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Optimization of Searches on Social Networks using Graph theory and Formal Concepts Analysis

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***Abstract*— Social networking system is an online service, platform that focuses on facilitating the building of social relations among people who, for example, share interests, activities, backgrounds, or real-life connections. It consists of a representation of each user often a profile, his/her social links, and a variety of additional services. With all this benefits of social media networks, there is a challenge when it comes to searching ones interest on the network. It becomes difficult for people to search and get results of all things they liked and other activities that connect them and others. For example one cannot currently find all those he is related to (family wise, etc) that have come from his hometown on these social networks as well as all his friends who currently visited a particular place within a particular period. The relationships and links between data sets on such networks can be analyzed in the domain of mathematical ontologies where the data representation is done in a hierarchical manner based on formal concepts (mathematization of concept and concept hierarchy).**

This paper proposes a new way of searching and getting results from the linked data available on social networks. This paper combined two approaches: that is graph theory (graph search) for searching through the data set and Formal Concept Analysis, or Galois Lattices, a data analysis technique grounded on Lattice Theory and Propositional Calculus for evaluation, analysis and visualization of data. This method considered the set of common and distinct attributes (links and likes) of objects in such a way that categorization and presentation of searched results are arranged in a way that neighbor results that are related to the search criteria are displayed first.

***Index Terms*— Social networks, Graph theory, FCA, graph search, optimization**

I. INTRODUCTION

In today's world, everybody wants to connect to each other via mobile devices and find or locate anything of interest by the click of the mouse. Social networks provide such opportunity for people to get connected and share ideas and communicate in real time. But with all these opportunities and availability of data on social networks, it becomes very difficult for one to easily just search and get results from these related data. Google likes wise provide a search for information about connected data across the internet but failed to provide results on linked data to an individual and his relationship with other data sets. Social networks such as Facebook, Google+, tumblr and Twitter widely used worldwide; Nexopia in Canada;[1] Badoo,[2] Bebo,[3] VKontakte, Draugiem.lv (mostly in Latvia), Hi5, Hyves (mostly in The Netherlands), and others stand a chance of creating a possibility where data can be viewed based on how a search is related to a particular key word or set of key words. People on twitter, Facebook and co will like to search for connected activities that is common to a particular group or that is related to a particular group they have belonged to. Every individual will one day like to know in the future a family tree from which he belongs based on dataset stored on his generation years before and currently. The social networks provide data for such opportunity in the future. Hence this research provides a way for how such data and results can be retrieved from these stored and related data in an optimized way by using the approach of graph search and formal concept analysis.

Social networking system is an online service, platform that focuses on facilitating the building of social relations among people who, for example, share interests, activities, backgrounds, or real-life connections. It consists of a representation of each user often a profile, his/her social links, and a variety of additional services. Most social network services are web-based and provide means for users to interact over the Internet, such as e-mail and instant messaging. Online community services are sometimes considered as a social network service, though in a broader sense, social network service usually means an individual-centered service whereas online community services are group-centered. Social networking sites allow users to share ideas, activities, events, and interests within their individual networks. [4]

Social networking has a lot of positive influence on society in today's world, ranging from academics, parenting, industry, and to other social and relational part of human life. Nonetheless the minor risks in online social networking potential benefits are more. Social networking can provide opportunities for new relationships as well as strengthening existing relationships, whether your kids' friends are close to home or across the world. It's important to be vigilant when your kids are getting involved in online social networking, but it's also good to encourage positive relationships through various avenues, including the Internet. [5]

As the increase in popularity of social networking is on a

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constant rise,[6] new uses for the technology are constantly being observed.Social networking is becoming increasingly important in schools—Facebook, Moodle, SecondLife, Digg, and other sites are often used by teachers to communicate with students or for out-of-classroom discussions.

The National School Boards Association reports that almost 60 percent of students who use social networking talk about education topics online, and more than 50 percent talk specifically about schoolwork. Yet the vast majority of school districts have stringent rules against nearly all forms of social networking during the school day — even though students and parents report few problem behaviors online. Social networks focused on supporting relationships between teachers and their students are now used for learning, educational professional development, and content sharing. Ning for teachers, TermWiki, Learn Central,[4] TeachStreet and other sites are being built to foster relationships that include educational blogs, eportfolios, formal and ad hoc communities, as well as communication such as chats, discussion threads, and synchronous forums. These sites also have content sharing and rating features.[4] Hence it is necessary for to be able to search for groups based on certain discussions on these social network provided it has been made public (public settings).

The use of virtual currency systems inside social networks creates new opportunities for global finance. Hub Culture operates a virtual currency Ven used for global transactions among members, product sales and financial trades in commodities and carbon credits.[4, 7, 8]

Social networks are also being adopted by healthcare professionals as a means to manage institutional knowledge, disseminate peer to peer knowledge and to highlight individual physicians and institutions. [9]

Social networking sites have recently showed a value in social and political movements. [10] In the Egyptian revolution, Facebook and Twitter both played a pivotal role in keeping people connected to the revolt. Egyptian activists have credited social networking sites with providing a platform for planning protest and sharing news from Tahrir Square in real time. By presenting a platform for thousands of people to instantaneously share videos of mainly events featuring brutality, social networking proves to be a vital tool in revolutions. [4, 11]

With all this benefits of social media networks, there is a challenge when it comes to searching ones interest on the network. It becomes difficult for people to search and get results of all things they liked and other activities that connect them and others. For example one cannot currently find all those he is related to (family wise, etc) that have come from his hometown on these social networks as well as all his friends who currently visited a particular place within a particular period.

This research work proposes a new way of solving the above challenge of the social networking sites. It proposes a method that combines two approaches: that is graph theory (graph search) for searching through the data set and Formal Concept Analysis, or Galois Lattices, a data analysis technique grounded on Lattice Theory and Propositional Calculus for evaluation, analysis and visualization of data.

The organization of this paper is as follows, section II of this paper provides details of the related work in the domain of graph theory, graph search and formal concept analysis. Section III proposes how the new approach will be implemented to facilitate effective data search using graph theory and FCA. Section IV provides application and results: A data will be used as sample and the algorithms for search will be implemented and demonstrated to show its effectiveness. The last section of this paper, section V, Concludes the paper.

