Assignment 3 (Car Controller)

Due Date: September 04, 2022 by 8:30 a.m.
Note: This assignment is an individual assignment. Copied assignments from any source will get zero points. You have to provide a tape binding of the report along with the running code at the time of viva.
Consider Figure 1 in which a simplified cruise controller is modelled as a deterministic Kripke structure. The bit-vector $\mathbb{B}^k$ has a value of $k = 5$ in this case. The first two bits of the bit-vector represent the mode of the cruise controller. The cruise controller can be in manual mode(bit encoding 00), cruise mode (bit encoding 01) and disengaged mode(bit encoding 10). The second two bits represent the speed of the cruise controller. The speed below the cruising speed is encoded by bits 00, the cruising speed by bits 01 and above the cruising speed is represented by the bits 10. The last bit represents the state of the button used to turn on or off the cruise controller. A bit value of 1 represents the cruise controller is turned on and a bit value of 0 shows that it is turned off. The input symbols for this cruise controller consist of $\{brake, acc, dec, gas, button\}$ where brake represents the brake input when it is pressed, acc respresent the external input due to which the vehicle can gain speed while going downhill and dec represents the external input when the vehicle will decelerate when going uphill. The gas input represents the acceleration gained by pressing the gas pedal or accelerator. The button input represents the input given from the button to turn on or off the cruise controller.
Part 1: You are required to encode this model in NuSMV and then write LTL properties for NC, EC and CC (condition coverage). Find the trace sequences you after executing these properties in NuSMV.
Part 2: You are also required to verify the behavior of cruise controller for correctness for the behaviorial quirements mentioned in the Section Behaviroal Requirements by first translating them into LTL and then running them in NuSMV for the above model to find correctness.
Part 3: Finally, find out the coverage corresponding to Requirements formalized in LTL in Part 2 above.

Behavioral Requirements:

1. Whenever the brake pedal or gas pedal is pressed in the cruise mode the cruise controller will be disengaged.
2. If the cruise controller is in cruise mode it will remain in the cruise mode even if the vehicle is going uphill or downhill.
3. The cruise controller will eventually stop when the brake is applied no matter which mode is it in currently.
4. The cruise controller once in the disengaged mode will remain in this mode no matter even if it received acceleration via the gas pedal or external accelaration while going downhill.

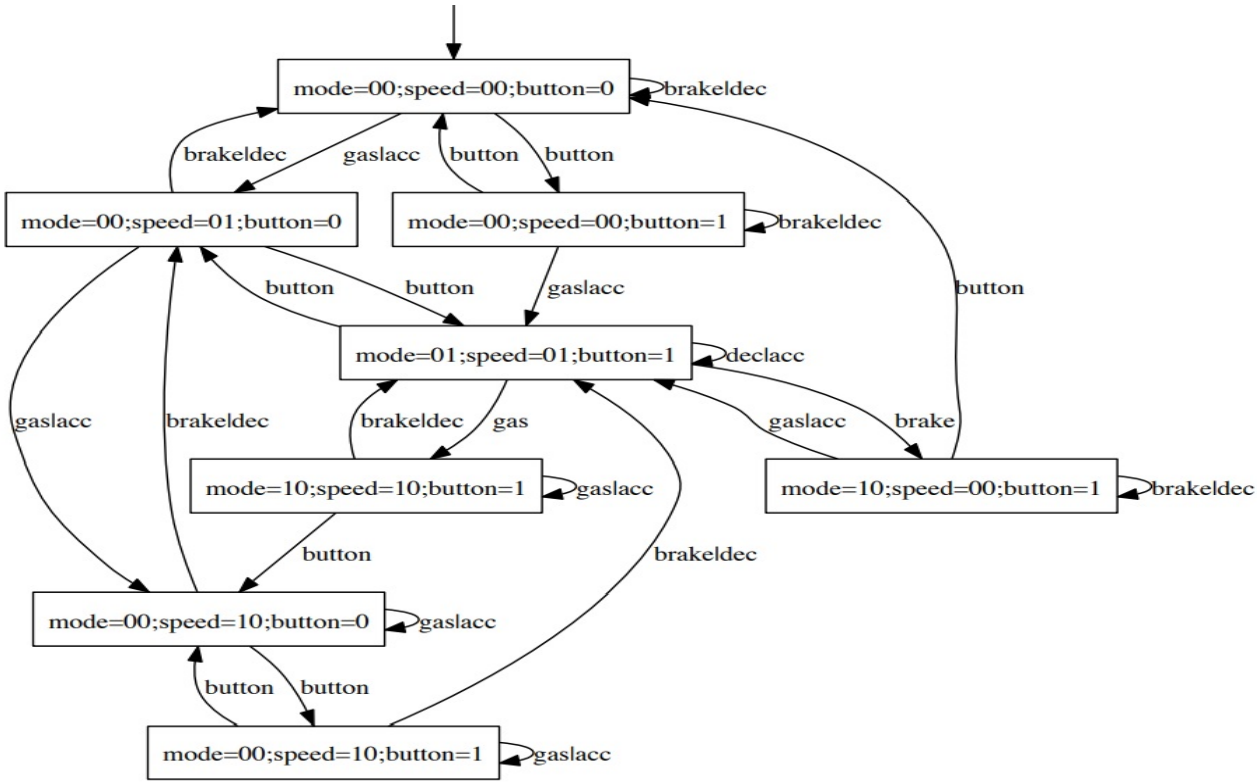

Figure 1: 5-bit Cruise Controller