

INDIAN SCHOOL AL WADI AL KABIR



ARTIFICIAL INTELLIGENCE

UNIT-3: MATH FOR AI

The Mathematical Engine of AI

Demystifying the invisible architecture that powers artificial intelligence through Statistics and Probability.

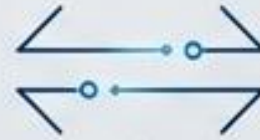


Intelligence is Simply Pattern Recognition

Human Intelligence



Humans identify order and arrangement intuitively.



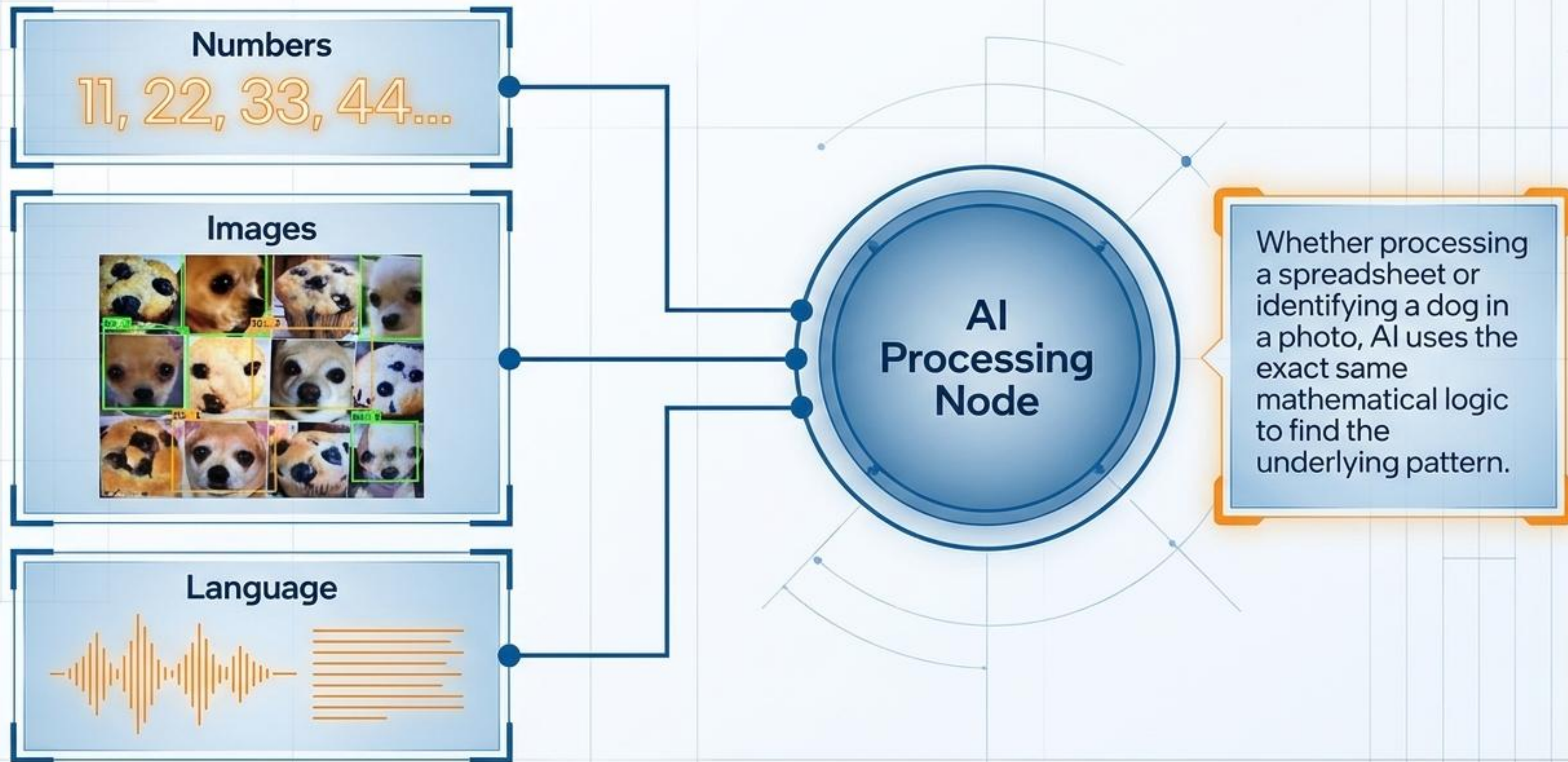
Artificial Intelligence



AI needs Math to study and recognize patterns in order to make decisions.

Math is the study of patterns. **AI** is the digital engine built to recognize them.

Translating the World into Data



