
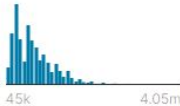
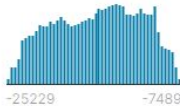


**Course Project:** Nutritional Labels for Automated Decision Systems by Home Credit Default Risk

**Team:** Wonkwon Lee (wl2733), Soowhan Park (sp6682)

# Background

- Dataset: Historical loan application data
- Goal: Predict whether or not an applicant will be able to repay a loan

# TARGET	CODE_GENDER	# AMT_CREDIT	NAME_EDUCATIO...	# DAYS_BIRTH
	F 66% M 34% Other (4) 0%		Secondary / secon... 71% Higher education 24% Other (14257) 5%	
1	M	406597.5	Secondary / secondary special	-9461
0	F	1293502.5	Higher education	-16765
0	M	135000.0	Secondary / secondary special	-19046
0	F	312682.5	Secondary / secondary special	-19005
0	M	513000.0	Secondary / secondary special	-19932
0	M	490495.5	Secondary / secondary special	-16941
0	F	1560726.0	Higher education	-13778
0	M	1530000.0	Higher education	-18850
0	F	1019610.0	Secondary / secondary special	-20099
0	M	405000.0	Secondary / secondary special	-14469
0	F	652500.0	Higher education	-10197
0	F	148365.0	Secondary / secondary special	-20417

<Snippet of dataset>

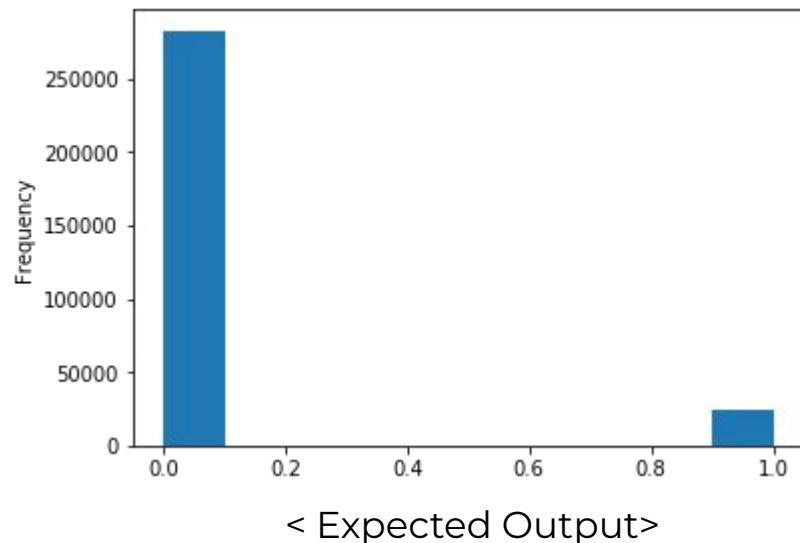
# Input and Output

Main input: application\_train|test.csv

- Data including information about each loan application at Home credit
- Sensitive attributes: Gender, Education status, and Age

Output: submission.csv

- "TARGET" column
- 0: loan was repaid
- 1: loan was not repaid



# Implementation and Validation - Preprocessing

## Missing value imputation

- 67 columns contain missing values
- Replaced with median

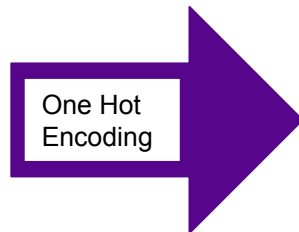
	Missing Values	% of Total Values
COMMONAREA_MEDI	214865	69.9
COMMONAREA_AVG	214865	69.9
COMMONAREA_MODE	214865	69.9
NONLIVINGAPARTMENTS_MEDI	213514	69.4
NONLIVINGAPARTMENTS_MODE	213514	69.4
NONLIVINGAPARTMENTS_AVG	213514	69.4
FONDKAPREMONT_MODE	210295	68.4
LIVINGAPARTMENTS_MODE	210199	68.4
LIVINGAPARTMENTS_MEDI	210199	68.4
LIVINGAPARTMENTS_AVG	210199	68.4
FLOORSMIN_MODE	208642	67.8
FLOORSMIN_MEDI	208642	67.8
FLOORSMIN_AVG	208642	67.8
YEARS_BUILD_MODE	204488	66.5
YEARS_BUILD_MEDI	204488	66.5
YEARS_BUILD_AVG	204488	66.5
OWN_CAR_AGE	202929	66.0
LANDAREA_AVG	182590	59.4
LANDAREA_MEDI	182590	59.4
LANDAREA_MODE	182590	59.4

