A Decision Support System Approach for Accreditation & Quality Assurance Council at Higher Education Institutions in Yemen

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***Abstract*—**Classification is used for discovery of a predictive learning function that classifies data item into one of several predefined classes. e.g., classify universities based on students number or based on offered programs, or classify cars based on gas mileage, and Presentation it by decision-tree, classification rule, neural network, and genetic algorithms, etc.
It is noted that, there are large amount of data obtained from the universities. We need to evaluate the accurate assessment of the performance of any institution. Currently the decision in ministry of higher education and scientific research is taken randomly, not based on logical analysis. Moreover, the education towards to universal, the ministry of higher education in Yemen has to activate the council of accreditation, and support it to start quickly and effectively.
In this paper, we have used approach to assist the council for accreditation to start automation for accreditation operations and mechanisms, that's proposed by using machine learning techniques, also to help decision makers for taking accurate and swift decisions. Our study is used to classify institution that wants to take a license from council to three classes: grant license of accreditation, grand license provided to improvement has done, or not granting accreditation license.
We have used the intelligent algorithms for calculate probability of grand accreditation license based on degree of council standards, which we used to predict through a model building to classification by using Naïve Bayes algorithm. The proposed method is typically for evaluation the new institution by depends on evaluation of existing institutions.
We experiment the proposed framework by flexible parameters and attributes with private training dataset, that's carefully generated and tested using real life applications. In addition, we implemented our proposed approach as a program.

Keywords*—Data mining, Classification, Naïve Bayes, Evaluation, Institution, Bayesian, Council, Ministry, license, Accreditation, Quality Assurance.*

I. INTRODOCTION

The developed world has perceptive to use technology and services to solve most of administrative and technical problems so thinking of solution starting on a logical basis and this is the basis which the computer science and its applications built on so development of this science that reached the highest level that make the machine respond and feel by using artificial intelligence techniques, while the information has become inadequate for decision-making but become inputs to the knowledge that have been excavated carefully, so we had the need to direct scientific research to serve the causes and solve our problems at all levels and never make it a mere compilation of data and narrative literature to obtain master degree or Ph.D. or requirement for the academic promotion. Because of my work in the Ministry of Higher Education and in the section most relevant to institutions of higher education I noted the large number of data sent from the universities, which cannot be the information

We need to evaluated accurate assessment of the performance of any institution as a whole, so how can we evaluate the particular Academic program. Thus, the Ministry of Higher Education and Scientific Research (MoHESR) makes a strategy for developing higher education during 2006-2011 to review laws and regulations in Yemen and it emphasize the need to adopt a system of quality assurance and accreditation in the various institutions of higher education and university, also, issued a republican Act No.(210) for the year 2009 for establishment of the Accreditation and Quality Assurance Council (AQAC) in higher education. And recently issued Education Law No.(13) in the year 2010 which included in the fourth chapter that contain supervisory and regulatory affairs, third: the AQAC of higher education where it determine the Council's powers and functions of the President of the Council, to complete the legislation and legal frameworks for higher education to be a reference stimulus and the determinants of the development and improvement and the transition the function of higher education and its institutions from routine work to the technical work and meet the requirements of development the local and international market accordance to short-and long-term Strategies [8].
The Yemeni universities are need quality assurance of education and achieved accreditation standards to capable for universal competition.

II. PROBLEM STATMENT

The accreditation is a new culture in Yemen and even on the level of organizational and management is new.
We propose an approach named YAC-Dss that help decision makers in Yemini Accreditation Council to achieve the above problem. Our approach uses intelligent techniques to decide either to give a license to an institution or not.

III. RELEATED WORK

There are many studies which used the intelligent method in higher education management and discuss the Accreditation mechanisms have been proposed in the literature. We briefly review some of them below:

In [1], Authors have been proposed an approach for assist the higher education ministry in decision making to grant licenses. The proposed approach have been used some criteria that approved by the ministry to evaluate the performance of existing institutions based on the available data of universities. The author used the science of artificial intelligence for knowledge discovery by using C4.5 algorithm to build a decision tree from which get knowledge rules that used to predict the performance of other universities not known their performance yet. This approach predicts of a new educational institution is grant the initial license

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or no. but our approach classify the institution to grant accredit license by accreditation standards after takes the initial license.

