DECISION –MAKING SYSTEM BY NEURONAL NETWORKS FOR TAKING INTO CARE CHILDREN SUFFERING FROM SERIOUS PALUDISM

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Abstract: neuronal networks developed since these last thirty years simultaneously at the paradigm of learning [3]. According to this paradigm, machines are not programmed in advance for any given task but learn to carry out this task from examples. By pursuing our analyses in field, we present in this research a contribution in setting up a system to grant benefits of children suffering from serious paludism [4]. Several cases amounting to millions on record each year around the world, with a great vulnerability or children lower than 5 years old. How to prevent these risks of complication and act on time on the basis of diagnosis taken from the patient?

Key words: learning, neuronal network, serious paludism.

I. INTRODUCTION [1], [2], [3]

The serious paludism is defined as feverish syndrome of dysfunction [5] of organs and / or metabolic dysfunctions secondary to the intra erythrocytary presence of plasmodium falciparum in its sexed form leading to the threat of vital prognosis.

The serious paludism becomes an emergency and requires a granting of benefits in intensive care for a high level mortality is reported.

Paludism remains a major problem of public health around the world, in particular in tropical and intertropical areas. So Africa is very concerned because of a big social problem of target countries whose the majority is developing (90% of cases)

In the world, each year, about 300-500 millions of cases are listed, making one of the most important parasitoses of paludism; one of the greatest sanitary health discussion for which several studies are devoted with a view to the improvement of the present situation and that of decades to come.

At present, it doesn't exist a way allowing to assess automatically and accurately the risk that a child carries to develop complications of serious paludism in the city of Kinshasa.

Therefore we suggest at the close of this work to set up a computer science, decision-making system allowing, from some factors collected on a child suffering from a serious paludism, to assess the risk that carries the latter to develop a complication by going by a set of data related to cases processed in the past.

We have wanted to go farther by setting up a system of assistance to the decision, system which is going to allow a better granting of benefits of children suffering from serious paludism.

The risk of complication being known, the medical profession will be able to provide adequate cares reported to it. Besides, a patient kept posted about risks he carries, he will better like his treatment, and that will have to result in reduction of mortality rate of complications of serious paludism.

To prepare this work, we have used several documentary searches in order to better understand the problem to resolve and the way to reach this resolution. We also have carried out interviews to evaluate problem of medical profession and to get important factors observed during complications of serious paludism.

We have had to apply technique of determining more accurately that of neuronal networks, on databases designed in Access 2007 that we have imported in SQL Server 2008 to analyze.
To prepare our application, we have modeled in UML and have used JAVA technology to implement our application.

The sample on which we have had to work has been collected within the Provincial General Reference Hospital of Kinshasa located in district of Gombe, it is during a period from November 5 to December 2013, that we had made up our sample.

II. LEARNING BY NEURONAL NETWORKS [3], [4]

II.1. simple perception

It can be seen as the simplest type of neuronal networks. It has a single layer

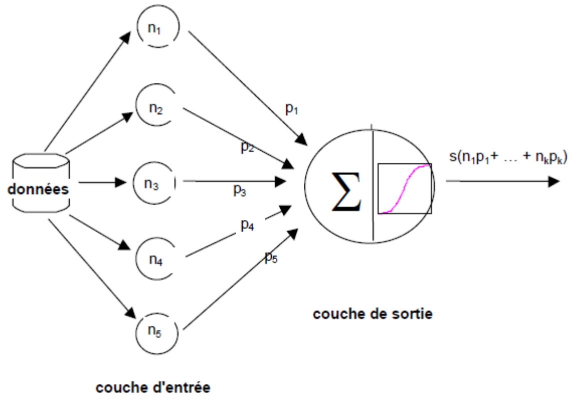

Fig 1: simple perception

And has only one output to which all input are connected.

II.2. multi-layered perception

It is a network of neuronal network, for each example presented in input, valued sent back (backpropagation) by the mode of output is compared to the actual value, and weight (pi) are adjusted. It is also used to predict a continuous or discrete target variable input layer of input hidden layer layer of output.

