Integrated Intelligent Research (IIR)

International Journal of Computing Algorithm
Volume: 03 Issue: 02 June 2014 Pages: 138-141
ISSN: 2278-2397

Symptoms of Breast Cancer – An Analysis Using Induced Fuzzy Cognitive Maps (IFCMS)

M. Albert William, A. Victor Devadoss, T. Pathinathan, J. Janet Sheeba
Department of Mathematics, Loyola College, Tamilnadu, India

Abstract - Cancer is a disease in which cells become abnormal and form more cells in an uncontrolled way. With breast cancer, the cancer begins in the tissues that make up the breasts. The cancer cells may form a mass called a tumor. (Note: Not all tumors are cancer.) They may also invade nearby tissue and spread to lymph nodes and other parts of the body. The most common types of breast cancer are: Ductal carcinoma – Cancer that begins in the ducts and grows into surrounding tissues. About 8 in 10 breast cancers are this type. Lobular carcinoma (LAH-byuh-luhr KAR-sih-NOH-muh) – Cancer that begins in lobules and grows into surrounding tissues. About 1 in 10 breast cancers are this type. Hence, this research investigatesthemostcontributing /impactful factor of symptoms of breast cancer using Induced Fuzzy Cognitive Maps (IFCMs). IFCMs area fuzzy-graph modeling approach based on expert's opinion. This is the non-statistical approachtostudytheproblemswithimpreciseinformation. In thecurrent study, Section 1 introduction about cancer. Section 2 overviews the Fuzzy CognitiveMapstheory,andits influence.Section 3explainsthe Algorithmic approachofIFCM models.Section 4discussesthe components (attributes) symptoms of breast cancer and implementationof IFCMmodeland Section5revealsthe conclusion of the problem.

Keywords- Breast cancer, IFCM, Symptoms.

I. INTRODUCTION

Cancer is the general name for a group of more than 100 diseases. Although there are many kinds of cancer, all cancers start because abnormal cells grow out of control. The body is made up of trillions of living cells. Normal body cells grow, divide, and die in an orderly fashion. During the early years of a person's life, normal cells divide faster to allow the person to grow. After the person becomes an adult, most cells divide only to replace worn-out or dying cells or to repair injuries[1].

By Dr Ananya Mandal, MD says that "Cancer possess the same common properties of:

- abnormal cell growth
- capacity to invade other tissues
- capacity to spread to distant organs via blood vessels or lymphatic channels (metastasis)

Untreated cancers can cause serious illness by invading healthy tissues and lead to death"[2].FuzzyCognitive Maps (FCMs) isa well established techniqueforpredictionand decisionmakingespeciallyfor situations wherefuzzinessand uncertainty exists. To deal imprecise information, Lofti A.Zadeh,1965,introduced the notionof fuzziness.In 1986,Kosko[3],theguruof fuzzylogic introduced theFuzzyCognitiveMaps.Itwasafuzzyextension oftheCognitive Map pioneered in1976 byPoliticalScientist RobertAxelrod,whousedit to representknowledgeasan interconnected, directed, bi-level-logic graph. Thus the FCM plays a vital role in modeling system. This paper describes the method of analyzing the most contributingfactor symptoms of breast cancerusingInducedFuzzy Cognitive Maps(IFCMs) which was introduced by T. Pathinathan[13] and which isthe advanced studyof FCM[4,5]. It is worth mentioning here, thebookentitled 'FCMs and Neutrosophic Cognitive Maps' byVasantha and Smarandache, 2003[6]. ThisbookinfersthatFCMsstronglyresemble neural networks andpowerful forreaching consequencesasa mathematicaltoolformodelingcomplexsystems Implicationsfor interdisciplinaryreading:National Implicationby Calais[7],FCMbasedtoolforpredictionof infectiousdiseasesbyElpiniki etal.,[7],Benefitsofliteracyin BhutanbyDevadoss etal.[8], Problemfaced by bonded labourersnearKodaikanal forests discussed andsolution given byVasantha[9]arenotablestudiesinthisareaofresearch.In all theabovestudies,thevariousreallifewithimprecise information takenandtheprecisesolutions givenbyFCMand itsadvancedstudies.

