**Data Mining**

kNN, 유사도 과제

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1.



(a)

① 정규화

학습표본의 설명변수인 x1, x2, x3 객체들은 각각 아래와 같은 스케일을 가지고 있다.

|  |  |  |
| --- | --- | --- |
| 객체 | 최솟값 | 최대값 |
|  | 2 | 9 |
|  | 0.3 | 0.8 |
|  | 3278 | 7200 |

각 객체들의 스케일 차이가 크므로 유클리드 거리를 구할 때 일부 변수가 전체를 지배함으로써 거리척도가 왜곡되는 문제가 생길 수 있다. 그러므로 정규화 및 표준화가 필요하다. 정규화 및 표준화 방식 중 이상치로 인해 발생하는 문제를 피할 수 있는 “z-score 정규화”를 사용하였다. z-score는 데이터의 평균과 표준편차를 계산하여, 데이터의 평균을 0으로 표준편차를 1로 만드는 기법이다.

정규화 결과는 아래 표와 같다.

|  |  |  |  |
| --- | --- | --- | --- |
| Sample No. |  |  |  |
| 1 | -0.17556172 | 0.78446454 | 0.801 |
| 2 | -0.58520574 | -1.96116135 | -1.98500012 |
| 3 | 0.64372631 | 1.47087101 | 1.44737267 |
| 4 | 1.05337032 | 0.09805807 | 0.20143271 |
| 5 | -0.99484975 | 0.09805807 | -0.05073872 |
| 6 | -1.40449377 | -0.58834841 | -0.51885413 |
| 7 | 1.46301434 | 0.09805807 | 0.10482619 |

② 3-NN으로 분류

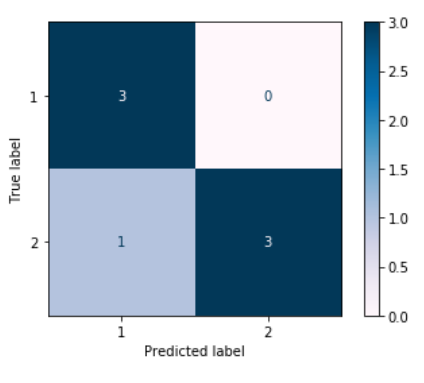
파이썬으로 진행하였으며 파이썬의 머신러닝 라이브러리인 Scikit-learn의 KNeighborsClassifier 모듈을 사용하였다. 모듈의 파라미터는 n\_neighbors는 3으로, metric는 'euclidean' 로 설정하여 KNN 모델을 생성하였다. 이는 유클라디안 거리 공식을 이용해 새로운 데이터와의 거리를 구하고, 가장 가까운 주변 3개의 데이터를 선택해 다수결을 통해 데이터의 클래스을 분류함을 의미한다.

3-NN 모델을 만들어 7개의 클래스를 예측한 결과는 아래 표와 같다.

|  |  |  |
| --- | --- | --- |
| Sample No. | 실제 클래스 | 예측 클래스 |
| 1 | 1 | 1 |
| 2 | 2 | 1 |
| 3 | 2 | 2 |
| 4 | 2 | 2 |
| 5 | 1 | 1 |
| 6 | 1 | 1 |
| 7 | 2 | 2 |

Sample No. 2 에서 실제 클래스는 2인데 예측 클래스는 1로 잘못 예측했음을 알 수 있다. 이 외의 데이터는 실제 클래스와 같은 클래스로 예측하였다

(b) (a)의 결과에 의해 만든 혼돈행렬



위의 혼돈행렬에서 볼 수 있듯이 Sample No. 2에서 실제 클래스는 2인데 예측 클래스를 1로 예측한 결과를 혼돈행렬의 2행 1열((True label, Predicted label)=(2,1))에서 확인할 수 있다.

(c) 두 개의 새로운 객체     와     의 범주를 3-NN으로 분류하라.

3-NN 모델로 예측을 진행하기 전에 , 을 정규화 시켰다. 정규화는 기존 데이터 7개의 평균, 표준편차를 이용하였다. 정규화 결과는 아래 표와 같다.

|  |  |  |  |
| --- | --- | --- | --- |
| 새로운 객체 명 |  |  |  |
|  | 0.23408229 | 0.78446454 | 0.42163875 |
|  | -0.58520574 | -2.64756782 | 0.1758604 |

이후 (a)-②에서 만든 3-NN 모델로 예측을 진행하였다. 그 결과는 아래 표와 같다.

|  |  |
| --- | --- |
| 새로운 객체 명 | 예측 클래스 |
|  | 2 |
|  | 1 |

2.