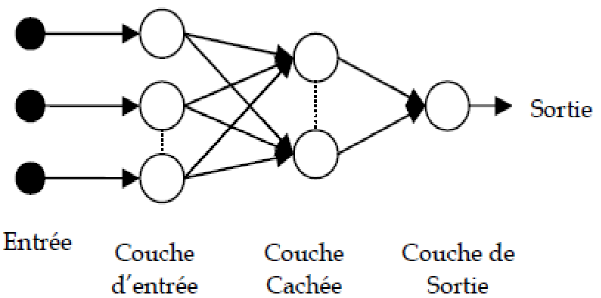

Fig 2: architecture of a multi-layered perception.

II.2.1. Networks with hidden layers.

They increase power of prediction by adding one or more layers between input and output layers.

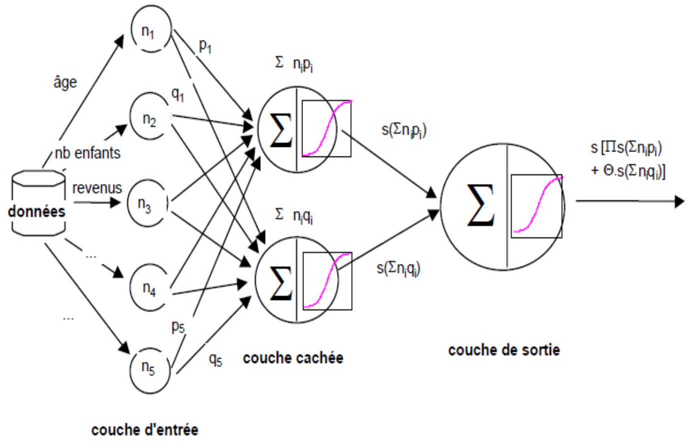

Fig 3: networks with hidden layers

II.2.2. Networks with several outputs.

The output layer of network can sometimes have several modes, when it has more values to predict.

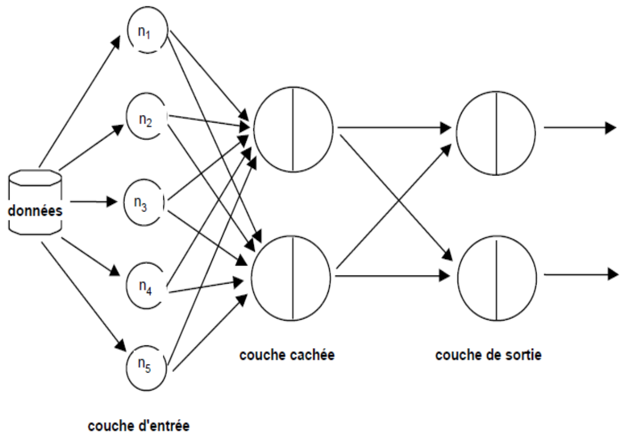

Fig 4: network with several outputs

II.3. Setting up a neuronal network.

Steps to set up a neuronal network for the prediction or ranking are:

- Identification of input and output data
- Normalization of data
- Constitution of a network with adapted typology
- Learning of network
- Test of network
- Application of model generated by learning
- Demoralization of output data.

II.4. Components of neuronal networks

Components are:

- Formal neurone
- Activation regulation
- An organization in layers
- A rule of learning.

II.5. Learning

May be considered as the problem of updating weights of connexions within the network, in order to succeed the task asked. Rule of learning allows network to evolue in the old days by taking into account previous experiences. Weights of connexion are modified according to previous results in order to find the best model with regard to examples given.
Neuronal networks are divided into two kinds: networks with learning overseen and networks with learning non overseen, we also talk about networks with hybrid learning.

For the networks with learning non overseen (Hopfield, Kohnen, etc…) we introduce an input to network and we let it evolue freely until it stabilizes.
Networks with hybrid learning
The two other approaches in the sense that one part of weights will be determined by learning non overseen. We have four rules of learning :

- Error correcting

It is a rule which fits into the paradigm of the learning overseen. That is to say in the case where we provide networks with an input and corresponding output. If we consider z output computed by network, and d output wanted, the principle of this rule is to use error (d-z) , in order to modify connexions and to decrease error of the system. The network is going to adapt until z be equal to d. This principle is the one used by the simple perception.

