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(54) Title: MULTI CLASS CLASSIFIER FROM SINGLE CLASS DATASET

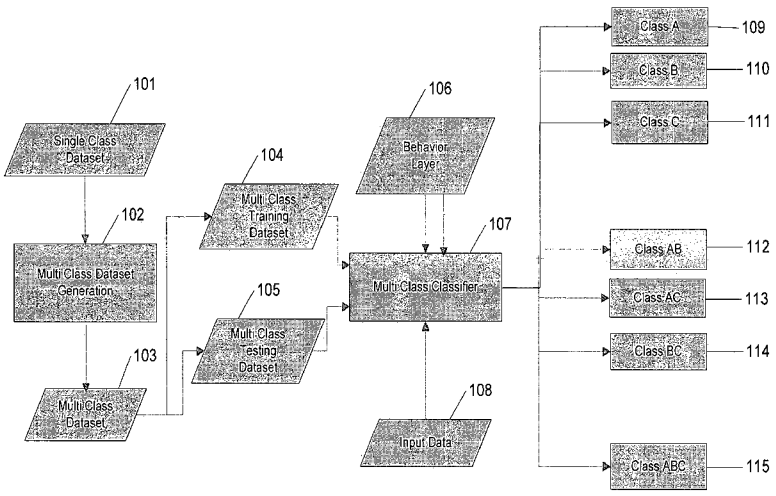

FIG. 1

(57) Abstract: The present invention addresses the methods and systems for multi class classifier which is capable to classify the given data item as member of one or multiple classes at same point of time. Invention also addresses various multi class classification methods and systems which include classification using single output unit and classification using multiple output units. To train and test such multi class classifiers, multi class dataset is required. Under the un-availability of such multi class dataset, the present invention is capable to generate multi class data item from single class data items. Further, present invention is also able to generate multi class data item from preexisting multi class data items, generated multi class data items or any combination of preexisting single class, preexisting multi class and generated multi class data items.

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Title of Invention

Multi Class Classifier From Single Class Dataset

Description

Definition of Terms Used

In this invention, the terms instance, record, object, data, data item, and input are intended to be synonymous.

In this invention, single class instance or data item or record or input or any object means that the instance or data item or record or input or any object is a member of any one of the multiple classes. Collection of such single class instance or data item or record or input or any object is referred as single class dataset. Further, in this invention, multi class instance or data item or record or input or any object means that the instance or data item or record or input or any object is a member of multiple classes. Collection of such multi class instance or data item or record or input or any object is referred as multi class dataset in this invention.

In this invention, single class classifier is defined as the classifier which classifies given input as a member of one the multiple classes. Similarly, multi class classifier is a classifier which classifies the given input as a member of one or multiple classes.

Field of the Invention

This invention relates to methods and systems of multi class classifier where the multi class classifier is trained and tested by generating multi class dataset from single class dataset and such trained multi class classifier automatically classifies instance or data

item or record or any object as member of one or multiple classes. In addition to the multi class classification, this invention can also be applied for multi class categorization of given instance or data item or record or any object.

Multi class classifier of this invention can be used for various purpose like : classification of network traffic as member of normal or one or multiple attack classes, for example classification of single instance of network traffic in to DOS and PROB attack classes; classification of a webpage as member of one or multiple classes, for example classification of a webpage as member of Education and Game classes; classification of a user or human or animal as member of one or multiple classes, for example classification of a user as member of Romantic and Emotional classes; classification of text as member of one or multiple classes, for example classification of a word as member of Indian Word and German Word classes; classification of a health record as member of one or multiple classes, for example classification of a health record as member of Diabetic and Asthma classes; classification of a email as member of one or multiple classes, for example classification of a email as member of Office and Education classes or in any method or system which requires the classification of a input as member of one or multiple classes where the multi class dataset for the training and testing purpose is not available.

Background of the Invention and Prior Art

Various single class classifiers had been already invented to classify the given object as member of single class from available multiple classes. Such classifiers are not capable to classify the given object as member of multiple classes. There are various applications where multi class classifier which classifies given object as member of multiple classes is required. To train and test such multi class classifier, collection of multi class record where each record is a member of multiple classes is required. If such collection of multi class record is not available then multi class classifier cannot be constructed.

This invention addresses the generation of multi class record from preexisting single class records. Presented invention also addresses the multi class classifier which classifies the input that may be in any form like instance or data item or record or object as member of one or multiple classes.

There are various inventions which claim multi class classification. For example, pattern No: CN 102722726 B with title multi-class support vector machine classification method based on dynamic binary tree and Paten No: US6816456 with title methods and apparatus for network use optimization which claims classification of the given input pattern as member of one of the available multiple classes. Above inventions are not be able to classify the given object as member of multiple classes and therefore they are not addressing multi class classifier in true sense.

For classification of given webpage content as member of multiple classes, patent No. US7974994 B2 with title sensitive webpage content detection disclosed a multi-class classifier. In the above invention, contents of web page are analyzed with the multi-class classifier and webpage is categorized as member of one or multiple sensitivity categories. In the above invention, for the given web page, words or phrases are extracted which are fed in to the classifier. As a result of such classification, for a given word, single class having highest probability value is selected. At outer level, webpage, having more than one word is classified in to multiple classes due to classification of each individual word in to one class. Hence, the classifier of above invention is not multi class classifier in true sense which is the major limitation of above invention.

Patent No: US20100014762 with title categorizer with user-controllable calibration classifies the given object as member of two or more classes. However, above invention uses user calibration for such classification. Classifying large amount of data like network traffic using user calibration is not sensible.

Patent NO: US006823323B2 with title Automatic classification method and apparatus which is very close to this invention classifies the record as member of one or multiple classes using ballpark classier. To train the classifier, above invention

uses records which itself belongs to multiple classes. If such multi class records are not available then above invention is of no use. Further, to properly train such classifier, sufficient number of records must be fed. Sufficient number of records depends upon the classifier, number of inputs and their type. Having sufficient multi class records or even having multi class record is very difficult.

As mention above, there aren't any inventions which use single class records and generate multi class records which in turn used to train and test the multi class classifier which classifies the given record as member of multiple classes. In this invention, methods and systems are discussed which unravel the above lacuna.

Brief Description of the Drawings

This invention is illustrated in the accompanying drawings, throughout which reference letters indicate corresponding parts in the respective figure.

FIG. 1 is a flow diagram showing the general flow of multi class classifier that uses single class dataset and generates multi class dataset which is used to train and test the multi class classifier;

FIG. 2(A) is a flow diagram illustrating an exemplary method or system for multi class dataset generation through single class dataset;

FIG. 2(B) is a flow diagram illustrating generation of multi class training and testing dataset from multi class dataset.

FIG. 3(A) is a flow diagram illustrating an exemplary method or system for working of ordinary classifier having single output unit which classifies given input in to single class from available multiple classes;

FIG. 3(B) is a diagram illustrating an exemplary method or system for mapping of single output value of ordinary classifier in to single class from available multiple classes;

FIG. 4(A) is a flow diagram illustrating an exemplary method for working of multi class classifier with single output unit;

FIG. 4(B) is a diagram illustrating an exemplary method or system for mapping of single output value of multi class classifier as member of one or multiple classes;

FIG. 5 is a flow diagram illustrating an exemplary method or system for working of ordinary classifier with multiple output units which classifies the given input in to a particular class by selecting or activating corresponding output unit;

FIG. 6 is a flow diagram illustrating an exemplary method or system for working of multi class classifier with multiple output units which classifies the given input as member of one or multiple classes.

