CSC410

LINEAR TEMPORAL LOGIC

Writing LTL Specifications

Use atomic propositions with the obvious meaning (e.g. cs_1 = "process 1 is in its critical section"). Events (a request, a button press, ...) are modelled as propositions that hold at the step where the event occurs. You may use the weak until $\varphi \,\mathsf{W}\, \psi \equiv (\varphi \,\mathsf{U}\, \psi) \vee \Box\varphi$.

1. **Mutual Exclusion**: processes 1 and 2 are never simultaneously in their critical sections.

2. **Client-Server Systems**: the system responds to all requests, but provides no guarantee on the timeline for responses.

3. **Process Scheduler**: (i) a process that, from some point on, is continuously ready to run is scheduled infinitely often; (ii) a process that is ready infinitely often (but perhaps not continuously) is scheduled infinitely often. Which of the two is the stronger requirement?

4. **Leader Election**: among nodes 1, 2, 3, there are never two leaders at the same time; moreover, provided the network eventually becomes stable for good, some node is eventually elected leader and remains leader forever.

5. **Elevator**: the doors are never open while the cabin is moving, and every call from floor k is eventually served, i.e. the cabin eventually stops at floor k with its doors open.

6. **Railway Crossing**: whenever a train is approaching, it does not enter the crossing until the gate is down, and the gate then stays down until the train has exited the crossing.

7. **ATM**: within a session, cash is dispensed only after the PIN has been verified, and at most once; a session starts when a card is inserted and ends when it is ejected.

Proving/Disproving LTL Equalities

(a) $\Diamond(\varphi \wedge \psi) \equiv \Diamond\varphi \wedge \Diamond\psi$

(b) $\Diamond(\varphi \vee \psi) \equiv \Diamond\varphi \vee \Diamond\psi$

(c) $\Box(\varphi \vee \psi) \equiv \Box\varphi \vee \Box\psi$

(d) $\varphi \,\mathsf{U}\, \psi \equiv \psi \vee (\varphi \wedge \bigcirc(\varphi \,\mathsf{U}\, \psi))$

(e) $\Diamond\Box(\varphi \vee \psi) \equiv \Diamond\Box\varphi \vee \Diamond\Box\psi$