Quiz on deterministic signals and systems

1. What is a dynamical system?

    - When is a dynamical system linear?

    - When is a dynamical system time-invariant?

2. What representations do you know of a linear time-invariant system? Write the corresponding formulas.

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3. What is the order of an linear time-invariant system?

    - What is the order of the system defined by a state space representation with parameters
    $$A = \begin{bmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{4} \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & 0 \end{bmatrix}, \quad D = 1$$

    - What is the order of the system defined by the transfer function $H(z) = \frac{z - \frac{1}{4}}{(z - \frac{1}{2})(z - \frac{1}{4})}$.

    - What is the order of the system with an impulse response $h = (1, \frac{1}{2}, \frac{1}{4}, \ldots)$

4. Describe shortly the realization problem and the approach for solving via the Hankel matrix.
    - Show how it works for a system with impulse response $h = (1, \frac{1}{2}, \frac{1}{4}, \ldots)$.
    - Characterize the nonuniqueness of the obtained state space representation.

    (White the answer of question 4 at the back of this page.)