# FORMAL DEFINITION OF THE CONCEPT "INFOS"

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*Abstract: The concept INFOS is very important for understanding the information phenomena. Because of this, it is basic for the General Information Theory. The more precise formal definition of this concept is given in the paper.*

## Introduction

The genesis of the concept of Infos started from the understanding that the concept "Information Subject" is perceived as human characteristic. It is clear that in the nature there exist many creatures which may be classified to this category. To exclude the misunderstandings we decide to introduce new word to denote all possessors of the characteristics of the Information Subject. This word is "*INFOS*".

The concept "Infos" is basic for the General Information Theory [Markov et al. 2003]. Its definition is only the starting point for further investigations and building the *Infos Theory*.

The variety of types of Infoses in the real world needs to be investigated and classified in the future research. At the first step, we may propose that may be at least two main types of Infoses exist:

- *infogens* - the natural creatures;
- *infotrons* - the artificial creatures.

Also, the Infos Theory needs to give answers to many other very important questions, such as:

- What is the nature of the activity of the Infos?
- What is the difference between the living level of the Infos and the non-living one?
- Is it true that the boundary between non-living and living entities is self-reflection and internal activity for satisfying the secondary (information) possibilities for internal or external contact?

Etc.

It is impossible to answer to all questions in a single article. We may make only the next little step. This is the aim of the present paper.

The formal definition of the concept of Infos needs theoretical basis which may support further mathematical investigations in this area. The first attempt was made in [Markov et al., 2003]. This brochure is the first attempt to compound all definitions of the main concepts of the General Information Theory, arisen during the years.

In [Markov et al., 2003a] we have continued our work with some new results, which make the previous formal definitions more precise. The main concepts, defined in this article are: "Entity", "Impact", "Interaction", "Reflection", and "Information".

The present work extends the basic definitions of [Markov et al., 2003a] with formal definitions, which concern the concepts "Information Witness", "Activity", and "Infos".

## The Information Witness

Let's remember the *definition* of "Entity" [Markov et al., 2003a].

The entity $A$ is the couple $A=(E_A,R_A)$ where:

$E_A$ is a collection of sub-sets of a set $M_A$;

$R_A=\{r_i|i\in I, I \text{ is a set}\}$ is a nonempty set of relations in $E_A$, i.e.

$r_i\subset E_A\times E_A=\{(X,Y)|X,Y\in E_A\}$ is a relation and $\check{r}_i=r_i\cup\{(X,Y)|(Y,X)\in r_i)\}$, $\forall i\in I$; and:

1. $\varnothing\in E_A$;
2. $M_A=\cup X,\ X\in E_A$;
3. $\forall r\in R_A$ and $\forall X,Y\in E_A \Rightarrow ((\exists(X,Y)\in\check{r})$ or
$(\exists\ Z_1,..,Z_p\in E_A,\ Z_k\neq\varnothing,k=1,..,p : (X,Z_1)\in\check{r},(Z_1,Z_2)\in\check{r},\ldots,(Z_p,Y)\in\check{r})$ □

*Definition 1.* Every relation $r_i \in R_A$ from the set of relations $R_A$ is said to be a state of $A=(E_A,R_A)$.■

Let's mention that often the set $M_A$ and collection $E_A$ are compounded by entities.

In the entities with very large and complicated structure which are built by another entities from lower levels, the impact may be considered as a basis for relations $(X,Y)$ which may be considered as a part of any state of the whole entity (relation $r_i \in R_A$).

Building the relationship between the entities is a result of the contact among them. During the contact, one entity impacts on the other entity and vice versa. In some cases the opposite impact may not exist, but, in general, the contact may be considered as two mutually opposite impacts which occur in the same time.

In [Markov et al., 2003a] we have formally defined the concepts "impact", "reflection", and "self-reflection".

