Data loan: Projet_Final3

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Stakeholders & Main Problem

The company seeks to automate (in real time) the loan qualifying procedure based on information given by customers while filling

Data Understanging and Preparation

This dataset profiles individuals who have received a loan and those who have not. It provides information across 13 columns and

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import scipy
import warnings

from sklearn.metrics import classification_report
from sklearn.metrics import accuracy_score
from sklearn.metrics import confusion_matrix
from sklearn.metrics import ConfusionMatrixDisplay
from sklearn.model_selection import GridSearchCV
from sklearn.preprocessing import MinMaxScaler
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import StratifiedShuffleSplit
from sklearn.neighbors import KNeighborsClassifier

warnings.filterwarnings("ignore")
```

```
print('Tout libreri nou bezwen yo enpote avek sikse!')
print('='*50)
```

```
Tout libreri nou bezwen yo enpote avek sikse!
==================================================
```

Data Exploratory

```
# Nap load dataset lan
data = pd.read_csv("data/loan_data_set.csv")
data.head()
```

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount
0	LP001002	Male	No	0	Graduate	No	5849	0.0	NaN	
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	128.0	
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	66.0	
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	120.0	
4	LP001008	Male	No	0	Graduate	No	6000	0.0	141.0	

```
# Dimansyon dataset lan
data.shape
```

```
(614, 13)
```

```
# Nap eksplore dataset lan gras ak kek mezi statistik
data.describe()
```

	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History
count	614.000000	614.000000	592.000000	600.00000	564.000000
mean	5403.459283	1621.245798	146.412162	342.00000	0.842199
std	6109.041673	2926.248369	85.587325	65.12041	0.364878
min	150.000000	0.000000	9.000000	12.00000	0.000000
25%	2877.500000	0.000000	100.000000	360.00000	1.000000
50%	3812.500000	1188.500000	128.000000	360.00000	1.000000
75%	5795.000000	2297.250000	168.000000	360.00000	1.000000
max	81000.000000	41667.000000	700.000000	480.00000	1.000000

```
# Nap eksplore kolon dataset lan
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 614 entries, 0 to 613
Data columns (total 13 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Loan_ID            614 non-null    object 
 1   Gender             601 non-null    object 
 2   Married            611 non-null    object 
 3   Dependents         599 non-null    object 
 4   Education          614 non-null    object 
 5   Self_Employed      582 non-null    object 
 6   ApplicantIncome    614 non-null    int64  
 7   CoapplicantIncome  614 non-null    float64
 8   LoanAmount         592 non-null    float64
 9   Loan_Amount_Term   600 non-null    float64
 10  Credit_History     564 non-null    float64
 11  Property_Area      614 non-null    object 
 12  Loan_Status        614 non-null    object 
dtypes: float64(4), int64(1), object(8)
memory usage: 62.5+ KB
```

```
# Nap gade sin gen liy ki repete
data.isnull().sum()/len(data)*100
```

```
Loan_ID              0.000000
Gender               2.117264
Married              0.488599
Dependents           2.442997
Education            0.000000
Self_Employed        5.211726
ApplicantIncome      0.000000
CoapplicantIncome    0.000000
LoanAmount           3.583062
Loan_Amount_Term     2.280130
Credit_History       8.143322
Property_Area        0.000000
Loan_Status          0.000000
dtype: float64
```

```
# Nap elimine vale mankan yo koz sa ka bay algoritm M.L yo pwoblem.
data = data.dropna()
```

```
# Nap regade dataset lan.
data.isnull().sum()/len(data)*100
```

```
Loan_ID              0.0
Gender               0.0
Married              0.0
Dependents           0.0
Education            0.0
Self_Employed        0.0
ApplicantIncome      0.0
CoapplicantIncome    0.0
LoanAmount           0.0
Loan_Amount_Term     0.0
Credit_History       0.0
Property_Area        0.0
Loan_Status          0.0
dtype: float64
```

