course_demonstration

November 1, 2025

0.0.1 Ch5. Apprentissage Supervisé – Classification

Régression logistique

Vehicle classification (en se basant sur la hauteur et nombre de roues)

[1]:
```
import numpy as np
import pandas as pd
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
```

[2]:
```
# sigmoid function
def sigmoid(z):
    return 1 / (1 + np.exp(-z))

# define the model
def model(X, theta):
    z = np.dot(X, theta)
    return sigmoid(z)

# define the cost function
def compute_cost(X, y, theta):
    m = len(y)
    y_pred = model(X, theta)
    cost = - (1/m) * np.sum(y * np.log(y_pred) + (1 - y) * np.log(1 - y_pred))
    return cost

# define the gradient descent optimization
def gradient_opt(X, y, theta, learning_rate=0.01, iterations=10000):
    m = len(y)
    cost_list = []
    for i in range(iterations):
        y_pred = model(X, theta)
        gradient = (1/m) * np.dot(X.T, (y_pred - y))
        theta -= learning_rate * gradient
        cost = compute_cost(X, y, theta)
        if(i%100 == 0):
            print("cost after ", i, "iteration is : ", cost)
```

```
        cost_list.append(cost)
    return theta, cost_list
```

[17]:
```
df = pd.read_csv("dataset_vehicules_classification_100k.csv")
df.head()
```

[17]:

	Hauteur_m	Nombre_de_roues	Type_de_vehicule
0	2.575420	12.0	Camion
1	3.454013	12.0	Camion
2	1.588844	4.0	Touristique
3	3.198565	12.0	Camion
4	2.913933	12.0	Camion

[5]:
```
# valeurs manquantes
def replace_missing_with_mean(column):
    mean_value = column.mean()
    return column.fillna(mean_value)

for col in df.select_dtypes(include=[np.number]).columns:
    df[col] = replace_missing_with_mean(df[col])

# valeurs aberrantes pour la colonne "Hauteur_m"
q1 = df["Hauteur_m"].quantile(0.25)
q3 = df["Hauteur_m"].quantile(0.75)
IQR =  q3 - q1
lower_bound = q1 - 1.5 * IQR
upper_bound = q3 + 1.5 * IQR
df = df[(df["Hauteur_m"] >= lower_bound) & (df["Hauteur_m"] <= upper_bound)]

# valeurs aberrantes pour la colonne "Nombre_de_roues"
q1 = df["Nombre_de_roues"].quantile(0.25)
q3 = df["Nombre_de_roues"].quantile(0.75)
IQR =  q3 - q1
lower_bound = q1 - 1.5 * IQR
upper_bound = q3 + 1.5 * IQR
df = df[(df["Nombre_de_roues"] >= lower_bound) & (df["Nombre_de_roues"] <=␣
 ↪upper_bound)]
df["Nombre_de_roues"].describe()
```

[5]:
```
count    99034.000000
mean         7.446263
std          4.234103
min          4.000000
25%          4.000000
50%          6.000000
75%         10.000000
max         18.000000
```

```
Name: Nombre_de_roues, dtype: float64
```

[6]:
```python
X = df.drop("Type_de_vehicule", axis=1)
y = df["Type_de_vehicule"]
```

[7]:
```python
from sklearn.preprocessing import StandardScaler
X = X.values
X = np.hstack((np.ones((X.shape[0], 1)),X))
sc = StandardScaler()
X_scaled = sc.fit_transform(X)
```

[8]:
```python
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
y_encoded = le.fit_transform(y)
y_encoded = y_encoded.reshape(-1, 1)
```

[9]:
```python
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y_encoded,␣
↪test_size=0.2, random_state=42)
```

[10]:
```python
theta_init = np.random.randn(X_train.shape[1], 1)
theta_opt, cost_list = gradient_opt(X_train, y_train, theta_init,␣
↪learning_rate=0.01, iterations=40000)
```

