SOON CHUN HYANG UNIVERSITY

2024 Probabilistic Model Class

Chapter 7. Application

7.4. Wine Quality Classification

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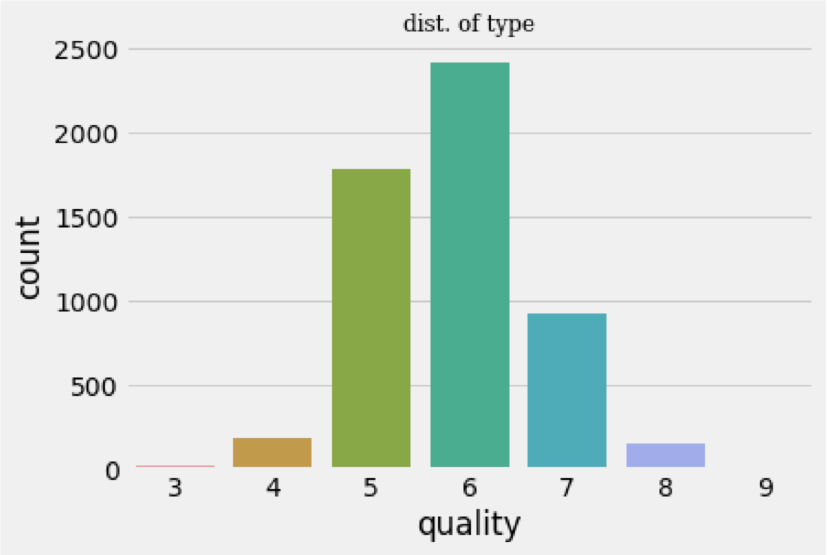
1. Introduction

Wine Quality Classification

- UCI machine-learning repository에서 제공하는 Basic Dataset
- 3~9의 값을 가지는 Quality에 대한 분류
- 두 개의 이진 분류로 단순화(3,4,5,6: Low / 7,8,9: High)

	fixed acidity	volatile acidity	citric acid	...	sulphates	alcohol	type	quality
0	5.6	0.695	0.06	...	0.44	10.2	white	5
1	8.8	0.610	0.14	...	0.59	9.5	red	5
2	7.9	0.210	0.39	...	0.52	10.9	white	5
3	7.0	0.210	0.31	...	0.50	10.8	white	6
4	7.8	0.400	0.26	...	0.43	10.9	white	6

와인 품질 분류 데이터 예시

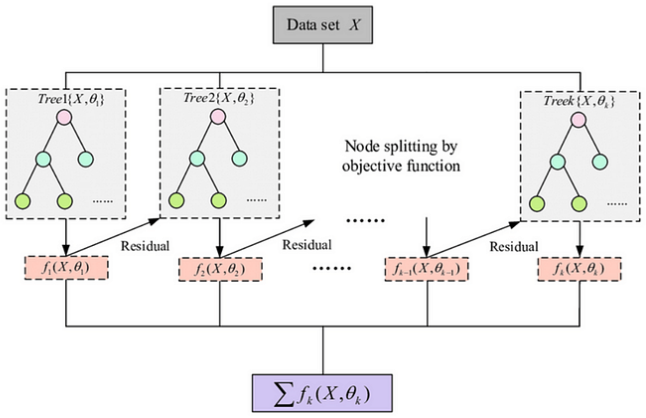


Target 변수 분포 시각화

1. Introduction

XGBoost Model

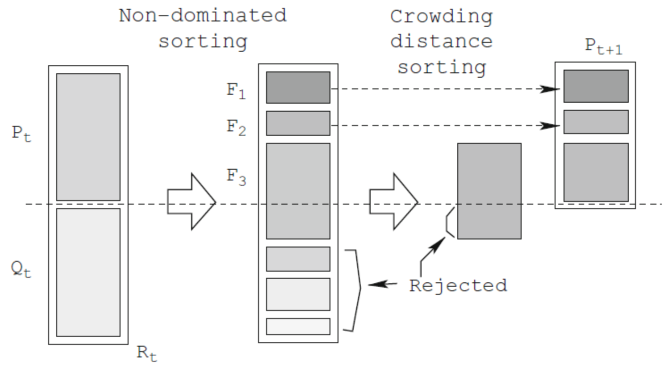
- 그레디언트 부스팅 기반의 의사결정 트리 알고리즘
- 최적의 성능을 위해 하이퍼파라미터에 대한 튜닝 필요



Flow chart of XGBoost

NSGA-II(Non-dominated Sorting Genetic Algorithm II)

- 비지배 정렬과 군집 거리 계산을 통해 랭킹을 매겨 다목적 최적화를 수행
- 하이퍼파라미터 튜닝(성능 최적화)과 Feature selection 두개의 다중 목적을 최적화



