

Towards an Object-Oriented Referencing System: Defining Multiple Forms of Asynchronous Collaboration and Authorship

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Abstract

In order to facilitate a practice of reuse of datasets in the humanities, an ecosystem has to exist in which scholars can publish their datasets, correctly attribute this data according to the roles played by each author, share these datasets, and allow for various scenarios of reuse. We have developed the web-based research environment *nodegoat*¹ that allows for the creation of complex datasets. Current publication channels do not allow for complex authorship attribution. In this paper we explore reuse scenarios by means of an object-oriented referencing system in which datasets, data selections, entities and records are all referenceable objects with uniquely identifiable authors. Once a reference has been made to any of these objects, a citation is automatically determined based on the position of the referenced object in the network and all their corresponding authors. This object-oriented referencing system paves the way for various scenarios of reuse and processes of asynchronous collaboration.

1 Introduction

Lisa Spiro has developed a comprehensive overview of collaborative practices in the digital humanities (Spiro, 2012, 2009). She identified three scenarios in which collaboration takes place: “(1) communicating and exchanging knowledge through participatory online environments; (2) building digital collections of primary and/or secondary scholarly resources; and (3) developing computational methods for analyzing humanities data” (Spiro, 2012. p. 45). In her work, she has mainly focused on synchronous forms of collaboration in which research groups or participatory projects work together on a set of resources. Still, in her exploration of the process of building digital collections of primary and/or secondary scholarly resources she highlights the opportunities offered by a continuous form of editing and re-editing of scholarly resources (Spiro, 2012. p. 57). Spiro discusses this in the context of a closed environment in which the project team, project data and collaborators all work together. We propose a different form of asynchronous collaboration that is open-ended and platform independent.

When scholars work in digital research environments, they create new resources of rich and complex datasets. These new resources can be stored and subsequently reused by other scholars. This process forms the basis for a practice of reusing research outcomes in the humanities. This practice will provide an additional mode of referencing to scholarly works and provides the basis for the concept of asynchronous collaboration.

¹ <http://nodegoat.net>

As current forms of referencing only include references to primary sources or citation of interpretive syntheses (in the form of for example monographs or journal articles), real reuse of data is not a common practice in the humanities. We do not refer to reuse of data in the light of ‘repeating experiments’ as is the practice in other sciences. Storing and reusing humanities datasets across platforms will allow scholars to use data produced in one project as ‘context’ for their study on a related topic. For example: researchers working on publication practices of German philologists in the nineteenth century can ‘pull in’ a dataset of correspondence networks of nineteenth century European intellectuals that will embed their actors in a wider network of scholarly communication.

The ideas behind our thesis are informed by two challenges. First, it is hard to receive academic credit for creating and sharing data resources. Second, it is difficult to ensure persistent author attribution on and within datasets. Both challenges relate to a more granular concept of authorship. Apart from writing and publishing a text, authorship can also be associated with conceptualising a database, populating a database based on new research outcomes, collaborative or participatory data entry processes, semi-automated import processes or fully automated import processes. These are all complex processes with multiple authors and multiple forms of authorship. To properly deal with these new forms of authorship, we propose a form of asynchronous collaboration that is part of a layered ecosystem. We do this based on an object-oriented referencing system in which every element (artifact, event, researcher, database, dataset, citation) is an object. Once we are able to properly address authorship questions, new modes of scholarly communication and collaboration emerge that will be flexible and that will support incentives or lower thresholds to create, share, and extend data.

These new forms of scholarly communication and collaboration have been, of course, largely dependant on new developments in web technology in recent decades. Just as the web has disrupted communication channels in general, the web now also ‘opens the workshop windows to disseminate scholarship as it happens, erasing the artificial distinction between process and product’ (Priem, 2013). Up until recently, researchers in the humanities have been mostly ‘receptive’ of new technological opportunities (Thaller, 2012). Now, to establish a new form of scholarly communication and collaboration, scholars in the humanities will have to set an agenda that addresses questions on forms of authorship, data reuse practices and awarding of academic credit for creating data resources. This agenda should focus on the creation of standards that will define practices regarding intellectual property rights and the definition of alternative metrics (‘altmetrics’) to map research outcomes (Priem, 2013). This will be an iterative process that will have to run for years and that is currently already underway. A good example of a research group dealing with multiple roles of authorship within their data creation processes is the group around Anne Baillot at the Humboldt University in Berlin, working on communication between Berlin intellectuals around 1800.² By means of the TEI elements ‘principal’ and ‘statement of responsibility’ they have been able to attribute and publish all the relevant authorship information for the researchers and institutes involved.³

In this paper we want to address a number of challenges and opportunities related to the establishment of new forms of scholarly communication and communication. We will do so by first introducing our online research environment nodegoat, then we will address a number of data storage scenarios and propose our object-oriented referencing system. Finally, we will explore scenarios of reuse and forms of asynchronous collaboration by means of a case study.

