UNITED INTERNATIONAL UNIVERSITY

Assignment - 3

Course Name:

CSE 4495: Software Testing, Verification, and Quality Assurance

Section: A

Group Name: X-Squad

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Problem Description:

Microwave Controller Model

- **Door: {Open, Closed} --** sensor input indicating state of the door
- **Button: {None, Start, Stop} --** button press (assumes at most one at a time)
- **Timer: 0...999 --** (remaining) seconds to cook
- **Cooking: Boolean --** state of the heating element

Now in this assignment your job is threefold

1. Designing the finite state model and implementing it in NuSMV.
2. Writing a list (at least five) of informal requirements for this microwave controller and expressing them in temporal logic (CTL or LTL). You can take help from your class test question ;)
3. Actually checking these if these requirements hold against your implemented NuSMV model.

Section - 1 (Solution)

Code:

```
MODULE main
VAR
      Door: {Open, Closed};
      Button: {None, Start, Stop};
      Timer: 0..999;
      Cooking: boolean;

ASSIGN
      init(Door) := Closed;
      init(Button) := None;
      init(Timer) := 0;
      next(Timer) :=
      case
```

```
            Timer > 0 & Cooking=TRUE : Timer - 1;
            Timer > 0 & Cooking=FALSE & Button!=Stop : Timer;
            Button=Stop : 0;
            Timer=0 : 0..999;
            TRUE: Timer;
      esac;

      init(Cooking) := FALSE;
      next(Cooking) :=
      case
            Timer > 1 & Button=Start & Door=Closed: TRUE;
            Cooking=TRUE & (Door=Open | Button=Stop | Timer<=1): FALSE;
            Cooking=TRUE & Timer>1 & Door!=Open & Button!=Stop: TRUE;
            TRUE: FALSE;
      esac;

SPEC AG (Door = Open -> AX(!Cooking));
SPEC AG (Cooking -> Timer > 0);
SPEC AG (Button = Stop & !Cooking -> AX (Timer = 0));
LTLSPEC G (Cooking -> F (!Cooking));
LTLSPEC G ((Cooking & G(Door = Closed) & G(Button!=Stop) -> F(Timer = 0));
```

Section - 2 (Solution)

