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Generalized net model of the process of avoiding healthcare fraud

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Abstract

The present paper describes the process of the avoiding healthcare fraud. For the purpose we use Generalized Nets. The opportunity of using GNs as a tool for modelling such process is analyzed as well.

Keywords: generalized nets, modelling, healthcare fraud.

1 Introduction

In a series of papers the process of functioning of the tax transactions were described [3] using apparatus of generalized nets [1, 2]. In [3, 4, 5] there were discussed different processes related to the electronic transactions and their encryptions using generalized nets. In [6], there was constructed a generalized net model of the knowledge discovery process in medical databases. The present paper describes the process of the avoiding healthcare fraud in an abstract healthcare system.

Healthcare fraud can affect everyone in the healthcare system. Certainly, only a small percentage of healthcare providers and consumers deliberately engage in healthcare fraud. However, even a small amount of healthcare fraud can raise the cost of healthcare benefits for everyone.

Healthcare fraud is a crime. It is committed when a dishonest provider or consumer intentionally submits, or causes someone else to submit, false or misleading information for use in determining the amount of healthcare benefits payable.

Some examples of provider healthcare fraud are:

- billing for services not actually performed;
- falsifying a patient's diagnosis to justify tests, surgeries or other procedures that are not medically necessary;

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- misrepresenting procedures performed to obtain payment for non-covered services, such as cosmetic surgery;
- upcoding – billing for a more costly service than the one actually performed;
- unbundling – billing each stage of a procedure as if it were a separate procedure;
- accepting kickbacks for patient referrals;
- waiving patient co-pays or deductibles and over-billing the insurance carrier or benefit plan;
- billing a patient more than the co-pay amount for services that were prepaid or paid in full by the benefit plan under the terms of a managed care contract.

The specificity of a developed system, implemented in the health insurance, involves a number of weaknesses regarding the control and accountability of GPs (GP-general practitioners). Along with the cases of so-called "Dead souls", lists the most common scams are reporting payments to reviewers patients. The lack of direct contact patient NHIF (National Hospital Insurance Fund) is the main reason. In general, the patient pays in cash examination, and in very rare cases requires a receipt or other evidence of the amount paid. The rapid development of mobile communications in recent years could help significantly to improve control and reliability of the NHS (National Health Service). Users of GSM services in the Bulgaria are already over 80% of the population, allowing the use of the handset as a means of authentication when using various services, inclusive and medical. This could be done without much additional investment in an existing information system of NHIF. It is necessary for the servers at regional / national level to be equipped with a GSM terminal, implementing the relationship between the patient (client of the mobile network) and the server that contains the patient's information (phone number, personal health data and for system development and debit / credit card automated payment of medical services and procedures). Supplement to the server can be built on a desktop PC with two GSM terminals connected through a standard COM ports on the computer or if necessary by a MULTI I/O card. One terminal serves incoming calls from patients and the other is for sending short SMS, notifying patients for confirmation. The device receives a fixed numbers from GSM operators, as each number is associated with particular medical service or it can be used for confirmation of visit in private GP. Entry applications are served on the FIFO principle (First In, First Out).

The implementation of this technology requires only to add the mobile number of the patient in the existing database.

Contact between patient and server can be done in two ways:

1. Free ring. The system accepts customer calls and disconnecting (Free call), interceptor subscriber number - the patient must activate CLIP (Calling Line Identification Presentation) service in his GSM. After that system check in the database for an existing subscriber, validating the health status and thus confirm the health service performed. For example, it can be applied to routine examination under GP, and in system development and automated payment of the fee.
2. Short text message (SMS), containing information for the chosen service or confirmation for its performance.

2 Generalized net model of avoiding healthcare fraud

The GN (Fig. 1) contains the following set of transitions:

$$A = \{Z_1, Z_2, Z_3, Z_4, \ldots, Z_{2+n}, Z_{3+n}, Z_{4+n}, Z_{5+n}\},$$

and they represent respectively:

- Z_1 – The activities of the patients;
- Z_2 – The work of the GSM terminal;
- $Z_3, \ldots, Z_{2+i}$ – The activities of the Database for service/procedure for access i, where $i = 1, 2, \ldots, n$, n is the number of the services;
- Z_{3+n} – Encryption of the information;
- Z_{4+n} – The work of the central station;
- Z_{5+n} – The work of the server for banking transactions.

The forms of the transitions are the following. Everywhere $i = 1, 2, \ldots, n$, where n is the number of the services and $j = 1, 2, \ldots, m$, where m is the number of the registered patients.

Initially, the tokens β_{DB}, γ, α_{DB1}, $\alpha_{DB2},\ldots, \alpha_{DBn}$, χ, δ stay in places l_{DB}, l_{GSM}, l_{DB1}, $l_{DB2},\ldots, l_{DBn}$, $l_{4+n,2}$ and $l_{5+n,2}$. They will be in their own places during the whole time during which the GN functions. While they may split into two or more tokens, the original token will remain in its own place for the whole time of GN functioning. The original tokens have the following characteristic:

- "Current status of the patients' Database", (in place l_{DB});
- "GSM Terminal" (in place l_{GSM});
- "Current status of the Database for service i", (in places l_{DB1}, $l_{DB2},\ldots, l_{DBn}$);
- "Central station" (in place $l_{4+n,2}$);
- "Server for banking transactions" (in place $l_{5+n,2}$).

