**Generative Adversarial Network (GAN)**

A **Generative Adversarial Network** (GAN) is a type of deep learning model designed to generate new, synthetic data that resembles a given dataset. GANs consist of two neural networks: the **generator** and the **discriminator**, which are trained together in a competitive process. Here's how it works:

1. **Generator**: The generator's job is to create fake data that looks as realistic as possible. It takes random noise as input and tries to transform it into convincing data samples (e.g., images that resemble real photographs).
2. **Discriminator**: The discriminator is tasked with distinguishing between real data (from the original dataset) and the fake data produced by the generator. It classifies the input as either "real" or "fake."
3. **Adversarial Process**: The two networks are trained together in a loop:
   * The **generator** improves its ability to create more realistic fake data.
   * The **discriminator** becomes better at distinguishing real data from fake data.

Over time, the generator gets better at fooling the discriminator, and the discriminator becomes better at spotting fakes, which helps both networks improve.

**Key Concepts:**

* **Adversarial**: The two networks are in competition (adversaries) with each other. The generator wants to create data that the discriminator cannot distinguish from the real data, while the discriminator wants to correctly identify fake data.
* **Training**: Both networks are trained simultaneously, and the goal is for the generator to produce data that is so realistic, the discriminator can no longer tell it apart from real data.

**Applications of GANs:**

* **Image generation**: GANs can generate realistic images from random noise (e.g., creating faces of people who don’t exist).
* **Image-to-image translation**: They can transform images from one domain to another (e.g., turning sketches into realistic images).
* **Video generation**: GANs are used for generating synthetic videos or filling missing frames in video sequences.
* **Style transfer**: GANs can change the style of an image, such as converting a daytime photo to a nighttime scene.

GANs have revolutionized many areas in artificial intelligence, particularly in the fields of image processing, video generation, and creative applications.