Medical Treatment Negligence Analysis

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Negligence is that violation of the responsibility to worry. A breach of such kind provides a patient with rights to initiate action against negligence.

Persons who provide medical recommendation and treatment implicitly state that they possess the ability and information to treat, that they need the ability to make your mind up whether or not to require a case, to make your mind up the treatment, and to administer that treatment. This is often referred to as associate “implied undertaking” on the part of a medical skilled. The Supreme Court has declared that each doctor “has a requirement to act with an inexpensive degree of care and skill”.

Doctors don't seem to be answerable for their services on an individual basis or vicariously if they are not charging fees. So free treatment at a non-government hospital, governmental hospital, health centre, clinic or home wouldn't be thought of a “service” as outlined in Section two of the buyer Protection Act, 1986.

However, no soul is ideal and even the foremost noted specialist may build a slip-up in detective work or identification truth nature of a malady. A doctor may be control answerable for negligence providing one will prove that she/ he's guilty of a failure that no doctor with normal skills would be guilty of if acting with tutelage.

Doctors should exercise a normal degree of ability. However, they can't provide a pledge of the perfection of their ability or a guarantee of cure. If the doctor has adopted the proper course of treatment, if she/ he's accomplished and has worked with a technique and manner best suited to the patient, she/ he can't be deuced for negligence if the patient isn't completely cured.

Sometimes, even the hospital facilities are not good, which in turn, makes the doctor perform poorly on his treatment work. This is a form of negligence of the hospital authorities as a whole.

Hence, our project aims to develop a mathematical model for analysis of the issues where negligence of doctors and hospitals has caused great distress to the affected families and people.

Fuzzy cognitive Mapping using R

Fuzzy cognitive feature Map may be a combination of formal logic and cognitive feature mapping, and it's the simplest way to represent data of systems that square measure characterised of uncertainty and complicated processes. FCMs were introduced by Kosko and since then they need bit by bit emerged as a strong paradigm for data illustration. FCMs measure ideal causative knowledge tools for modelling and simulating dynamic systems.

FCMs are fuzzy directed graphs and return feedback. Each connection between two concepts CiCi and CiCj has a directed weight, which indicates the strength of the causal relationships between the concepts. The value indicates how strongly influential CiCi on CiCj. The time varying concept measures the negative occurrence of an uncertain event. According to types of causal relationships and according to the weights' sign, there are three possible types of causal relationships.

1. wij>0wij>0 indicates a positive causality between concept CiCi and concept CjCj. This means that an increase/decrease in the value of concept CiCi leads to the increase/decrease of the value of concept CjCj. (positive causality)
2. wij<0wij<0 indicates a negative (inverse) causality between concept CiCi and concept CjCj. This means that an increase in the value of concept CiCi leads to a decrease of the value of concept CjCj and a decrease of the value of concept CiCi leads to an increase of the value of concept CjCj. (negative causality)
3. wij=0wij=0 indicates no relationship between concept CiCi and CjCj. (zero causality)

Inference rules and threshold function

Every concept in the FCM graph has a value AiAj expresses a physical value and it is derived by transformation of fuzzy values assigned by experts.. the values are calculated during each simulation step, computing the influence of other concepts. We are using Kosko's inference rule here.

Kosko's inference: $Ai(k+1)=f(\sum Nj=1,j\neq 1 wji\times Aj(k))$

We are using trivalent threshold function in our approach for computing the effects of attributes that result in death or police case gets registered.

Trivalent:

