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Political Discourse Analysis through Solving Problems of Graph Theory

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Abstract

In this article, we show how, using graph theory, we can make a content analysis of political discourse. Assumptions of this analysis are:

- we have a corpus of speech of each party or candidate;
- we consider that speech conveys economic, political, socio-cultural values, these taking the form of words or word families;
- we consider that there are interdependences between the values of a political discourse; they are given by the co-occurrence of two values, as words in the text, within a well defined fragment, or they are determined by the internal logic of political discourse;
- established links between values in a political speech have associated positive numbers indicating the "power" of those links; these "powers" are defined according to both the number of co-occurrences of values, and the internal logic of the discourse where they occur.

In this context we intend to highlight the following:

a) which is the dominant value in a political speech;

b) which groups of values have ties between them and have no connection with the rest;

c) which is the order in which political values should be set in order to obtain an equivalent but more synthetic speech compared to the already given one;

d) which are the links between values that form the "core" political speech.

To solve these problems, we shall use the *Political Analyst* program. After that, we shall present the concepts necessary to the understanding of the introductory graph theory, useful in understanding the analysis of the software and then the operation of the program. This paper extends the previous paper [6]

Keywords: graph theory, discourse analysis, political programs

1. Preliminary Elements of Graph Theory

The *graph* [1] means a couple G = (N, M), where N is a finite non-empty set, whose elements are called nodes, and M is a finite set, whose elements are called edges. Edges are pairs of nodes. If the order of nodes from an edge is important, then the graph is called directed graph (digraph), otherwise called untargeted graph (graph). Subsequently, we will refer only to untargeted graphs as they are used by the *Political Analyst* program.

An example of a graph is the following:

G = ({education, modernization, social dialogue, partnership, employment, privatization}, {(education, employment), (education, modernization), (social dialogue, civil society), (labor, competition)})

In this graph, we can highlight:

• set of nodes, N = (education, modernization, social dialogue, civil society, labor, and privatization)

• set of edges, M, given by pairs:

(education, employment)

(education, modernization)

(social dialogue, civil society)

(labor, competition)

(employment, modernization).

Often, the number of nodes is denoted by *n*, the number of edges by *m*. Thus, our graph is the set of nodes consists of $n = 7$ political values, economic and socio-cultural and edge set consists of $m = 5$ links between each two such values. These pairs (links) can be co-occurrence data in the same fragment of the corpus, or the internal logic of political discourse analysis. For ease of working with graphs, in practice we rely mostly on their graphical representation. Thus, nodes are represented by labelled circles or rectangles and straight lines or curved edges by connecting nodes, two by two.

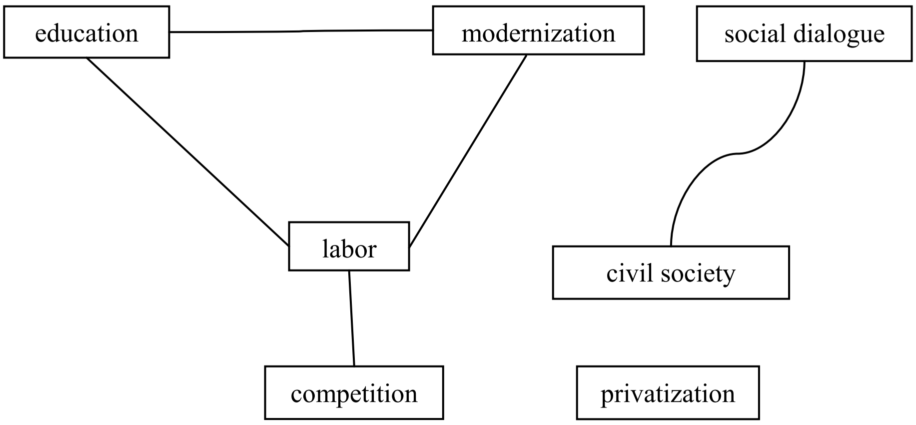

Figure 1. An example graph where nodes are the values of a political speech, and edges are links between them

It is to be noticed the fact that the graphic representation of a graph, the placing of the nodes in space is not important. Nor is the shape of the edges important or whether they intersect or not (usually straight lines are drawn and their intersecting is avoided as much as possible). What matters is just which are the nodes and which is connected to which.

Two nodes forming an edge are called neighbours or adjacent. A sequence of distinctive nodes, adjacent two by two, is called a path. For example, *(education, modernization, work, competition)* is a path in the graph in figure 1. a node with only one neighbour is called a leaf node. Examples of leaf nodes are the nodes *competition, social dialogue, civil society* from the graph in figure 1.

A node which has no neighbours is called an isolated node. The node *privatization* from the previous graph is an isolated node.

If in a graph, whichever the two nodes, there could be found a way from one to the other, then that graph is called *connected*. It is not the case of the previous graph which is *disconnected* [2]. Any disconnected graph can be decomposed, in a unique way, in a region of disjoined graphs which have no common elements. These (sub)graphs are called *connected components*. Thus if there is no path between the two nodes to join them, then these will belong to two different connected components. In the case of our graph (Figure 1), there are three connected components. The first connected component is provided by the nodes *education, modernization*, *labour*, the second is provided by the nodes *social dialogue* and *civil society*, whereas the third is given by the isolated node *privatization*.

When speaking about a connected component, one also means the edges which connect the respective nodes.

A path in which the first and the last node are neighbours is called a circuit (cycle). For example, the path *(education, modernization, work)* is a circuit, because the nodes *work* and *education* are neighbours.

A connected graph without circuits is called a *tree*. For example, the second and the third component from the graph analysed are tress because they are connected (sub)graphs with no circuits. On the other hand, the first connected component has a circuit and, although it is a connected (sub)graph, it will not be taken as a tree.

Using the notions introduced so far, we may mathematically model the problems raised in the introduction of this chapter.

Thus, (a) determining the dominant value in the political discourse may mean finding the node that has the largest number of neighbours. In the case of the graph in figure 1, which has three connected components, the dominant value is *work*. If the graph is not connected, as the one in figure 1, there occurs the problem of finding the dominant values for each of the connected components. However, if the graph is not connected, one may add edges, based on the previous analysis of the represented discourse, until obtaining a connected graph. In this case, the dominant value will be the one which has the greatest number of neighbours.

In problem (b) we must find the groups of values that are interconnected. This would mean determining the connected components of the values' graph. In our example, the answer for (b) has already been given.

For problems (c), (d) we should introduce new notions in the graph theory.

Often, modelling real problems requires the combination of numerical values to edges in a graph. These numbers (real, positive) that are associated to the edges form a *cost function* [3]. The number associated to an edge is called the cost of the edge and can represent, according to the case, different sizes:

- the cost of moving from one node to another (supposing that all nodes were towns and the edges would be the roads connecting them);
- the cost of achieving the connection between the two nodes (supposing the nodes were two buildings, and the edges were electric, TV, phone, etc. wires which should interconnect them);
- the trade margins which is paid between two traders within a process of selling-buying (the nodes would be the traders and the edges would be the trade agreements established between them);
- the time needed to change one technological line in order to pass from one product to another (the nodes would be the technological lines for those products and the edges would be the intervals of time needed to make the changes).

In our case, the cost of an edge between two nodes (representing political, economical and socio-cultural values) could be given by the "strength" of the connection existing between two such nodes.