Learning by Boltzmann :
This rule of learning is of stochastic type. That is to say it partially comes close to being a chance and it consists in adjusting weights of connexions, so that state of visible cells satisfy a distribution of probability expected.
Rule by Hebb :
Here learning is located, that is to say that modification of a synaptic weight wij depends only on the neuronal activity I and another j.
Learning by competition:
Here learning concerns only one neurone. The principle of this learning is to bring together data in categories.

II.5.1. Algorithms of learning

Algorithms of learning are procedures in which rules of learning are used with view to the adjustment of synaptic connexion weights. Among several algorithms, we have chosen to present the one of retro propagation of gradient. We have decided on this algorithm, because of its complexity which is of nature O (n^3).

II.5.2. Algorithm of retro propagation of gradient

The principle:

The principle is to minimize a function of error. Either a multi-layered perception defined by an architecture with n input and p output. And or w synaptic weights associated with all links of the network. The error measures the gap between expected output and output computed over the complete sample.

The problem is to determine w such as error E (w) either minimum. So we are going to minimize the error on each individual introduction of example. The error for an example will be :

II.5.3. Putting in place

The building of neuronal network is made up of following steps:
- Data preparation
- Determination of parameters
- Learning phase
- Phase of optimization
- Test phase
- Operating phase

We will detail only the first three steps, following steps not presenting specificity with regard to a classical computer science setting up.

II.5.4. Data preparation

Preparation of data consists in determining input and output, constitutes the basis of examples, encode input and finally optimize data game.

II.5.5. Determination of input and output

There are no rules as far as they are concerned, everything depends on problem to deal with and

II.5.6. Constitution of the basis of examples

The choice of examples depends, of course, on results. The purpose is to explain a phenomenon. If an action is positive in 90% of cases, it is not necessary if they take also a sample containing 90% of positive cases. It is better to balance and make 50/50 in order to force the network to understand 10% of negative cases.

II.5.7. Encoding of input

The encoding of input is the association of variables to neurone. Therefore a continuous value will be represented by a neurone whereas a discrete variable talking, for example, values, active or not active worker will be encoded by two neurones.

II.5.8. Optimization of data game

Data game made up from the previous step, can contain either a lot of variables, which would make heavier the work of learning, either aberrant values would distort calculation. So it is Important to go back to work this sample.

II.5.9. Determination of parameters

Architecture: determination of numbers of layers and number of neurons of each layer.

Function of addition: definition of the nature of the operator who combines weights of wi (sum, minimum, maximum, majority, product). The most used is the sum.

Function of transfer: determination of the function to apply to the result of the function of addition (sigmoid, linear, gaussian). The most used is sigmoid – error calculation of the gap between given output and output computed.

III. APPLICATION OF NEURONAL NETWORKS FOR THE DETERMINATION OF THE IMPORTANCE OF FACTORS OF COMPLICATIONS OF SERIOUS PALUDISM AT CHILDREN. [1], [2],[4]

In the framework of our work, we are interested in five complications of serious paludism at children, that is to say: Neuropaludism, serious paludism, with neurological form (SPNF), serious paludism with hemoglobinuric (SPHF), serious paludism with anaemic and neurological form (SPA & AF)

To point out some factors gaining in importance in indication of complications of serious paludism at children we talked with many doctors and conducted documentary research.