FIG. 7 is a flow diagram illustrating an exemplary method or system for working of ordinary classifier with multiple output units which classifies the given input in to a particular class by using binary pattern generated by output units.

FIG. 8 is a flow diagram illustrating an exemplary method or system for working of multi class classifier with multiple output units which classifies the given input as member of one or multiple classes by using binary pattern generated by output units.

Description of Preferred Embodiments

In the following description, reference numbers are used to illustrate major features of exemplary embodiments in a diagrammatic manner. The drawings are not drawn to scale. Moreover, drawings are not intended to depict every feature of actual embodiments nor relative dimensions of the depicted elements.

Referring to the drawings, FIG. 1 is a flow diagram showing the general flow of multi class classifier which has been trained by single class dataset (101). This single class dataset (101) may be in any format which stores data or records or objects. Examples of such formats are text format, CSV format, database format, or folder format which contains objects and their class label. After preprocessing or directly, this single class dataset (101) is used by multi class dataset generation (102) module to generate multi class dataset (103). Detailed process of generation of multi class dataset from single class dataset is shown in FIG. 2(A), while generation of training dataset (104) and testing dataset (105) from generated multi class dataset (103) is shown in FIG. 2(B).

Sample copy of single class dataset (101) and generated multi class dataset (103) are shown in Table 1 and Table 4 respectively at letter part of this document.

These multi class training dataset (104) and multi class testing dataset (105) which might be pre-proposed or directly used by multi class classifier (107) for respectively training and testing of behavior layer (106). After testing complete, finalized behavior layer (106) is used by the multi class classifier (107) for the real-time or offline classification of input data (108) as member of one or multiple classes. For the simplicity, in FIG. 1, multi class classifier with three classes, Class A (109), Class B (110), and Class C (111) has been shown. Classifier shown in FIG. 1 is able to classify the given single instance or data item or record or object in to the Class A (109) only; Class B (110) only; Class C (111) only; Class A and Class B, that is Class AB (112); Class A and Class C, that is Class AC (113); Class B and Class C, that is Class BC (114); Class A, Class B and Class C, that is Class ABC (115). Here combination of two or more class is shown as Class {Label 1} {Label 2}....{Label N}. For example Class AB means combination of Class A as well as Class B.

For classification of input into one or more classes, multi class classifier (107) is design and trained in such a way that it gives output or outputs which can be mapped to one or more classes. Detailed methods or systems for mapping of output or outputs as member of one or multiple classes are shown in FIG. 4, FIG. 6 and FIG. 8 and discussed in more details at letter part of this document. On the basis of the number of output units used, multi class classifier presented in FIG. 4, FIG. 6 and FIG. 8, are broadly categorized in classifier with single output unit and classifier with multiple output units. Multi class classifier shown in FIG. 4 uses single output unit whose output value is mapped to one or more classes, while classifier shown in FIG. 6 and FIG. 8 uses multiple output units.

FIG. 2(A) shows step by step process or method of generating multi class dataset (206) from the single class dataset (201). Sample copy of single class dataset and multi class dataset are shown in Table 1 and Table 4 respectively. For simplicity, in all the tables used in this document, normal values of Attribute -1, Attribute -2, Attribute-3 and Attribute-4 are taken as 0.1, 0.2, 0.3 and 0.4 respectively. As per the

FIG. 2(A), invention applies association technique (202) on single class dataset (201) and discovers feature to class association (203) and generates rules based on feature's value that decide the class labels (204). Any technique which generates such rules (204) by mapping the attribute and their values to a specific class can be used as association technique (202). Sample copy of rules (204) generated by applying such association technique (202) on single class dataset available in Table 1 is shown in Table 2.

Table 1: Sample Copy of Single Class Dataset
(Data row belongs to single class from multiple classes available)

Attribute-1	Attribute-2	Attribute-3	Attribute-4	Class Label
0.3	0.2	0.3	0.4	A
0.4	0.2	0.3	0.4	A
0.5	0.2	0.3	0.4	A
0.6	0.2	0.3	0.4	A
0.7	0.2	0.3	0.4	A
0.8	0.2	0.3	0.4	A
0.1	**0.5**	**0.4**	0.4	A
0.1	**0.5**	**0.5**	0.4	A
0.1	**0.5**	**0.6**	0.4	A
0.1	0.2	**0.7**	0.4	B
0.1	0.2	**0.8**	0.4	B
0.1	0.2	**0.9**	0.4	B
0.2	0.2	**0.2**	0.4	B
0.1	0.2	0.3	**0.9**	C
0.1	0.2	**0.1**	**0.1**	D

Table 2 : Sample Copy of Rules Generated From Single Class Dataset of Table-1 by Applying Association Technique

Class	Attributes	Attribute Value Relationship	Rules
A	1	Attribute-1→ 0.3 to 0.8	**Rule 1:** If (Attribute-1 →0.3 to 0.8) then Class A
	2,3	Attribute-2→0.5, Attribute-3 →0.4 to 0.6	**Rule 2:** If((Attribute-2 →0.5) AND (Attribute-3 → 0.4 to 0.6)) then Class A
B	3	Attribute-3 →0.7 to 0.9	**Rule 3:** If (Attribute-3 →0.7 to 0.9) then Class B
	1,3	Attribute-1→0.2,	**Rule 4:**

		Attribute-3 →0.2	If ((Attribute-1 →0.2) AND (Attribute-3 →0.2)) then Class B
C	4	Attribute-4 →0.9	**Rule 5:** If (Attribute-4 →0.9) then Class C
D	3,4	Attribute-3→0.1, Attribute-4 →0.1	**Rule 6:** If ((Attribute-3 →0.1) AND (Attribute-4 →0.1)) then Class D

As per the Table 2, the Rule 1: "If (Attribute-1 →0.3 to 0.8) then Class A" means that attribute 1 with value [0.3 to 0.8] leads to the classification of record in to the class A. Similarly, Rule -2 means that attribute-2 with value [0.5] and attribute-3 with value [0.4 to 0.6] collectively classify the given record in to the class A. Likewise, as per Rule 3, attribute-3 with value [0.7 to 0.9] classify the given record in to class B. Similarly, other rules are generated. Number of the rules generated in the Table 2 and their constrains mainly depends upon: number of records fed in association technique; number of attributes contained by the dataset; and verities of the records available in the dataset.

Table 3: Multi Class Dataset Generation Method or System (By Applying Rules of Table 2 on Table 1's Data Row)

Step No.	Attribute-1	Attribute-2	Attribute-3	Attribute-4	Class Label
1	Select any preexisting single class record. (From Table 1, following preexisting single class record for class A is selected.)				
	0.7	0.2	0.3	0.4	A
2	Select any other preexisting single class record which does not belongs to the class which is selected in step-1. (From Table 1, following preexisting single class record for class B is selected.)				
	0.1	0.2	**0.8**	0.4	B
3	Generate multi class records from above two selected records by applying the non conflicting rules related to the class selected in step-1 and step-2. (From Table 2, following Rule 1 and Rule 3 which are related to class A and class B and does not conflict with each other are selected and applied on records selected in step-1 and step-2. Rule 1: If (Attribute-1 →0.3 to 0.8)				

	then class A Rule 3: If (Attribute-3 →0.7 to 0.9) then class B Sample copies of the records generated by above steps are shown below.)				
	0.3	0.2	**0.7**	0.4	A,B or AB
	0.4	0.2	**0.7**	0.4	A,B or AB
	0.5	0.2	**0.7**	0.4	A,B or AB
	0.6	0.2	**0.7**	0.4	A,B or AB
	0.7	0.2	**0.7**	0.4	A,B or AB
	0.8	0.2	**0.7**	0.4	A,B or AB
	0.3	0.2	**0.8**	0.4	A,B or AB
	0.3	0.2	**0.9**	0.4	A,B or AB

For generation of multi class record, rules of Table 2, which clearly classify the given record in to a specific category, are selected. By applying one or more rules on the preexisting single class record, multi class record is generated. Self explanatory detailed process of generation of multi class record is shown in Table 3, while sample copy of multi class dataset generated from the Table 1's dataset is shown in Table 4.