Referring to the example of the graph in figure 1, we associate some costs to the edges and we obtain figure 2.

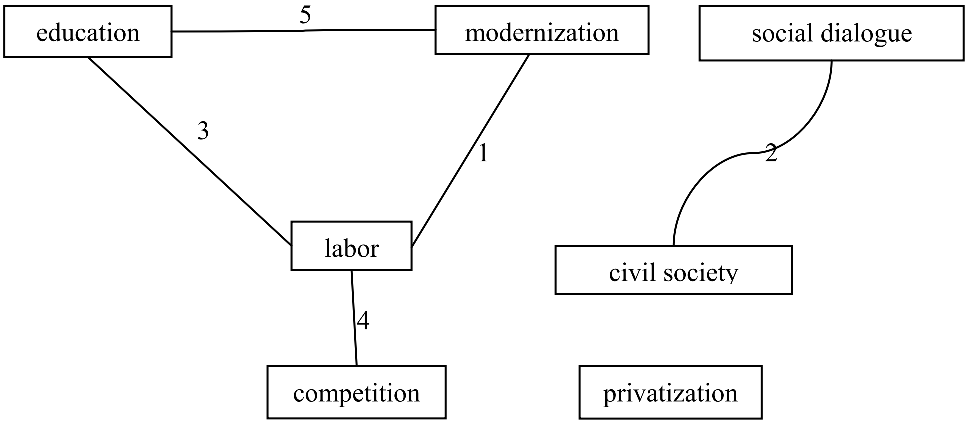

Figure 2. The graph from Figure 1, where edges have costs, the costs representing the power of relationships between values

Costs may be given either by the number of co-occurrence of those two values, or by different implications between them, in the political discourse. Another possibility is represented by the thickness of the edges (this option is used by the program). The more it indicates a higher cost, i. e. a closer connection, the thicker the edge is (Figure 3).

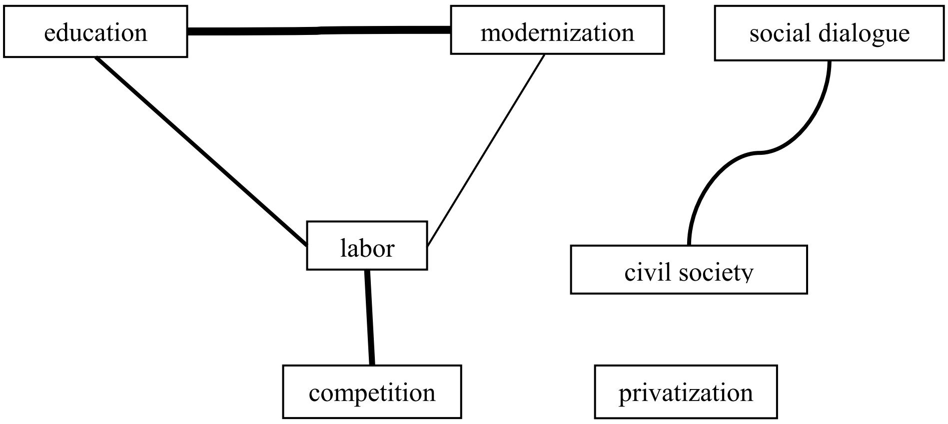

Figure 3. The graph from Figure 1, where the edges have costs, represented by the thickness of the edges

Suppose that, after this analysis, there were found other links, previously nonexistent. Also, suppose that there were found new sizes for the costs of edges already considered. Suppose that all this leads to the graph in Figure 4.

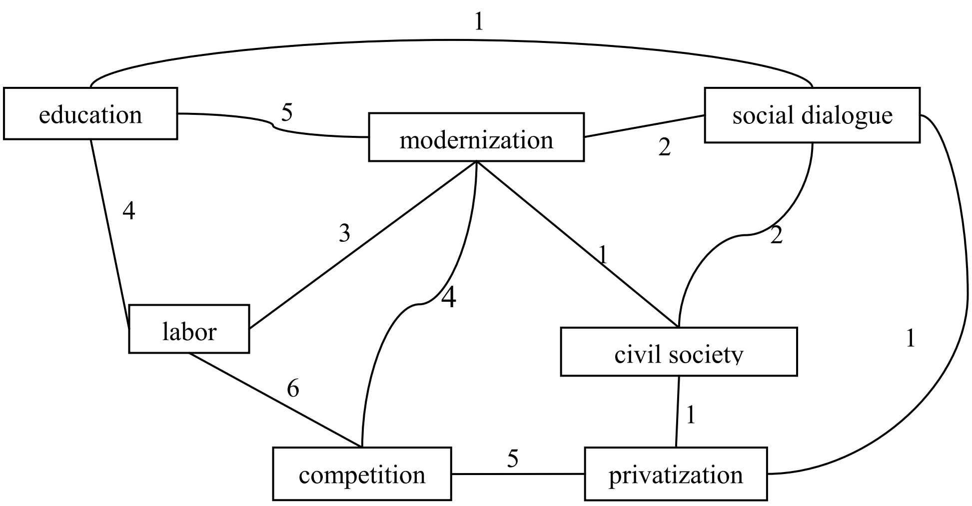

Figure 4. The graph from Figure 3, with new edges and their costs, based on further analysis of discourse

Unlike the starting graph, the graph in Figure 4 is connected. Furthermore, it contains more circuits, and among these circuits there are also some circuits containing all nodes. Such a circuit passing through all nodes in a graph is called a Hamiltonian circuit [4].

An example of Hamiltonian circuit for the graph in Figure 4 is shown in Figure 5:

(*education, social dialogue, privatization, civil society, modernization, competition, employment*).

Another example is shown in Figure 6:

(*education, modernization, social dialogue, civil society, privatization, competition, employment*).

The cost of a Hamiltonian circuit is defined as the sum of the costs of its component edges. Thus, the first Hamiltonian circuit has the cost 1+1+1+1+4+6+4 = 18, and the second has the cost 5+2+2+1+5+6+4 = 25.

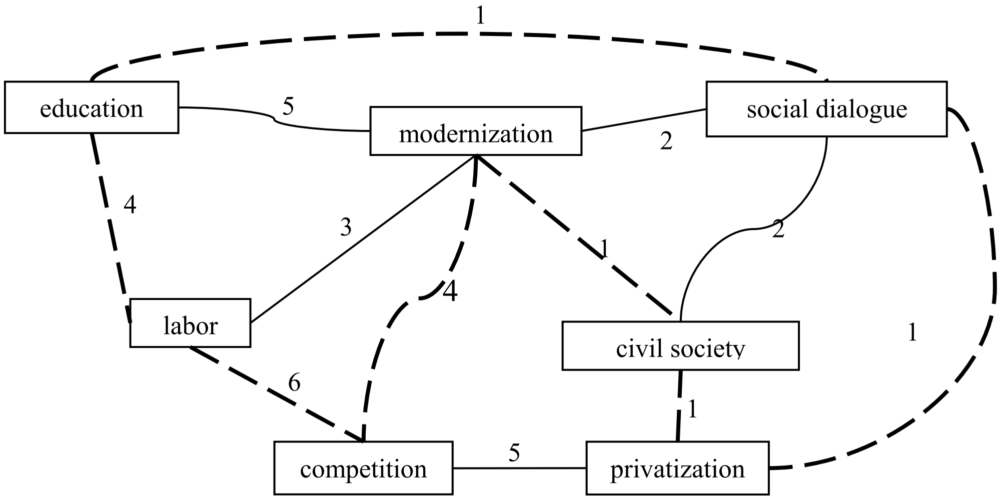

Figure 5. An example of Hamiltonian circuit, beginning with the value "education." The circuit has the cost 18

