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A Better Heuristic Approach For n-Job m-Machine Flow Shop Scheduling Problem

Vasudevan G[1], Dr Jayakumar S[2] and Sathiya shanthi R[3]
[1,3]Research Scholar PD & Research Department of Mathematics,
Arignar Anna Government Arts College, Cheyyar.
[2]Assistant Professor & Head, PG & Research Department of Mathematics,
Arignar Anna Government Arts College, Cheyyar.

Abstract

Scheduling problem has its origin in manufacturing industry.In this paper we describe a simple approach for solving the flow shop scheduling problem. The result we obtained has been compared with Palmers Heuristic and CDS algorithms along with NEH. It was found that our method will reach near optimum solution within few steps compared to CDS and NEH algorithm and yield better result compared to Palmers Heuristic with objective of minimizing the Makespan for the horizontal rectangular matrix problems.

Key words: Heuristic, Flow Shop Scheduling, Makespan, Scheduling .

1. Introduction

Sequencing is nothing but the selection of an appropriate order for a series of jobs to be done on a finite number of machines or service facilities in some pre assigned order. In particular scheduling is nothing but allocation of resources over a period of time in order to perform a collection of tasks. In many industrial systems the jobs processing time can increase due to deterioration of machines that has a negative influence on the total output. Additional resource allocated jobs can decrease their processing time and increase the production cost. A flow shop problem exists when all the jobs share the same processing order on all the machines.The processing time is the time require for a job to process on a particular machine. In particular total elapsed time is the total time required to complete the job from the start of the first job to the end of the last job in the sequence. The idle time is the time when there is

[2]sundarajayakumar@gmail.com

no jobs to process on a machine that is it is a time for which machine remains free.

In this paper we are focused attention on minimizing the makespan and compared our algorithm with palmers Heuristic algorithm and CDS algorithm and NEH algorithm. It has been found that our algorithm performs better than palmers Heuristic and our algorithm solves the problem at quicker possible time when compared to CDS and NEH algorithm.

2. Literature Review

In the year 1965 Palmer develop an algorithm for solving sequencing of jobs through a multi stage process in the minimum total time a quick method of obtaining near optimum. In the year 1970 Herbert G Campbell, Richard A Dudek and Milton L Smith (CDS) find an algorithm to solve the flow shop scheduling using an Heuristic approach even though the result obtained are near optimum its a lengthy process to find near optimum. Nawaz. M.,Enscore Jr. E. And Ham. L., the n job flow shop problem using a Heuristic algorithm for the machine, n- job flow shop scheduling problem in the year 1983.

Our algorithm is based on the following assumptions:

- There are 'n' jobs to be processed on 'm' machines.
- All jobs are available at time zero.
- The number of machines is always greater than number of jobs.
- Only one job can be processed at a given point of time on one machine.
- Pre-emption not allowed.
- Processing times are denoted by 'Pij'.
- Each operation once started must be processed till its completion.
- All jobs are known and are ready to start processing before the period under consideration begins.
- The time required to pass the job from one machine to another is negligible.
- We have focused our attention on $n < m$ problems only.

An JayaVasu Algorithm to solve 'n'-job 'm'-machine problem where '$n < m'$**:**

1. Check whether the number of machines is greater than number of jobs if yes go to step 2 where m and n are greater than two.
2. If so calculate $[\frac{m}{2}] + 1$ and add the first $[\frac{m}{2}] + 1$ processing times for each and every machines and put it on M_1'.
3. Similarly calculate and add the last$[\frac{m}{2}] + 1$; the processing time for each and every row in the reverse order and then put it on M_2'.
4. The given problem now reduced to two machines n job problem and easily solved by using Johnsons algorithm.

[2]sundarajayakumar@gmail.com

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Numerical Problem:

Machines Jobs	M1	M2	M3	M4	M5	M6
J1	3	5	2	4	8	1
J2	9	7	6	4	5	3
J3	1	3	5	2	6	4
J4	2	4	8	3	5	7

Using Jayavasu algorithm:

Step 1: Assume number of jobs by n and number of machines by m
Step 2: Calculate $[\frac{m}{2}] + 1$

Here m=6,n=4,$[\frac{6}{2}] + 1 = 4$.

Step 3: Add first $[\frac{m}{2}] + 1$ machines and assume it as $M_1^{'}$.

That is $M_1^{'} = M1 + M2 + M3 + M4$ and

Step 4: Add last $[\frac{m}{2}] + 1$ machines and assume it as $M_2^{'}$.

That is $M_2^{'} = M3 + M4 + M5 + M6$.