유사도 계수 계산과 맨하튼 거리를 구하기 위해 속성 값을 다음과 같이 바꿔 주었다.

|  |  |
| --- | --- |
| 속성 값 | 변경 후 속성 값 |
| Y | 1 |
| N | 0 |
| high | 1 |
| low | 0 |
| A | 1 |
| B | 0 |

속성 값을 변경한 후 테이블의 형태는 아래와 같다.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No | house | Marriage | Education | Income | Car | Loan | credit |
| 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| 2 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| 3 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 4 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 5 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| 6 | 1 | 0 | 1 | 1 | 0 | 1 | 0 |

(a) simple matching coefficient

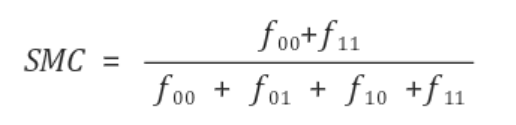
Simple matching coefficient란 변수 x와 y가 이진 속성만을 가지는 경우 유사도를 측정하는 방식이다. 구하는 식은 아래와 같다.

: x가 0일 때 y도 0인 값을 가지는 속성의 수

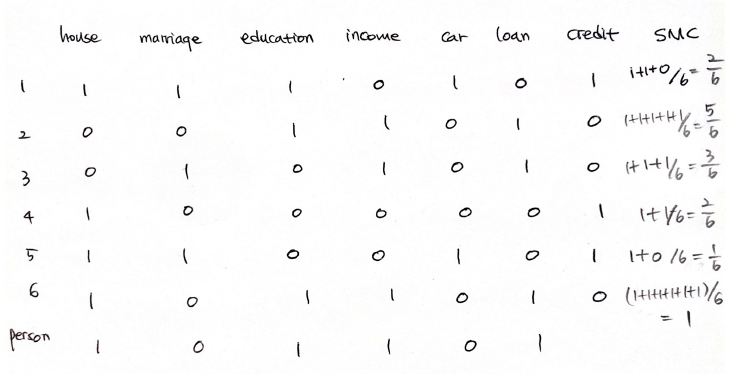
: x가 0일 때 y가 1인 값을 가지는 속성의 수

: x가 1일 때 y가 0인 값을 가지는 속성의 수

: x가 1일 때 y도 1인 값을 가지는 속성의 수



Person과 각 변수의 SMC를 구하면 다음과 같다.



k=3일 때의 k-NN을 이용해 구하는 방법은 다음 설명과 같다.

1) SMC의 값을 내림차순으로 나열한다.

2) 첫번째 ~ 세번째로 큰 SMC를 가진 데이터 3개를 고른다.

3) 3개의 데이터의 credit 값 중 다수결에 따라 가장 많이 있는 값을 선택한다.

4) 다수결로 고른 credit 값을 person의 credit으로 예측한다.

위의 표를 통해 첫번째~ 세번째로 큰 SMC를 가진 데이터는 아래 표의 첫 열과 같음을 알 수 있다. 또한 이들의 credit 값은 모두 0이다.

|  |  |  |
| --- | --- | --- |
| No | SMC | Credit |
| 6 | 1 | 0 |
| 2 | 5/6 | 0 |
| 3 | 3/6 | 0 |

그러므로, 다수결에 의해 person의 credit은 0으로 예측한다. 즉, 변경하기 전 속성 값인 B로 예측했음을 의미한다.

(b) Manhattan distance

① 3-NN으로 분류

파이썬으로 진행하였으며 파이썬의 머신러닝 라이브러리인 Scikit-learn의 KNeighborsClassifier 모듈을 사용하였다. 모듈의 파라미터는 n\_neighbors는 3으로, metric는 ‘manhattan’으로 설정하여 KNN 모델을 생성하였다. 이는 맨하튼 거리 공식을 이용해 새로운 데이터와의 거리를 구하고, 가장 가까운 주변 3개의 데이터를 선택해 다수결을 통해 데이터의 클래스을 분류함을 의미한다.