```
# Nap gade sin gen data ki repete.
print(data.duplicated().sum())
```

```
0
```

```
# Nap regade dimansyon dataset lan.
data.shape
```

```
(480, 13)
```

Data Preprocessing

```
# Nap divize Dataset lan an label
X = data.drop(columns=['Loan_ID','Loan_Status'],axis=1)
Y = data['Loan_Status']
Y.head()
```

```
1    N
2    Y
3    Y
4    Y
5    Y
Name: Loan_Status, dtype: object
```

```
# Kounya nap divize dataset lan an done pou antrenman epi done pou tes
train, X_test = train_test_split(X,test_size=.20,random_state=42)
```

```
# Nou kreye yon dataset ki genyen selman done kategoryel yo.
train_categorical = train.select_dtypes(exclude=['int64','Float64'])
train_categorical.head()
```

	Gender	Married	Dependents	Education	Self_Employed	Property_Area
172	Male	Yes	3+	Not Graduate	No	Rural
288	Female	No	0	Graduate	No	Semiurban
607	Male	Yes	2	Not Graduate	No	Rural
55	Male	Yes	2	Graduate	No	Semiurban
461	Male	Yes	3+	Graduate	No	Urban

```
# Nap ankode data kategoryel yo.
train_categorical = pd.get_dummies(train_categorical,drop_first=True,dtype=float)
train_categorical.head()
```

	Gender_Male	Married_Yes	Dependents_1	Dependents_2	Dependents_3+	Education_Not Graduate	Self_Employed_Yes	Property_Area_Semiu
172	1.0	1.0	0.0	0.0	1.0	1.0	0.0	
288	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
607	1.0	1.0	0.0	1.0	0.0	1.0	0.0	
55	1.0	1.0	0.0	1.0	0.0	0.0	0.0	
461	1.0	1.0	0.0	0.0	1.0	0.0	0.0	

```
# Nap verifye dimansyon dataset kategoryel yo.
train_categorical.shape
```

```
(384, 9)
```

```
# Kounya nap kreye yon dataset ki genyen selman done nimerik.
numerical_features = ['ApplicantIncome','CoapplicantIncome','LoanAmount','Loan_Amount_Term','Credit_History']
train_numerical = train[numerical_features]
train_numerical.head()
```

	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History
172	3522	0.0	81.0	180.0	1.0
288	4124	0.0	115.0	360.0	1.0
607	3987	1411.0	157.0	360.0	1.0
55	2708	1167.0	97.0	360.0	1.0
461	7740	0.0	128.0	180.0	1.0

```
# Nap nomalize data yo.
scaler = MinMaxScaler()
scaler.fit(train_numerical)
train_scaled = pd.DataFrame(
    scaler.transform(train_numerical),
    index=train_numerical.index,
    columns=train_numerical.columns
)

train_scaled.head()
```

	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History
172	0.041707	0.000000	0.121827	0.324324	1.0
288	0.049153	0.000000	0.179357	0.729730	1.0
607	0.047458	0.041700	0.250423	0.729730	1.0
55	0.031639	0.034489	0.148900	0.729730	1.0
461	0.093878	0.000000	0.201354	0.324324	1.0

```
# Nap divize taget data yo an done antrenman e done poun teste.
Y_train, Y_test = train_test_split(Y,test_size=0.20,random_state=42)
Y_train.shape
```

```
(384,)
```

```
# Nap fe diferan tip done yo fe yn sel.
X_train_full = pd.concat([train_scaled,train_categorical],axis=1)
X_train_full.head()
X_train_full.shape
```

```
(384, 14)
```

```
# Nap transfome done tes yo.

test_categorical = X_test.select_dtypes(exclude=['int64','Float64'])
test_categorical.head()

test_categorical = pd.get_dummies(test_categorical,drop_first=True,dtype=float)
test_categorical.shape


test_numerical = X_test[numerical_features]


test_scaled = pd.DataFrame(
    scaler.transform(test_numerical),
    index=test_numerical.index,
    columns=test_numerical.columns
)

