

Exercise 1, Lecture slides p.19
(Neumann et al, 2003)

Set of nodes $V = \{0, 1, 2, 3, 4, 5, 6\}$
Processing times $p = (0, 6, 4, 2, 4, 2, 0)$

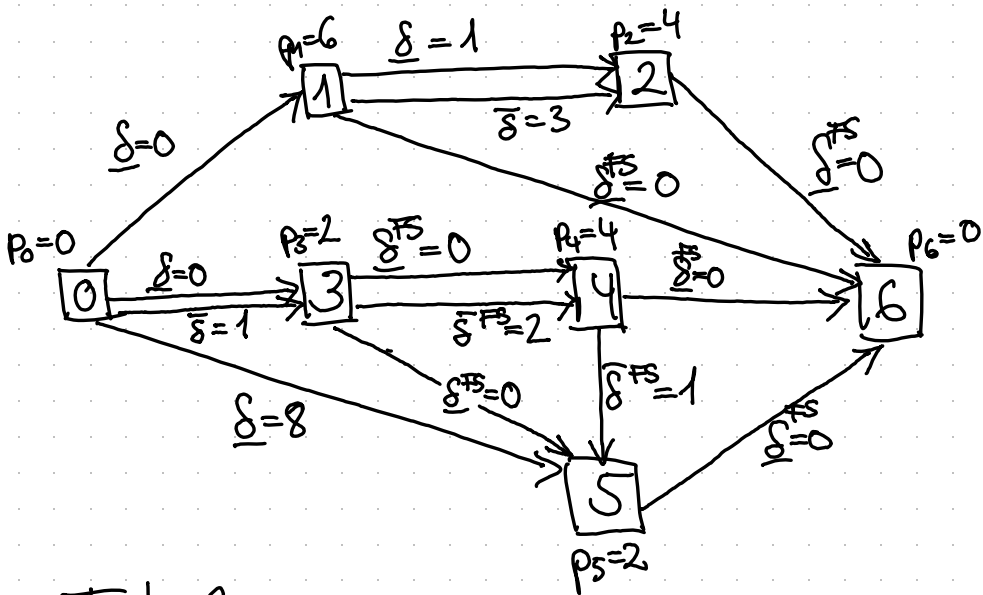
Task 1:

Time lags:

- $\underline{\delta}_{0,1} = \underline{\delta}_{0,3} = 0$
- $\underline{\delta}_{0,5} = 8$
- $\underline{\delta}_{1,2} = 1$, $\bar{\delta}_{1,2} = 3$
- $\underline{\delta}_{3,4}^{\text{FS}} = \underline{\delta}_{3,5}^{\text{FS}} = 0$
- $\bar{\delta}_{3,4}^{\text{FS}} = 2$
- $\bar{\delta}_{4,5}^{\text{FS}} = 1$
- $\bar{\delta}_{0,3} = 1$
- $\underline{\delta}_{i,6}^{\text{FS}} = 0 \quad \forall i \in \{2, 4, 5\}$
(terminal activities)
- $\underline{\delta}_{1,6}^{\text{FS}} = 0$ (see remark 1.1.2c on p. 3 in Neumann et al. 2003)

AON-graph (task 1)

(time lags are start-to-start if not δ denoted otherwise)