Table 4 : Multi Class Dataset which is Generated from Single Class Dataset of Table 1 by Applying Rules of Table 2
(Data row belongs to two or more classes)

Attribute-1	Attribute-2	Attribute-3	Attribute-4	Class Label
0.7	0.2	**0.8**	0.4	A,B or AB
0.2	0.2	**0.2**	**0.9**	B,C or BC
0.7	0.2	**0.8**	**0.9**	A,B,C or ABC

If separate single class training and single class testing dataset are available, in that case in FIG. 2(A), instead of single class dataset(201), such separate training or testing dataset can be taken as input to the association technique(202) and instead of multi class dataset (206), multi class training or multi class testing dataset is generated respectively. Instead of such separate training and testing dataset if single class dataset is used in FIG. 2(A) as input to the association technique (202) then multi class dataset (206) is generated. This multi class dataset(206) must be divided in to multi class training dataset (207) and multi class testing dataset(208) which is shown in FIG. 2(B). In FIG. 2(B), from the given dataset, for generation of separate

training and testing dataset, any existing techniques which generates such training and testing dataset from the single class dataset can be used.

System or method presented in FIG. 2(A) and (B) can also be used to generate additional multi class records from already generated multi class records by replacing single class dataset (201) with generated multi class dataset. Further, for generation of additional multi class records, preexisting multi class dataset can also be used instead of single class dataset (201). In general, any combination of preexisting single class dataset, preexisting multi class dataset and generated multi class dataset can be used instead of single class dataset (201) in FIG. 2(A). Self explanatory detailed process of generation of multi class record from preexisting multi class dataset or generated multi class dataset is shown in Table 5. Similarly, Table 6 shows self explanatory detailed process for generation of multi class dataset from single class dataset and multi class dataset which may be preexisting or generated.

Table 5: Multi Class Dataset Generation from Preexisting Multi Class or Generated Multi Class Dataset

Step No.	Attribute-1	Attribute-2	Attribute-3	Attribute-4	Class Label
1	Select any multi class record which is preexisting or generated as per this invention. (Record for class LM is selected with following rule. If (Attribute-1 →0.7) then Class LM)				
	0.7	0.2	0.3	0.4	L, M or LM
2	Select any other preexisting or generated multi class record which does not belongs to the combination of the classes which is selected in step-1. (Record for class NO is selected with following rule. If (Attribute-3 →0.8) then Class NO)				
	0.1	0.2	**0.8**	0.4	N,O or NO
3	Generate multi class records from above two records by applying the non conflicting rules shown above.				
	0.7	0.2	**0.8**	0.4	L,M,N,O or LMNO

Hence, in FIG. 2(A), to generate additional multi class dataset, single class dataset (201) can be replaced by: preexisting multi class dataset; or generated multi class

dataset; or combination of preexisting single class and preexisting multi class dataset; or combination of preexisting single class and generated multi class dataset; or combination of preexisting multi class and generated multi class dataset; or combination of preexisting single class, preexisting multi class and generated multi class dataset.

Table 6: Multi Class Dataset Generation from Preexisting Single Class Dataset and from Preexisting or Generated Multi Class Dataset

Step No.	Attribute-1	Attribute-2	Attribute-3	Attribute-4	Class Label
1	Select any preexisting single class record. (Preexisting single class record for class L with following rule is selected. If (Attribute-1 →0.5) then Class L)				
	0.5	0.2	0.3	0.4	L
2	Select preexisting multi class record or generated multi class record. (Preexisting or generated multi class record for class NO is selected with following rule. If (Attribute-3 →0.8) then Class MN)				
	0.1	0.2	0.8	0.4	M,N or MN
3	Multi class record generated for class LMNO by applying the non conflicting rules shown above.				
	0.5	0.2	**0.8**	0.4	L,M,N or LMN

In general, classifier may use single output unit or multiple output units. Classifier with single output unit is shown in FIG. 3(A) and FIG. 4(A) while classifier with multiple output units is shown in FIG. 5, FIG. 6, FIG. 7 and FIG. 8. FIG. 3(A) shows basic working of the ordinary classifier having single output unit which classifies the given input data in to one of the available classes. As per the FIG. 3(A), classifier (304) uses single class training data (301) and single class testing data (302) and generates behavior layer (305) which is used for classification of input data (303). Classifier (304) classifies the input data (303) in to any one of the available multiple

classes. For example in the FIG. 3(A), classifier (304) classifies input in to any one of three classes namely Class A (306) or Class B (307) or Class C (308). Method for mapping of output value of classifier with single output unit (304) in to one of the available multiple classes is presented in FIG. 3(B). As per the FIG. 3(B), output range is divided in to sub range as per the available classes. For example, if number of the classes are three then sub ranges could be 0.0 (309) to 0.30 (311), 0.35 (312) to 0.65(314), 0.7(315) to 1.0(317). Gap between two classes, for example, gap between Class A (310) and Class B (313) which is 0.31 to 0.34, is used for overcoming the class overlapping. These ranges and gap are only for the illustration purpose and hence it can be varied as per the requirement. Collectively FIG. 3(A) and FIG. 3(B) classify the given input in to one of the available classes. For example, as per FIG. 3(A), for the given input data (303), if classifier (304) gives output as 0.2 then as per FIG. 3(B), 0.2 output value is mapped to Class A and hence, given input is classified as member of Class A.

FIG. 4(A) shows architecture of multi class classifier having single output unit which classifies the give record as member of one or multiple classes. As per the FIG. 4(A), the classifier uses the multi class training dataset (401) and multi class testing dataset (402) which can be generated as per FIG. 2(A) and FIG. 2(B). The classifier classifies the input data (403) as member of one or multiple classes. For example as shown in FIG. 4(A), classifier classifies input data either in to the Class A(406) or Class B(407) or Class C(408) or Class AB(409) or Class AC(410) or Class BC(411) or Class ABC(412). For mapping of the singe output value to the various classes, approach presented in FIG. 4(B) is used which is very similar to approach shown in FIG. 3(B). As per FIG. 4(B), output range is divided in to the 7 sub ranges having gap between each range. This ranges and gaps are only for the illustration purpose and hence can be varied as per the requirement. Collectively FIG. 4(A) and FIG. 4(B) classify the given input as member of one or multiple classes. For example, as per FIG. 4(A), for the given input data (403), if classifier (404) gives output as 0.89 then as per FIG. 4(B), 0.89 output value is mapped to Class ABC (432) and hence, given input is classified as member of Class ABC.