II. FUZZYCOGNITIVEMAPS

FuzzyCognitiveMaps(FCMs) are digraphs that capture the cause/effect relationship inasystem. Nodesofthegraphstand fortheconceptsrepresentingthekey factorsandattributesof the modeling system, such asinputs, variable states, components factors,events,actionsof anysystem.Signedweightedarcs describe thecausal relationships, whichexists amongconcepts and interconnect them, with adegreeof causality. The constructed graph clearly shows how concepts influence each otherandhowmuchthedegree of influenceis. Cognitive Maps(CMs) wereproposed fordecision making by Axelrod[10] for the firsttime. Using two basic types of elements; concepts and causal relationship, the cognitive map canbeviewed asasimplified mathematical model of a belief system.FCMswereproposedwiththe extensionof the fuzzified causal relationships. Kosko[3],introducedFCMsasfuzzygraph structuresforrepresenting causalreasoning.Whenthenodesof theFCMarefuzzysetsthentheyarecalledfuzzynodes.FCMs withedgeweightsorcausalitiesfromtheset{-1,0, 1} arecalled simpleFCMs. Consider thenodes/concepts P_1,P_2, P_3,…,$P_n$oftheFCM. Supposethedirectedgraphisdrawnusingedgeweight$e_{ij}$from {-1,0,1}. Thematrix Mbedefined by$M$=(e_{ij}) wheree_{ij}isthe weightof thedirectededgeP_iP_j.$M$is calledthe adjacency matrixoftheFCM,also known as connection matrix.Thedirected edgee_{ij}fromthecausalconcept $P_i$to concept $P_j$measureshowmuch-
$P_i$causesP_j.Theedgee_{ij}takesvaluesintherealinterval[−1,1].

International Journal of Computing Algorithm
Volume: 03 Issue: 02 June 2014 Pages: 138-141
ISSN: 2278-2397

e_{ij}=0indicatesnocausality.
e_{ij}>0indicatescausalincrease/Positivecausality.
e_{ij}<0indicatescausaldecrease/Negativecausality.

Simple FCMs provide quick first-hand information to an expert's stated causal knowledge. Let P_1,P_2, P_3,…,$P_n$be the nodesof FCM. Let A=(a_1,a_2, …,a_n) iscalledastate vector whereeithera_i=0or1.Ifa_i=0,theconcept$a_i$intheOFFstate and ifa_i=1, theconcept$a_i$intheONstate,for$i$=1,2, …,n. LetP_1P_2, P_2P_3, …, P_iP_j.betheedgesoftheFCM($i \neq j$). Then the edges formadirected cycle.

III. ANFCMISSAID TO BE CYCLIC IF IT POSSESSES A DIRECTED CYCLE

AnFCMwithcyclesis saidtohaveafeedback,whenthereisa feedbackinanFCM,i.e.,whenthecausalrelationsflowthrough acycleinarevolutionary way,theFCMiscalledadynamical system.Theequilibriumstateforthedynamicalsystemiscalled thehiddenpattern.Iftheequilibrium stateofadynamical state isa uniquestatevector,itiscalledafixedpointorlimitcycle. Inferencefromthehiddenpatternsummarizesthejointeffectsof allinteractingfuzzyknowledge.

A. Algorithmic approach in IFCM

EventhoughIFCM isanadvancement ofFCMitfollows thefoundationof FCM,ithasa slightmodificationonlyin Algorithmic approaches. Toderiveanoptimistic solutiontothe problem with anunsupervised data,the following steps tobe followed:

Step 1:For the given model(problem),collect the unsupervised data that is indeterminant factors called nodes.

Step 2: According to the expert opinion, draw the directed graph.

Step 3: Obtain theconnectionmatrix, M_1,from the directed graph (FCM). Herethenumber ofrowsinthegivenmatrix = numberofstepstobeperformed.

Step 4: Consider thestatevector $S(X_1)$.by setting c_1 inONposition thatisassigningthefirst componentofthevectortobe1andthe rest of thecomponents as 0.Find $S(X_1) \times M_1$.The state vector isupdated and threshold at eachstage.

