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O'FAIRE: Ontology FAIRness Evaluator in the AgroPortal semantic resource repository

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Abstract. O'FAIRE, the *Ontology FAIRness Evaluator*, is a methodology to automatically assess to which level a semantic resource or ontology respects the FAIR Principles. This paper describes the online tool implementing O'FAIRE within the AgroPortal ontology repository, through 61 questions/tests, among 80% are based on the ontology metadata description. For a specific ontology or a group of semantic resources, O'FAIRE web service outputs both global and detailed scores (normalized) against the 15 FAIR Principles. O'FAIRE results are visualized and explained with new specific user-friendly interfaces (such as the FAIRness wheel) in order to help AgroPortal users improve the FAIRness of their resources. O'FAIRE is currently implemented in two different public ontology repositories as they offer the required metadata descriptions. In the future, we will deploy the service in other OntoPortal family repositories such as the NCBO BioPortal, Fraunhofer's MatPortal or LifeWatch's EcoPortal.

Keywords: FAIR Principles, FAIRness assessment, ontologies and semantic resources, ontology metadata, ontology repository.

1 Context and motivations

In 2014, the FAIR Principles established fundamental guidelines to make scientific data interoperable, persistent, and reusable for humans and machines [1]. Since then, several assessment methodologies and tools have been proposed to manually or automatically evaluate to what extent data or different research objects adhere to the FAIR Principles. For instances, FAIRdata [2], FAIR metrics [3], FAIRshake [4], F-UJI [5], or FAIR-checker [6]. Only one specific tool for ontologies called FOOPS! was released end of 2021 [7]. Still, no specific methodology has been proposed dedicated to ontologies or semantic resources (vocabularies, terminologies, thesaurus, etc.). FOOPS! is a good starting point for automatic FAIRness assessment, still, it has several limits: it does not cover all the sub-principles, and does not consider and test all the related aspects of a sub-principle (e.g., "I1/I2" are evaluated with straightforward tests), and does not provide actionable guidelines to address the detected issues. It does not work with a group of ontologies. One strong difference is that FOOPS! does not depend/rely on any ontology repository nor a standard way to describe ontologies/metadata, which is somehow both an advantage and a limitation.

From our point-of-view, clear metadata descriptions and open semantic repositories are two key elements of making semantic resources FAIR. In a previous paper, we introduced an *integrated quantitative FAIRness assessment grid* for ontologies and semantic resources [8] which dispatches 478 credits to each FAIR principle, depending on its importance when assessing the FAIRness of semantic resources. The proposed grid is based on the *Metadata for Ontology Description and Publication Ontology* [9], previous work harmonizing several metadata vocabularies into one model that has been implemented within AgroPortal [9]. With O'FAIRe,¹ we go a step further and present a clear methodology, based on 61 questions to automatically assess the FAIRness level of ontologies, guide semantic stakeholders to make their semantic resources FAIR, and select relevant FAIR semantic resources for use. This methodology considers FAIRness assessment of ontologies should as much as possible be based on the evaluation of their metadata properties, which ones shall be ideally indexed, shared, and standardized by reference ontology repositories or libraries. As illustrated hereafter, we have implemented O'FAIRe as a web service working with any OntoPortal installation (<https://ontportal.org>) respecting MOD 1.4 properties and implemented specific visualizations in the AgroPortal ontology repository [10].

2 O'FAIRe: conception, implementation and demonstration

O'FAIRe is based on 61 questions that describe the unambiguous tests to determine to which level a semantic resource respects a particular aspect of FAIR. The distribution of the 61 questions is as follows: Findable (13), Accessible (13), Interoperable (15), Reusable (20). Each question disposes of certain number of credits (as defined by the grid [8]) to assign to an ontology depending on how it passes the test. When assigned to an ontology, credits become points that are added and normalized into scores. The higher the number of points, the better the test is passed. The tool evaluates how a semantic resource responds to the 61 questions and provides a score for each sub-principles as well as a global normalized [0-100] FAIR score. The questions and the web service have been implemented in a Java Servlet application, which consumes as entry the JSON ontology metadata descriptions returned by AgroPortal's web service API. The code is open-source, fully documented and available for reuse/customization on GitHub: <https://github.com/agroportal/fairness>. O'FAIRe prototype (v2) was released in AgroPortal v2.2 release (on 2/2/22) (<http://agroportal.lirmm.fr>).²

The web service is accessible at following base URL: <http://services.agroportal.lirmm.fr/ofaire>. It takes as input parameter an *ontology acronym* or a list of ontology acronyms. It returns a *JSON output* which contains the FAIR scores obtained for each question aggregated by sub-principle, principle and then in total (*score*). The total score is maximized by 478 (cf. [8]) and normalized for convenience and comparison (*normalizedScore*). Every test result is justified by a short sentence (*explanation*) and when relevant the list of MOD1.4 metadata properties used (*properties*), so users may be aware of how this score was obtained.

¹ Long article currently under review at *Journal of Web Semantics*.

² And in the SIFR BioPortal (<http://bioportal.lirmm.fr>), a repository of French biomedical terminology. Both are two distinct open ontology-repositories based on the OntoPortal technology and implementing MOD 1.4.