The Four Pillars of AI Mathematics

Exploring Data

Statistics

What is the middle value?
Which is the most common?



Predicting Events

Probability

Will it rain tomorrow?
What is the outcome of a coin toss?



Finding Unknowns

Linear Algebra

How many total cars are in the city?

$$\begin{bmatrix} 1 & -2 & 0 \\ 2 & 5 & 1 \\ 0 & 3 & -2 \end{bmatrix}$$

Improving Models

Calculus

Which line is more slanted?
Which figure covers more area?

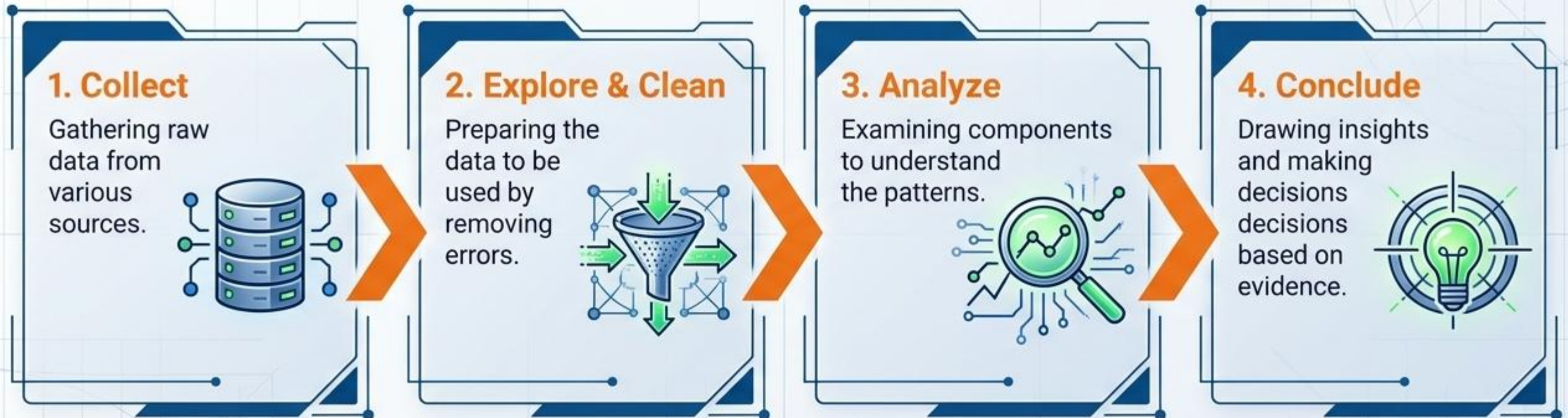


Statistics

Definition of Statistics:” Statistics is used for collecting, exploring, and analyzing the data. It also helps in drawing conclusions from data.”