*Definition 2.* Let $B=(E_B,R_B)$ is an entity. We say that $B$ has possibility for reflection, if there exists any entity $A=(E_A,R_A)$ and $\psi_f=(A\rightarrow B)_\psi$ is an direct impact of $A$ on $B$, and state $g \in R_B$ of $B$, which contain the reflection $F_\psi$.■

*Definition 3.* Let $A=(E_A,R_A)$ is an entity. We say that $A$ has possibility for self-reflection, if there exists any entity $B=(E_B,R_B)$ and transitive self-impact $\xi(A\rightarrow B\rightarrow A)$ and state $h \in R_A$ of $A$ which contains the reflection $F_\xi$.■

Let's remember the *definition* of Information [Markov et al., 2003a].

Let:

$A=(E_A,R_A)$ and $B=(E_B,R_B)$;

$\tau$ is an impact of $A$ on $B$, i.e. $\tau=(A\rightarrow B)_\tau$, $\tau \in \Omega_{AB}$;

$\exists$ entity $C=(E_C,R_C)$: $C\neq A$, $C\neq B$;

$\exists$ $\psi=(B\rightarrow C)_\psi$ which can be composed with $\tau=(A\rightarrow B)_\tau$;

$\exists$ transitive impact $\xi=\{\tau,\psi\}=(A\rightarrow B\rightarrow C)_\xi$;

$\exists$ impact $\varphi=(A\rightarrow C)_\varphi$, $\varphi \in \Omega_{AC}$ and $\varphi\neq\xi$;

$F_\varphi$ is a reflection of the impact $\varphi$ and $F_\xi$ is a reflection of the impact $\xi$.

$F_\tau$ is information for $A$ in $B$ if $\exists r \in R_C:(F_\varphi\rightarrow F_\xi)_r$. □

The entity $A$ is called source, the entity $B$ is called recipient. The relation $r \in R_C$ for which $(F_\varphi\rightarrow F_\xi)_r$ is called reflection evidence and the entity $C$ is called information evidence.

Let denote the information $F_\tau$ for $A$ in $B$ with information evidence $C$ by $\mathbf{F_\tau=inform(A,B:C)}$.

$F_\tau$ is the reflection of an impact and we consider it as sub-entity of $B$.

Let denote by $\mathbf{r=evidence(A,B:C)} \in R_C$ the state of entity $C=(E_C,R_C)$ in which there exist the evidence $F_\tau=inform(A,B:C)$.

In [Markov et al., 2003a] we have formally defined the concept "interactive reflection".

*Definition 4.* If $V_{AB}$ is an interactive reflection of between entities $A$ and $B$, and entity $C$ contains reflection evidences for all reflections of $V_{AB}$ than $C$ is called information witness.

## Activity

Every forming relationship as well as every relationship unites the entities and this way it satisfies some theirs possibilities for building the relationship by establishing the contact. In other words, for creating the forming relationship we need:

- entities, from which the new entity is able to built;
- possibilities of the entities for establishing the contact by satisfying of which the forming relationship may be originated.

The forming relationship is the aggregate of the satisfied possibilities for establishing the contact.

It is clear that after establishing the relationship we may have any of two cases:
- all possibilities of the entities for establishing the contact are satisfied by such possibilities of other entities;
- there are any free possibilities after finishing the establishment of the new relationship - on the low levels of the entity or, if it is a new entity, on the level of the whole entity. Disintegration of the entity may generate any possibilities too.

In the second case, the entity has *"free valency"* which needs to be satisfied by corresponded contacts with other entities. We may say the entity has *activity* generated by the free possibilities for establishing the contacts with the entities from the environment.

The process of interaction is satisfying the possibilities for contact of the entities. From point of view of the entity, the interaction may be external or internal.

During the interaction given entity may be destroyed partially or entirely and only several but not all parts of the destroyed entity may be integrated in the new entity. This means that there exist both constructive and destructive processes in the process of interaction between entities. The determination of the type of the interaction depends on the point of view of given entity. The interaction dialectically contains constructive and destructive sub-processes.