Among these factors, we can name :

- Age
- Sex
- Consciousness disorder
- Repeated convulsion
- Respiratory distress
- Icterus
- Fever
- Hepatomegaly
- Splenomegaly
- Pallor
- Asthenia
- Vomit
- Headache
- Severe anemia (< 15%)
- Severe anemia (15-25%)
- Medical histories (coma)
- Neuropaludism
- SPNF
- SPH
- SPAF
- SPAF & A

III.1. INTRODUCTION OF THE LEARNING SAMPLE FOR THE METHOD OF NEURONAL NETWORKS

idcas	idpatient	idtemps	age	sexe	trouble_cor	convulsion_	detresse_re
001	001/a	5	1	M	oui	oui	non
002	002/a	6	2	F	non	non	oui
003	003/a	7	1	F	non	oui	non
004	004/a	8	1	M	oui	non	non
005	005/a	9	1	F	non	non	non
006	006/a	10	1	F	oui	oui	oui
007	007/a	11	3	M	non	non	non
008	008/a	12	6	F	non	non	non
009	009/a	13	4	M	non	oui	non
010	010/a	14	1	M	non	non	non
011	011/b	15	5	F	non	non	non
012	012/b	16	7	M	non	oui	non
013	013/b	17	4	F	non	non	non
014	014/b	18	2	M	oui	non	non
015	015/b	19	8	F	non	oui	non
016	016/b	20	1	M	non	non	non
017	017/b	21	9	F	oui	oui	oui
018	018/b	22	1	M	non	non	non
019	019/b	23	3	F	non	non	non
020	020/b	24	7	F	oui	non	non
021	021/c	25	1	M	non	oui	non
022	022/c	26	4	M	oui	non	non
023	023/c	27	1	M	non	non	non
024	024/c	28	1	M	oui	non	non
025	025/c	29	1	M	non	oui	non
026	026/c	30	6	M	non	non	non
027	027/c	31	5	F	non	non	non

Table 1: outline of data recorded in the table

To constitute the sample of the learning, we used data collected in the Provincial General Hospital of Reference of Kinshasa within the department of paediatrics in the intensive care unit.

These data have been stored in the database access 2007 named BDT2.Database contain 3 tables:

A patient table which contains identity of patient and a table comp Paludgrav which still contains factors in complications of serious paludism and different cases of complications of this disease. Finally, a table temps. To design our MCD, we have used rules such as: a patient can face zero or more cases of complication

A case of complication concerns only one patient, because every time a case appears. Each patient has its own unique number that has been allocated. It is important for us to present an overview of data on which we are going to work in order to achieve our decision-making basis.

III.2. TABLE OF IMPORTANCE OF FACTORS OVER COMPLICATIONS OF SERIOUS PALUDISM AT CHILDREN

Nom facteur	Neuropaludisme	PGF hemoglubinurique	PGFA	PGFAN	PGFN
Antécédent Coma (1)	78,96	16,56	0,74	1,31	10,45
Antécédent Coma (2)	5,17	10,56	27,97	7,52	16,32
Détresse respiratoire (1)	36,65	51,97	56,21	57,80	75,33
Détresse respiratoire (2)	6,13	8,32	16,74	4,20	10,06
Vomissement (1)	1,44	0,30	2,81	0,32	84,38
Vomissement (2)	8,92	14,29	22,68	7,84	11,66
Pâleur (1)	18,85	7,21	54,43	6,01	39,59
Pâleur (2)	2,23	22,70	2,44	9,09	3,28
Hépatomégalie (1)	20,80	6,27	41,36	19,12	16,60
Hépatomégalie (2)	2,81	20,90	7,95	2,18	14,65
Asthénie (1)	17,87	0,47	18,93	1,46	29,22
Asthénie (2)	6,61	20,89	19,91	8,40	13,88
Sexe F	17,65	63,81	29,98	20,00	27,11
Sexe M	5,19	2,89	16,55	3,27	10,43
Splénomégalie (1)	15,33	49,85	11,45	8,09	23,42
Splénomégalie (2)	5,53	4,19	27,13	5,59	11,94
Anémie sévère entre 15-25 (1)	4,19	2,53	95,11	3,84	1,88
Anémie sévère entre 15-25% (2)	12,41	27,24	0,29	10,24	42,27
Convulsion répétée (1)	11,00	1,61	26,68	1,23	7,88
Convulsion répétée (2)	6,99	24,91	17,82	13,25	18,87
Ictère (1)	5,57	9,82	0,58	68,69	54,00
Ictère (2)	8,62	12,06	36,37	3,28	10,56
Anémie sévère <15% (1)	9,20	24,60	3,19	89,22	5,39
Anémie sévère <15% (2)	7,34	8,74	31,48	1,79	18,78
Fièvre (1)	8,30	16,39	19,66	7,71	14,35
Fièvre (2)	6,75	1,48	32,49	2,02	16,99
Trouble Conscience (1)	8,32	16,14	0,03	14,33	18,30
Trouble Conscience (2)	8,03	9,65	66,78	4,78	14,07
Age (1-2)	8,50	9,43	16,83	6,99	15,11
Age (2-3)	7,99	9,95	17,96	6,48	14,78
Age (3-5)	7,36	11,45	20,83	5,77	14,53
Age (5-9)	7,01	14,82	27,15	5,32	14,94

