ECE 321: Software Requirements Engineering Assignment 3

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December 5, 2018

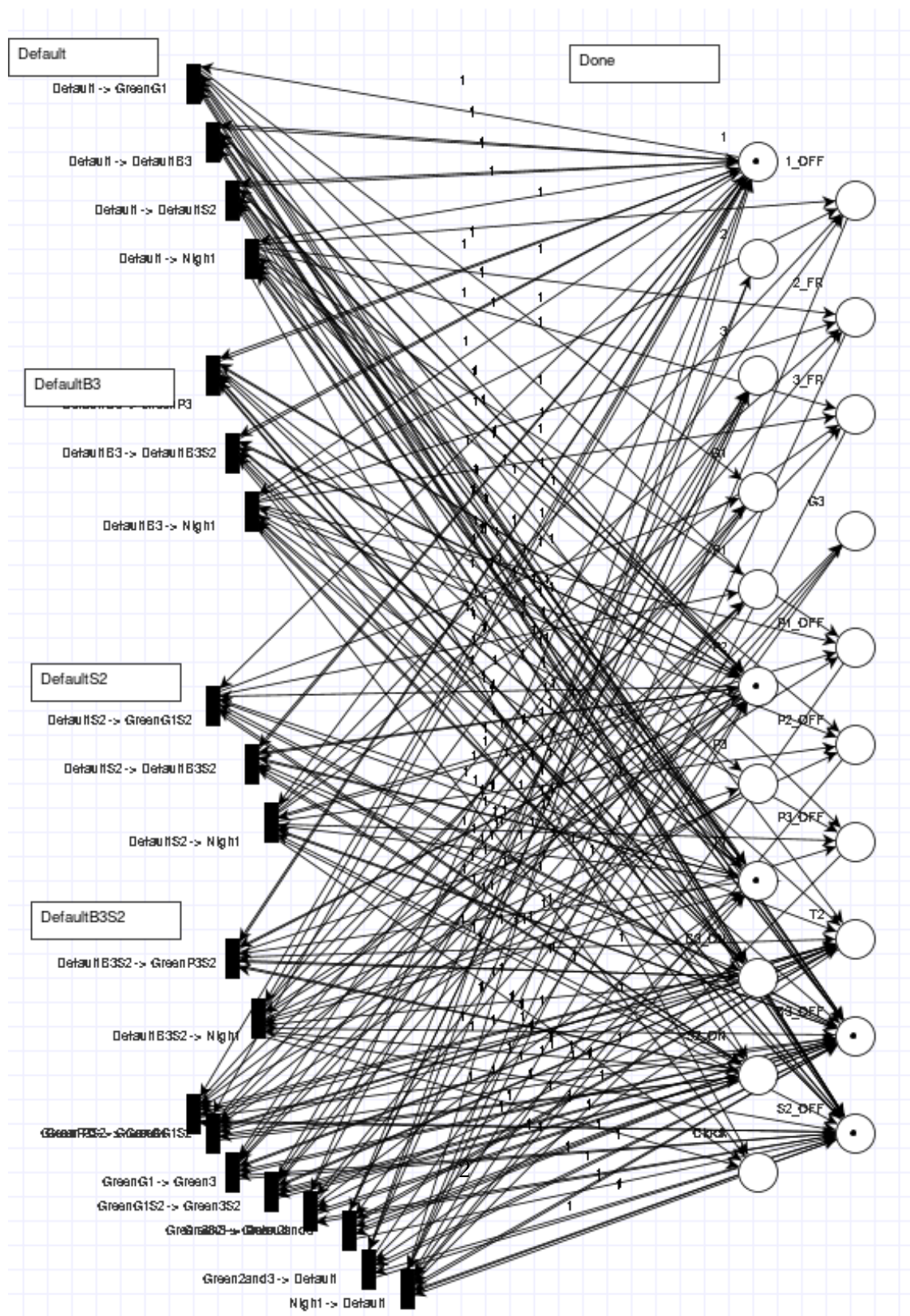# 1

