paper we have used bottleneck heuristic algorithms is to be developed to Minimize the maximum completion make span time. The result obtained is to be compared with lekin software.
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2. LITERATURE REVIEW:

The objective of this paper is used to minimize the make-span : total time. Most of the Research Work done on the field of flow shop scheduling problem. Chun-LungChen & Chuen Lung Chen (2009)-The main purpose of this paper is to minimize the make span flow-line with the use of bottleneck –based heuristic; In this they proposed three machines for typical flow-shop. Ciaxia Jing,Guochun Tang & Xingsan Qian(2008)- A heuristic algorithm is used for two machine re-entrant in flow shop scheduling problem to minimize the make span time, it also shows some assumptions, before developing a schedule, have to be identified. Anurag Agrawal,Selcuk Colak and Enes Eryarsoy (2006)-author used a different approach by using heuristic based on adaptive learning, and also used upper –bound solution to compare results. Li Xiaoping,Liu Lianchen & Wu Cheng (2006) A heuristic fast method is used in solve a large-scale flow shop scheduling by heuristic fast method. They compute the completion time of flow-shop by using completion time computing method. Pawal Jan Kalczynski & Jerzy Kamburowski(2005)- A heuristic algorithm is used to minimize the make span time in flow shop scheduling. the author focus on m-machine flow shop problem; this problem is also called NP-hard. Chun-Lung (2009) A heuristic bottle neck-based algorithm is used to minimize total make span time for flexible flow line. Salleh Ahmad Bareduan, Sulaiman Hasan (2010)-Make span Algorithms and Heuristic for Manufacturing Process Using Bottleneck Approach

3. METHODOLOGY: In Job Shop Scheduling Problem; there are number of optimization method used. The methods are

Traditional Technique:

1. Mathematical programming- Integer programming, Goal programming, Dynamic programming, Liner programming, Branch and bound method , Genetic method, mixed integer liner programming, Transportation, Network, cutting plane/ column generation method
2. Enumerate procedure Decomposition
3. Lagrangian relaxation
4. Efficient Methods

Non Traditional Techniques

5. Constructive Methods (priority rules, dispatching rules)
6. Insertion Algorithms (Bottleneck heuristic, shifting bottleneck procedure)
7. Evolutionary programs (Genetic Algorithms)
8. Local search techniques (ant colony optimization, tabu search, simulated annealing, problem space method, heuristic method)
9. Iterative methods: (Artificial intelligence techniques)
10. Heuristics algorithms (NEH ,CDS, Palmers)
11. Beam search & Hybrid Technique

Shifting Bottleneck Heuristics:

Algorithms:

1. Initialization
M0 = (job shop scheduled machines
Cmax = Maximum make span time
2. (Choice of machine.) For each Mi 2 M −M0,
Create the 1|rj|Lmax schedule
Find out L|max(i).
3. Scheduling is bottleneck machine
k be the machine that maximizes Lmax(i)
Schedule k by the solution of !|rj|Lmax
Form the 1|rj|Lmax

Consider 5 jobs & 5 machine problem

J-m	M1	M2	M3	M4	M5
J1	4	2	2	12	3
J2	3	1	2	12	1
J3	5	3	4	11	4
J4	6	4	3	12	3
J5	7	2	4	14	4

Step 1st : Total load of each machine
M1= 4+3+5+6+7= 25 , M2= 2+1+3+4+2=12, M3=2+2+4+3+4=15
M4=12+12+11+12+14=61, M5=3+1+4+3+4=15
Make span Cmax= 61 (longest path)
Start with LB of 61 on M4 because it has the highest load among the 5 machines
Machine 4 is the bottleneck
Applying 1/rj/Lmax to M4
LB=27 (M4)
dj = Cmax - Node values on right side

Job	J1	J2	J3	J4	J5
Pi	12	12	11	12	14
Ri	8	6	12	13	13
Di	58	60	57	58	57

pj = Processing time for job j.

rj = Earliness for job j. dj = j job for Due date

We have a five possible sequence to apply

Seq.(1)	J1	J2	J3	J4	J4
CT	20	32	43	55	69
DD	58	60	57	58	57
LP	-38	-28	-14	-3	12

So longest path is 12

Seq.(2)	J2	J3	J4	J5	J1
CT	18	29	41	55	67
DD	60	57	58	57	58
LP	-42	-28	-17	-2	9

Longest path is 9

Seq.(3)	J3	J4	J5	J1	J2
CT	23	35	49	61	73
DD	57	58	57	58	60
LP	-34	-23	-8	3	13

Longest path is 13

Seq.(4)	J4	J5	J1	J2	J3
CT	25	39	51	63	74
DD	58	57	58	60	57
LP	-33	-18	-7	3	17

Longest path is 17

Seq.(5)	J5	J1	J2	J3	J4
CT	27	39	51	62	74
DD	57	58	60	57	58
LP	-30	-19	-9	5	16

Longest path is 16

Among the following sequence the lowest path is 9 so we have choose a LB technique 9
LB=9 we have a 4 possible sequence
J2-1,J2-3,J2-4 & J2-5
We find
J2-1= Longest path 10, J2-3= Longest path 9
J2-4= Longest path 10,J2-5= Longest path 9
The sequence lowest path is 9
So we have 3 possible sequences
J2-3-1= Longest path 10
J2-3-4= Longest path 9
J2-3-5= Longest path 9
Above sequence lowest path is 9 so we have 2 possible sequences.
J2-3-4-1= Longest sequence 10 & J2-3-4-5= Longest sequence 9.
i.e Cmax = higest load +Lmax =61+9=70 hr
Bottleneck heuristic algorithms make span time is giving 70 hr.