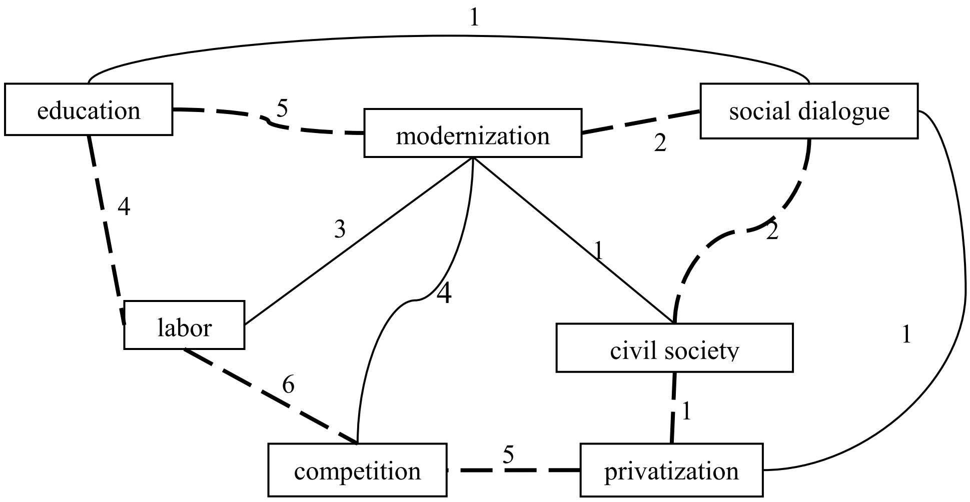

Figure 6. Another example of Hamiltonian circuit beginning with the value “education”. The circuit has the cost 25

The problem of the Hamiltonian circuit with minimum cost consists in finding the cheapest Hamiltonian circuit (if there is one) for a given connected graph.

The solution to this problem is not unique. The same Hamiltonian circuit may start from any of the nodes of the graph and the scrolling order may be in one direction or another. For example, the Hamiltonian circuit in figure 5 may be regarded as starting from the node *education* and following the order *education – social dialogue – privatization – civil society – modernization – competition – work*, or backwards: *education – work – competition– modernization – civil society –*

privatization – social dialogue – education. We may also start getting through the circuit from the node *education* or from any other node. If we start from *social dialogue*, we will have the equivalent circuit *social dialogue - privatization – civil society – modernization – competition – work – education*.

If the links between the values in a political discourse are given by the co-occurrence of the two values within the discourse, then a Hamiltonian circuit of minimum cost represents an order where values may be presented so as to use the least number of sentences but so as to keep the basic ideas of the discourse.

Therefore, the answer to this problem of graph theory provides the answer to our problem of political discourse analysis: (c) which should be the order of presenting political values so as to achieve a political discourse equivalent with the given one but much more synthetic?

For problem (d) we shall have to present the concept of partial tree. Given a connected graph, but which has circuits (therefore it is not a tree), we can discard some of the edges so that circuits are eliminated but connectivity is kept. Thus, we obtain a tree with the same nodes but only part of the edges of the initial graph. Such a tree is called a *partial tree* [5] of the initial graph. In Figure 7 we have highlighted a partial tree of the graph in Figure 4.

If we take into consideration the costs attached to the edges, we can define the cost of the partial tree as the sum of the costs of the component edges. In this case, in the graph theory, there often arises the problem of obtaining a *partial tree of a minimum cost*. In our case, if the costs of edges are given by the strength of the connections between the values from the nodes, then we are interested in determining a *partial tree of a maximum cost*. The problem may be solved in a similar way to the problem of the partial tree of minimum cost. For these problems, we use the algorithms of Robert Clay Prim and Vojtěch Jarník.

For the case of our graph, the partial tree of maximum cost is the one in Figure 7. A tree always has n-1 edges (n being the number of nodes).

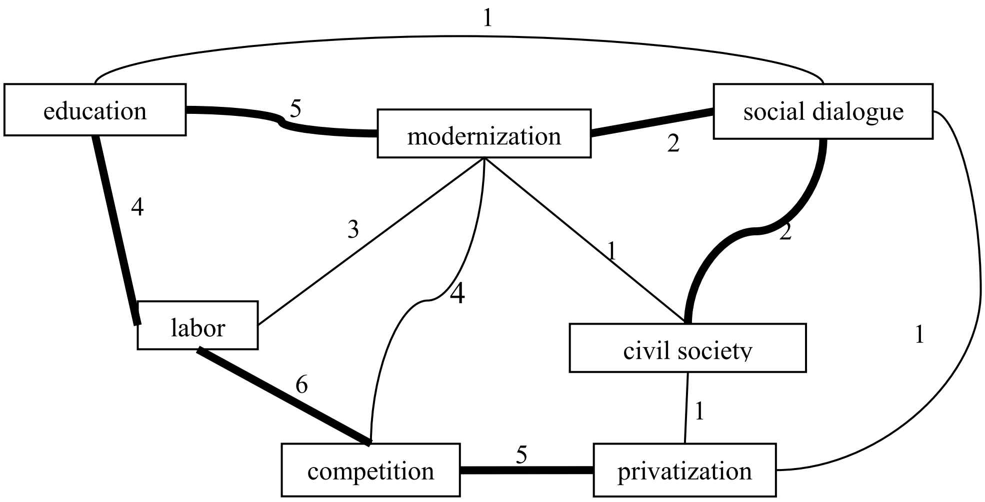

Figure 7. The partial tree of maximum cost for the graph in Figure4. Its cost is 24

The graph theory may also be useful in determining the optimal sequence of passing from the presentation of one value (political idea) to another by using phrases from the given discourse. Thus, Edsger W. Dijkstra's algorithm determines the path of minimum cost within a graph, starting from a node and reaching another. The problem which arises is that of establishing a cost function which is representative for problem (e): *how can one get from one value to another by as few words as possible from the analysed discourse?*

If we consider the cost of an edge as being the minimum distance (in words) between the two values, within a phrase, then Dijksra's algorithm will provide us with the scrolling order required to reach from one value to the other using as few words as possible. Another possible interpretation would be the following: the cost of an edge is always the same (for example 1), so that Dijkstra's algorithm will provide us with the least number of intermediary nodes (values) between two given values.

For this second interpretation, the path of minimum cost between the nodes *education* and *privatization* (from the graph in Figure 8), will be *education – social dialogue – privatization*, with only one intermediary node. In other words, keeping the expressions in the analysed discourse, in order to quickly pass from approaching the issue oat of privatization, the candidate or the party will speak, first of all, about social dialogue.