II. Related works

A social network is a social structure made up of a set of actors and the dyadic ties between these actors. [12] The study of these structures uses social network analysis to identify local and global patterns, locate influential entities, and examine network dynamics. At the micro-level, social network begins with an individual, snowballing as social relationships are traced, or may begin with a small group of individuals in a particular social context as shown in figue 1 below[13,14].

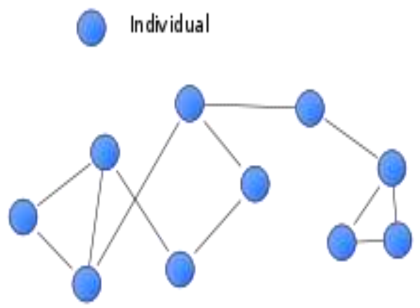

Fig 1 Social network diagram, micro-level

At the messo (population size that falls between the micro- and macro-levels) shown in figure 2 [14] and macro level as shown in figure 3[14], social complexity is displayed. The interpersonal interactions at this level analyses generally the outcomes of interactions over a large population.

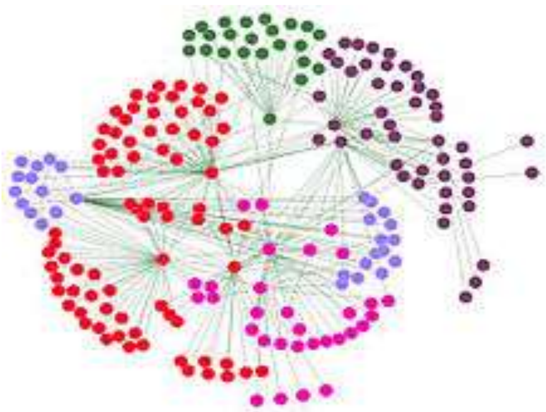

Fig 2 Social network diagram, messo-level

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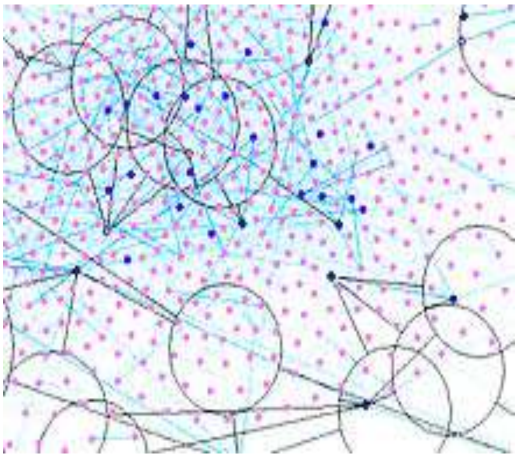

Fig 3 Social network diagram, macro-level

Collaboration graph modeling technique can be used be analyze the social network where the vertices represent participants of that network (usually individual people) and where two distinct participants are joined by an edge whenever there is a collaborative relationship between them of a particular. [15, 16, 17]

Formal concept analysis (FCA) is a method of data analysis with growing popularity across various domains .FCA analyzes data which describe relationship between a particular set of objects and a particular set of attributes. Such data commonly appear in many areas of human activities. FCA produces two kinds of output from the input data. The first is a concept lattice. A concept lattice is a collection of formal concepts in the data which are hierarchically ordered by a subconcept-super concept relation. Formal concepts are particular clusters which represent natural human-like concepts such as “organism living in water”, “car with all wheel drive system”, “number divisible by 3 and 4”,etc. The second output of FCA is a collection of so-called attribute implications. An attribute implication describes a particular dependency which is valid in the data such as “every number divisible by 3 and 4 is divisible by 6”,“every respondent with age over 60 is retired”, etc.[18]

In the field of software engineering and computer science, Formal Concept Analysis (FCA) has generally been applied to support software maintenance activities — the refactoring or medication of existing code — and to the identification of object-oriented (OO) structures.

Risk Matrix is a matrix that is used during Risk Assessment to define the various levels of risk as the product of the harm probability categories and harm severity categories. This is a simple mechanism to increase visibility of risks and assist management decision making. Risk matrix is presented for use in identifying and assessing project risks quickly and cost effectively. But how risks are related and visualized at various phases becomes very difficult to be seen as the activity becomes many and complex with software projects. QA kester proposed a new method of evaluation, analysis and visualization of the Assessment Evaluation of Risks Matrix in software engineering based on Formal Concept Analysis, or Galois Lattices, a data analysis technique grounded on Lattice Theory and Propositional Calculus. The method has helped in building a more defined and conceptual systems for Evaluation of risk Levels that can easily be visualized in software engineering projects. [19]

There is also a body of literature reporting the application of FCA to the identification and maintenance of class hierarchies in database schemata [20, 21, 22]. And also Simon Andrew sand Simon Polovina presented an outline of a process by which operational Software requirements specification can be written for Formal Concept Analysis (FCA). The Z notation was issued to specify the FCA model and the formal operations on it. They conceive a novel approach where by key features of Z and FCA can be integrated and put to work in contemporary software development, thus promoting operational specification as a useful application of conceptual structures. [23]

Module and Object Identification with FCA: Sahraoui et al. [24] present a method that extracts objects from procedural code using FCA. Important concepts are looked for in the resultant lattices using heuristics. Another approach compares the object identification capability of clustering and FCA techniques [25]. A few heuristics are described to interpret the concepts of the lattice. An approach to transform a COBOL legacy system to a distributed component system is proposed by Canfora et al. [26]. Siff and Reps explore the relationship between program variables and procedures through FCA for restructuring of C programs [27].

Modern police organizations and intelligence services are adopting the use of FCA in crime pattern analysis for tracking down criminal suspects through the integration of heterogeneous data sources and visualizing this information so that a human expert can gain insight in the data [28] It has also been applied in the analysis and visualization of crime patterns [29].

