Examples of Quiz 3 questions

* Provide the first 3 iterations of the CORDIC algorithm when the goal is to rotate the vector (x_0, y_0) = (1.0, -0.5) by 5 degrees. Compute the intermediate (x_i, y_i, z_i) values with full precision to the table below.

A CORDIC reminder: $x_{i+1} = x_i - d_i y_i 2^{-i}$
$y_{i+1} = y_i + d_i x_i 2^{-i}$

The values of arctan(2^{-i}) for the iterations are:

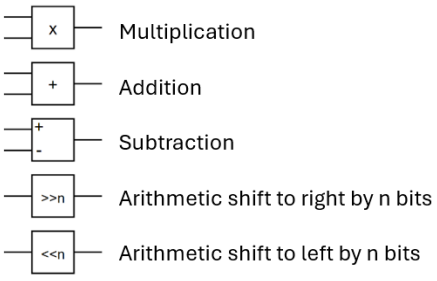
i	arctan (2^{-i})[deg]
0	45.00
1	26.57
2	14.04

i	x_i	y_i	z_i
0	1.0	-0.5	5.00
1			
2			
3			

* When $|x| < 1$, computation of function $\sqrt{1+x}$ can be based on binomial series

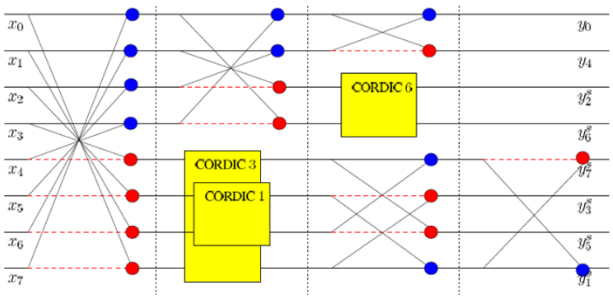
$$(1+x)^{\frac{1}{2}} = 1 + \frac{1}{2}x - \frac{1}{8}x^2 + \frac{1}{16}x^3 - \frac{5}{128}x^4 + \ldots$$

Assume that the five terms shown provide an approximation which is good enough for an application. For a fixed-point implementation, you can use multiplications, additions, subtractions, and arithmetic shifts. Trying to minimize the number of multiplications, present an implementation for the computation using the block symbols shown on the right.



* Explain the implementation of 2-D DCT for image block transform in JPEG coding.

* Explain how the following structure for computation of 8-point DCT can be used to implement the 2-D DCT transform of 8x8 pixel blocks in JPEG coding. Explain also how one can compensate for the gain introduced by the shown CORDIC blocks.



* Describe how modulation of a signal $s(n)$ can be implemented using CORDIC.

* Explain

(a) 3-valued CORDIC

(b) CORDIC gain

* Discuss alternatives for dealing with CORDIC gain in DSP implementations.

* Modified DCT produces N/2 samples for a signal section consisting of N samples. Sketch how MDCT is used in implementation of audio encoding, that is, what are the main steps in analysis done at encoder and synthesis at decoder.

* In the framework of unified CORDIC, combination of the linear system running in vectoring mode can be used to implement division y/x. Referring to the equations of the unified CORDIC shown on the right, explain how division is implemented.

$$x_{i+1} = x_i - m \cdot d_i \cdot y_i \cdot 2^{-i}$$
$$y_{i+1} = y_i + d_i \cdot x_i \cdot 2^{-i}$$
$$z_{i+1} = z_i - d_i \cdot \varepsilon_i$$