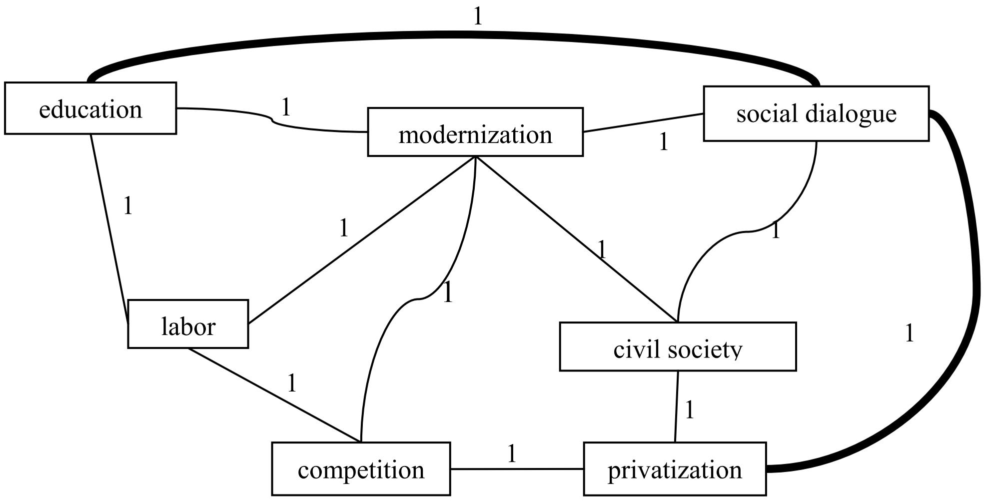

Figure 8. The graph in Figure 4, where the edges have the same cost. We have highlighted the path of minimum cost between education and civil society

The Hamiltonian circuit of minimum cost, the partial tree of minimum/maximum cost and *the path of minimum cost* are examples of problems of improving the political discourse, provided that they want to express the same political ideas but use less words and the same relations among political values, as in the initial discourse. These mathematical instruments can be used to achieve a summary or a synthesis of the discourse of some politician, when it is restricted to a page in a newspaper or to limited time in a televised appearance.

Therefore, solving a problem of political discourse analysis will follow the diagram of Figure 9:

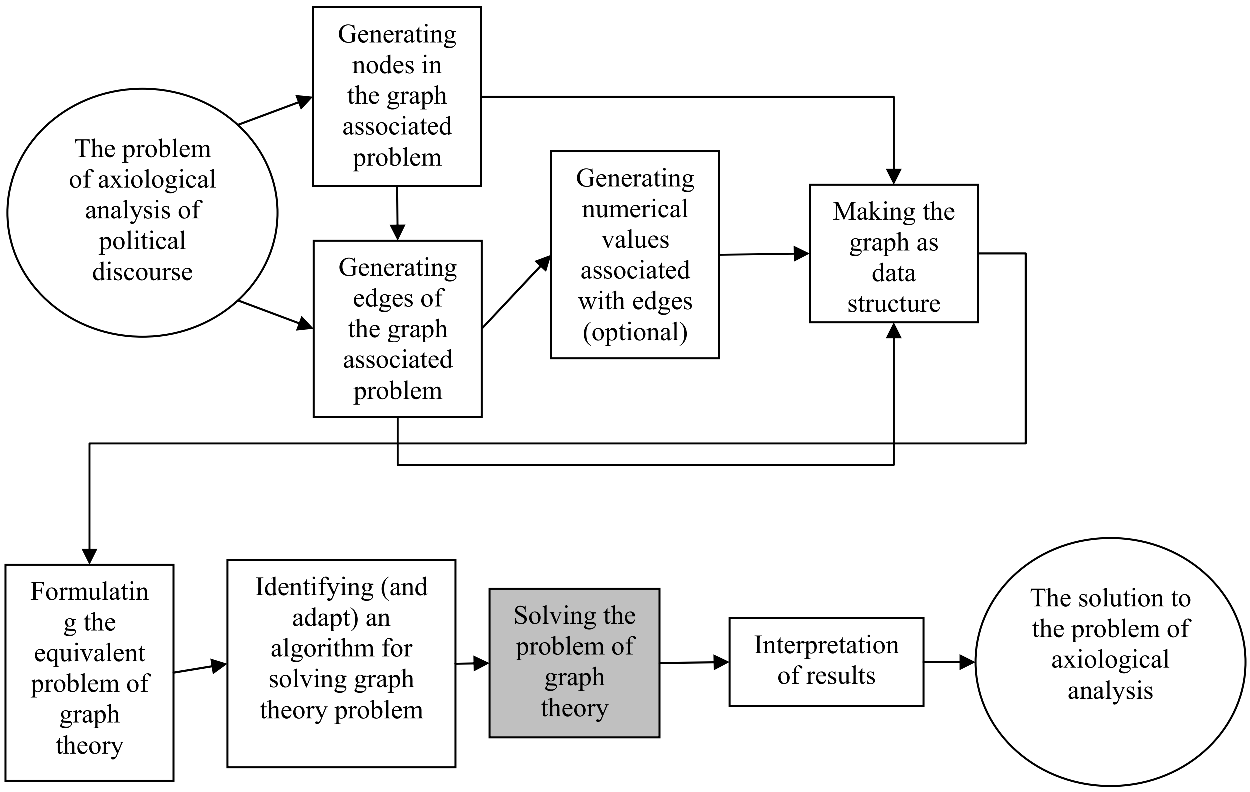

Figure 9. Political speech analysis scheme using graph theory.
Only the grey phase is the responsibility of a computer

2. Using *Political Analyst* for the axiological analysis of the political discourse

The program *Political Analyst* has been developed by programmers from the University of Bacău. It runs on Windows operating systems, requiring a minimum of 5 MB for installation. The proper functioning of the program, the discourse corpora have to be in plain text format. The current version can simultaneously analyse different types of (political, economic and socio-economic) values for several parties and their candidates. Although there is a set of predefined values, the user can create his own sets of values. Add, delete, select or deselect operations are allowed. Once a value has been added into a set of values, it can also be included in the subsequent analysis.

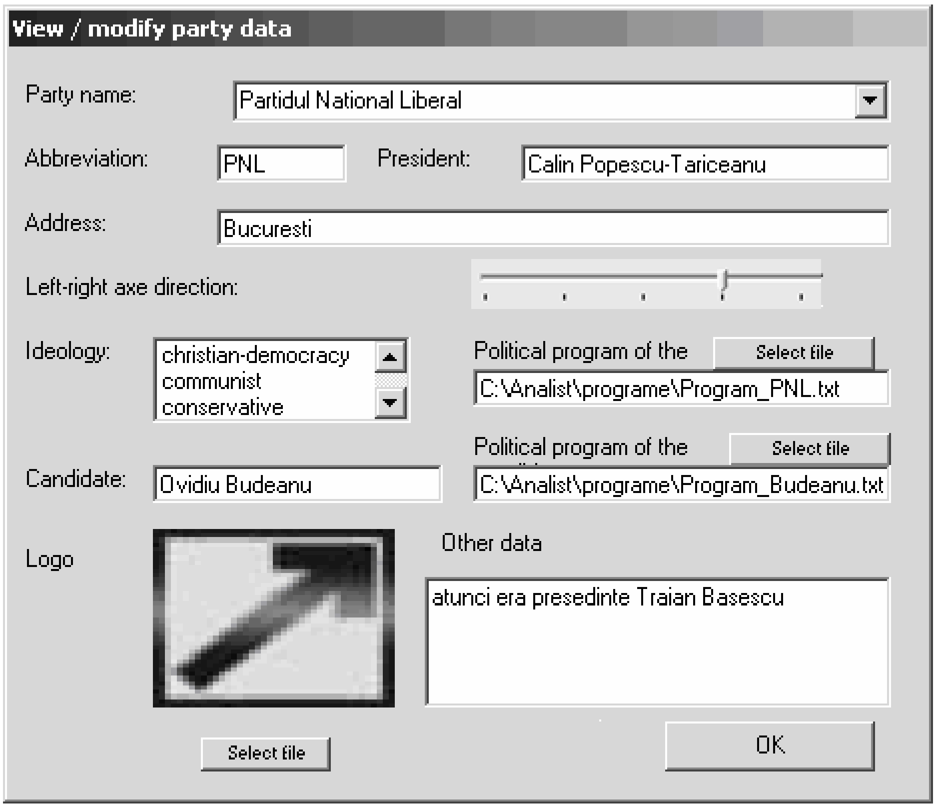

Figure 10. Viewing data on one party (e.g. NLP)