- Data is collected from various sources.
 - Data is explored and cleaned to be used.
 - Analysis of data is done to understand it better.
 - Conclusions and decisions can be made from the data.
- Applications of Statistics:
- Predict the performance of sports teams
 - It can be used to find out specific things such as:
 - the reading level of students
 - the opinions of voters
 - the average weight of a city's resident

Statistics: The Architecture of Exploring Data



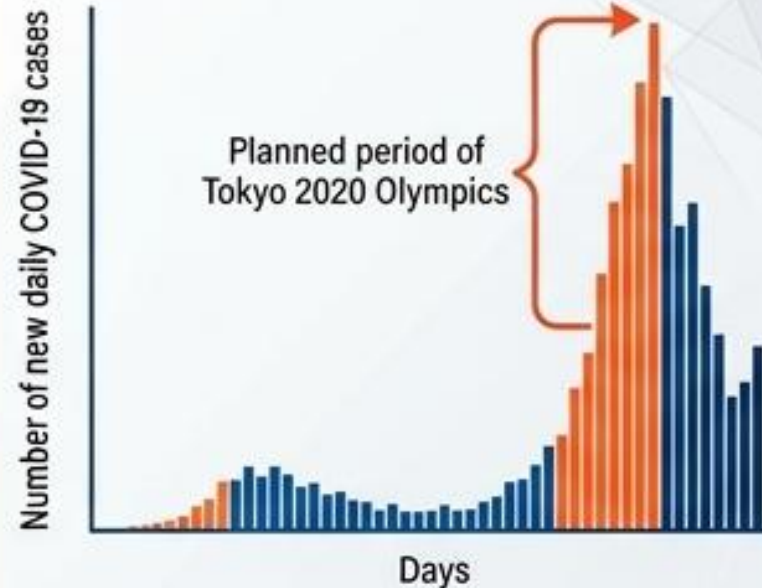
Statistics is the toolset for making sense of the data we already have.

Real-World Applications of Statistics



Disaster Management

Alerting citizens and assessing risks based on population density and infrastructure data.



Sports

Tracking metrics like the sharp increase in COVID cases during the planned Tokyo 2020 Olympics to make structural decisions.



Public Health

Disease Prediction: Helping governments understand which illnesses are affecting populations the most to allocate resources.

Probability: The Architecture of Prediction

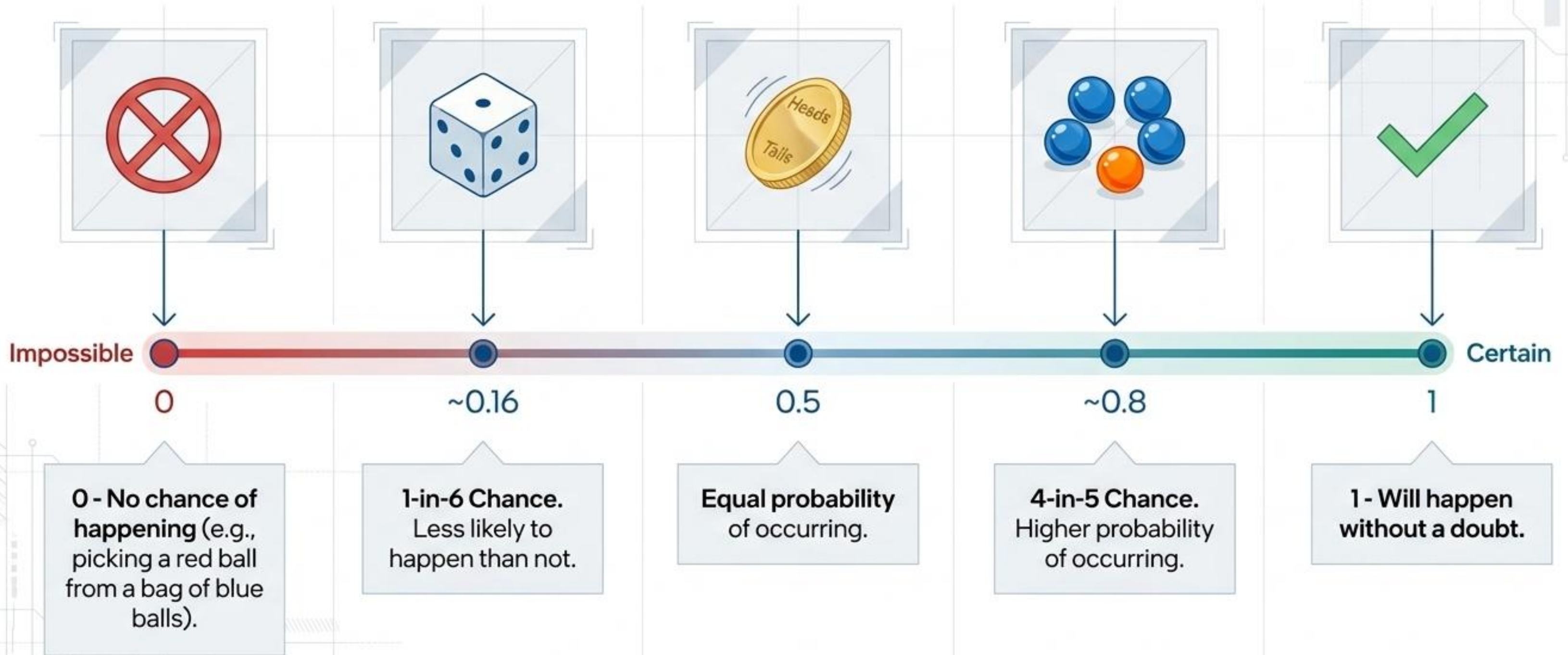
Probability is a way to tell us how likely something is to happen.



