CLARA search engine: Linking Licensed Educational Resources

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Abstract. A basic keyword search is the most frequent technique used by teachers looking for reusable Educational Resources (ER). Despite the abundance of ERs on the Web, many remain undiscovered because they are not well connected. In addition, usage rights issues arising from incompatible licences of ERs are a barrier for teachers. In this demonstration, we introduce the CLARA search engine, a web application based on a knowledge graph designed to help teachers in discovering relevant and license-compatible ERs. Based on a set of subjects given by a teacher, the CLARA search engine provides a ranked set of ERs that can be bookmarked to be reused in a new course. The licenses of bookmarked ERs are organised within a compatibility graph, which suggests the license that could protect the new course based on the compatibility of the licenses of the bookmarked ERs.

1 Introduction and motivation

In the CLARA project[1], we aim to help teachers create content reusing relevant Educational Resources (ER) without having to delve into licensing aspects. Despite the abundance of valuable resources available on the Web, ranging from slides, videos, figures, text, and code, many remain undiscovered because they are not well connected [1]. In addition, there are usage rights problems since it is not legal to combine resources in a teacher's course if their licenses are not compatible with the course's license. These legal issues represent a barrier for the teacher himself and the institution that is hosting his course. Ideally, analysing available resources to match a course plan and the license verification should not be time-consuming.

There are platforms to help learners construct personalized learning paths[2], to allow teachers to share their ERs[3], or even platforms to help teachers create new ERs[4][5]. However, a solution to help teachers find relevant and license-

[1] https://project.inria.fr/clara/
[2] https://labs.tib.eu/edoer/
[3] https://www.merlot.org/
[4] https://www.oercommons.org
[5] See this this metasearch engine of OERs https://oer.deepwebaccess.com/

compatible ERs is missing. CC Search Portal[6], finds images licensed under a Creative Commons license. Similarly, the Google search engine can filter images by access rights according to licenses (Creative Commons licenses and other commercial licenses). However, if a user wants to reuse multiple images protected by different licenses, these search engines do not suggest the license that might protect the image mashup. Moreover, there are tens of open and free licenses[7] and they are not considered in these solutions.

As the most effective way to enhance the discoverability and reusability of ERs is by using Linked Data principles, we have developed a search engine based on a knowledge graph (KG) to help teachers find ERs. Its functionalities are the following: (1) It returns an ordered set of the most relevant ERs to a subject search. (2) Each ER indicates its accessible URL, authors, license, year of publication and most relevant subjects. (3) The search can be filtered by language, format, and license. (4) A visual graph with the resulting ERs linked with their most relevant subjects is provided. (5) ERs that are interesting for a new course can be bookmarked and the compatibility graph of their licenses is provided [4]. The goal is to highlight licenses capable of protecting new content based on the licenses of the bookmarked ERs. If a suitable license cannot be found, our tool provides explanations regarding incompatible licenses. This strategic feature gives teachers the means to design new resources that integrate ERs without the hassle of incompatible licensing issues.

In this paper, we describe the design of the CLARA search engine.

2 CLARA search engine

ERs can be described with several properties such as title, authors, language, license, etc., as well as the subjects they cover. While ERs may cover multiple subjects, not all are equally significant to the resource. Some subjects serve as primary focal points, while others are briefly mentioned. Consequently, it is essential to assess the relevance of each subject and weigh their relationship with each ER accordingly. Statement-level reification[8], allows us to annotate with scores the relation between ERs and the subjects they treat. As an example, the following triple (in RDF-star[9]) states that an ER focuses on a subject with a score of 0.4: `« :ER1 dct:subject :Query_Language » uno:pageRank "0.4".`

Various reification models exist, each with distinct syntax and performance implications for storage and query processing. In [2], we compare four statement-based reification models (including standard reification, singleton properties, named graphs, and RDF-star) on four triplestores (Virtuoso, Jena, Oxigraph, and GraphDB) to determine the most pertinent choice for our use case. The four versions of analyzed knowledge graphs (KG) are available in [3]. Our experiments indicate that both, standard reification and named graphs, when used

[6] https://search.creativecommons.org/

[7] https://en.wikipedia.org/wiki/Free_license/

[8] In the world of RDF, reification allows to write RDF statements about a RDF statement.

[9] https://w3c.github.io/rdf-star/cg-spec/2021-12-17.html

with the Virtuoso triplestore, exhibit similar performance with our KG. While RDF-star presents an elegant and concise model for statement-based annotations, the efficiency of its implementations should be improved if *quoted triples* are included in RDF 1.2[10].

The CLARA KG links 45,000 ERs (licenced under twelve different open licences) with 135,000 subjects, collected in the European project X5GON[11]. Statement-level reification is used to annotate the `dct:subject` relation with a PageRank score, ranging from 0 to 1, obtained through a wikification process[12]. The PageRank score of a concept is local to an ER, it depends on the number of concepts associated with this ER. The sum of the PageRank values of all concepts linked with an ER is 1. Thus, the greater the number of concepts, the lower their PageRank scores. On average, each ER is related with 184 subjects (with a median of 171 subjects per ER). In contrast, concepts are more sparsely distributed, with an average of 61 ERs linked to each concept (with a median of 2 ERs per concept).

