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ECE300 Communication Theory

Problem Set III: MAP and ML Decision Rules

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1. Urn I contains R_1 red balls and B_1 blue balls, and Urn II contains R_2 balls and B_2 blue balls. A ball is selected at random from Urn I and put into Urn II. Then a ball from Urn II is selected. Based on the color of the ball chosen from Urn II, we try to guess the color of the ball that was chosen from Urn I. Consider both the MAP and ML decision rules for this case.

Take parameter values $R_1 = 2$, $B_1 = 7$, $R_2 = 3$, $B_2 = 7$, and perform $N = 10^5$ trials. Write code to perform computations as indicated below using MATLAB (i.e., no "pencil and paper"), in terms of general parameter values, and then run your code with the specific parameter values given here. The only special function should use in MATLAB is *randi*. You should determine and output the following information:

- Summarize the parameters: R_1, B_1, R_2, B_2, N .
- The MAP and ML decision rules (e.g., "Guess Red if Red, Blue if Blue" etc.).
- The theoretical probability of error for MAP and ML.
- The estimated probability of error (i.e., the fraction of the time the decision rule is wrong), for MAP and ML.

Repeat the above now for the cases $R_1 = 4$, $B_1 = 5$, $R_2 = 3$, $B_2 = 7$ (still $N = 10^5$).