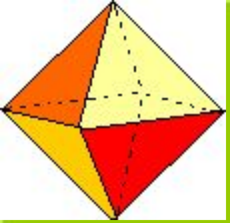
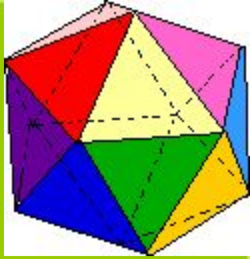
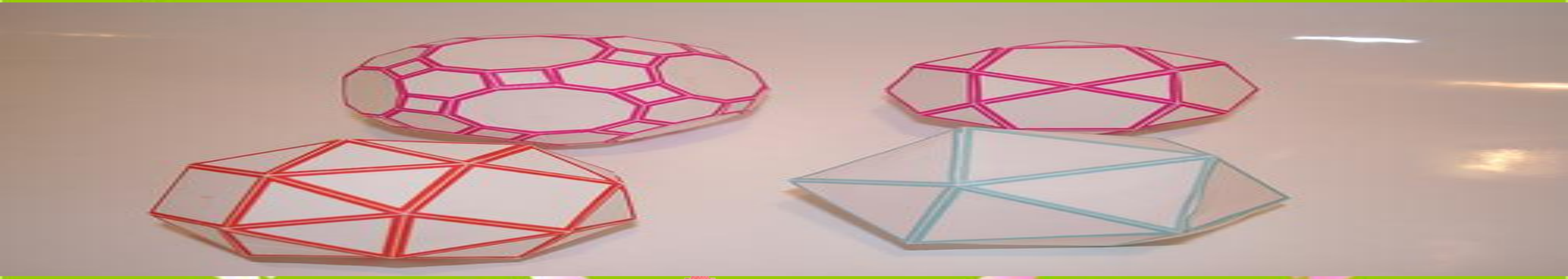


'An order is to be observed in all things'



WELCOME



A STUDY ON SEQUENCING MODELS

BY

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SEQUENCING

Definition: Selection of an appropriate order for a series of job to be done on a number of service facilities so as to optimize the total effectiveness (may be time, cost etc which is a function of the order)

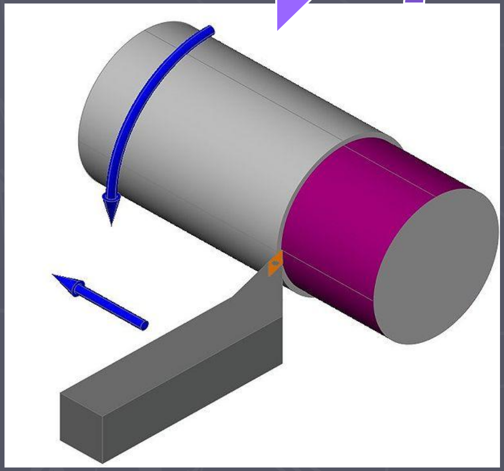
BASIC TERMS

- Number of machines
- Processing order
- Processing time
- Idle time on a machine
- Total elapsed time
- No Passing Rule

Machine operations in lathe

Materials 1, 2, 3, 4, 5,6 (Jobs)

Job	1	2	3	4	5	6
Turning	3	12	5	2	9	11
Threading	8	6	4	6	3	1
Knurling	13	14	9	12	8	13



Turning

Threading

Knurling

Machine operations in lathe

- Machine order fixed – Turning Threading Knurling
- Job order 123456 132456 . . .

  234561 243561 . . .

  345612 354612 . . .

  456123 465123 . . .

  561234 516234 . . .

  612345 621345 . . . Total 6! Orders
- From these find the order which minimizes time/ cost
- This is a 6 job – 3 machine problem

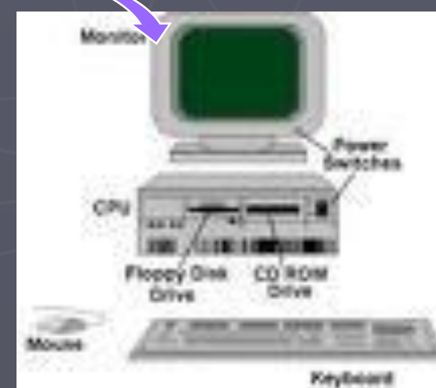
Sequencing in computer systems

Programs 1, 2, 3, 4 (Jobs)

Job	1	2	3	4	5
M	3	8	7	5	2
CPU	3	4	2	1	5
I/O	5	8	10	7	6

Memory

CPU



Input/ Output

This is a 4 job – 3 machine sequencing problem

General Sequencing problem

- n jobs on m machines
- $(n!)^m$ possible sequences
- Find the sequence minimizing the total time
- When n =4, m =5 there are

  $(4!)^5$ = 7962624 possible sequences
- Enumeration impossible for even smaller m and n