FIG. 5 shows working of the single class classifier with multiple output units. The classifier (504) uses training data (501) and testing data (502) and generates behavior layer (505). Using this behavior layer (505), the classifier (504) classifies the given input data (503) in to the one of the available multiple classes. For example in FIG. 5, classifier classifies the input in to either Class A (506) or Class B (507) or Class C (508). As per the example presented in the FIG. 5, classifier uses three output units for the classification. Particular class is selected if respective output unit is activated. Output value 100 indicates Class A (506), 010 indicates Class B (507) and 001 indicates Class C (508). Architecture presented in FIG. 5, can be extended in to multi class classifier by providing multi class training and testing data and by training the classifier by allowing to activate one or more output units. Such architecture is shown in FIG. 6.

FIG. 6 shows working of multi class classifier having multiple output units. As per the FIG. 6, classifier (604) uses multi class training data (601) and multi class testing data (602) which can be generated as per FIG. 2(A) and FIG. 2(B). Such multi class training data (601) and multi class testing data (602) is used to generate behavior layer (605). Such trained classifier (604) classifies the given input data (603) as member of one or multiple classes. Particular class or classes are selected as per the activation of respective output units. For example, in the FIG. 6, for the case of three classes, three output units are used for multi class classification. If output of the classifier (604) is 100 then Class A (606), if output is 010 then Class B (607), if output is 001 then Class C (608), if output is 110 then Class AB (609), if output is 101 then Class AC (610), if output is 011 then Class BC (611) and if output is 111 then Class ABC (612) is selected.

One more approach for classification of given input as member of multiple classes is shown in FIG. 7. FIG. 7 is an ordinary classifier which classifies the input data (703) in to one of the available multiple classes by activation of output unit in binary pattern. For example in FIG. 7, two output units are used for classification of input data (703) in to any one of three classes, i.e. Class A (706), Class B (707) and Class C (708). Binary pattern generated by the output units helps to classify the input data

(703) in to the three classes mentioned above. For example, as per FIG. 7, if output pattern generated is 01 then Class B (707) is selected. Architecture presented in FIG. 7, can also be extended in to multi class classifier which is shown in FIG. 8.

FIG. 8 shows working of multi class classifier that classifies given input as member of one or multiple classes using binary output pattern. As per the FIG. 8, classifier (804) uses multi class training dataset (801) and multi class testing dataset (802). These multi class training and testing dataset can be generated as per FIG. 2(A) and FIG. 2(B). Such multi class training data (801) and multi class testing data (802) are used to generate behavior layer (805). Such trained classifier (804) classifies the given input data (803) in to the multiple classes. Particular class or classes are selected as per the binary pattern generated by the output units. For example, in the FIG. 8, three output units are used for multi class classification. If output of the classifier (804) is 000 then Class A (806), if output is 001 then Class B (807), if output is 010 then Class C (808), if output is 011 then Class AB (809), if output is 100 then Class AC (810), if output is 101 then Class BC (811) and if output is 110 then Class ABC (812) is selected.

Claims

We Claim:

1. The multi class classification method or system for classification of instance or record or data item or object or any input as member of one or multiple classes.
2. From the preexisting single class instance or records or objects or data items, a method or system for generation of multi class instance or record or data item or object which belongs to two or more classes or multiple classes.
3. From the preexisting multi class instance or records or objects or data items, method and system for generation of multi class instance or record or data item or object which belongs to combination of two or more classes or multiple classes.
4. From the preexisting multi class and preexisting single class instances or records or objects or data items, method and system for generation of multi class instance or record or data item or object which belongs to combination of two or more classes or multiple classes.
5. From the generated multi class records, method or system for generation of additional multi class records.
6. From the combination of generated multi class records and preexisting single class records, method or system for generation of multi class records.
7. Form the combination of generated multi class records and preexisting multi class records, method or system for generation of multi class records.
8. From the combination of preexisting records which contains single class and multi class records; and generated multi class records, method or system for generation of multi class records.
9. Method or system for multi class classifier having single output unit which classifies instance or record or data item or object as member of one or multiple classes.
10. Multi class classifier having multiple output units which classifies instance or record or data item or object as member of one or multiple classes.

11. Method or system for multi class classifier having single output unit comprising: Selection of any one of the following single class or multi class records as input to the classifier:

pre-existing single class records or

pre-existing multi class record or

generated multi class record or

any combination of pre-existing single class record, pre-existing multi class and generated multi class record; and

generates multi class records or dataset; and

such generated multi class records or dataset is used to train the classifier having single output unit which classifies the given instance or record or data item or object as member of one or multiple classes.

12. Method or system for multi class classifier having multiple output units comprising: Selection of any one of the following single class or multi class records as input to the classifier:

pre-existing single class records or

pre-existing multi class record or

generated multi class record or

any combination of pre-existing single class record, pre-existing multi class and generated multi class record; and

generates multi class records or dataset; and

such generated multi class records or dataset is used to train the classifier having multiple output units which classifies the given instance or record or data item or object as member of one or multiple classes.

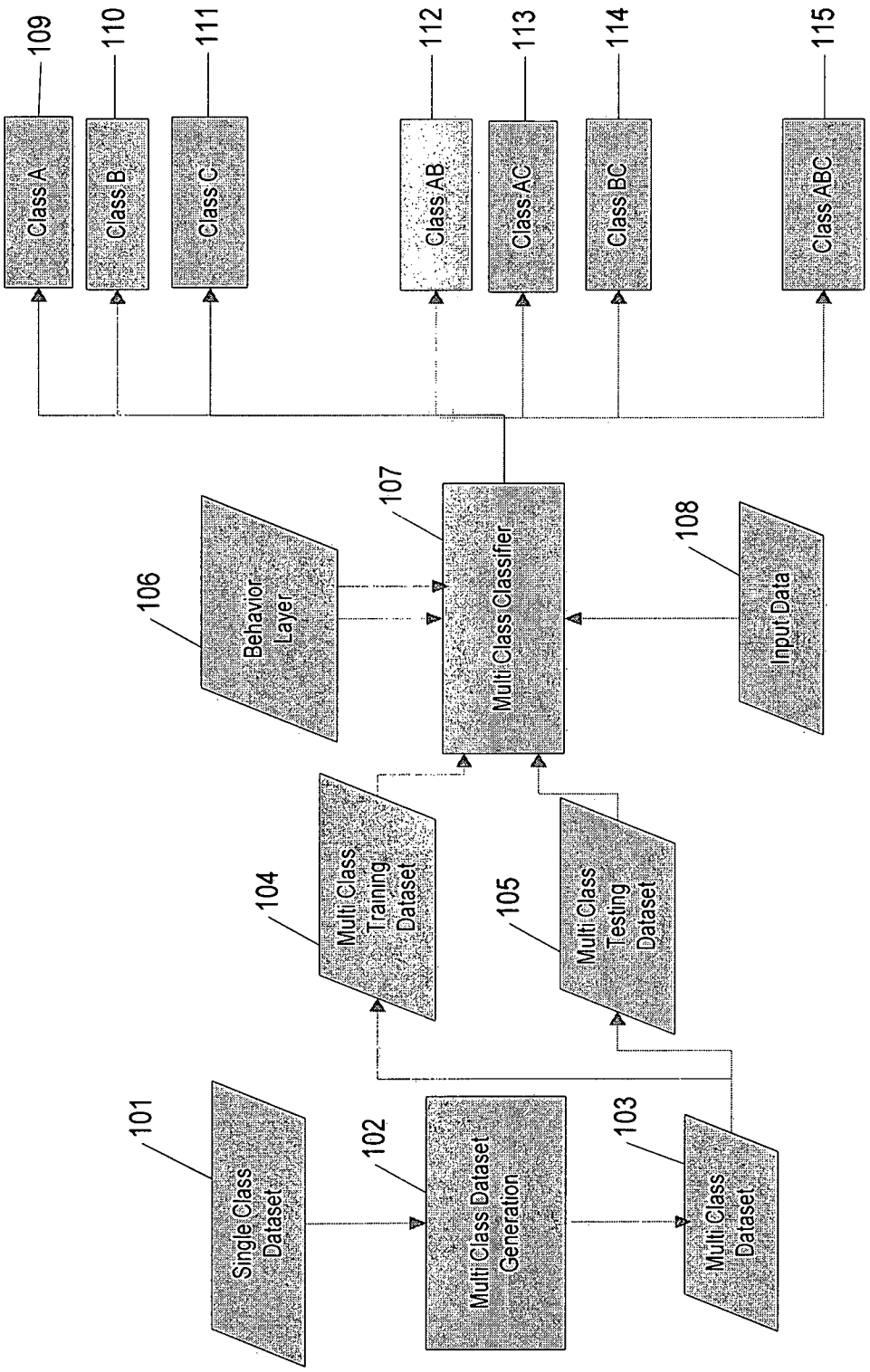
Single Class Dataset
101
Multi Class Dataset Generation
102
Multi Class Dataset
103
Multi Class Training Dataset
104
Multi Class Testing Dataset
105
Behavior Layer
106
Multi Class Classifier
107
Input Data
108
Class A
109
Class B
110
Class C
111
Class AB
112
Class AC
113
Class BC
114
Class ABC
115

