GAN

Imports

In [ ]:
```
import tensorflow as tf
from tensorflow.keras.layers import Dense, Reshape, Flatten
from tensorflow.keras.models import Sequential
import matplotlib.pyplot as plt
import numpy as np
from PIL import Image
import os
from tensorflow.keras.preprocessing import image_dataset_from_directory
import tensorflow as tf
```

Carga de datos

In [ ]:
```
gpus = tf.config.experimental.list_physical_devices('GPU')
if gpus:
    try:
        # Limita el uso de la memoria GPU según sea necesario
        for gpu in gpus:
            tf.config.experimental.set_memory_growth(gpu, True)
        # Elige la GPU 0 (puedes cambiarlo según tus necesidades)
        tf.config.experimental.set_visible_devices(gpus[0], 'GPU')
        print("GPU detectada y configurada.")
    except RuntimeError as e:
        print(e)

# Transformaciones para el preprocesamiento de imágenes
transform = tf.keras.Sequential([
    tf.keras.layers.experimental.preprocessing.Rescaling(1./255),
    tf.keras.layers.experimental.preprocessing.RandomFlip("horizontal"),
    tf.keras.layers.experimental.preprocessing.RandomRotation(0.2),
    tf.keras.layers.experimental.preprocessing.RandomZoom(0.2),
    tf.keras.layers.experimental.preprocessing.RandomTranslation(0.2, 0.2),
    tf.keras.layers.experimental.preprocessing.Resizing(128, 128),
])

# Directorio que contiene las imágenes de personas reales
directorio_imagenes = "images"

# Cargar las imágenes desde el directorio y aplicar las transformaciones
conjunto_datos_imagenes = image_dataset_from_directory(
    directorio_imagenes,
    label_mode=None,
    batch_size=32,
    image_size=(128, 128),
    shuffle=True,
)
```

```
# Tomar solo las primeras 1,000 imágenes del conjunto de datos
conjunto_datos_imagenes = conjunto_datos_imagenes.take(3000)
```

```
Found 200000 files belonging to 1 classes.
```

Generador

In [ ]:
```
# Crear el generador
np.random.seed(42)
tf.random.set_seed(42)
tamanio_codificacion = 100

generador = Sequential()
generador.add(Dense(100, activation="relu", input_shape=[tamanio_codificacion]))
generador.add(Dense(256, activation='sigmoid'))
generador.add(Dense(512, activation='sigmoid'))
generador.add(Dense(3 * 128 * 128, activation="sigmoid"))  # Salida para imágenes 1
generador.add(Reshape([128, 128, 3]))
```

Discriminador

In [ ]:
```
# Crear el discriminador
discriminador = Sequential()
discriminador.add(Flatten(input_shape=[128, 128, 3]))
discriminador.add(Dense(512, activation='relu'))
discriminador.add(Dense(256, activation='sigmoid'))
discriminador.add(Dense(1, activation="sigmoid"))
discriminador.compile(loss="binary_crossentropy", optimizer="adam")
```

Crear GAN

In [ ]:
```
# Crear la GAN
GAN = Sequential([generador, discriminador])
discriminador.trainable = False
GAN.compile(loss="binary_crossentropy", optimizer="adam")
```

Entrenar GAN

In [ ]:
```
# Parámetros de entrenamiento
epocas = 2
tamanio_tanda = 32

# Entrenamiento de la GAN
for epoca in range(epocas):
    print(f"Época {epoca + 1}/{epocas}")
    for imagenes in conjunto_datos_imagenes:
        ruido = tf.random.normal(shape=[tamanio_tanda, tamanio_codificacion])
        imagenes_generadas = generador.predict(ruido)
        etiquetas_reales = np.ones((tamanio_tanda, 1))
        etiquetas_falsas = np.zeros((tamanio_tanda, 1))

        # Entrenar el discriminador
```

```
        d_loss_real = discriminador.train_on_batch(imagenes, etiquetas_reales)
        d_loss_fake = discriminador.train_on_batch(imagenes_generadas, etiquetas_fa
        d_loss = 0.5 * (d_loss_real + d_loss_fake)

        # Entrenar la GAN
        ruido = tf.random.normal(shape=[tamanio_tanda, tamanio_codificacion])
        etiquetas_gan = np.ones((tamanio_tanda, 1))
        g_loss = GAN.train_on_batch(ruido, etiquetas_gan)

    # Mostrar el progreso
    print(f"Discriminador Loss: {d_loss}, Generador Loss: {g_loss}")
```