2. Methods

Learning Process

1. Initialization : 임의의 초기 Population 생성
2. Pareto Front 생성 : 두 개의 목표에 대해 모든 측면에서 우수하거나 동일한 성능을 보이는 해를 찾음
3. Pareto Front의 Ranking 산출 : 각 솔루션의 랭크를 결정
4. 군집 거리(Crowding Distance) 계산 : 인접한 개체 사이의 차이를 계산
5. Crossover & Mutation : 랭크와 군집 거리에 기반한 선택 / 유전자를 조합하거나 변형

```
NSGAII optimization:
1 evaluations (AUC: 0.78 nr.features:7)
20 evaluations (AUC: 0.76 nr.features:4)
40 evaluations (AUC: 0.8 nr.features:6)
60 evaluations (AUC: 0.78 nr.features:6)
80 evaluations (AUC: 0.63 nr.features:3)
100 evaluations (AUC: 0.77 nr.features:3)
120 evaluations (AUC: 0.77 nr.features:2)
140 evaluations (AUC: 0.75 nr.features:4)
160 evaluations (AUC: 0.5 nr.features:1)
180 evaluations (AUC: 0.8 nr.features:7)
200 evaluations (AUC: 0.77 nr.features:2)
220 evaluations (AUC: 0.79 nr.features:3)
time elapsed: 43.27
```

2. Methods

R Shiny

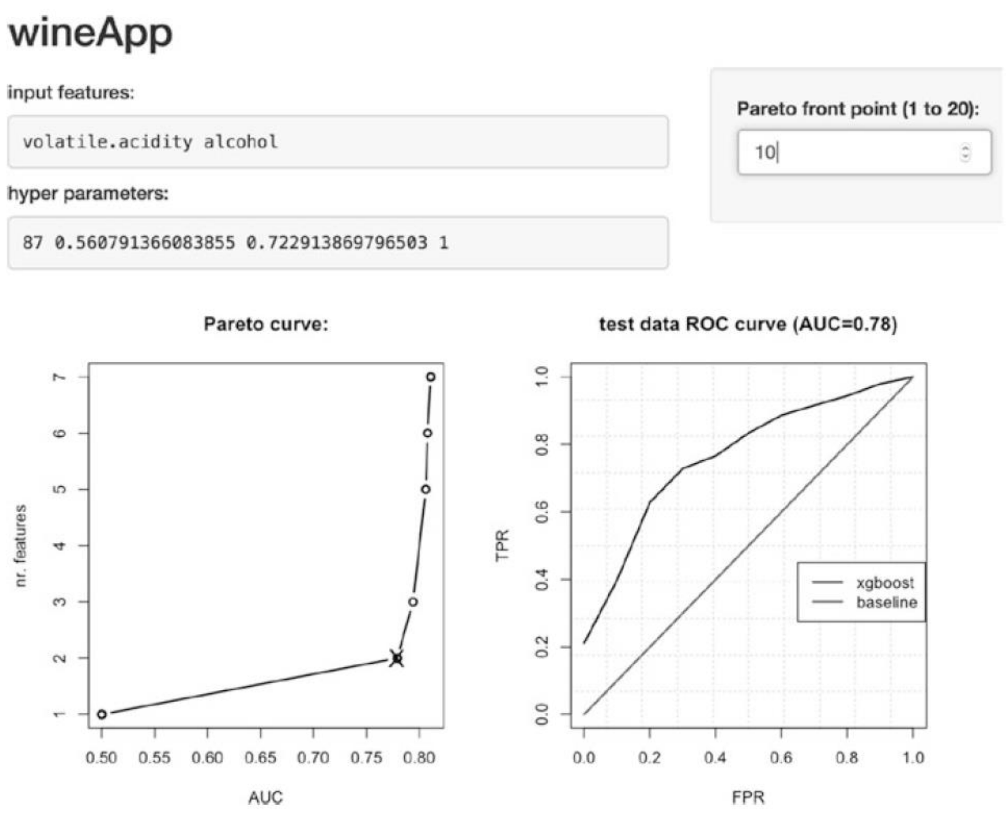


Fig. 7.7 Example of the wineApp execution

3. Comparison of algorithm

```
NSGAII optimization:
1 evaluations (AUC: 0.78 nr.features:7)
20 evaluations (AUC: 0.76 nr.features:4)
40 evaluations (AUC: 0.8 nr.features:6)
60 evaluations (AUC: 0.78 nr.features:6)
80 evaluations (AUC: 0.63 nr.features:3)
100 evaluations (AUC: 0.77 nr.features:3)
120 evaluations (AUC: 0.77 nr.features:2)
140 evaluations (AUC: 0.75 nr.features:4)
160 evaluations (AUC: 0.5 nr.features:1)
180 evaluations (AUC: 0.8 nr.features:7)
200 evaluations (AUC: 0.77 nr.features:2)
220 evaluations (AUC: 0.79 nr.features:3)
time elapsed: 43.27
```

SMS-EMOA optimization:

```
1 evaluations (AUC: 0.78 nr.features:7)
20 evaluations (AUC: 0.76 nr.features:4)
40 evaluations (AUC: 0.61 nr.features:2)
60 evaluations (AUC: 0.81 nr.features:8)
80 evaluations (AUC: 0.62 nr.features:2)
100 evaluations (AUC: 0.8 nr.features:4)
```

Thanks