In [2], Authors propose an approach for analyzed data which belongs to educational, administrative and students' activities services at University of Science and Technology. The study used critical for a mining approach to discover the knowledge According to the results of analyzing process, the evaluation of services quality to reach to an optimal decision which will lead to improve performance of the university at all through selecting the best teaching staff and improve the level others services. The author aims to discover the knowledge from the websites information to taking a decision.

In [6], presents an algorithm based on attribute information gain which can combine the subjective evaluation method and objective evaluation method together to discover interesting classification rules. The algorithm allows the users themselves to set the weight of each attribute's information gain, and the weights can reflect they preference, with different weights the algorithm can discover different interesting classification rules.

The disadvantage is that the accuracy of the interesting rules is not near to 1, and it costs too much time because the authors have to run the algorithm for each class especially for the large database.

In [5, 6, 7, 8], Generally, all studies build a model of training set that is selected to contain examples of the important (i.e. novel) class. Subsequently, the mechanisms detect the deviation from this model by some way.

In [9], Authors propose an approach the history of accreditation in Philippines, quality assurance system, quality assurance agencies, which some of agencies are independent and another has a relation with government, like the commission on higher education, and national network for quality assurance agencies, Authors propose an approach the levels of accreditation, in generally the study is very good to take the backgrounds about our subject.

In [10], Authors propose an approach the model of the Science and Technology University (STU) for quality assurance and method that used to performance measurement by uses the international standards, finally the authors discussed the many of recommendations and Conclusions for STU experimentation.

Our proposed approach use the intelligent method for validate institutions to help decision maker to decide either to give accreditation license or not, and obtain basic requirements at our approach attendant Manners during classify process based on novelty measure to get good performance class prediction.

IV. DATA MINING and CLASSIFICATION

Data mining involves the use of sophisticated data analysis tools to discover previously unknown, valid patterns and relationships in large data sets. These tools can include statistical models, mathematical algorithms, and machine learning methods (algorithms that improve their performance automatically through experience, such as neural networks or decision trees). Consequently, data mining consists of more than collecting and managing data, it also includes analysis and prediction.

V. The YAC-Dss APPROACH

We would like to create decision supports system approach to products clear result dependent it to issue decision.

The proposed approach, named YAC-Dss, where Y indicate Yemeni, A indicate to Accreditation, C indicate to Council, and Dss also indicate for Decision support system. The main purpose of this approach is the Classification for institutions according to the national Standards adopted in the accreditation and quality assurance council (AQAC) at higher education in Yemen.

In our approach we generated a private training dataset dependency for data of some public and private institutions.

Also we estimated training data that require for YAC-Dss Algorithm to use by naïve Bayesian classifier for get classification model. Input value in training dataset for all attributes, however, the values for institutions standards input manually.

A. The YAC-Dss Framework

The general scheme of proposed approach is illustrated in figure (1)

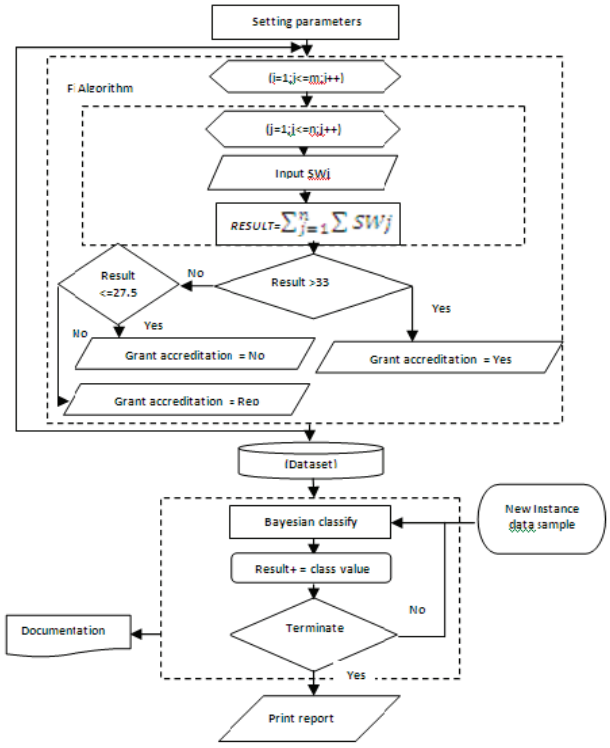

Fig. 1 The YAC-Dss Framework.

