Case Study Summary

The growth of research on AI methods, models, datasets and benchmarks during the last 20 years had led to a difficulty on tracking where AI models are applied, monitoring progress, and identifying unexplored areas or areas where synergies could be potentially achieved.

Intelligence Task Ontology and Knowledge Graph (ITO) was created in order to provide a systematic way of organizing knowledge in the AI area. In addition, considering the diversity of AI data modalities and its application domains, the purpose of this manually curated, well-structured and comprehensive data resource is to enable in depth and more meaningful analyses of the AI domain (Blagec, et al., 2022).

In particular, ITO was developed in order to mainly fulfil the below objectives:

- Provide a comprehensive and well-organized way to classify AI tasks and benchmarks;
- Support monitoring of performance metrics across different domains and over time;
- Enable interoperability with external datasets and other knowledge graphs;
- Enable easy data querying.

The current version of ITO, which is openly accessible, includes 685.560 edges, 1.100 classes for AI processes, and 1.995 properties for performance metrics.

Methodology

The methodology applied to create the ITO included several steps. Initially, the data used for the creation of the first version of ITO was extracted from the *Papers with Code* repository of PWC. Then this data was converted with a Python script into the Resource Description Framework (RDF) and Web Ontology Language (OWL) in order to support formal knowledge representation and reasoning. Following these steps, extensive manual curation was performed using Web Protégé tool and tasks and benchmarks were systematised and mapped to AI processes. Finally, all scripts and workflows were reviewed and refined to ensure

continuous update and curation of data over time, in order to ensure that ITO will be up-to-date (Blagec, et al., 2022).

Critical Evaluation

ITO has adopted a process-centric approach given the fact that such approach offers clear definitions for processes. Thus, ambiguous or not well-structured task definitions can be avoided and alignment with formal ontological structures is enabled.

In ITO, AI processes are under 16 major parent classes such as “Vision Process” or “Natural Language Processing”, and further into a hierarchy of subclasses such as “machine learning”. In addition, one sub-class can involve several parent classes enabling that way the use of ITO for specific cases; e.g. image captioning.

Such approach of ITO comes with several strengths but also with some drawbacks that researchers should take into consideration. Table 1 below provides a summary of such analysis.

Table 1. Strengths and Drawbacks of ITO

Strengths	**Drawbacks**
Rich Semantic Representation ITO is able to support advanced querying and automated reasoning through RDF and OWL, enabling researchers to extract more than just flat data repositories.	**Limited Automation** The need for manual intervention, apart from being time consuming, creates barriers in the long-term scalability and expansion of ITO.

Manual Curation Process Manual curation process has enhanced the quality of the ITO, enabling high levels of accuracy, clarity and consistency.	**Low Relationship Richness among classes** Considering that the majority of relations are at the individual instance level, low relationship richness among classes can create barriers in some types of logical inference.
Integration The use of existing vocabularies such as EDAM and FOAF enables the interoperability of ITO with other systems and facilitates its integration into more complex knowledge systems.	**Data Dependency** The fact that data are retrieved from the “Papers with Code”, owned by PWC creates some doubts with regards to coverage or bias.
Proven Usefulness ITO has already been used in researches proving its value especially for meta-analysis.	
Maintenance Model ITO, by the way it was developed and structured, enables incremental updates; new entities are flagged for curation.	

Real-world applications and Implications

ITO can be used in several real-world cases facilitating in-depth analyses in various fields of the AI domain (Blagec et al., 2023; Verlingue et al., 2024).

First of all, ITO could be applied in meta-research and meta-analysis. For example, ITO can support researchers, research centres, or even policymakers to identify under-researched areas that need to be examined, as well as monitor trends over time and see research trends. In this way accountability on AI development can be tracked; a critical area of concern for organizations and government nowadays.

Additionally, ITO could be a useful tool in education. More specifically, ITO could be used by educators is order to support the design of curricula that include evolving trends in AI, as well as to support educators in the identification of canonical tasks, relevant benchmarks and metrics.

Beyond research and education, ITO could be used by practitioners and developers in order to identify which model should be used for a specific task. For example, a practitioner in the healthcare sector who is looking for a model suitable for medical image segmentation, could apply ITO in order to identify the relevant dataset, other benchmarked models, and performance indication. Adopting ITO, the practitioner could save time and effort and in turn expedite deployment.

Conclusion

To sum up, as presented in the work of Blagec, et al. (2022), the Intelligence Task Ontology (ITO) is a significant advancement in the analysis and organization of artificial intelligence domain. Its process-centric approach provides a robust approach that avoids ambiguous or not well-structured task definitions. Among its strengths are its rich semantic representation, manual curation process, integration with other systems, proven usefulness, and maintenance approach to be always up-to-date.

Though as any other tool, it has its limitations, such as limited automation, low relationship richness among classes, and data dependency to PWC “Papers with Code”, the application of ITO in research, education, professional environment is undoubtedly a game changer in terms of how it could enhance analyses, facilitate tasks and benchmarking, and ensure relevant metrics are identified.

References

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