X_test_full = pd.concat([test_scaled,test_categorical],axis=1)
X_test_full.head()
X_test_full.shape
```

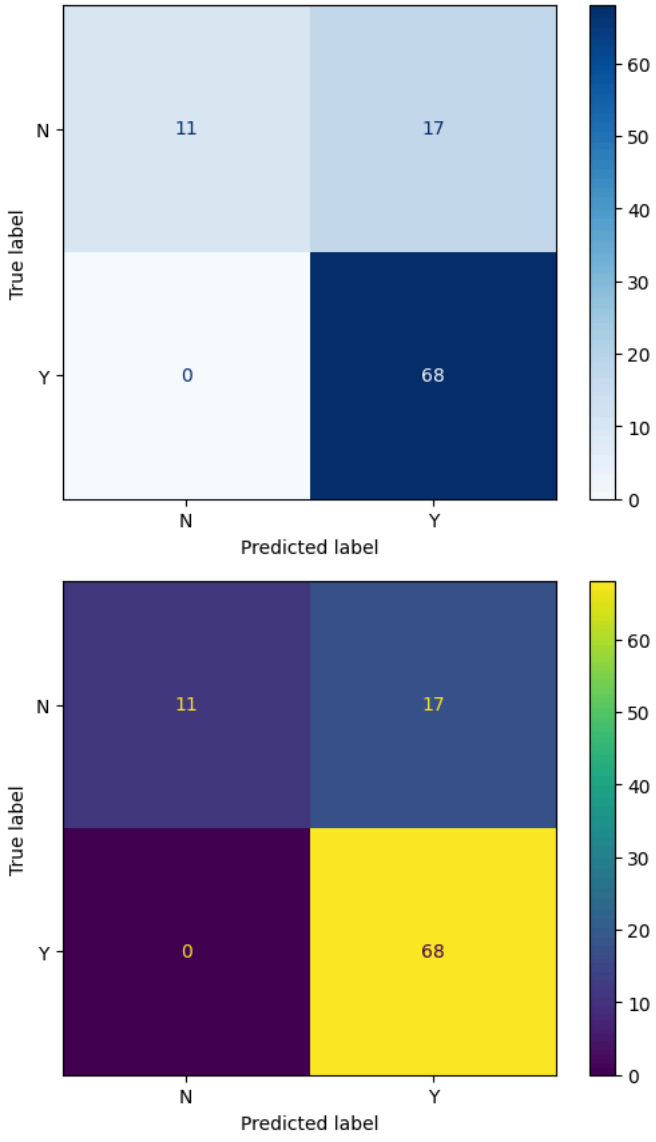
```
(96, 14)
```

Modelizasyon

Logistic Regression

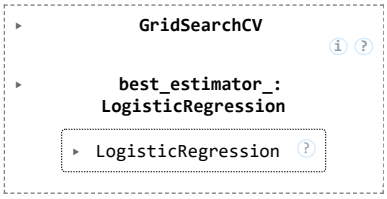
```
# Nap antrene algoritm Lojistik Regresyon an.
logreg = LogisticRegression()
logreg.fit(X_train_full,Y_train)
Y_pred_lr = logreg.predict(X_test_full)

log_train = round(logreg.score(X_train_full,Y_train)*100,2)
log_accuracy = round(accuracy_score(Y_pred_lr,Y_test)*100,2)


print("Training Accuracy     :",log_train ,"%")
print("Model Accuracy score     :",log_accuracy ,"%")

print("\033[1m-------------------------------------------------------------\033[0m")
#confusion_matrix(logreg,X_test_full,Y_test);
#plt.title('confusion_matrix');

y_pred = logreg.predict(X_test_full)
disp = ConfusionMatrixDisplay.from_predictions(Y_test, y_pred, cmap="Blues")
disp.plot()
plt.show()
```

```
Training Accuracy     : 80.47 %
Model Accuracy score     : 82.29 %
-------------------------------------------------------------
```




