

Homework 1

Analysis of Software Artifacts

Due Date: Feb 1, 2000 (Tuesday)

Question 1 (Review, 10 points): Please give an English description of the path operators (modalities) and path quantifiers given below. Also express each operator/quantifier in terms of **X**, **U**, and **E** (use the duality equations here).

Path operators: **X**, **U**, **R**, **F**, **G**.

Path quantifiers: **A**, **E**.

Question 2 (Review, 40 points):

Part A: Classify each formula given below as CTL^* , CTL , or LTL . Give a short justification for your answer.

$A(\neg Fp \vee Gq)$, $AG EF AFp$, or $A(\neg Fp \vee EGq)$.

Part B: The path formula $fU_w g$ (U_w is called the *weak until*) is true on a path if f remains true until g becomes true, but we allow g to be false on the entire path. Express weak until U_w as a combination of until **U** and globally **G**.

Question 3 (Modeling, 50 points): Express the following English descriptions in CTL^* . Also write the negation of the formula and provide English description of that.

Part A: It is not possible to reach a state that is faulty (where the atomic proposition *faulty* is true).

Part B: If a transaction is started (denoted by truth of the atomic proposition *started*), it always finishes (denoted by the truth of the atomic proposition *finished*).

Things to think about: Download NuSMV or SMV from the web-site provided on the course home page. Start looking at some examples provided with NuSMV or SMV distribution.