Mehdi Kaytoue-Uberall, S´ ebastien Duplessis, and Amedeo Napoli worked on Using Formal Concept Analysis for the Extraction of Groups of Co-expressed Genes. They presented a data-mining approach in gene expression traces. Their method was aimed at extracting formal concepts, representing sets of genes that present similar quantitative variations of expression in certain biological situations or environments. Formal Concept Analysis was used both for its abilities in data-mining and information representation. [30]

Formal Concept Analysis has been developed as a field of applied mathematics based on a mathematization of concept and concept hierarchy. It there by allows us to mathematically represent, analyze and construct conceptual structures. It has been proven useful in a wide range of application areas such as medicine and psychology, sociology and linguistics, archaeology and anthropology, biology and chemistry, civil and electrical engineering, information and library sciences, information technology and software engineering, computer science and even mathematics itself.[31 32]

The theory of complex networks plays an important role in a wide variety of disciplines, ranging from computer science, sociology, engineering and physics, to molecular and population biology. A social network is usually represented by a graph, in which the set of vertices represent the actors in asocial network and the edges represent ties between them [33].

Typically, actors are people, and examples of a tie between two actors include acquaintance, friendship, or other type of association between them, such as visiting the same social event or place at the same time. Alternately, actors can be companies, with ties representing business transactions between them.

Complex social and information network search becomes important with a variety of applications as growth in networks becomes cumbersome and complex. In the core of these applications, lies a common and critical problem: Given a labeled network and a query graph, how to efficiently search the query graph in the target network. The presence of noise and the incomplete knowledge about the structure and content of the target network make it unrealistic to find an exact match. Rather, it is more appealing to find the top-k approximate matches. In solving this problem, Arijit Khan et al proposed a neighborhood-based similarity measure that could avoid costly graph isomorphism and edit distance computation. Under this new measure, they proved that subgraph similarity search is NP hard, while graph similarity match is polynomial. By studying the principles behind this measure, they have found a formation propagation model that was able to convert a large network into a set of multidimensional vectors, where sophisticated indexing and similarity search algorithms are available. The proposed method, called Ness (Neighborhood Based Similarity Search),was appropriate for graphs with low automorphism and high noise, which are common in many social and information networks. Ness is not only efficient, but also robust against structural noise and information loss. Empirical results showed that it can quickly and accurately find high-quality matches in large networks, with negligible cost.[34]

Modern search engines such as Google, Bing, yahoo etc, logically retrieve information on searches based on keyword-based queries extremely efficiently. The impressive speed is due to clever inverted index structures, caching, a domain-independent knowledge of strings, and thousands of machines. Several research efforts have attempted to generalize keyword search to keytree and keygraph searching, because trees and graphs have many applications in next-generation database systems. Shasha, Dennis, Jason TL Wang, and Rosalba Giugno[35] proposed an algorithm that focused primarily on pattern-matching based algorithm for fast searching in trees and graphs. This algorithm supported directly queries on data types and it could also be used as preprocessor for join-like algorithms [36]

Many AI problems can be cast as the problem of finding a path in a graph. A graph is made up of nodes and arcs. Arcs are ordered pairs of nodes that can have associated costs. For a finite graph without cycles, it will eventually find a solution no matter which order you select paths on the frontier. Some strategies for selecting paths from the frontier expand fewer nodes that other strategies. As part of the definition of the algorithm a solution is only found when a goal node is selected from the frontier, not when it is added. [37]

This research work proposes a new way of searching on the social networking by proposing a method that combines graph theory (graph search) for searching through the data set and Formal Concept Analysis for structuring and analyzing data.

III. Methodology

The first step of this research work is to use formal concept analysis to organize the data based on their relationships and then, secondly, use graph search theory to find paths, based on key words of interest, within the Hasse diagram generated from the data.

Formal Concept Analysis, or Galois Lattices, is a data analysis technique grounded on Lattice Theory and Propositional Calculus. This method considered the set of common and distinct attributes (links and likes) of objects in such a way that categorization and presentation of searched results are arranged in a way that neighbor results that are related to the search criteria are displayed first.

In FCA a formal context consists of a set of objects, G, a set of attributes, M, and a relation between G and M, $I \subseteq G \times M$. A formal concept is a pair (A, B) where $A \subseteq G$ and $B \subseteq M$. Every object in A has every attribute in B. For every object in G that is not in A, there is an attribute in B that objects does not have. For every attribute in M that is not in B there is an object in A that does not have that attribute. A is called the extent of the concept and B is called the intent of the concept.

If $g \in A$ and $m \in B$ then $(g,m) \in I$,or gIm.
A formal context is a tripel (G,M,I), where
- G is a set of objects,
- M is a set of attributes
- and I is a relation between G and M.
- $(g,m) \in I$ is read as „object g has attribute m".

For $A \subseteq G$, we define
$A' := \{m \in M \mid \forall g \in A: (g,m) \in I\}$.
For $B \subseteq M$, we define dually
$B' := \{g \in G \mid \forall m \in B: (g,m) \in I\}$.

For A, A1, A2 ⊆ G holds:
- $A1 \subseteq A2 \Rightarrow A`2 \subseteq A`1$
- $A 1 \subseteq A``$
- $A` = A```$

For B, B1, B2 ⊆ M holds:
- $B1 \subseteq B2 \Rightarrow B`2 \subseteq B`1$
- $B \subseteq B``$
- $B` = B```$

A formal concept is a pair (A, B) where
- A is a set of objects (the extent of the concept),
- B is a set of attributes (the intent of the concept),
- $A` = B$ and $B` = A$.

The concept lattice of a formal context (G, M, I) is the set of all formal concepts of (G, M, I), together with the partial order

$(A1, B1) \leq (A2, B2): \Leftrightarrow A1 \subseteq A2$ $(\Leftrightarrow B1 \supseteq B2)$.

The concept lattice is denoted by 𝔅(G,M,I) .

• Theorem: The concept lattice is a lattice, i.e. for two concepts (A1, B1) and (A2, B2), there is always

•a greatest common subconcept: (A1∩A2, (B1∪ B2) ´´)

•and a least common superconcept: ((A1 ∪ A2) ´´, B1∩B2)

More general, it is even a complete lattice, i.e. the greatest common subconcept and the least common superconcept exist for all (finite and infinite) sets of concepts.

Corollary: The set of all concept intents of a formal context is a closure system. The corresponding closure operator is h(X):= X``.

An implication X→Y holds in a context, if every object having all attributes in X also has all attributes in Y.

Def.: Let X ⊆M. The attributes in X are independent, if there are no trivial dependencies between them.