² <http://tei.ibi.hu-berlin.de/berliner-intellektuelle/>

³ <http://www.tei-c.org/release/doc/tei-p5-doc/en/html/ref-principal.html>, <http://www.tei-c.org/release/doc/tei-p5-doc/en/html/ref-respStmt.html>, <http://tei.ibi.hu-berlin.de/berliner-intellektuelle/xml/BriefI01VarnhagenanBoeckh.xml>

2 nodegoat

nodegoat is a web-based research environment that facilitates an object-oriented form of data management with an integrated support for diachronic and spatial modes of analysis. This research environment has been designed to allow scholars to determine and design custom relational database models. nodegoat dynamically combines functionalities of a database management system (e.g. Access/FileMaker) with visualisation possibilities (e.g. Gephi or Pajek) and extends these functionalities (e.g. with in-text referencing) in one web-based GUI. As a result, nodegoat offers researchers an environment that seamlessly combines data management functionalities with the ability analyse and visualise data. The explorative nature of nodegoat allows researchers to trailblaze through data; instead of working with static ‘pushes’ – or exports – of data, data is dynamically ‘pulled’ within its context each time a query is fired. The environment can be used in self defined collaborative configurations with varying clearance levels for different groups of users.

As a result of nodegoat's object-oriented set-up, *everything* is an object. In the case of a research project on correspondence networks, this means that a researcher would define three types of objects in nodegoat: 'letter', 'person', 'city'. Each object relates to an other object via relations (e.g. a letter relates to persons to identify the sender/receiver and this letters has been sent from/received in a city). In an extended research process, researchers could also define themselves as objects in the dataset, their sources or other datasets. Due to the focus on relations and associations between heterogeneous types of objects, the platform is equipped to perform analyses spanning multitudes of objects. By enriching objects with chronological and geospatial attributed associations, the establishment and the evolution of networks of objects is inherently contextualised (Van Bree, Kessels, 2013). In nodegoat, these contexts and sets of networked data can be instantly visualised through space and time.

This open-ended approach makes nodegoat different from tools like the Social Networks and Archival Context Project⁴, Alan Liu's Research Oriented Social Environment⁵, the Software Environment for the Advancement of Scholarly Research⁶, Prosop⁷, or tools with a main focus on coding of qualitative data as seen in various computer-assisted qualitative data analysis software. With its object-oriented approach, nodegoat facilitates the aggregation of collections, coding of texts, and analysis of networks, but models these methods towards the creation and contextualisation of single objects that move through time and space.

The analyses performed by nodegoat and the visualisations produced in nodegoat allow scholars in a variety of disciplines within the humanities to explore new research practices and methodologies. Joep Leerssen of the University of Amsterdam uses nodegoat for his project ‘SpInTime – Dynamically visualizing how cultural patterns, networks and exchanges evolve in space and time’. By using nodegoat's data management and visualisation functionalities, SpInTime ‘aims to map the dissemination of cultural nationalism across Europe by charting cultural patterns and networks as they evolve over time’.⁸ The project ‘Mapping Notes and Nodes in Networks’ runs at Huygens-ING in cooperation with the University of Amsterdam and the Dutch Royal Institute in Rome and uses

⁴ <http://socialarchive.iath.virginia.edu/snac/search>

⁵ <http://liu.english.ucsb.edu/rose-research-oriented-social-environment/>

⁶ <http://www.seasr.org/>

⁷ <http://www.prosop.org/>

⁸ <http://spinnet.eu/spintimemappings>

nodegoat to integrate a number of heterogenous datasets.⁹ The Ghent Center for Digital Humanities uses nodegoat to map conference attendance in the long nineteenth century.¹⁰ In June 2014, students of UNIKA university in Semarang Indonesia used nodegoat during a workshop organised by NIOD. During this workshop, they interviewed survivors of anti-communist violence and built interactive mappings of an infrastructure of violence in nodegoat.¹¹