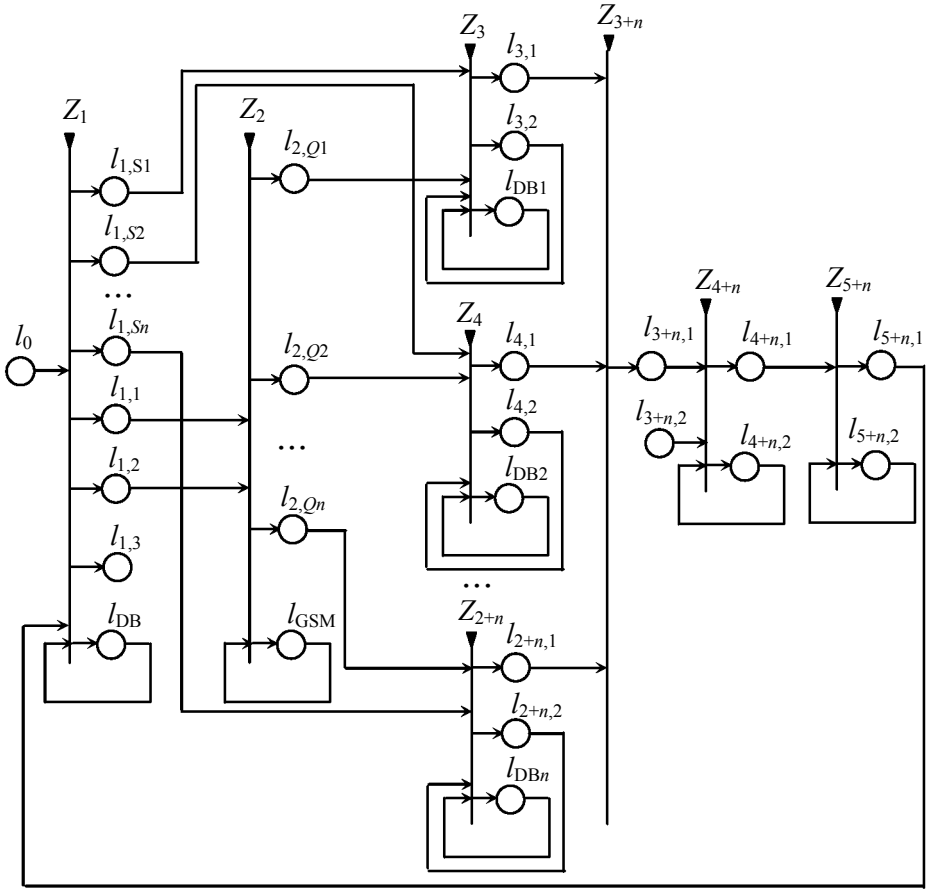

Figure 1: Generalized net model of avoiding healthcare fraud

Tokens β will enter the net via place l_0 in certain time-moments that will be determined stochastically, when the model is simulated, or they will correspond to real events, when the GN is used for observation of real processes. These tokens have initial characteristic:

"New patient; Name and surname; Address; PID;
Cellular Phone Number; Types of services / procedures for access;
Additional information: debit / credit card; IBAN number".

Tokens ε enter the net via place $l_{3+n,2}$ in some time-moments with initial characteristic:

"Query from the eStore".

$$Z_1 = <\{l_0, l_{DB}, l_{5+n,1}\}, \{l_{1,1}, l_{1,2}, \ldots, l_{1,n}, l_{1,n+1}, l_{1,n+2}, l_{1,n+3}, l_{DB}\},$$

	$l_{1,1}$	$l_{1,2}$	...	$l_{1,n}$	$l_{1,n+1}$	$l_{1,n+2}$	$l_{1,n+3}$	l_{DB}
l_0	*false*	*false*	...	*false*	*false*	*false*	*false*	*true*
l_{DB}	$W_{1,1}$	$W_{1,2}$	...	$W_{1,n}$	$W_{1,n+1}$	$W_{1,n+2}$	$W_{1,n+3}$	*true*
$l_{5+n,1}$	*false*	*false*	...	*false*	*false*	*false*	*false*	*true*

>,

where:

$W_{1,i}$ = "There is a new patient for service i",
$W_{1,i+1}$ = "There is a free call from patient",
$W_{1,i+2}$ = "There is a SMS from patient",
$W_{1,i+3}$ = "There is an unregistered patient".

The $\beta_1', \beta_2', ..., \beta_n'$, tokens entering respectively places $l_{1,1}$, $l_{1,2}$, …, $l_{1,n}$ obtain characteristic

"Patient j: Name and surname, Address, PID, Cell Phone Number,
Service i, Additional information: debit / credit card, IBAN number".

