

STRUCTURAL ALIGNMENT METHOD OF CONCEPTUAL CATEGORIES OF ONTOLOGY AND FORMALIZED DOMAIN

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1. Manziuk E., Krak I., Barmak O., Mazurets O., Kuznetsov V., Pylypiak O. Structural alignment method of conceptual categories of ontology and formalized domain. *CEUR-WS*. 2021. Vol. 3003. Pp. 11–22.
2. Manziuk E., Barmak O., Krak I., Mazurets O., Skrypnyk T. Formal model of trustworthy artificial intelligence based on standardization. *CEUR-WS*. 2021. Vol. 2853. Pp. 190–197
3. Krak I., Barmak O., Manziuk E. Visual analytics to build a machine learning model. *Research Advancements in Smart Technology, Optimization, and Renewable Energy*. IGI Global, 2021. Pp. 313–329. <https://doi.org/10.4018/978-1-7998-3970-5.ch015>

Introduction

The problem of the structural method of ontology alignment and the more formally represented structured domain is considered. The applied area of research belongs to the field of ethical AI. The ontology developed on the basis of the ISO / IEC TR 24028 standard - Overview of trustworthiness in Artificial Intelligence, and the formalized research based on the corpus of gray literature which represents global landscape is investigated.

In order to prevent the creation of negative consequences from the introduction of AI, prevention of risks and dangers, as well as preserving the benefits and positive effects of AI on human life and society on a global scale at the present stage of human development are considered AI. As part of this concept, the EU Commission's High-Level Expert Group on AI (AI HLEG) European AI Alliance in the "Ethics Guidelines for Trustworthy AI" proposed the Trustworthy AI concept.

Purpose and objectives of the work

The purpose of the work is to develop a structural alignment method of conceptual categories of ontology and formalized domain.

1. Development of a model of structural alignment based on a direct alignment of entities, as well as on the alignment of related entities within the relative sets.
2. Study of structural alignment for an entity on the domain of ontology and finding the appropriate structure on the structured domain.
3. The practical implementation of the structural method of alignment for determining the level of importance of the structural components of the concept of AI trustworthiness

Research objectives

Model of structural alignment ontology and structured domain

$$structure(ent, ent') = \begin{cases} \frac{|A| + |B|}{2|\pi_{ent}(Link_O)|}; \\ A = \sigma_{link_{Ds(ent', y)}: \exists link_{O, Ds, filter(x, y)} \wedge \exists link_{O(ent, x)} \wedge (\forall x \in Ent_O) \wedge (\forall y \in Ent_{Ds})} (\pi_{ent'}(Link_{Ds})); \\ B = \sigma_{link_{O, Ds, filter(x, y)}: \exists link_{O(ent, x)} \wedge (\forall y \in Ent_{Ds}) \wedge (\forall z \in Ent_O)} (Link_{O, Ds, filter}), \end{cases}$$

s.t. $structure(ent, ent') \neq structure(ent', ent)$, $structure(ent, ent') \in [0, \dots, 1]$,

$\exists link_{O, Ds, filter(ent, ent')}$, $ent \in Ent_O$, $ent' \in Ent_{Ds}$, $\exists ! link = \sigma_{\max_w}(Link)$, $w \in [0, \dots, 1]$.

Research objectives

Set of relations in the form of constraints of the selection function on $Link_{O,Ds,filter}$

$$\sigma_{link_{O,Ds,filter}(x,y):\exists link_{O(ent,x)} \wedge (\forall y \in Ent_{Ds}) \wedge (\forall z \in Ent_O)} \left(Link_{O,Ds,filter} \right)$$

Set of relations in the form of constraints of the selection function on the projection on the entity ent' on $Link_{Ds}$

$$\sigma_{link_{Ds(ent',y)}:\exists link_{O,Ds,filter}(x,y) \wedge \exists link_{O(ent,x)} \wedge (\forall x \in Ent_O) \wedge (\forall y \in Ent_{Ds})} \left(\pi_{ent'} \left(Link_{Ds} \right) \right)$$

