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Semantic models to indicate post-truth with fake news channels

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Abstract

The notion of post-truth currently is used for denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief. At present, the post-truth, which means any fact that is interpreted in that system of values that you already know and are already familiar with, is taking an increasing share in the information space. Post-truth means circumstances in which objective facts have less influence on the formation of public opinion than emotions or personal beliefs. In this space, the subject is vulnerable to targeted informational impact, and his cognitive activity is redirected under the influence of the environment. In fact, from the point of view of information processes, the subject is not even in the world of post-truth, but in the world of fake news, which is beginning to crowd out healthy information resources. A semantic model of such an information space is proposed, which allows one to record the occurrence of a channel of potential undesirable effects. A computational model of the channeled impact is formulated on the basis of the original model of the interaction of information processes when the formation of an erroneous opinion (bug) for an information resource (Page) with its damage (harm), i.e. causing damage by indicating a false benefit (fake), provided that the user of the resource pursues (hit) a certain interest or benefit (Gain).

Keywords: semantic information processing; computational model; variable domains

1. Introduction

Social media for the consumption of news not only benefit, but also cause tangible material damage. On the one hand, they generate a low cost of information exchange, easy access to it and rapid dissemination, which encourages people to seek and consume news from social networks. On the other hand, an environment is emerging that provides widespread "fake news", i.e. low quality news with intentionally false information. Widespread fake news can have a very negative impact on individuals and society. Therefore, the discovery of fake news on social media has recently

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become a new study that attracts great attention. The detection of fake news on social networks presents unique characteristics and problems that make existing detection algorithms from traditional media ineffective or inapplicable.

First, fake news is intentionally written to mislead readers. rely on false information, which makes it difficult and non-trivial to detect based on news content, so you need to include supporting information, such as social interactions of users in social networks, to help determine. Secondly, the use of this supporting information is a difficult task and of itself as the social interaction of users with fake news gives large, incomplete data, unstructured and noisy. Since the problem of detecting fake news on social networks is complex and relevant, a semantic model for the distribution of fake news is being developed, using which you can build a constructive computational model. This model provides a computing framework for the subject study of disseminated information.

In this paper, we formulate a computational model of channeled impact on the basis of the original model of the interaction of information processes when an error opinion (bug) is generated for an information resource (Page) with its damage (harm), i.e. causing damage by indicating a false benefit ($fake^{+}$, $fake^{-}$), provided that the user of the resource pursues (hit) a certain interest or benefit (Gain).

The proposed model is based on the concept of displacement of concepts [3], which allows you to create a model of the environment. The model is equipped with a semantic stabilization mechanism based on [4]. In fact, [5] data granulation constructs were used, allowing for taking into account [6] data dynamics. The model based on variable domains develops the apparatus for representing conceptual dependencies [9]. The branching capabilities of information channels take into account the representation in [11]. The promotion of information in a post-truth environment is possible taking into account the cognitive characteristics of the information consumer [12], and the resulting semantic model should have a certain semantic stability. The promotion of fake news directly illustrates the effect of entangling information processes, which is used in [13].

The wireframe representation of the model is a cross-cutting example illustrating the fruitfulness of applying conceptual mathematics [7] to represent the interaction of information processes based on the *variable domain* construct.

2. Characteristics of fake news

Briefly describe the main social and psychological theories associated with fake news, and discuss the more advanced models presented by social networks. In particular, we first discuss the various definitions of fake news and distinguish between related concepts that are usually misunderstood as fake news. Then we'll point out various aspects of fake news in traditional media and new patterns found on social networks.

2.1. Fake News

False news have continued for a very long time, almost as much as the time that has passed since the beginning of the widespread dissemination of news after the invention of the printing press in 1439. However, there is no agreed definition of the term "fake news". On this basis, we first discuss and compare some commonly used definitions of fake news in the existing literature and propose the definition of false/fake news, on the basis of which we will first build a computational model, and then a semantic model for the distribution of fake news.

The narrow definition of fake news is news articles that are intentionally and reliably false and can mislead readers [1]. There are two key features of this definition: authenticity and intention.

Firstly, fake news contains false information that can be verified as such.

Secondly, fake news is created with an unfair intent to mislead consumers.

This definition is widely used in recent studies [2]. The broader definitions of fake news focus on either the authenticity or intent of the content of the news. Some newspapers view satirical news as fake because tents are false, although satire is often fun-oriented and reveals its deceit to consumers [14]. Other sources directly look at misleading news as fake news [8], which include serious fabrications, hoaxes and satires.