3 Storing data

In order to facilitate a practice of reuse, an ecosystem has to exist in which scholars can publish their datasets, correctly attribute this data according to the roles played by each author, share these datasets and allow for multiple reuse scenarios. Currently, this ecosystem is only partially in place. Various initiatives exist that facilitate the storage of scholarly datasets and provide persistent references to these datasets, for example: Dryad¹², Figshare¹³ and GenBank¹⁴. Of these initiatives, Figshare is the service that is most open to data from the humanities as Dryad and GenBank focus mainly on scientific and medical data. Since 2012 Figshare allows scholars to upload any type of dataset. Figshare was developed by Mark Hahnel in 2011 to give him the opportunity to publish all the data he had gathered in the course of his PhD research project. Since then, it has been used by scholars from varying disciplines to publish research data regardless the fact if the data was used in the final publication (Singh, 2011). A positive result of this practice is the reuse of data that was not of use for the project in which it originated, but could be of value for other research projects. Next to Figshare, multiple national data storage services exist that provide similar services.¹⁵ Although national, decentralised services play an important role in the establishment of an ecosystem in which research data is shared and reused, their separated and distinct data storage and data publishing formats have to be streamlined in the coming years. One important goal for all the mentioned data storage services should be to define a common standard for the persistent identification of datasets and sub-selections of datasets. Once this is in place, data that are published online can be listed on a scholar's ORCID profile.¹⁶

Publishing data as an independent resource adds a new dynamic to traditional publishing mechanisms in the humanities. Currently, the vast majority of research projects in the humanities produce end products in the form of narrative texts that include the syntheses of each aspect of the research process (e.g. journal articles, monographs). Traditionally, in the humanities this process is carried out individually or in small groups (Spiro, 2012, p. 47). With the rise of the digital technologies, collaborative practices such as building digital collections of primary resources or crowd sourcing projects have found their way into the humanities (Spiro, 2012, p. 47. Nyhan, Duke-Williams, 2014). This trend has created a number of challenges for scholars in the humanities, as no long standing practices

⁹ <https://www.huygens.knaw.nl/mapping-notes-and-nodes-in-networks/?lang=en>

¹⁰ http://www.tic.ugent.be/?q=VRE_description

¹¹ <http://www.niod.nl/en/projects/memory-landscapes-and-regime-change-1965-66-semarang>

¹² <http://datadryad.org/>

¹³ <http://figshare.com>

¹⁴ <http://www.ncbi.nlm.nih.gov/genbank/>

¹⁵ For an overview of these initiatives, see the member list of the Research Data Alliance: <https://rd-alliance.org/organisation/rda-organisation-affiliate-members.html>

¹⁶ <http://orcid.org>, <https://orcid.org/blog/2013/06/17/connecting-research-datasets-and-researchers?lang=fr>

exist on the sharing of academic credit among diverse team members working together on one project in the humanities (Nowvieskie, 2011). To tackle some of these issues a ‘Collaborators’ Bill of Rights’ has been designed by the Maryland Institute for Technology in the Humanities to provide all team members (programmers, designers, researchers) with an opportunity to specify their role within a project in order to receive academic credit for their work. Still, all these processes keep the traditional publishing model in mind: once a research project is finished it is synthesised and published in the form of a text. All questions regarding awarding academic credit boil down to the question of who to list as an author and how to order this list.

Publishing research data transcends this process on four levels. Firstly, publishing data may happen before any synthesised text is in sight. Secondly, research outcomes in the form of data can have an extended life cycle that stretches far beyond the reach of a static text. Thirdly, research data that would not have been included in the final syntheses can still be published as data and find its way to a wider audience. Fourthly, published research data can be integrated with new or existing datasets in centralised repositories and help to answer new research questions. These opportunities show the potential of publishing data in the humanities. Still, a number of challenges have to be overcome to arrive at the position in which scholars in the humanities will directly publish their data.

One of the most prominent challenges we still face is the awarding of academic credit for publishing datasets. As Claudine Mouline has stated, we need a ‘change of publication cultures and recognition of these new publication cultures as equal to traditional ones’. Next to the monograph and the article, results and achievements in the form of the database, data visualisation, the scientific blog and micropublications in different forms should be recognised as well (Mouline, 2013).

Once we start thinking along these lines, new challenges emerge that have a resemblance to the challenges raised in relation to the awarding of credit within diverse teams working on humanities projects that make use of digital methodologies. Publishing a closed dataset that has been conceptualised and built by an individual scholar does not pose a challenge in terms of credit attribution. However, as soon as multiple scholars work on one dataset, the distribution of authorship becomes a point of concern. Especially when datasets are created within a traditional hierarchical research group, questions regarding authorship have to be handled punctiliously. How do heads of the research teams ensure that they receive academic credit for the conceptualisation of the dataset and the research questions whilst simultaneously ensuring that their team members receive credit for the manual labour that they have put into the creation of the dataset? As research teams grow and collaborative and participatory practices are used more often, questions about authorship become more important.

