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Knowledge Discovery and Data Mining I

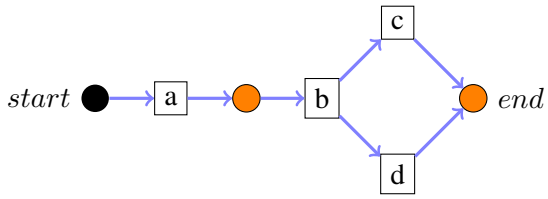
WS 2019/20

Exercise 12: Process Mining

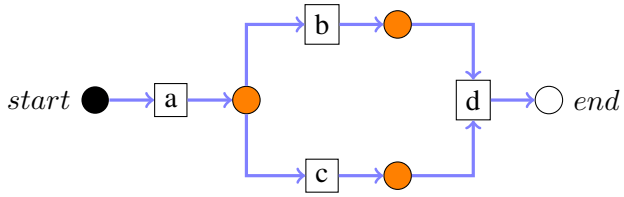
Exercise 12-1 Petri Nets

Explain if the following graphs are petri nets, workflow nets, or even sound workflow nets.
Further express the graph as a sound workflow net if the graph is not yet a sound workflow net.

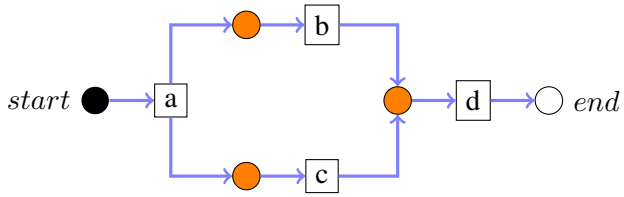
(a)



(b)



(c)



Exercise 12-2 α-Miner

(a) For the α-Miner algorithm, we use the relations $>, \rightarrow, \|, \#$ to denote direct successions, causality, parallelism or choice. Considering the set of activities $\{a, b, c\}$, give notion (graphically) about the following patterns and associate the right relations with them according to the activities having been used:

- Sequence Pattern
- XOR-Split and XOR-Join pattern
- AND-split and AND-join pattern

(b) Given the trace $L_1 = [\langle a, b, c, d\rangle, \langle a, c, b, d\rangle, \langle a, e, d\rangle]$. Determine the following sets:

- Set of activities: $T_L = \{t \in T | \exists_{\sigma \in L} t \in \sigma\}$
- Set of start activities: $T_I = \{t \in T | \exists_{\sigma \in L} t = first(\sigma)\}$
- Set of end activities: $T_O = \{t \in T | \exists_{\sigma \in L} t = last(\sigma)\}$
- Set of paired activities:

$$\begin{aligned} X_L = \{(A, B) | & A \subseteq T_L \wedge A \neq \emptyset \wedge \\ & B \subseteq T_L \wedge B \neq \emptyset \wedge \\ & \forall_{a \in A} \forall_{b \in B} a \rightarrow_L b \wedge \\ & \forall_{a_1, a_2 \in A} a_1 \#_l a_2 \wedge \forall_{b_1, b_2 \in B} b_1 \#_L b_2\} \end{aligned}$$

- Set of paired activities that are maximal:

$$Y_L = \{(A, B) \in X_L | \forall_{(A', B') \in X_L} A \subseteq A' \wedge B \subseteq B' \implies (A, B) = (A', B')\}$$

- Set of places: $P_L = \{p_{(A,B)} | (A, B) \in Y_L\} \cup \{i_L, o_L\}$
- Flow relations:

$$\begin{aligned} F_L = & \{(a, p_{(A,B)} | (A, B) \in Y_L \wedge a \in A\} \cup \\ & \{p_{(A,B),b} | (A, B) \in Y_L \wedge b \in B\} \cup \\ & \{(i_L, t) | t \in T_I\} \cup \{(t, o_L) | t \in T_O\} \end{aligned}$$

- Definition (*no task*): α-Miner on event log L is then defined as: $\alpha(L) = (P_L, T_L, F_L)$

(c) Construct the Footprint Table for trace L_1.