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Discriminador Loss: 0.6977085471153259, Generador Loss: 0.6258054375648499
```

Generar imagen

In [ ]:
```
# Generar una imagen nueva
ruido = tf.random.normal(shape=[1, tamanio_codificacion])
imagen_generada = generador.predict(ruido)
```

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Visualizar imagen

In [ ]:
```
# Visualizar la imagen generada
plt.imshow(imagen_generada[0])
plt.axis('off')
plt.show()
```

In [ ]:
```
# Guardar la imagen generada en tu proyecto
imagen_generada = (imagen_generada[0] + 1) / 2  # Escalar los valores de píxeles de
imagen_generada = (imagen_generada * 255).astype(np.uint8)  # Escalar de (0, 1) a (
```

```
imagen_generada = Image.fromarray(imagen_generada)  # Crear una imagen PIL desde el
imagen_generada.save("imagen_generada.png")  # Guardar la imagen en formato
```

Respuestas

1. ¿Qué conceptos de la teoría encontraron más desafiantes y por qué?

Personalmente para esta práctica fue un reto la construcción y configuración tanto del generador como del discriminador, pues fue un reto encontrar las capas necesarias y los parámetros adecuados para que pudieran manipular correctamente las imagenes del dataset. Así mismo el concepto de incluir ruido e imagenes fakes para confundir al discriminador fueron conceptos que un principio no comprendiamos del todo y no estabamos seguros cual era el papel que tenian en nuestra GAN, esto significó cierto retraso en la realización de la práctica pues tuvimos que hacer varias pruebas antes de poder conseguir buenos resultados, en un principio obteniamos como resultado imagenes grises, luego mejoramos y obteniamos imagenes con mayor grado de definición y así eventualmente fuimos mejorando nuestro modelo. Finalmente uno de los conceptos que más nos complicó la realización de la práctica fue el manejo de memoria y recursos en nuestra computadora, ya que debido al gran volumen de datos en muchas de las pruebas nuestra máquinas no eran capaces de procesar las imagenes y terminabamos con problemas de memoria y de congelamiento en el sistema.

2. ¿Cómo les ayudó el laboratorio a consolidar o entender mejor estos conceptos?

Principalmente el hecho de ver ejemplos, repasar los ejercicios vistos en clase y leer documentación en internet, fueron aspectos de suma importancia que nos permitieron consolidar las deficiencias que teniamos al inicio con estos conceptos. Asi mismo el aplicar la teoria y ponerla en práctica es lo que más nos ayudó, ya que no solo estamos aprendiendo y entendiendo dichos conceptos sino que estamos viendo de primera mano como es que se aplican en los modelos reales y como se pueden ir ajustando para obtener los resultados que deseamos.

3. ¿Qué aplicaciones potenciales ven para las GANs en la industria o en la investigación?

Consideramos que las aplicaciones potenciales de las GAN son demasiado diversas y no se limitan a un solo campo. Como pudimos ver en esta prática las GAN tienen un desempeño muy destacado en la generación de imágenes y contenido visual, entonces esto nos indica que pueden se de gran ayuda en campos como el arte, en la creación de obras de arte generativo y en la industria de las redes sociales y servicios multimedia en los que podemos usarlas en la síntesis de contenido visual. Otra aplicación potencial que vemos, es para la mejora de imágenes y restauración, pues tienen la capacidad de aumentar la calidad de imágenes, eliminar ruido o incluso recuperar información de imágenes dañadas. Se nos ocurre tambíen en el campo de la investigación, ya que pueden ser herramientas valiosas para la generación de datos complejos, pues permiten entrenar modelos en situaciones en

las que los datos reales son escasos o costosos de obtener. Hemos llegado a la conclusión de que las aplicaciones son muy variadas y solo se limitan a la imaginación del ser humano, pues nos atrevemos a decir que pueden ser aplicadas en todos los campos posibles.