The program allows for the automatic generation of the values' graph and of the connections among them based on the co-occurrence of words-values in fragments of text-size established by the user (the default size is 400 characters). Subsequently, the user may insert new edges and associate sizes of the edges' costs. The nodes may be moved on the graph's editing area and the edges between these nodes are preserved.

After entering all the data related to the party and its candidate (Figure 10) by using the *Operations→Search for values in the political programme*, the frequency of values in the political programme of a party or its candidate can be determined. In the example in Figure 11, the National Liberal Party has been selected together with all types of values (political, economic and socio-cultural), and the program is looking for whole words and does not distinguish between capital and small letters. By clicking the *Start search* button we obtain a table of appearances (Figure 14).

#	Valoare	Aparitii
1	PNL	166
2	partid	162
3	liber	132
4	politic	120
5	econom	112
6	acti	108
7	stat	94
8	soci	94
9	roman	90
10	public	86
11	dezvolta	53
12	privat	53
13	local	50
14	guvern	41
15	cetate	41
16	propriet	40
17	national	38

Figure 11. The most common political values NLP program (the values and their occurences)

The most important command of the program is *Operations→Create and analyze the graph of values*. This provides the user with a graph editing area (centre-left area), a screen for result presentation (roght-bottom). Also, at the bottom, there is a control panel with several buttons (see Figure 12).

Figure 12. The control panel for generating and analysing the axiologic graph

One may choose the types of values that will constitute the graph (these will be represented by nodes of different colours), th eparty or candidate, after which one can pass on directly to the automatic generation of the values' graph. Firstly, the graph is generated without any edges (*the null graph*), with values displayed vertically, as a list.

After that, one can proceed to filling the graph with edges. It is recommended that the nodes should be first placed conveniently on the editing surface (after clicking the *Move nodes*). After that, the edges from one node to another can be drawn, after having previously clicked the button *Draw edges*. Drawing an edge is done through the well-known mouse operation of *drag and drop*, followed by the entrance of the edge's cost (this cost is entered by the researcher on the basis of the discourse).

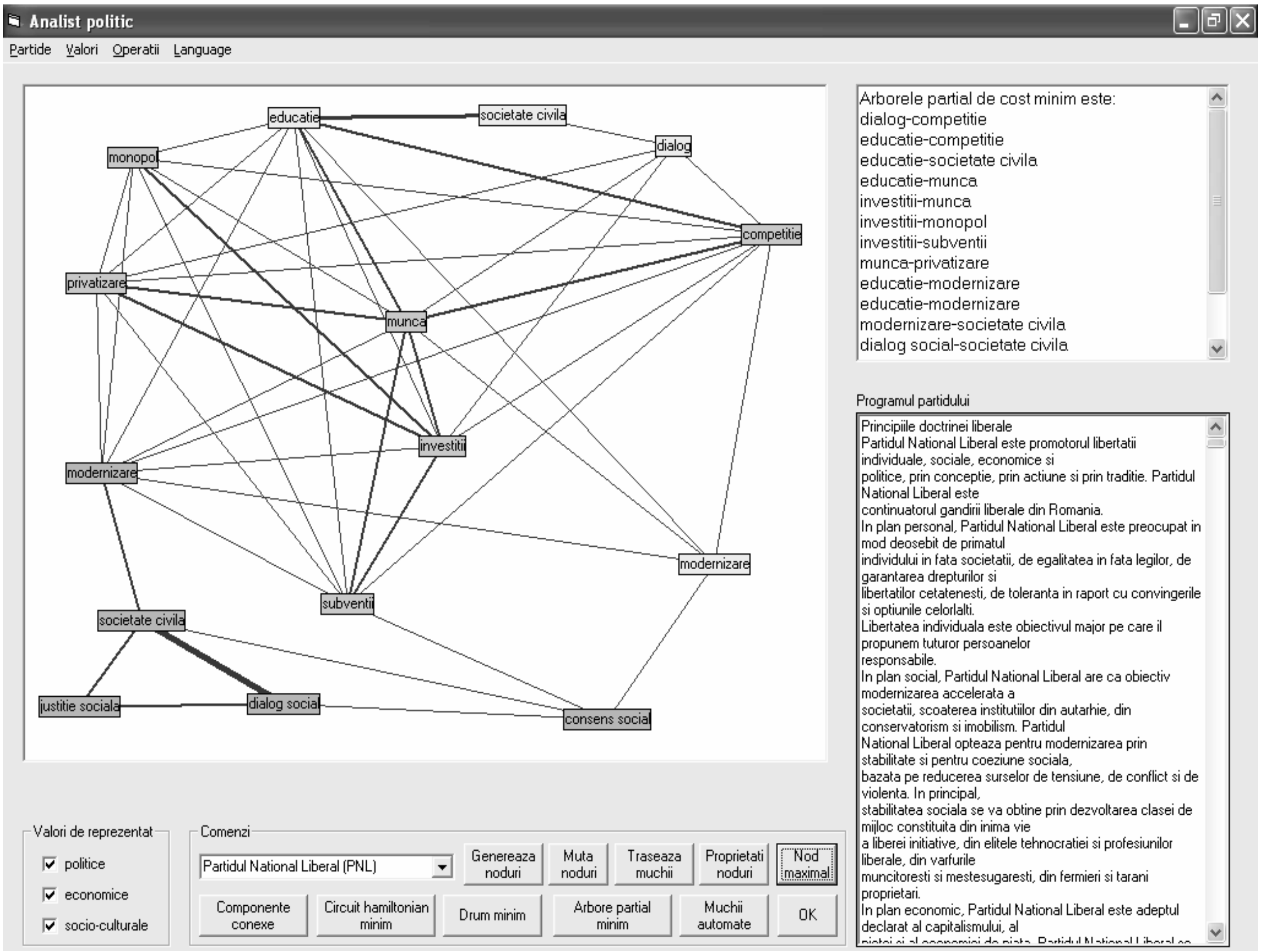

Figure 13. An example of graph and the result of the maximal spanning tree problem[1]

The edges may also be automatically generated, using the button *Automated edges*. The current version of the program can generate edges among the co-occuring nodes within a fragment of text of 400 characters (or another size established by the user). The costs of the edges will be given by the number of co-occurrences of the two values forming the edge. The thickness of an edge is directly commensurate with its cost (Figure 13).

