Architecting Attribution: expanding the scope of academic credit

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Abstract
Traditional metrics for scholarship typically only measure publication records and grants received. However scholarly contributions can extend well beyond these traditional contributions. In order to properly give attribution for scholarship, we need improved mechanisms for recognizing and quantifying these efforts. We aim to develop a computable system to better attribute scholars for the work they do.

A need for better recognition of contributions
Open science, team science, and a drive to understand meaningful outcomes have transformed research at all levels. Scholars and researchers contribute to research and scholarship in ways that can no longer be recognized only via traditional means of publication counts and grant dollars received [1]. We need a more nuanced characterization and contextualization of research products, and contributor roles related to the development of those products, and the ability to consider this on the individual or collective level. Unfortunately, little infrastructure exists to identify, aggregate, present, and understand the impact of non-traditional contributions (e.g. curation or analysis). Moreover, challenges to recognizing these contributions are technical as well as cultural, and addressing them requires an approach that assimilates various perspectives for investigators and organizations, alike. The goal of this project is to 1) understand the requirements for a computable attribution system from a large diversity of stakeholders, including scholars, researchers, publishers, funders, and librarians, 2) build a model to meet these requirements, and 3) evaluate the models in real pilot systems with real data.

A Computational Approach to Attribution
Initial work was done to gather requirements from stakeholders, in order to best understand the types of non-traditional roles and contributions that are made. Over a series of workshops at related conferences, we collected information on the types of contributions that scholars wanted credit for during brainstorming sessions [2-4]. In combination with work from existing evaluation frameworks [such as 5-12], we created the Contributor Role Ontology (CRO) [13], a structured representation of scholarly roles and contributions. The CRO integrates the CASRAI Contributor Role Taxonomy (CRediT) [5-6], which is a high level taxonomy representing roles in scientific research, and extends it to include representation of contributions in other domains. The CRO contains terms representing contributor roles for a range of different activities which are essential for successful collaborative science.

The CRO can be used in combination with research object types to develop infrastructure to understand the scholarly ecosystem, so we can better understand, leverage, and credit a diverse workforce and community. We are developing a data model to model the relationship between an entity, an agent who contributes to it, and a contribution role that sits between them to describe how individual contributions were made. The entity is the thing to which contributions are made; it can be any research related artifact or product - physical or digital. Our initial model aims to utilize research objects from wikidata, which could include things like websites,

videos, conference posters, and lectures. The agent is the thing that makes the contribution. It can be an individual person, an organization of multiple individuals acting together, or a computational agent such as a software program or algorithm. Contributions in this model represent the actions taken by a particular agent in the creation, modification, assessment, or deprecation of an entity. Ultimately, we aim to deliver a formal JSON(-LD) schema implementation and a tab file format implementation of this information model, with accompanying user documentation.

Applications for this model may include **publishers and institutional repositories** capturing author contributions to papers and other objects created during the research process, **curated knoweldgebases** collecting information on curators contributions to annotation records as they mature through the system, **research profiling systems** describing contributions of researchers to diverse research artifacts, **research data management platforms** detailing contributions to data objects it manages, **data repositories** capturing contributions to submitted data sets it catalogs, and **institutional promotion workflows** to supplement promotion and tenure processes in the context of team science, open science, and the continuously evolving environment of scholarly activities and systems. In these contexts, this model will support the collection, provision, and exchange of detailed contribution metadata, display of this metadata to system users, and the ability to perform precise contribution-related queries and computational analyses.

Call to Action
Beyond this technical approach, we need to address this challenge from a cultural perspective. This effort requires a community approach, and will be most successful if everyone works together. This work is being conducted through the Architecting Attribution Project [14]. We encourage stakeholders from various communities and roles to get involved, provide perspective, make feature requests, and help shape the future of academic credit and incentives. We want to create a thoughtful and inclusive collaboration spanning publishing, research, scholarly societies, funding agencies, libraries, administrators, data stewards, organizations working in support of persistent identifiers, and more. For more information, sign up here (https://docs.google.com/forms/d/e/1FAIpQLSfwJqygCgZICVLaimbBaiMcRXd6pVeooOnEZSyFIO5k4c3D6A/viewform), join our Slack channel (https://cd2h.slack.com/messages) or view our GitHub repository here: https://github.com/data2health/architecting_attribution. What do YOU wish to get credit for?

Acknowledgements

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