Table 2: Importance of factors

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III.3. Interpretation of results provided by the method of neuronal networks

Going from the application of algorithm Microsoft Neuronal Network over data related to cases of complication of serious paludism at children, result deduced from the importance of factors are the following:

- (medical) history coma is an important factor leading to Neuro paludism at a child suffering from paludism with 79 %.
- Children suffering from paludism presenting the sign of respiratory distress are exposed to SPNF with 75% and to SPNF with 58%
- Vomiting is a very important factor which influences SPAF with 54%
- Children suffering from paludism presenting the sign of hepatomegaly risk to develop SPAF
- Asthenia is an important factor which risks to lead to SPNF
- Children suffering from paludism presenting the sign of splenomegaly carry a risk to develop Hemoglobinuric SPF with 50% and SPNF with 23%
- Harsh anaemia between 15-25% is a very important factor which influences SPAF with 95%
- Icterus is a very important factor which influences SPANF with 69% and SPNF with 54%
- Children suffering from paludism presenting the sign of repeated convulsion carry the risk to develop SPAF
- Harsh anaemia < 15% is a very important factor which influences SPAF with 89%
- Children suffering from paludism presenting the sign of fever carry more the risk to develop SPAF and hemoglobinuric SPF
- Children suffering from paludism presenting the sign of consciousness disorder risk to develop SPNF and Hemoglobinuric SPF
- Children suffering from paludism whose age varies from 1 to 9 years old carry the risk to develop all these complications.

III. 4. Design of an application for evaluation of risk of complications serious paludism at children

As for implementation, let us point out that database which has acted as example of learning has been designed in our laboratory.

Our contribution consisted in setting up a system of assistance to the decision capable of preventing patients of risks they carry to develop complications of serious paludism.

This system will allow doctors to better take care of children suffering from complications of serious paludism. The method of neuronal networks has allowed us to determine the importance of different factors by going by a sample of observed cases. We can evaluate the risk that presents a patient with regard to one of complications, all the more as we know already the Importance of each factor. To evaluate this, we have devised an application in Java, capable of retrieving values of different factors and form these, evaluate the risk for each of five types of complications. The table deduced from the application of the method of neuronal networks in this chapter provides probabilities of indications with a complication when a factor is present.

III. 4.1. Initial specification of the application

We must design a system allowing the evaluation of risk that carries a patient suffering from serious paludism to develop one of five complications. The system should allow the insertion of all new case of complication in the database, evaluation of risks of complication, consultation of chart of influence of factors along with chart of forecasting.
Only members of the medical profession who have access to data can it, the webmaster will have the possibility to use all functionalities of the system.

III. 4.2. Modeling

To model our system, we have used the language of modeling UML 2. Our system expanded according to the object- directed approach.
Diagram of class
After the analysis, we have noticed following classes:
- Patients
- Cases of complication of serious paludism
- Risks of complication of patients
- Factors
- Final users
- Webmaster
- Associations related to different classes are the following:
- The webmaster manages databases by updating information and the addition of users
- The patient expands one case of complication
- He presents risks of complication
- Factors allow the evaluation of risks of complication
- Final user consults database
- The case of complication gives information about a patient.

