TIE-50406 DSP Implementations
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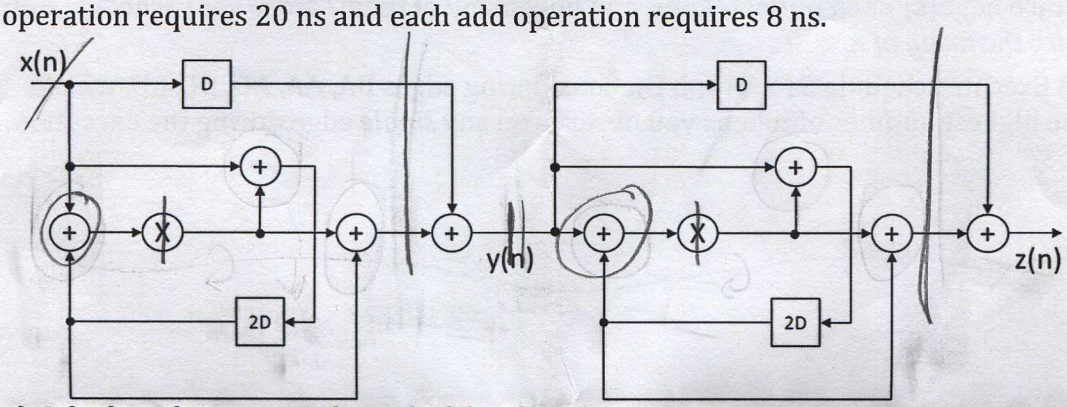
Calculators and dictionaries are allowed

1. Explain shortly:
a) recursive DFG
b) M-level pipelined system
c) Biased exponent
d) SDFG
e) L-slow
f) precedence constraint in data flow graphs

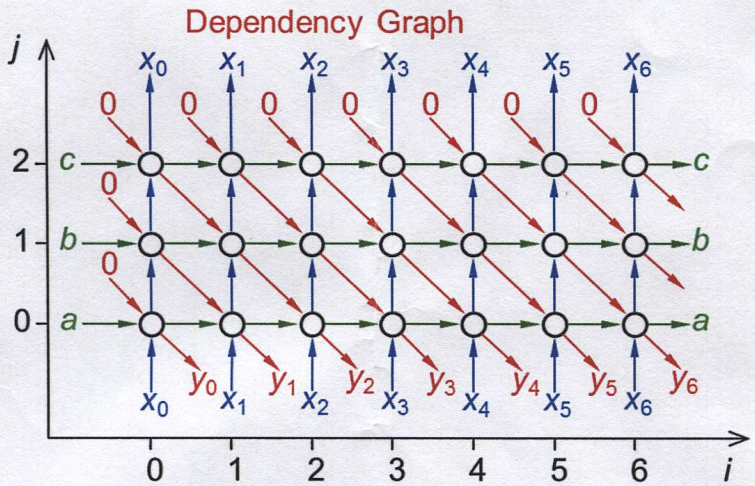
2. Consider the wave digital filter shown below. Assume that each multiply operation requires 20 ns and each add operation requires 8 ns.



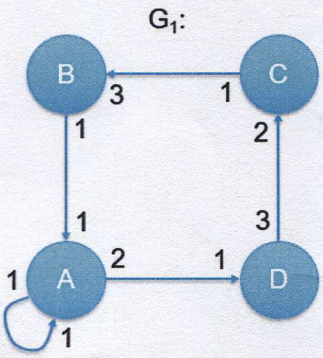
a) Calculate the iteration bound of this filter by inspection.
b) What is the critical path?
c) Manually pipeline and/or retime this filter to achieve a critical path equal to the iteration bound.

3. Draw the systolic architecture block diagram and the space-time mapping for the 3-tap FIR digital filter (dependence graph below) with the projection, processor, and scheduling vectors as follows:

$$\mathbf{d} = \begin{pmatrix} 1 \\ -1 \end{pmatrix}, \qquad \mathbf{p}^T = (1 \quad 1), \qquad \mathbf{s}^T = (2 \quad 1).$$



4. Consider the synchronous dataflow graph G_1 below:



a) Determine the topology matrix Γ of G_1

b) Acquire the repetition vector $\mathbf{q}$ by solving $\Gamma\mathbf{q}^T = \mathbf{0}$ or by balance equations.

c) Construct a valid and periodic sequential schedule S for G_1. For S to be periodic, which edge(s) need initial tokens, and how many of them? *Make your schedule start with the firing of A.*

d) Execute schedule S for graph G_1. Considering edges BA, AA, AD, DC, CD, what is the highest number of tokens you observe on any *single* edge during the execution of S?