$$f(x) = \begin{cases} 1 & x > 0 \\ 0 & x = 0 \\ -1 & x < 0 \end{cases}$$

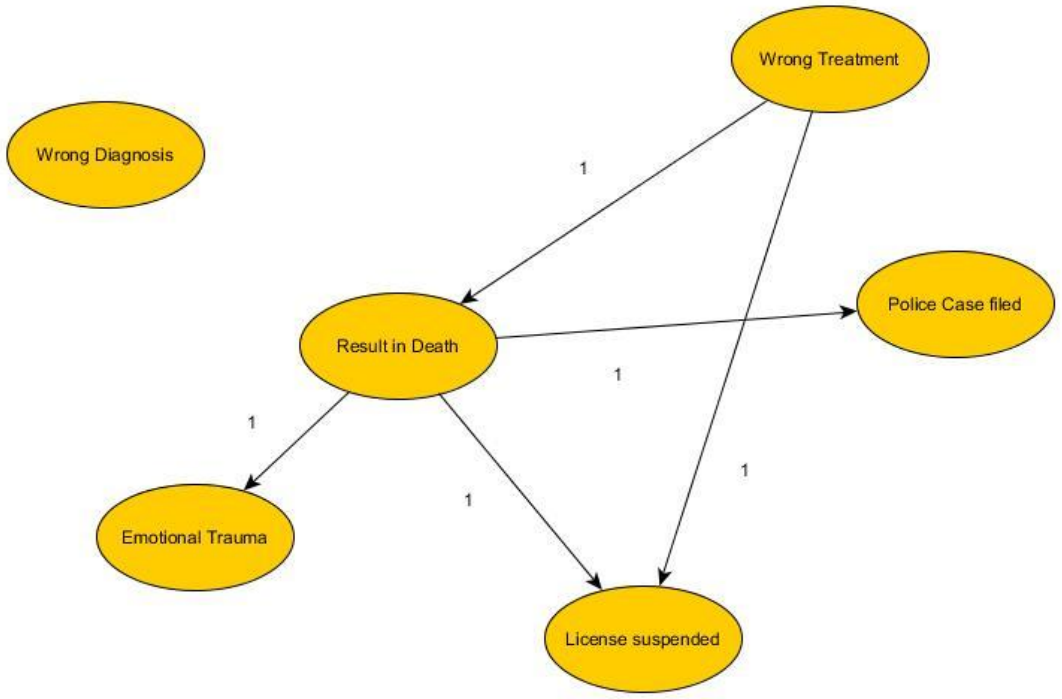
Dataset

Title	Location	Victim's name	Victim's gender	Problem Suffered	Wrong Diagnosis	Wrong Treatment	Emotional trauma	Education Status	Economic Status	Social Status	Result in death	Money fleeced	Police case registered	License suspended
2 Apollo docs suspended over negligence death	Kolkata	Sanjoy Roy	M	Internal bleeding	No	Yes	Yes	Educated	Not poor	Common	Yes	Yes	Yes	Yes
Anuradha saha 1998 medical negligence case in AMRI hospital.	Kolkata	Anuradha Saha	F	Fever	Yes	Yes	No	Educated	Not poor	Common	Yes	No	Yes	Yes
Medical negligence kills class 9 student	Kolkata	Suhana Yasmin Mondol	F	Bleeding	No	Yes	Yes	Educated	Not poor	Common	Yes	Yes	Yes	No
WB patient's family files case of medical negligence for infusing wrong blood	Kolkata	Baisakhi Saha	F	Abdominal pain	No	Yes	Yes	Educated	Not poor	Common	No	Yes	Yes	No
Kolkata hospital loses part of patient's skull	Kolkata	Amab Dutta	M	Head injury	No	Yes	Yes	Educated	Not poor	Common	No	No	No	No
Family find 'Dead Man' Alive, medical negligence registered	Bhopal	Hari Singh Rajput	M	Breathing issues	No	Yes	Yes	Educated	Not poor	Common	No	Yes	Yes	No
Doctors leave severed foot on victim unattended	Sultanpur	Atul Pandey	M	Lost foot	No	No	Yes	Educated	Not poor	Common	No	No	No	No
Father moves to court after infant's death, medical negligence against doctor	Bengaluru	Vedika	F	Fever	Yes	Yes	No	Not educated	Not poor	Common	Yes	No	Yes	No
Second negligence case in 2 months: Infant dies in Apollo Gleneagles	Kolkata	Kuheli Chakroborty	F	Stool blood	Yes	Yes	No	Not educated	Not poor	Common	Yes	Yes	Yes	No
4 month old dies in Delhi hospital given pain killer post surgery	Delhi	Unidentified	M	Cut in lip	No	No	No	Uneducated	Not poor	Common	Yes	No	Yes	No
Woman given acid in place of water	Bihar	Shyamala Devi	F	Eye surgery	No	No	Yes	Uneducated	poor	Common	Yes	No	Yes	Yes
Man accuses doctors of leaving needle in son's head	Uttar Pradesh	Daudayal	M	Head injury	No	No	Yes	Educated	Not poor	Common	No	No	Yes	No
Man goes to Delhi hospital for head injury,doctor operates his leg	Delhi	Vijendra Tyagi	M	Head injury	No	Yes	Yes	Uneducated	Not poor	Common	No	No	Yes	Yes
Woman with stomach ache had to undergo dialysis	Delhi	Rekha Devi	F	Abdominal Surgery	Yes	Yes	Yes	Educated	Not poor	Common	No	No	No	Yes