```
# Nap itilize GridSearch pou nou jwenn meye paramet model Lojistik Regresyon an.
C_vals = [1,2,3,4,5,6,7,8,9,10,12,13,14,15,16.5,17]
penalties = ['l2']

param = {'penalty': penalties, 'C' : C_vals}

logreg = LogisticRegression()

grid_log = GridSearchCV(estimator=LogisticRegression(),param_grid=param,scoring='accuracy',cv=5)
```

```
grid_log.fit(X_train_full,Y_train)
```

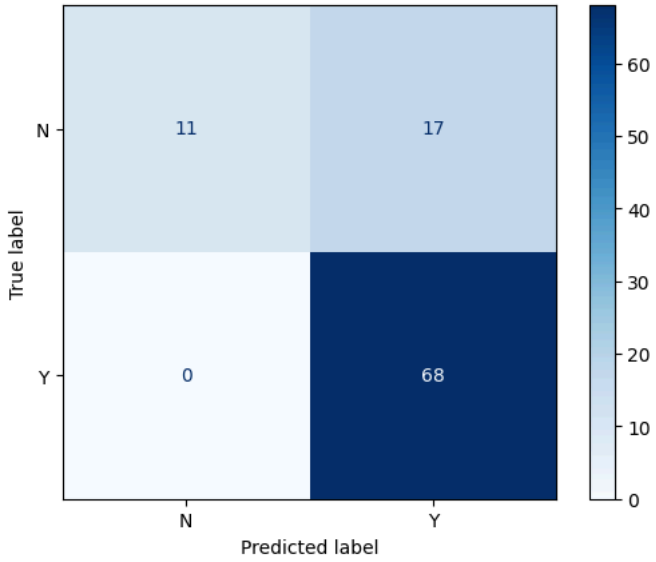


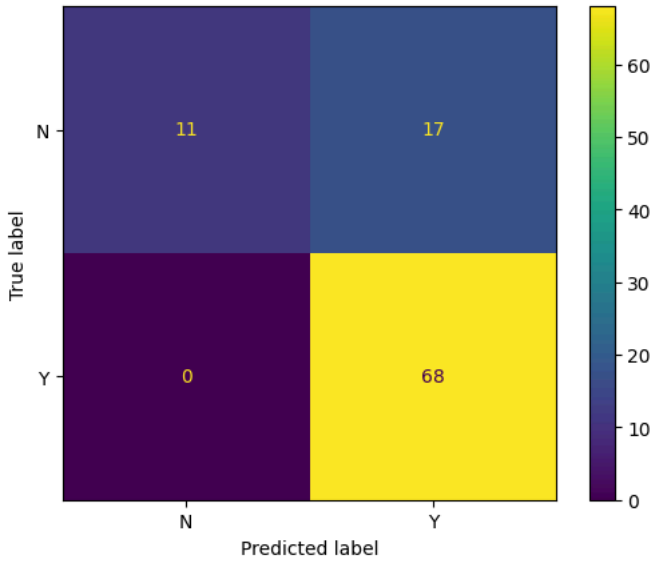

```
# Nap afiche meye paramet nou jwenn yo.
print(grid_log.best_score_)
print(grid_log.best_params_)
print(grid_log.best_estimator_)
```

```
0.8100136705399864
{'C': 5, 'penalty': 'l2'}
LogisticRegression(C=5)
```

```
# Nap teste model lan
logreg_grid = grid_log.best_estimator_


log_train_grid = round(logreg_grid.score(X_train_full,Y_train)*100,2)
log_accuracy_grid = round(logreg_grid.score(X_test_full,Y_test)*100,2)


print("Training Accuracy     :",log_train_grid ,"%")
print("Model Accuracy score     :",log_accuracy_grid ,"%")

print("\033[1m------------------------------------------------------------\033[0m")
#confusion_matrix(logreg,X_test_full,Y_test);
#plt.title('confusion_matrix');

y_pred = grid_log.predict(X_test_full)
disp = ConfusionMatrixDisplay.from_predictions(Y_test, y_pred, cmap="Blues")
disp.plot()
plt.show()
```

