École Nationale Supérieure
d'Informatique et d'Analyse
des Systèmes

Report of practical work of data mining

Realized by :

Youssef Faraby

Chakir Ayoub

Supervised by:

M.Ali Idrl

University year 2017 – 2018

1-Dataset description

Students' Academic Performance Dataset (xAPI-Edu-Data)

Data Set Characteristics: Multivariate

Number of Instances: 480

Area: E-learning, Education, Predictive models, Educational Data Mining

Attribute Characteristics: Integer/Categorical

Number of Attributes: 16

Date: 2016-11-8

Associated Tasks: Classification

Missing Values? No

File formats: xAPI-Edu-Data.csv

Source:

Elaf Abu Amrieh, Thair Hamtini, and Ibrahim Aljarah, The University of Jordan, Amman, Jordan, http://www.Ibrahimaljarah.com

Dataset Information:

This is an educational data set which is collected from learning management system (LMS) called Kalboard 360. Kalboard 360 is a multi-agent LMS, which has been designed to facilitate learning through the use of leading-edge technology. Such system provides users with a synchronous access to educational resources from any device with Internet connection.

The data is collected using a learner activity tracker tool, which called experience API (xAPI). The xAPI is a component of the training and learning architecture (TLA) that enables to monitor learning progress and learner's actions like reading an article or watching a training video. The experience API helps the learning activity providers to determine the learner, activity and objects that describe a learning experience. The dataset consists of 480 student records and 16 features. The features are classified into three major categories: (1) Demographic features such as gender and nationality. (2) Academic background features such as educational stage, grade Level and section. (3) Behavioral features such as raised hand on class, opening resources, answering survey by parents, and school satisfaction.

The dataset consists of 305 males and 175 females. The students come from different origins such as 179 students are from Kuwait, 172 students are from Jordan, 28 students from Palestine, 22 students are from Iraq, 17 students from Lebanon, 12 students from Tunis, 11 students from Saudi Arabia, 9 students from Egypt, 7 students from Syria, 6 students from USA, Iran and Libya, 4 students from Morocco and one student from Venezuela.

The dataset is collected through two educational semesters: 245 student records are collected during the first semester and 235 student records are collected during the second semester.

The data set includes also the school attendance feature such as the students are classified into two categories based on their absence days: 191 students exceed 7 absence days and 289 students their absence days under 7.

This dataset includes also a new category of features; this feature is parent parturition in the educational process. Parent participation feature have two sub features: Parent Answering Survey and Parent School Satisfaction. There are 270 of the parents answered survey and 210 are not, 292 of the parents are satisfied from the school and 188 are not.

(See the related papers for more details).

Attributes

1 Gender - student's gender (nominal: 'Male' or 'Female')

2 Nationality- student's nationality (nominal:' Kuwait',' Lebanon',' Egypt',' SaudiArabia',' USA',' Jordan',' Venezuela',' Iran',' Tunis',' Morocco',' Syria',' Palestine',' Iraq',' Lybia')

3 Place of birth- student's Place of birth (nominal:' Kuwait',' Lebanon',' Egypt',' SaudiArabia',' USA',' Jordan',' Venezuela',' Iran',' Tunis',' Morocco',' Syria',' Palestine',' Iraq',' Lybia')

4 Educational Stages- educational level student belongs (nominal: 'lowerlevel','MiddleSchool','HighSchool')

5 Grade Levels- grade student belongs (nominal: 'G-01', 'G-02', 'G-03', 'G-04', 'G-05', 'G-06', 'G-07', 'G-08', 'G-09', 'G-10', 'G-11', 'G-12 ')

6 Section ID- classroom student belongs (nominal:'A','B','C')

7 Topic- course topic (nominal:' English',' Spanish', 'French',' Arabic',' IT',' Math',' Chemistry', 'Biology', 'Science',' History',' Quran',' Geology')

8 Semester- school year semester (nominal:' First',' Second')

9 Parent responsible for student (nominal:'mom','father')

10 Raised hand- how many times the student raises his/her hand on classroom (numeric:0-100)

11- Visited resources- how many times the student visits a course content(numeric:0-100)

12 Viewing announcements-how many times the student checks the new announcements(numeric:0-100)

13 Discussion groups- how many times the student participate on discussion groups (numeric:0-100)

14 Parent Answering Survey- parent answered the surveys which are provided from school or not (nominal:'Yes','No')

15 Parent School Satisfaction- the Degree of parent satisfaction from school(nominal:'Yes','No')

16 Student Absence Days-the number of absence days for each student (nominal: above-7, under-7)

The students are classified into three numerical intervals based on their total grade/mark:

Low-Level: interval includes values from 0 to 69,

Middle-Level: interval includes values from 70 to 89,

High-Level: interval includes values from 90-100.

	gender	NationalIT	PlaceofBir	StageID	GradeID	SectionID	Topic	Semester	Relation	raisedhand	VisITedRe
1	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	15	16
2	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	20	20
3	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	10	7
4	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	30	25
5	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	40	50
6	F	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	42	30
7	M	KW	KuwaIT	MiddleScho	G-07	A	Math	F	Father	35	12
8	M	KW	KuwaIT	MiddleScho	G-07	A	Math	F	Father	50	10
9	F	KW	KuwaIT	MiddleScho	G-07	A	Math	F	Father	12	21
10	F	KW	KuwaIT	MiddleScho	G-07	B	IT	F	Father	70	80
11	M	KW	KuwaIT	MiddleScho	G-07	A	Math	F	Father	50	88
12	M	KW	KuwaIT	MiddleScho	G-07	B	Math	F	Father	19	6
13	M	KW	KuwaIT	lowerlevel	G-04	A	IT	F	Father	5	1
14	M	lebanon	lebanon	MiddleScho	G-08	A	Math	F	Father	20	14
15	F	KW	KuwaIT	MiddleScho	G-08	A	Math	F	Mum	62	70
16	F	KW	KuwaIT	MiddleScho	G-06	A	IT	F	Father	30	40
17	M	KW	KuwaIT	MiddleScho	G-07	B	IT	F	Father	36	30
18	M	KW	KuwaIT	MiddleScho	G-07	A	Math	F	Father	55	13
19	F	KW	KuwaIT	MiddleScho	G-07	A	IT	F	Mum	69	15
20	M	KW	KuwaIT	MiddleScho	G-07	B	IT	F	Mum	70	50
21	F	KW	KuwaIT	MiddleScho	G-07	A	IT	F	Father	60	60
22	F	KW	KuwaIT	MiddleScho	G-07	B	IT	F	Father	10	12
23	M	KW	KuwaIT	MiddleScho	G-07	A	IT	F	Father	15	21

Figure 1-Dataset

2-K-NN Algorithm

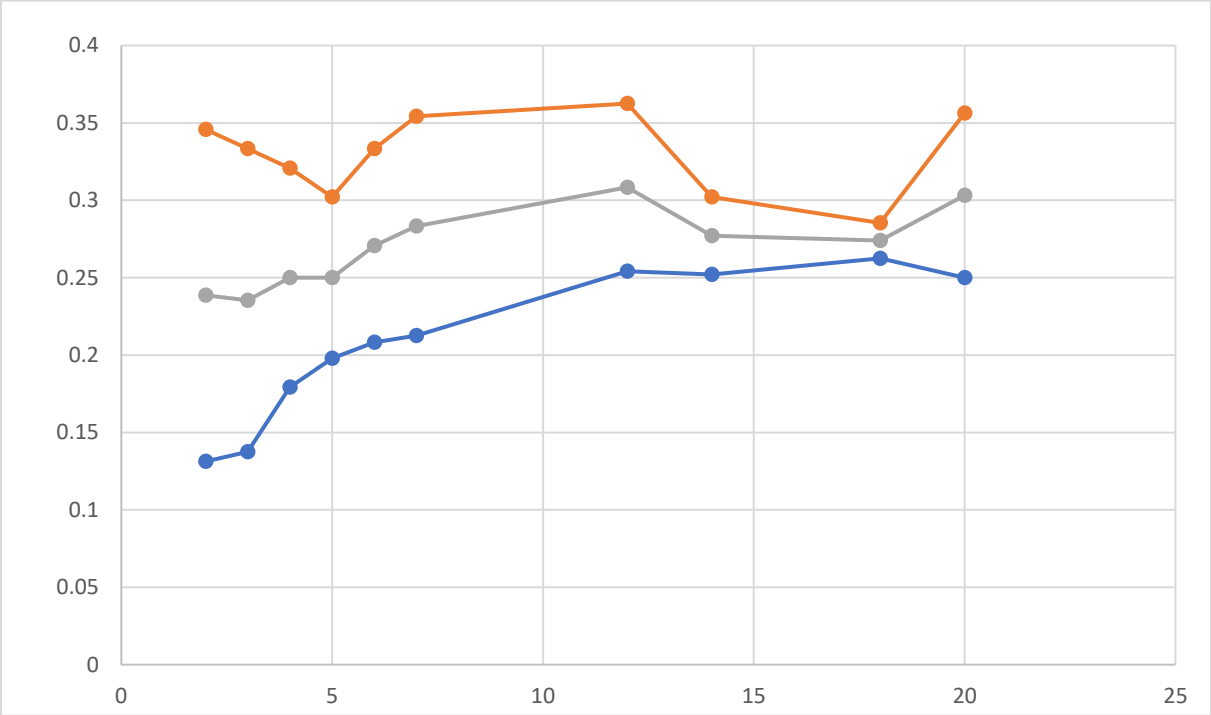
KNN is a simple algorithm that stores all available cases and classifies new cases based on a similarity measure. The purpose of the k Nearest Neighbors (kNN) algorithm is to use a database in which the data points are separated into several separate classes to predict the classification of a new sample point. This sort of situation is best motivated through examples.

