

Assignment 2: Model Checking Heating System

In this assignment, you will verify a heating system using the NuSMV model checking tool. You will represent the heating system as a NuSMV model and specify the desired properties the system should satisfy using temporal logic formulas. Then you check if your NuSMV model satisfies the properties.

The heating system consists of a furnace, a controller, and a room to be heated, which are specified in statecharts as shown in the figures as follows. The room has a valve that controls airflow into the room; the valve can be open, half open, or closed. The room also has a sensor that measures the room's temperature and a thermostat by which a user can set the desired temperature. If the room temperature is lower than desired, the system warms the room by opening the valve, to increase the inflow of heated air; if the room continues to be too cold, the room requests heat. The system behaves analogously when the room temperature is too hot. The controller statechart describes how to activate and deactivate the furnace on request from the room. The furnace statechart has hierarchical states: super-states (e.g., furnaceNormal) contain child states, and basic states (e.g., furnaceRun) contain no other states. A super-state has a default child state that is entered when the super-state is a transition's destination (e.g., furnaceNormal and furnaceOff are entered by transition t6). The room statechart has two super-states: noHeatReq for when the furnace is off, and heatReq for when the furnace is on. All the timers in the heating system time out in five states.

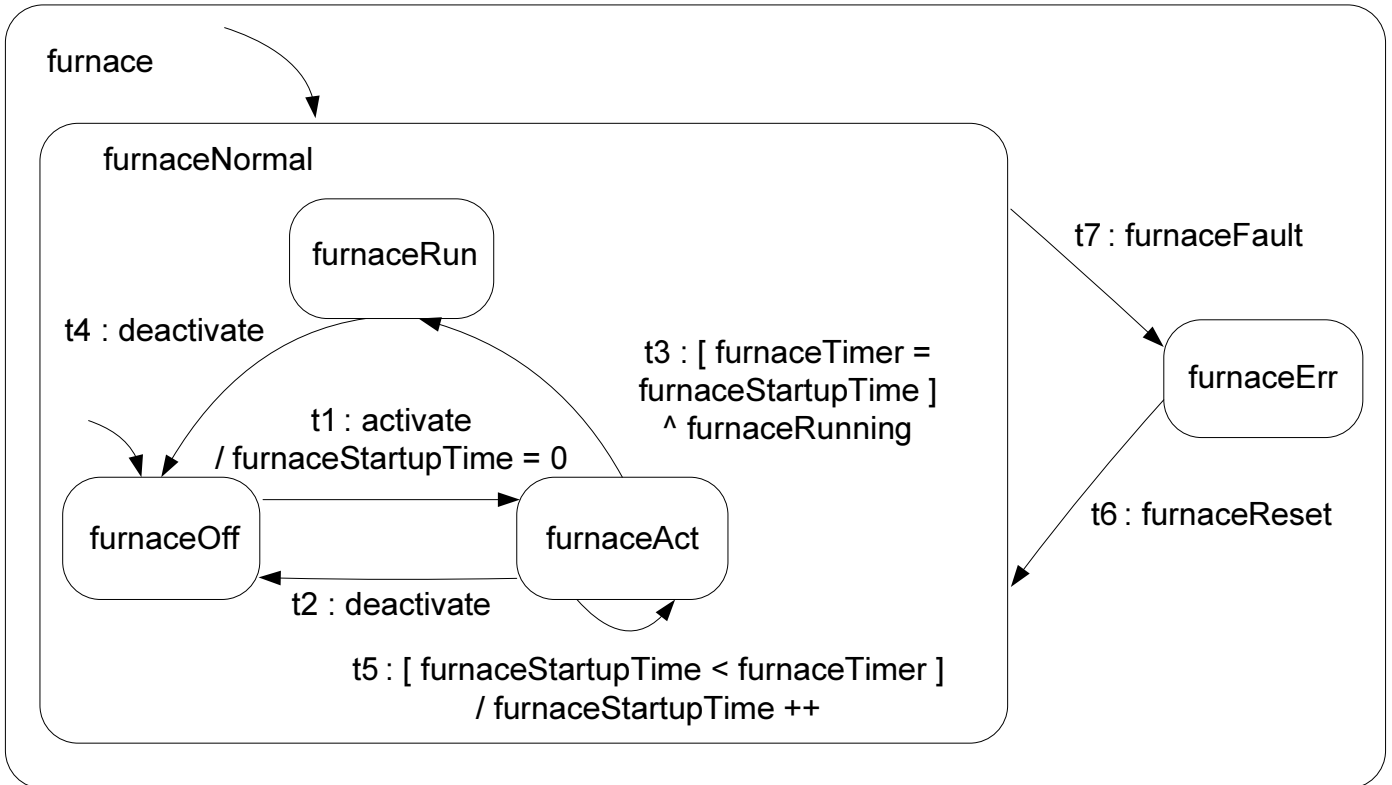
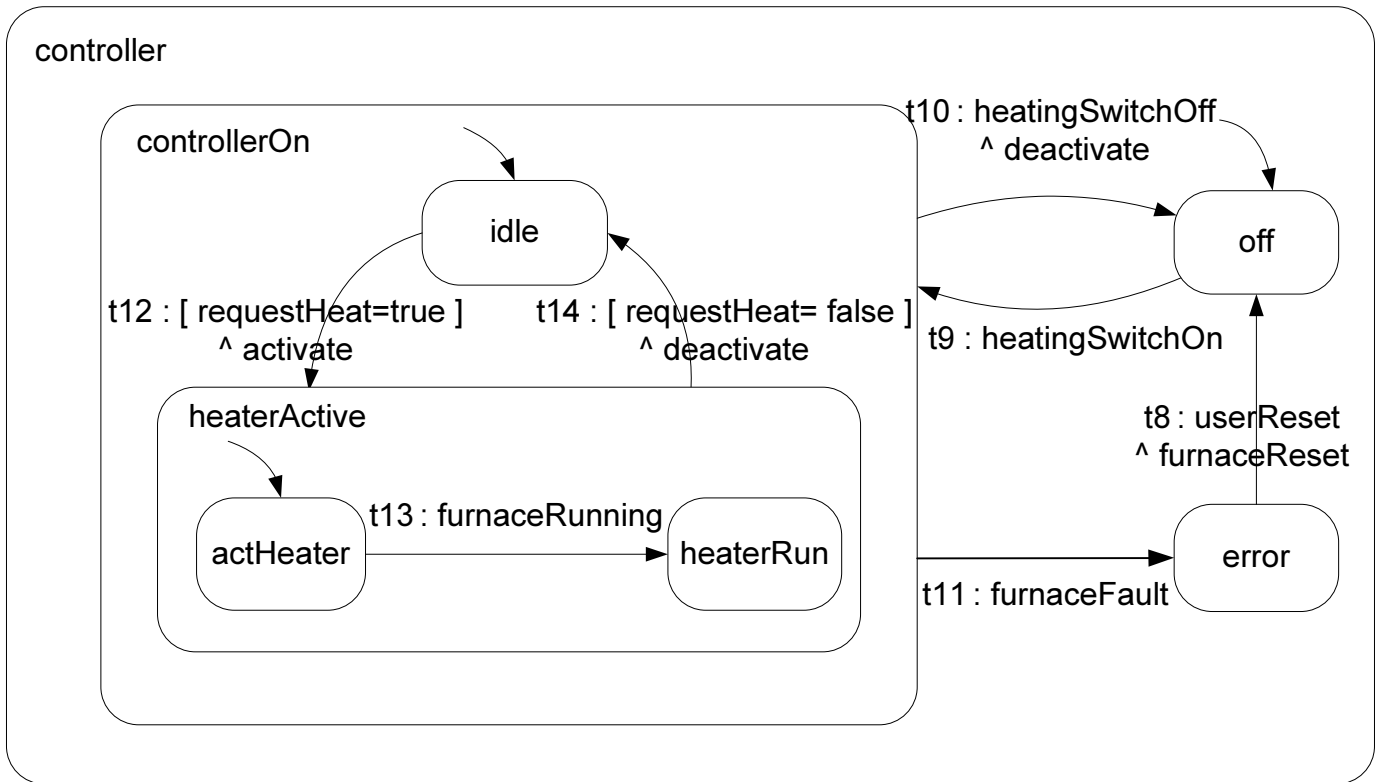
Those three statecharts are composed using parallel composition to form the specification of the heating system: The room, the controller, and the furnace execute concurrently; Events are broadcast; Data variables are global and shared among the statecharts.

