CSE422 “Computer Controlled Systems” Final Exam Model Answer
June, 2021

## Question (1):

**1.** Car Traffic Light (Fig. 1): Deterministic,
Pedestrian Traffic Light (Fig. 2): Non-deterministic.

**2.** For Fig. 1:
The count variable has 61 possible values and there are 4 bubbles, so the total number of combinations is 61×4=244. The size of the state space is therefore 244.
The number of reachable states, therefore, is 61×3+6=189.

**3.** Mathematical model for Fig. 2**:**

$$\begin{aligned}
States &= \{\text{none}, \text{waiting}, \text{crossing}\} \\
Inputs &= (\{sigG, sigY, sigR\} \to \{present, absent\}) \\
Outputs &= (\{pedestrian\} \to \{present, absent\}) \\
initialStates &= \{\text{crossing}\}
\end{aligned}$$

$$possibleUpdates(s, i) = \begin{cases} \{(\text{none}, absent)\} & \\ \quad \text{if } s = \text{crossing} & \\ \quad \wedge\, i(sigG) = present & \\ \{(\text{none}, absent), (\text{waiting}, present)\} & \\ \quad \text{if } s = \text{none} & \\ \{(\text{crossing}, absent)\} & \\ \quad \text{if } s = \text{waiting} & \\ \quad \wedge\, i(sigR) = present & \\ \{(s, absent)\} & \text{otherwise} \end{cases}$$

## Question (2):

**1.**

$$\begin{aligned}
q_A &= q_B \\
2q_B &= q_C \\
2q_A &= q_C
\end{aligned}$$

$$\Gamma = \begin{bmatrix} 1 & -1 & 0 \\ 0 & 2 & -1 \\ 2 & 0 & -1 \end{bmatrix}, q = \begin{bmatrix} q_A \\ q_B \\ q_C \end{bmatrix}, \Gamma q = \vec{0}$$

**2.** The least positive integer solution to these equations is $q_A = q_B = 1$, and $q_C = 2$.

**3.** Scheduling pattern: A, B, C, C.