4 Towards an Object-oriented referencing system

To deal with these questions, we propose an object-oriented referencing system based on the object-oriented methodology applied to primary data in nodegoat by leveraging the versioning functionalities that track changes to it.¹⁷ In an object-oriented referencing system the metadata structure storing information on the primary data become referenceable objects themselves. Within types related to citation, each object has a timestamp of creation and a relation to the data being part of the citation. Through its versioning, these two properties allow for the recreation of the dataset back to the moment of citation, subsequently the accessibility of the cited data itself, and finally the identification of all contributing authors. A citation object is able to establish a persistent bridge between its networked data and the outside, whatever that may be (e.g article, dataset).

¹⁷ <http://historicalnetworkresearch.org/?topic=nodegoat-faq>

The following example is an abstraction of the data structure applied in nodegoat that supports this object-oriented approach.¹⁸ In this example the person 'Grimm, Jacob' was created whereas a more specific detail within this object of a person, an object description which specifies the location of birth, was created later and then changed afterwards.

Project ('19th Century Intellectuals')

=> Type (Person)

=> Versioning => User (Eva on 01-01-2014, Type Description)

=> Object ('Grimm, Jacob')

=> Versioning => User (Hugo on 01-01-2014, version 'Grimm, Jacob')

=> Description (Born) => Record ('Hanau')

=> Versioning => User (Jaap on 02-01-2014, version 'Hannover')

=> Versioning => User (Jan on 03-01-2014, version 'Hanau')

By elevating the versioning data structure itself into an object-oriented approach the following citation could be a possible outcome based on the example above:

Project ('19th Century Intellectuals')

=> Type (Citation)

=> Object ('Grimm, Jacob')

=> Description (Citing) => Record ('Grimm, Jacob')

=> Description (Cited By) => Record (Mark)

=> Description (Description) => Record (Eva)

=> Description (Definition) => Record (Hugo, Jan)

=> Description (Correction) => Record (Jan)

=> Sub-Object

(When) => Record (01-02-2015)

¹⁸ See chapter Terminology in <http://historicalnetworkresearch.org/?topic=nodegoat-faq>

(Where) => Record (Book 'People from Hanau')

In order to achieve interoperability between platforms, persistent identifiers have to be used for the dataset, each object in the dataset as well as for the researcher. These persistent identifiers are needed to create a complete overview of the provenance of the dataset as well as of each object in the dataset (on the level of a project, object, description or citation). Moreover, by means of a persistent identifier for each researcher, authorship attribution can be transferred across platforms. ORCID is a unique identifier for scholars that is used across platforms and would also bridge the gap between textual publications on the one hand, connected via Crossref, and datasets on the other.¹⁹

Just like entities or records, a selection of entities or a full dataset should also have a correct metadata attribution to describe the creator of the selection or the initiator of the complete dataset. Storing unique identifiers of authors on this level ensures that intellectual credit is given in the same manner as other scholarly activities are credited. By means of this process, each collaborator on the hierarchical academic ladder has the ability to receive credit for the work they have done. In projects that rely on the labour of dozens of undergraduate students, graduate students or PhD students, senior researchers will be able to give credit where credit is due and still describe their own role within the project. Once the dataset or a selection of the dataset is published, the dataset or selection contains the information about the multiplicity of authors in itself.

A major challenge that still needs to be tackled is the development of a publishing environment that is able to do justice to multiple forms of authorship within combined or single datasets. Although Figshare and other data storage services can list multiple authors, no functionality is in place that specifies the role of each author. Ultimately, by making use of an object-oriented referencing system, citations could automatically be generated for authors and their roles based on the information contained within the dataset itself.

5 Reuse of data

Comprehensive version management of objects paves the way for other scholars to reuse a dataset once it has been published. If there is no system in place to deal with authorship attribution on the level of individual records, it would be impossible to correctly assign authorship roles once a dataset is reused. If a scholar reuses a dataset on nineteenth century intellectuals and enriches this dataset with extensive genealogical information, at which point does this scholar become the 'author' of the reused dataset? To avoid this question, an object-oriented referencing system can be used which will simply list, or abstract, all the authors together with their specific roles.