Rats nibble on dead baby's face	Telangana	Gnathi Kishan	F	None	No	No	Yes	Uneducated	poor	Common	No	No	Yes	No
Student dies of medical negligence	Hyderabad	Sathwick Reddy	M	Hydrocele operation	No	No	No	Educated	Not poor	Common	Yes	Yes	Yes	Yes
Government doctors to pay for medical negligence of placing gauze in gut	Pondicherry	Dharani	F	Tubectomy procedure	No	No	Yes	Educated	Not poor	Common	No	No	Yes	Yes
Remove lump from throat leads to death	Chennai	Rohini Sathish	F	Lump in throat	No	No	No	Educated	Not poor	Common	Yes	No	Yes	No
Remove phlegm from lungs	Vadaplani	Nirmala Nambi	F	Phlegm in lungs	No	No	Yes	Educated	Not poor	Common	Yes	No	Yes	Yes
Treated dead man for 3 days	Thanjavur	Sekhar	M	Dead treatment	Yes	No	Yes	Educated	Not poor	Common	Yes	Yes	Yes	No
Doctors Operate Wrong Leg Of An Odisha Patient Who Went For Wound	Odisha	Mitarani Jena	F	Wound	Yes	Yes	Yes	Educated	Not poor	Common	No	No	Yes	No
Woman Complained Of Severe Stomach Pain, X-Ray Revealed Forceps Left By	Telangana	Maheshwari Chowdary	F	Stomach Pain	No	Yes	Yes	Educated	Not poor	Common	No	No	No	Yes
Tension at hospital in Odisha Capital following patient's death	Odisha	Itishree Mishra	F		No	Yes	No	Educated	Not poor	Common	Yes	Yes	Yes	No
Boy injured in mishap dies due to 'medical negligence'	Odisha	Arjun Sodi	M	Accident	Yes	No	No	Educated	Not poor	Common	Yes	No	Yes	No
Child on ventilator support dies in ambulance after cylinder runs out of oxygen	Chhatisgarh	Bulbul Kudiyam	F	Breathing issues	No	Yes	No	Uneducated	Not poor	Common	Yes	No	Yes	No
Chhattisgarh man dies in hospital under alleged medical negligence; ants found	Chhatisgarh	Unidentified	M	Regular patient	No	Yes	Yes	Educated	poor	Common	Yes	No	No	No
Family alleges medical negligence in boy's death	Chhatisgarh	Ravi Jhaali	M		No	Yes	Yes	Uneducated	Not poor	Common	Yes	No	Yes	No
Three docs may lose licence for botching up eye surgeries	Maharashtra	Unidentified	M	Eye surgery	No	Yes	Yes	Educated	Not poor	Common	No	No	Yes	Yes
Medical Negligence Alleged on Assam Medical College Doctor	Assam	Shyam Sundar Gupta	M	Nose infection	No	Yes	Yes	Educated	Not poor	Common	No	No	Yes	No
Negligence at Dibrugarh AMCH: Man dies due to wrong group Blood Transfusion	Assam	Siddheswar Moran	M	Regular patient	No	Yes	No	Educated	Not poor	Common	Yes	No	Yes	No

