EE 703: Digital Message Transmission (Autumn 2021)
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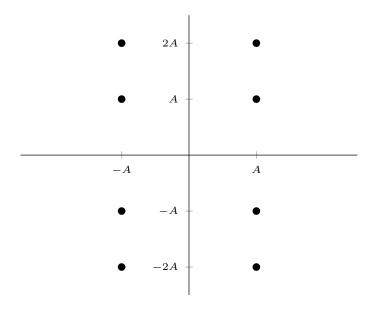Quiz 2: 10 points   Date: October 23, 2021

1. [6 points] For the below constellation of 8 symbols, assume that the transmitted symbol is corrupted by adding $N = N_c + jN_s$ where N_c and N_s are independent Gaussian random variables with zero mean and variance $\frac{N_0}{2}$. All the constellation points are equally likely to be transmitted. Calculate the following for the optimal decision rule in terms of E_b and N_0.

   (a) The union bound on the exact error probability.

   (b) The intelligent union bound on the exact error probability.

   (c) The nearest neighbor approximation of the exact error probability.

2. [4 points] Suppose N_1, N_2 are independent Gaussian random variables each having mean 0 and variance $\sigma^2 > 0$. The variance σ^2 is assumed to be known. We observe two observations Y_1, Y_2 given by

$$Y_1 = 2\lambda + N_1,$$
$$Y_2 = 4\lambda + N_2.$$

Find the ML estimator of the parameter λ. Show your steps.