While publishing a dataset, multiple licensing options are available that specify the legal framework for reuse.²⁰ Next to the legal framework, researchers should also define the scholarly weight of their dataset. The weight of a dataset should form the basis for reuse scenarios that are allowed on a dataset. Is the dataset only offered as a static file available for download, or is it a communicative file that can be enriched by scholars who continue to work on the dataset? In the latter case, the authorship question is transformed to a question on authority. A research group or scholar may decide that the authority on the dataset rests with the creator of the dataset. In this scenario, the dataset

¹⁹ <https://orcid.org/blog/2013/06/17/connecting-research-datasets-and-researchers>

²⁰ <https://creativecommons.org/licenses/>

becomes an authority file to which other scholars can make references but can not be modified by anybody else than the primary authors.

In addition to retaining full authority over a dataset, it is possible to share authority over a dataset with other scholars. Once authority is shared, primary authors may decide to accept any modifications and enrichments or set up a review policy in which modifications or enrichments have to be accepted before they are included in the dataset. In this process, a practice could emerge that is similar to the process of ‘forking’ on the web-based revision control service GitHub.²¹ Here, users can clone a project, modify or enrich it and suggest their modifications to the main branch of the project. When we translate this practice to scholarly collaboration, new forms of shared authorship emerge. By appropriating the proposed object-oriented referencing system, the multiple forms of authorship will be fully documented. In contrast to a plain partition in a digital repository, this process of asynchronous collaboration keeps datasets accessible, navigational, and promotes their *remixability* (Manovich, 2013). This conceptual openness joins spheres and stimulates experimental and interdisciplinary research.

6 Case study: Mapping Notes and Nodes in Networks

In 2014, Dutch research institute Huygens ING together with the University of Amsterdam (UvA), the Free University of Amsterdam (VU), the Royal Dutch Institute in Rome (KNIR) and LAB1100 led by Charles van den Heuvel ran a project that relied on asynchronous collaboration. For this project, ‘Mapping Notes and Nodes in Networks’, multiple existing datasets were brought together and manually enriched in order to map meaningful relationships between artists and intellectuals by combining biographical data with relevant contextual information for the history of the creative industry in Amsterdam and Rome in the early modern period.²² Three complementary, but heterogeneous datasets: Biographical Reference Works (Huygens ING), Ecartico (UvA), and Hadrianus (KNIR) were integrated in nodegoat.²³

Mapping multiple datasets is in itself already a form of asynchronous collaboration as any form of overlap produces new data that can be used as enrichment or modification for the parent datasets. By means of a semi-automated data mapping process, this project was able to connect 117 artists from the Hadrianus dataset to artists in the Ecartico dataset. This led to the identification of conflicting biographical data and to an enrichment of both datasets as information available in one dataset could be transferred to the other.

Moreover, in the course of the project a number of researchers carried out individual research projects within the research environment that contained the three datasets. This led to a productive form of asynchronous collaboration as all the biographical data about artists available in the existing datasets was used as context for new research questions. The biographical information was subsequently enriched with information about society membership in Italy (the *Accademie*). By adding this data, research questions regarding weak ties between these societies could be explored. An example of a weak tie is the Dutch engineer Cornelis Meijer.²⁴ In Figure 1 a visualisation is shown

²¹ <https://guides.github.com/activities/forking/>

²² <https://www.huygens.knaw.nl/mapping-notes-and-nodes-in-networks/?lang=en>

²³ <http://www.biografischportaal.nl/>, <http://www.vondel.humanities.uva.nl/ecartico/>, <http://hadrianus.it/>

²⁴ <http://www.hadrianus.it/people/cornelis-meijer>, <http://www.vondel.humanities.uva.nl/ecartico/persons/5228>

which depicts him highly connected to a number of diverse objects making him a broker between different spheres of societies.²⁵