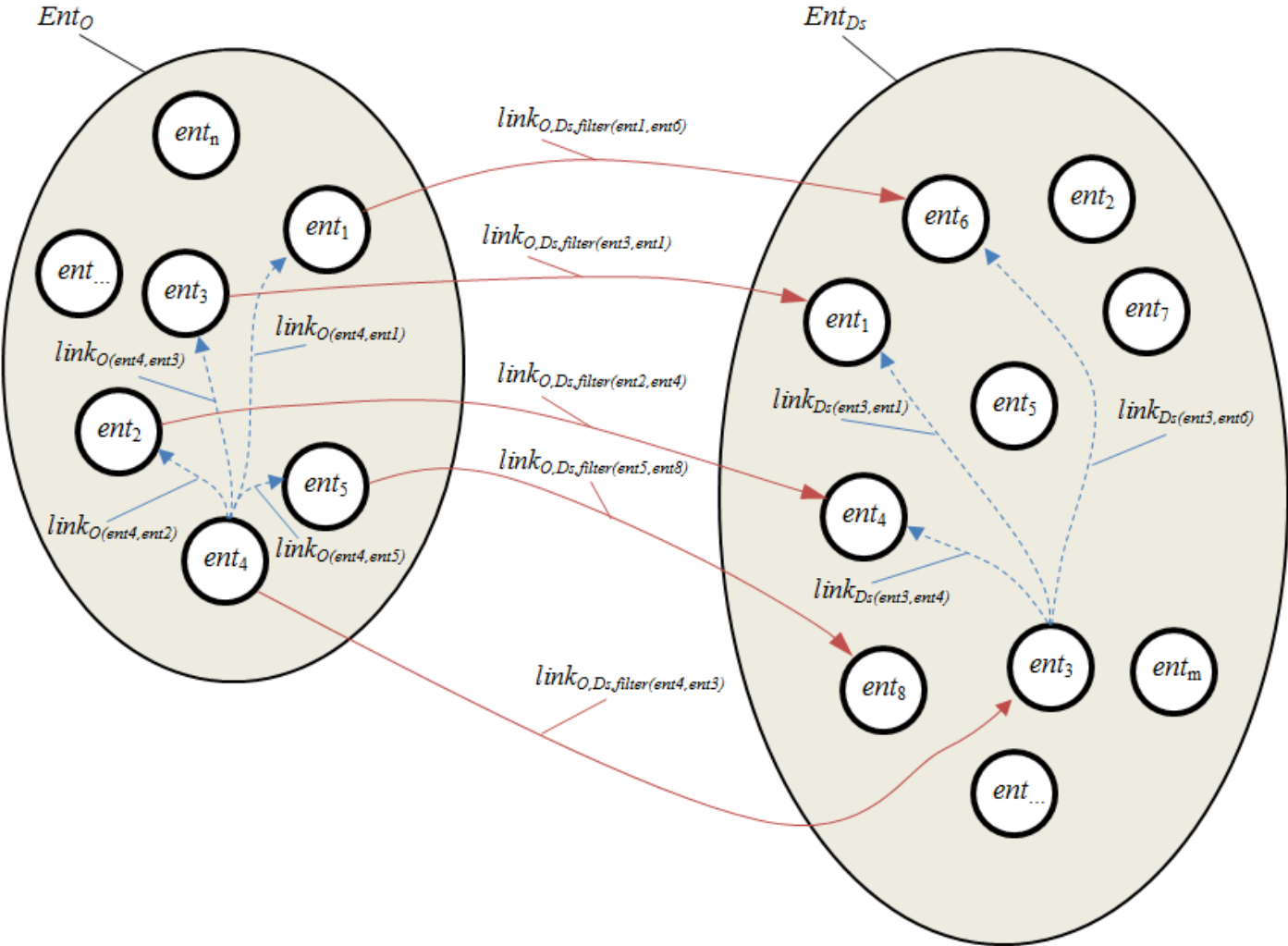
The relationship between the entities **and** ent'

$$\exists (ent, ent'), ent \in Ent_O, ent' \in Ent_{Ds} : (ent R_1 x) \wedge (x R_2 y) \wedge (y R_3 ent') \Rightarrow (ent R_{ent'}),$$

$$R_1 \in Link_O, R_2 \in Link_{O,Ds,filter}, R_3 \in Link_{Ds}, x \in Ent_O, y \in Ent_{Ds}$$

Research objectives

Scheme of relationships of structural alignment of entities for detection of the alignment degree