In this article, we use a narrow understanding of fake news, similar to [10].

2.2. Defining Fake News

Potentially, the following can be taken as a definition: *fake news is a news article that is intentionally and reliably false*.

The reasons for choosing this narrow definition are threefold.

Firstly, the basic meaning of fake news provides both theoretical and practical value, which allows a deeper understanding and analysis of this topic.

Secondly, any verification methods applicable to the narrow concept of fake news can also be applied in a broader sense.

Thirdly, this definition can eliminate the ambiguity between fake news and related concepts that are not considered in this paper.

The following concepts are not fake news as defined by the definition: (1) satirical news with an appropriate context that does not intend to mislead or deceive consumers and is unlikely to be mistaken as factual; (2) rumors that did not arise from news events; (3) conspiracy theories that are difficult to verify as true or false; (4) misinformation created unintentionally; and (5) deceptions that are motivated only by fun or cheating against people.

As it turns out, the adopted definition is not too burdensome, it relies on promoting a kind of "information bait" and allows you to maintain intuitive clarity, which is important for constructing a target semantic model.

3. Semantic component

In everyday life, by *post-truth* is meant any fact that is interpreted in that system of values that you already know and understand. According to the Oxford Dictionary, post-truth means "circumstances in which objective facts less influence the formation of public opinion than emotions or personal beliefs". In fact, from the point of view of information processes, the subject is not even in the world of post-truth, but in the world of growing fake news, which begin to supplant healthy information resources.

As an example, consider the process of generating an erroneous opinion (bug) for an information resource (Page) with its damage (harm), i.e. causing damage by indicating a false benefit ($fake^+$, $fake^-$), provided that the user of the resource pursues (hit) a certain interest or benefit (Gain).

Key designations: in search of G – gain, there is *hit* – hit, to malicious *harm* content P with the virus being damaged by the *bug* virus.

$f : B \to A$ – development of events from A to B, h is the event script, s is the original (unchangeable) script, j is the substitution script.

U – available *sources of concern* (upset), U_f – f-reachable sources, u – current source (as a process). P – information resource (Page). Scenarios are mappings from U to P, i.e. $h : U \to P$. P^- – a damage-free resource, used to search for benefits. P^+ – damage, damaged (virus) pages, damaged resource, no profit is sought. $g^- : P \to P^-$ – separation of a healthy resource, $g^+ : P \to P^+$ – separation of the virus resource, damage. $bug : P^- \to P^+$ – defeat a healthy resource, not necessarily by promoting fake news with a "false benefit". It can be assumed that all damage can be localized.

G – gain (Gain). G^- is a real benefit. G^+ – false benefit promoted by malicious bait. $fake^+ : G \to G^+$ – fake benefits $fake^- : G \to G^-$ – check the benefits for authenticity.

C_f^- – non-affected (informational) resources lead to real benefits. C_f^+ – damage done, resources caught for false benefit.

The following diagram in Fig. 1 differs from the phishing diagram except for the presence of a gantry for pairing the stages of knowledge with the current stock of sources (information), which, in turn, responsible for indexing/parameterization in the target data structure.

Since P is *assumed* to be fixed, the use of parameterization/indexing leads to a reduction in the volume of a healthy resource P^-:

$$P^- = P \setminus P^+$$

$harm^+ \circ fake^+ \circ hit \circ (s_u)_f = bug \circ (s_u)_f$ = "having fallen for false profit (fake news) and having suffered damage, he began to behave like a virus resource".

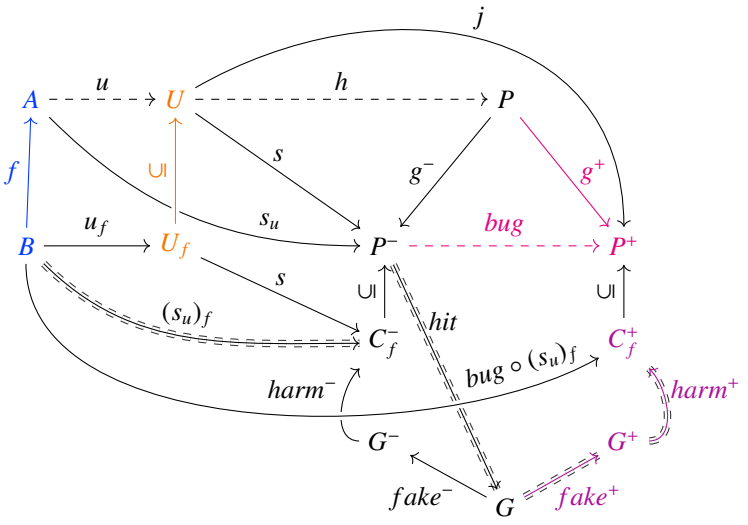

Fig. 1. Formation of a channel for promoting fake news.

