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Секція 9. Мова і засоби мовної комунікації

MATHEMATICAL ANALYSIS OF THE CONCEPT AS A SELF-ORGANIZED LIMITLESSLY BRANCHABLE STRUCTURE (ON THE BASIS OF THE FRACTAL GEOMETRY BY B. MANDELBROT)

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An inherent part of human life is acquiring and sharing knowledge that in the form of structured mental information is stored and modified in mind as concept. Equivalent to the meaning activated by a word, the concept can be visualized via the network (the methodology “semantics of lingual networks” [2, p. 58-62]) or matrix (the component analysis [1, p. 81]) formats. The former is aimed at processing corpus contexts, namely the concept name with its logical predicates. The latter traditionally researches dictionary definitions that objectify a nomenclature of domains representing essence of the studied concept. It is for us reasonable to explicate the potential of component analysis in reproducing matrix format of the concept as a self-organized structure liable to permanent limitless fractal branching of contained information. The above-stated has not been previously performed through American narrowly-specialized dictionaries, which defines the **research relevance**.

In the conference abstract, definitions of the name of a randomly selected concept – the *politics* lexeme as a nomination of the POLITICS concept itself (the **research object**) – are studied by the component analysis (the **research methodology**) with modeling an endlessly branchable matrix structure of POLITICS (the **research topic**). The pattern is mathematically interpreted by Mandelbrot’s formulas to check whether the POLITICS concept is a pure fractal in terms of geometry (the **research aim**).

As a **research material** we engage *Dictionary of American Politics by Edward Conrad Smith, Arnold John Zurcher* [4] to illustrate the principles of fractal branching of the POLITICS concept as information stored in mind of American society.

Research implementation. The component analysis of definitions of the *politics* word reveals microcontexts activating implicit (COORDINATION) and explicit (FORM, SPHERE / OBJECT, SUBJECT, TOOL, EVALUATION, WAY OF COORDINATION) semes. The semes are equated to corresponding domains, and within them the components are thematically arranged as lexical-semantic fields (LSFs) being an analogue for subdomains:

Politics is regarded as: 1. the art and science of organizing the state and managing its affairs, both internal and external; 2. the art of controlling, protecting, assisting and governing individuals and groups in society; 3. the art of developing and guiding public policy; 4. the adjustment and regulation of the complex of relationships among individuals or groups; 5. the organization of political parties and the promotion of candidacy for public office; 6. the policy-forming function of government, as distinguished from administration and law; 7. the designation, somewhat more comprehensive than either government or political science, as the study of the state; 8. the manipulation, often by resort to intrigue, of public affairs for private or factional advantage [4, p. 289].

Integral seme: COORDINATION.

Differential semes:

1) FORM OF COORDINATION:

1. SCIENCE: *science, study of the state, art*;

2. ACTIVITY:

2.1. WORK: *policy-forming function*;

2.2. RELATIONS: *relations*;

2) SPHERE / OBJECT OF COORDINATION:

1. SOCIAL-ADMINISTRATIVE FORMATION: *state and its affairs (internal and external), public policy, public affairs, candidacy*;

2. PUBLIC-ORGANIZATIONAL FORMATION: *society, groups, individuals*;

3) SUBJECT OF COORDINATION:

1. PEOPLE: *political parties, government, groups, individuals*;

4) TOOL OF COORDINATION:

1. TECHNIQUES: *intrigue*;

5) WAY OF COORDINATION:

1. NON-BIASED COORDINATION: *to organize and manage state affairs (internal and external); to control, protect, assist and govern society groups and individuals; to develop and guide public policy, to adjust and regulate relationships*;

2. BIASED COORDINATION: *to promote candidacy for public office, to manipulate for private or factional advantage*;

6) EVALUATION OF COORDINATION:

1. DISHONESTY: *manipulation of public affairs*.

Thus, there is the matrix of 7 macrodomains that are connected through profiling operations “profile – base”: COORDINATION as a center is profiled by FORM, SPHERE / OBJECT, SUBJECT, TOOL, WAY and EVALUATION as bases. Subsequently, a hexagon structure of the POLITICS concept is obtained.

The LSFs in the domains of the constructed matrix produce a further branching of information activated initially in American mind by the *politics* word. As an example, let us perform a component analysis of the *society* lexeme taken from the LSF “PUBLIC-ORGANIZATIONAL FORMATION”:

Society is regarded as: 1. a group of individuals united by common interests who possess a sense of corporate unity and discipline; 2. an organization to promote the common objectives of its members [4, p. 344];

The definitions reveal that the implicit COORDINATION is explicitly realized in FORM (*sense*) by SUBJECT (*individuals, organization*) concerning SPHERE / OBJECT (*group, corporate, members*) via TOOL (*unity, discipline*), which is directed at the biased aim (*common interests, to promote the common objectives*) as WAY OF COORDINATION. Such COORDINATION has its implicit EVALUATION.