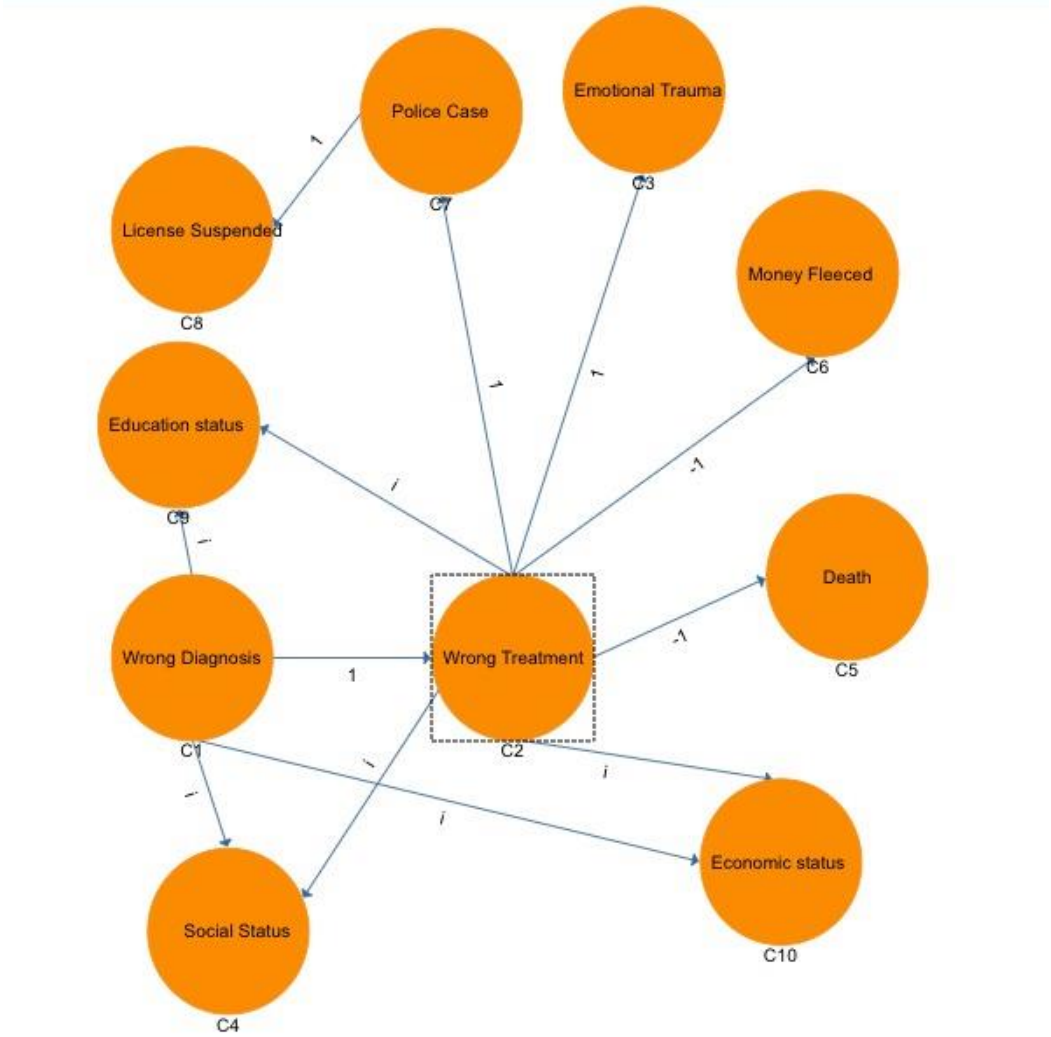
Our implementation

The **weight matrix** stores the weights assigned to the pairs of concepts which are usually normalized to the interval [0,1][0,1] or [−1,+1][−1,+1]. The dimension of the weight matrix is *m x m*, where m denotes the number of the columns (nodes).
The **activation vector** contains the initial concept values which each concept is turned on or activated by making its vector element 1 or 0 or in [0,1][0,1]. The dimension of the activation matrix is *1 x m*.

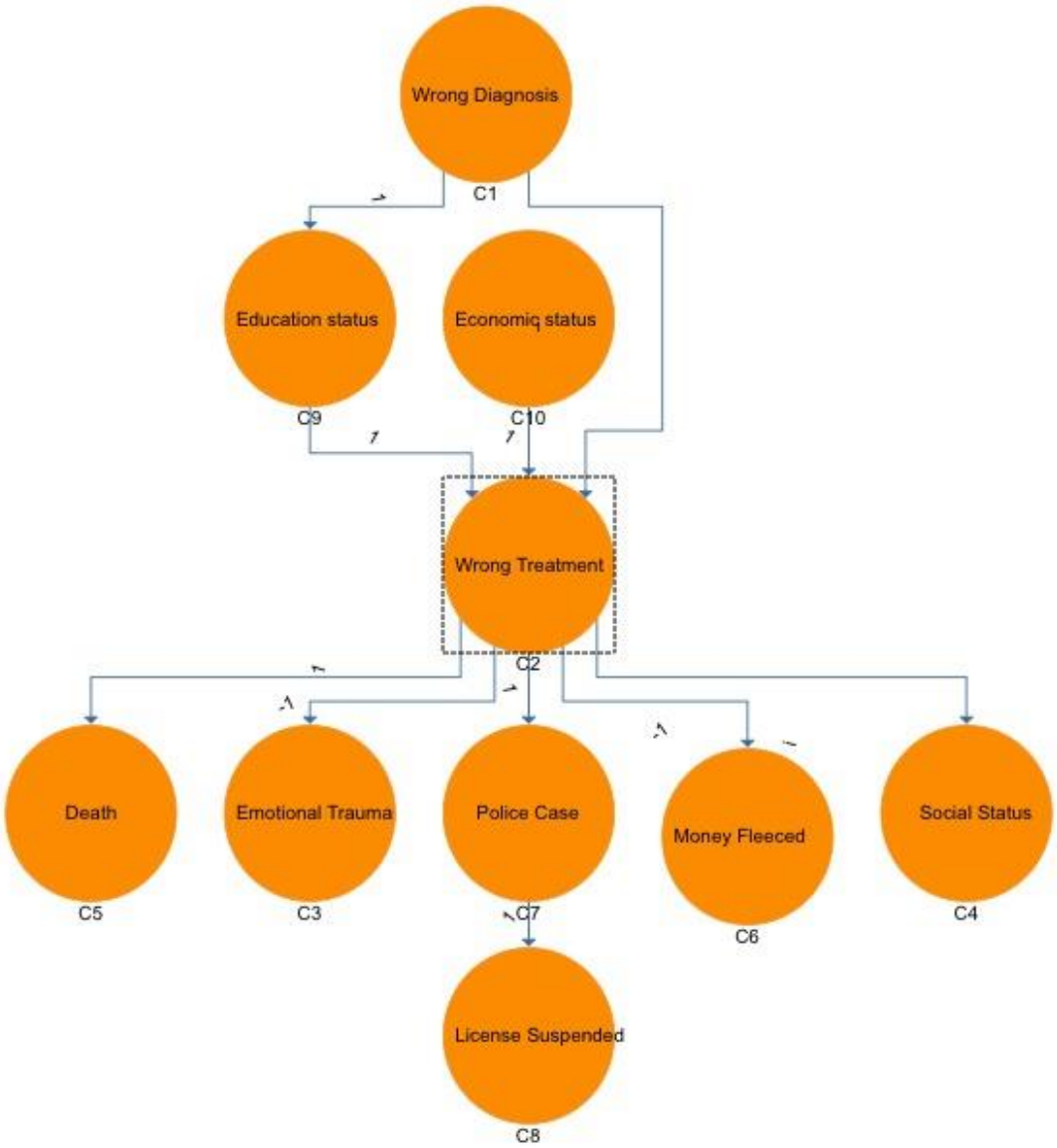
We have used **R Studio** to implement our approach. In R Studio, we used **fcm** package. We used the inference rules from the fcm package using various arguments.
We then multiply the adjacency weight matrix with the activation vector, with multiple iterations, on with trivalent threshold function is used.
Cognitive maps for 5 records:



WD	WT	ET	PC	Death	LS
0	0	0	0	0	0
0	0	0	0	1	1
0	0	0	0	0	0
0	0	0	0	0	0
0	0	1	1	0	1
0	0	0	0	0	0



WD	WT	EduS	SS	EcoS	ET	PC	MF	LS	D
0	1	0	1	0	0	0	0	0	0
0	0	0	0	0	1	1	-1	0	-1
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0



WD	WT	EduS	SS	EcoS	ET	PC	MF	LS	D
0	1	1	0	0	0	0	0	0	0
0	0	0	1	0	1	1	-1	0	1
0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0
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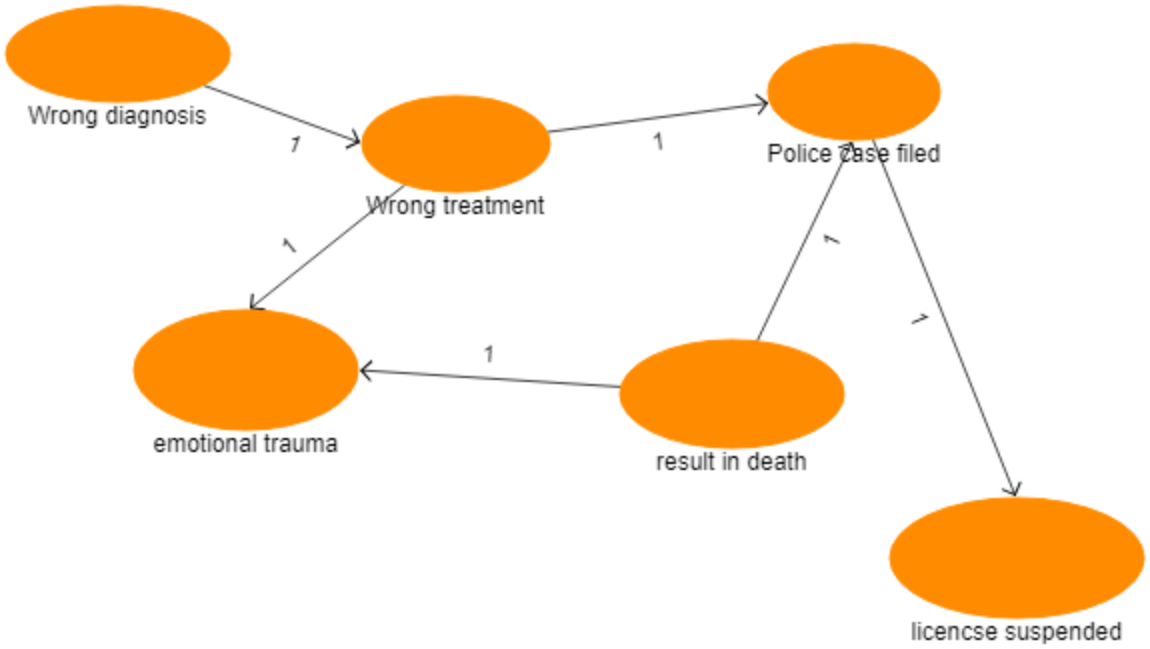
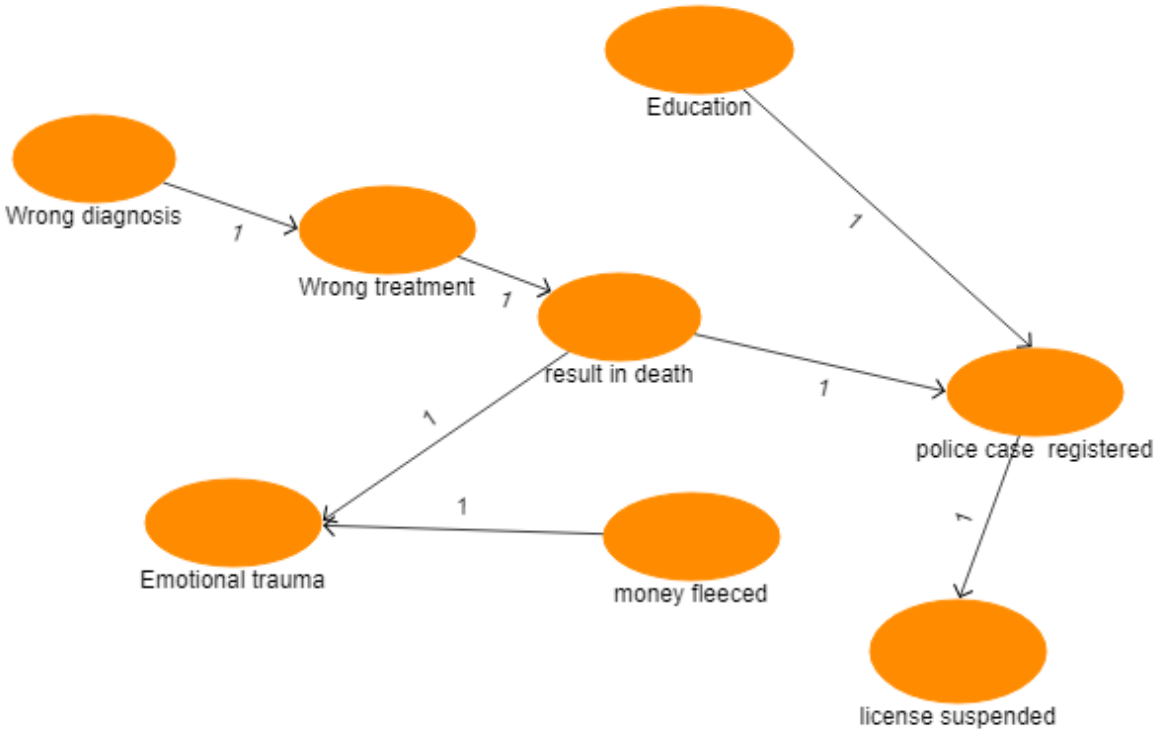


WD	WT	ET	PC	Death	LS
0	1	0	0	0	0
0	0	1	0	0	0
0	0	0	0	0	0
0	0	0	0	0	1
0	0	1	1	0	0
0	0	0	0	0	0



WD	WT	ET	ES	MF	PC	Death	LS
0	1	0	0	0	0	0	0
0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0
0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	1
0	0	1	0	0	1	0	0
0	0	0	0	0	0	0	0

Implementation (Code)

```
install.packages("fcm")

library(fcm)

act.vec <- data.frame(1, 1, 1, 0, 0, 0 )

colnames(act.vec) <- c("C1", "C2", "C3", "C4", "C5", "C6")


C1 = c(0.0, 1.0, 0.0, 0.0, 0.0, 0.0)

C2 = c(0.0, 0.0, 1.0, 0.0, 0.0, 0.0)

