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Probability: reasoning under uncertainty

CSE examples:

1. Performance: failures uncertain, arrival rates and completion times uncertain
2. Patterns in data: Data mining, knowledge discovery.

Netflix recommendations, Google page ordering, spam filter

3. Scientific data analysis: Uncertainty due to measurement ~~errors~~ errors.

4. Algorithm design: randomized algorithm
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Counting.

Motivation: If some probabilistic experiment has a finite set Ω of equally likely outcomes (e.g., roll of a fair die), the probability of an event $A \subseteq \Omega$ is

$$P(A) = \frac{|A|}{|\Omega|} \leftarrow \begin{array}{l} \text{counting} \\ \text{problems} \end{array}$$

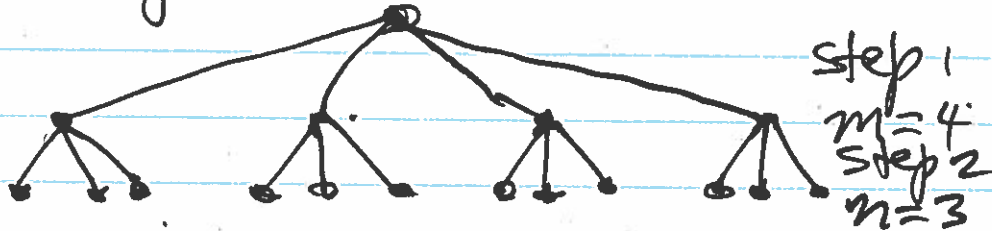
Ex: $A = \{1, 3, 5\}$, $\Omega = \{1, 2, 3, 4, 5, 6\}$.

$$P(A) = \frac{3}{6} = \frac{1}{2}$$

Ex: Given a random 5-card Schmpfen hand, what is the probability it contains ≤ 2 spades?

Product Rule:

If there are m choices for step 1 and, for each choice, there are then n choices for step 2, there are mn choices in total.



Easily generalizes to s sequential steps.

Ex: How many n -bit strings are there? 2^n

Ex: How many subsets does an n -element set have? 2^n

For each element x of the set, there are 2 choices: either x is in the subset or it is not.