```
Training Accuracy     : 80.73 %
Model Accuracy score     : 82.29 %
----------------------------------------------------------
```






```
# Nap itilize GridSearch pou nou jwenn meye paramet model 'Decision Tree" an.
params = {
    'max_depth' : [5,10,20,25],
    'min_samples_leaf' : [10,20,50,100,120],
    'criterion' : ['gini','entropy']
    }

cv = StratifiedShuffleSplit(n_splits = 10, test_size = .25)

grid_dec = GridSearchCV(estimator = DecisionTreeClassifier(),
                        param_grid=params,
                        cv=cv, n_jobs=-1,verbose=1,scoring = 'accuracy')

grid_dec.fit(X_train_full,Y_train)
```

```
Fitting 10 folds for each of 40 candidates, totalling 400 fits
```

▸ **GridSearchCV**

▸ **best_estimator_: DecisionTreeClassifier**

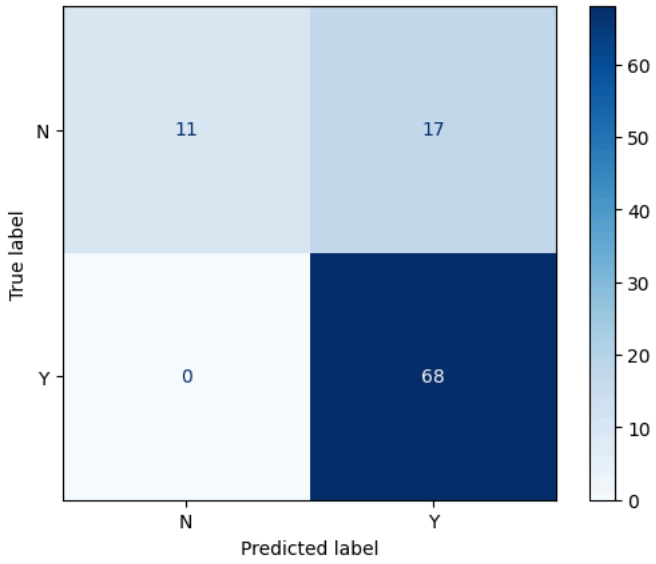
▸ DecisionTreeClassifier

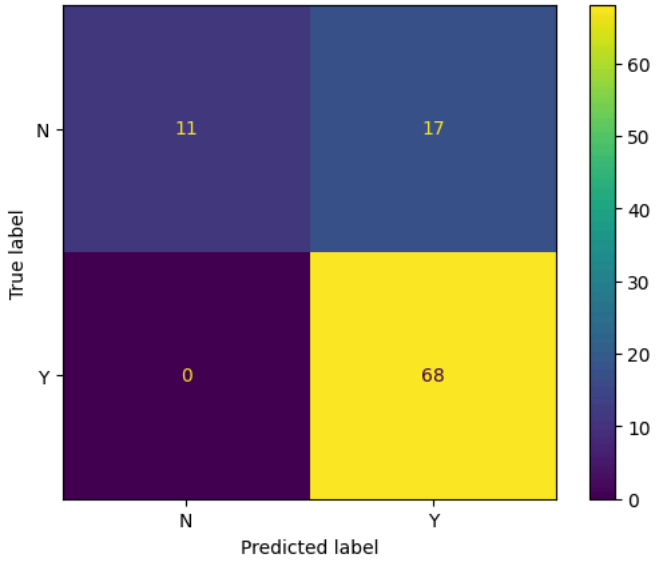
```
# Nap afiche meye paramet nou jwenn yo.
print(grid_dec.best_score_)
print(grid_dec.best_params_)
print(grid_dec.best_estimator_)
```