Step 5: Table $M_1^{'}$ and $M_2^{'}$

	J1	**J2**	**J3**	**J4**
M_1	14	26	11	17
M_2	15	18	17	23

Step:6

Using Johnsons algorithm we can find a sequence

J3	**J1**	**J4**	**J2**

Step:6 Now we can find the Makespan:

[2]sundarajayakumar@gmail.com

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Machines Jobs	M1	M2	M3	M4	M5	M6
J3	0-1	1-4	4-9	9-11	11-17	17-21
J1	1-4	4-9	9-11	11-15	17-25	25-26
J4	4-6	9-13	13-21	21-24	25-30	30-17
J2	6-15	15-22	22-28	28-32	32-37	37-40

We get the Makespan is 40

Palmers Heuristic:

Using Palmers Heuristic
We get the sequence of jobs

J4	**J3**	**J1**	**J2**

Machines Jobs	M1	M2	M3	M4	M5	M6
J4	0-2	2-6	6-14	14-17	17-22	22-29
J3	2-3	6-9	14-19	19-21	22-28	29-33
J1	3-6	9-14	19-21	21-25	28-36	36-37
J2	6-15	15-22	22-28	28-32	36-41	41-44

Makespan is 44 from Palmers Heuristic

Campbell, Dudek, and Smith (CDS) Algorithms:

There are six machines in this problem, five (m-1) surrogate problem will be found

I surrogate problem:

We get sequence

J3	**J4**	**J2**	**J1**

Machines Jobs	M1	M2	M3	M4	M5	M6
J3	0-1	1-4	4-9	9-11	11-17	17-21
J4	1-3	4-8	9-17	17-20	20-25	25-32
J2	3-12	12-19	19-25	25-29	29-34	34-37
J1	12-15	19-24	25-27	29-33	34-42	42-43

[2]sundarajayakumar@gmail.com

Here Makespan is 43

II surrogate problem:

We get sequence

J3	**J4**	**J1**	**J2**

Machines Jobs	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**
J3	0-1	1-4	4-9	9-11	11-17	17-21
J4	1-3	4-8	9-17	17-20	20-25	25-32
J1	3-12	12-17	17-19	20-24	25-33	33-34
J2	12-21	21-28	28-34	34-38	38-42	42-45

Here Makespan is 45

III surrogate problem:

We get sequence

J3	**J1**	**J4**	**J2**

This sequence is same as our sequence (Here C_{max} is 40)

IV surrogate problem:

We get sequence

J3	**J1**	**J4**	**J2**

This sequence is same as our sequence (Here Makespan is 40)

V surrogate problem:

We get sequence

J3	**J1**	**J4**	**J2**

This sequence is same as our sequence (Here Makespan is 40)

Nawaz, Enscor and Ham (NEH) algorithm:

Ordered list of jobs J2, J4, J1, J3 since Jobs J2 and J4 have highest value of T_j.

I Iteration:

The calculation of Makespan value for partial schedule J2 J4 ** and J4 J2 **

The Makespan value of partial schedule J2 J4 ** is 41 and J4 J2 ** is 35.

II Iteration:

The calculation of Makespan value for partial schedule J1 J4 J2 * , J4 J1 J2 * and

J4 J2 J1 *.
The Makespan value of partial schedule J1 J4 J2 * is 39 , J4 J1 J2 * is 39 and J4 J2 J1 * is 42.
There is a tie between the partial schedule J1 J4 J2 *, J4 J1 J2 *.
Now we take for further investigate the partial schedule J1 J4 J2 *, J4 J1 J2 *.
We can get Eight partial schedule for next Iteration.
III Iteration:
The Makespan value of possible schedule are

1. J3 J1 J4 J2 is 40
2. J1 J3 J4 J2 is 43
3. J1 J4 J3 J2 is 43
4. J1 J4 J2 J3 is 44
5. J3 J4 J1 J2 is 41
6. J4 J3 J1 J2 is 44
7. J4 J1 J3 J2 is 44
8. J4 J1 J2 J3 is 46

Authors Algorithm	**Palmers Heuristic**	**CDS Algorithm**	**NEH Algorithm**	**JayaVasu Algorithm Algorithm**
Makespan obtained for the above problem	44	40 (Five Surrogate)	40(out of Eight Schedule in third Iteration)	40

3. Conclusion

Based on result obtained in our problem it was found that our algorithm is superior than Palmers heuristic Algorithm and our algorithm found the solution in quick time when compared to CDS algorithms. Hence conclude that our algorithm performs better when solving the Horizontal rectangular matrix problem.

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[2]sundarajayakumar@gmail.com