Figure 1: Screenshot of the petri net created in PIPE
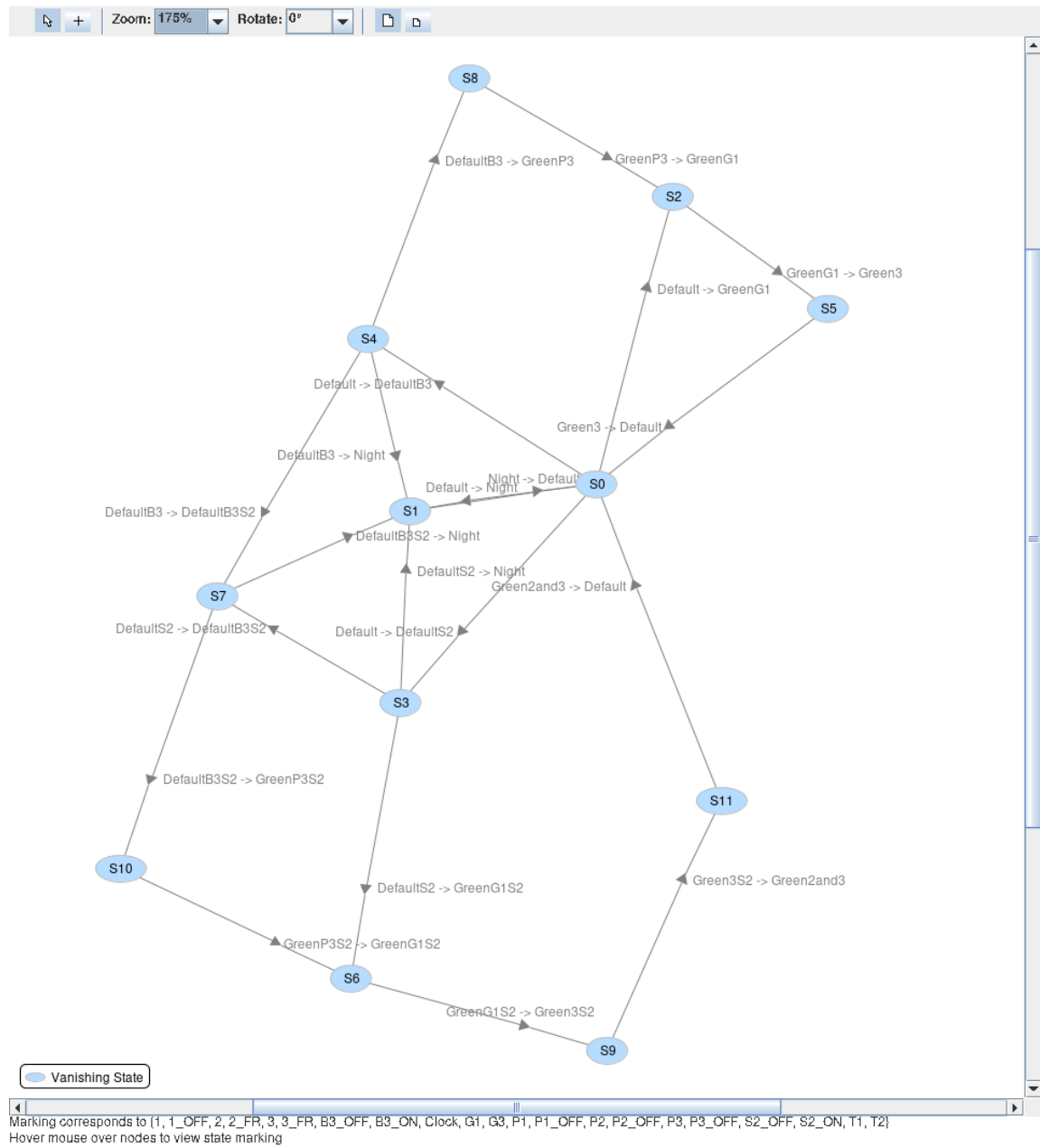
Figure 2: Screenshot of the reachability graph generated from the petri net