# Implementation and Validation - Preprocessing

Encoding categorical variables

- float64 : 65
- int64: 41
- object : 16

	Gender
0	Male
1	Female



	Gender _Male	Gender _Female
0	1	0
1	0	1

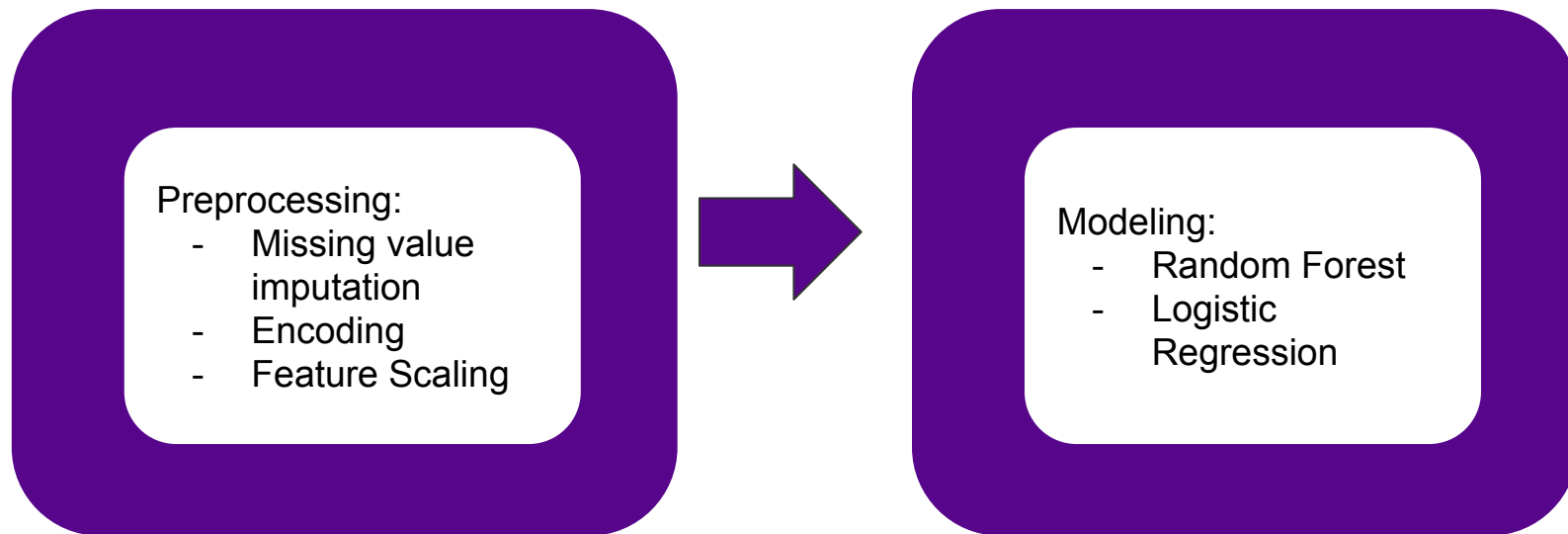
# Implementation and Validation - Preprocessing

Scaling features to range

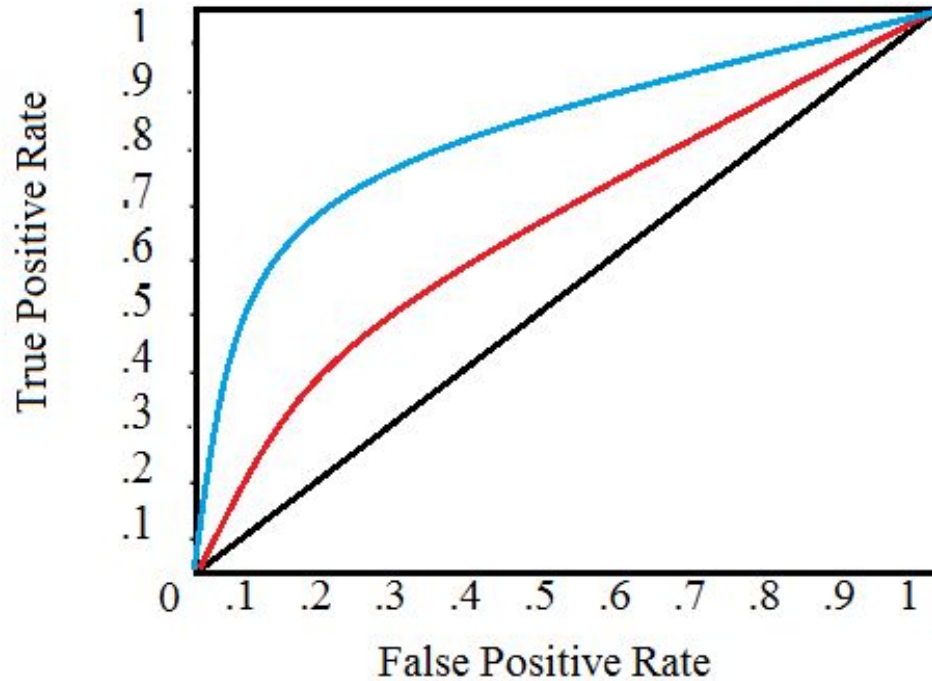
- Range [0, 1]

```
# Scale each feature to 0-1  
scaler = MinMaxScaler(feature_range = (0, 1))
```