Comparing the initial and derived matrixes enables to find out that in both cases there are unchangeably 7 domains geometrically self-organized as hexagons (whose 6 angle points contain their LSFs). This fact gives a logical presupposition to state that further subsequent branching via LSFs will be represented as hexagon matrixes as well. Therefore, we have a schema of forecasted limitless branching of the POLITICS concept (as information initially activated in American mind by the *politics* lexeme):

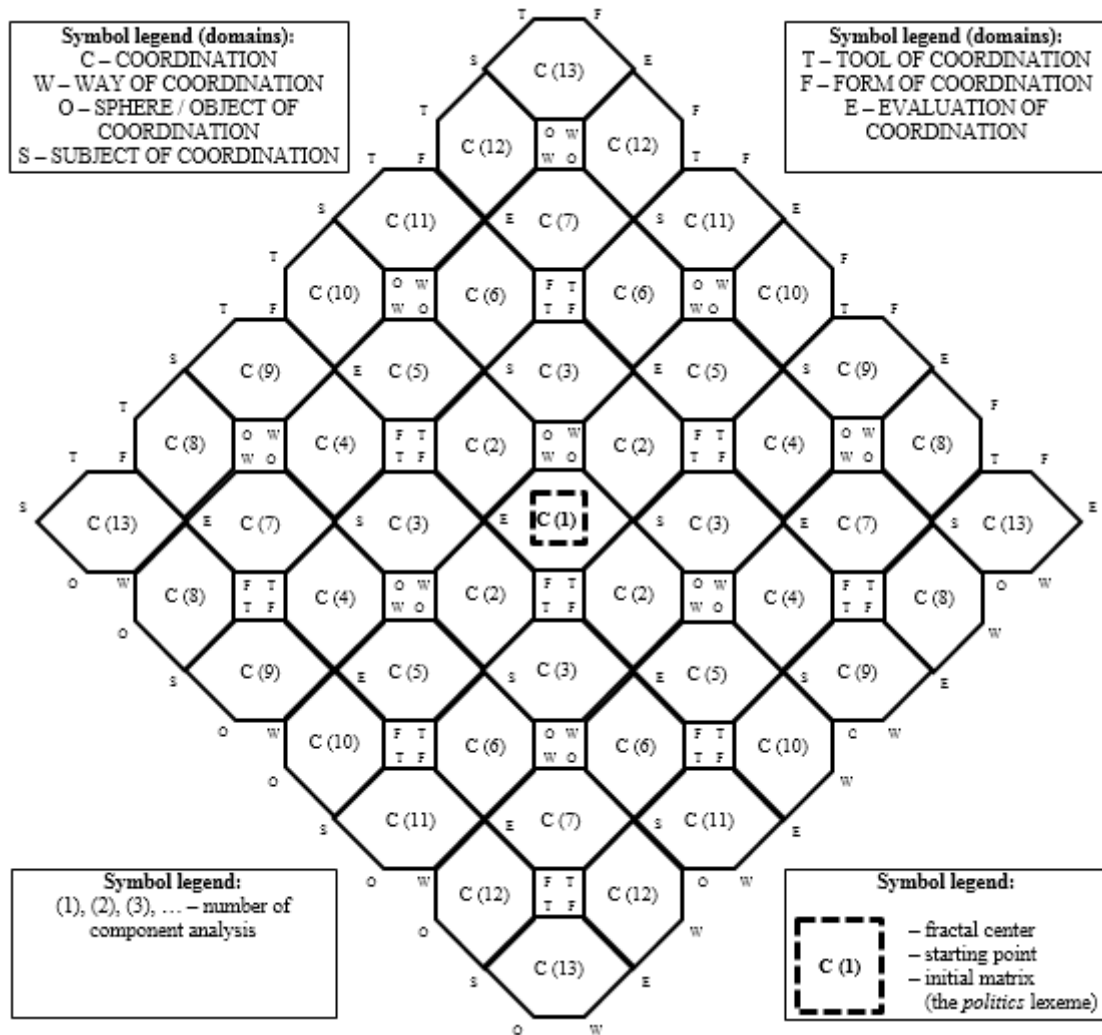


Figure 1. Limitless fractal branching of the POLITICS concept (as information in mind of American society)

The schema review detects several important facts confirming the fractality of the branchable information initially activated by the *politics* word:

1) In the process of limitless branching, there are constantly the same hexagon matrixes. Each new branching gives 4 new hexagons – they correspond to the number of subsequent component analysis of words from a current matrix;

2) By the odd number of component analysis matrixes are horizontally orientated, by the even one they are vertically orientated;

3) There is a clockwise-counterclockwise chain of the same domains in adjacent matrixes;

4) If we draw horizontal and vertical axes through the initial matrix as a starting point of information branching, we see with the naked eye a symmetrical self-similarity of larger shapes (numbers 1, 3, 7, 13). The difference of subsequent figures increases by 2, which generates an arithmetic progression of further self-similarities: 1, 3, 7, 13, 21, 31, 43, 57, 73, 91, 111 ...;

5) Each symmetrical self-similar shape (according to the above-mentioned arithmetic progression) has an increase of matrixes by the square arithmetic progression: 1, 9, 25, 49 ...

Now let us check the pattern via the fractal geometry formulas by B. Mandelbrot [3, p. 63-64]. Let us regard all 4 schema edges as equal to unit-length lines of an imagined square. Each edge has 7 identical hexagons, that is why it is split by seven equal intervals $b = 7$ into shapes with length of $r = 1/b = 1/7$. In case of squares (according to B. Mandelbrot [3, p. 72-73]), the total quantity N of obtained smaller shapes will be $N = b^2$, namely $7^2 = 49$. Plugging the values in the equation $D = \ln N / \ln(1/r)$ produces the value of fractal dimension $D = \ln 49 / \ln(1/7) = 2 \ln 7 / \ln 7 = 2$. Eventually, we recheck the fractal dimension via the formula Nr^D : $49 \times (1/7)^2 = 49/49 = 1$; thus, the equation $Nr^D = 1$ is valid. When $D = 2$, the fractal dimension coincides with that of Euclidean ($D \geq D_T$), which is valid for simple shapes too. Therefore, the POLITICS concept as a limitlessly branchable information in American mind is really a fractal entity in terms of geometry by B. Mandelbrot.

The conducted research gives presuppositions to say that other concepts may be fractals as well if they are reconstructed through the matrix format. Yet, that is going to be established in **further research prospects**.

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