1. The microwave shall never cook when the door is open.
   AG (Door = Open -> !Cooking)

2. The microwave shall cook only as long as there is some remaining cook time.
   AG (Cooking -> Timer > 0)

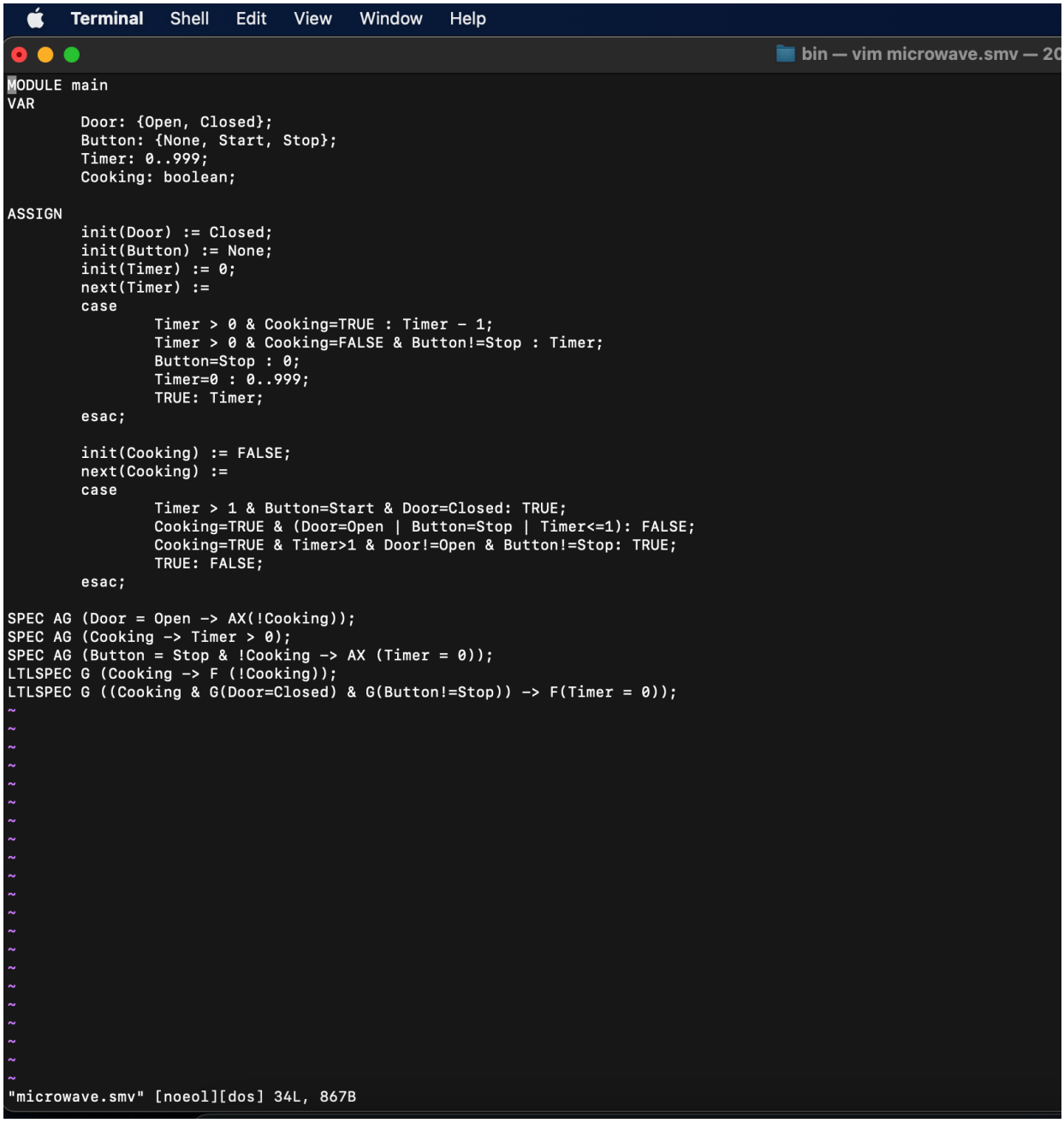
3. If the stop button is pressed when the microwave is not cooking, the remaining cook time shall be cleared.
   AG (Button = Stop & !Cooking -> AX (Timer = 0))

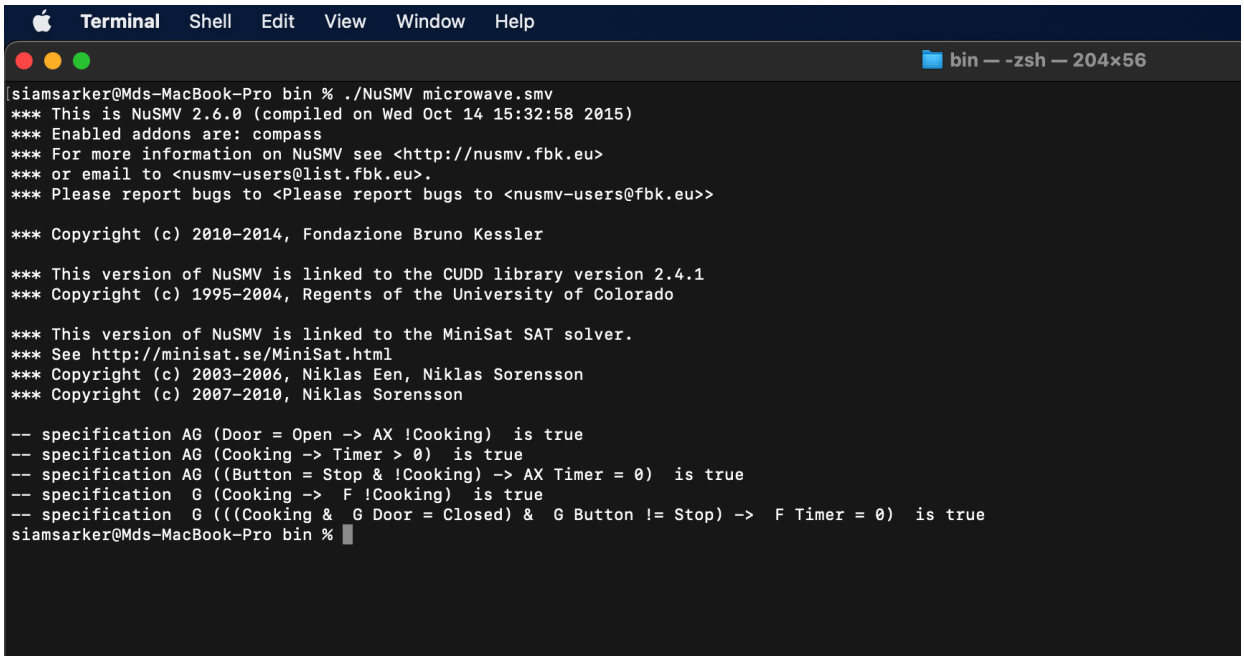
4. It shall never be the case that the microwave can continue cooking indefinitely.
   G (Cooking -> F (!Cooking))