Galois lattice formation: for a context (ε , *A*, R)

In a context (ε , *A*, R), each concept (E, A) with E ⊆ ε and A ⊆ *A*. follows the properties:

• E contains each of the objects e ∈ ε verifying all the attributes in A,With A ⊆ *A*, e(A) = {e ∈ ε | e R a, ∀ a ∈ A} represents the extension part of A.

• A contains each of the attributes a ∈ *A* true for the objects in E. With E ⊆ ε , d(E)={a ∈ *A* | e R a, ∀ e ∈ E} represents the intention part of E.

• a pair (E,A) with E⊆ ε and A⊆*A* , is a concept iff d(E)=A and e(A)=E. For a context (ε , *A*, R), the structure L(ε ,*A*,R)={(E,A) | (E,A) is a concept of (ε ,*A*,R)} ordered by (E1 , A1)≥(E2 , A2) ⇔ A1 ⊆ A2 (formally equivalent to E2 ⊆ E1) is a concept lattice [37].

For a context (ε ,*A*,R) and two concepts (E1 , A1), (E2 , A2), the operations ∧ and ∨ are :

(E1 , A1) ∨ (E2 , A2) = (E, A) with E=e(A1 ∩ A2) and A= A1 ∩ A2

(E1 , A1) ∧ (E2 , A2) = (E, A) with E=E1 ∩ E2 and A= d(E1 ∩ E2).

The ∧ operation is defined from the intersection of the extensions while the ∨ operation corresponds to the intersection of the intensions as seen in figure 4.

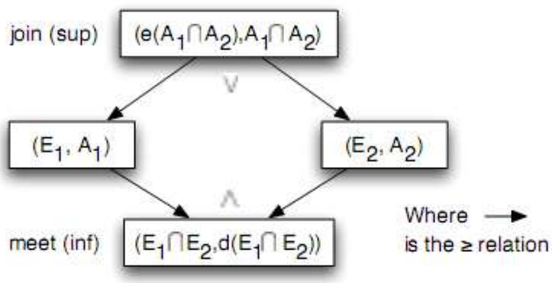

Fig 4 Classical Galois lattice operations

There are many algorithms for the construction of the Galois lattice for a context (E,A,R) [38]. In this paper used the algorithm [39] because it is simple, it uses general lattice operations and it is incremental: it computes the lattice at step n+1 from the lattice at step n and the description of a new example (at the first step begins with an empty lattice). The general description of the algorithm is shown below.

```
Algorithm: A concept Lattice construction algorithm
Procedure: maximal
Data: A couple (E,A)
Data: A list Ln of concepts
Result: A boolean
if (there is a (Ej ,Aj ) ∈ Ln with Aj = A) then
    return false;
else
    return true;
end
Procedure:AddExample
Data: Cn :(En , An , Rn )
Data: A list Ln of concepts
Result: A boolean
if (there is a (Ej ,Aj ) ∈ Ln with Aj = A) then
    return false;
else
    return true;
end
Procedure:AddExample
Data: Cn :( ε n , An , Rn )
Data: A new Example : a couple ({e},A), with e an identifier of an example, and
A ⊆ An the description of the example e.
Result: A list Ln+1 of concepts
Ln+1 =Ln ;
for each concept (Ei , Ai ) ∈ Ln do
if (Ai ⊆ A) then
    Replace (Ei , Ai ) in Ln by (Ei ∪{e},Ai );
else
    // ∨ operation;
    compute (E ´ ,A ´ )=(e(Ai ∩ A),(Ai ∩ A));
if maximal((E ´ ,A ´ ),Ln+1 ) then
    add (E ´ ,A ´ ) to Ln+1 ;
end
end
end
if maximal(({e},A),Ln+1 ) then
    add ({e},A) to Ln+1 ;
end
    return Ln+1 ;
    Algorithm: Norris's Algorithm:
    Data: A context (E, A, R)
    Result: The list L of all concepts in (E, A, R)
    L = Ø;
for each example e ∈ E do
    L= AddExample(({e},d(e)),L);
end
return L;
```

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Let's consider the relation R between E={e0 ,e1 ,e2 ,e3 ,e4 } and A={a0 ,a1 ,a2 ,a3 ,a4 ,a5 ,a6 } defined by the table in figure 5 below.

$$\begin{array}{c} \\ e_0 \\ e_1 \\ e_2 \\ e_3 \\ e_4 \end{array}\begin{array}{ccccccc} a_0 & a_1 & a_2 & a_3 & a_4 & a_5 & a_6 \\ 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 & 1 & 1 \end{array}$$

Fig 5 Relation R

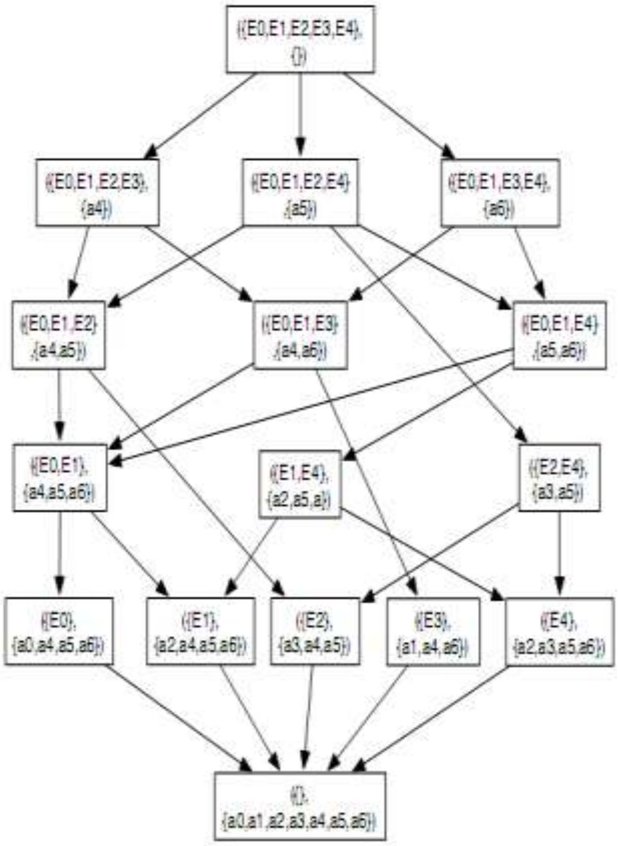

Fig 6 the Galois lattice of R, on the form of its Hasse diagram.

