

1. (10pts) Use your own words, describe the semantic meaning of the following **LTL expressions** (note that the U symbol is the **Until** operator, not the set union operator, **true** is a Boolean constant that always holds at any state in a sequence)
 - a. $p \rightarrow F q$
 - b. $G F p$
 - c. $F G p$
 - d. **true** U q
 - e. $\neg (F \neg p)$
2. (6pts) Consider the traffic light in one particular direction, describe the following properties in an **LTL expression** using r/g/y to represent the light being red/green/yellow respectively
 - a. The light will turn green infinitely often
 - b. Once green, the light must become yellow next
 - c. Every red light will eventually become green
3. (4pts) Sometimes, an additional temporal operator could be defined for LTL called **Release (R)**. The expression "**p R q**" means that q has to be true until and including when p first becomes true; if p never becomes true, q must remain true forever. In other words, "p becoming true" releases "q" from "having to be true".

Note that unlike the **Until** operator, the "p" operand does not have to become true (can stay false forever) in **Release**.

- a. Rewrite "**p R q**" using negation and the **Until** operator
- b. What is the semantic meaning of "**false R p**"?