Figure 5 : authenticated form to get access to the application

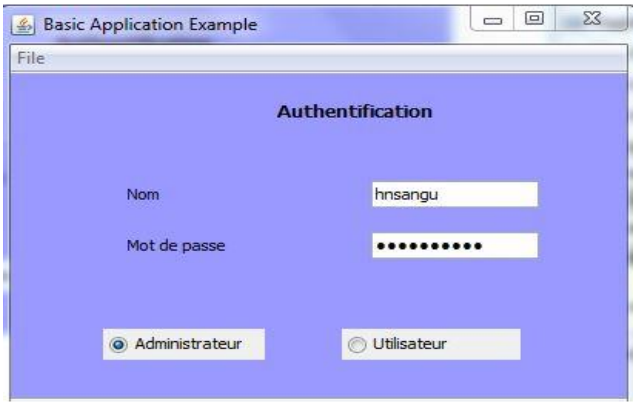


Figure 6 : recording form of patients in database

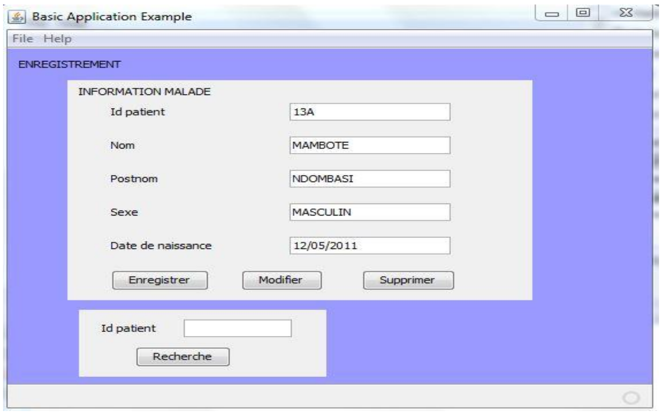


Figure7: recording form of a new case of complication which appears in database.

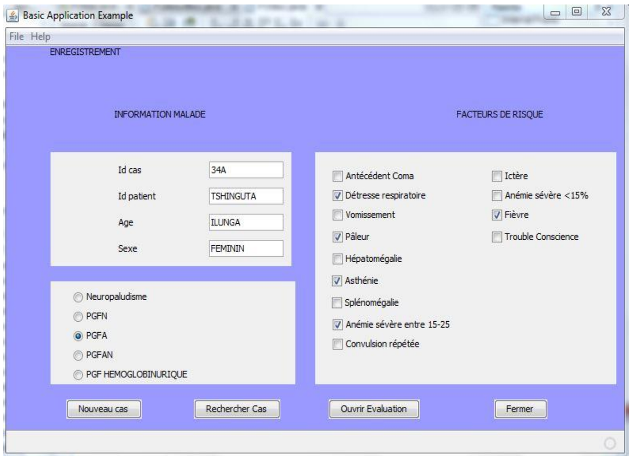
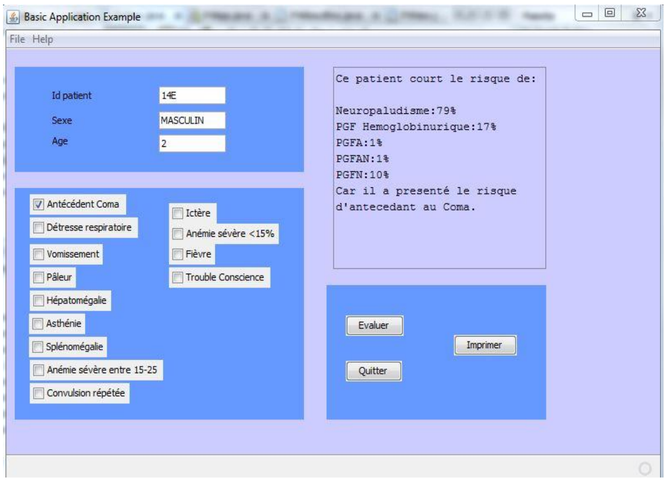


Figure 8: evaluation form of risks of complication that carries a child suffering from serious paludism.