Step 5: Threshold value is calculated by assigning 1 for the values>0and0forthevalues<1.Thesymbol'↪'represents thethresholdvaluefortheproductofthe result.

Step 6:Now eachcomponent in theC_1vectoris taken separatelyand productof the givenmatrix is calculated. The vector which has maximum number of one'sis found. The vector with maximum number of one's which occursfirst is consideredas C_2.

Step7:Whenthesamethresholdvalueoccurstwice.Thevalue isconsideredasthefixedpoint.Theiterationgetsterminated.

Step8:ConsiderthestatevectorC_1bysettingC_2inONstatethatisassigningthesecondcomponentofthevectortobe1andthe rest of thecomponents as 0.Proceedthe calculations discussedinSteps4to6.

Step9:Continue Step9 for all the state vectors and find hidden pattern.

IV. ABOUT BREAST CANCER

Breast cancer is a disease in which certain cells in the breast become abnormal and multiply without control or order to form a tumor. The most common form of breast cancer begins in cells lining the ducts that carry milk to the nipple (ductal cancer). Other forms of breast cancer begin in the glands that produce milk (lobular cancer) or in other parts of the breast. Early breast cancer usually does not cause pain and may exhibit no noticeable symptoms. As the cancer progresses, signs and symptoms can include a lump or thickening in or near the breast; a change in the size or shape of the breast; nipple discharge, tenderness, or retraction (turning inward); and skin irritation, dimpling, or scaliness. These changes can occur as part of many different conditions, however. Having one or more of these symptoms does not mean that a person definitely has breast cancer. In some cases, cancerous tumors can invade surrounding tissue and spread to other parts of the body. If breast cancer spreads, cancerous cells most often appear in the bones, liver, lungs, or brain. Tumors that begin at one site and then spread to other areas of the body are called metastatic cancers. A small percentage of all breast cancers cluster in families. Hereditary cancers are those associated with inherited gene mutations. Hereditary breast cancers tend to occur earlier in life than non inherited (sporadic) cases and are more likely to involve both breasts.

Researchers estimate that more than 178,000 new cases of invasive breast cancer will be diagnosed in U.S. women in 2007. Most breast cancers occur in women, but they can also develop in men. Scientists estimate that more than 2,000 new cases of breast cancer will be diagnosed in men in 2007.An estimated 5 percent to 10 percent of all breast cancers are hereditary. Particular mutations in genes associated with breast cancer are more common among certain geographic or ethnic groups, such as people of Ashkenazi (central or eastern European) Jewish heritage and people of Norwegian, Icelandic, or Dutch ancestry. Particular genetic changes occur more frequently in these groups because they have a shared ancestry over many generations[11] The crude breast cancer cases in urban Indian women is 25-30 and the age adjusted rate is 30-35 new cases per 1,00,000 women per year. Breast cancer is increasing – the average increase over a 30 year period in Mumbai was 11 per cent per decade Breast cancer is increasing both in young (11per cent per decade) and old women (16per cent per decade) There are an estimated 1,00,000-1,25,000 new breast cancer cases in India every year. The number of breastcancercases in India is estimated to double by 2025[12].

A. Symptoms of Breast Cancer

In its early stages, breast cancer usually has no symptoms. As a tumor develops, you may note the following signs:A lump in the breast or underarm that persists after your menstrual cycle. This is often the first apparent symptom of breast cancer. Lumps associated with breast cancer are usually painless, although some may cause a prickly sensation. Lumps are usually visible on a mammogram long before they can be seen or felt.

- Swelling in the armpit.

International Journal of Computing Algorithm
Volume: 03 Issue: 02 June 2014 Pages: 138-141
ISSN: 2278-2397

- Pain or tenderness in the breast. Although lumps are usually painless, pain or tenderness can be a sign of breast cancer.
- A noticeable flattening or indentation on the breast, which may indicate a tumor that cannot be seen or felt.
- A marble-like area under the skin.

