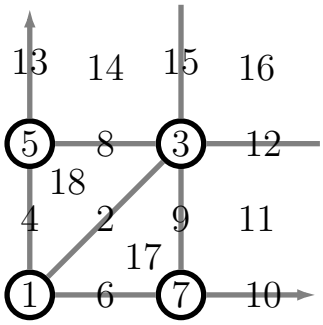
Technische Universität München
Institut für Informatik I07
Theoretical Computer Science

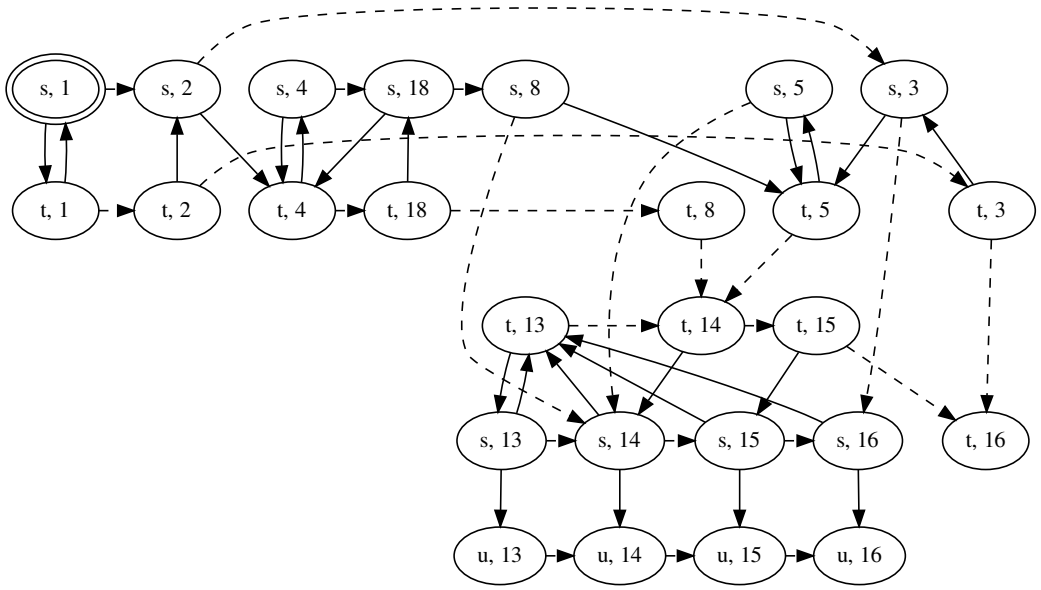
Quantitative Verification 3 - Solutions

Ex 1: Region Construction

Regions: We have $c_x = c_y = 1$.



1. $x = y = 0$
2. $x = y \in (0,1)$
3. $x = y = 1$
4. $x = 0, y \in (0,1)$
5. $x = 0, y = 1$
6. $x \in (0,1), y = 0$
7. $x = 1, y = 0$
8. $x \in (0,1), y = 1$
9. $x = 1, y \in (0,1)$
10. $x > 1, y = 0$
11. $x > 1, y \in (0,1)$
12. $x > 1, y = 1$
13. $x = 0, y > 1$
14. $x \in (0,1), y > 1$
15. $x = 1, y > 1$
16. $x > 1, y > 1$
17. $x > y,\ x, y \in (0,1)$
18. $x < y,\ x, y \in (0,1)$



The Region Automaton. Delay transitions are dashed, transitive delay transitions and delay self-loops on states with regions 11, 14, 16, 17, and 18 are omitted for readability.

Ex 2: TA Network

1. $(\texttt{error}, \cdot, \cdot)$: Reachable
   - $(\texttt{wait}, \texttt{produce}, \{x \mapsto 0, y \mapsto 0\})$
   - $(\texttt{process}, \texttt{wait}, \{x \mapsto 0, y \mapsto 0\})$
   - $(\texttt{error}, \texttt{wait}, \{x \mapsto 0, y \mapsto 0\})$

2. $(\texttt{finished}, \texttt{consume}, \{x \mapsto 1, y \mapsto 1\})$: Not reachable – While in `process` and `wait`, $x = y$, hence when transitioning to `finished` / `consume` we have $x = 1$ and $y = 0$. Due to the invariant on `finished`, the network has to transition to `wait` immediately.

3. $(\texttt{wait}, \texttt{produce}, \{x \mapsto 2, y \mapsto 2\})$: Reachable
   - $(\texttt{wait}, \texttt{produce}, \{x \mapsto 0, y \mapsto 0\})$
   - τ $(\texttt{process}, \texttt{wait}, \{x \mapsto 2, y \mapsto 2\})$

4. $(\texttt{process}, \texttt{produce}, \cdot)$: Reachable
   - $(\texttt{wait}, \texttt{produce}, \{x \mapsto 0, y \mapsto 0\})$
   - $(\texttt{process}, \texttt{wait}, \{x \mapsto 0, y \mapsto 0\})$
   - τ $(\texttt{process}, \texttt{wait}, \{x \mapsto 1, y \mapsto 1\})$
   - $(\texttt{process}, \texttt{consume}, \{x \mapsto 1, y \mapsto 0\})$
   - $(\texttt{process}, \texttt{produce}, \{x \mapsto 1, y \mapsto 0\})$

5. $(\texttt{wait}, \cdot, \{x \mapsto 3, y \mapsto 2\})$: Reachable
   - $(\texttt{wait}, \texttt{produce}, \{x \mapsto 0, y \mapsto 0\})$
   - $(\texttt{process}, \texttt{wait}, \{x \mapsto 0, y \mapsto 0\})$
   - τ $(\texttt{process}, \texttt{wait}, \{x \mapsto 1, y \mapsto 1\})$
   - $(\texttt{process}, \texttt{consume}, \{x \mapsto 1, y \mapsto 0\})$
   - $(\texttt{process}, \texttt{produce}, \{x \mapsto 1, y \mapsto 0\})$
   - $(\texttt{finished}, \texttt{produce}, \{x \mapsto 1, y \mapsto 0\})$
   - $(\texttt{wait}, \texttt{produce}, \{x \mapsto 1, y \mapsto 0\})$
   - τ $(\texttt{wait}, \texttt{produce}, \{x \mapsto 3, y \mapsto 2\})$