FIG. 1

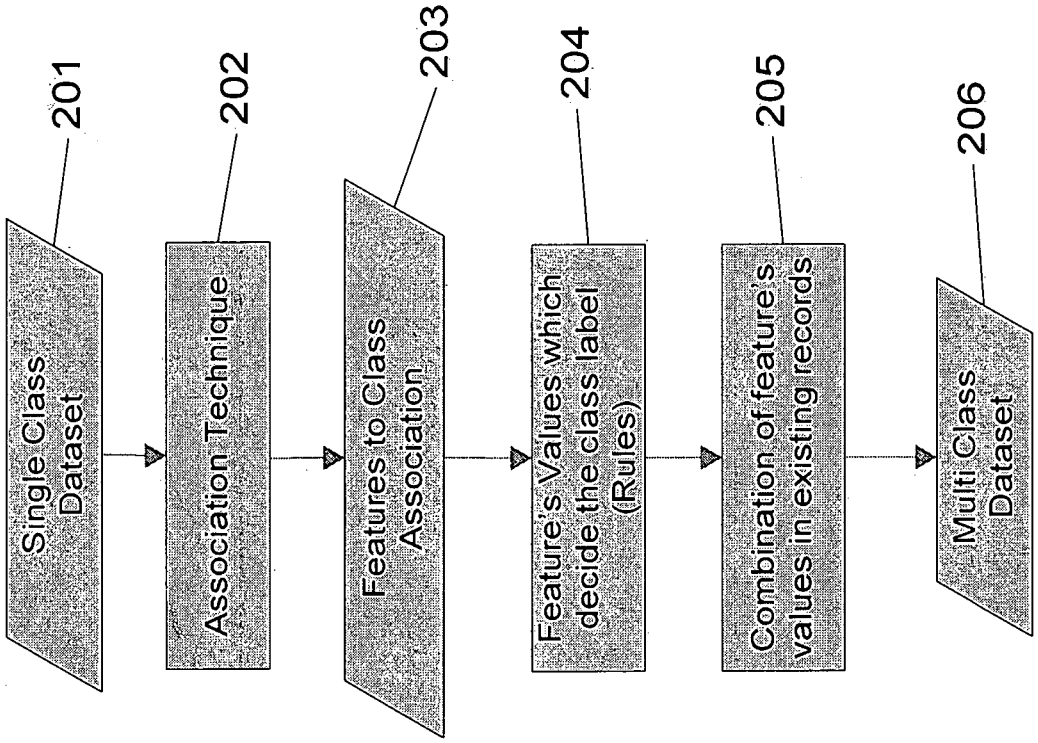
Single Class Dataset
201
Association Technique
202
Features to Class Association
203
Feature's Values which decide the class label (Rules)
204
Combination of feature's values in existing records
205
Multi Class Dataset
206

FIG. 2(A)

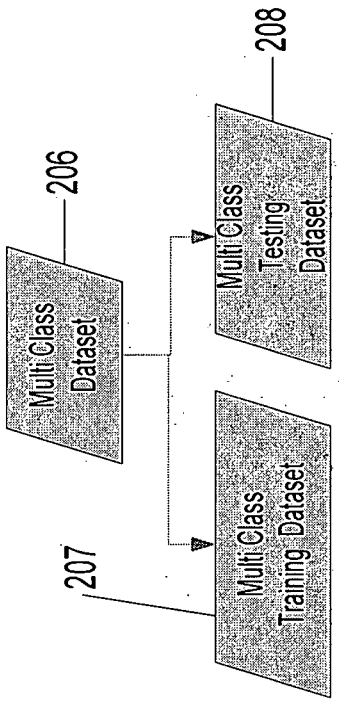
Multi Class Dataset
206
Multi Class Testing Dataset
208
Multi Class Training Dataset
207

FIG. 2(B)

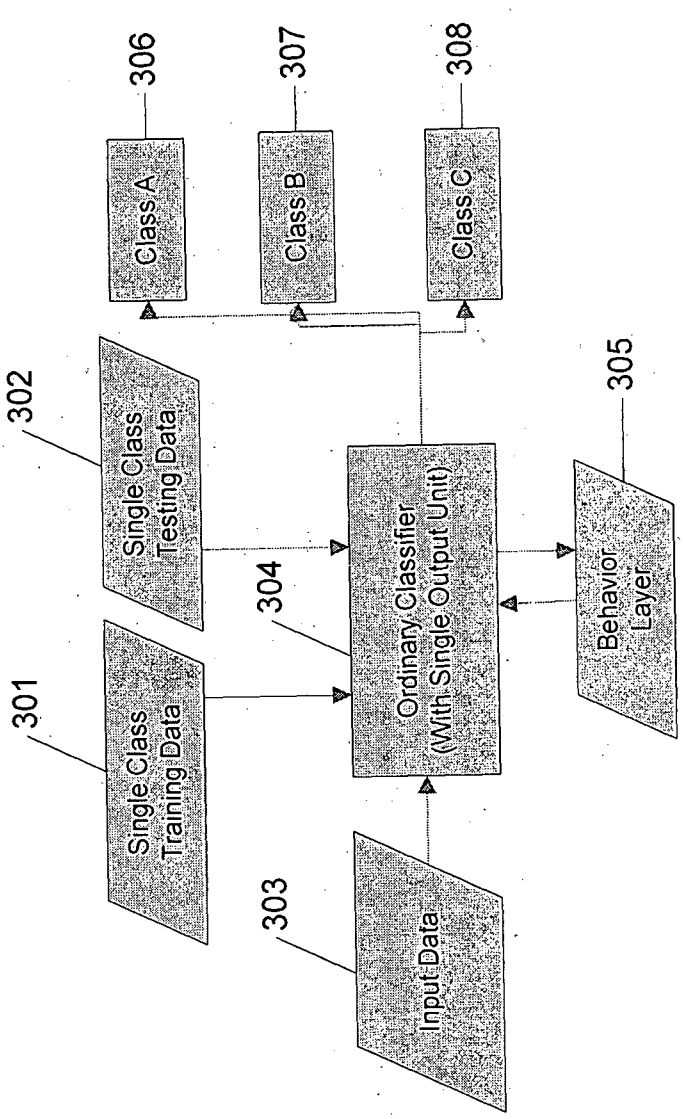
306
307
308
Class A
Class B
Class C
302
Single Class Testing Data
305
Behavior Layer
304
Ordinary Classifier (With Single Output Unit)
301
Single Class Training Data
303
Input Data

