

Exercise Sheet 9

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Due: Tue, Jan 7

Exercise 9.1 Tree Decoration (with LTL and Automata)

Consider the following rules to decorate Christmas trees with ornament balls and candles:

φ_1 : Whenever a ball is added to the tree, a candle will be added sometime later.

φ_2 : Whenever a candle is added to the tree, a ball is added immediately after.

Translate the above rules into generalized Büchi automata by doing the following:

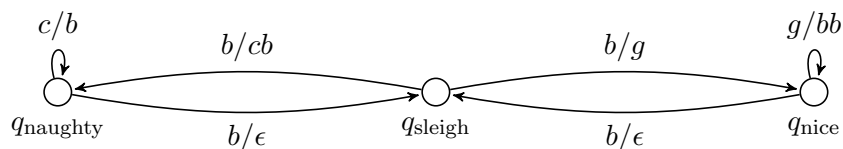
- (a) Translate the rules into LTL formulas.
- (b) Construct the corresponding GNBA's.

Optional: forward the exercise to your friends if they find it hard to decorate their tree.

Exercise 9.2 Travelling Santa (with Pushdown Systems)

Santa Claus realised that the performant sleigh he acquired last year will be more helpful if he also swaps his old-fashioned bag for the brand new *State-of-the-art Santa Carryall* equipped with the latest present distribution system *Pushdown Knapsack v0.(9)beta* which can be linked to Santa's presents factory at the North Pole.

After contacting the producers of the *State-of-the-art Santa Carryall* it was revealed the *Pushdown Knapsack* is a pushdown automaton over $\Sigma = \{b(\text{biscuit}), c(\text{oal}), g(\text{ift})\}$:



Depending on whether Santa visits a naughty or a nice child, the *Pushdown Knapsack* exchanges biscuits, coal, and gifts as depicted above.

Help Santa find what can be the initial content of his *State-of-the-art Santa Carryall* by computing $A_{pre^*(C)}$ for $C = \{(q_{naughty}, c), (q_{nice}, g)\}$.

Merry Christmas and a Happy New Year!