B. The YAC-Dss Techniques

The approach YAC-Dss is based on some techniques to obtain basic requirements at our approach attendant, moreover, get optimal steps to get good performance class prediction. In this section we explain the YAC-Dss techniques used to complete classified data sample depends at dataset that's generate in following:

1) The Training Dataset

The dataset used by our approach to training, contains the following:

1. Attributes that indicator to standards is illustrated in table (1)
2. Tuples that indicator to institutions that use model to training.
3. Standards Weights value (SWj) that's estimate and input manually, Is illustrated in table (2).We will take into consideration the availability of values in each attribute for every class value in order to we have not zero values those may due to bias results.

4. Attribute of class value that produce by compute sum weighs for tuple to get result, that's get knowledge by three class value (Yes ,Rep or No).
5. Classify the class attribute "Grand_accredatation" depend for total Standards weight in tuple (SWj) as Fi equation(1):

$$Fi = \begin{Bmatrix} NO,\ IF\ \sum SWj \le \frac{(MR*50)}{100},\ \text{in our study}\ \sum SWj \le 27.5 \\ REP,\ IF\ \sum SWj > \frac{(MR*50)}{100} AND \le \frac{(MR*60)}{100},\ \sum SWj > 27.5\ \&\ \le 33 \\ YES,\ IF\ \sum SWj > \frac{(MR*60)}{100},\ \sum SWj > 33 \end{Bmatrix} (1)$$

Where:
- Fi = equation to validate result.
- SW_j = the total standards weight of tuple .
- N = Number of attributes that will be use it for classify.
- M = Number of tuples that will be use it for classify.
- M_R = maximum result of threshold value.

6. Then we organize that data to be come to usage as a dataset to training and testing the Naïve Bayes Classifier, is illustrated in table (3).

- The number of attributes that's use to train are eleven. That's represent a standards.

Table I: Standards Symbols.

Standards Name	Vision and Mission	Teaching Staff	Infrastructure and Facilities	Library	Research	Community Service	Students	Governance and Management &learning / Academic Program	Financial Resources	Quality Assurance
Standards Symbols	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	SW 9	SW 10	SW 11

2) The Instrument of Standards Weights

We must write the rating for each Standard in the dataset table. Below is the rating scale which should be used:

1- Poor : the provision or condition is limited and functioning poorly.
2- Fair : the provision or condition is limited and functioning minimally.
3- Good : the provision or condition is met and functioning adequately.
4- Very good: the provision or condition is moderately extensive and functioning well.
5- Excellent : the provision or condition is very extensive and functioning perfectly.

Table II: Standards Weight Symbols.

Standards Weight	excellent	very good	Good	fair	poor
Standards Weight symbols	5	4	3	2	1

Table III: Training dataset for a classification using Naïve Bayesian Classifier.

N	Institution Name	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	SW 9	SW 10	SW 11	Result	Grant_ accreditation
1	Sana'a	5	5	5	4	5	3	4	2	4	4	3	44	Yes
2	Al-Bydaa	2	5	2	1	3	4	1	1	1	1	5	26	No
3	Hodeidah	1	3	2	2	4	4	1	3	2	3	4	29	Rep
4	Aden	5	4	4	5	3	3	3	3	3	5	4	42	Yes
5	Hajjah	1	1	1	2	2	2	4	3	3	5	3	27	No
6	Ibb	4	4	3	1	1	5	3	4	1	1	5	32	Rep
7	Taiz	4	5	3	3	3	4	5	5	5	2	2	41	Yes
8	Amran	3	3	4	4	5	1	2	2	1	1	1	27	No
9	Thamar	4	5	4	3	2	2	4	1	2	4	1	32	Rep
10	Hadramout	3	2	4	4	4	3	3	4	4	4	1	36	Yes
11	Al-Yemenia	3	2	5	2	1	1	3	4	1	4	1	27	No
12	Queen Arwa	5	2	2	4	5	1	5	1	3	2	2	32	Rep
13	STU	5	3	4	2	3	3	2	3	2	4	3	34	Yes
14	Al-Andalus	4	3	2	2	2	2	3	2	2	3	2	27	No
15	Sheba	2	1	1	5	1	3	2	2	4	5	3	29	Rep
16	Al-Watanyah	2	4	4	3	5	2	5	1	4	1	3	34	Yes
17	Yemen	5	2	1	3	4	2	1	3	1	2	1	25	No
18	Modern	4	4	3	5	1	3	1	3	1	1	1	27	No
19	Dar Alsalam	1	1	2	4	1	5	1	5	5	5	4	34	Yes
20	Arab Academic	5	5	1	1	2	1	5	5	1	3	5	34	Yes
21	Future	2	1	1	1	1	5	5	5	1	1	4	27	No
22	ALSaeed	3	1	5	2	3	1	3	5	5	3	1	32	Rep