# Implementation and Validation - High level Implementation



# Implementation and Validation - Validation



< ROC curve graph >



## Outcomes - Accuracy

	Age	Gender	Education
Overall Accuracy	0.919	0.918	0.92
AUC	0.711	0.703	0.709
Privileged Accuracy	0.925	0.895	0.921
Unprivileged Accuracy	0.886	0.931	0.891

## Outcomes - Fairness Metrics

	Age	Gender	Education
Mean Difference	0.0396	-0.031	0.0291
Disparate Impact	1.5288	0.6639	1.3623
Error rate difference	0.0394	-0.0351	0.0187
FPR (privileged)	0.000103	0.000160	0.000352
FPR (unprivileged)	0.00028	0.000132	0.0000
FPR difference	-0.000028	-0.000028	-0.000352
FNR (privileged)	0.998492	0.997714	0.999367
FNR (unprivileged)	0.997082	0.998581	1.000000
FNR ratio	0.998588	1.000869	1.000633

Table 2: Measures for fairness or diversity



# Outcomes - LIME

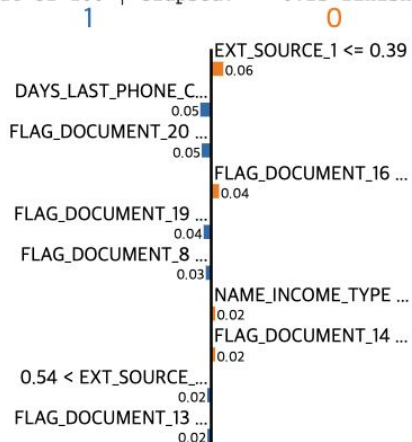
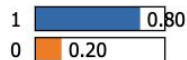
Actual class: 0

[Parallel(n\_jobs=2)]: Using backend ThreadingBackend with 2 concurrent workers.

[Parallel(n\_jobs=2)]: Done 46 tasks | elapsed: 0.1s

[Parallel(n\_jobs=2)]: Done 100 out of 100 | elapsed: 0.2s finished

Prediction probabilities



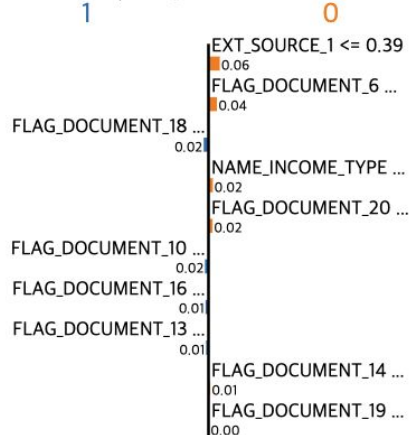
FLAG_DOCUMENT_11	0.00
FLAG_DOCUMENT_12	0.00
FLAG_DOCUMENT_13	0.00
FLAG_DOCUMENT_14	0.00
FLAG_DOCUMENT_15	0.00
FLAG_DOCUMENT_16	0.00
FLAG_DOCUMENT_17	0.00
FLAG_DOCUMENT_18	0.00
FLAG_DOCUMENT_19	0.00
FLAG_DOCUMENT_20	0.00
FLAG_DOCUMENT_21	0.00
AMT_REQ_CREDIT_BUREAU_HOUR	0.00
AMT_REQ_CREDIT_BUREAU_DAY	0.00
AMT_REQ_CREDIT_BUREAU_WEEK	1.00

