EECS20n, Quiz 3

Solution

1. For the Simulink diagram shown below, write a differential equation (with no integrals, just
derivatives) that describes the signal $w$.

![Simulink Diagram](image)

**Solution:**

\[ \forall t \in \text{Reals}_+, \quad \dot{w}(t) = -0.9w(t). \]

2. The Simulink diagram in the previous problem can be described as a first-order differential in
the following form:

\[ \forall t \in \text{Reals}_+, \quad \dot{z}(t) = Az(t). \]

Give a definition of $z$ in terms of $w$ and give $A$.

**Solution:**

\[ \forall t \in \text{Reals}_+, \quad z(t) = \begin{bmatrix} w(t) \\ \dot{w}(t) \end{bmatrix} \quad A = \begin{bmatrix} 0 & 1 \\ -0.9 & 0 \end{bmatrix}. \]

3. For the following hybrid system, assume the input is given by

\[ \forall t \in \text{Reals}, \quad u(t) = \begin{cases} a & \text{if } t = 1 \\ b & \text{if } t = 2 \\ \text{absent} & \text{otherwise} \end{cases} \]

Sketch the output over the range $t \in [0, 3]$. 
Solution:

In addition, at times $t = 1$ and 2, the output is \textit{absent}.