The web application is implemented with the framework Vue in TypeScript. The backend sends SPARQL queries to a Virtuoso endpoint. Elasticsearch is used to index the subjects, the related ERs and the corresponding normalized PageRank scores. Normalization was necessary because the local nature of the PageRank metric provided by the wikification process prevents the positioning of ERs by subject. That is, an ER highly relevant for a particular subject but linked with multiple other subjects, may have a lower PageRank for that subject than a less relevant ER that is linked with fewer subjects. Thus, the ranking function we have developed uses the normalized PageRank scores to take into account how evenly distributed these values are by subject. From a subject(s) search, the ranking function creates a hypothetical ER (a goal) that perfectly answers the query and then ranks the existing ERs based on their distance (cosine similarity) towards this goal. The backend is accessible from a public API and can be used independently. The frontend ensures continuity of teacher activities by saving bookmarked ERs between sessions using the browser's local storage, facilitating continued selection of ERs over time.

3 Demonstration

Figure 1 shows a screenshot of the CLARA search engine. In this example, four ERs are bookmarked to be reused in a new course. On the right, the compatibility graph of licenses shows in green the license that is compliant to the licenses of the bookmarked resources. If all the licenses are red, a problem of license compatibility exists. During the demonstration, attendes will be able to use the CLARA search engine.

All our resources are publicly available under open licenses.

- The CLARA search engine: `https://clara.univ-nantes.fr/`.
- The associated API: `https://clara.univ-nantes.fr/api-docs`.

[10] `https://www.w3.org/TR/rdf12-concepts/`
[11] `https://www.x5gon.org`
[12] Wikifier tool `https://wikifier.org`

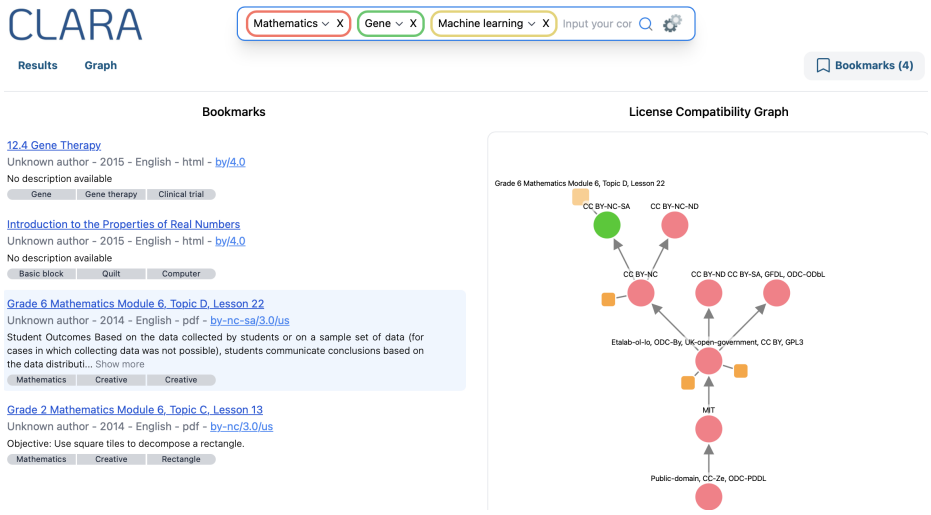

Fig. 1. Screenshot of the CLARA search engine. It shows the compatibility graph of licences of some bookmarked ERs. The license in green can protect a new course mixing-up bookmarked ERs.

- The source code: `https://gitlab.univ-nantes.fr/clara/`
- A SPARQL endpoint to access the knowledge graph (in standard reification): `https://clara.univ-nantes.fr/sparql`.
- A video of the CLARA search engine: `https://youtu.be/2MEZd5Wr-IE`.

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References

1. Cortinovis, R., Mikroyannidis, A., Domingue, J., Mulholland, P., Farrow, R.: Supporting the Discoverability of Open Educational Resources. Education and Information Technologies **24**, 3129–3161 (2019)
2. Kieffer, M., Fakih, G., Serrano-Alvarado, P.: Evaluating Reification with Multi-valued Properties in a Knowledge Graph of Licensed Educational Resources. In: 19th International Conference on Semantic Systems (SEMANTiCS). Leipzig, Germany (Sep 2023). https://doi.org/10.3233/SSW230008
3. Kieffer, M., Fakih, G., Serrano Alvarado, P.: CLARA Knowledge Graph of Licensed Educational Resources (Oct 2023). https://doi.org/10.5281/zenodo.8403142, `https://doi.org/10.5281/zenodo.8403142`
4. Moreau, B., Serrano-Alvarado, P., Perrin, M., Emmanuel, D.: Modelling the Compatibility of Licenses. In: 16th Extended Semantic Web Conference (ESWC). Springer, Portoroz, Slovenia (Jun 2019), `https://hal.archives-ouvertes.fr/hal-02069076`