<Misclassified>

# Outcomes - LIME

Actual class: 1  
 [Parallel(n\_jobs=2)]: Using backend ThreadingBackend with 2 concurrent workers.  
 [Parallel(n\_jobs=2)]: Done 46 tasks | elapsed: 0.1s  
 [Parallel(n\_jobs=2)]: Done 100 out of 100 | elapsed: 0.3s finished

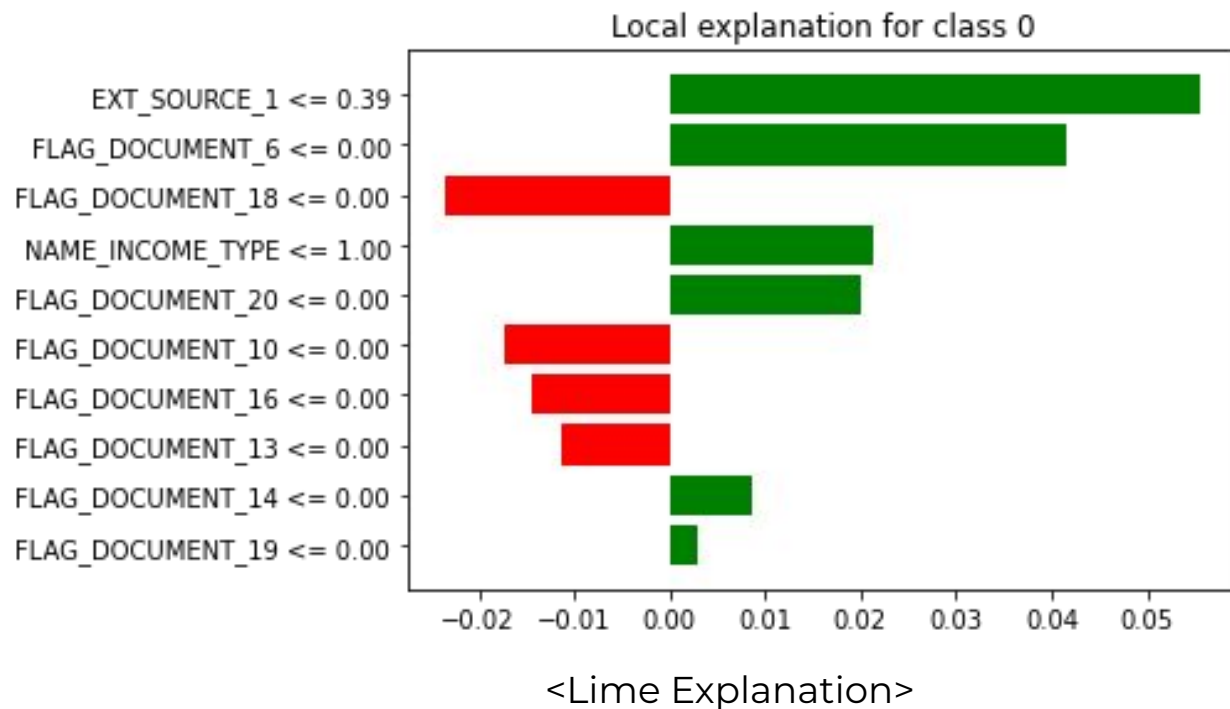
Prediction probabilities



FLAG_DOCUMENT_8	0.00
FLAG_DOCUMENT_9	0.00
FLAG_DOCUMENT_10	0.00
FLAG_DOCUMENT_11	0.00
FLAG_DOCUMENT_12	0.00
FLAG_DOCUMENT_13	0.00
FLAG_DOCUMENT_14	0.00
FLAG_DOCUMENT_15	0.00
FLAG_DOCUMENT_16	0.00
FLAG_DOCUMENT_17	0.00
FLAG_DOCUMENT_18	0.00
FLAG_DOCUMENT_19	0.00
FLAG_DOCUMENT_20	0.00
FLAG_DOCUMENT_21	0.00

<Correctly classified>

## Outcomes - LIME



## Summary

1. Data was not appropriate for ADS
  - a. Solution: over sampling, under sampling, additional datasets.
2. Missing value imputation is not optimal
3. No explicit bias between privileged vs unprivileged
4. Overall, this ADS is inappropriate to be deployed in public sector or industry
5. Future improvements
  - a. Reweighting the target attribute
  - b. Use external datasets