Exercise - combinatorics

- Assume a propositional logic over n variables. Compute the number of non-equivalent:
  - Monotone conjunctions
  - Conjunctions
- Can we similarly compute the number of non-equivalent s-DNFs? Can we put an upper bound on such number?

Exercise - union bound (a.k.a. Boole's inequality)

- $P(A \cup B) \leq P(A) + P(B)$
  - Generalize to $P(\bigcup_i A_i)$.
  - How does is it relate to the inclusion-exclusion principle?

Exercise - Hoeffding's inequality

- Theorem: For random variables $X_i, i = 1, ..., n$ such that $0 \leq X_i \leq 1$ and an $\epsilon > 0$, it holds that: $P(\overline{X} - \mathrm{E}\overline{X} \geq \epsilon) \leq \exp(-2n\epsilon^2)$.
- Derive a similar bound for: $P(|\overline{X} - \mathrm{E}\overline{X}| \geq \epsilon)$

Exercise - Prosecutor's fallacy

- A DNA sample is found at a crime place.
- A match is found in a DB of 10000 people.
- The prosecutor explains that the probability that two profiles match by chance is only 1 in 10000.
- How strong evidence is it against the suspect? I.e. what is the probability of getting at least one match?
- Give a bound on the probability of the match, such that probability of matching an innocent is at most ϵ?