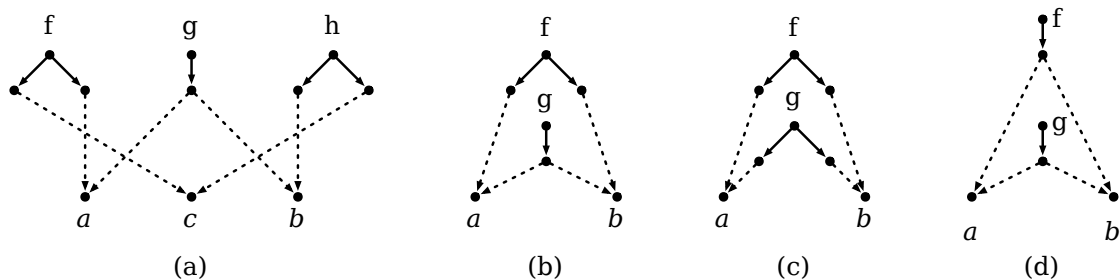


1. Consider the following dominance graphs:



Which of the graphs are hypernormally connected?

2. Optional / Bonus: Consider the following tree automaton

$A = \langle Q = \{q\}, \Sigma = \{\neg|_1, \exists x|_2, \exists y|_2, \text{stud}_{x|0}, \text{book}_{y|0}, \text{read}_{x,y|0}\}, Q_f = \{q\}, \Delta \rangle$

where Δ contains the following transition rules:

- $\neg(q(x_1)) \rightarrow q(\neg(x_1))$
- $\exists x(q(x_1), q(x_2)) \rightarrow q(\exists x(x_1, x_2))$
- $\exists y(q(x_1), q(x_2)) \rightarrow q(\exists y(x_1, x_2))$
- $\text{stud}_x \rightarrow q(\text{stud}_x)$
- $\text{book}_y \rightarrow q(\text{book}_y)$
- $\text{read}_{x,y} \rightarrow q(\text{read}_{x,y})$

This automaton simply accepts *all* trees over Σ .

- (a) Modify (extend) the automaton so that it accepts all trees over Σ *except* those trees that contain $\exists x(_, \exists y(_, _))$ as a subtree (trees where $\exists y$ occurs as the right child of $\exists x$).
- (b) Intersect the automaton from (a) with the automaton on slide 24 from the lecture.

Appendix: Intersection (see Comon &al. 2007, page 29)

Let $A_1 = \langle Q_1, \Sigma, Q_{f1}, \Delta_1 \rangle$ and $A_2 = \langle Q_2, \Sigma, Q_{f2}, \Delta_2 \rangle$ be two tree automata. An automaton that accepts $L(A_1) \cap L(A_2)$ can be defined as follows:

- $A = \langle Q_1 \times Q_2, \Sigma, Q_{f1} \times Q_{f2}, \Delta \rangle$
- $\Delta = \{ f(\langle p_1, q_1 \rangle(x_1), \dots, \langle p_n, q_n \rangle(x_n)) \rightarrow \langle p, q \rangle(f(x_1, \dots, x_n)) \mid$
 $f(p_1(x_1), \dots, p_n(x_n)) \rightarrow p(f(x_1, \dots, x_n)) \in \Delta_1 \text{ and}$
 $f(q_1(x_1), \dots, q_n(x_n)) \rightarrow q(f(x_1, \dots, x_n)) \in \Delta_2 \}$

To be turned in Monday, 2012-07-09, 10:00h