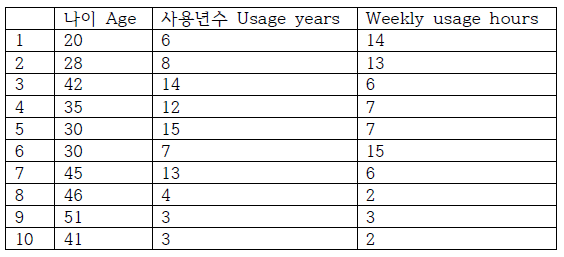
② Person의 속성 값을 이용해 credit 예측

1과 0으로 이진화 한 person의 속성 값을 넣어 credit을 예측하였다.

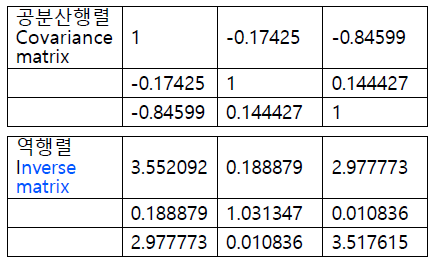
그 결과, Credit을 0으로 예측했다. 즉, 변경하기 전 속성 값인 B로 예측했음을 의미한다.

정리: 3-KNN을 이용해 만든 모델로 following person의 credit을 예측하였고, 예측한 credit의 값은 0, 즉 B이다. following person의 주어진 속성값으로 분류한 credit은 B이다.

3.



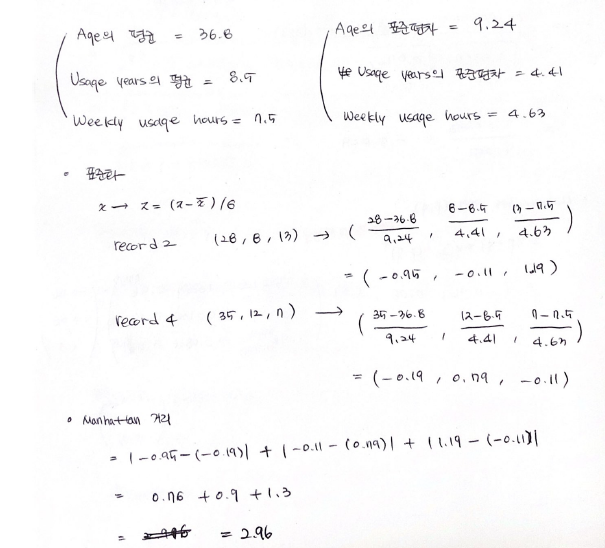
표준화한 후 세 변수의 공분산 행렬은 다음과 같다.

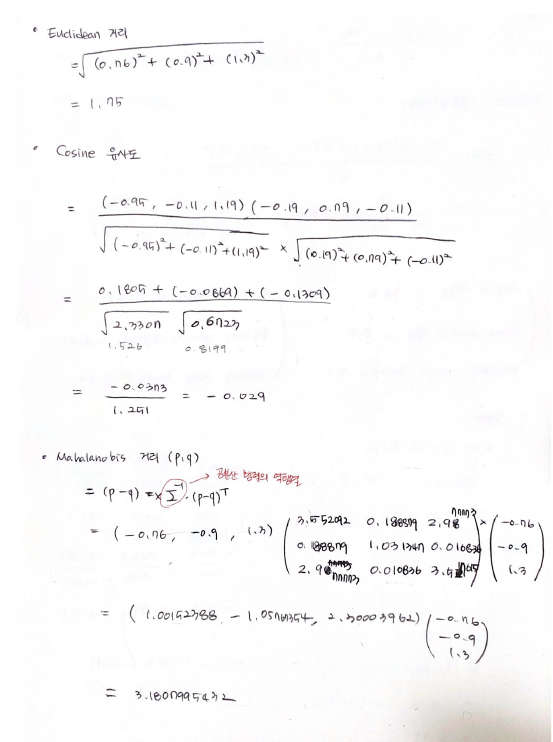


Manhattan 거리, Euclidean 거리, Cosine 유사도, Mahalanobis 거리

![텍스트이(가) 표시된 사진

자동 생성된 설명](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAkACQAAD/4RDiRXhpZgAATU0AKgAAAAgABAE7AAIAAAAIAAAISodpAAQAAAABAAAIUpydAAEAAAAQAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEl0c2hvbnkAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzc5AACSkgACAAAAAzc5AADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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