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cost after  0 iteration is :  2.440882021552157
cost after  100 iteration is :  1.5084115033583614
cost after  200 iteration is :  0.8829247569360753
cost after  300 iteration is :  0.5722525602807177
cost after  400 iteration is :  0.4278133982889871
cost after  500 iteration is :  0.35102040025816955
cost after  600 iteration is :  0.30441212085917624
cost after  700 iteration is :  0.27333677634280007
cost after  800 iteration is :  0.25120340440158884
cost after  900 iteration is :  0.2346631321441605
cost after  1000 iteration is :  0.22184653803333446
cost after  1100 iteration is :  0.2116314429627438
cost after  1200 iteration is :  0.20330459200118395
cost after  1300 iteration is :  0.19639132549976415
cost after  1400 iteration is :  0.19056364769241618
cost after  1500 iteration is :  0.18558768938340628
cost after  1600 iteration is :  0.18129221765407483
cost after  1700 iteration is :  0.17754898469385233
cost after  1800 iteration is :  0.17426003442694812
cost after  1900 iteration is :  0.17134925517895586
cost after  2000 iteration is :  0.1687566097158263
cost after  2100 iteration is :  0.1664341026455183
cost after  2200 iteration is :  0.1643429041386903
cost after  2300 iteration is :  0.16245126079847141
cost after  2400 iteration is :  0.16073295329966217
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cost after  2500 iteration is :  0.1591661407929327
cost after  2600 iteration is :  0.15773248343211865
cost after  2700 iteration is :  0.15641646791574315
cost after  2800 iteration is :  0.1552048832568604
cost after  2900 iteration is :  0.1540864091220897
cost after  3000 iteration is :  0.15305128949932528
cost after  3100 iteration is :  0.1520910717376997
cost after  3200 iteration is :  0.15119839616684033
cost after  3300 iteration is :  0.15036682520976863
cost after  3400 iteration is :  0.1495907035973981
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cost after  3600 iteration is :  0.14818542803100937
cost after  3700 iteration is :  0.1475479340800123
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cost after  3900 iteration is :  0.1463856880129424
cost after  4000 iteration is :  0.14585500192636833
cost after  4100 iteration is :  0.1453544814485772
cost after  4200 iteration is :  0.14488185046114335
cost after  4300 iteration is :  0.14443505098377
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cost after  4600 iteration is :  0.14323182452983296
cost after  4700 iteration is :  0.14287131465448144
cost after  4800 iteration is :  0.142528840516684
cost after  4900 iteration is :  0.14220322405067098
cost after  5000 iteration is :  0.14189338440665716
cost after  5100 iteration is :  0.14159832821017976
cost after  5200 iteration is :  0.14131714096716358
cost after  5300 iteration is :  0.1410489794605545
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cost after  5800 iteration is :  0.13987824480870953
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cost after  6000 iteration is :  0.13947790915060168
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cost after  7300 iteration is :  0.13754280363633642
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cost after  26500 iteration is :  0.13385013998031384
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cost after  33200 iteration is :  0.13381939877923982
cost after  33300 iteration is :  0.13381918968138787
cost after  33400 iteration is :  0.13381898483742072
cost after  33500 iteration is :  0.13381878415937035
cost after  33600 iteration is :  0.13381858756113077
cost after  33700 iteration is :  0.13381839495841788
cost after  33800 iteration is :  0.1338182062687296
cost after  33900 iteration is :  0.13381802141130647
cost after  34000 iteration is :  0.13381784030709423
cost after  34100 iteration is :  0.13381766287870622
cost after  34200 iteration is :  0.13381748905038737
cost after  34300 iteration is :  0.1338173187479785
cost after  34400 iteration is :  0.13381715189888171
cost after  34500 iteration is :  0.1338169884320266
cost after  34600 iteration is :  0.13381682827783684
cost after  34700 iteration is :  0.13381667136819822
cost after  34800 iteration is :  0.13381651763642669
cost after  34900 iteration is :  0.13381636701723734
cost after  35000 iteration is :  0.13381621944671465
cost after  35100 iteration is :  0.13381607486228236
cost after  35200 iteration is :  0.13381593320267487
cost after  35300 iteration is :  0.13381579440790906
cost after  35400 iteration is :  0.13381565841925647
cost after  35500 iteration is :  0.1338155251792164
cost after  35600 iteration is :  0.1338153946314897
cost after  35700 iteration is :  0.1338152667209525
cost after  35800 iteration is :  0.13381514139363163
cost after  35900 iteration is :  0.13381501859667919
cost after  36000 iteration is :  0.13381489827834933
```