At the A stage, the initial script is j_u, which confuses the resource for a healthy s_u with the affected one, which happens by the f evolvent and occurs at the B stage:

$$bug \circ (s_u)_f = (j_u)_f = \text{“began to behave like } (j_u)_f\text{”}$$

$$g^- \circ h_u = s_u = \text{“behaves like } s_u\text{”} = \text{“behaves like an original script”}$$

$$g^+ \circ h_u = j_u = \text{“behaves like } j_u\text{”} = \text{“behaves like a superseded script”}$$

$$harm^+ \circ fake^+ = push^+ = \text{“behaves like advancing damage”}$$

$$harm^- \circ fake^- = push^- = \text{“behaves like promoting profit”}$$

We emphasize that a “healthy”, non-fake (script, individual) s in the world of post-truth and fake news when evolving f events gets informational defeat by fake, turning into $bug \circ (s_u)_f$. In turn, this newly afflicted individual turns out to be *confused* (tangled) with the fake individual $(j_u)_f$, which, when forcing f, is expressed as “forced equality” $bug \circ (s_u)_f \simeq (j_u)_f$. Thus, a mathematical model arises of filling the world with fake news. A reduction in the volume of a healthy resource P^- is expressed by $P^- = P \setminus P^+$, as the fake resource P^+ grows.

4. The map of variable domains

Next, the individual semantic map will be transformed to a map of variable domains, which is a conceptual model consisting of vertex processes and process connections between them. The resulting model, on the one hand, formalizes the information environment of post-truth, based on the displacement of concepts to a certain limit, cognitively “invisible” by the consumer of information. In the context of post-truth, a network of information channels is being formed, some of which are possible for the dissemination of fake news. The model allows fixing the channeled distribution of information, which creates the basis for the development of a system of “recognition functions” for various purposes.

4.1. Conceptual framework

The semantic information dissemination model presented below is based on variable domains. Notation conventions used: for $h : A \to T$, $f : B \to A$ and $g : T \to S$ we write $H_T(A) = \{h \mid h : A \to T\}$ and

