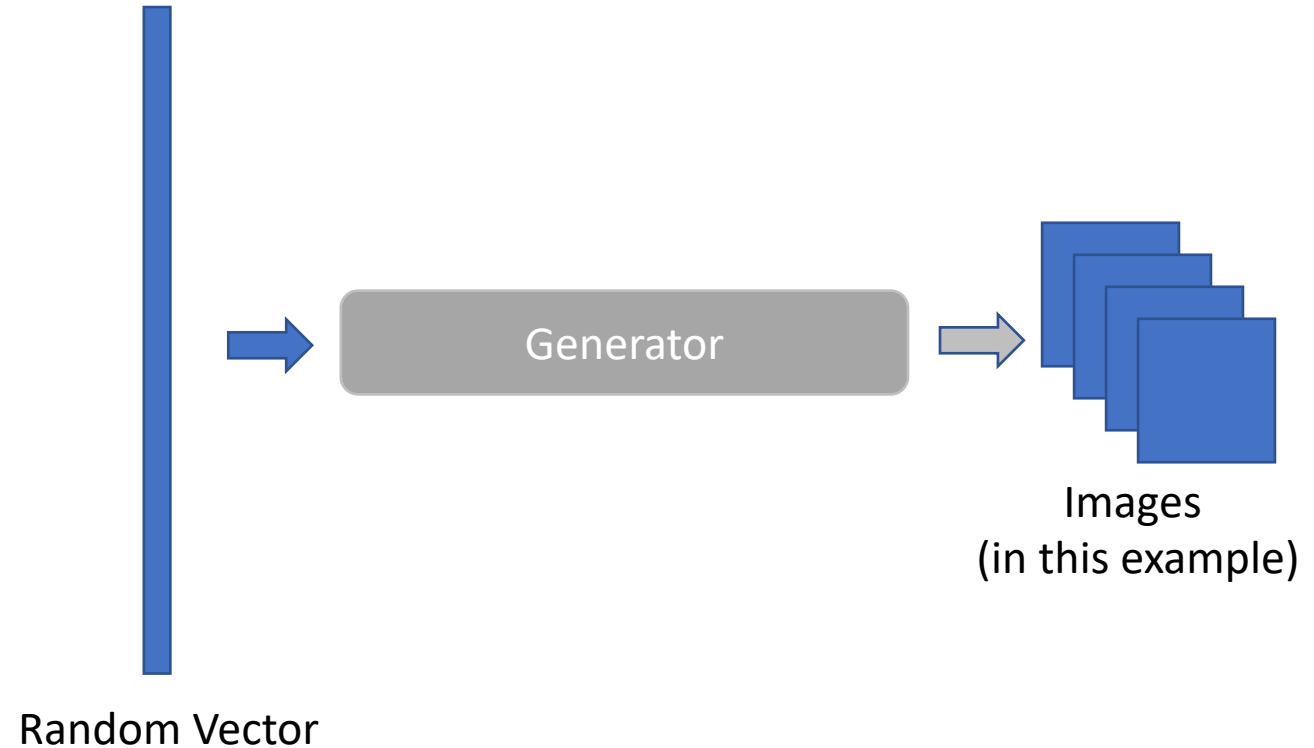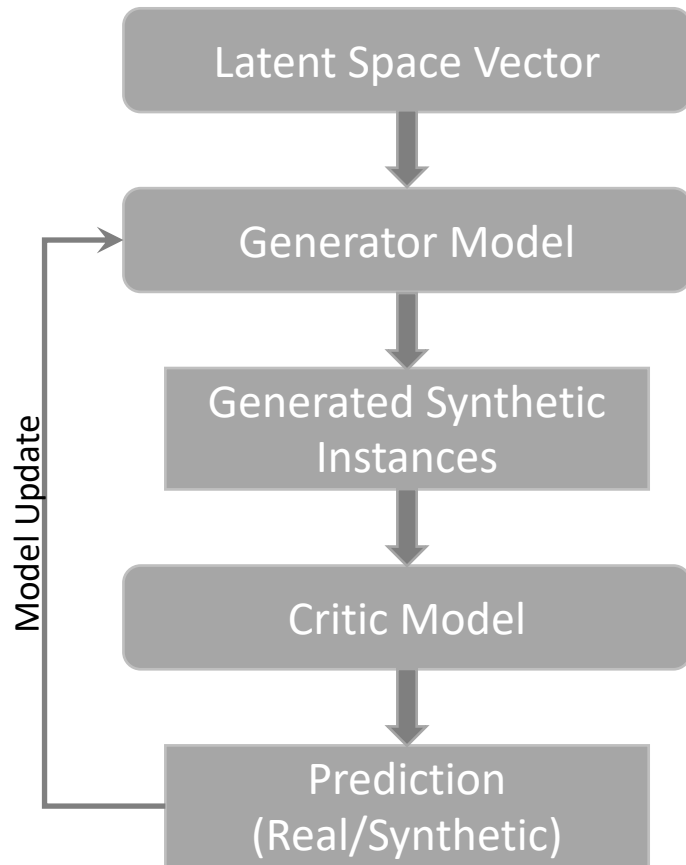# Discriminator

- Objective: Learn to discriminate between real & fake images.

- Supervised training, Classification model.

