**DIT636/DAT560 - Finite State Verification Activity**

| Temporal Operators: A quick reference list. p is a Boolean predicate or atomic variable.   * G p: p holds globally at every state on the path from now until the end * F p: p holds at some future state on the path (but not all future states) * X p: p holds at the next state on the path * p U q: q holds at some state on the path and p holds at every state before the first state at which q holds. * A: for all paths reaching out from a state, used in CTL as a modifier for the above properties (AG p) * E: for one or more paths reaching out from a state (but not all), used in CTL as a modifier for the above properties (EF p)   An LTL example:   * G ((MESSAGE\_STATUS = SENT) -> F (MESSAGE\_STATUS = RECEIVED)) * It is always true (G), that if the message is sent, then at some point after it is sent (F), the message will be received.   + More simply: A sent message will always be received eventually.   A CTL example:   * EG ((WEATHER = WIND) -> AF (WEATHER = RAIN)) * There is a potential future where it is a certainty (EG) that - if there is wind - it will always be followed eventually (AF) by rain.   + More simply: At a certain probability, wind will inevitably lead to eventual rain. (However, that probability is not 100%) |
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Consider a finite state model of a traffic-light controller for a single direction with a pedestrian crossing and a button to request right-of-way to cross the road.

**State variables:**

* **traffic\_light: {RED, YELLOW, GREEN}**
* **pedestrian\_light: {WAIT, WALK, FLASH}**
* **request\_button: {RESET, SET}**

**Initially**, the state is: **traffic\_light = RED, pedestrian\_light = WAIT, request\_button = RESET**

**Transitions**:

pedestrian\_light:

* **WAIT → WALK if traffic\_light = RED**
* **WAIT → WAIT otherwise**
* **WALK → {WALK, FLASH}**
* **FLASH → {FLASH, WAIT}**

traffic\_light:

* **RED → GREEN if button = RESET**
* **RED → RED otherwise**
* **GREEN → {GREEN, YELLOW} if button = SET**
* **GREEN → GREEN otherwise**
* **YELLOW→ {YELLOW, RED}**

reset\_button:

* **SET → RESET if pedestrian\_light = WALK**
* **SET → SET otherwise**
* **RESET → {RESET, SET} if traffic\_light = GREEN**
* **RESET → RESET otherwise**

1. Briefly describe a safety-property (nothing “bad” ever happens) for this model and formulate it in CTL.
2. Briefly describe a liveness-property (something “good” eventually happens) for this model and formulate it in LTL.