We first start by identifying different values of error rate from learning and testing database that match different values of K.

neighborhood size	Erreur rate	train test	moyen
2	0.1313	0.3458	0.23855
3	0.1375	0.3333	0.2354
4	0.1792	0.3208	0.25
5	0.1979	0.3021	0.25
6	0.2083	0.3333	0.2708
7	0.2125	0.3542	0.28335
12	0.2542	0.3625	0.30835
14	0.2521	0.3021	0.2771
18	0.2625	0.2854	0.27395
20	0.25	0.3563	0.30315

Tableau 2 : Learning and testing error rate vs K

The objective is to find the suitable value of K by defending the minimum of testing and learning errors rate.



To choose the most suitable K, we should calculate the average between the two curves, in our case, we found a minimum error rate lower that 20%, which led us to choose the smaller error rate that coincide with K = 3.
We find the classifier performance above of the same K:

Classifier performances

Error rate	0.2500
Values prediction	Confusion matrix

Value	Recall	1-Precision
M	0.7014	0.2673
L	0.9213	0.2403
H	0.6690	0.2339

	M	L	H	Sum
M	148	35	28	211
L	9	117	1	127
H	45	2	95	142
Sum	202	154	124	480

Figure 4 – K-NN confusion matrix

The confusion matrix show typically a good result, we rarely find that the class representing reality is not confused with the one representing the model, which brought us a very small error rate equal to 0.25, and this is the best case for us.

ID3 Algorithm

In decision tree learning, ID3 (Iterative Dichotomiser 3) is an algorithm used to generate a decision tree from a dataset. ID3 is typically used in the machine learning and natural language processing domains.

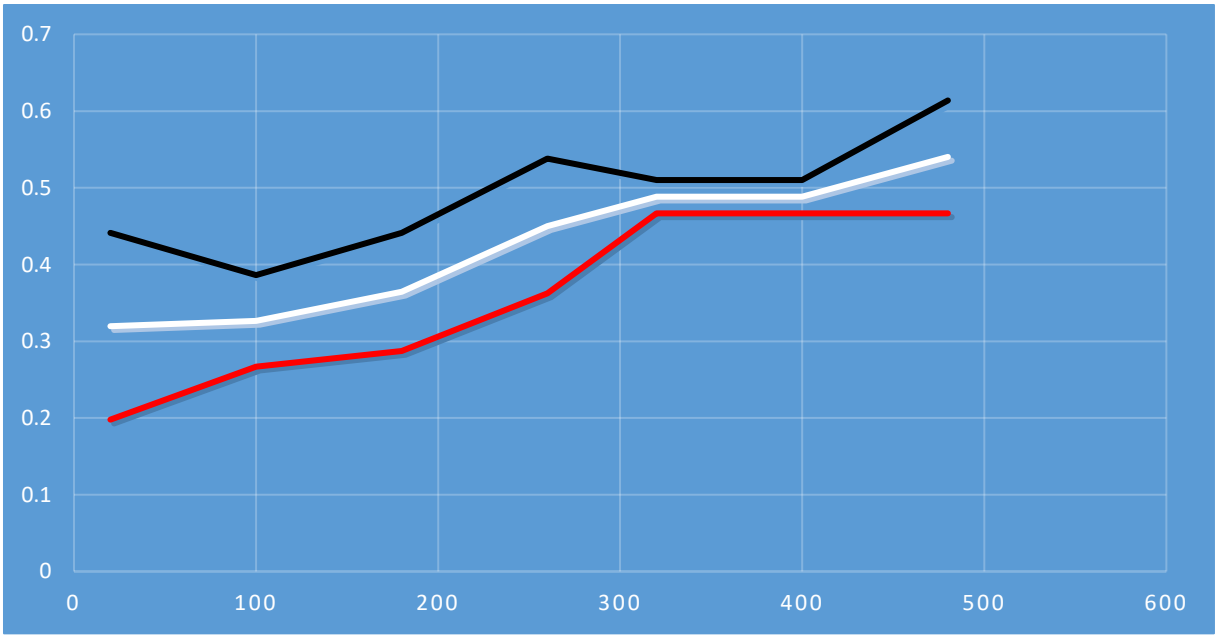
The ID3 algorithm begins with the original set S as the root node. On each iteration of the algorithm, it iterates through every unused attribute of the set S and calculates the entropy H(S) (or information gain IG(A)) of that attribute. It then selects the attribute which has the smallest entropy (or largest information gain) value. The set S is then split by the selected attribute to produce subsets of the data. The algorithm continues to recurse on each subset, considering only attributes never selected before.