FIG. 3(A)

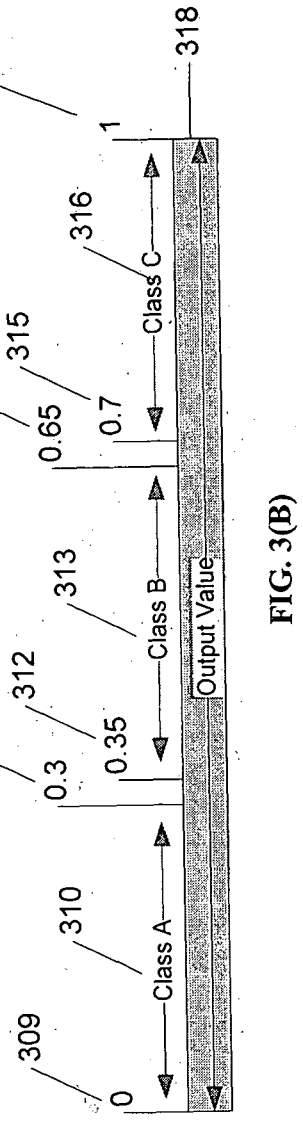
317
318
1
316
Class C
314
315
0.65
0.7
313
Class B
311
312
0.3
0.35
Output Value
310
Class A
309
0

FIG. 3(B)

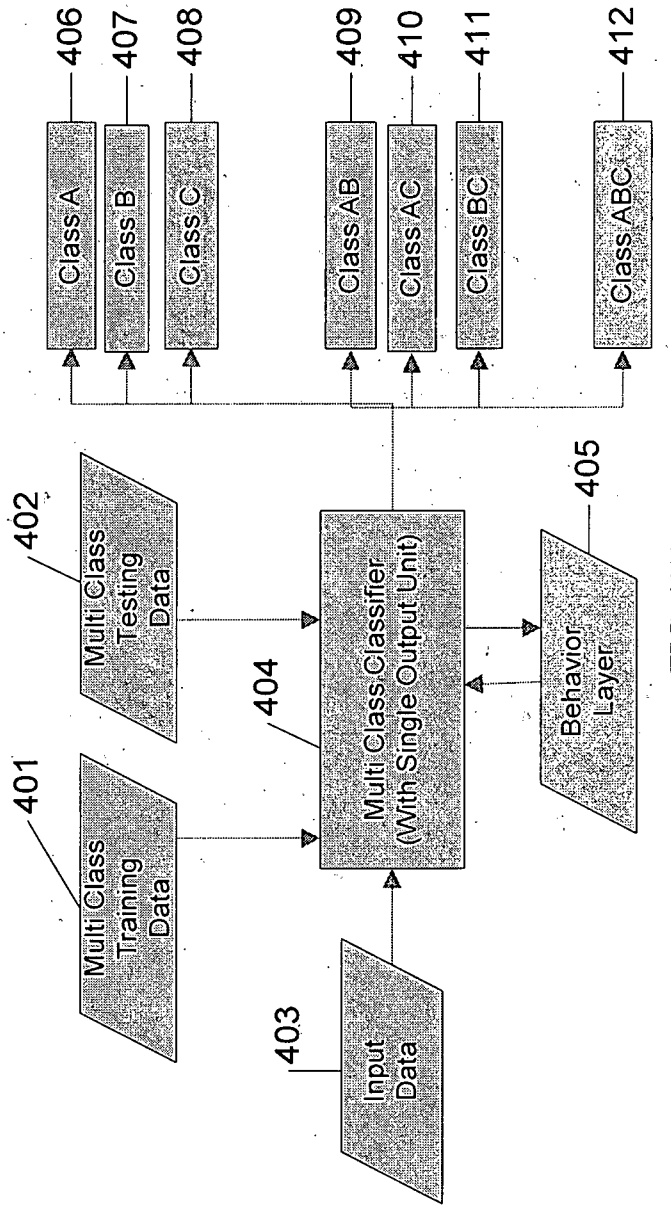
401
Multi Class Training Data
402
Multi Class Testing Data
403
Input Data
404
Multi Class Classifier (With Single Output Unit)
405
Behavior Layer
406
Class A
407
Class B
408
Class C
409
Class AB
410
Class AC
411
Class BC
412
Class ABC

FIG. 4(A)

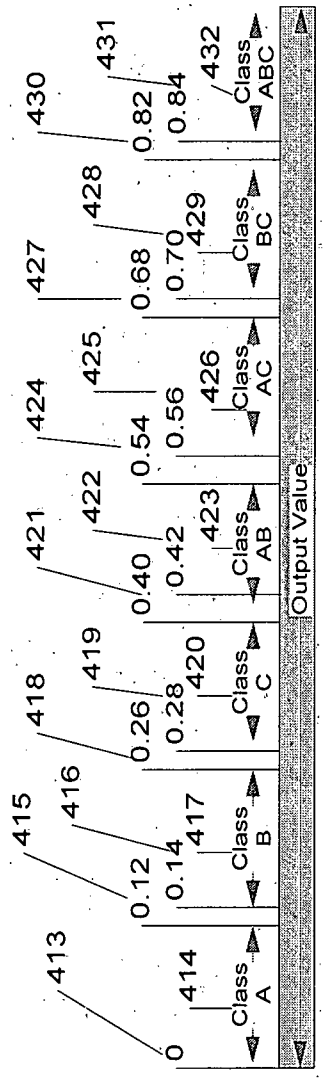
413
0
414
Class A
415
0.12
416
0.14
417
Class B
418
0.26
419
0.28
420
Class C
421
0.40
422
0.42
423
Class AB
424
0.54
425
0.56
426
Class AC
427
0.68
428
0.70
429
Class BC
430
0.82
431
0.84
432
Class ABC
Output Value

FIG. 4(B)

