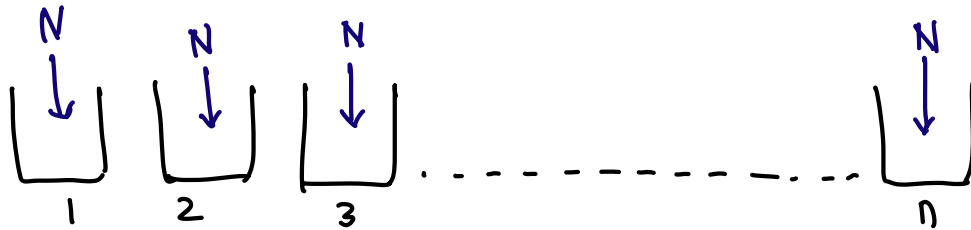


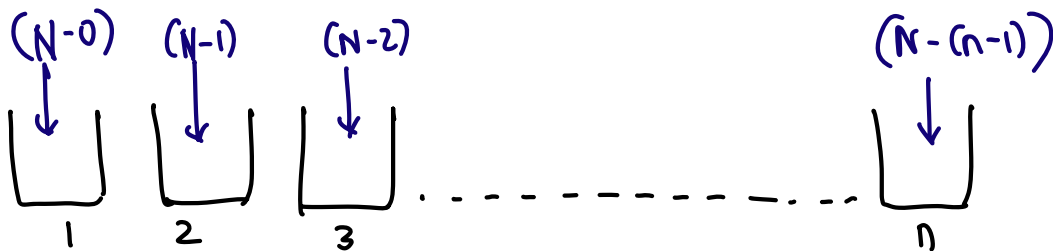
BALLS IN BINS

Problem statement: We have n people who we want to assign passwords. There are N passwords to choose from. We don't keep track of the passwords assigned. What is the probability that same password has been assigned two or more times. ($n \leq N$) -
→ Assumption each password is chosen uniformly at random



← These bins are people

Total number of possible outcomes = N^n



Total outcomes when no two people have been assigned the same password = $N(N-1)(N-2) \dots (N-(n-1))$

$$\begin{aligned} P(\text{no collision}) &= \frac{N(N-1)(N-2) \dots (N-(n-1))}{N^n} \\ &= \frac{N(N-1)(N-2) \dots (N-(n-1))}{N \cdot N \cdot N \dots N} \end{aligned}$$

$$P(\text{no collision}) = \prod_{i=0}^{n-1} \frac{N-i}{N}$$

$$P(\text{collision}) = 1 - P(\text{no collision})$$

$$P(\text{collision}) = 1 - \left(\prod_{i=0}^{n-1} \frac{N-i}{N} \right)$$