

Homework 1

Analysis of Software Artifacts

Due Date: Sept 24, 2001 (Mon)

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 \mathbf{X} , \mathbf{U} , and \mathbf{E} (use the duality equations here).

Path operators: \mathbf{X} , \mathbf{U} , \mathbf{R} , \mathbf{F} , \mathbf{G} .

Path quantifiers: \mathbf{A} , \mathbf{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.

$\mathbf{A}(\neg \mathbf{F}p \vee \mathbf{G}q)$, $\mathbf{AG} \mathbf{EF} \mathbf{AF}p$, or $\mathbf{A}(\neg \mathbf{F}p \vee \mathbf{EG}q)$.

Part B: The path formula $f\mathbf{U}_w g$ (\mathbf{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 \mathbf{U}_w as a combination of until \mathbf{U} and globally \mathbf{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 from the web-site provided on the course home page. Start looking at some examples provided with NuSMV distribution.