3) Evaluation Algorithm for Dataset Creation

This algorithm shows Dataset generation which takes SWj of input and number of attributes then repeatedly compute result attribute from the range 1 to number of tuples as shows bellow:

```
Begin
Input (Number of attribute)
Input (Number of tuples)
n= number of attributes
m= number of tuples
      For (i =1; i<=m; i ++)
      For (j =1; j <=n; j ++)
            Input (Sw j)
       Compute Fi
            If Terminate then
          Print grant_ accreditation
            End
```

Fig.2 shows the flowchart of algorithm.

C. Bayesian Approach to Determine Classes

In this process we computation the percentage of each class in the dataset using the Bayesian theorem,[14]:

There are many steps and rules to implement Bayesian classify approach:

A. Calculate the probability of class attribute in the dataset that does can estimated from training data.

In this process we compute the percentage of each class in the dataset using the equation (2):

$$P(Ci) = p(c) / p(x) \quad (2)$$

Where,

- P(X) = the number of tuple in D.
  - D = is a Record set of tuple and their associated class labels.
- P (c) = the number of tuple of class Ci in D.

Figure (2) demonstrates how the proposed approach Computation prior probability of classes in the dataset, and the following steps will be played:

1. Set i = 0
2. Import all class values (labels) from Dataset to classes array $C_V[i]$, (with out duplicate of class labels).
3. Take the class label from classes array.
4. Set counter = 0 , j = 0.
5. Start at tuple = j in D, and value check in the class label attribute.
6. IF C [j] = $C_V[i]$, set counter = counter + 1.
7. IF j ≤ P(X), set j = j+1, then Go to Step 5, else set P(Ci) = counter, then compute P(X|Ci).
8. IF i ≤ $C_V[i]$.count, set i= i+1, then Go to step 3.

B. Calculate the probabilities of attributes that represent the standards as:

$$P(Xj|Ci) = \prod_{k=1}^{n} p(Swj \mid Ci)$$

Where: **k** = Number of classes in the dataset.

n = Number of attributes that will be use it for mining.

C. Calculate the average probabilities as:

Cn = [P (SW1 | Ci) * P (SW2 | Ci) * … P (SWk | Ci)] *P (Ci) (4)

D. Compare between probability result and show the max result as:

$$C = avrgmax_{ci \in C}\, P(c_i)\pi P(x_j|c_i) \quad (5)$$

D. Experimental Study

The proposed approach is used private dataset for training and tested by amount of data sample, implemented using oracle 10g database, forms developer 6i and Excel sheet.

1) Computational Results and Discussion

Compute measurements of Probability:

We Can Produce Percent for grand_ accreditation decision at:

Probability (yes)=p(C|yes)/p(C|yes)+ p(C|no)+ p(C|rep)

This simple and intuitive method is based on Bayes(6) of conditional probability, and represents results in chart diagram to show result by percentage.

2) Example to classify a new institution

Table IV: data sample table.

Institution Name	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	SW 9	SW 10	SW 11	Grant_ accreditation
Al-Ahkaf	4	3	2	2	1	2	5	4	3	4	2	?