This binary relation gives the Galois lattice as shown in figure 6 above.

A Hasse diagram is obtained for a particular situation where the states (nodes) are linked to others with edges based on their relationships. Hasse diagrams are a type of mathematical diagram used to represent a finite partially ordered set, in the form of a drawing of its transitive reduction.

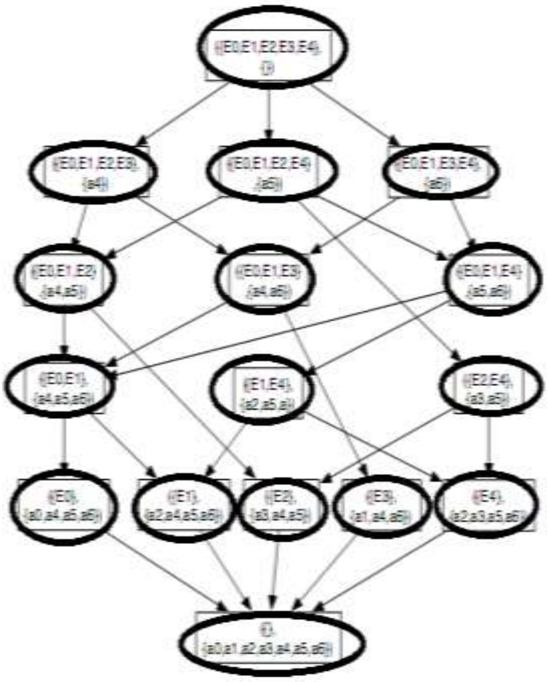

Fig 7 nodes and edges from the Hasse diagram

We obtain the nodes and edges from the Hasse diagram from figure 6 as shown in figure 7. We then initialize a search based on the key attributes of keywords and then retrieve a subgraph as an output result from the main.

The graph searching algorithm will have the following:

Repeat

- Select a path on the frontier that is having the keyword or keywords. Let's call the path selected P.
- if P is a path to a goal node, stop and return P,
- remove P from the frontier
- for each neighbor of the node at the end of P, extend P to that neighbor and add the extended path to the frontier.

Continue until the frontier is empty. When it is empty there are no more solutions based on the search.

This paper will look at two algorithms which represent the two main approaches to searching graphs that is a process that visits each node of a graph. These algorithms are known as breadth first search (BFS) and depth first search (DFS) and they are polar opposites. Each search has to begin with some node known as root. After searching from a given root, the search may terminate based on results obtained without having reached all of the nodes. Hence the search must be restarted from a new node [40].

The Breadth First Search Algorithm

{Initialization}

Label each node- 1; {-1 means that the node has not been visited}

Set d←0;

{Main Program}

While there are nodes labeled -1 {choose a root}

Choose such a node with no antecedents label it d;

Else {there is no node labeled -1 and without antecedents} choose a node labeled- 1 and label it d;
d←d+1;
While there are nodes labeled -1 that can be reached from node labeled d
Mark each node d+1 {that is those nodes just referred to}
d←d+1.
{end While}
{end While}

In DFS, let each node have two labels v and l. The label v refers to when the node was first visited and the label 1 refers to when it was last visited. Once the l-value of a node is set to a positive number then v<l for that node. At the beginning of the algorithm each node is marked (0,0). Once the algorithm is finished, the only 0 is the v coordinate of the first root.

Given two nodes labeled (v1, l1) and (v2, l2) there are two possibilities. Either one pair is within the other pair as here: v1<v2<l2< l1 or the pairs are disjoint as here: v1, l1 < v2,l2. If the pairs are disjoint then they fall along different branches of the search tree. Otherwise, the inner pair is deeper in the same tree as the outer pair. That means that it is from the root. We will separate the DFS algorithm into four distinct procedures: Get Root, Go Forward, Go Backward and DFS. Once the algorithm is underway, there is a current node, C. If a node N has label (x,y) we write V(N) = x and L(N) = y. At any given time the algorithm is designed to go forward). When it can't go further it backs up to the prior node and tries to go further down another path. When the algorithm cannot go further and cannot back up then the algorithm looks for another root. When the algorithm looks for another root and fails to find one, it terminates [40].

The DFS algorithm is as follows:

Get Root {This procedure is only run when it is called from DFS}
If there is a node labeled (0,0) with no antecedent
Then make this node C {it is current} and set V(C) ←T;{T for time}
Else If there is a node labeled (0,0) {and all such nodes have antecedents}
Make it C and set V(C) ←T;
Else Stop {algorithm is finished};
T←T+1. {end Get Root}

Go Forward {This procedure is only run when it is called from DFS}
Iterate2 ← True; Iterate←False
While Iterate2
If an arc goes from C to a node labeled (0,0)
Then make it C and set V(C) ←T; Iterate←True; T←T+1;
Else Iterate2 = False;
{end Go Forward}.

Go Backward {This procedure is only run when it is called from DFS}
Iterate←False;
L(C) ←T
If there is an antecedent node
Then
Find an antecedent node, N, with V(N) = V(C)-1;
Set L(C) ←T;
C←N; {make N current}
Else Iterate←False;
T←T+1.{End Go Backward}.

DFS {This is the main procedure}
Mark each node (0,0);
Set T←0
Repeat
Get Root {termination occurs in Get Root}
Iterate←True
While Iterate
Go Forward
Go Backward
{end DFS}.

This paper proposes a new way of searching and getting results from linked data available on social networks. This links can be the likes of an individual, relationship between photos and people as well as places, friends of people, places one have been to, public comments made by an individual, photos or comments shared by individuals, etc. Formal lattices as a visualization and analysis tool will be used to analyze the relationships between an individual and other entities based on search key words. Graph search algorithm will be used to find key terms within each concept of the lattice and return the results in a hierarchical manner.

This paper combined two approaches: that is graph theory (graph search) for searching through the data set and Formal Concept Analysis, or Galois Lattices, a data analysis technique grounded on Lattice Theory and Propositional Calculus for evaluation, analysis and visualization of data. This method considered the set of common and distinct attributes (links and likes) of objects in such a way that categorization and presentation of searched results are done in a way that neighbor context with more attributes that are related to the search criteria are displayed first.

