

# Modele1\_cnn

November 17, 2025

```
[85]: import sys
import numpy as np
import matplotlib.pyplot as plt

np.random.seed(0)
```

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[86]: import tensorflow as tf
print(tf.__version__)
```

2.20.0

```
[87]: import pickle
import numpy as np
from sklearn.model_selection import train_test_split
import tensorflow as tf
from keras import layers, models
path_to_data = 'ift-3395-6390-kaggle-2-competition-fall-2025/train_data.pkl'

# --- Load data ---
with open(path_to_data, "rb") as f:
    train_data = pickle.load(f)

X = train_data["images"]
y = train_data["labels"].reshape(-1)

# --- Preprocessing ---
X = X.astype("float32") / 255.0

# --- Split ---
X_train, X_val, y_train, y_val = train_test_split(
    X, y,
    test_size=0.2,
    random_state=42,
    stratify=y
)

class_counts = np.bincount(y_train)
total = len(y_train)
```

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class_weight = {i: total/(5*class_counts[i]) for i in range(5)}

data_augmentation = models.Sequential([
    layers.RandomFlip("horizontal"),
    layers.RandomRotation(0.05),
    layers.RandomZoom(0.1),
    layers.RandomTranslation(0.1, 0.1),
    layers.RandomContrast(0.1),
    layers.RandomBrightness(0.1)
])

# --- CNN definition ---
model = models.Sequential([
    data_augmentation,
    layers.Conv2D(32, (3,3), activation="relu", padding="same"),
    layers.BatchNormalization(),
    layers.Conv2D(32, (3,3), activation="relu"),
    layers.MaxPooling2D(),

    layers.Conv2D(64, (3,3), activation="relu", padding="same"),
    layers.BatchNormalization(),
    layers.Conv2D(64, (3,3), activation="relu"),
    layers.MaxPooling2D(),

    layers.Flatten(),
    layers.Dense(128, activation="relu"),
    layers.Dropout(0.3),
    layers.Dense(5, activation="softmax")
])

model.compile(
    optimizer='adam',
    loss='sparse_categorical_crossentropy',
    metrics=['accuracy']
)
from keras.callbacks import EarlyStopping

early_stop = EarlyStopping(
    monitor='val_loss',
    patience=5,
    restore_best_weights=True
)
# --- Train ---
history = model.fit(
    X_train, y_train,
    class_weight=class_weight,

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    epochs=100,
    batch_size=32,
    validation_data=(X_val, y_val),
    callbacks=[early_stop],
    shuffle=True
)

# --- Save CNN ---
model.save("cnn_model.keras")

