fase2_1

May 18, 2025

1 Visão Geral da Etapa 2

Meta principal: construir um GAN simples (1 hidden layer com 10 neurônios) para gerar vetores RSSI realistas a partir dos 1000 vetores reais já simulados.

1.1 Estrutura esperada

- `X_real`: matriz 1000×10 (RSSI dos 10 APs) extraída de `df_simulated`
- `Generator`: entrada = vetor ruído (tamanho 10), saída = vetor RSSI com 10 valores
- `Discriminator`: entrada = vetor RSSI com 10 valores, saída = probabilidade real/fake

---

1.2 Etapa 2A — Implementação do GAN

Aqui está a implementação completa inicial (sem ainda salvar os modelos ou plotar):

[1]:
```python
import tensorflow as tf
from tensorflow.keras import layers, Sequential, Input
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

```
2025-05-18 17:51:37.628455: I external/local_xla/xla/tsl/cuda/cudart_stub.cc:32]
Could not find cuda drivers on your machine, GPU will not be used.
2025-05-18 17:51:37.719359: I external/local_xla/xla/tsl/cuda/cudart_stub.cc:32]
Could not find cuda drivers on your machine, GPU will not be used.
2025-05-18 17:51:37.817468: E
external/local_xla/xla/stream_executor/cuda/cuda_fft.cc:467] Unable to register
cuFFT factory: Attempting to register factory for plugin cuFFT when one has
already been registered
WARNING: All log messages before absl::InitializeLog() is called are written to
STDERR
E0000 00:00:1747605097.904899   14223 cuda_dnn.cc:8579] Unable to register cuDNN
factory: Attempting to register factory for plugin cuDNN when one has already
been registered
E0000 00:00:1747605097.934106   14223 cuda_blas.cc:1407] Unable to register
cuBLAS factory: Attempting to register factory for plugin cuBLAS when one has
```

```
already been registered
W0000 00:00:1747605098.084807   14223 computation_placer.cc:177] computation
placer already registered. Please check linkage and avoid linking the same
target more than once.
W0000 00:00:1747605098.084857   14223 computation_placer.cc:177] computation
placer already registered. Please check linkage and avoid linking the same
target more than once.
W0000 00:00:1747605098.084861   14223 computation_placer.cc:177] computation
placer already registered. Please check linkage and avoid linking the same
target more than once.
W0000 00:00:1747605098.084864   14223 computation_placer.cc:177] computation
placer already registered. Please check linkage and avoid linking the same
target more than once.
2025-05-18 17:51:38.110417: I tensorflow/core/platform/cpu_feature_guard.cc:210]
This TensorFlow binary is optimized to use available CPU instructions in
performance-critical operations.
To enable the following instructions: AVX2 FMA, in other operations, rebuild
TensorFlow with the appropriate compiler flags.
```

[2]:

```python
path_file = '/home/darkcover/Documentos/Gan/Data/
 ↪ujindoorsubset_building1_floor2.csv'
df_simulated = pd.read_csv(path_file)
```

[3]:

```python
# ================================
# Dados reais de entrada
# ================================
X_real = df_simulated.iloc[:, :10].values.astype(np.float32)  # Apenas WAP001-
WAP010
n_features = X_real.shape[1]
latent_dim = n_features  # 10

# ================================
# Gerador
# ================================
def build_generator():
    model = Sequential([
        Input(shape=(latent_dim,)),
        layers.Dense(10, activation='relu'),
        layers.Dense(n_features, activation='tanh')  # saída entre -1 e 1
    ])
    return model


# ================================
# Discriminador
# ================================
def build_discriminator():
```

```
    model = Sequential([
        Input(shape=(n_features,)),
        layers.Dense(10, activation='relu'),
        layers.Dense(1, activation='sigmoid')
    ])
    return model

# ================================
# Compilação do Discriminador
# ================================
generator = build_generator()
discriminator = build_discriminator()
discriminator.compile(loss='binary_crossentropy', optimizer=tf.keras.optimizers.
 ↪Adam(learning_rate=0.01))

