



RHIZOME

National Digital Stewardship Residency | New York

Final Report

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Host: Rhizome

Born-Digital Preservation in the Rhizome ArtBase

NDSR-NY Final Report
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Rhizome
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Project Description

Project title: Born-Digital Preservation in the Rhizome Artbase

A. Overview

This National Digital Stewardship Residency focused on preservation and access for born-digital artworks in the Rhizome Artbase, and included work with artwork metadata, condition reporting, and conservation tools and processes. Rhizome's organizational mission is to further production, dissemination, and critical engagement across a wide spectrum of activities within digital cultures and artistic practices. Within this mission, internet-based artworks have been a particularly significant area of focus for the organization, as exemplified by Rhizome's Artbase, a collection of internet-based artworks that began with an open submissions policy around 1999.

The difficulty of defining boundaries for internet-based artworks means that they are inherently fragile digital objects at both technical and conceptual levels; a range of potential vulnerabilities in these works as websites pose significant challenges to their accurate and complete rendering as artworks. One of the most common examples of these works' permeability is the frequency of conceptual and structural reliance on hyperlinks that incorporate Web content spanning domains as inseparable threads within the viewer's total experience of a work of art. Outmoded software and related dependencies reflecting the rapid changes of the past twenty years of Web development contribute another significant source of instability, and are particularly well-represented within the Artbase. The specific circumstances of Rhizome's collection and organizational culture as a host site for an NDS Resident therefore provided a unique opportunity for developing and testing conservation practices with heightened attentiveness to the expressive potential of interdependent form, content, and context in the World Wide Web as a medium for born-digital artworks.

B. Project Goals

Project goals outlined in Rhizome's NDSR-NY project proposal included developing a metadata element set to express significant types of damage to internet-based artworks, conducting an audit of the Artbase using these elements, and raising public awareness of and implementing within artwork conservation processes new software that Rhizome has developed with partner organizations.

Atlas of Damage: Metadata Element Set for the Rhizome Artbase

The goal of the metadata element set developed in this project is to articulate types and degrees of damage to artworks affecting their rendering as websites within a browser. In this context, kinds of "damage" include factors such as missing content from archived copies of artworks, which would manifest within the website as missing resources such as images or other content; broken links to external content located on the web outside the domain of the artwork; and software incompatibilities between current versions of web browsers in which an artwork would be experienced by a visitor to Rhizome's website, and source code structure or required software plug-ins supporting the web browsers for/in which an artwork was originally created.

Artbase Audit

Prior to this project, the condition of most works in the Artbase was undocumented. Varying degrees of damage manifested in artworks caused confusion for viewers (visitors to the artworks via Rhizome's website) about what they were seeing, and to what extent a work's current rendering matched the artwork originally submitted to the Artbase. The goal of the audit was to address this situation, by using the metadata element set to provide consistent criteria for conducting an audit evaluating the access quality of artworks, thereby building a detailed work-by-work condition report of the Artbase. From the data gathered in the audit, Rhizome will be able indicate each artwork's access quality via labels created for public-facing use on Rhizome's website, to give visitors a better sense of what to expect in viewing a work.

Rhizome requested two options for website labels. The first approach would be as simple as possible, and provide one evaluation for the work as a whole, using a visual "stoplight" system of green, yellow, or red labels, to indicate that an artwork is OK, has some problems, or probably won't run at all in a

contemporary browser without additional plug-ins. The second approach would use separate text-based labels for each of the categories of problems identified, to briefly indicate, for example: “missing internal resources”, “external links: high risk”, or “browser plug-in issues”, with additional information about these categories provided through hover text for each label, and links to an internet-based artwork conservation glossary page within Rhizome’s website.

In addition to the public-facing labels, project goals also included incorporating the Artbase metadata elements and audit data within Rhizome’s Wikibase cataloging system, for internal use in informing and prioritizing future conservation efforts.

New Conservation Tools: Public Awareness, Engagement, and Implementation

Finally, the project proposal also included documentation, testing, and incorporation into conservation workflows of two tools Rhizome has been jointly building with partner organizations: the Emulation-as-a-Service (EaaS) platform for running software emulators remotely; and Webrecorder, a tool for browser-based web archiving that Rhizome is currently developing with software developer Ilya Kreymer. Each of these tools contributes significant new capabilities in relation to prior limitations within established practices for software emulation and web archiving. Consequently, public communications and conference presentations contextualizing the architecture, and demonstrating the use of these new preservation and access tools comprised a fourth project goal and a substantial part of the overall learning and work involved in this Residency.