C3 = c(0.0, 0.0, 0.0, 0.0, 0.0, 0.0)

C4 = c(0.0, 0.0, 0.0, 0.0, 0.0, 1.0)

C5 = c(0.0, 0.0, 1.0, 1.0, 0.0, 0.0)

C6 = c(0.0, 0.0, 0.0, 0.0, 0.0, 0.0)



w.mat <- matrix(c(C1, C2, C3, C4, C5, C6), nrow =6, ncol=6, byrow=TRUE)

w.mat <- as.data.frame(w.mat)

colnames(w.mat) <- c("C1", "C2", "C3", "C4", "C5", "C6")

w.mat

output1 <- fcm.infer(act.vec, w.mat)

output2 <- fcm.infer(act.vec, w.mat, 35, "r", "s", lambda = 2, e = 0.0001)

output2$values

library (reshape2)
```

```
library (ggplot2)
iterations <- as.numeric(rownames(output1$values))
df <- data.frame(iterations, output1$values)
df2 <- melt(df, id="iterations")
ggplot(data=df2,
    aes(x=iterations, y=value, group=variable, colour=variable)) +
    theme_bw() + geom_line(size=0.7) + geom_point(size = 3)
iterations <- as.numeric(rownames(output2$values))
df <- data.frame(iterations, output2$values)
df2 <- melt(df, id="iterations")
ggplot(data=df2,
    aes(x=iterations, y=value, group=variable, colour=variable)) +
    theme_bw() + geom_line(size=0.7) + geom_point(size = 3)
```