5. The only way to initiate cooking shall be pressing the start button when the door is closed and the remaining cook time is not zero.
   G (!Cooking U ((Button = Start & Door = Closed) & (Timer > 0)))

Section - 3 (Solution)

NuSVM Console Screenshots:


Terminal Shell Edit View Window Help
bin — vim microwave.smv — 20
MODULE main
VAR
Door: {Open, Closed};
Button: {None, Start, Stop};
Timer: 0..999;
Cooking: boolean;
ASSIGN
init(Door) := Closed;
init(Button) := None;
init(Timer) := 0;
next(Timer) :=
case
Timer > 0 & Cooking=TRUE : Timer - 1;
Timer > 0 & Cooking=FALSE & Button!=Stop : Timer;
Button=Stop : 0;
Timer=0 : 0..999;
TRUE: Timer;
esac;
init(Cooking) := FALSE;
next(Cooking) :=
case
Timer > 1 & Button=Start & Door=Closed: TRUE;
Cooking=TRUE & (Door=Open | Button=Stop | Timer<=1): FALSE;
Cooking=TRUE & Timer>1 & Door!=Open & Button!=Stop: TRUE;
TRUE: FALSE;
esac;
SPEC AG (Door = Open -> AX(!Cooking));
SPEC AG (Cooking -> Timer > 0);
SPEC AG (Button = Stop & !Cooking -> AX (Timer = 0));
LTLSPEC G (Cooking -> F (!Cooking));
LTLSPEC G ((Cooking & G(Door=Closed) & G(Button!=Stop)) -> F(Timer = 0));
"microwave.smv" [noeol][dos] 34L, 867B


Terminal Shell Edit View Window Help
bin — -zsh — 204×56
siamsarker@Mds-MacBook-Pro bin % ./NuSMV microwave.smv
*** This is NuSMV 2.6.0 (compiled on Wed Oct 14 15:32:58 2015)
*** Enabled addons are: compass
*** For more information on NuSMV see <http://nusmv.fbk.eu>
*** or email to <nusmv-users@list.fbk.eu>.
*** Please report bugs to <Please report bugs to <nusmv-users@fbk.eu>>
*** Copyright (c) 2010-2014, Fondazione Bruno Kessler
*** This version of NuSMV is linked to the CUDD library version 2.4.1
*** Copyright (c) 1995-2004, Regents of the University of Colorado
*** This version of NuSMV is linked to the MiniSat SAT solver.
*** See http://minisat.se/MiniSat.html
*** Copyright (c) 2003-2006, Niklas Een, Niklas Sorensson
*** Copyright (c) 2007-2010, Niklas Sorensson
-- specification AG (Door = Open -> AX !Cooking) is true
-- specification AG (Cooking -> Timer > 0) is true
-- specification AG ((Button = Stop & !Cooking) -> AX Timer = 0) is true
-- specification G (Cooking -> F !Cooking) is true
-- specification G (((Cooking & G Door = Closed) & G Button != Stop) -> F Timer = 0) is true
siamsarker@Mds-MacBook-Pro bin %

Thank You.