The generated graphs can be subsequently modified by the researcher who may analyse by himself the political program displayed in the right-bottom screen. Generally, the resulted graphs are very complex, so their visual analysis is difficult to achieve. The program *Political Analyst* can generate answers to all of the questions specified in the previous paragraph. Thus, Figure 12 presents the solution to the problem of the partial tree of minimum/maximum cost for the graph associated to a political party.

[1] The party's programme: The principles of the liberal doctrine: The National Liberal Party is a promoter of individual, social, economic and political freedom, by conception, by action and by tradition. The National Liberal Party continues the liberal thinking of Romania. On a personal level, the National Liberal Party is particularly concerned about the primacy of the individual before that of society, of equality before the law, of guaranteeing citizen rights and freedoms, of tolerance in relation to the beliefs and options of others. Individual freedom is the major goal that we propose to all those responsible. In social terms, the National Liberal Party aims at accelerated modernization of the society, removal of autarchy institutions, conservatism and immobility. The National Liberal party opts for modernization through stability and social cohesion based on minimizing the sources of tension, conflicts and violence. Essentially, social stability will be obtained by developing the middle class made up of the living heart of free initiative, of the elites of technocrats and liberal professions, of the top workers and craftsmen, of farmers and landowners. In economic terms, the National Liberal party is the open supporter of capitalism, the market and market economy…

3. Case Study 2: The National Liberal Party programme analysis using *Political Analyst*

By analysing (using *Political Analyst*) the programme of the National Liberal Party [7] during the 2004 election campaign, we can observe the presence of 17 dominant values whose frequency was measured: *NLP*, the acronym of the party – 166 times mentioned; *party* – 162; *liberal/ liberty* – 132; *political* – 120; *economic/ economy* – 112; *active/ activity* – 108; *state* – 94; *social/ society* – 94; *Romanian* – 90; *public* – 86; *development* – 53; *private* – 53; *local* – 50; *government* – 41; *citizen* – 41; *property/ owner* – 40; *national* – 38.

At the opposite end, there are the values with a low frequency within the same programme (*labour* – 14; *competition* – 14, *reform* – 12, *investments* – 12, *low tax* – 13, *equality* – 12, *protection* – 10).

We used *Operations->Search values in political programme* to obtain their frequencies of occurence (Figure 11).

Interpretation: The NLP programme focuses on its brand, liberal ideas and economy.

Considering these values as nodes of a graph and considering the costs of edges as the number of co-occurrences in 75 characters-long fragments from the political programme, we have obtained the following results:

1) 58 edges, a connected graph

Interpretation: The small number of edges obtained in relation to the number of node-values (55) and the connectedness of the graph shows that we have a not too dense graph, which corresponds to a well-structured electoral program.

2) maximum node: econ

Interpretation: the economy and economic issues are the focus of the NLP program.

We identified the node/nodes with the highest number of neighbors. Within the programme of the NLP the nodes have in general between 10 and 20 neighbors. The nodes with the greatest number of neighbors are: *econom{-ic,-y}, NLP* (PNL, being its Romanian counterpart), *soci{-ety,-al}, state, acti{-ve, -vity}, liber{-al,-ty}, public, politic{-s,-ies}, educ{-ation, -ational}, privat{-e}, develop{-ment}, citiz{-en, -enship}, competi{-tive,-on}, party, own{-ers, -ership}, respect, ensur{-e, -ance}, environment* and *Roman{-ia,-ian}*.

We will discuss each node and its links to the neighbors (in a decreasing order according to the strength of the respective link):

The node *econom* has 42 neighbors: *liber* (24), *soci* (22), *develop* (14), *state* (14), *acti* (13), NLP (9), *market* (8), *politic* (8), *privat* (7), *own* (7), *competi* (6), *equal* (6), *capital* (4), *agric* (3), *corrupt* (3), *educ* (3), *function* (3), *investment* (3), *environment* (3), *respect* (3), *life* (3), *competition* (2), *manage* (1), *ensur* (1), *citiz* (1), *guarantor* (1), *tax* (1), *individ* (2), *institute* (2), *produc* (2), *protect* (1), *public* (2), *resources* (2), *Roman* (2), *enterprise* (1), *local* (1), *labour* (1), *opposition* (1), *decrease* (1), *reform* (1), *services* (1), *transactions* (1).

Interpretation: Economy is closely related to liberal political concepts, such as liberty, liberal, activity, market, ownership, competition, and capital.

The node *NLP* has 37 neighbors: *politic* (25), *party* (20), *acti* (19), *government* (11), *econom* (9), *liber* (9), *soci* (8), *agric* (7), *fortress* (6), *opposition* (6), *Parliament* (5), *educ* (5), *promote* (5), *state* (5), *ensur* (4), *corrupt* (4), *local* (3), *develop* (2), *environment* (2), *labour* (1), *national* (2), *market* (2), *public* (2), *decrease* (2), *respect* (2), *resources* (2), *manage* (1), *capital* (1), *finan* (1), *guarantor* (1), *initiative* (1), *enterprise* (1), *invested* (1), *produc* (1), *reform* (1), *Roman* (1), *life* (1),

Interpretation: The brand NLP occurs in contexts regarding government, economy, agriculture, opposition, Parliament.

The node *state* has 37 neighbours: *econom* (14), *own* (12), *politic* (9), *acti* (8), *ensur* (6), *privat* (6), *liber* (5), NLP (5), *public* (5), *soci* (5), *agric* (4), *finan* (4), *institutions* (4), *party* (4), *Roman* (4), *develop* (3), *government* (3), *individ* (3), *environment* (3), *tax* (2), *resources* (3), *corrupt* (2), *promote* (2), *transparent* (2), *transactions* (2), *fortress* (1), *educ* (1), *equal* (1), *guarantor* (1), *enterprise* (1), *invested* (1), *local* (1), *produc* (1), *protect* (1), *decrease* (1), *respect* (1), *manage* (1).

Interpretation: The word *state* occurs in contexts which involve political and economic issues.

The node *acti* has 35 neighbors: NLP (19), *econom* (13), *liber* (11), *party* (9), *state* (8), *politic* (7), *government* (6), *competition* (4), *own* (4), *ensur* (3), *educ* (3), *market* (3), *decrease* (3), *soci* (3), *competi* (2), *develop* (2), *guarantor* (2), *produc* (2), *resources* (2), *life* (2), *agric* (1), *fortress* (1), *corrupt* (1), *Europ* (1), *finan* (1), *tax* (1), *initiative* (1), *enterprise* (1), *invested* (1), *national* (1), *opposition* (1), *privat* (1), *promote* (1), *responsabil* (1), *Roman* (1).

Interpretation: The free economy is a field in which NLP brings forth concrete actions.

The node *liber* has 35 neighbors. *econom* (24), *acti* (11), *politic* (10), NLP (9), *privat* (8), *public* (8), *competiti* (7), *initiative* (7), *own* (7), *partid* (7), *guarantor* (6), *individ* (6), *develop* (6), *competition* (5), *soci* (5), *state* (5), *government* (4), *fortress* (4), *capital* (3), *market* (3), *equal* (3), *Roman* (3), *promote* (3), *educ* (2), *enterprise* (2), *respect* (2), *resources* (2), *job* (2), *transparent* (2), *manage* (1), *function* (1), *produc* (1), *protect* (1), *reform* (1), *responsible* (1),

Interpretation: Liberalism means liberty, competition, initiative, private ownership, development, the respect of the values promoted by the state of right, equality in rights, transparency in administration, reforms and responsibility.