```

Epoch 1/100  
27/27 1s 17ms/step -  
accuracy: 0.1782 - loss: 2.0157 - val\_accuracy: 0.0602 - val\_loss: 1.6147  
Epoch 2/100  
27/27 0s 16ms/step -  
accuracy: 0.1713 - loss: 1.6608 - val\_accuracy: 0.1204 - val\_loss: 1.6092  
Epoch 3/100  
27/27 0s 15ms/step -  
accuracy: 0.1921 - loss: 1.6330 - val\_accuracy: 0.0602 - val\_loss: 1.6203  
Epoch 4/100  
27/27 0s 14ms/step -  
accuracy: 0.2037 - loss: 1.6227 - val\_accuracy: 0.2407 - val\_loss: 1.6019  
Epoch 5/100  
27/27 0s 13ms/step -  
accuracy: 0.3287 - loss: 1.6160 - val\_accuracy: 0.4491 - val\_loss: 1.5929  
Epoch 6/100  
27/27 0s 13ms/step -  
accuracy: 0.2153 - loss: 1.6158 - val\_accuracy: 0.1898 - val\_loss: 1.6032  
Epoch 7/100  
27/27 0s 13ms/step -  
accuracy: 0.1343 - loss: 1.6186 - val\_accuracy: 0.1806 - val\_loss: 1.6024  
Epoch 8/100  
27/27 0s 13ms/step -  
accuracy: 0.1481 - loss: 1.6156 - val\_accuracy: 0.1806 - val\_loss: 1.6106  
Epoch 9/100  
27/27 0s 13ms/step -  
accuracy: 0.2500 - loss: 1.6112 - val\_accuracy: 0.0602 - val\_loss: 1.6125  
Epoch 10/100  
27/27 0s 15ms/step -  
accuracy: 0.0961 - loss: 1.6103 - val\_accuracy: 0.1806 - val\_loss: 1.6127

```
[88]: import matplotlib.pyplot as plt

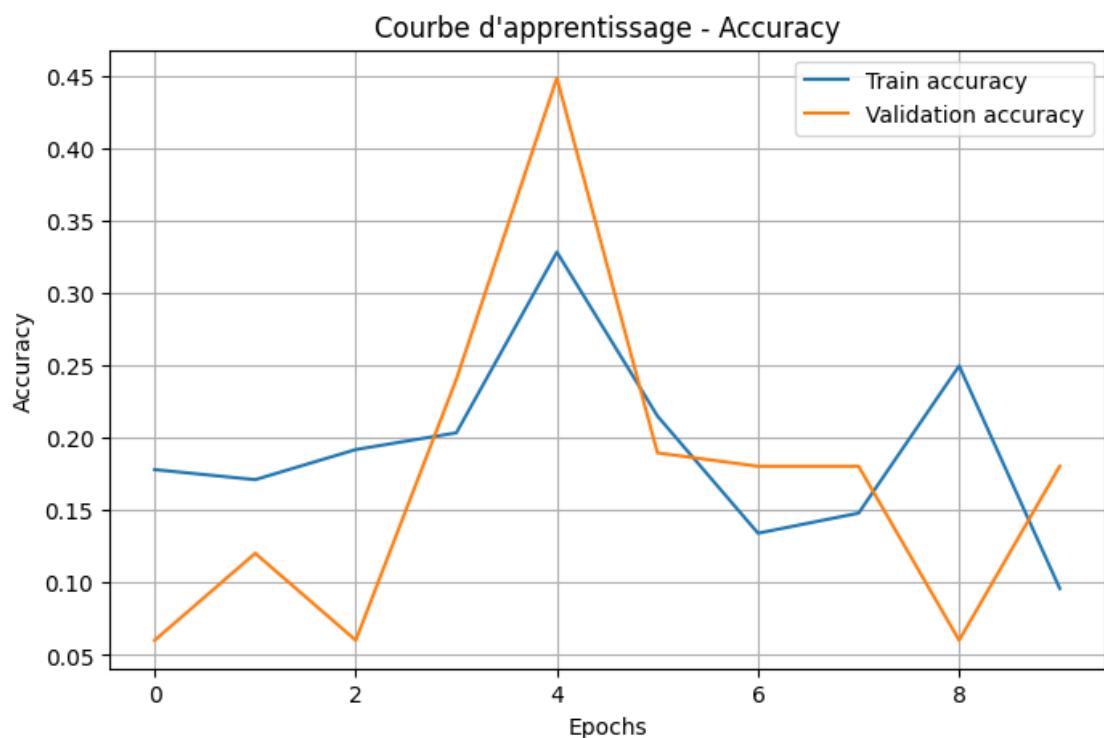
# Accuracy
plt.figure(figsize=(8,5))
plt.plot(history.history["accuracy"], label="Train accuracy")
plt.plot(history.history["val_accuracy"], label="Validation accuracy")
```