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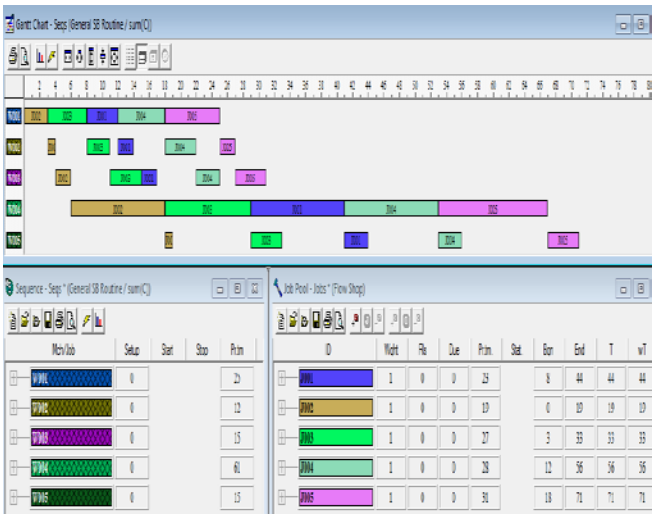
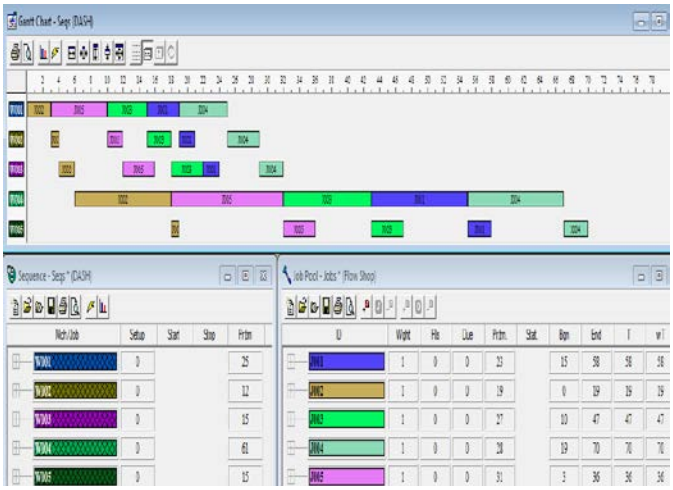
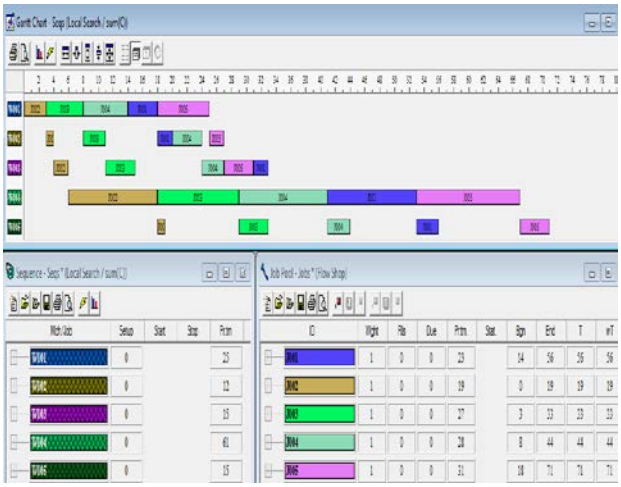
4. Lekin: In Generic job shop scheduling system ,it contains a number of scheduling & heuristics algorithms , & its allow the user to link and test his own heuristics and compare their performance with the heuristics algorithms that are embedded in the system. The Lekin system can be accommodating various machine environments:

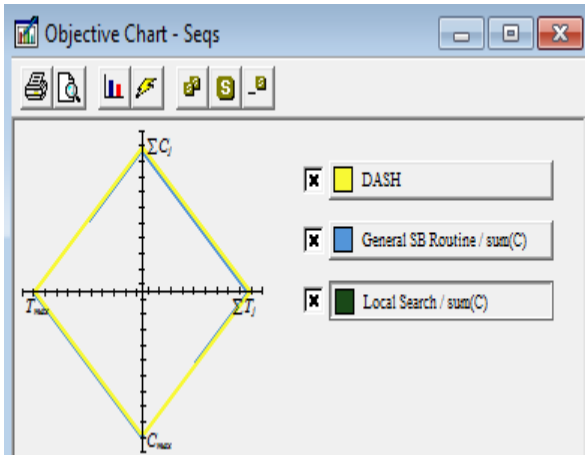
(1) Single machine (2) Parallel machine (3) Flow shop (4) Flexible flow shop (5) Job shop

In the lekin software, firstly the user can select a menu in machine environment & enter the all necessary machine data and job data manually. In the main menu the user also has the option of opening an existing data file. An existing file contains the data with the machine environments And specific set of jobs. If the user wants to open an existing file & make changes in the file and work in the modified file. At last the user can save the modified file with a new name. If the user wants to enter a data set that is completely new, firstly the user must select a machine environment, the dialog box appears where he has to enter the most basic information. i.e. the number of work centers and the number of schedules. After the user has done , a second dialog box appears and where the user enters the more detailed work center information .i.e. the no. of machine at the work center with their availability and the details needed to determine the setup times on each machine .In the third dialog box the user has to enter the detailed information related with the job









5. RESULT: comparison between algorithms with lekin software

Algorithms	**Make span time(hr)**
Shifting bottleneck heuristic	70
DASH	70
General SB Routine	71
Local Search	71

6. Conclusion: The present work focused on job shop scheduling problem using Bottleneck heuristic Algorithm to minimize the make span time. There is a wide scope of work in the job shop scheduling problem but there is a no perfect method found till date. So: There are continuous research is going on to minimize the make span for a job shop scheduling problem.

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