We have implemented specific visualizations (such as the new FAIRness wheel) in AgroPortal for O'FAIRe. Fig. 1 shows an overview of the results returned for an individual evaluation of the Basic Formal Ontology (BFO) in AgroPortal. Corresponding web service call is: <http://services.agroportal.lirmm.fr/ofaire?ontologies=BFO>

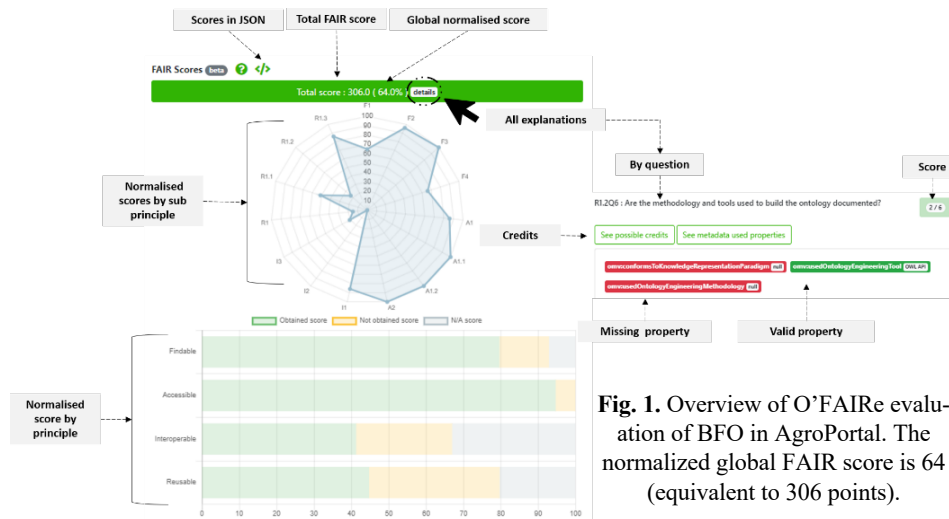


Fig. 1. Overview of O'FAIRe evaluation of BFO in AgroPortal. The normalized global FAIR score is 64 (equivalent to 306 points).

When a list of ontologies is passed as entry, the combined parameter computes metrics for the group of ontologies requested (average, min, max and median and returns the average scores). Fig. 2. shows an illustration in AgroPortal for a group of ontologies.

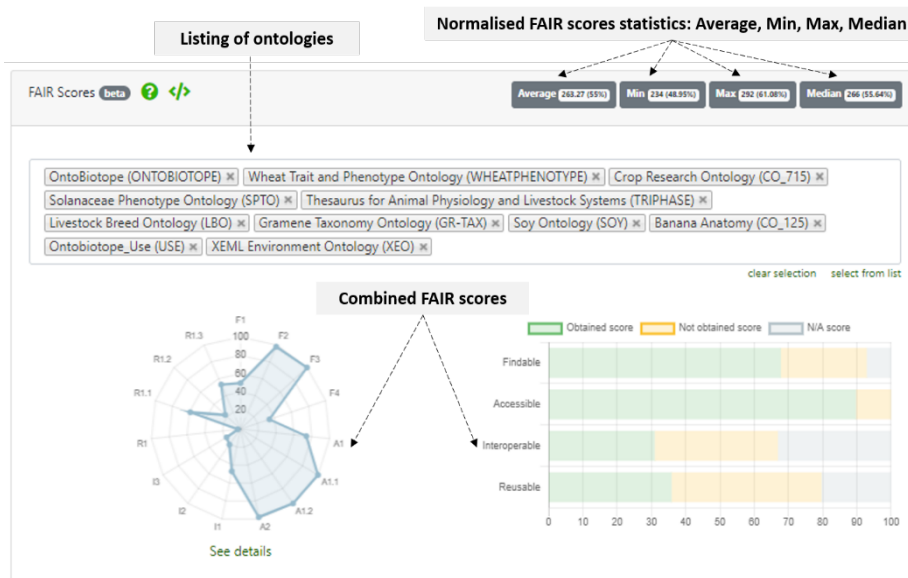


Fig. 2. O'FAIRe combined FAIRness evaluation of 11 ontologies in the OBO group in AgroPortal: average= 55, min=48, max=61, and median=55.

3 Conclusion

O’FAIRe offers both a methodology and a tool (illustrated here in AgroPortal) to enable automatic FAIRness assessment of ontologies. It differs from existing initiatives, as it is specialized for ontologies or semantic resources and it is based on metadata description harmonized in an ontology repository. O’FAIRe main goal is to offer a metric measure the level of FAIRness to guide semantic stakeholders to make their semantic resources more FAIR, and select relevant FAIR semantic resources for their use. The grid on which O’FAIRe is conceived as well as its methodology (e.g., list of questions) can be customized, extended, or improved by other semantic experts in further studies. Currently, O’FAIRe can be used in the AgroPortal an ontology repository dedicated to agronomy and the SIFR BioPortal, a French biomedical terminology repository. Collaborations within the OntoPortal Alliance will enable us to extend and maybe customize O’FAIRe for other repositories such as the NCBO BioPortal, LifeWatch’s EcoPortal or Fraunhofer’s MatPortal.

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