

A NEW APPROACH FOR THE DIAGNOSIS OF TUBERCULOSIS: A MINIMUM UPDATE METHOD

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Abstract

In this study, for the diagnosis of tuberculosis, tuberculosis' symptoms are analyzed and truth table have created by considering the probabilities of tuberculosis (12 symptoms, $2^{12}=4096$ different cases). According to the probabilities of tuberculosis disease, 6 different cases have accepted as output values and reduced rule bases have obtained whereby minimization method. As a results, we have tried to diagnosis of the tuberculosis disease, according to these output values, we can say a person is tuberculosis disease, if some output cases has (look table3). In this study, we have obtained very good results in diagnosis of the tuberculosis with minimization method. The results of analyses have indicated that reliable, consistent diagnosis and that are feasible to in real life.

Keywords: tuberculosis, minimization method, reduced rule bases, diseases, algorithms.

INTRODUCTION

Tuberculosis (TB) is one of the leading causes of infectious disease mortality in the world, with over 2 million deaths recorded annually, and it is estimated that one third of the world's population is latently infected [1]. Although effective drugs are available for most cases and rates of tuberculosis infection have decreased dramatically in industrialised countries, poor public health systems in developing countries, the HIV (Human Immunodeficiency Virus) / AIDS (Acquired immune deficiency syndrome) pandemic, and the emergence of multidrug-resistant strains, have all contributed to an ongoing increase in reported cases worldwide [2].

EXPOSITION

1. Tuberculosis' symptoms

There are 12 general symptoms and 3 specially symptoms [3].

General semptoms;

- Weariness
- Hemoptysis

- Thorax, back and flank aches
- Shortness of breath (respiratory symptom)
- Hoarseness (in the future)
- A cough that lasts (for more than 3 weeks)
- High fever (systematic symptom)
- Sweat (specially during night)
- Come out sputum and blood as coughing
- Loss of appetite
- Weight loss
- Weakness

Specially semptoms:

- Cough, Sputum, hemoptysis,
- Thorax, back and flank aches
- Heartbeat

Some similar diseases; [4.5.6.7];

- Primary TBC,
- Post Primary TBC,
- Sarcoidosis,

- Pleuritis
- Mumps

Input Symbols	Input Cases	Output Symbols	Output Cases
x1	A long lasting cough	y1	Tuberculosis
x2	High fever (systematic symptom)	y2	Primary Tub.
x3	Sweat (specially during night)	y3	Post Primary Tub.
x4	Come out sputum and blood as coughing	y4	Sarcoidosis
x5	Loss of appetite	y5	Pleuritis
x6	Weight loss	y6	Mumps
x7	Weakness		
x8	Weariness		
x9	Hemoptysis		
x10	Thorax, back and flank aches		
x11	Shortness of breath (respiratory symptom)		
x12	Hoarseness (in the future)		

Table 1. Input, output cases and symbols.

2. Minimization Method

The minimization of Boolean Functions (BFs) can lead to more effective programs and circuits from cost, energy dissipation, weight, dimensions and other important point of view. An incompletely-specified BF F with n inputs and m outputs is a mapping $F: B^n \rightarrow Y^m$, where $B = \{0,1,x\}$ where x is a non-appearing coordinate value and $Y = \{0,1,d\}$ where d is a unspecified value. B^n is called the domain and Y^m is called the range of the function. A point in the domain of the function is called a minterm. if $m=1$, F is called an incompletely-specified single-output function. The On-set S_{ON} , Do not care set S_{DC} , and Off-set S_{OFF} of an incompletely-specified single-output function F are sets of minterms that are mapped by F to 1, x , and 0, respectively. The function is customarily denoted by the triplet $F = (S_{ON}, S_{OFF}, S_{DC})$. Since S_{ON} , S_{OFF} and S_{DC} partition of B^n , only S_{ON} and S_{DC} are usually specified. S_{OFF} is obtained by complementing the union of S_{ON} and S_{DC} . If $S_{DC} = \emptyset$, the function is called a completely-specified single-output function [8,9,10,11].

In order to obtain a minimum solution for

the given BF, the typical minimization method is realized by repeating the following steps until S_{ON} is covered completely.

Minimization // Input: S_{ON} , S_{OFF} ; Output: A minimum form of the given BF.

- A Target Minterm (TM) is chosen from the S_{ON} set,
- The set of Prime Implicants (PIs) is generated (PIs cover the chosen TM),
- The Essential Prime Implicant (EPI) is determined from the set of PIs,
- A covering operation is performed.

2.1 Minimization algorithm

In order to minimize the given Boolean Function, Minimization Algorithm has been developed. Minimization Algorithm, determination of $S_{PI}(TM)$ and cover procedures are given in below.

