IE 516 Manufacturing Planning and Control Take Home Final Examination due January 6th , 2013

Fall 2012

Question Number One:

Give an instance of a scheduling problem with the following property: if the processing time of one job is reduced by 1 unit of time, the makespan of the best nondelay schedule increases.

Question Number Two:

Consider the following instance of the job shop with time to complete all jobs and the objective function must be minimized.

Jobs	Ready times	Machine Sequence	Processing times
1	0	1-2-3-4	$p_{11} = 10, p_{21} = 20, p_{31} = 25, p_{41} = 20$
2	15	1-3-2-4	$p_{12} = 25, p_{32} = 10, p_{22} = 20, p_{42} = 15$
3	15	4-2-3-1	$p_{43} = 20, p_{23} = 40, p_{33} = 10, p_{31} = 10$
4	30	2-3-1-4	$p_{24} = 25, p_{34} = 15, p_{14} = 10, p_{44} = 30$

Define the environment for this problem, find the suitable algorithm for it, then implement the algorithm using the above data (i.e. solve the problem).

Question Number Three:

Consider $P_m \mid r_j, prmp \mid L_{\max}$. Show through a counterexample that the preemptive EDD rule does *not* necessarily yield an optimal schedule.

Question Number Four:

Consider $Q_\infty \mid prec, prmp \mid C_{\max}$. There are an unlimited number of machines that operate at the same speed. There is *one* machine that is faster. Give an algorithm that minimizes the makespan and prove its optimality.

Question Number Five:

Consider the following single machine data:

Job *j*	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
r_j	8	15	9	23	8	16	7	18
p_j	5	17	2	8	13	10	7	20

Provide the optimal solution of the corresponding $1|r_j|\Sigma C_j$ scheduling problem

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Question Number Six:

Proof that for problem $F_m || C_{max}$ an optimal schedule exists with the following:

- The job sequence on the first two machines is the same
- The job sequence on the last two machines is the same

Question Number Seven:

Determine an upper and a lower bound for the makespan in an m machine flow shop. The processing time of job j on machine i is p_{ij}

Question Number Eight:

Let S be a complete selection for an instance of $J || C_{max}$ and let P be a critical path in G(S). Show that reversing the direction of a disjunctive arc, which is part of the critical path P, leads again to a complete selection. Show that this in general is not true for reversing an arbitrary disjunctive arc.

Question Number Nine:

Eleven patients came to a surgery run by two doctors, A and B. Let {1,2,3,4} be the set of patients who want to see doctor A before doctor B; the patients of set {5,6,7} want to see doctor B before doctor A; the patients of set {8,9} want to see only doctor A; the patients of set {10,11} want to see only doctor B. The times for each visit (in suitable time units) are given in the table:

Job	1	2	3	4	5	6	7	8	9	10	11
a_j	3	2	1	1	2	4	3	1	2		
b_j	2	1	2	1	4	8	9			1	1

Find a schedule with the smallest makespan. (use shifting bottleneck heuristic)