Output

```
> w.mat
  C1 C2 C3 C4 C5 C6
1  0  1  0  0  0  0
2  0  0  1  0  0  0
3  0  0  0  0  0  0
4  0  0  0  0  0  1
5  0  0  1  1  0  0
6  0  0  0  0  0  0
> output1 <- fcm.infer(act.vec, w.mat)

 The concepts' values are converged in the 5th state (e <= 0.001000)

  C1        C2        C3        C4  C5        C6
 0.5 0.6224593 0.7544446 0.6224593 0.5 0.6507777
```

```
> output2 <- fcm.infer(act.vec, w.mat, 35, "r", "s", lambda = 2, e = 0.0001)

 WARNING: More iterations are required to reach the convergence.

> output2$values
          C1        C2        C3          C4        C5          C6
1  1.0000000 1.0000000 1.0000000 0.00000000 0.0000000 0.00000000
2  0.8807971 0.9820138 0.8807971 0.01798621 0.1192029 0.01798621
3  0.8210075 0.9692682 0.8730340 0.03073180 0.1789925 0.02071204
4  0.7831350 0.9593440 0.8894543 0.04065602 0.2168650 0.02200522
5  0.7563073 0.9511964 0.9057364 0.04880363 0.2436927 0.02299185
6  0.7359900 0.9442764 0.9170179 0.05572362 0.2640100 0.02382705
7  0.7198988 0.9382583 0.9242271 0.06174172 0.2801012 0.02455933
8  0.7067384 0.9329322 0.9289286 0.06706780 0.2932616 0.02521456
9  0.6957104 0.9281546 0.9321687 0.07184537 0.3042896 0.02580934
10 0.6862922 0.9238229 0.9345300 0.07617707 0.3137078 0.02635519