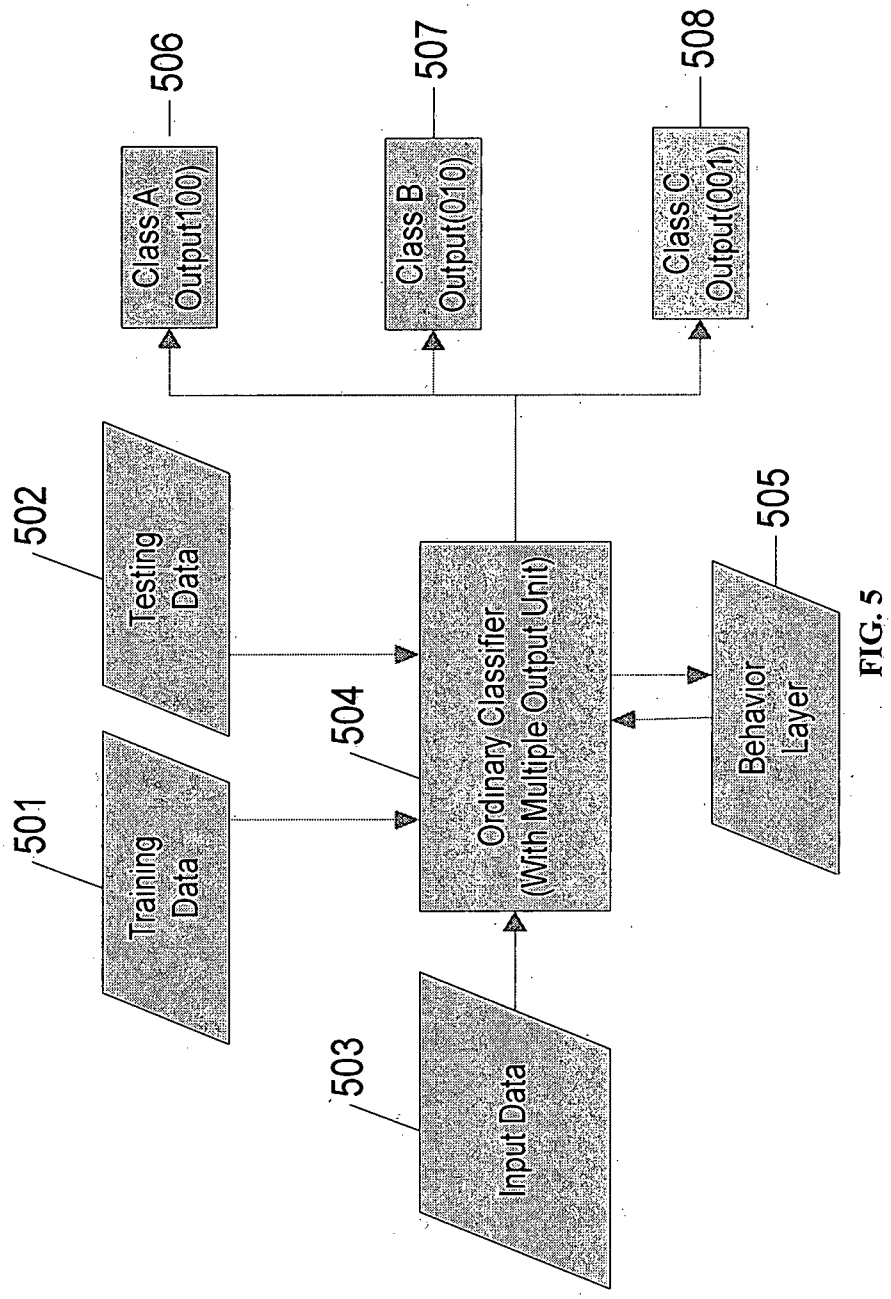
506
Class A
Output100)
507
Class B
Output(010)
508
Class C
Output(001)
502
Testing
Data
505
Behavior
Layer
504
Ordinary Classifier
(With Multiple Output Unit)
501
Training
Data
503
Input Data

FIG. 5

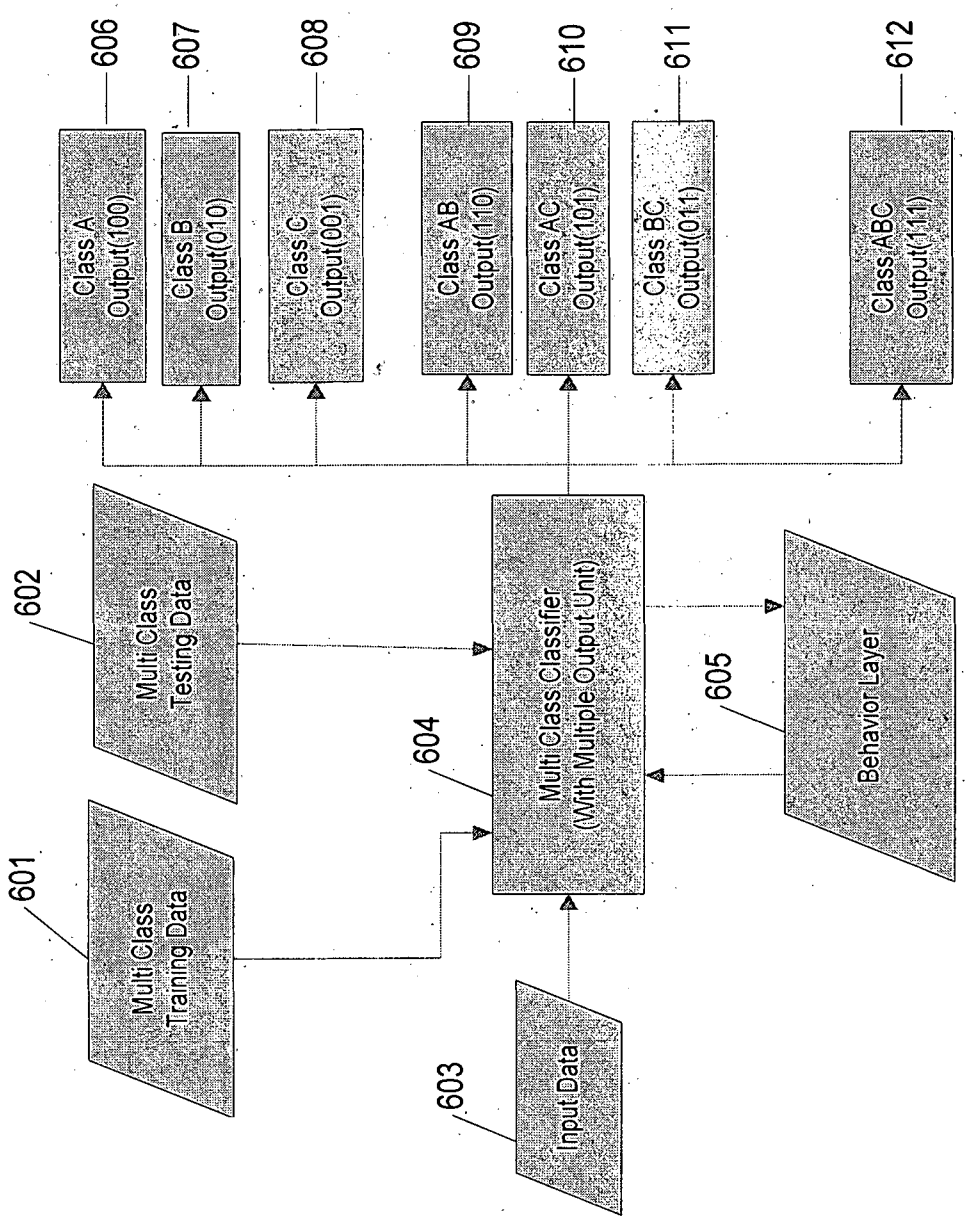
606
607
608
609
610
611
612
Class A Output(100)
Class B Output(010)
Class C Output(001)
Class AB Output(110)
Class AC Output(101)
Class BC Output(011)
Class ABC Output(111)
602
Multi Class Testing Data
601
Multi Class Training Data
604
Multi Class Classifier (With Multiple Output Unit)
605
Behavior Layer
603
Input Data