# ================================
# Modelo GAN
# ================================
discriminator.trainable = False
gan_input = Input(shape=(latent_dim,))
gan_output = discriminator(generator(gan_input))
gan = tf.keras.Model(gan_input, gan_output)
gan.compile(loss='binary_crossentropy', optimizer=tf.keras.optimizers.
 ↪Adam(learning_rate=0.01))
```

```
2025-05-18 17:51:50.663885: E
external/local_xla/xla/stream_executor/cuda/cuda_platform.cc:51] failed call to
cuInit: INTERNAL: CUDA error: Failed call to cuInit: UNKNOWN ERROR (303)
```

1.3 Etapa 2B — Loop de Treinamento (200 épocas)

Abaixo está o **código completo do treino**, com:

- Treinamento separado do **Discriminador**
- Atualização do **Generator via GAN**
- Armazenamento das perdas por época
- Gráfico de evolução das perdas

1.3.1 Implementação do Loop de Treinamento

[4]:
```
# ================================
# Loop de Treinamento do GAN
# ================================
epochs = 200
batch_size = 64
```

```python
half_batch = batch_size // 2

# Armazenar perdas
d_losses = []
g_losses = []

for epoch in range(epochs):
    # === 1. Treinar Discriminador ===
    # Amostras reais
    idx = np.random.randint(0, X_real.shape[0], half_batch)
    real_samples = X_real[idx]
    real_labels = np.ones((half_batch, 1))

    # Amostras falsas
    noise = np.random.uniform(-1, 1, (half_batch, latent_dim))
    fake_samples = generator.predict(noise, verbose=0)
    fake_labels = np.zeros((half_batch, 1))

    # Treinar o discriminador
    d_loss_real = discriminator.train_on_batch(real_samples, real_labels)
    d_loss_fake = discriminator.train_on_batch(fake_samples, fake_labels)
    d_loss = 0.5 * (d_loss_real + d_loss_fake)

    # === 2. Treinar Generator ===
    noise = np.random.uniform(-1, 1, (batch_size, latent_dim))
    valid_y = np.ones((batch_size, 1))  # Generator quer que D acredite que é␣
↪real
    g_loss = gan.train_on_batch(noise, valid_y)

    # === 3. Registrar perdas
    d_losses.append(d_loss)
    g_losses.append(g_loss)

    # === 4. Exibir progresso
    if (epoch + 1) % 20 == 0 or epoch == 0:
        print(f"Epoch {epoch+1}/{epochs} | D_loss: {d_loss:.4f} | G_loss:␣
↪{g_loss:.4f}")
```

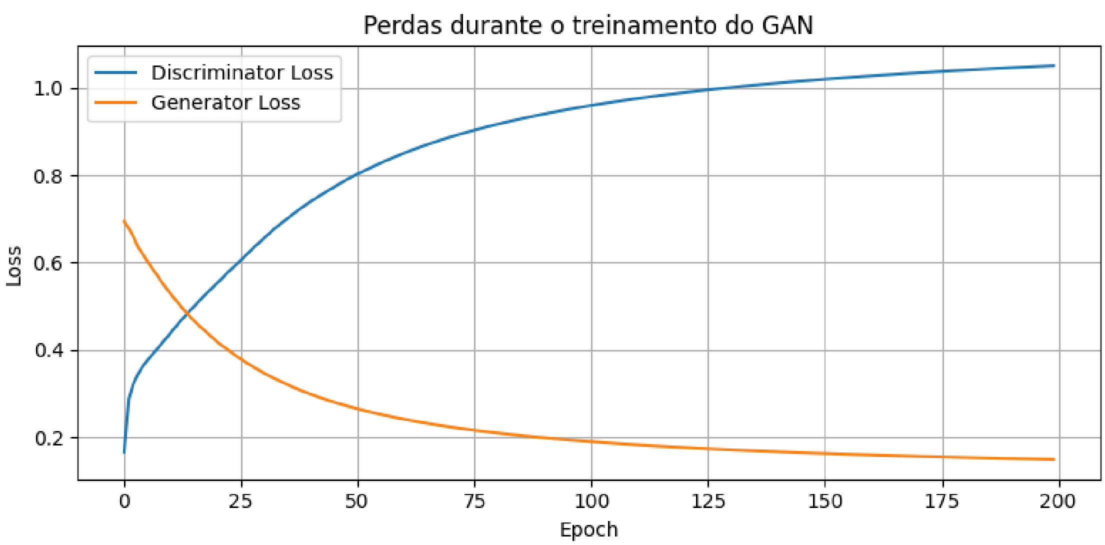
```
/home/darkcover/.cache/pypoetry/virtualenvs/gan-oPyfrVEv-
py3.12/lib/python3.12/site-packages/keras/src/backend/tensorflow/trainer.py:82:
UserWarning: The model does not have any trainable weights.
  warnings.warn("The model does not have any trainable weights.")
```