	1	1_OFF	2	2_FR	3	3_FR	G1	G3	P1_ON	P1_OFF	P2_ON	P2_OFF	P3_ON	P3_OFF	T1	T2	B3_ON	B3_OFF	S2_ON	S2_OFF	Clock
Default	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0
DefaultB3	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	1	0
DefaultS2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0
DefaultB3S2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0
GreenP3	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	0
GreenP3S2	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	1	0	0
GreenG1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	1	0
GreenG1S2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	1	0	0
Green3	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	0
Green3S2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	1	0	0
Green2and3	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0

Table 1: A table indicating where tokens should be for each state (1 represents 1 token, and 0 represents no tokens)

2 Description of transitions

1. Default → GreenG1
   This transition happens when the system is in the default state and timer T1 fires.

2. Default → DefaultB3
   This transition happens when the system is in the default state and a pedestrian hits the button B3

3. Default → DefaultS2
   This transition happens when the system is in the default state and a vehicle is detected on sensor S2

4. Default → Night
   This transition happens when the system is in the default state and the clock indicates nighttime

5. DefaultB3 → GreenP3
   This transition happens when the system is in the DefaultB3 state and timer T1 fires. DefaultB3 is similar to the Default state, except that a pedestrian hit the button B3.

6. DefaultB3 → DefaultB3S2
   This transition happens when the system is in the DefaultB3S2 state, and a vehicle is detected on sensor S2. DefaultB3 is similar to the Default state, except that a pedestrian hit the button B3.

7. DefaultB3 → Night
   This transition happens when the system is in the DefaultB3 state and the clock indicates nighttime

8. DefaultS2 → GreenG1S2

   This transition happens when the system is in the DefaultB3 state and timer T1 fires. This is similar to the transition Default → GreenG1, except that a vehicle is detected on sensor S2

9. DefaultS2 → DefaultB3S2

   This transition happens when the system is in the DefaulS2 state, and a vehicle is detected on sensor S2. DefaultB3S2 is similar to the Default state, except that a pedestrian hit the button B3, and a vehicle is detected on sensor S2.

10. DefaultS2 → Night

    This transition happens when the system is in the DefaultS2 state and the clock indicates nighttime

11. DefaultB3S2 → GreenP3S2

    This transition happens when the system is in the DefaultB3S2 state and timer T1 fires. This is similar to the transition Default → GreenG1, except that a vehicle was detected on sensor 2 and a pedestrian requested to cross

12. DefaultB3S2 → Night

    This transition happens when the system is in the DefaultB3S2 state and the clock indicates nighttime

13. GreenP3 → GreenG1

    This transition happens when the system is in the GreenP3 state and timer T2 fires

14. GreenP3S2 → GreenG1S2

    This transition happens when the system is in the GreenP3 state and timer T2 fires. This is very similar to the transition above, except that a vehicle was detected on sensor S2

15. GreenG1 → Green3

    This transition happens when the system is in the Green3 state and timer T2 fires.

16. GreenG1S2 → Green3S2

    This transition happens when the system is in the GreenG1S2 state and timer T2 fires. This is very similar to the transition above, except that a vehicle was detected on sensor S2

17. Green3 → Default
    This transition happens when the system is in the Green3 state and timer T2 fires.

18. Green3S2 → Green2and3
    This transition happens when the system is in the Green3 state and timer T2 fires. This is similar to the transition above, except that a vehicle was detected on sensor S2, so we go to state Green2and3 before returning to the default state

19. Green2and3 → Default
    This transition happens when the system is in the Green2and3 state and timer T2 fires.

20. Night → Default
    This transition happens when the clock signals daytime, and it was previously night.

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3.1 Is the model conservative?

We can clearly see that the number of tokens in the petri net is not constant, therefore the model is not conservative.

3.2 Can we have deadlock?

Using the *Space analysis tool* in PIPE, we see that the model is bounded, safe, and has no deadlock.

3.3 Can we have starvation?

Yes, the model can have starvation The transitions are as follows:

1. Default → GreenG1

2. GreenG1 → Green3

3. Green3 → Default
   ...

Starvation can be prevented here by adjusting the firing times of the timers.