The node *politic* has 31 neighbors: NLP (25), *party* (13), *liber* (10), *state* (9), *econom* (8), *public* (8), *acti* (7), *responsible* (7), *soci* (6), *government* (5), *agric* (4), *develop* (3), *finan* (3), *opposition* (3), *promote* (3), *Roman* (3), *fortress* (2), *corrupt* (2), *educ* (2), *equal* (2), *function* (2), *local* (2), *privat* (1), *own* (2), *reform* (2), *life* (2), *manage* (1), *competi* (1), *resources* (1), *transparent* (1), *transactions* (1).

Interpretation: The word *politic* and its semantic family is to be found in the NLP discourse whenever it refers to the party, state, economy and the liberal values.

The node *privat* has 27 neighbors: *own* (14), *liber* (8), *develop* (7), *econom* (7), *public* (6), *state* (6), *competi* (4), *guarantor* (4), *Europ* (3), *market* (3), *initiative* (3), *competition* (3), *ensur* (2), *capital* (2), *individ* (2), *acti* (1), *agric* (1), *educ* (1), *environment* (1), *labour* (1), *politic* (1), *produc* (1), *reform* (1), *health* (1), *job* (1), *soci* (1), *transactions* (1).

Interpretation: The economic development is closely connected to liberty, competition, capital and the guarantee of private property, all of this ensuring the diminishing of the transaction period and the successful integration within the European structures.

The node *competi* has 23 neighbors: *liber* (7), *econom* (6), *market* (6), *privat* (4), *acti* (2), *capital* (2), *function* (2), *initiative* (2), *fortress* (1), *corrupt* (1), *equal* (1), *ensur* (1), *labour* (1), *natural* (1), *politic* (1), *produc* (1), *promote* (1), *own* (1), *public* (1), *Roman* (1), *soci* (1), *transparent* (1), *life* (1).

Interpretation: The free market economy, based on competition, capital attraction, civil initiative, corruption abolishment, citizens' equal chances, transparency promotion, are the methods that the Romanian NLP promotes.

The node *own/ property* has 21 neighbours: *privat* (14), *stat* (12), *liber* (7), *econom* (7), *guarantor* (5), *acti* (4), *individ* (2), *initiative* (2), *politic* (2), *develop* (2), *ensur* (1), *fortress* (1), *competi* (1), *corrupt* (1), *equal* (1), *Europ* (1), *market* (1), *protect* (1), *Roman* (1), *soci* (1), *transparent* (1).

Interpretation: According to the NLP in Romania, private property should be guaranteed by state. The Romanian economy develops if four conditions are fulfilled: 1) if the individual initiatives are supported; 2) if there is competition, 3) if there is transparency in the governing act; 4) if corruption is abolished within the Romanian society.

Node *environment* has 20 neighbors: *natural* (6), *protect* (5), *agric* (3) *econom* (3), *state* (3), *develop* (2), *educ* (2), *NLP* (2), *capital* (1), *city* (1), *corrupt* (1), *company* (1), *work* (1), *private* (1), *reduce* (1), *reform* (1), *respect* (1) *Roman* (1), *health* (1), *job* (1).

Interpretation: Referring to the environment, NLP focuses on environmental quality and agriculture. Of the foregoing is a political program that liberals appropriate classical liberal doctrine.

5) The maximum spanning tree shows key relationships underpinning the NLP program

Using the *Political Analyst* software, we obtained the following maximum spanning tree, where the brackets are given the strength of relations between values. Consider, in turn, extracts from the tree and an interpretation of edge components:

The maximal spanning tree is:

acti-NLP (19), NLP-political (25), party-NLP (20), acti-econom (13), econom-free (24), econom-soci (22), develop-econom (14), econom-state (14), own-state (12), privat-own (14), govern- NLP (11), econom-market (8), free-public (8), administra-public (14), public-service (14), function-public (12), party-transparent (8), agric- NLP (7), competiti-free (7), initiativ-free (7), politic-responsible (7), Roman-soci (7), ensur-soci (6), fortress- NLP (6), econom-equal (6), guarant-free(6), govern-opozition (6), individual-free (6), ensur-health (5), competi-free (5), educ- NLP (5), educ-reduc (18), parliament- NLP (5), local-parliament (6), party-respect (5), NLP -promo (5), public-reform (5), capital-econom (4), corrupt- NLP (4), finan-state (4), instituti-public (4), party-resources (4), agric-environmemnt (3), environment-natural (6), environment-protect (5), econom-invested (3), econom-life (3), europ-private (3). acti-produc (2), capital-work (2), develop-enterpri (2), tax-reduc (2), local-national (2), Roman-transiti (2).