$$P(A) = \frac{\text{Number of Favorable Outcomes}}{\text{Total Number of Possible Outcomes}}$$

Example: A coin toss has 2 possible outcomes. The probability of landing Heads is $1/2$.

The Spectrum of Probability



Probability can be expressed in the following ways:

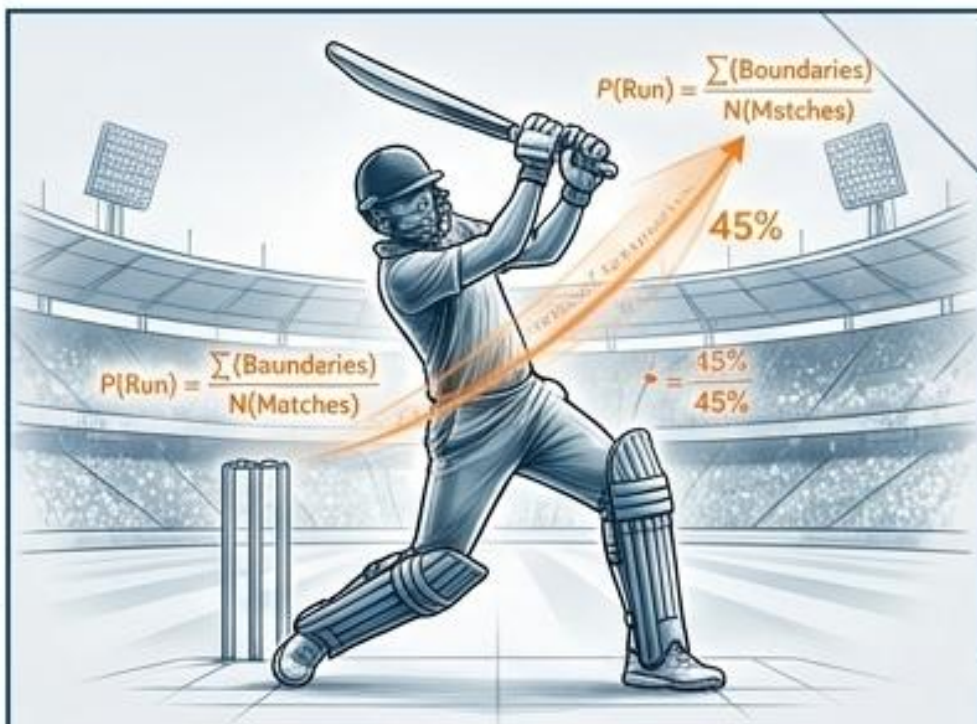
- Certain events: An event will happen without a doubt
- Likely events: The probability of one event is higher than the probability of another event
- Unlikely events: One event is less likely to happen than another event
- Impossible events: There's no chance of an event happening
- Equal Probability events: Chances of each event happening is same

