1. Below you see a Kripke structure; let’s call it $M$. Give its explicit definition in terms of a tuple etc (see the formal definition in the slides).

(a) Why don’t we have final states there?
(b) How is the notion of ‘execution’ defined for a Kripke structure? And what is an ‘abstract execution’?
(c) Give an execution of $M$ that satisfies the property $\mathbf{X} (\text{busy U } (x=0))$. Does $M$ satisfies the property?
(d) So, given a property Kripke structure $M$, an (abstract) execution $\Pi$, and a property $\phi$, and an natural number $i$, what is the difference between:
   - $M \models \psi$
   - $\Pi \models \psi$
   - $\Pi \models_i \psi$

2. Express the following requirements in LTL. Make the necessary assumptions if you have to; but be reasonable.

(a) $P$ and $Q$ cannot not use a resource $r$ simultaneously.
(b) If $P$ requests access to $r$, eventually it will get the access.
(c) If $P$ requests access to $r$, eventually it will get the access; but only if $P$ persists on maintaining the request.
(d) $P$ cannot access $r$ without first requesting it; and it cannot do so (make a request) without first releasing $r$ (if it was busy using $r$).

3. Construct Buchi automata representing the following LTL formulas:

(a) $p \mathbf{W} q$, where $p, q$ are atomic propositions.
(b) $\neg (x>0 \mathbf{U} x=y)$
(c) $p \mathbf{U} (q \mathbf{U} r)$, where $p, q$ are atomic propositions.
(d) $(\mathbf{X} x>0) \mathbf{U} x=y$
(e) $\Diamond \Box (x>0 \Rightarrow x=y)$
(f) $(p \mathbf{U} q) \mathbf{W} r$