- Probability Of Grand_accreditation:

P(Grand _ accreditation ="Yes")= 0.36

P(Grand _ accreditation ="No") = 0.36

P(Grand _ accreditation ="Rep") = 0.27

Table V: Probability of Standards.

SW 1 Yes	SW 1 No	SW 1 Rep	SW 2 Yes	SW 2 No	SW 2 Rep
0.125	0.25	0.333	0.125	0. 25	0.167
SW 3 Yes	SW 3 No	SW 3 Rep	SW 4 Yes	SW 4 No	SW 4 Rep
0.125	0.25	0.333	0.125	0.375	0.333
SW 5 Yes	SW 5 No	SW 5 Rep	SW 6 Yes	SW 6 No	SW 6 Rep
0.125	0.375	0.333	0.125	0.375	0.167
SW 7 Yes	SW 7 No	SW 7 Rep	SW 8 Yes	SW 8 No	SW 8 Rep
0.375	0.125	0.167	0.125	0.125	0.167
SW 9 Yes	SW 9 No	SW 9 Rep	SW10 Yes	SW10 No	SW10 Rep
0.125	0.125	0.167	0.375	0.125	0.167
SW11 Yes		SW11 No		SW11 Rep	
0.125		0.125		0.167	

- **Calculate the probabilities of attributes:**

P(Xj| Yes) = 0.000000001

P(Xj| No) = 0.000000025

P(Xj| Rep) = 0.000000044

- **Calculate the average probabilities:**

P(Yes) P(Xj| Yes)= 0.0000000004

P(NO) P(Xj| NO) = 0.0000000091

P(Rep) P(Xj|Rep)= 0.0000000120

- **Compare between probability result and show the max results value:**

Since 0.0000000120 > 0.0000000091 > 0.0000000004,
So X belongs to "Grant_accreditation =Rep"

- **The Measurements of Probability**

Probability of *No* =0.0000000091 /(0.0000000091 + 0.0000000120 +0.0000000004)= **42.3%**

Probability of Rep =0.0000000120 /(0.0000000091 + 0.0000000120 +0.0000000004)= **55.8%**

Probability of *yes*=0.0000000004/(0.0000000091 + 0.0000000120 +0.0000000004)= **1.9%**

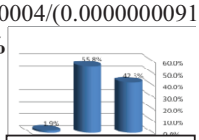

Fig.3 Probability of Grand-accreditation

- The (AQAC) Decision

Grand accreditation to al-Ahkaf College provided to improvement has done,

C. Validation of Our Classified Approach

Through Second method for Bayes naive classifier

- Equation and parameters

$$C = avrgmax_{ci \in C}\, P(c_i)\pi P(x_j|c_i)$$

P(xj|ci)= (m*p+ n_c) /m+n
P(Ci) = p(c) / p(x)

- Extract Variables

Table VI: Variables table

Variable	Yes:	No:	Rep:
N	8	8	6
M	11	11	11
P	1/3=0.33	0.33	0.33

- Compute n_c requirement

Table VII: n_c requirement table.

Sw1="4"			
n_c	Yes:	No:	Rep:
	1	2	2
Sw2="3"			
n_c	Yes:	No:	Rep:
	1	2	1
Sw3="2"			
n_c	Yes:	No:	Rep:
	1	2	2
Sw4="2"			
n_c	Yes:	No:	Rep:
	1	3	2
Sw5="1"			
n_c	Yes:	No:	Rep:
	1	3	2
Sw6=2"			
n_c	Yes:	No:	Rep:
	1	3	1
Sw7="5"			
n_c	Yes:	No:	Rep:
	3	1	1
Sw8="4"			
n_c	Yes:	No:	Rep:
	1	1	1
Sw9="3"			
n_c	Yes:	No:	Rep:
	1	1	1
Sw10="4"			
n_c	Yes:	No:	Rep:
	3	1	1
Sw11="2"			
n_c	Yes:	No:	Rep:
	1	1	1

Now apply: P(xj|ci) = (m*p+ n_c) /(m+n), and P(ci) *P(xj|ci) for any class:

- Probability of Grand_accreditation = Yes

Table VIII: Probability of first attribute "Yes" at class attribute

P(Yes) *P(xj| Yes)		
P(xj|ci) =	(m*p+ n_c) /(m+n)=	
P(sw 1|Yes) =	(11*.33+1) /(11+8)	0.25
P(sw 2|Yes) =	(11*.33+1)/(11+8)	0.25
P(sw 3|Yes) =	(11*.33+1)/(11+8)	0.25
P(sw 4|Yes) =	(11*.33+1)/(11+8)	0.25
P(sw 5|Yes) =	(11*.33+1)/(11+8)	0.25
P(sw 6|Yes) =	(11*.33+1)/(11+8)	0.25
P(sw 7|Yes) =	(11*.33+3)/(11+8)	0.35
P(sw 8|Yes) =	(11*.33+1)/(11+8)	0.25
P(sw 9|Yes) =	(11*.33+1)/(11+8)	0.25
P(sw10|Yes)=	(11*.33+3)/(11+8)	0.35
P(sw11|Yes)=	(11*.33+1)/(11+8)	0.25
P(Yes) * P(sw1 | Yes) * P(sw2 | Yes) * ……..*P(swn|Yes)		
0.000000146		

- Probability of Grand_accreditation = No

Table IX: Probability of second attribute "No" at class attribute

P(No) *P(xj| No)		
P(xj|ci) =	**(m*p+ n_c) /(m+n)=**	
P(sw 1|No)=	(11*.33+2) /(19)	0.30
P(sw 2|No)=	(11*.33+2) /(19)	0.30
P(sw 3|No)=	(11*.33+2) /(19)	0.30
P(sw 4|No)=	(11*.33+3) /(19)	0.35
P(sw 5|No)=	(11*.33+3) /(19)	0.35
P(sw 6|No)=	(11*.33+3) /(19)	0.35
P(sw 7|No)=	(11*.33+1) /(19)	0.24
P(sw 8|No)=	(11*.33+1) /(19)	0.24
P(sw 9|No)=	(11*.33+1) /(19)	0.24
P(sw 10|No)=	(11*.33+1) /(19)	0.24
P(sw11|No)=	(11*.33+1) /(19)	0.24
P(No) * P(sw1 |No) * P(sw2 | No) * ……..*P(swn|No)		
0.000000345		

- Probability of Grand_accreditation = Rep

Table X: Probability of third attribute "Rep" at class attribute

P(Rep) *P(xj| Rep)		
P(xj|ci) =	(m*p+ n_c) /(m+n)=	
P(sw 1|Rep) =	(11*.33+2) /(11+6)	0.33
P(sw 2|Rep) =	(11*.33+1) /(11+6)	0.27
P(sw 3|Rep) =	(11*.33+2) /(11+6)	0.33
P(sw 4|Rep) =	(11*.33+2) /(11+6)	0.33
P(sw 5|Rep) =	(11*.33+2) /(11+6)	0.33
P(sw 6|Rep) =	(11*.33+1) /(11+6)	0.27
P(sw 7|Rep) =	(11*.33+1) /(11+6)	0.27
P(sw 8|Rep) =	(11*.33+1) /(11+6)	0.27
P(sw 9|Rep) =	(11*.33+1) /(11+6)	0.27
P(sw10|Rep)=	(11*.33+1) /(11+6)	0.27
P(sw11|Rep)=	(11*.33+1) /(11+6)	0.27
P(Rep) * P(sw1 |Rep) * P(sw2 | Rep) * ……..*P(swn|Rep)		
0.000000365		

Finaly compares between final results and takes the max value
Since 0.000000365>0.000000345> 0.000000146,
Result of validate method: X belongs to "Grant_accreditation = **Rep**"
The decision: grand accreditation to Al- Ahkaf College provided to improvement has done,
We conclude that approach is efficient and effective.

VI. CONCLUSIONS

In this work, we proposed machine learning approach for evaluation of quality assurance at some public and private universities in Yemen. We implemented the proposed approach

using entity modeling. The framework is experimented and evaluated using artificial dataset and results have been presented.

VII. FUTURE WORK

Future work should consist of more experiments with other dataset. We will use a dataset that is incremental as well as more elaborated experiments to optimize several parameters of the algorithm. In addition, we will implement and experiments the framework with new real data from report of accreditation and quality assurance council (AQAC).

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