gan means generative adversarial networks.it is an approach to generative modeling using deep learning methods, such as convolutional neural networks. moreover, Generative modeling is an unsupervised learning task in machine learning that involves automatically discovering and learning the regularities or patterns in input data. Furthermore, GANs are a clever way of training a generative model by framing the problem as a supervised learning problem with two sub-models. The two models are trained together in a zero-sum game, adversarial, until the discriminator model is fooled about half the time, meaning the generator model is generating plausible examples. Though, GANs are an exciting and rapidly changing field, delivering on the promise of generative models in their ability to generate realistic examples across a range of problem domains, most notably in image-to-image translation tasks such as translating photos of summer to winter or day to night, and in generating photorealistic photos of objects, scenes, and people that even humans cannot tell are fake.

Generative models------

There are some generative models. We will describe supervised & unsupervised learning paradigms and discriminative vs. generative modeling.

In supervised learning, This requires a training dataset that is used to train a model, comprised of multiple examples, called samples, each with input variables (*X*) and output class labels (*y*). though, i*n the predictive or supervised learning approach, the goal is to learn a mapping from inputs x to outputs y, given a labeled set of input-output pairs. Moreover,* Examples of supervised learning problems include classification and regression, and examples of supervised learning algorithms include logistic regression and random forest.

In unsupervised learning, There is another paradigm of learning where the model is only given the input variables (*X*) and the problem does not have any output variables (*y*). here, A model is constructed by extracting or summarizing the patterns in the input data. There is no correction of the model, as the model is not predicting anything. This lack of correction is generally referred to as an

unsupervised form of learning, or unsupervised learning. Examples of unsupervised learning problems include clustering and generative modeling, and examples of unsupervised learning algorithms are K-means and Generative Adversarial Networks.

Discriminative vs. Generative Modeling-----

In supervised learning, we predict a class label given an example of input variables.This predictive modeling task is called classification. Classification is also traditionally referred to as discriminative modeling. This is a model must discriminate examples of input variables across classes; it must choose or make a decision as to what class a given example belongs.

Alternately, unsupervised models that summarize the distribution of input variables may be able to be used to create or generate new examples in the input distribution. We can see, in the picture, these types of models are referred to as generative model. *Approaches that explicitly or implicitly model the distribution of inputs as well as outputs are known as generative models, because by sampling from them*

it is possible to generate synthetic data points in the input space. Naive Bayes is an example of a generative model that is more often used as a discriminative model.

Generative Adversarial Networks-------

The GAN model architecture has two sub-models: a *generator model* for generating new examples and another one is a *discriminator model* for classifying whether generated examples are real, from the domain, or fake, generated by the generator model.

- **Generator**. Model that is used to generate new plausible examples from the problem domain.
- **Discriminator**. Model that is used to classify examples as real (*from the domain*) or fake (*generated*).

The Generator Model----

The generator model takes a fixed-length random vector as input and generates a sample in the domain. The vector is drawn from randomly from a Gaussian distribution, and the vector is used to seed the generative process. After training, points in this multidimensional vector space will correspond to points in the problem domain, forming a compressed representation of the data distribution. Moreover, *Machine-learning models can learn the statistical latent space of images, music, and stories, and they can then sample from this space, creating new artworks with characteristics similar to those the model has seen in its training data. In the picture,* After training, the generator model is kept and used to generate new samples.

The Discriminator Model---

The discriminator model takes an example from the domain as input (real or generated) and predicts a binary class label of real or fake (generated). The real example comes from the training dataset. The generated examples are output by the generator model. The discriminator is a normal (and well understood) classification model. After the training process, the discriminator model is discarded as we are interested in the generator.

So, *one way to build good image representations is by training Generative Adversarial Networks (GANs), and later reusing parts of the generator and discriminator networks as feature extractors for supervised tasks.*

Example of the Generative Adversarial Network Model Architecture

The two models, the generator and discriminator, are trained together. The generator generates a batch of samples, and these, along with real examples from the domain, are provided to the discriminator and classified as real or fake. The discriminator is then updated to get better at discriminating real and fake samples in the next round, and importantly, the generator is updated based on how well, or not, the generated samples fooled the discriminator.

GANs and Convolutional Neural Networks---

GANs typically work with image data and use Convolutional Neural Networks, or CNNs, as the generator and discriminator models. The reason for this may be both because the first description of the technique was in the field of computer vision and used CNNs and image data, and because of the remarkable progress. that has been seen in recent years using CNNs more generally to achieve state-of-the-art results on a suite of computer vision tasks such as object detection and face recognition.

Modeling image data means that the latent space, the input to the generator, provides a compressed representation of the set of images or photographs used to train the model. It also means that the generator generates new images or photographs, providing an output that can be easily viewed and assessed by developers or users of the model.

Why Generative Adversarial Networks?----

- **Image Super-Resolution**. The ability to generate high-resolution versions of input images.
- **Creating Art**. The ability to great new and artistic images, sketches, painting, and more.
- **Image-to-Image Translation**. The ability to translate photographs across domains, such as day to night, summer to winter, and more.