```
cost after  36100 iteration is :  0.1338147803879737
cost after  36200 iteration is :  0.1338146648759393
cost after  36300 iteration is :  0.1338145516936653
cost after  36400 iteration is :  0.13381444079358124
cost after  36500 iteration is :  0.13381433212910548
cost after  36600 iteration is :  0.1338142256546241
cost after  36700 iteration is :  0.13381412132547033
cost after  36800 iteration is :  0.13381401909790416
cost after  36900 iteration is :  0.13381391892909295
cost after  37000 iteration is :  0.1338138207770919
cost after  37100 iteration is :  0.13381372460082544
cost after  37200 iteration is :  0.13381363036006844
cost after  37300 iteration is :  0.13381353801542847
cost after  37400 iteration is :  0.13381344752832802
cost after  37500 iteration is :  0.1338133588609873
cost after  37600 iteration is :  0.13381327197640736
cost after  37700 iteration is :  0.1338131868383534
cost after  37800 iteration is :  0.13381310341133892
cost after  37900 iteration is :  0.13381302166060974
cost after  38000 iteration is :  0.13381294155212858
cost after  38100 iteration is :  0.13381286305255985
cost after  38200 iteration is :  0.13381278612925507
cost after  38300 iteration is :  0.13381271075023823
cost after  38400 iteration is :  0.13381263688419165
cost after  38500 iteration is :  0.13381256450044224
cost after  38600 iteration is :  0.1338124935689478
cost after  38700 iteration is :  0.13381242406028396
cost after  38800 iteration is :  0.133812355945631
cost after  38900 iteration is :  0.13381228919676136
cost after  39000 iteration is :  0.13381222378602 7
cost after  39100 iteration is :  0.13381215968634758
cost after  39200 iteration is :  0.13381209687119813
cost after  39300 iteration is :  0.133812035314598
cost after  39400 iteration is :  0.13381197499109887
cost after  39500 iteration is :  0.13381191587577404
cost after  39600 iteration is :  0.13381185794420744
cost after  39700 iteration is :  0.1338118011724828
cost after  39800 iteration is :  0.1338117455371735
cost after  39900 iteration is :  0.13381169101533213
```

[11]:
```python
y_pred_prob = model(X_test, theta_opt)
y_pred = (y_pred_prob >= 0.5).astype(int)
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy * 100:.2f}%')
```

```
Accuracy: 96.49%
```

[ ]:
```
from sklearn.linear_model import LogisticRegression
clf = LogisticRegression()
clf.fit(X_train, y_train.ravel()) #.ravel() pour ignorer le warning
y_sklearn_pred = clf.predict(X_test)
sklearn_accuracy = accuracy_score(y_test, y_sklearn_pred)
print(f'Sklearn Accuracy: {sklearn_accuracy * 100:.2f}%')
```

```
Sklearn Accuracy: 96.83%
```

Enregistrement des modèles entrainé

Le Modèle entrainé manuellement (préférable d'utliser pickle)

[15]:
```
import pickle

# sauvegarder theta_opt, cost_list
with open("logreg_model.pkl", "wb") as f:
    pickle.dump({"theta": theta_opt, "cost_list": cost_list}, f)
print("Model saved successfully!")
```

```
Model saved successfully!
```

[16]:
```
# pour l'utilisation ultirieurment
with open("logreg_model.pkl", "rb") as f:
    data = pickle.load(f)
theta_loaded = data["theta"]
cost_list_loaded = data["cost_list"]

print("Model loaded successfully!")
print("Theta optimum : ", theta_loaded)
```

```
Model loaded successfully!
Theta optimum :  [[ 0.05171361]
 [-3.41246575]
 [-2.65280325]]
```

Le Modèle entrainé via sklearn (préférable d'utliser joblib)

[ ]:
```
import joblib
print("\nSauvegarde du modèle entraîné...")
joblib.dump(clf, 'logistic_regression_sklearn.pkl')
print("Modèle sauvegardé sous le nom : logistic_regression_sklearn.pkl")
```

```
Sauvegarde du modèle entraîné…
Modèle sauvegardé sous 'logistic_regression_sklearn.pkl
```

[ ]:
```

```