- Any change in the size, contour, texture, or temperature of the breast. A reddish, pitted surface like the skin of an orange could be a sign of advanced breast cancer.
- A change in the nipple, such as a nipple retraction, dimpling, itching, a burning sensation, or ulceration. A scaly rash of the nipple is symptomatic of Paget's disease, which may be associated with an underlying breast cancer.
- Unusual discharge from the nipple that may be clear, bloody, or another color. It's usually caused by benign conditions but could be due to cancer in some cases.
- An area that is distinctly different from any other area on either breast.

B. Adaptation of IFCM to the problem

To analyze the symptoms of breast cancer, we have interviewed and discussed with 100 women in different ages from 26 to 65 in adyar cancer institute and with the experts opinion we have taken the following attributes.

c_1 - swelling of all or part of the breast

c_2 - skin irritation or dimpling

c_3 - breast pain

c_4 - nipple pain or the nipple turning inward

c_5 - redness, scaliness, or thickening of the nipple or breast skin

c_6 - a nipple discharge other than breast milk

c_7 - a lump in the underarm area

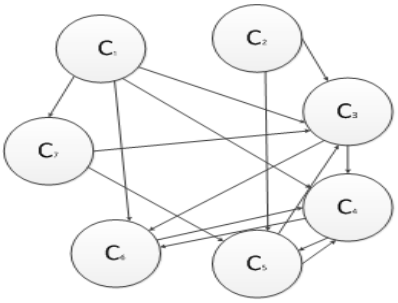

Figure-1

Figure-1 gives the directed graph with c_1, c_2, …, c_7 as nodes

The connection matrix M_1 related to the graph in Figure-1. is given below.

$$M_1 = \begin{pmatrix} 0 & 0 & 1 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 \end{pmatrix}$$

Step 1-Let us consider $S(X_1)$ in the step1, by setting the concept c_1 to ON state i.e., the first component of the vector is set to be 1 and the rest are assigned to 0.

$S(X_1) = (1\ 0\ 0\ 0\ 0\ 0\ 0)$

$S(X_1)M_1 = (0\ 0\ 1\ 1\ 0\ 1\ 1)$

$\hookrightarrow (0\ 0\ 1\ 1\ 0\ 1\ 1) = C_0'$

$C_0'M_1 \approx$

$(0\ 0\ 1\ 0\ 0\ 0\ 0)M_1 = (0\ 0\ 0\ 1\ 0\ 1\ 0)$

$= C_1.$

$(0\ 0\ 0\ 1\ 0\ 0\ 0)M_1 = (0\ 0\ 0\ 0\ 1\ 1\ 0)$

$(0\ 0\ 0\ 0\ 0\ 1\ 0)M_1 = (0\ 0\ 0\ 1\ 0\ 0\ 0)$

$(0\ 0\ 0\ 0\ 0\ 0\ 1)M_1 = (0\ 0\ 1\ 0\ 1\ 0\ 0)$

$C_1M_1 = (0\ 0\ 0\ 1\ 1\ 1\ 0) \hookrightarrow (0\ 0\ 0\ 1\ 1\ 1\ 0)$

$(0\ 0\ 0\ 1\ 0\ 0\ 0)M_1 = (0\ 0\ 0\ 0\ 1\ 1\ 0)$

$= C_2$

$(0\ 0\ 0\ 0\ 1\ 0\ 0)M_1 = (0\ 0\ 1\ 1\ 0\ 0\ 0)$

$(0\ 0\ 0\ 0\ 0\ 1\ 0)M_1 = (0\ 0\ 0\ 1\ 0\ 0\ 0)$

$C_2M_1 = (0\ 0\ 1\ 2\ 0\ 0\ 0) \hookrightarrow$

$(0\ 0\ 1\ 1\ 0\ 0\ 0)$

$(0\ 0\ 1\ 0\ 0\ 0\ 0)M_1 = (0\ 0\ 0\ 1\ 0\ 1\ 0)$

$= C_3 = C_1.$

$(0\ 0\ 0\ 1\ 0\ 0\ 0)M_1 = (0\ 0\ 0\ 0\ 1\ 1\ 0)$

The fixed point is $(0\ 0\ 0\ 1\ 0\ 1\ 0)$ When the same threshold value occurs twice, the value is considered as the fixed point. The iteration gets terminated and the calculation gets terminated. When the first attribute is kept in ON state, we get the triggering pattern as $C_1 \Rightarrow C_3 \Rightarrow C_4 \Rightarrow C_3$ Similarly, we get the following table, which gives the triggering pattern for each step.