We start by calculating learning and testing error rate in function of the min size of split, the table below show this result:

Error rate			train test	moyen
480	0.4667		0.6138	0.54025
400	0.4667		0.5103	0.4885
320	0.4667		0.5103	0.4885
260	0.3625		0.5379	0.4502
180	0.2875		0.4414	0.36445
100	0.2667		0.3862	0.32645
20	0.1979		0.4414	0.31965

Tableau 3 : Learning and testing error rate vs split

Our objective is to determinate the minimum value of error rate in both curves.

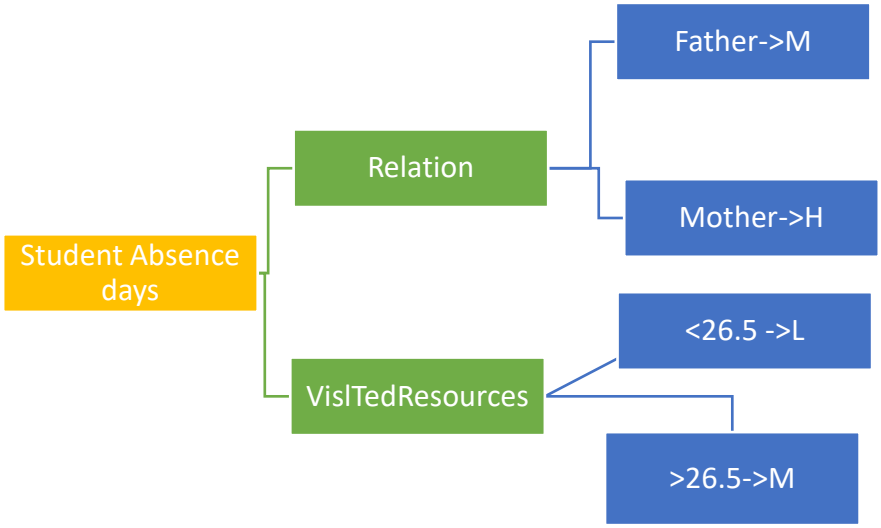


We can see that the learning test keep the same value of error rate which is 0.46 with large number of minimum size of split.

we are looking for the maximum value of the «minimum size for split »with minimum error rate which led us to choose the value 180.

Decision tree

- StudentAbsenceDays in [Under-7]
  - Relation in [Father] then Class = M (64.14 % of 145 examples)
  - Relation in [Mum] then Class = H (67.36 % of 144 examples)
- StudentAbsenceDays in [Above-7]
  - VisITedResources < 26.5000 then Class = L (89.32 % of 103 examples)
  - VisITedResources >= 26.5000 then Class = M (68.18 % of 88 examples)



Conclusion: Comparison between K-NN and ID3:

The error rate of K-NN algorithm is 0.25 in the testing database, while in ID3 we find 0.46, which mean that ID3 generate better result than K-NN.
The error rate of K-NN in learning test is the same for the ID3 all over the curve.
The both algorithm typically gives very satisfying results.