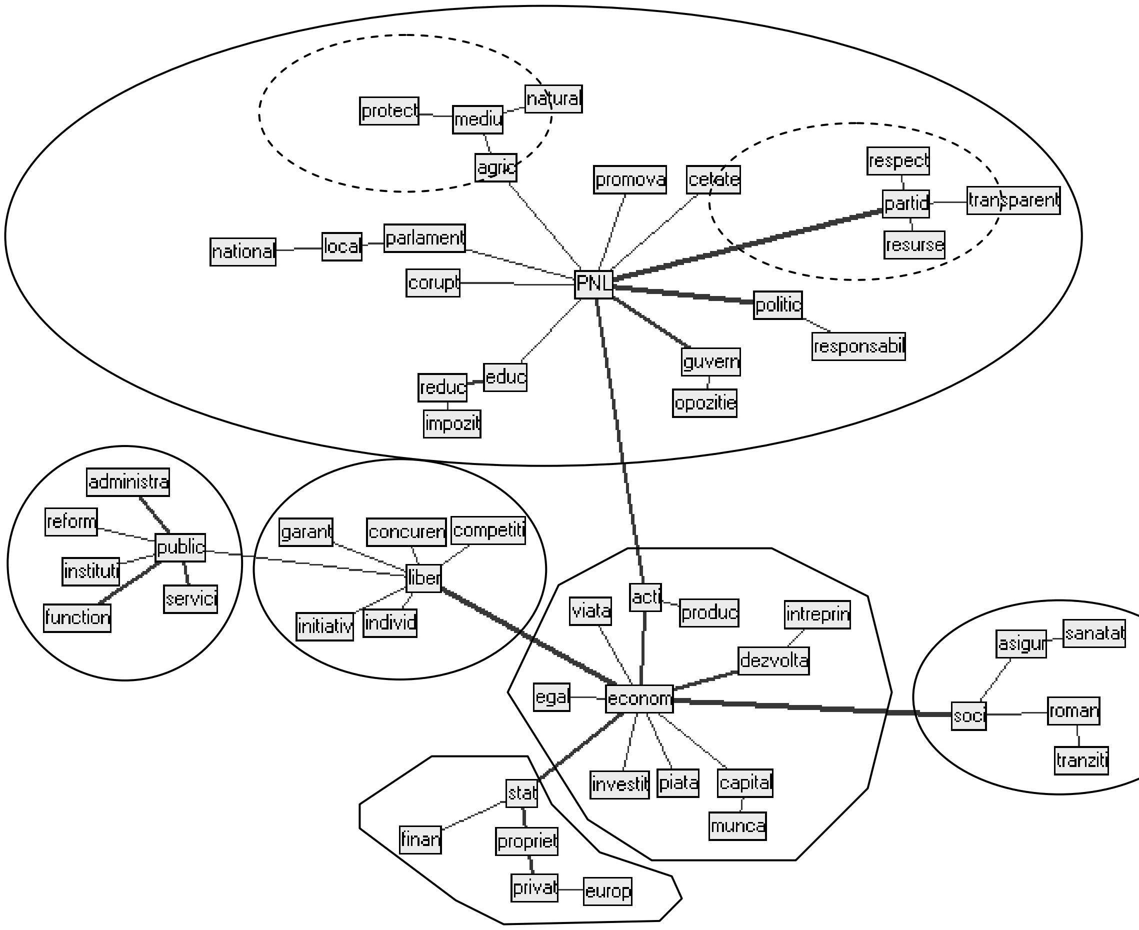

Figure 13. Nuclei of interest for NLP

We notice (Figure 13) the existence of several nuclei of interest for the NLP program given by the nodes with the largest number of neighbours, as follows:

1. The node *NLP* has 10 neighbours: acti (19), agric (7), fortress (6), corrupt (4), educ (5), govern (11), parliament (5), party (20), politic (25), promoti (5);
2. The node *econom* has 10 neighbours: acti (13), capital (4), develop (14), equal (6), invested (3), free (24), market (8), soci (22), state (14), life (3);
3. The node *free* has 7 neighbours: competiti (7), concuren (5), econom (24), guarant (6), individ (6), initiative (7), public (8);
4. The node *public* has 6 neighbours: administra (14), function (12), instituti (4), free (8), reform (5), service (14);
5. The node *soci* has 3 neighbours: asigur (6), econom (22), Roman (7);
6. The node *party (partid)* has 4 neighbours: PNL (20), respect (5), resources (4), transparent (8);
7. The node *state* has 3 neighbours: econom (14), finan (4), own (12);
8. The node *environment (mediu)* has 3 neighbours: agric (3), natural (6), protect (5).

The graphical representation of the nodes of interest within the NLP political programme offer a “synthesis” of the main cultural, economic, moral and political values and, respectively, the links between them. This synthesis could be very useful especially for the reader/ citizen who has neither the time nor the patience to read the lengthy political programmes of 30 or 40 pages, sometimes very difficult to be grasped.

The following analysis focused on determining a Hamiltonian circuit of minimum cost within a sub-graph of the initially analysed graph. For this, only the first two political values have been approached (excluding the words *NLP* and *party*), according to their frequency in the NLP programe. The edges have been generated based on the co-occurence in fragments of 75 charcaters.

We have obtained the graph in Figure 14, for which the Hamiltonian circuit of minimum cost has been the following:

acti->privat->politic->develop->stat->free->soci->public->econom->Roman->

Interpretation: this is the order in which these values could be presented as the essence of the NLP program.

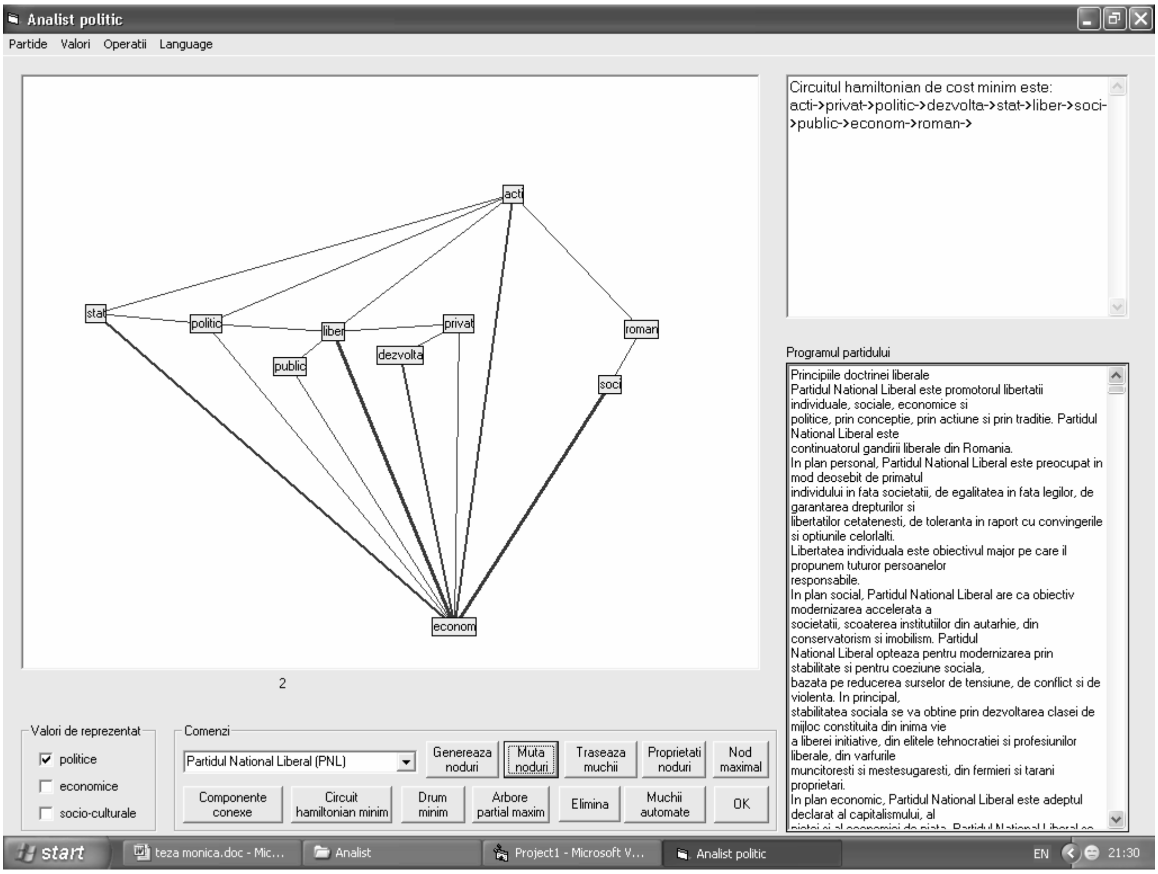

Figure 14. The minimal cost Hamiltonian circuit for the sub-graph of some essential values from the NLP programme

5. Conclusions

Sometimes political programmes of parties may be difficult to analyse. They may be either too long, extending over several pages, or too stuffy and difficult to follow or they use dry language, or make references to issues that are intertwined and difficult to "decipher".

Graph analysis can be, in this case, a useful mathematical tool in the systematic programmes of parties, highlighting interest centres, and links between topics.

Through collaboration between researchers in political sciences and computer scientists, approaching the interdisciplinary problem of political values and party programmes, we have developed a program for analysis based on the graph theory. By the mathematical modelling of such problems, using the *Political Analyst* programme, we could highlight aspects of the political programmes of parties that may escape a superficial analysis. We conducted a case study for the Liberals and have highlighted various important aspects of this political party’s doctrines. Our article has set up a model that can be used for any ticket or candidate.

6. References

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