4. ¿Qué limitaciones o preocupaciones éticas pueden identificar en el uso de GANs?

Consideramos que una de las principales preocupaciones se relaciona con la generación de contenido falso, donde las GAN tienen la capacidad de crear imágenes y videos fraudulentos, incluyendo deepfakes. Esto nos lleva a reflexionar sobre los desafíos que surgen en términos de la difusión de desinformación y la potencial invasión de la privacidad. Además, nos percatamos de que si los datos de entrenamiento utilizados en las GAN presentan sesgos, estos sesgos pueden persistir en el contenido generado, lo que a su vez puede contribuir a la propagación de prejuicios y estereotipos, algo que pensamos que es importante abordar. La preocupación sobre el uso no ético de las GAN también ha sido motivo de discusión entre nosotros, ya que estas redes pueden ser utilizadas en actividades ilegales, como la creación de documentos falsificados. Asimismo, concluimos que es esencial tener en cuenta la privacidad de las personas cuyos datos se utilizan en la generación de contenido. Por último, en nuestras conversaciones, hemos llegado a la conclusión de que la robustez y seguridad de los modelos generativos son aspectos críticos, ya que estos pueden ser vulnerables a ataques y dar lugar a resultados no deseados si no se diseñan y utilizan adecuadamente.

5. ¿Cómo se sienten con respecto a la implementación y entrenamiento de GANs después de la experiencia práctica?

Pensamos que es un tema muy interesante y con mucho potencial de aplicación, con el cual se pueden conseguir muchos beneficios y resultados impresionantes. Sin embargo fue un reto bastante complejo debido al alto consumo de recursos que implica y por esto mismo en determinados momentos fue algo frustrante y tedioso la construcción del modelo pues tuvimos que hacerlo a prueba y error, sin embargo, al final vemos esto como un aprendizaje que nos permitió tener un acercamiento a la verdadera aplicación de la inteligencia articial en la industria de hoy en día y es algo que nos permite aprender y entender lo que debemos conocer y entender como desarrolladores.

Aspectos importantes

Como se puede observar en el resultado obtenido, las imagenes que en este momento nuestra GAN genera no presentan una muy buena calidad, ya que se ve en muy baja resolución y no es tan precisa. Identificamos que esto se puede deber a ciertos factores relacionados a la gestión y uso de recursos de nuestra máquina pues como se sabe este tipo de modelos requiere de bastante recurso de memoria y procesamiento. En este caso nuestras máquinas no pudieron ser compatibles para hacer uso de GPU en este proceso y debido al gran volumen de imagenes en nuestro dataset no fue posible usar la herramiente Google Collab. Es por ello que identificamos los siguientes puntos de mejora que podrian darnos mejores resultados en implementaciones futuras que hagan uso de GANs

- Aumentar la capacidad del modelo: Consideramos que aumentar la cantidad de unidades en las capas ocultas de tu generador y discriminador puede ser un factor que nos ayude a mejorar nuestro modelo ya que este puede capturar detalles más finos en las imágenes.

- Ajustar los hiperparámetros de entrenamiento: Podemos obtener mejores resultados si trabajamos con diferentes tasas de aprendizaje y números de épocas de entrenamiento. A veces, un entrenamiento más largo con una tasa de aprendizaje más baja puede conducir a mejores resultados.

- Regularización: Consideramos que agregar técnicas de regularización como la regularización L2 o la normalización por lotes en las capas de la red puede ayudar a estabilizar el entrenamiento y mejorar la calidad de las imágenes generadas.

- Tratar de implementar recursos adiciones: En este caso consideramos necesario para proximos trabajos implementar el uso de GPU de manera local. Es un concepto que puede ser complejo de habilitar en una máquina, sin embargo es de gran ayuda en este tipo de problemas.