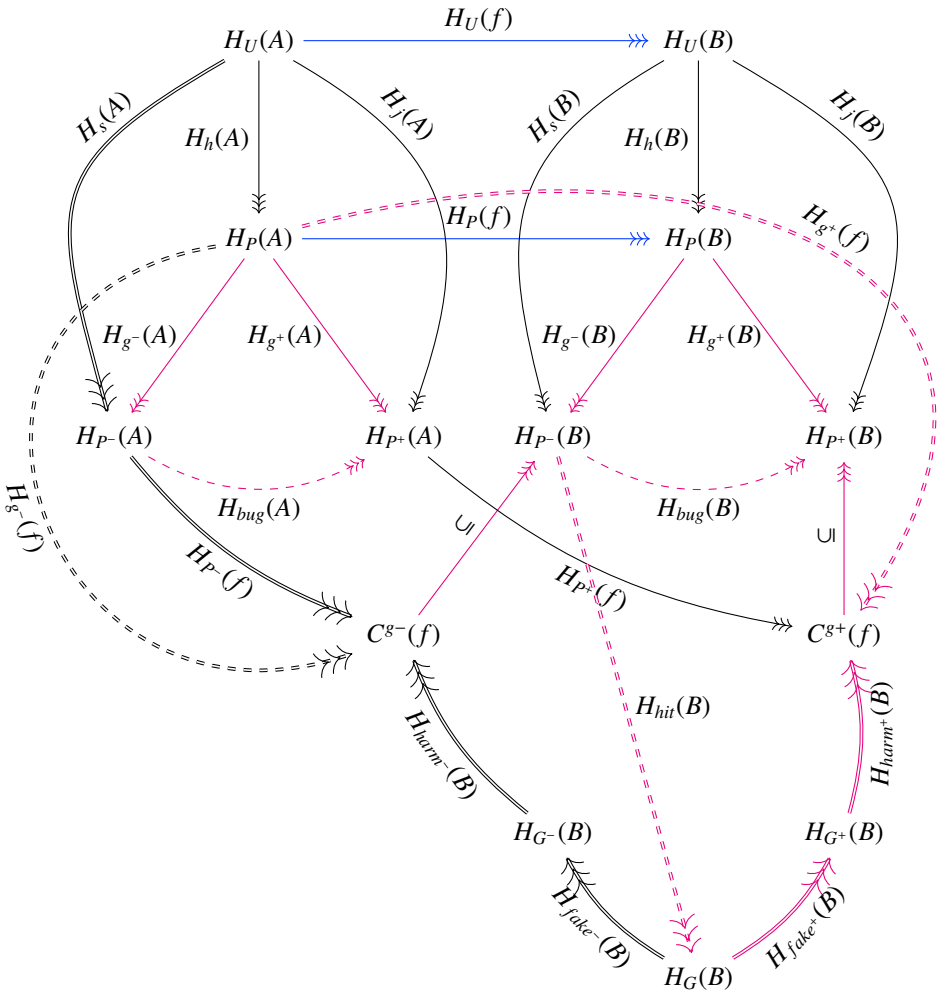

Fig. 2. Post-truth and fake news.

$H_g(f) : h \mapsto g \circ h \circ f$. Of course, $g \circ h \circ f \in H_S(B)$. We also use $C^g(f) = C^g_f$ to indicate a subset $H_S(B)$ obtained by applying $H_g(f) : H_T(A) \to H_S(B)$, i.e. $C^g_f \subseteq H_S(B)$. The $H_T(A)$ variable domains represent processes, and $H_g(f)$ represent process transformations. A map of the variable domains is shown in Fig. 2. This map is obtained by the natural transformation of the diagram shown in Fig. 1. Evolution occurs in the direction from A to B.

The defeat of fake news occurs along the direction

$$H_{hit}(B) : H_{P^-}(B) \to H_G(B).$$

4.2. Channel to promote fake information

There is a channel $H_{harm^+}(B) \circ H_{fake^+}(B)$, on which the promotion of fake information is possible. The consumer is faked $C^{g^+}_f = C^{g^+}(f)$, which is a g^+-separate and f-biased concept. Insofar as $C^{g^+}_f \subseteq H_{P^+}(B)$, then the consumer is cognitively redirected to the resource $H_{P+}(B)$. This resource delivers fake news since $H_{bug}(B) : H_{P^-}(B) \to H_{P^+}(B)$. In other words, the information process in $H_{P^+}(B)$ is deliberately biased by the fake *bug*.

4.3. Channel for promoting healthy information

Healthy news are also spreading along $H_{hit}(B) : H_{P^-}(B) \to H_G(B)$. There is a channel $H_{harm^-}(B) \circ H_{fake^-}(B)$, on which the promotion of healthy information is possible. The consumer receives the information $C_f^{g^-} = C^{g^-}(f)$, which is a g^--separated and f-biased concept. Insofar as $C_f^{g^-} \subseteq H_{P^-}(B)$, then the consumer is cognitively redirected to the resource $H_{P^-}(B)$. This resource delivers good news, as there is *no* way to falsify $H_{bug}(B) : H_{P^-}(B) \to H_{P^+}(B)$. In other words, the information process in $H_{P^-}(B)$ is obviously *not* biased by the fake *bug*.

The interpretation of the remaining branches of the general diagram is carried out just as directly and left to the reader.

5. Conclusion

The paper develops the concept of semantic modeling of the distribution of fake news. The model is based on the assumption that with such forgery of information, a "healthy" resource is defeated by a semantic virus, which intentionally distorts the original content.

1) A semantic framework is constructed for an individual resource, which is represented by an information process. An individual map of the channeled distribution of fake news has been formed.

2) An individual semantic map is transformed to a map of variable domains, which is a conceptual model consisting of vertex processes and process connections between them.

3) The resulting model, on the one hand, formalizes the information environment of post-truth, based on the displacement of concepts, to a certain limit, cognitively "invisible" by the consumer of information. In the context of post-truth, a network of information channels is being formed, some of which are possible for the dissemination of fake news.

4) The model allows fixing the channeled distribution of information, which creates the basis for the development of a system of "recognition functions" for various purposes.

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References

[1] Ariu, D., Frumento, E., Fumera, G., 2017. Social engineering 2.0: A foundational work: Invited paper, in: Proceedings of the Computing Frontiers Conference, ACM, New York, NY, USA. pp. 319–325. URL: http://doi.acm.org/10.1145/3075564.3076260, doi:10.1145/3075564.3076260.