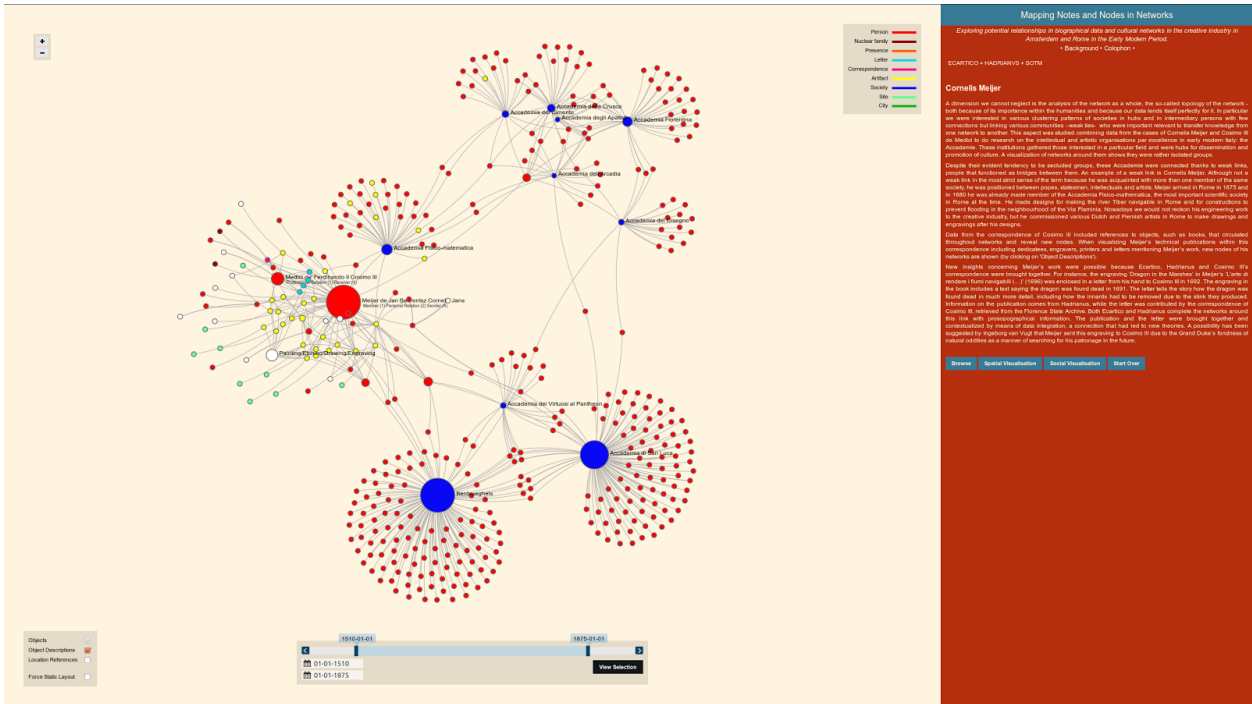


Figure 1: Cornelis Meijer is represented by the largest red node

As this case study shows, asynchronous collaboration in the form of reuse and enrichment of pre-existing datasets helps scholars to work towards new research practices. Instead of *citing* a research outcome, research outcomes in the form of datasets are effectively *reused*. This process is both productive and constructive as researchers can start a new research process within a research environment that has been populated with relevant datasets. Not only does this increase the impact of the work of the original authors of the pre-existing dataset, it also immediately adds a wider context to the new research questions at hand. In this scenario, using an object-oriented referencing system facilitates the correct attribution of all the layers of authorship. As authorship statements will be saved on every level of the dataset and will be updated on every adjustment or enrichment of the dataset, every researcher working on the dataset will be able to correctly attribute their role.

7 Concluding remarks

The effective reuse of the data functions as the dividing line between asynchronous collaboration and traditional citation practices. Whereas traditional citation practices also reference to other scholarly resources and in doing so extend their lifespan and validity, the underlying data is never reused. Although we can cite *The Waning of the*

²⁵ <http://mnn.nodegoat.net/viewer>, see the scenario 'Cornelis Meijer'.

Middle Ages of Dutch historian Johan Huizinga, we will never *reuse* his research notes or card catalogue. Since the emergence of digital research tools, historians and other scholars in the humanities have the ability to create digital card catalogue systems (databases). Asynchronous collaboration will open up these vast resources of rich data in order to establish an ecosystem of reuse and multiple forms of authorship.

In traditional forms of scholarship in the humanities, the claim on authorship is closely connected to the composition of a narrative in which the syntheses of the research project are brought together. We propose new forms of asynchronous authorship that are connected to the publication of datasets. These forms of authorship are in essence hybrid as the creation process of a dataset is often a collaborative process. Moreover, once reuse of these datasets takes place, new forms of authorship emerge that can span multiple layers of conceptualisation, creation, selection and publication processes. The process of asynchronous collaboration is to be regarded as an additional collaborative methodology for the humanities and poses new opportunities for scholarly communication and collaboration.

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LAB1100 (<http://lab1100.com>) is a research and development firm established by **Pim van Bree** and **Geert Kessels**. Their joint skill set in new media, history, and software development allows them to conceptualise and develop complex software applications. Working together with universities and research institutes, LAB1100 has built digital research platforms and interactive data visualisations.

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