- Input: Images
  Output: Labels (real/fake)
  Loss: Binary Cross Entropy



Images
(in this example)

Critic Model/
Discriminator

[0,1,1,0]

# Generator

- Objective: Generate fake images...that should **"fool"** the discriminator.
Ergo, Adversarial.

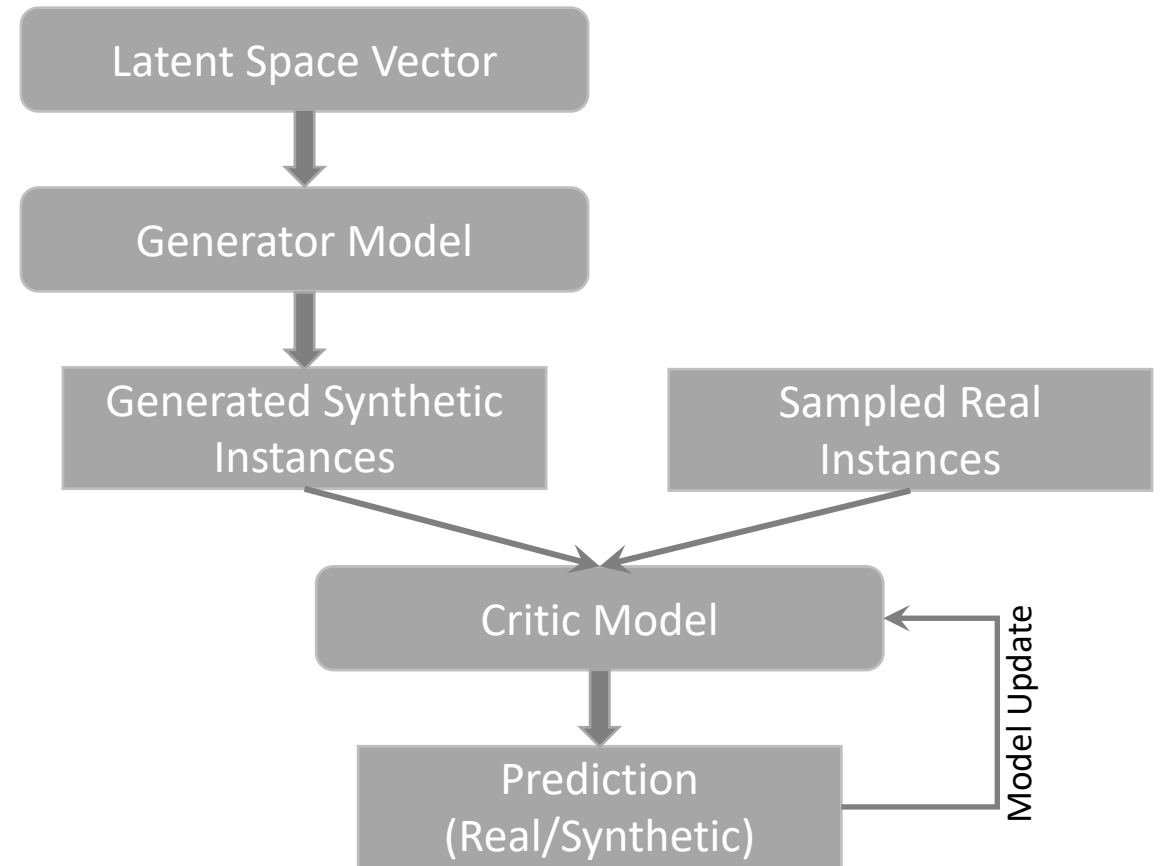- Input: Random Vector (Diversity/variability)
Output: Images

Random Vector

Generator

Images
(in this example)

# Generator Training

```
┌─────────────────────────┐
│   Latent Space Vector   │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│     Generator Model     │◄──┐
└─────────────────────────┘   │
            │                  │
            ▼                  │ Model Update
┌─────────────────────────┐   │
│   Generated Synthetic   │   │
│       Instances         │   │
└─────────────────────────┘   │
            │                  │
            ▼                  │
┌─────────────────────────┐   │
│      Critic Model       │   │
└─────────────────────────┘   │
            │                  │
            ▼                  │
┌─────────────────────────┐   │
│      Prediction         │───┘
│    (Real/Synthetic)     │
└─────────────────────────┘
```

- Ideal answer for the generator is all images were real.

- Hence target vector = [1,1,1,1,1....1]

- Discriminator Prediction: [0,1,0,1,1,0,0,...0]

- Calculate the BCE loss between target and prediction.

- Apply gradient descent...but *only on the parameters of the generator model*.

# Discriminator Training

- Old fashioned supervised training step.

```
┌─────────────────────────┐
│   Latent Space Vector    │
└─────────────────────────┘
             │
             ▼
┌─────────────────────────┐
│     Generator Model      │
└─────────────────────────┘
             │
             ▼
┌─────────────────────┐        ┌─────────────────────┐
│ Generated Synthetic │        │    Sampled Real     │
│     Instances       │        │     Instances       │
└─────────────────────┘        └─────────────────────┘
             \                  /
              \                /
               ▼              ▼
        ┌─────────────────────────┐
        │      Critic Model       │◄──────┐
        └─────────────────────────┘       │  Model Update
                     │                     │
                     ▼                     │
        ┌─────────────────────────┐       │
        │       Prediction        │───────┘
        │     (Real/Synthetic)    │
        └─────────────────────────┘
```

# GAN Training = Discriminator Train* + Generator Train*