Case Study 3: Kripke Models and Alloy

Due Date Upload your report on or before 5:00PM, 4/10/2015. 24 hour rules apply.

Introduction Recall that in our studies of first order logic (HR, Example 2.15) and temporal logic, the underlying models are variant of a state machine (HR, Section 2.7.1). In this case study, we will consider Kripke's model, according to the definition stated in Exercise 2.7, question 5. Note that, in our text, there are similar structures which are also referred as Kripke's Models. For our text refers the models of modal logic (HR Chapter 5) as Kripke's models as well.

In this case study, we consider Kripke's model and use allow to model its properties. In particular, you will develop an Alloy module which will

1. Write Signature that defines Kripke's models
2. Write Alloy statements which describe common system properties
3. Use Alloy to check consistencies of these properties
4. Use Alloy to attempt to verify the inter-relationships among these properties.

Although our treatment is similar to what is stated in the Question 5, note that the book's description may not fit in the current version of Alloy (4.2).

Part I Base on Question 5 (Exercise 2.7), write an Alloy module `KripkeModel` which will include the following:

a). The Signature of a Kripke Model and Sigatures of other objects that are needed. For the purpose of this case study, we assume that any Kripke's Model has at least one final states.

b). Instead of writing a fun statement, write a pred statement which tests if a state s is reachable from the initial states of a Kripke Model K.

c). Instead of writing fun statements for each case, write pred statement for each case stated. Demonstrate the consistency of each property by showing a Kripke Model with at least 3 states and 3 properties does satisfy the given property.

d). The requirement is the same as what's stated in the question.

e). The requirement is the same as what's stated in the question.

f). Again, write pred statement (not fun-statement) to meet the given requirement.

Part II Consider the following two properties of a Kripke's Model:

i). `NoCycle`

- Takes a Kripke Model K, an atomic property p as input:
- `CycleFree` represent the property:
  "For any state s which has property p, s is not on any cycle (if any) in K "

ii). `EventuallyFails`

- Takes a Kripke Model K, an atomic property p as input:
- `EventuallyFails` represent the property:
  "Along any paths that starts from an initial state of K, p eventually fails and remain to be false from some point on"

Analyze, by choosing an appropriate scope, if the following implication holds:

- `NoCycle` implies `EventuallyFails`
- `EventuallyFails` implies `NoCycle`

Submission Your submission should have

- Concise explanations on your formulations of each of the Alloy constructs you developed.
- A summary on how you use your Alloy module(s) to perform the required work
- A summary of the results obtained (include screenshots of test runs) and the conclusions that can be drawn from the results provided by running Alloy.

Also, your alloy module(s) should be commented properly. The detail submission requirements will be specified by our TAs and will be posted in our blackboard's site.