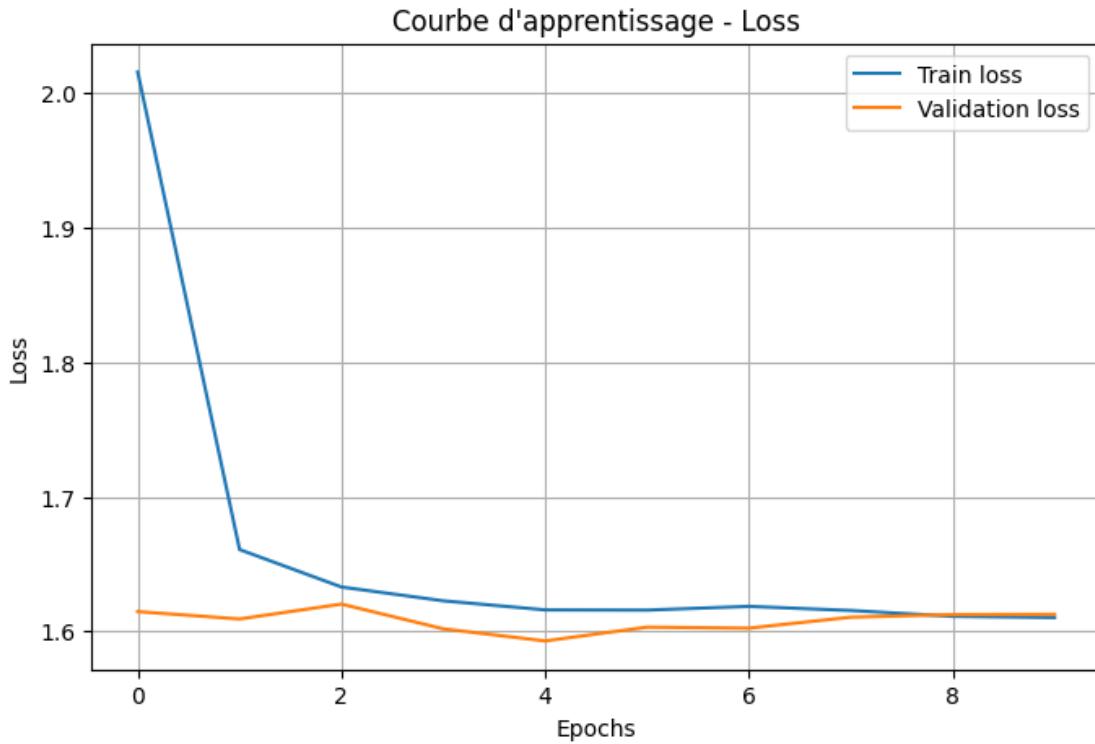
```

plt.xlabel("Epochs")
plt.ylabel("Accuracy")
plt.title("Courbe d'apprentissage - Accuracy")
plt.legend()
plt.grid(True)
plt.show()

# Loss
plt.figure(figsize=(8,5))
plt.plot(history.history["loss"], label="Train loss")
plt.plot(history.history["val_loss"], label="Validation loss")
plt.xlabel("Epochs")
plt.ylabel("Loss")
plt.title("Courbe d'apprentissage - Loss")
plt.legend()
plt.grid(True)
plt.show()

```



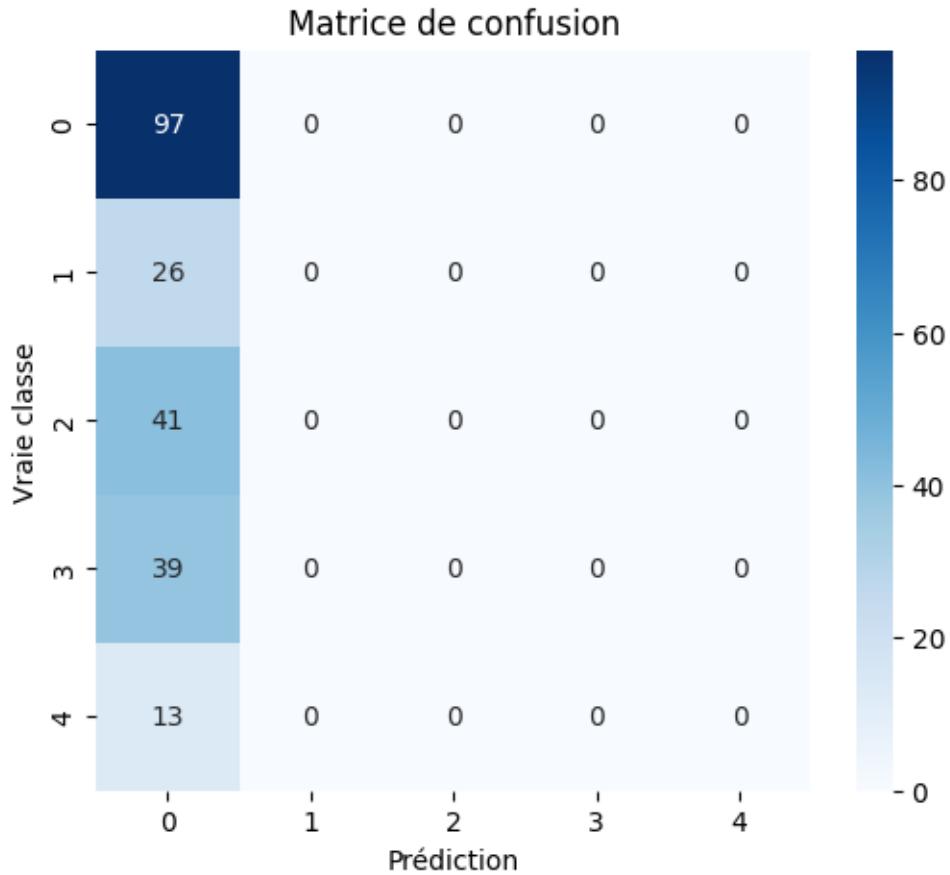


```
[89]: y_val_pred = model.predict(X_val)
y_val_pred_classes = y_val_pred.argmax(axis=1)
from sklearn.metrics import confusion_matrix, accuracy_score
import seaborn as sns

cm = confusion_matrix(y_val, y_val_pred_classes)

plt.figure(figsize=(6,5))
sns.heatmap(cm, annot=True, cmap="Blues", fmt="d")
plt.title("Matrice de confusion")
plt.xlabel("Prédiction")
plt.ylabel("Vraie classe")
plt.show()
from sklearn.metrics import recall_score

recall_per_class = recall_score(y_val, y_val_pred_classes, average=None)
recall_macro = recall_score(y_val, y_val_pred_classes, average="macro")
acc = accuracy_score(y_val, y_val_pred_classes)
print("Recall par classe :", recall_per_class)
print('acc:', acc)
print("Recall macro :", recall_macro)
```