Processing n jobs through 2 machines

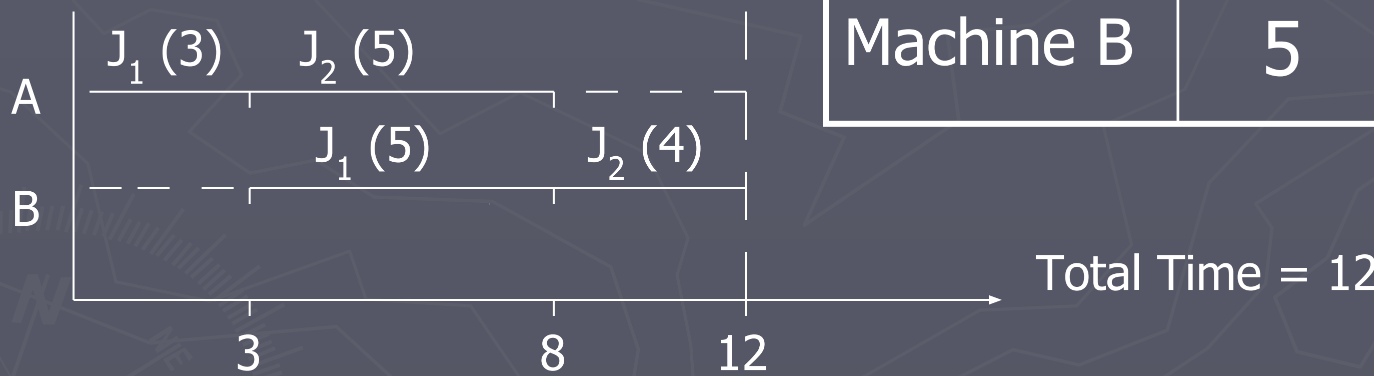
- *General Form*

Jobs	1	2 . . .	n
Mac A	a_1	a_2 . . .	a_n
Mac B	b_1	b_2 . . .	b_n

Gnatt Chart

- Consider the two job - Two machine problem

Job	J_1	J_2
Machine A	3	5
Machine B	5	4



Optimum Sequence Algorithm

*Illustration:*A book binder has a printing press , a binding machine & the manuscripts of different books. The processing times are given. Determine the optimum sequence.

BOOK	1	2	3	4	5	6
Printing Time (hrs)	30	120	50	20	90	100
Binding Time (hrs)	80	100	90	60	30	10

Optimum sequence Algorithm

- Find the smallest processing time. If it is for first machine, place the job in first available position of the sequence. If it is for second machine place the job in the last available position of the sequence.
- If there is a tie

Optimum sequence Algorithm

(i) among the two machines ($a_k = b_r$) place job corresponding to first machine (job k) in first available position of the sequence and the job corresponding to second machine (job r) in the last available position of the sequence.

(ii) among same machine ($a_k = a_r$ / $b_k = b_r$), break the tie arbitrarily

					6

Optimum sequence Algorithm

- Cross off the jobs already assigned and repeat the above procedure

4					6
4	1			5	6
4	1	3		5	6
4	1	3	2	5	6

Optimum sequence Algorithm

- Calculate the idle times and total elapsed time

Books	Printing In Out	Binding In Out	Idle times Printing	Idle times Binding
4	0 -20	20 – 80	0	20
1	20 - 50	80 - 160	0	0
3	50 -100	160 -250	0	0
2	100 - 220	250 - 350	0	0
5	220 - 310	350 - 380	0	0
6	310 – 410	410 - 420	10	30

Processing n jobs through 3 machines

- General form

Jobs	1	2	. . .	n
Mac A	a_1	a_2	. . .	a_n
Mac B	b_1	b_2	. . .	b_n
Mac C	c_1	c_2	. . .	C_n

- Solution Procedure

  If minimum among a_i / among c_i is greater than or equal to the maximum among c_i then we can reduce this to an n job – 2 machine problem as below:

Processing n jobs through 3 machines

Introduce two fictitious machines G and H whose processing times are defined by

$$g_i = a_i + b_i \;\&\; h_i = b_i + c_i$$

Then proceed as in the above case

Processing n jobs through m machines

- General form

Jobs	1	2 . . .	n
Mac A	a_1	a_2 . . .	a_n
Mac B	b_1	b_2 . . .	b_n
… …	…	…	
Mac F	f_1	f_2 . . .	f_n

- Solution Procedure

  If minimum among a_i / among f_i is greater than or equal to the maximum among b_i , c_i , … , e_i then we can reduce this to an n job – 2 machine problem as below

Processing n jobs through m machines

Introduce two fictitious machines G and H whose processing times are defined by

$$g_i = a_i + b_i + \ldots + e_i \;\&$$

$$h_i = b_i + c_i + \ldots + fi$$

Then proceed as in the above case

EXAMPLE

- Determine the optimum sequence for the 4 job – 6 machine problem.

