

# **Introduction to Probability**

**Topics :** <u>Computer engineering</u> Written on <u>March 13, 2024</u>

### 1. **Definition:**

- $\circ\,$  Probability is a measure of the likelihood that an event will occur.
- $\circ\,$  It is expressed as a number between 0 and 1, where 0 indicates impossibility and 1 indicates certainty.

### 2. Sample Space and Events:

- $\circ$  The sample space, denoted by S, is the set of all possible outcomes of an experiment.
- $\circ\,$  An event is any subset of the sample space.

### 3. Probability of an Event:

- $\circ~$  The probability of an event A, denoted by P(A), is the sum of the probabilities of all outcomes in A.
- It satisfies the following properties:
  - 1.  $0 \le P(A) \le 1$  for any event A.
  - 2. P(S) = 1, where S is the sample space.
  - 3. If A and B are disjoint events (i.e., they have no outcomes in common), then  $P(A \cup B) = P(A) + P(B)$ .

### 4. Probability Rules:

- **Complement Rule:** The probability of the complement of an event A, denoted by A' or  $A^c$ , is P(A') = 1 P(A).
- **Union Rule:** The probability of the union of two events A and B, denoted by  $A \cup B$ , is  $P(A \cup B) = P(A) + P(B) P(A \cap B)$ .
- **Intersection Rule:** If A and B are independent events, then  $P(A \cap B) = P(A) \times P(B)$ .

### 5. Types of Probability:

- **Classical Probability:** Based on equally likely outcomes in a sample space.
- **Empirical Probability:** Based on observed frequencies from data.
- Subjective Probability: Based on personal judgment or opinion.

### 6. Conditional Probability:

- $\circ\,$  Conditional probability measures the likelihood of an event occurring given that another event has already occurred.
- It is denoted by P(A|B) and calculated as  $P(A|B) = P(A \cap B) / P(B)$ .

## 7. Independence:

- $\circ\,$  Two events A and B are independent if the occurrence of one event does not affect the occurrence of the other.
- Mathematically,  $P(A \cap B) = P(A) \times P(B)$ .

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