Recall par classe : [1. 0. 0. 0. 0.]

acc: 0.44907407407407407

Recall macro : 0.2

```
[90]: import pickle
import numpy as np
import pandas as pd
"""
# -----
# 1. Charger le modèle entraîné
# -----
model, scaler = pickle.load(open("model_softmax.pkl", "rb"))

# -----
# 2. Charger le test_data.pkl
# -----
with open("ift-3395-6390-kaggle-2-competition-fall-2025/test_data.pkl", "rb") as f:
    test_data = pickle.load(f)
```

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X_test_imgs = test_data["images"]

# Apply to test set
X_test_feats = np.array([extract_features(img) for img in X_test_imgs], □
    ↪dtype=np.float32)

# -----
# 4. Normaliser avec les stats du train
# -----
X_test_norm = scaler.transform(X_test_feats)

# -----
# 5. Prédire
# -----
y_pred = model.compute_output(X_test_norm).astype(int)

# -----
# 6. Générer le CSV Kaggle
# -----
df = pd.DataFrame({
    "ID": np.arange(1, len(y_pred)+1),
    "Label": y_pred
})

df.to_csv("ift3395_YamirPoldoSilvaV7.csv", index=False)

print("Fichier 'submission.csv' généré !")
"""

```

```

[90]: '\n# -----'\n# 1. Charger le modèle entraîné\n#\n-----\nmodel, scaler =\npickle.load(open("model_softmax.pkl", "rb"))\n#\n# -----'\n#\n2. Charger le test_data.pkl\n# -----'\nwith\nopen("ift-3395-6390-kaggle-2-competition-fall-2025/test_data.pkl", "rb") as f:\n    \n    test_data = pickle.load(f)\n    \n    X_test_imgs = test_data["images"]\n    \n    # Apply to test set\n    X_test_feats = np.array([extract_features(img) for img in\n        X_test_imgs],\n        dtype=np.float32)\n    \n    # -----'\n# 4. Normaliser avec les stats du train\n# -----'\n    X_test_norm =\n        scaler.transform(X_test_feats)\n    \n    # -----'\n# 5. Prédire\n# -----'\n    y_pred =\n        model.compute_output(X_test_norm).astype(int)\n    \n    # -----'\n# 6. Générer le CSV Kaggle\n# -----'\n    df = pd.DataFrame({\n        "ID": np.arange(1, len(y_pred)+1),\n            "Label":\n                y_pred\n    })\n    \n    df.to_csv("ift3395_YamirPoldoSilvaV7.csv",\n        index=False)\n    \n    print("Fichier 'submission.csv' généré !")\n'

```