IV. APPLICATIONS AND RESULTS

The application approach considers a set of persons, P, as the object and the entities they liked, A, as the attributes.

Let A= {male, female, schoolmate, co-worker, brother, sister, city Accra, swimming, 19<age<30}

P= {Kester, Elorm, Quist, Yao, Aphetsi, Habame, Woemikpor}

Let the table 1 below, be a relationship between Yakayake, a person, and his friends from the set of P that the shared some common attributes, A, with him(Yakayake)

Let Yakayake = Y

Table 1: Relation Q (Relationship between Y and elements of set P)

	A1	A2	A3	A4	A5	A6	A7	A8	A9
P1	x		x	x			x	x	
P2		x				x	x		x
P3	x		x		x		x	x	
P4	x			x				x	
P5									
P6		x		x			x		x
P7		x	x						x

Below is the binary relation codind represented in the table 1 above.

```
<?xml version="1.0" encoding="UTF-8"?>
<BIN name="YContext.slf" nbObj="7" nbAtt="9" type="BinaryRelation">
  <OBJS>
    <OBJ id="0">P1</OBJ>
    <OBJ id="1">P2</OBJ>
    <OBJ id="2">P3</OBJ>
    <OBJ id="3">P4</OBJ>
    <OBJ id="4">P5</OBJ>
    <OBJ id="5">P6</OBJ>
    <OBJ id="6">P7</OBJ>
  </OBJS>
  <ATTS>
    <ATT id="0">A1</ATT>
    <ATT id="1">A2</ATT>
    <ATT id="2">A3</ATT>
    <ATT id="3">A4</ATT>
    <ATT id="4">A5</ATT>
    <ATT id="5">A6</ATT>
    <ATT id="6">A7</ATT>
    <ATT id="7">A8</ATT>
    <ATT id="8">A9</ATT>
  </ATTS>
  <RELS>
    <REL idObj="0" idAtt="0" />
    <REL idObj="0" idAtt="2" />
    <REL idObj="0" idAtt="3" />
    <REL idObj="0" idAtt="6" />
    <REL idObj="0" idAtt="7" />
    <REL idObj="1" idAtt="1" />
    <REL idObj="1" idAtt="5" />
    <REL idObj="1" idAtt="6" />
    <REL idObj="1" idAtt="8" />
    <REL idObj="2" idAtt="0" />
    <REL idObj="2" idAtt="2" />
    <REL idObj="2" idAtt="4" />
    <REL idObj="2" idAtt="6" />
    <REL idObj="2" idAtt="7" />
    <REL idObj="3" idAtt="0" />
    <REL idObj="3" idAtt="3" />
    <REL idObj="3" idAtt="7" />
    <REL idObj="5" idAtt="1" />
    <REL idObj="5" idAtt="3" />
    <REL idObj="5" idAtt="6" />
    <REL idObj="5" idAtt="8" />
    <REL idObj="6" idAtt="1" />
    <REL idObj="6" idAtt="2" />
    <REL idObj="6" idAtt="8" />
  </RELS>
</BIN>
```

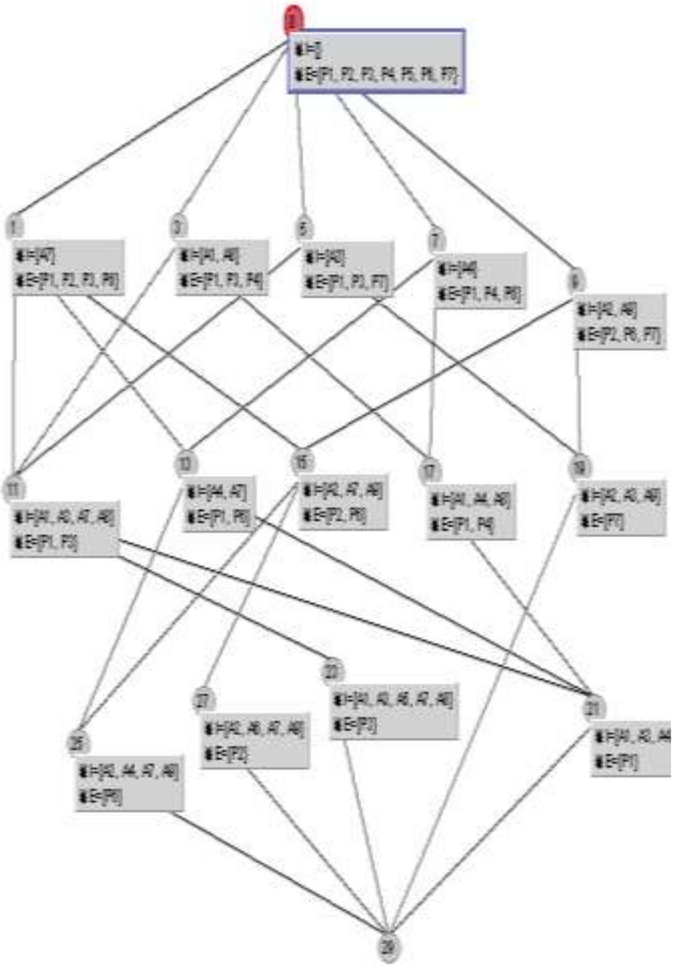

Fig 8 the Galois lattice of Q, on the form of its Hasse diagram.

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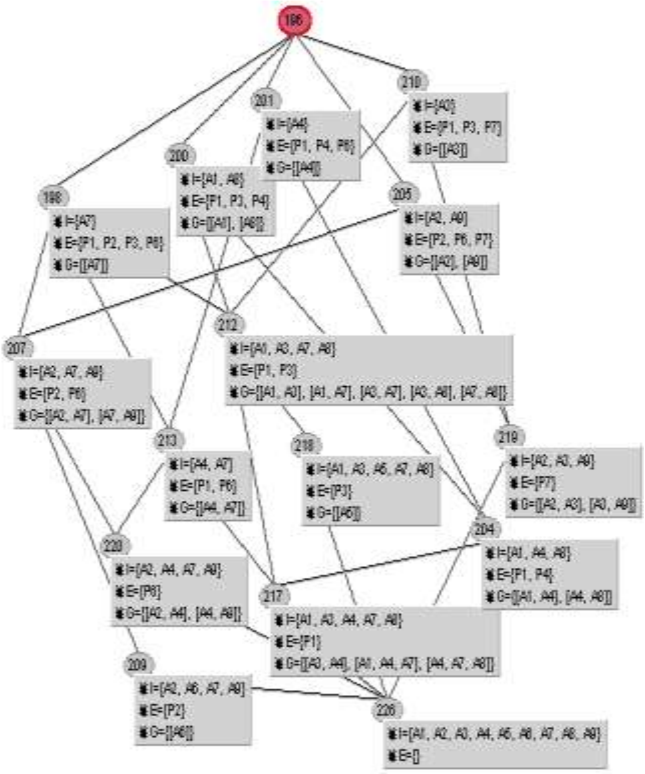

Fig 9 Galois lattice of (G, M, I).

