Class activity – GAN

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Generative Adversarial Networks (GANs) have evolved rapidly from simple image generators to sophisticated tools capable of artistic style transfer and high-resolution synthesis.

1. DCGAN (Deep Convolutional GAN)

Description: This was the first architecture to successfully use **Convolutional Neural Networks (CNNs)** instead of fully connected layers. It introduced architectural constraints—like using strided convolutions instead of pooling and removing fully connected hidden layers—to make GAN training more stable.

- **Key Feature:** Uses "Fractionally-strided convolutions" (Upsampling) to generate images.
- **Task 1:** Take the MNIST dataset (handwritten digits) and build a DCGAN to generate new, synthetic digits.
- **Task 2:** Experiment with the **latent space**. Generate two different faces, then "average" their latent vectors to see if the resulting image looks like a blend of the two.

2. CGAN (Conditional GAN)

Description: Standard GANs are "unconditional," meaning you can't tell them *what* to generate; they just output a random sample from the training distribution. CGANs fix this by feeding a **label (y)** into both the Generator and Discriminator.

- **Key Feature:** Direct control over the class of the generated output (e.g., "generate a 7" or "generate a dog").
- **Task 1:** Modify your MNIST DCGAN to be "conditional." Use the digit labels (0-9) as input so you can request a specific number on demand.
- **Task 2:** Create a CGAN that generates clothing items based on a text tag like "Shirt" or "Shoe" using the Fashion-MNIST dataset.

3. Pix2Pix (Image-to-Image Translation)

Description: This is a type of Conditional GAN designed for **paired** image-to-image translation. It learns a mapping from an input image to an output image (e.g., a black-and-white sketch to a color photo).

- **Key Feature:** Uses a **U-Net** architecture for the Generator and a "PatchGAN" Discriminator that looks at local image patches rather than the whole image.
- **Task 1:** Use the "Edges-to-Shoes" dataset to train a model that turns a simple line drawing into a realistic-looking photo of a sneaker.
- **Task 2:** Train a model to convert daytime street photos into nighttime versions using a paired dataset of cityscapes.

4. CycleGAN (Unpaired Image Translation)

Description: Unlike Pix2Pix, CycleGAN does not require paired examples. It can learn to turn photos of horses into zebras even if you don't have a photo of the *exact same* horse as a zebra. It uses **Cycle Consistency Loss** to ensure the translated image can be "translated back" to the original.

- **Key Feature:** Works on two collections of images (Set A and Set B) without one-to-one mapping.
- **Task 1:** Perform a "Style Transfer" task, such as turning a standard landscape photo into the style of a Claude Monet painting.
- **Task 2:** Create a "Summer to Winter" filter that changes the foliage and lighting of a forest photo without changing the actual trees' positions.

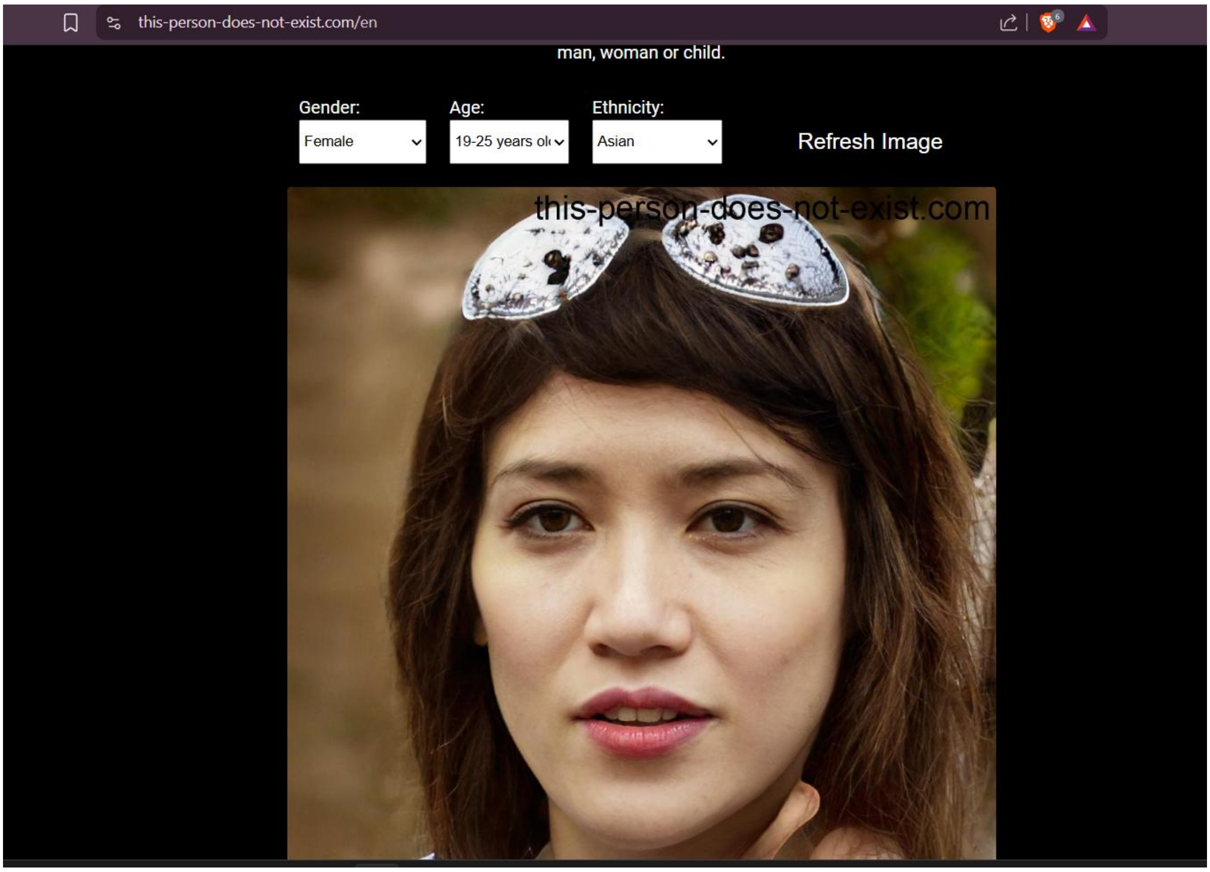
5. StyleGAN

Description: Developed by NVIDIA, StyleGAN focuses on the **style** of the image at different scales (coarse features like pose, and fine features like hair color). It doesn't feed the latent code at the beginning; instead, it injects it at every layer of the generator.

- **Key Feature:** Progressive growing and "Adaptive Instance Normalization" (AdaIN) for incredible high-resolution detail.
- **Task 1:** Use a pre-trained StyleGAN (like StyleGAN2 or 3) to perform **"Face Swapping"** or attribute manipulation (e.g., adding glasses or changing the age of a generated face).
- **Task 2:** Explore the **Mapping Network**. Visualize how changing a single "style" parameter affects the output at different resolutions (e.g., changing skin texture vs. changing head shape).

Model	**Input**	**Mapping Type**	**Best For**
DCGAN	Random Noise	Unconditional	Basic image generation
CGAN	Noise + Label	Conditional	Specific category generation
Pix2Pix	Image A	Paired	Maps (satellite to street), Colorization
CycleGAN	Image A	Unpaired	Artistic style, Season changes
StyleGAN	Latent Code	Style-based	High-res photorealism (Faces)

Generating face using – “This person does not exist”



this-person-does-not-exist.com/en

man, woman or child.

Gender: Female

Age: 19-25 years ol

Ethnicity: Asian

Refresh Image
this-person-does-not-exist.com