

# Boulder Theoretical Biophysics 2019

## Neuroscience Mini-course: Exercise Set 1

In Lecture 1, we set up a 12-coin weighing problem, and you were asked to solve it by taking an approach that Shannon might have advocated by maximizing the entropy of the potential outcomes of our weighings.

*Recall:* You are given 12 coins, one of which is counterfeit, and a balance. In as few weighings as possible, determine which coin is fake and whether it is heavier or lighter than a true coin. The optimal strategy solves this problem in 3 weighings.

1. As a first step, you should weigh 4 coins against another 4, leaving 4 coins aside. Calculate the entropy of this weighing.
2. If the outcome of the first weighing is “uneven”, devise a second weighing and report its entropy. Show your work.
3. If you were given 16 coins, again one of them is counterfeit and you must identify it **and** determine if it is light or heavy, what would be the optimal first weighing? What would Shannon have to say about the fewest number of weighings that might possibly solve the 16-coin problem?