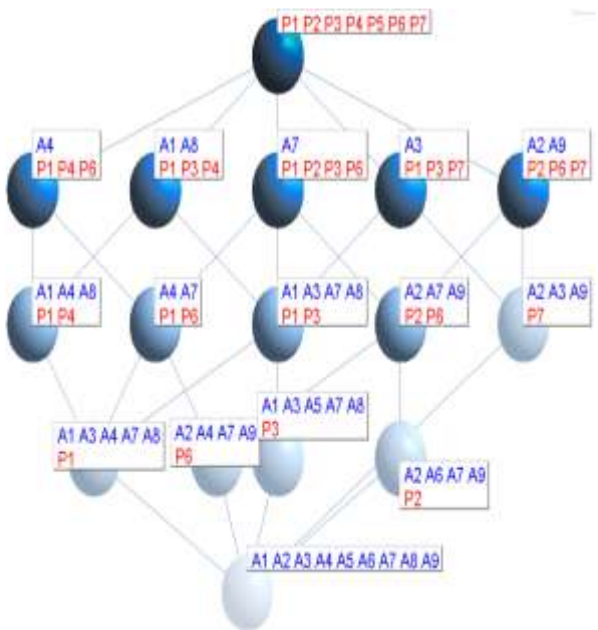

Fig 10 Representing concepts with nodes

Figure 8 represent the Galois lattice of Q, on the form of its Hasse diagram and figure 9 represents Galois lattice of (G, M, I). Figure 10 used nodes to represent each concept. It can be observed that the more the elements of the set of attributes are shared with y the lesser the elements of the set of people who shared those attributes with Y. This observation is common with search engines where the more the key words used the lesser the results.

A search was performed on the following criteria:

All the friends of Y who has attribute A4, A8 and A9.

From the above, the key words A4, A8 and A9.

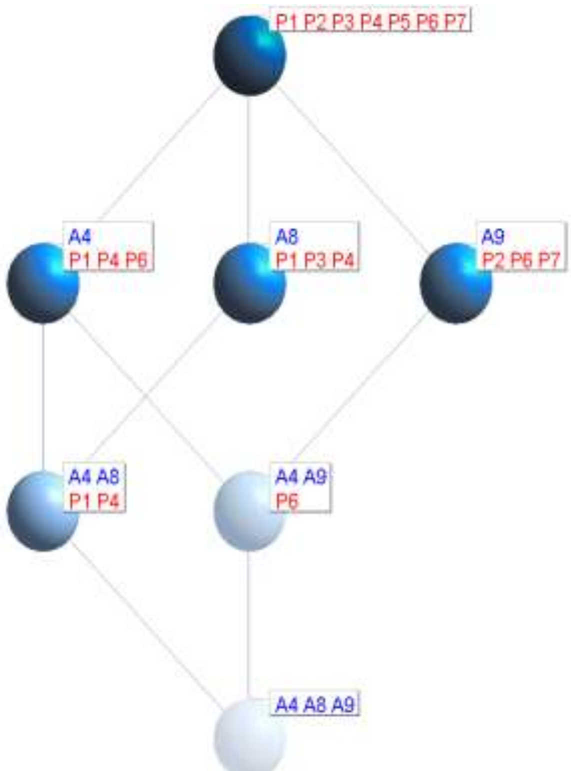

Fig 11 Representing concepts with nodes from the searched results

From the search results as shown in figure 11, for the first concept at the top from the left: p1, p4 and p6 have attributes A4. For the second concept: p1, p3 and p4 have attributes A8 and for the third concept: p2, p6 and p7 have attribute A9. For the first lower concept P1 and P4 shared two attributes A4 and A8, and P6 also shared two attributes A4 and A9. There is no element of P that has shared all the three attributes with Y during the search. For the vertex degree, counting from up to down and left to right we have V1, degree: 3, V2, degree: 3, V3, degree: 2, V4, degree: 2, V5, degree: 3, V6, degree: 3, and V7, degree: 2,

V. CONCLUSIONS

With this newly proposed method for social net networks, a graph search can now be possible. That is with the two approaches: graph theory (graph search) for searching through the data set and Formal Concept Analysis, or Galois Lattices, a data analysis technique grounded on Lattice Theory and Propositional Calculus for evaluation, analysis and visualization of data.

One can also do a search on what his friends like most, what his friends' friends likes as well as where they are and etc. The results one can get about a search on friend's likes and attributes will depend on what that friend is willing to share with others as well as his or her private settings. This means that a search with the same keyword or keywords can be performed by a set of individuals about an entity but they will all get different results at the end based on how they are related to that entity.

REFERENCES

[1] Nexopia stats on. Retrieved from http://www.Alexa.com.

[2] Elevator Pitch: Why Badoo wants to be the next word in social networking, Mark Sweney , The Guardian, December 24, 2007 .

[3] Bebo - most popular of its kind in UK,(August 2007): TechCrunch website. Retrieved on January 15, 2008.

[4] Social networking service. Retrieved from http://en.wikipedia.org/wiki/Social_networking_service

[5] Benefits of Online Social Networking Retrieved from http://www.parentfurther.com/technology-media/social-networking/benefits

[6] Search for e-commerce, social networking. Google Trends. Retrieved from http://www.mashable.com

[7] Economic insight and analysis from The Wall Street Journal. The Currency Revolution Retrieved from: http://blogs.wsj.com/economics /2009/09/09/ the-currency-revolution/

[8] Virtual currency used for commodity trade Retrieved from: http://www.finextra.com/news/fullstory.aspx?newsitemid=22475

[9] Social Networking: Now Professionally Ready". Retrieved from: http://www.primarypsychiatry.com.