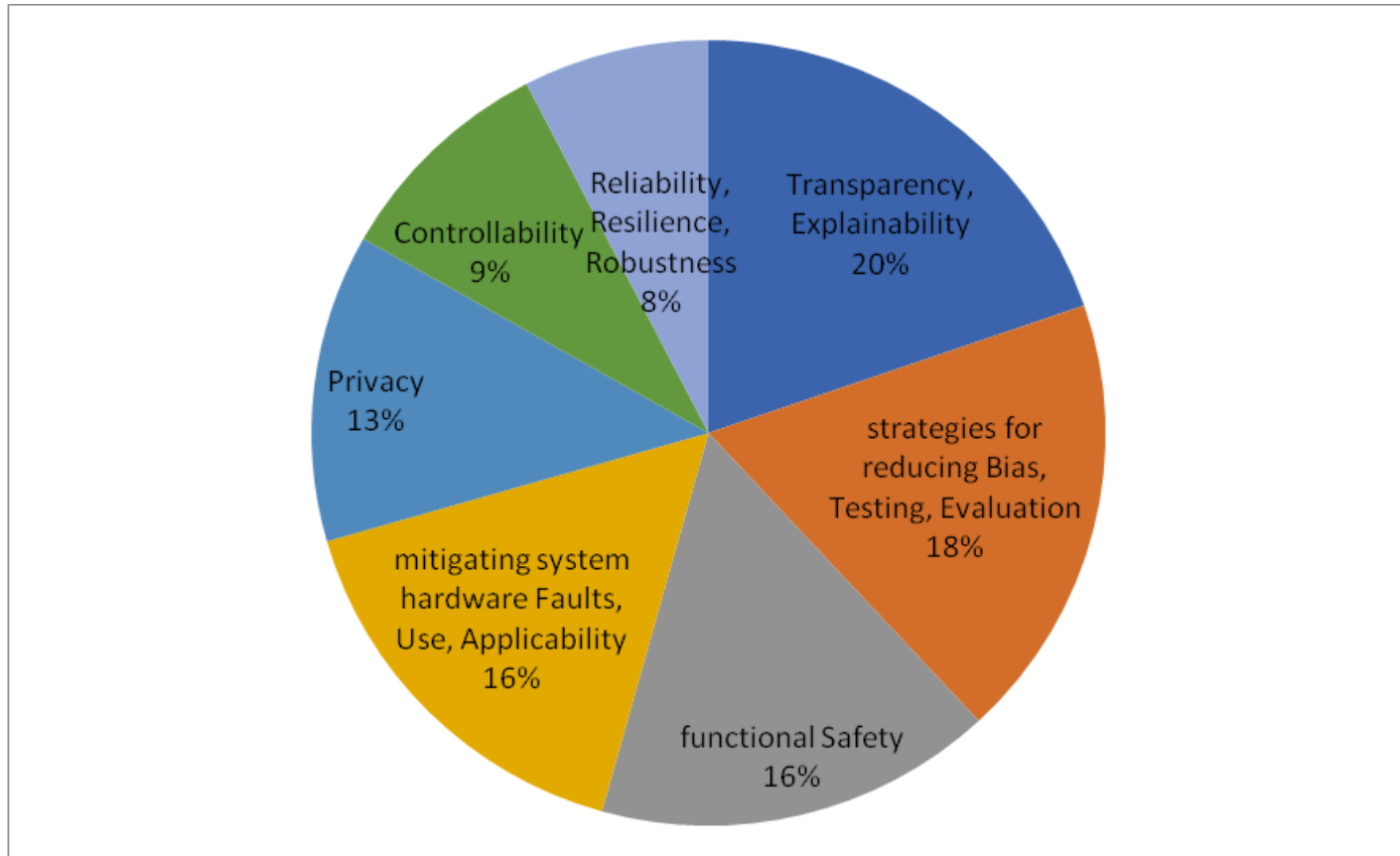


Research objectives

According to the figure, we define three types of relationships that combine entities in alignment system

1. Relationships within the trust ontology AI domain $dom O$, and connect entities that have a certain relationship to the study entity, i.e. the entity relatively which the structure of relations with other entities of this domain.
2. Relationships within the structured domain of the corpus $dom Ds$, and connect entities that have a certain relationship to the entity that in the current step is maximum similar as possible to the study entity.
3. Relationships between entities of domains O and Ds . In the study of detecting the degree of alignment with the structural approach, we build links between the entities of domains that have the appropriate links within the respective domains with the entities of the baseline comparison, i.e. the study entity and the closest relative entity at the current stage of alignment.

Experimental studies



The relative importance of the concept based on the data of Jobin A. (2019) *
distribution of ethical principles of AI using structural alignment

* A. Jobin, M. Ienca, and E. Vayena, "The global landscape of AI ethics guidelines," Nat Mach Intell, 2019, vol. 1, no. 9, pp. 389–399 (Health Ethics & Policy Lab, ETH Zurich, Switzerland)

CONCLUSIONS

The practical implementation of the structural method of alignment made it possible to determine the level of importance of the structural components of the concept of AI trustworthiness. Also, generalize the structural relationship of the concept with the definition of directions for further practical implementation in specific embodiment of AI.

That is, related concepts are practically provided by one tool within the implementation of AI. This has a significant advantage in terms of a systems approach with the allocation and integration of areas of responsibility in areas without losing aspects of implementation.

The accordance of the ontology of trustworthy AI with the global landscape of ethical AI has shown the correctness of the need to further formalize AI methods at a practical level while ensuring compliance with ethics AI.