11 0.6781251 0.9198610 0.9363293 0.08013896 0.3218749 0.02686049
12 0.6709534 0.9162110 0.9377463 0.08378904 0.3290466 0.02733153
13 0.6645893 0.9128275 0.9388896 0.08717254 0.3354107 0.02777320
14 0.6588913 0.9096745 0.9398292 0.09032549 0.3411087 0.02818934
15 0.6537503 0.9067230 0.9406126 0.09327702 0.3462497 0.02858308
16 0.6490808 0.9039489 0.9412734 0.09605106 0.3509192 0.02895698
17 0.6448146 0.9013325 0.9418361 0.09866748 0.3551854 0.02931315
18 0.6408968 0.8988570 0.9423190 0.10114300 0.3591032 0.02965337
19 0.6372821 0.8965082 0.9427361 0.10349180 0.3627179 0.02997918
20 0.6339334 0.8942740 0.9430985 0.10572601 0.3660666 0.03029186
21 0.6308194 0.8921439 0.9434147 0.10785611 0.3691806 0.03059255
22 0.6279138 0.8901088 0.9436917 0.10989119 0.3720862 0.03088222
23 0.6251944 0.8881608 0.9439351 0.11183922 0.3748056 0.03116175
24 0.6226421 0.8862928 0.9441495 0.11370718 0.3773579 0.03143188
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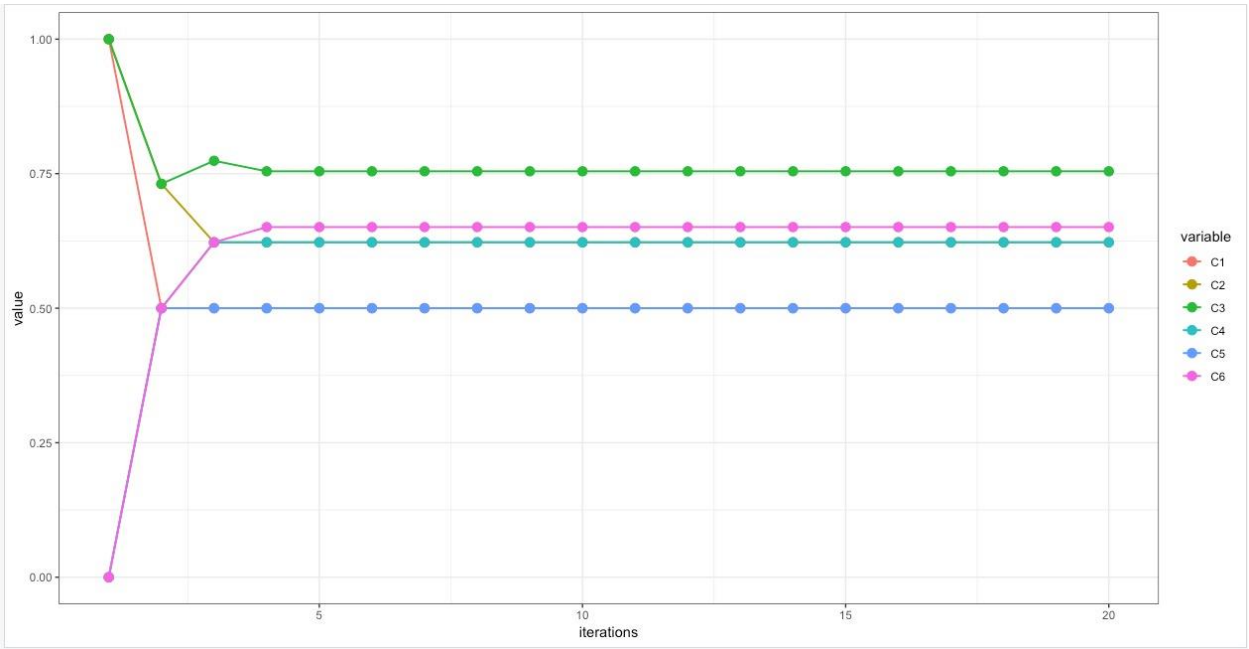
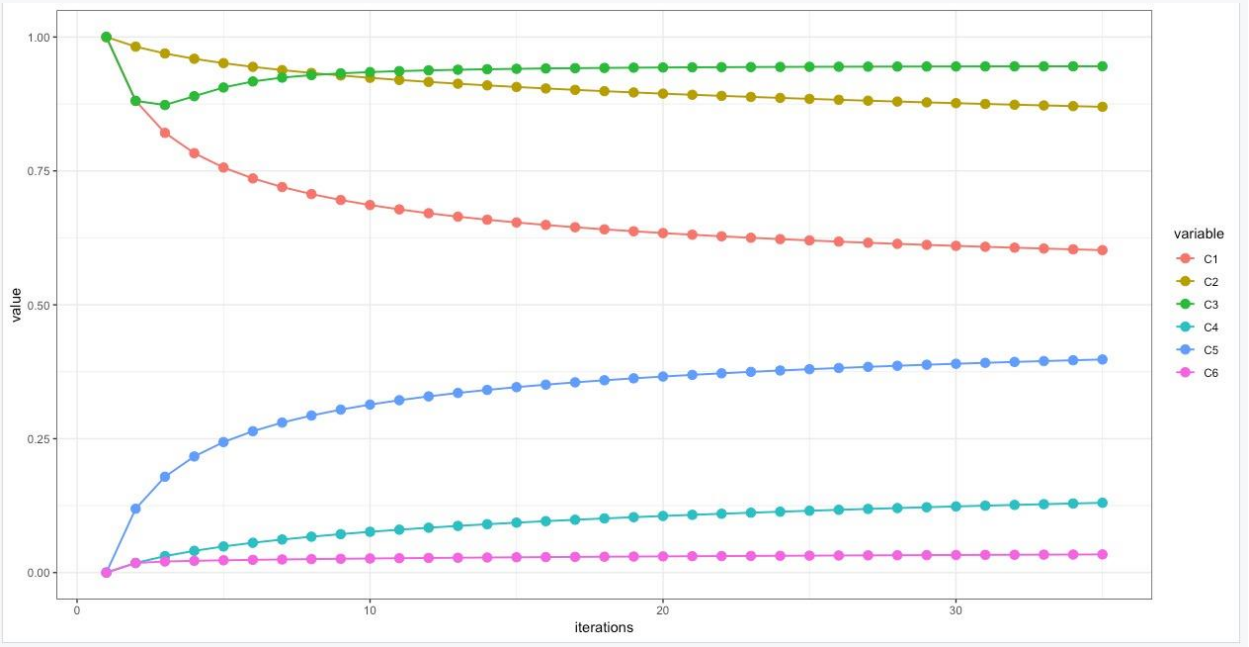

1.00
0.75
0.50
0.25
0.00
value
5
10
15
20
iterations
variable
C1
C2
C3
C4
C5
C6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variable
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C5
C6