```
Epoch 1/200 | D_loss: 0.1657 | G_loss: 0.6942
Epoch 20/200 | D_loss: 0.5431 | G_loss: 0.4268
Epoch 40/200 | D_loss: 0.7328 | G_loss: 0.3021
Epoch 60/200 | D_loss: 0.8461 | G_loss: 0.2429
Epoch 80/200 | D_loss: 0.9140 | G_loss: 0.2106
```

```
Epoch 100/200 | D_loss: 0.9577 | G_loss: 0.1904
Epoch 120/200 | D_loss: 0.9879 | G_loss: 0.1767
Epoch 140/200 | D_loss: 1.0098 | G_loss: 0.1669
Epoch 160/200 | D_loss: 1.0265 | G_loss: 0.1594
Epoch 180/200 | D_loss: 1.0397 | G_loss: 0.1535
Epoch 200/200 | D_loss: 1.0504 | G_loss: 0.1488
```

[5]:

```python
#=====Plotar gráfico de perdas=====
# Gráfico de perda
plt.figure(figsize=(8, 4))
plt.plot(d_losses, label="Discriminator Loss")
plt.plot(g_losses, label="Generator Loss")
plt.xlabel("Epoch")
plt.ylabel("Loss")
plt.title("Perdas durante o treinamento do GAN")
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```



1.4 Geração dos 40.000 vetores RSSI sintéticos

Este passo inclui:

1. **Gerar os vetores usando o Generator**
2. **Converter para DataFrame com colunas WAP001–WAP010**
3. **Aplicar truncamento se necessário** (valores devem estar entre -110 e -40)
4. **Salvar em CSV**

