🔹 **What are GANs?**

- **Generative Adversarial Networks (GANs)** consist of two competing neural networks:
- **Generator**: Creates fake data samples.
- **Discriminator**: Determines whether samples are real or fake.
- Training is a **minimax game**, aiming to reach **Nash equilibrium**.

🔹 **Key Applications of GANs**

✅ **Image Processing & Computer Vision**

- Super-resolution (e.g., SRGAN, ESRGAN)
- Image synthesis (e.g., DR-GAN, PG-GAN)
- Texture synthesis & object detection

✅ **Sequential Data**

- NLP (e.g., RankGAN, IRGAN)
- Music generation (e.g., RNN-GAN, ORGAN)

✅ **Other Fields**

- Medical imaging
- Data augmentation
- Style transfer

🔹 **Advantages of GANs**

✔ Generates **realistic samples** without explicit probability models.
✔ Works with **high-dimensional & complex data**.
✔ Can be trained **without labeled data**.
✔ Used for **unsupervised & semi-supervised learning**.

🔹 **Challenges & Limitations**

⚠️ **Mode collapse** – Generator produces limited variety.
⚠️ **Training instability** – Hard to balance Generator & Discriminator.
⚠️ **Computationally expensive** – Requires large datasets & computing power.