Imagine you have a bag full of stars where 7 stars are  and 3 stars are 

Try to fill in the blanks with – likely, unlikely, certainly, impossible, equal probability

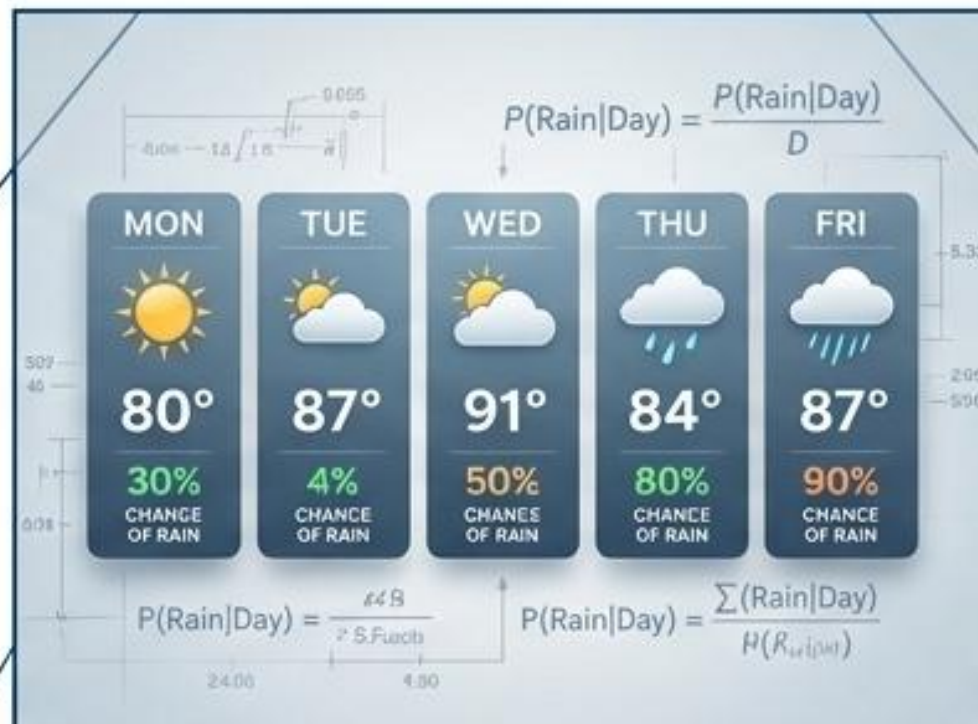
1. If you pick a star from the bag without looking, it is _____ that you will pick .
2. If you pick a star from the bag without looking, it is _____ that you will pick a .
3. If you pick a star from the bag without looking, it is _____ that you will pick a .
4. If you remove 4  from the bag, and pick a star without looking, there is an _____ that
you will pick either  or .
5. If you pick an object from the bag without looking, you will _____ pick a star.

Real-World Applications of Probability



Sports Analytics

Estimating batting averages by calculating the chance a batsman will score runs from boundaries in their next match based on historical data.



Weather Forecasting

Assessing the likelihood of rain, snow, or clouds (e.g., "70% chance of rain today").



Traffic Estimation

Predicting the severity of traffic based on time of day, location, and weather conditions to optimize routing.

The Foundation of Artificial Intelligence



1. Deep Understanding

Math is the essential x-ray vision needed to understand how AI models actually work beneath the surface.

2. The Big Four

Every AI model is built on the combined power of Statistics, Probability, Linear Algebra, and Calculus.

3. Universal Application

From disaster recovery to predicting traffic, the mathematical algorithms powering AI are already shaping everyday life.