

Structures for Realization of Discrete Time Systems

1. The general linear constant coefficient difference equation characterizing an LTI discrete time system is:

- a) $y[n] = - \sum_{k=1}^N a_k y[n-k] + \sum_{k=0}^N b_k x[n-k]$
- b) $y[n] = - \sum_{k=0}^N a_k y[n-k] + \sum_{k=0}^N b_k x[n-k]$
- c) $y[n] = - \sum_{k=1}^N a_k y[n] + \sum_{k=0}^N b_k x[n]$
- d) None of the Mentioned

Answer: a

Explanation: We know that, the general linear constant coefficient difference equation characterizing an LTI discrete time system is given by the expression $y[n] = - \sum_{k=1}^N a_k y[n-k] + \sum_{k=0}^N b_k x[n-k]$

2. Which of the following is the rational system function of an LTI system characterized by the difference equation

$$y[n] = - \sum_{k=1}^N a_k y[n-k] + \sum_{k=0}^N b_k x[n-k] ?$$

- a) $\frac{\sum_{k=0}^N b_k x[n-k]}{1 + \sum_{k=0}^N a_k y[n-k]}$
- b) $\frac{1 + \sum_{k=1}^N a_k y[n-k]}{\sum_{k=0}^N b_k x[n-k]}$
- c) $\frac{\sum_{k=0}^N b_k x[n-k]}{1 + \sum_{k=1}^N a_k y[n-k]}$
- d) $\frac{1 + \sum_{k=0}^N a_k y[n-k]}{\sum_{k=0}^N b_k x[n-k]}$

Answer: c

Explanation: The difference equation of the LTI system is given as

$$y[n] = - \sum_{k=1}^N a_k y[n-k] + \sum_{k=0}^N b_k x[n-k]$$

By applying the z-transform on both sides of the above equation and by rearranging the obtained equation, we get the rational system function as

$$H(z) = \frac{\sum_{k=0}^N b_k z^{-k}}{1 + \sum_{k=1}^N a_k z^{-k}}$$

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3. Which of the following is used in the realization of a system?
a) Delay elements b) Multipliers c) Adders
d) All of the mentioned

Answer:d

Explanation: From each set of equations, we can construct a block diagram consisting of an interconnection of delay elements, multipliers and adders.

4. Computational complexity refers to the number of:
a) Additions b) Arithmetic operations c) Multiplications
d) None of the mentioned

Answer:b

Explanation: Computational complexity is one of the factors which is used in the implementation of the system. It refers to the numbers of Arithmetic operations (Additions, multiplications and divisions).

5. The number of times a fetch from memory is performed per output sample is one of the factors used in the implementation of the system.
a) True b) False

Answer:a

Explanation: According to the recent developments in the design and fabrication of rather sophisticated programmable DSPs, other factors, such as the number of times a fetch from memory is performed or the number of times a comparison between two numbers is performed per output sample, have become important in assessing the computational complexity of a given realization of a system.

6. Which of the following refers the number of memory locations required to store the system parameters, past inputs, past outputs and any intermediate computed values?
a) Computational complexity b) Finite world length effect
c) Memory requirements d) none of the mentioned

Answer:c

Explanation: Memory requirements refers the number of memory locations

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required to store the system parameters, past inputs, past outputs and any intermediate computed values.

7. Finite word length effects refer to the quantization effects that are inherent in any digital implementation of the system, either in hardware or software.
- a) True
 - b) False

Answer:a

Explanation: The parameters of the system must necessarily be represented with finite precision. The computations that are performed in the process of computing an output from the system must be rounded off or truncated to fit within the limited precision constraints of the computer or hardware used in the implementation. Thus, Finite word length effects refer to the quantization effects that are inherent in any digital implementation of the system, either in hardware or software.

8. Which of the following are called as finite word length effects?
- a) Parameters of the system must be represented with finite precision
 - b) Computations are truncated to fit in the limited precision constraints
 - c) Whether the computations are performed in fixed point or floating point arithmetic
 - d) All of the mentioned

Answer:d

Explanation: All the three of the considerations given above are called as finite word length effects.

9. The factors Computational complexity, memory requirements and finite word length effects are the ONLY factors influencing our choice of the realization of the system.
- a) True
 - b) False

Answer: b

Explanation: Apart from the three factors given in the question, other factors such as, whether the structure or the realization lends itself to parallel processing or whether the computations can be pipelined are also the factors which influence our choice of the realization of the system.