III. 4.3. Some of captures of our application

Figure 5: authenticity form to have access to the application.

In order to help medical profession to a better granting of benefits of their patients, we have set up a decision-making system which comes to their aid in the questioning. By use of data mining, which brings together a set of extraction techniques of knowledge, more particularly neuronal networks, we have set up our system allowing evaluation of risks of complication of serious paludism at children. This study has shown once more efficiency of algorithm of (retro propagation) of (graduant) in the case of multi-layered networks.

Source codes

```
package Paludisme;
//import com.jtattoo.plaf.mint.MintLookAndFeel;
importjava.sql.ResultSet;
importjava.sql.Statement;
importjava.sql.Connection;
importjava.sql.DriverManager;
importjavax.swing.JOptionPane;
/**
 *
 * @author Herve
*/
public class Identité extendsjavax.swing.JFrame {
Statementexecuteur = null;
Connection conne;
ResultSetresultat;
 Connection con;
Statement stat;
ResultSet res;
/** Creates new form Identité */
publicIdentité() {
try {
// UIManager.setLookAndFeel(new
MintLookAndFeel());
//pour le design
} catch (Exception e)
}
//connexion bd
try {
Class.forName( "sun.jdbc.odbc.JdbcOdbcDriver");
conne =
DriverManager.getConnection("jdbc:odbc:Driver={M
icrosoft Access Driver (*.mdb)};DBQ=
C:/BDT2.mdb");
executeur = conne.createStatement();
//
JOptionPane.showMessageDialog(this,"Connectionr
eussit");
System.out.println("Connection reussit");
} catch (Exception e) {
System.out.println("echeque et mat");
} initComponents();
// pour le dimension et affichage au centre
this.setLocationRelativeTo(null);
this.setResizable(false);
 } private void
BRechercherActionPerformed(java.awt.event.Action
Eventevt) {
// TODO add your handling code here:
try {
// stat = con.createStatement();
resultat = executeur.executeQuery("Select * from
Patient where IdPatient='"+txtrech+"'");
 //
inti=0;
while (resultat.next()) {
TT.setValueAt(resultat.getString("IdPatient"), i, 0);
TT.setValueAt(resultat.getString(2), i, 1);
TT.setValueAt(resultat.getString(3), i, 2);
```

```
TT.setValueAt(resultat.getString(4), i, 3);
i++; }
} catch (Exception e) {
System.out.println("erreur de la connexion "); } }
private void
BEnregistrementActionPerformed(java.awt.event.Ac
tionEventevt) {
// TODO add your handling code here:
try {int n = executeur.executeUpdate("INSERT INTO
Patient VALUES('" + txtid.getText() + "','" +
txtnom.getText() + "','" + txtpostnom.getText() + "','"
+ txtdate.getText() + "')");
if (n == 1) { JOptionPane.showMessageDialog(this,
"ok"); }
 } catch (Exception e) {
JOptionPane.showMessageDialog(this, "erreur"+e); }
private void
BaffActionPerformed(java.awt.event.ActionEventevt
) {
// TODO add your handling code here:
try { resultat = executeur.executeQuery("SELECT *
FROM Patient");
inti = 0;
while (resultat.next() == true) {
TT.setValueAt(resultat.getString("IdPatient"), i, 0);
TT.setValueAt(resultat.getString(2), i, 1);
TT.setValueAt(resultat.getString(3), i, 2);
TT.setValueAt(resultat.getString(4), i, 3);
i++; } } catch (Exception e) { e.printStackTrace(); } }
private void
BSupActionPerformed(java.awt.event.ActionEventev
t) {
```

CONCLUSION

In order to help the medical profession to take better care of patients, we have set up a decision-making system which comes to their assistance in the questioning.

By use of Data mining which brings together the set of techniques of extracting knowledge, more particularly neuronal networks, we have set up our system allowing the assessment of risks of complication of serious paludism at children.

This study has shown that once more efficiency of the algorithm of backpropagation of the graduating in the case of multi-layered networks.

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