Table:1

Stepno	AttributeON	Triggering pattern
Step 1	c_1	$c_1 \Rightarrow c_3 \Rightarrow c_4 \Rightarrow c_3$
Step 2	c_2	$c_2 \Rightarrow c_3 \Rightarrow c_4 \Rightarrow c_3$
Step 3	c_3	$c_3 \Rightarrow c_4 \Rightarrow c_3$
Step 4	c_4	$c_4 \Rightarrow c_5 \Rightarrow c_4$
Step 5	c_5	$c_5 \Rightarrow c_3 \Rightarrow c_4 \Rightarrow c_3$
Step 6	c_6	$c_6 \Rightarrow c_4 \Rightarrow c_3 \Rightarrow c_4$
Step 7	c_7	$c_7 \Rightarrow c_3 \Rightarrow c_4 \Rightarrow c_3$

Merging all these induced paths on a singlegraph we obtainthe following Graph.

International Journal of Computing Algorithm
Volume: 03 Issue: 02 June 2014 Pages: 138-141
ISSN: 2278-2397

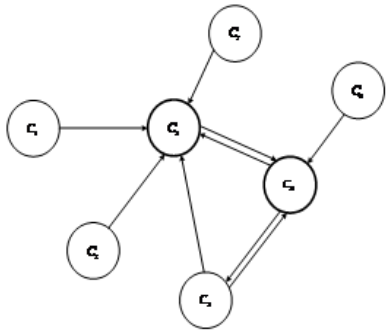

Figure-2

V.CONCLUSION

From the above calculation, breast painand nipple pain or the nipple turning inwardis the main symptom to alert one to the medical verification of breast cancer. We have observed that when any one of the symptoms of breast cancer (attributes) is switched onto ON state, c_3 and c_4 goes to ON state.The Induced FCM method clearly highlights the interrelationship with all the other attributes to the symptom of breast pain and nipple pain or the nipple turning inward pain in breast.

REFERENCES

[1] http://www.cancer.org/cancer/cancerbasics/ what-is-cancer.
[2] [http://www.newsmedical.net/health/What- is-Cancer.aspx.
[3] Kosko, B., January, "Fuzzy Cognitive Maps", International journal of man-machine studies, pp.62-75, (1986).
[4] Stephen. S., Vivin Arokia Raj.T., and Clement King. A., Analysis of the Real world Problems using Induced Fuzzy Cognitive Maps (IFCM), (2008).
[5] Ritha.W., Mary Mejrullo Merlin. M., Predictors of interest in cosmetic surgery-An analysis using induced fuzzy cognitivemaps (IFCMs). Annals of FuzzyMathematics and Informatics, (2), pp.161-169, (2011).
[6] VasanthaKandasamy. W.B., and FlorentinSmarandache, Fuzzy Cognitive Maps and Neutrosophic Cognitive Maps, Copyright, 510E, Townley Ave, USA, (2003).
[7] Gerald J. Calais, Fuzzy Cognitive Maps Theory: Implications for Interdisciplinary Reading, National Publications FOCUS on Colleges 2 ,pp.1–15, (2008).
[8] Victor Devadoss. A., Vijayakumar. G., and SingyeNamgyel, Sustainable development of Teacher Education in Bhutan, (2007).
[9] VasanthaKandasamy. W.B., Narayanamoorthy. S., and Mary John, Study of problems faced by bonded labourers near Kodaikanal forests using FCMs, (2008).
[10] Axelrod. R., Structure of Decision, the cognitive maps of Political Elites, Princeton, NJ: Princeton University Press,(1976).
[11] http://ghr.nlm.nih.gov/condition/breast- cancer.
[12] "The Times Of India" – news paper in Chennai, Oct 20, (2012).
[13] Vasantha,W.B., and Pathinathan,T., "LinkedFuzzy Relational maps to study the relation between migration and school dropouts in TamilNadu". Ultra.Sci.17, 3(M), pp. 441- 465,(2005)