```
0.8010416666666668
{'criterion': 'gini', 'max_depth': 5, 'min_samples_leaf': 20}
DecisionTreeClassifier(max_depth=5, min_samples_leaf=20)
```

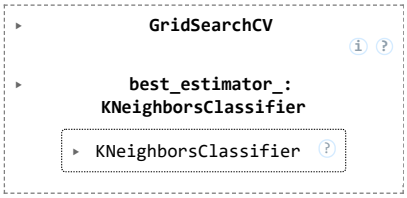
```
# Nap teste model lan
dec_grid = grid_dec.best_estimator_


decision_train_grid = round(dec_grid.score(X_train_full,Y_train)*100,2)
decision_accuracy_grid = round(dec_grid.score(X_test_full,Y_test)*100,2)


print("Training Accuracy     :",decision_train_grid ,"%")
print("Model Accuracy score     :",decision_accuracy_grid ,"%")

print("\033[1m-------------------------------------------------------------\033[0m")
#confusion_matrix(logreg,X_test_full,Y_test);
#plt.title('confusion_matrix');

y_pred = dec_grid.predict(X_test_full)
disp = ConfusionMatrixDisplay.from_predictions(Y_test, y_pred, cmap="Blues")
disp.plot()
plt.show()
```

```
Training Accuracy     : 80.47 %
Model Accuracy score     : 82.29 %
-------------------------------------------------------------
```





```
# Nap itilize GridSearch pou nou jwenn meye paramet model KNN lan.
k_range = range(1,13)

weights_options = ['uniform','distance']
param = {'n_neighbors': k_range,'weights':weights_options}

cv = StratifiedShuffleSplit(n_splits=10,test_size=.30,random_state=15)

grid_knn = GridSearchCV(KNeighborsClassifier(),param, cv=cv,verbose=False,n_jobs=-1)
grid_knn.fit(X_train_full,Y_train)
```

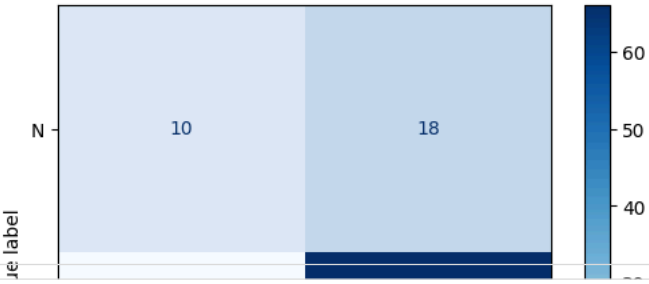



```
# Nap afiche meye paramet nou jwenn yo.
print(grid_knn.best_score_)
print(grid_knn.best_params_)
print(grid_knn.best_estimator_)
```

```
0.7577586206896553
{'n_neighbors': 12, 'weights': 'distance'}
KNeighborsClassifier(n_neighbors=12, weights='distance')
```

```
# Nap teste model lan
knn_grid = grid_knn.best_estimator_

knn_train_grid = round(knn_grid.score(X_train_full,Y_train)*100,2)
knn_accuracy_grid = round(knn_grid.score(X_test_full,Y_test)*100,2)

print("Training Accuracy     :",knn_train_grid ,"%")
print("Model Accuracy score     :",knn_accuracy_grid ,"%")

print("\033[1m------------------------------------------------------------\033[0m")
#confusion_matrix(logreg,X_test_full,Y_test);
#plt.title('confusion_matrix');

y_pred = knn_grid.predict(X_test_full)
disp = ConfusionMatrixDisplay.from_predictions(Y_test, y_pred, cmap="Blues")
disp.plot()
plt.show()
```

```
Training Accuracy     : 100.0 %
Model Accuracy score     : 79.17 %
----------------------------------------------------------
```




```
# Nap konpare model yo.
models = pd.DataFrame({
    'Model' : [
        'Logistic Regression', 'Decision Tree','KNN'
    ],

    'Model Accuracy score with GridSearch':[
        log_accuracy_grid, decision_accuracy_grid,knn_accuracy_grid
    ]

})

models.sort_values(by='Model Accuracy score with GridSearch', ascending=False).style.background_gradient(
    cmap='Paired'
).hide(axis="index")
```