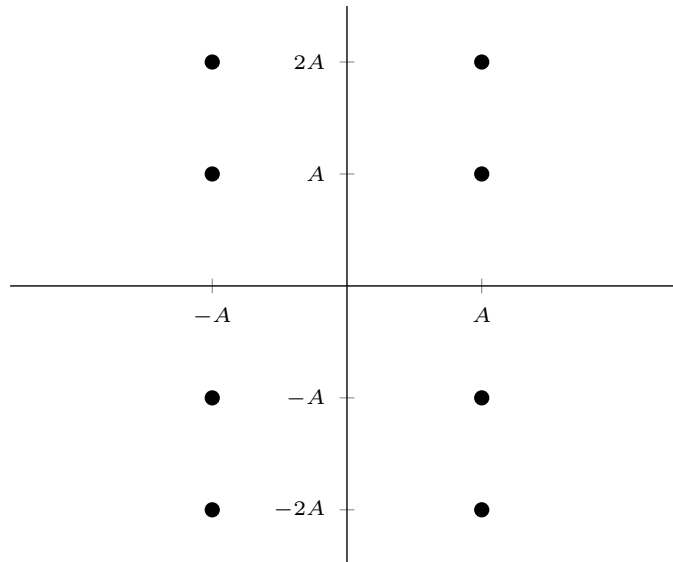


1. [6 points] For the below constellation of 8 symbols, assume that the transmitted symbol is corrupted by adding $N = N_c + jN_s$ where N_c and N_s are independent Gaussian random variables with zero mean and variance $\frac{N_0}{2}$. All the constellation points are equally likely to be transmitted.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



2. [4 points] Suppose observations Y_i , $i = 1, 2, \dots, N$ are Rayleigh distributed with parameter σ^2 . A Rayleigh distributed random variable with parameter $\sigma^2 > 0$ has probability density function given by

$$p(y) = \frac{y}{\sigma^2} e^{-y^2/2\sigma^2} \text{ for } y \geq 0.$$

Assume that the Y_i 's are independent. Derive the ML estimator for σ^2 .