Minimization Algorithm (S_{ON} , S_{OFF})

Begin

start:

if ($S_{ON} = \emptyset$) then goto end

TM $\leftarrow$ select any On minterm from

the S_{ON} set

Call $S_{PI}(TM)$ procedure

if $|S_{PI}(TM)|=1$ then goto result

Select PI which is cover the most

minterm from the S_{ON} set

result:

$S_{EPI}(TM) \leftarrow$ selected $S_{PI}(TM)$

set of result $\leftarrow S_{EPI}(TM)$

Call cover procedure

goto start

end:

end

End

Determination of $S_{PI}(TM)$ Procedure

Begin

1) Expand the elements of S_{OFF} set by the TM x

2) Remove from a result the non maximal cubes

3) Subtract the result from the n -cube $S_{PI}(TM) \leftarrow (x)^n \#$ (step 2)

4) Return ($S_{PI}(TM)$)

End

Cover Procedure

Begin

$S_{ONi} \leftarrow S_{ON(i-1)} \# S_{EPI}(TM)$

$S_{EPI} \leftarrow S_{EPI} \cup S_{EPI}(TM)$

Return (S_{ONi} and S_{EPI})

End

CONCLUSION

Tuberculosis causes a staggering burden of mortality worldwide, killing an estimated 1.9 million persons annually. Effective treatment of tuberculosis in developing countries is hampered by the cost of antituberculosis drugs, inability to ensure completion of therapy, and rising drug resistance rates [12]. Furthermore, there are many methods to prevention of tuberculosis. Our used method is considerably a new method, including truth table, input and output values, reduced rule bases.

Output Symbols	Output Cases	Simplification function	
y1	tuberculosis	010100000010	111x11011010
		1111xx0xxxx1	1111xxxxx00x
		1111xxxxx1x0	1111xxx0xxxx
		1111x0xxxxxx	1111xx1xxx1x
		11111xxxxxxx	1111xxxx1xxx
y2	Primary tub.	1010x1101000	10101x101101
		xx1x11xxx0x0	xx1x111xxx1
		xx1x1101xxx	xx1x11x0x1xx
		xx1x11xxx0x	xx1011xxxxxx
		x11x11xxxxxx	xx1x11xx1xxx
y3	Post Primary tub.	1x1x11xxx1x	
		101010101100	111xx11x1111
		1011101001x1	1011x01x0010
		101000110x1x	1x101x10001x
y4	Sarcoidosis	101x011x011x	101xxxx1x01x
		1111xx1xxx1x	1x1xxxx1xx11
		1x1x0xx0xx1x	1x1xx00xxx1x
		1x1xxxx0x11x	1x11xxxxx11x
		1x1x11xxx1x	1x11xxxx1x1x
y5	Pleuritis	1x1xxxxx111x	110xxxxxxx1x
		11x0xxxxxx1x	
		xxxxxxx111xx	
		101010101010	111110111x11
		xxxx1x1x11xx	xxx0xx1x11x1
y6	Mumps	0xx1xx1x11xx	x0xxxx1x11x0
		xxxxx11111xx	11xxxx1x11xx
		xx0xxx1x11xx	xxxxx01x11xx
		xxxxxx1x111x	

Table 2. Simplification output values

Output Symbols	Cases	Symptom and Output Cases											
		x ₁	x ₂	x ₃	x ₄	x ₅	x ₆	x ₇	x ₈	x ₉	x ₁₀	x ₁₁	x ₁₂
y2	Primer Tuberculosis 1010x1101000	1	0	1	0	x	1	1	0	0	1	0	0
y2	Primer Tuberculosis 10101x101101	1	0	1	0	1	x	1	0	1	1	0	1

Table 3. Symptoms and Output Cases for y2

The mean of 0, 1 and x which shows like simplification function at Table 2 is: For 0; there is not symptom For 1; there is a symptom. For x; it is not importing for symptom of represent disease who is ill person. For example; Disease probabilities and results for y2 have been given in table 3.

According to Table 3, the mean of 1010x 1101000 output values; we can say Primer Tuberculosis a person which has x1, x3, x6, x7 and x9 probabilities and has not x2, x4, x8, x10, x11, x12 probabilities. x5 does not matter whether or not the any symptom.

In this study; all the probabilities of the 12 symptoms that are the general symptoms and simplified output values have been evaluated (12 symptom, $2^{12}=4096$ different cases and 6 different cases). In function, 4096 different cases evaluated for each one output function. In the reduction of symptoms, minimization algorithm has been used. By this method, reduced functions for each output have been obtained in Table 2.

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