PROBABILITY

Ever wondered if it'll rain tomorrow or if you'll win a game? That's probability! It's a math way to guess how likely things are to happen.

A OUTCOMES

> **Definition Outcome**
>
> An **outcome** is one possible result of a random experiment.

> **Definition All Possible Outcomes**
>
> **All possible outcomes** are the complete list of everything that could happen in a random experiment.

Ex: What are all the possible outcomes when you flip a coin?

Answer: All possible outcomes are Heads (H) and Tails (T).

**Ex:** What are all the possible outcomes when you roll a six-sided die?

Answer: All possible outcomes are 1=⚀,2=⚁,3=⚂,4=⚃,5=⚄,and 6=⚅.

B EVENTS

> **Definition Event**
>
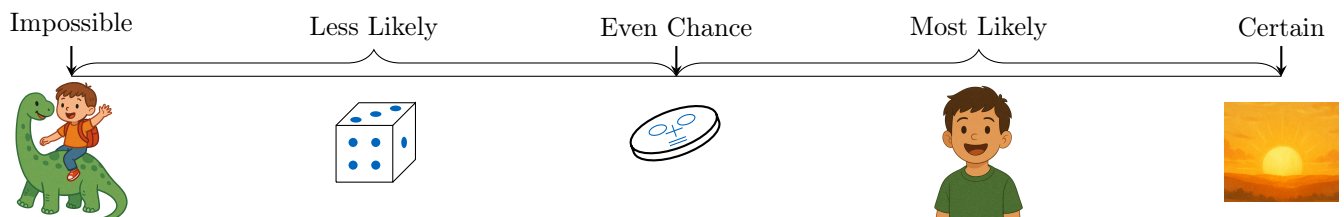> An **event** is a set of outcomes from all possible outcomes.

Ex: In the experiment of rolling a die, find the outcomes that correspond to rolling a number greater than 4.

Answer: The outcomes for "rolling an even number" are 2=⚁,4=⚃,and 6=⚅.

C USING WORDS TO DESCRIBE PROBABILITY

We often use words to talk about probability. If something will never happen, it's impossible. If it will definitely happen, it's certain. In between, we say things like 'likely,' '50-50 chance,' or 'unlikely.' We can line them up from least to most likely.

> **Definition Probability Line**
>
> Impossible Less Likely Even Chance Most Likely Certain
>
>
>
> - **Impossible**: It can't happen.
>   *Example: Riding a dinosaur.*
>
> - **Less likely**: It probably won't happen.
>   *Example: Rolling a die and getting a 3.*
>
> - **Even chance**: It has the same chance to happen or not.
>   *Example: Tossing a coin and getting head.*
>
> - **Most likely**: It will probably happen.
>   *Example: Smiling at school today.*
>
> - **Certain**: It will happen.
>   *Example: The sun will rise tomorrow.*

D USING NUMBERS TO QUANTIFY PROBABILITY

When you flip a coin, there are two possible outcomes: heads or tails. The chance of getting heads is the same as getting tails—it's 1 out of 2! In math, we write:
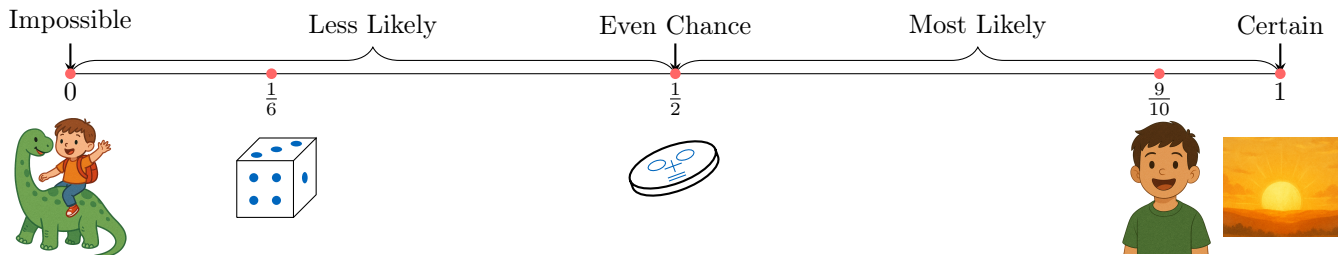
$$P\text{ ("Getting Heads")} = \tfrac{1}{2}$$

The probability | of getting heads | is equal | 1 chance out of 2

This means heads will happen about half the time!

> **Definition Probability**
>
> The **probability of an event**, written $P(\textbf{event})$, is a number that tells us how likely the event is to happen. It's always between 0 (impossible) and 1 (certain).
>
> Impossible   Less Likely   Even Chance   Most Likely   Certain
>
> 0 $\tfrac{1}{6}$ $\tfrac{1}{2}$ $\tfrac{9}{10}$ 1
>
>

E CALCULATING PROBABILITIES

In some experiments, every outcome is equally likely to occur, such as when flipping a fair coin or olling a fair die. These are referred to as equally likely outcomes.

> **Definition Equally Likely**
>
> When all outcomes are **equally likely**, the probability of an event is given by the formula:
>
> $$P(\textbf{event}) = \frac{\textbf{number of outcomes in the event}}{\textbf{total number of possible outcomes}}$$

Ex: Calculate the probability of rolling an even number with a fair six-sided die.

Answer:

- The total number of possible outcomes when rolling a fair six-sided die is 6, since there are 6 faces.

- The number of outcomes for the event "even number" is 3, as there are three even numbers on the die: 2, 4, and 6.

- Therefore, the probability of rolling an even number is given by:

$$
\begin{aligned}
P(\text{even number}) &= \frac{\text{number of outcomes in the event}}{\text{total number of possible outcomes}}\\
&= \frac{3}{6}\\
&= \frac{1}{2}
\end{aligned}
$$