[10] Auer, Matthew R. "The Policy Sciences of Social Media". Policy Studies Journal '"39"' (4): 709–736". Retrieved from: http://www.Papers.ssrn.com.

[11] Sutter, John D. (21 Feb 2011). "The faces of Egypt's 'Revolution 2.0'". Retrieved from: http://www.CNN.com.

[12] Wasserman, Stanley; Faust, Katherine (1994). "Social Network Analysis in the Social and Behavioral Sciences". Social Network Analysis: Methods and Applications. Cambridge University Press. pp. 1–27. ISBN

[13] Scott, W. Richard; Davis, Gerald F. (2003). "Networks In and Around Organizations". Organizations and Organizing. Pearson Prentice Hall. ISBN 0-13-195893-3.

[14] Social network. Levels of analysis. Retrieved from: http://en.wikipedia.org/ wiki/Social_network

[15] Pinheiro, Carlos A.R. (2011). Social Network Analysis in Telecommunications. John Wiley & Sons. p. 4. ISBN 978-1-118-01094-5.

[16] D'Andrea, Alessia et al. (2009). "An Overview of Methods for Virtual Social Network Analysis". In Abraham, Ajith et al.. Computational Social Network Analysis: Trends, Tools and Research Advances. Springer. p. 8. ISBN 978-1-84882-228-3.

[17] Social network analysis Retrieved from: http://en.wikipedia.org/wiki /Social_network_analysis

[18] Radimbˇ Elohl ´ Avek introduction to formal concept analysis Olomouc 2008.

[19] Kester, Quist-Aphetsi. "Application of Formal Concept Analysis to Visualization of the Evaluation of Risks Matrix in Software Engineering Projects." Interna-tional Journal of Science, Engineering and Technolo-gy Research [Online], 2.1 (2013): pp:220-225. Web. 15 Jan. 2013

[20] I. Schmitt and S. Conrad. Restructuring object-oriented database schemata by concept analysis. In T. Polle, T. Ripke, and K.-D. Schewe, editors, Funda-mentals of Information Systems(Post-Proceedings 7th International Workshop on Foundations of Models and Languages forData and Objects FoMLaDO'98), pages 177–185, Boston, 1999. Kluwer Academic Publish-ers.

[21] I. Schmitt and G. Saake. Merging inheritance hierar-chies for database integration. InProceedings of the 3rd International Conference on Cooperative Information Systems(CoopIS'98), New York, August 1998.

[22] H. Dicky, C. Dony, M. Huchard, and T. Libourel. ARES, adding a class and restructuringinheritance hierarchy. In BDA : Onzi` emes Journ´ ees Bases de Donn´ ees Avanc´ ees, pages 25–42, 1995.

[23] ANDREWS, S. and POLOVINA, S. (2008). Opera-tional specification for FCA using. In: 16th Interna-tional Conference on Conceptual Structures, Toul-ouse, France,

[24] H. A. Sahraoui, H. Lounis, W. Melo ,and H.Mili. A concept formation based approach to object identification in procedural code. Automated Software Engineering Journal,6(4):387–410,1999.

[25] A. Deursen and T. Kuipers. Identifying objects using cluster and concept analysis. In Proceedings of ICSE'99,pages246–255.ACMPress,1999.

[26] U.Dekel and Y.Gil. Revealing class structure with concept lattices. In WCRE, pages 353–362. IEEE Press,Nov.2003.

[27] M.Siff and T.Reps. Identifying modules via concept analysis. Transactions on Software Engineer-ing,25(6):749–768,Nov.1999.

[28] Security Informatics, Special issues on Formal Con-cept Analysis in Intelligence and Security Informatics Springer, 2012.

[29] Kester, Quist-Aphetsi. "Optimization of Searches on Social Networks using Graph theory and Formal Concepts Analysis." International Journal of Remote Sensing & Geoscience (IJRSG), 2.1 (2013):pp:30-35.

[30] Mehdi Kaytoue-Uberall, S´ ebastien Duplessis, and Amedeo Napoli. Using Formal Concept Analysis for the Extraction of Groups of Co-expressed Genes MCO2008,CCIS14,pp.445–455,2008.

[31] Bernhard Ganter, Gerd Stumme and Rudolf willie. Formal Concept analysis foundations and applications. ISSN 0302-9743/ ISBN-103-540-27891-5 Springer Berlin Heidelberg New York Pp 149, pp 250-349

[32] Uta Priss Formal Concept Analysis in Information Science Annual Review of Information Science and Technology, ASIST,Vol.40

[33] Scott,J.:Social Network Analysis: A Handbook, 2edn. Sage Publications, London(2000)

[34] Khan, A., Li, N., Yan, X., Guan, Z., Chakraborty, S., & Tao, S. (2011, June). Neighborhood based fast graph search in large networks. In SIGMOD Conference (pp. 901-912).

[35] Shasha, D., Wang, J. T., & Giugno, R. (2002, June). Algorithmics and applications of tree and graph searching. In Proceedings of the twenty-first ACM SIGMOD-SIGACT-SIGART symposium on Principles of database systems (pp. 39-52). ACM.

[36] Al-Khalifa, S., Jagadish, H. V., Koudas, N., Patel, J. M., Srivastava, D., & Wu, Y. (2002). Structural joins: A primitive for efficient XML query pattern matching. In Data Engineering, 2002. Proceedings. 18th International Conference on (pp. 141-152). IEEE.

[37] Wille.R, 1989."Knowledge acquisition by methods of formal concept analysis", in E.Diday, editor, Data analysis, Learning Symbolic and numeric knowledge, pages 365-380.1989.

[38] B.Ganter, R.Wille, « Formal concept analysis, mathematical foundation », 1998, SpringerVerlag Ed.] R.Godin, R.Missaoui 1994, An incremental concept formation approach for learning from databases Theorical computer science 133 (1994) 387-419

[39] Norris E.M., "An algorithm for computing the maximal rectangles of a binary relation,"Journal of ACM, 21 :356-366, 1974.

[40] J. M. Cargal. Discrete Mathematics for Neophytes: Number Theory, Probability, Algorithms, and Other Stuff pp 7.1-7.10

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