You must check the following properties using NuSMV.

1. All the basic states are reachable.
2. If the room is too cold and stays cold when the valve is open, the furnace will turn on.
3. If the room is too hot and stays hot when the valve is closed, the furnace will turn off.
4. If the furnace is in its running state, the controller is in its running state.

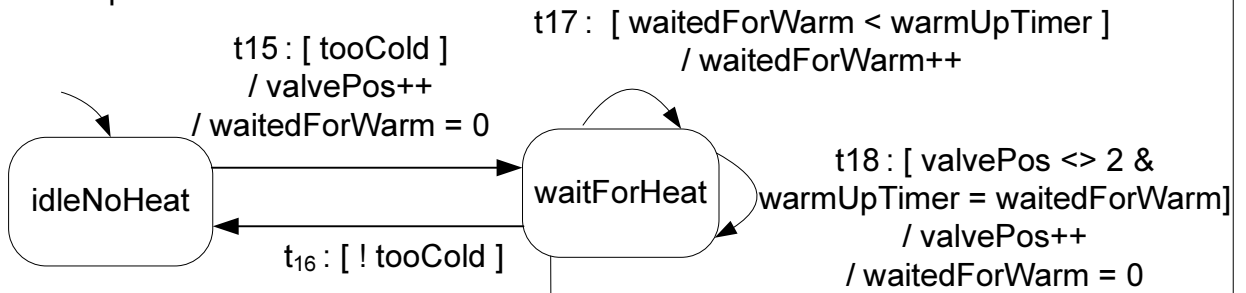
Additionally, you may want to check other properties to facilitate you to debug your model.

Please send your NuSMV model and property specification to Jianwei Niu as an email attachment by **October 25, 2011**.



room

noHeatReq



t20 : [waitedForWarm = warmUpTimer & valvePos = 2 & tooCold] / requestHeat = true

t19 : [waitedForCool = coolDownTimer & valvePos = 0 & tooHot] / requestHeat = false

heatReq