[2] Fernández, L., Robles, S., Fortier, A., Ducasse, S., Rossi, G., Gordillo, S., 2009. Meteoroid towards a real mvc for the web, in: Proceedings of the International Workshop on Smalltalk Technologies, ACM, New York, NY, USA. pp. 28–37. URL: http://doi.acm.org/10.1145/1735935.1735941, doi:10.1145/1735935.1735941.

[3] Ismailova, L., Kosikov, S., Zinchenko, K., Wolfengagen, V., 2020a. Environment of modeling methods for indicating objects based on displaced concepts, in: Samsonovich, A.V. (Ed.), Biologically Inspired Cognitive Architectures 2019, Springer International Publishing, Cham. pp. 137–148.

[4] Ismailova, L., Wolfengagen, V., Kosikov, S., Parfenova, I., 2020b. Increasing of semantic sustainability in the interaction of information processes, in: Samsonovich, A.V. (Ed.), Biologically Inspired Cognitive Architectures 2019, Springer International Publishing, Cham. pp. 149–156.

[5] Ismailova, L., Wolfengagen, V., Kosikov, S., Volkov, I., 2020c. Computational model for granulating of objects in the semantic network to enhance the sustainability of niche concepts, in: Samsonovich, A.V. (Ed.), Biologically Inspired Cognitive Architectures 2019, Springer International Publishing, Cham. pp. 157–164.

[6] Kosikov, S., Ismailova, L., Wolfengagen, V., 2020. Dynamics of recognition of properties in diagnostics, in: Samsonovich, A.V. (Ed.), Biologically Inspired Cognitive Architectures 2019, Springer International Publishing, Cham. pp. 246–259.

[7] Lawvere, F.W., 1975. Continuously variable sets; algebraic geometry = geometric logic, in: Rose, H., Shepherdson, J. (Eds.), Logic Colloquium '73. Elsevier. volume 80 of *Studies in Logic and the Foundations of Mathematics*, pp. 135 – 156. URL: http://www.sciencedirect.com/science/article/pii/S0049237X08719475, doi:https://doi.org/10.1016/S0049-237X(08)71947-5.

[8] Shu, K., Sliva, A., Wang, S., Tang, J., Liu, H., 2017. Fake news detection on social media: A data mining perspective. SIGKDD Explor. Newsl. 19, 22–36. URL: http://doi.acm.org/10.1145/3137597.3137600, doi:10.1145/3137597.3137600.

[9] Slieptsov, I.O., Ismailova, L.Y., Kosikov, S.V., 2020. Representation of conceptual dependencies in the domain description code, in: Samsonovich, A.V. (Ed.), Biologically Inspired Cognitive Architectures 2019, Springer International Publishing, Cham. pp. 507–514.

[10] Stefanone, M.A., Vollmer, M., Covert, J.M., 2019. In news we trust?: Examining credibility and sharing behaviors of fake news, in: Proceedings of the 10th International Conference on Social Media and Society, ACM, New York, NY, USA. pp. 136–147. URL: http://doi.acm.org/10.1145/3328529.3328554, doi:10.1145/3328529.3328554.

[11] Wolfengagen, V., Dohrn, M., 2020. On capturing the variability in the modeling of individual behavior, in: Samsonovich, A.V. (Ed.), Biologically Inspired Cognitive Architectures 2019, Springer International Publishing, Cham. pp. 574–580.

[12] Wolfengagen, V., Ismailova, L., Kosikov, S., 2020a. Cognitive features for stability of semantic information processing, in: Samsonovich, A.V. (Ed.), Biologically Inspired Cognitive Architectures 2019, Springer International Publishing, Cham. pp. 581–588.

[13] Wolfengagen, V., Ismailova, L., Kosikov, S., Maslov, M., 2020b. Mutable applicative model to prevent entanglement of information processes, in: Samsonovich, A.V. (Ed.), Biologically Inspired Cognitive Architectures 2019, Springer International Publishing, Cham. pp. 589–596.

[14] Zhou, X., Zafarani, R., Shu, K., Liu, H., 2019. Fake news: Fundamental theories, detection strategies and challenges, in: Proceedings of the Twelfth ACM International Conference on Web Search and Data Mining, ACM, New York, NY, USA. pp. 836–837. URL: http://doi.acm.org/10.1145/3289600.3291382, doi:10.1145/3289600.3291382.