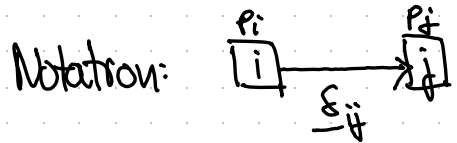
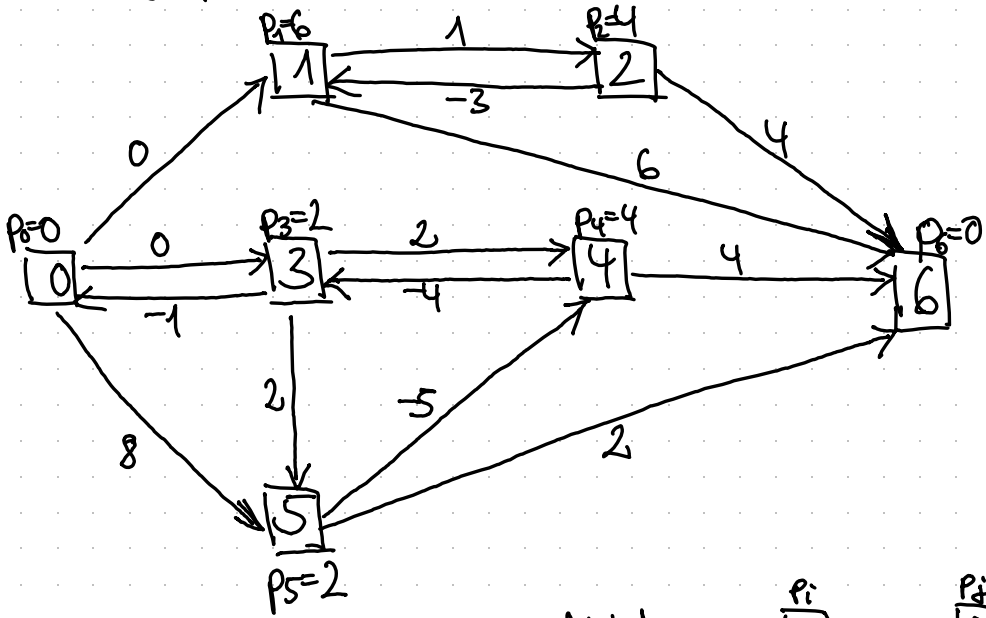


Task 2

Time lags (minimum, start-to-start):

- $\underline{\delta}_{0,1} = \underline{\delta}_{0,3} = 0$, $\underline{\delta}$
- $\underline{\delta}_{0,5} = 8$
- $\underline{\delta}_{1,2} = 1$, $\bar{\delta}_{1,2} = 3 \rightarrow \underline{\delta}_{2,1} = -3$
- $\bar{\delta}_{3,4}^{\text{FS}} = \bar{\delta}_{3,5}^{\text{FS}} = 0 \rightarrow \underline{\delta}_{3,4} = \underline{\delta}_{3,5} = p_3 = 2$
- $\bar{\delta}_{3,4}^{\text{FS}} = 2 \rightarrow \underline{\delta}_{4,3} = -(\bar{\delta}_{3,4}^{\text{FS}} + p_3) = -4$
- $\bar{\delta}_{4,5}^{\text{FS}} = 1 \rightarrow \underline{\delta}_{5,4} = -(\bar{\delta}_{4,5}^{\text{FS}} + p_4) = -5$
- $\bar{\delta}_{0,3} = 1 \rightarrow \underline{\delta}_{3,0} = -1$
- $\underline{\delta}_{i,6}^{\text{FS}} = 0 \quad \forall i \in \{1,2,4,5\} \rightarrow \underline{\delta}_{i,6} = p_i \quad \forall i \in \{1,2,4,5\}$

AoN-graph (task 2)



Task 3

Decision variables:

$$S_i \geq 0 \quad \forall i \in V$$

Objective Function:

$$\text{Min } S_6$$

(makespan)

subject to (constraints)

$$S_j - S_0 \geq 0 \quad \forall j \in \{1, 3\}$$

$$S_5 - S_0 \geq 8$$

$$S_2 - S_1 \geq 1$$

$$S_2 - S_1 \leq 3$$

$$S_j - S_3 \geq p_3 \quad \forall j \in \{4, 5\}$$

$$S_4 - S_3 \leq 2$$

$$S_5 - S_3 \leq 1$$

$$S_3 - S_0 \leq 1$$

$$S_i \geq 0 \quad \forall i \in \{0, 1, 2, 3, 4, 5, 6\}$$

Task 4

\Rightarrow see colab