The $\beta_1'', \beta_2'', ..., \beta_n''$, tokens entering respectively places $l_{1,n+1}$, $l_{1,n+2}$, $l_{1,n+3}$ obtain characteristics, respectively:

"Patient j, Free call",
"Patient j, SMS",
"Unregistered patient".

$$Z_2 = <\{ l_{1,n+1}, l_{1,n+2}, l_{GSM}\}, \{l_{2,1}, l_{2,2}, \ldots, l_{2,n}, l_{GSM}\},$$

	$l_{2,1}$	$l_{2,2}$	...	$l_{2,n}$	l_{GSM}
$l_{1,n+1}$	*false*	*false*	...	*false*	*true*
$l_{1,n+2}$	*false*	*false*	...	*false*	*true*
l_{GSM}	$W_{2,1}$	$W_{2,1}$	...	$W_{2,n}$	*true*

>,

Where:

$W_{2,i}$ = "There is a Free call or SMS for service i".

The $\gamma_1', \gamma_2', ..., \gamma_n'$, tokens entering respectively places $l_{2,1}$, $l_{2,2}$, …, $l_{2,n}$ obtain characteristic

"Patient j: Service / procedures for access i"

$$Z_{2+i} = <\{ l_{1,i}, l_{2,i}, l_{2+i,2}, l_{\mathrm{DB}i}\}, \{ l_{2+i,1}, l_{2+i,2}, l_{\mathrm{DB}i} \},$$

	$l_{2+i,1}$	$l_{2+i,2}$	$l_{\mathrm{DB}i}$
$l_{1,i}$	*false*	*false*	*true*
$l_{2,i}$	*false*	*false*	*true*
$l_{2+i,2}$	*false*	*false*	*true*
$l_{\mathrm{DB}i}$	$W_{\mathrm{DB}i,1}$	$W_{\mathrm{DB}i,2}$	*true*

$>$,

where:

$W_{\mathrm{DB}i,1}$ = "There is a transaction ready for starting",
$W_{\mathrm{DB}i,2}$ = "There is a Checks on incoming transaction for service i".

The $\alpha'_{DBi}, \alpha''_{DBi}$ tokens entering places $l_{2+i,1}$, $l_{2+i,2}$ obtain the characteristics

"Transaction for starting"

in place $l_{2+i,1}$, and they obtain the characteristics

"Checked transaction"

in place $l_{2+i,2}$.

$$Z_{3+n} = <\{ l_{3,1}, l_{4,1}, ..., l_{2+n,1}\}, \{ l_{3+n,1}\},$$

	$l_{3+n,1}$
$l_{3,1}$	*true*
$l_{4,1}$	*true*
....	....
$l_{2+n,1}$	*true*

$>$.

The α' token that enters place $l_{3+n,1}$ obtain characteristic:

"Encrypted transaction".

$$Z_{4+n} = <\{ l_{3+n,1}, l_{3+n,2}, l_{4+n,2}\}, \{ l_{4+n,1}, l_{4+n,2}\},$$

	$l_{4+n,1}$	$l_{4+n,2}$
$l_{3+n,1}$	*false*	*true*
$l_{3+n,2}$	*false*	*true*
$l_{4+n,2}$	W_4	*true*

$>$,

where:

W_4 = "There is a transaction for the server for banking transactions".

The χ' token that enters place $l_{4+n,1}$ obtain characteristic:

"Approved transaction for the server for banking transactions".

$$Z_{5+n} = <\{ l_{4+n,1}, l_{5+n,2}\}, \{ l_{5+n,1}, l_{5+n,2}\},$$

	$l_{5+n,1}$	$l_{5+n,2}$
$l_{4+n,1}$	*false*	*true*
$l_{5+n,2}$	W_5	*true*

>,

where:
W_5 = "There is a message for a patient".

The δ' token that enters place $l_{5+n,1}$ obtain characteristic:
"Message for a patient for the status of a transaction".

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The papers presented in this Volume 2 constitute a collection of contributions, both of a foundational and applied type, by both well-known experts and young researchers in various fields of broadly perceived intelligent systems.
It may be viewed as a result of fruitful discussions held during the Ninth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2010) organized in Warsaw on October 8, 2010 by the Systems Research Institute, Polish Academy of Sciences, in Warsaw, Poland, Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences in Sofia, Bulgaria, and WIT - Warsaw School of Information Technology in Warsaw, Poland, and co-organized by: the Matej Bel University, Banska Bystrica, Slovakia, Universidad Publica de Navarra, Pamplona, Spain, Universidade de Tras-Os-Montes e Alto Douro, Vila Real, Portugal, and the University of Westminster, Harrow, UK:

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The consecutive International Workshops on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGNs) have been meant to provide a forum for the presentation of new results and for scientific discussion on new developments in foundations and applications of intuitionistic fuzzy sets and generalized nets pioneered by Professor Krassimir T. Atanassov. Other topics related to broadly perceived representation and processing of uncertain and imprecise information and intelligent systems have also been included. The Ninth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2010) is a continuation of this undertaking, and provides many new ideas and results in the areas concerned.

We hope that a collection of main contributions presented at the Workshop, completed with many papers by leading experts who have not been able to participate, will provide a source of much needed information on recent trends in the topics considered.

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