If the entity is a complex, it is possible for it to have an opportunity of self-reflection. In such case, it is able to reflect any reflection, which has been already reflected in it. In this case, because of the new internal changes (self-reflection) the entity may obtain any new *"secondary activity"*.

The secondary activity is closely connected to the structural level of the entity, which correspond to the level of the self-reflection. This way the secondary activity may be satisfied by internal or external entity from point of view of the given entity. In other words, *the resolving* of the secondary activity may be *internal or external*.

*Definition 5.* Let $A=(E_A,R_A)$ is an entity and $r\in R_A$ is a state of $A$.
- $(X,\varnothing)\in$ř where $X\in E_A$, $\varnothing\in E_A$, is called free valency of $A$ in the state $r$;
- the set $P_r$ of free valences for the state $r\in R_A$ is called activity or expectation for contact of $A$ in the state $r$: $P_r = \{(X,\varnothing) \mid X\in E_A, \varnothing\in E_A, (X,\varnothing)\in$ř$\}$ ■

During the establishment of the information relationship it is possible to be generated any secondary free activity (possibilities on the low levels of the entity or on the level of the whole entity) which needs to be satisfied by corresponded contacts with other entities.

The secondary activity in the information witness generated by the information relationship is called *"information activity"*.

*Definition 6.* Let $A=(E_A,R_A)$, $B=(E_B,R_B)$ and $C=(E_C,R_C)$ are entities; $F_\tau=\text{inform}(A,B{:}C)$ is an information for $A$ in $B$ and $r=\text{evidence}(A,B{:}C)$, where $r\in R_C$ is a information evidence of $\text{inform}(A,B{:}C)$. In such case:
- $(X,\varnothing)\in$ř where $X\in E_C$, $\varnothing\in E_C$, is called free information valency of $C$ based on the $\text{inform}(A,B{:}C)$;
- the set $P_r = \{(X,\varnothing) \mid X\in E_C, \varnothing\in E_C, (X,\varnothing)\in$ř$\}$ of free valences of the state $r\in R_C$ is called information activity or information expectation of $C$ based on the $\text{inform}(A,B{:}C)$.■



On given level of complexity of the entities a new quality becomes - the existing self-reflection and internal activity based on the main possibilities for contact of the sub-entities as well as on the new (secondary) possibilities created after internal self-reflection.

The internal activity may be resolved by:
- the internal changes which lead to partial internal disintegration of the sub-entities and theirs a posterior internal integration in the new structures;
- the external influence on the environment.

The internal changes may lead to removing of some sub-entities if they have no possibilities for integration with the others, i.e. if they have no free valences to be resolved in the process of integration.

The external influence is the most important. The impact on the entities around the entity is the way to resolve its activity. The destroying of the external entities and including the appropriate theirs parts in itself is the main means to exist and satisfy the free valences.

One special kind of activity is the information one. The secondary activity need to be resolved by relevant to the information valences corresponded (information) valences. So, not every entity may be used for resolving the secondary activity.

This way, the entity needs a special kind of (information) contacts and (information) interaction for resolving the information activity.

*Definition 7.* The Information Witness $C=(E_C,R_C)$, which has:

- possibility for reflection in a state $r_1 \in R_C$;
- possibility for self-reflection in a state $r_2 \in R_C$;
- (primary) activity in a state $r_3 \in R_C$;
- a state $r_4 \in R_C$ in which $C$ has non-empty information expectation (information activity)

is called Infos. ■

## Conclusion

What gives us the concept "INFOS"?

At the fist place, this is the common approach for investigating the natural and artificial information agents.

In other hand, this is the set of common characteristics which are basic for all entities, which we may classify to the category of the INFOS.

And, at the end, this is a common philosophical basis for understanding the information subjects.

Our main goal is to provoke the scientists to continue the research in this important area and to make the next step.

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