EEL 4930/5934 Automated HW/SW Verification

Assignment 1
Due: Monday, September 29th (by midnight)

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1. (16 pts) Assuming that p, q, and r denote propositional logic formulas, for each of the following LTL formula draw the equivalent Buchi automata. Make sure all the accepting and nonaccepting states (including the sink states) and all the transitions are shown. (**Important note:** Also check whether there exists at least one run that satisfy the formula. If not, the corresponding Buchi automata shouldn't accept any runs.)

   (a) $p\ U\ (q\ \rightarrow\ Gr)$
   (b) $G(p\ \rightarrow\ X(\neg p\ \wedge\ Xr))$
   (c) $G(q\ U\ (r\ \wedge\ Xp))$
   (d) $G(p\ \wedge\ X\neg p)$

2. (14 pts) For the microwave oven example given in Figure 18 in the lecture notes (lnts.pdf on CANVAS), find out whether $AG((!error\ \wedge\ AF(start))\ \rightarrow\ AF(AG(\neg close\ \wedge\ start\ \wedge\ \neg heat\ \wedge\ \neg error)))$ is satisfied. Show the resulting satisfying set of states for each intermediate CTL formula and explain how you conclude whether the microwave oven system satisfies or does not satisfy the formula. If the formula is not satisfied, generate a counter example that starts from the initial state.

3. **Bonus Question** (5 pts) Show that the CTL formula $AGEF$ and the LTL formula AGF are not equivalent by drawing a Kripke structure that satisfies $AGEFp$ and but not $AGFp$, where p is an atomic proposition.