Machines	M_1	M_2	M_3	M_4	M_5	M_6
Job A	18	8	7	2	10	25
Job B	17	6	9	6	8	19
Job C	11	5	8	5	7	15
Job D	20	4	3	4	8	12

Min of M_1 = 11, Max M_2, M_3, M_4, M_5 = 10, Min M_6 = 12

Solution

Condition for fictitious Machines is satisfied.

	Jobs	A	B	C	D
Fictitious	Machine G	45	46	36	39
	Machine H	52	48	40	31

Sequence

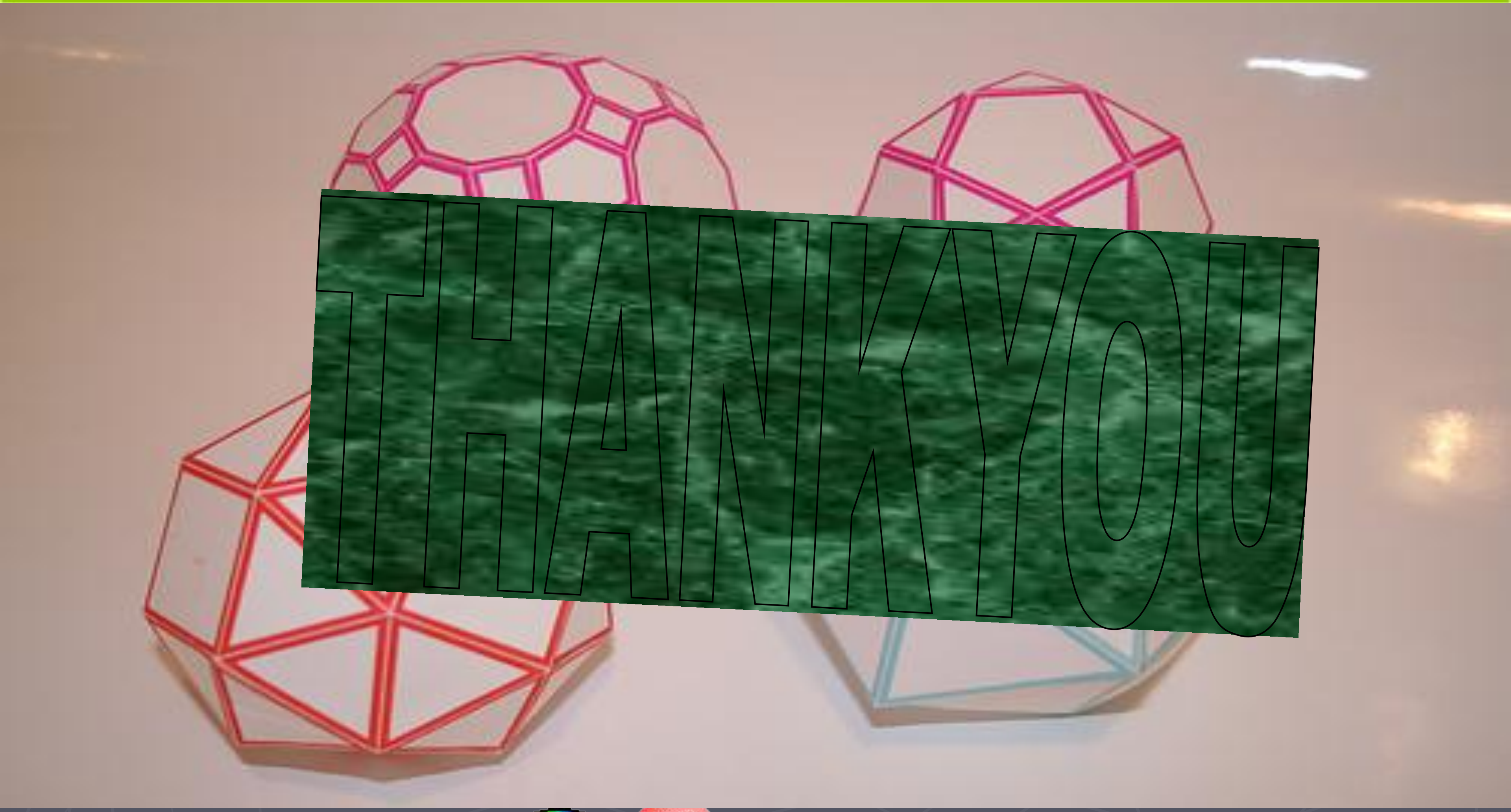
C	A	B	D

Processing

Jobs	M_1 In Out	M_2 In Out	M_3 In Out	M_4 In Out	M_5 In Out	M_6 In Out
C	0 -11	11 -16	16 -24	24 -29	29 -36	36 -51
A	11 -29	29 -37	37 -44	44 -46	46 -56	56 -81
B	29 -46	46 -52	52 -61	61 -67	67 -75	81 -100
D	46 -66	66 -70	70 -73	73 -77	77 -85	100 -112

Total elapsed time = 112 hrs

Idle times M1 to M6 are 46, 89, 85, 95,79,41 respectively


THANKYOU