# Introduction to Model Checking
Winter term 2013/2014

– Series 9 –

Hand in on January 8$^{\text{th}}$ before the exercise class or in the box in front of the chair's secretary's office.

For this series we have taken questions (from an old exam) that cover various topics which we have looked at (so far). Hopefully this will help you to recap the material and prepare for the final exam a bit already now.

We wish you a Merry Christmas and a happy New Year!
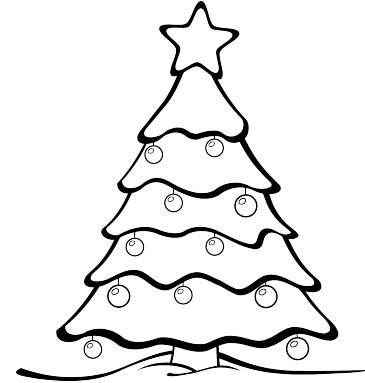
Exercise 1 (3 points)

Let P and P' be safety properties. Prove that $BadPref(P) \cap BadPref(P') = BadPref(P \cup P')$.

Exercise 2 (3 points)

Consider the linear-time property P over $AP = \{a, b\}$:

"$(\neg a \wedge \neg b)$ holds infinitely often and $(a \wedge b)$ never holds and
between any two occurrences of $(\neg a \wedge \neg b)$, the number of states where b holds is even."

a) Provide an NBA $\mathcal{A}$ over 2^{AP} such that $\mathcal{L}_\omega(\mathcal{A}) = P$.
   Hint: Parts (b) and (c) can be solved without a solution for part (a).

b) Formally prove or disprove the following statements:
   - P is a safety property.
   - P is a liveness property.

c) Let $\mathcal{A}'$ be an NBA over 2^{AP}. Then $P' = \mathcal{L}_\omega(\mathcal{A}')$ is the linear-time property defined by $\mathcal{A}'$.
   Is it always the case that there exists an LTL-formula φ such that $P' = Words(\varphi)$?
   Justify your answer!

Exercise 3 (4 points)

Let $\varphi = (a \wedge \bigcirc a) \cup (a \wedge \neg \bigcirc a)$ be an LTL–formula over $AP = \{a\}$.

a) Compute all elementary sets with respect to φ.

b) Construct the GNBA $\mathcal{G}_\varphi$ according to the algorithm from the lecture such that $\mathcal{L}_\omega(\mathcal{G}_\varphi) = Words(\varphi)$.

c) Give an ω-regular expression E such that $\mathcal{L}_\omega(\mathcal{G}_\varphi) = \mathcal{L}_\omega(E)$.