Exam Mastermath course ‘Scheduling’ 2020 — 15-6-2020

The exam consists of 5 questions worth 10 points each. Your grade is given by $1 + \frac{9p}{50}$, where p is the total number of points obtained.

Important: Please write down the following **statement** on your first sheet of paper: “This exam will be solely undertaken by myself, without any assistance from others, and without use of sources other than my personal notes and the sources available on the Scheduling website of elo.mastermath.nl.”

Note that you are only allowed to use the **material** that we provided on the Scheduling website of elo.masthermath.nl and your personal notes.

Do not forget to include your **student ID** in the scans of your work. Good luck!

Question 1 *(10 points)*:

Consider the following instance of problem $F2||C_{max}$:

$$n = 5,\ p = \begin{pmatrix} 2 & 3 & 3 & 4 & 4 \\ 3 & 4 & 1 & 3 & \alpha \end{pmatrix}.$$

a. Give the optimal schedule with corresponding makespan for $\alpha = 2$. Explain in detail how you obtained this optimal schedule. *(2 points)*
b. Give the optimal schedules with corresponding makespan for each value of α. Explain your results in detail. *(8 points)*

Question 2 *(10 points)*:

Consider problem $1||Var(\sum C_j)$ where job j has processing time P_j with mean $\mathbb{E}[P_j]$ and variance $Var(P_j)$.

Give an optimal scheduling rule for this problem and proof that it leads to an optimal solution.

Question 3 *(10 points)*:

Consider a single machine problem P with n jobs where job j has release date r_j, due date d_j, and processing time p_j. Does there exist a schedule that meets all due dates?

Prove that answering this question is strongly NP-complete.

Question 4 *(10 points)*:

Consider the LPT rule for $P||C_{max}$.

Prove that LPT returns a factor $\frac{k+1}{k}$ approximation algorithm if the machine i which processes the job which finishes last, processes k other jobs.

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Question 5 *(10 points, indication 300 words)*:

Describe how you can apply list scheduling to the BIM problem (introduced in Lecture 11) and explain the pros and cons of applying this approach to the BIM problem.

IMPORTANT: please submit **one pdf file** using for example the app Tiny Scanner.

END OF THE EXAM