FIG. 6

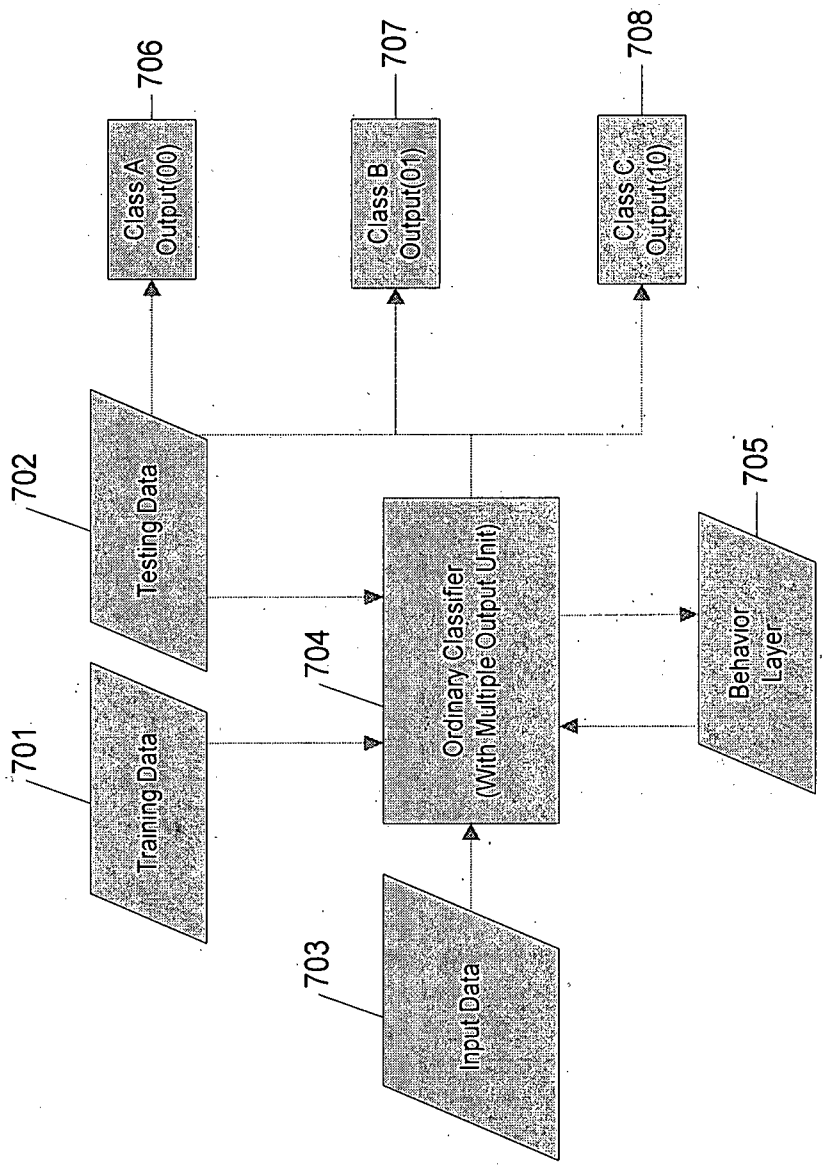
706
Class A
Output(00)
707
Class B
Output(01)
708
Class C
Output(10)
702
Testing Data
701
Training Data
704
Ordinary Classifier
(With Mutiple Output Unit)
705
Behavior
Layer
703
Input Data

FIG. 7

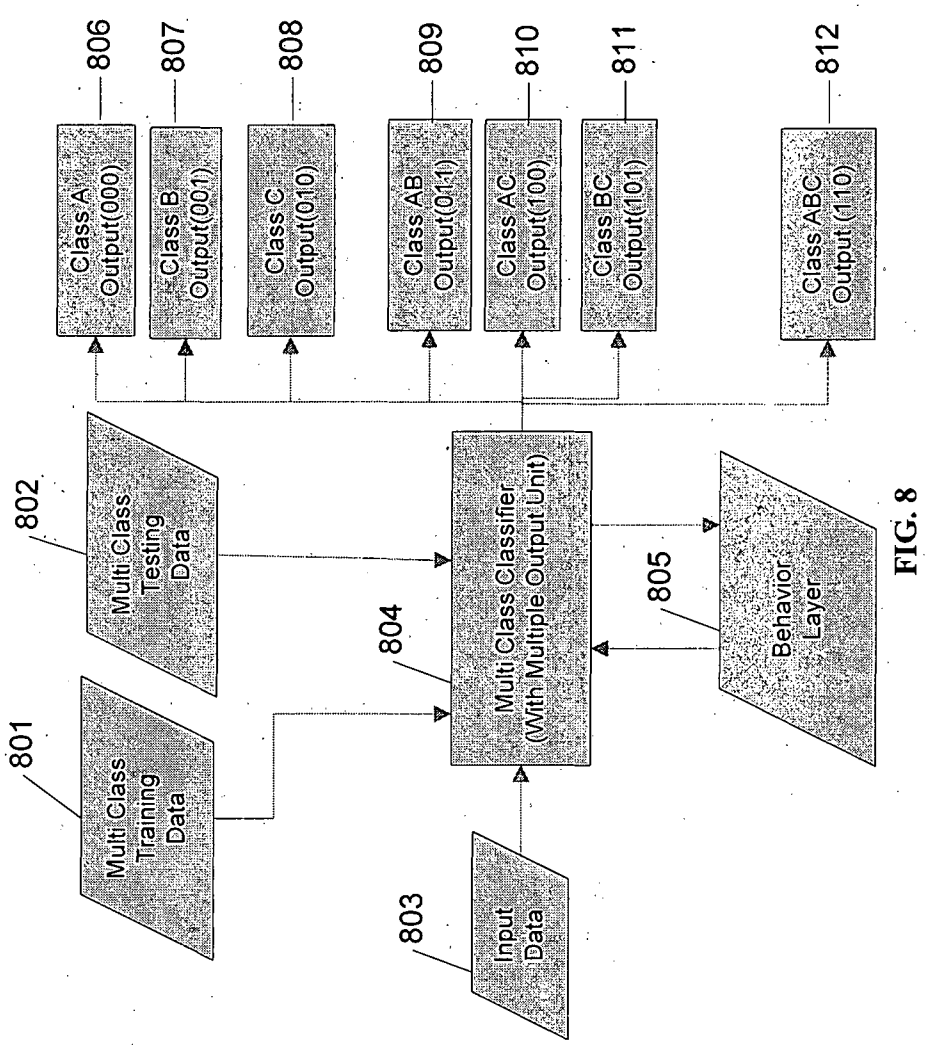
806
807
808
809
810
811
812
Class A Output(000)
Class B Output(001)
Class C Output(010)
Class AB Output(011)
Class AC Output(100)
Class BC Output(101)
Class ABC Output (110)
802
Multi Class Testing Data
804
Multi Class Classifier (With Multiple Output Unit)
805
Behavior Layer
801
Multi Class Training Data
803
Input Data

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2016/000116

A. CLASSIFICATION OF SUBJECT MATTER
G06K9/00,G06F17/00 Version=2016.01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06K, G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Databases: Patseer, IPO Internal Database
Search terms: multi class classifier, data item, multi class dataset

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US2011302111 A1 (XEROX CORPORATION) 08.12.2011 (08 December, 2011). Paragraphs [0003]-[0011], [0016], [0019]-[0020], [0028]-[0038]; figure 3; abstract.	1-12
X	US7769228 B2 (SIEMENS CORP et al) 03.08.2010 (03 August, 2010). Column 2 lines 33-49; column 2 line 65 - column 4 line 65; figure 2.	1-12

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30-08-2016	30-08-2016

Name and mailing address of the ISA/	Authorized officer
Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Dilip Dandotiya Telephone No. +91-1125300200

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IN2016/000116

Citation	Pub.Date	Family	Pub.Date
US 7769228 B2	03-08-2010	US 2005249401 A1	10-11-2005
		EP 1745414 A1	24-01-2007
		JP 2007537542 A	20-12-2007
		WO 2005111918 A1	24-11-2005