5. **Visualizar graficamente a dispersão dos dados gerados versus reais**

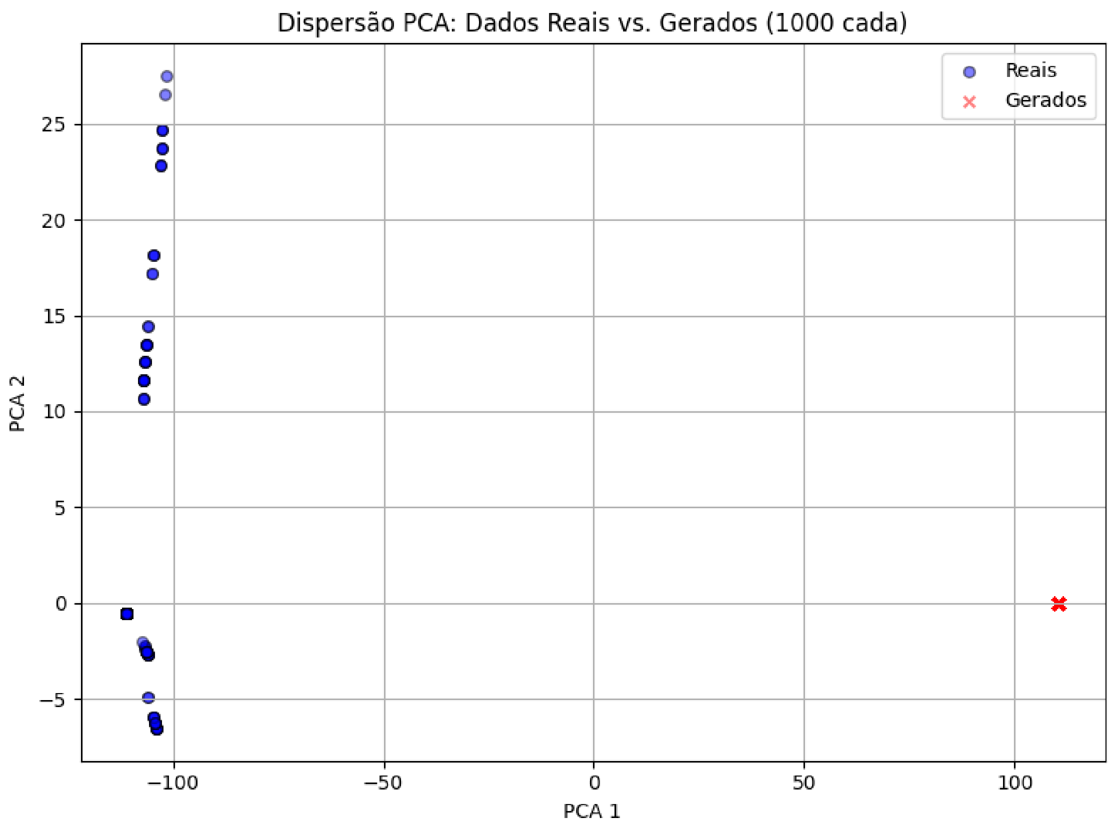
1.5 Código completo da geração + visualização

[6]:
```
# ================================
# 1. Gerar vetores sintéticos
# ================================
n_generated = 40000
latent_dim = 10
noise = np.random.uniform(-1, 1, size=(n_generated, latent_dim))
generated_rssi = generator.predict(noise, verbose=1)

# Aplicar limite de RSSI típico
generated_rssi = np.clip(generated_rssi, -110, -40)

# ================================
# 2. Criar DataFrame
# ================================
columns = [f'WAP{str(i+1).zfill(3)}' for i in range(generated_rssi.shape[1])]
df_generated = pd.DataFrame(generated_rssi, columns=columns)
df_generated["source"] = "generated"

# ================================
# 3. Salvar
# ================================
df_generated.to_csv("/home/darkcover/Documentos/Gan/Data/df_generated.csv",␣
 ↪index=False)
print("  40.000 vetores sintéticos salvos em: data/df_generated.csv")
```

```
1250/1250             3s 2ms/step
 40.000 vetores sintéticos salvos em: data/df_generated.csv
```

[7]:
```
## Dispersão visual (reais vs. gerados)

# Pegar amostras reais para comparar visualmente
df_real_sample = df_simulated.sample(1000, random_state=42).copy()
df_real_sample["source"] = "real"

# Combinar para visualização
df_vis = pd.concat([df_real_sample, df_generated.sample(1000,␣
 ↪random_state=42)], ignore_index=True)

# PCA para reduzir de 10 → 2 dimensões
from sklearn.decomposition import PCA

X_vis = df_vis.iloc[:, :10].values
```

```
pca = PCA(n_components=2)
X_pca = pca.fit_transform(X_vis)

# Plot
plt.figure(figsize=(8, 6))
plt.scatter(X_pca[df_vis["source"] == "real", 0], X_pca[df_vis["source"] ==␣
↪"real", 1],
            alpha=0.5, label="Reais", c="blue", edgecolors='black', s=30)
plt.scatter(X_pca[df_vis["source"] == "generated", 0], X_pca[df_vis["source"]␣
↪== "generated", 1],
            alpha=0.5, label="Gerados", c="red", marker='x', s=30)

plt.title("Dispersão PCA: Dados Reais vs. Gerados (1000 cada)")
plt.xlabel("PCA 1")
plt.ylabel("PCA 2")
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```



- Arquivo `df_generated.csv` com 40.000 vetores prontos
- Visualização clara da **coerência dos dados gerados**
- Fim da **Etapa 2** com todos os entregáveis completos