C. Project Partners

At Rhizome, my host site mentors for the Residency were Michael Connor, Artistic Director, and Dragan Espenschied, Digital Conservator. Mentorship roles outlined in the project plan were as follows: Dragan Espenschied, as the primary mentor for the project, was responsible for overseeing and providing guidance for technical and conceptual activities necessary for successful completion of the Residency. Michael Connor provided on-site administrative support for the Resident as a staff member for nine months at Rhizome, as well as overseeing and providing guidance in ongoing communications with the primary mentor.

Dragan was in Germany for the duration of the project, with the exception of visits to New York in October 2015 and February 2016, when Dragan worked on-site at Rhizome's office space. As a result, mentorship participation with the primary mentor was conducted via remote methods. My remote communications with Dragan throughout the Residency included a variety of real-time and asynchronous methods: via email, Rhizome's Slack channels and private messaging, various voice and video chat platforms, and collaborative work within shared documents located in a range of platforms.

As a highly collaborative organization, Rhizome also provided many opportunities throughout the Residency for my participation in on-going work with off-site partners, and Dragan and Michael facilitated my interactions with a number of Rhizome's collaborators. These experiences provided exceptionally rich opportunities to learn from professionals in the field. Significant support and cooperative work during this Residency included:

- Participation in a presentation/demonstration and panel discussion on software emulation organized by Julia Kim, Folklife Specialist (Digital Assets Management) at the Library of Congress (NDS-NYC Resident at NYU during 2014-15) along with Alison Rhonemus, Digital Archives Assistant at New York Public Library; and Dianne Dietrich, Digital Projects Librarian at Cornell University Library. As I began the Residency focused on Rhizome's work with EaaS, I benefited greatly from the depth of Julia, Alison, and Dianne's expertise in this area.
- Rhizome's partner at the University of Freiburg, Dr. Klaus Rechert, provided very generous support and documentation about the EaaS platform, providing essential context for me to understand the architecture of the Baden-Wurttemberg Functional Long-Term Archiving and

Access (bwFLA) project's work relative to other approaches to software emulation, and potential applications of the modular approach employed by EaaS to advancing metadata for software and emulation environments.

- In support of my goal to conduct and post an interview in the Library of Congress Signal blog about intellectual property rights and software emulation, Dragan put me in touch with Jessica Meyerson and Zach Vowell, co-principal investigators of the Software Preservation Network, and Euan Cochrane, Digital Preservation Manager at Yale University Library and a project partner in emulation work with Rhizome and the University of Freiburg. All three interviewees provided extensive written responses to my interview questions, and offered additional recommendations during the post editing and submission process.
- Webrecorder work including participating in project planning and development meetings, software testing, and analysis of use cases and user design considerations with Ilya Kreymer, primary project developer, and Masha Lifkin, software developer and user interface designer who joined the project in March 2016. Ilya also very graciously contributed his time for an interview for the NDSR-NY blog.
- Finally, NDSR-NY's expanded mentorship and cohort model made it possible to seek out advice and critical feedback on project work throughout the Residency. In particular, 2014-15 NDSR-NY Residents Peggy Griesinger and Karl-Rainer Blumenthal, and 2014-15 NDSR-NY project mentor Sumitra Duncan offered expertise across a number of relevant areas; their generosity and support was instrumental in the completion of my project.

In summary, as NDS Resident at Rhizome I benefited from a great deal of support from a number of unofficial contributors in addition to the dedicated involvement from host site mentors. I view the diversity and depth of these engagements as a particularly strong recommendation for the combined educational/professional experience offered by NDSR, which facilitates Residents' immersion not only in the specific needs, assets, and challenges of the host site, but also in participation with a wider community of practitioners. I see this form of support for new professionals to take on the necessary risks involved in learning and attempting ongoing development within digital preservation practice as one of the greatest strengths of the program.

Project Execution

A. Project Activities

Emulation as a Service

I began my Residency at Rhizome in mid-September of 2015. Working from the original proposal submitted to NDSR-NY, I wrote a detailed project plan defining specific deliverables within the goals originally outlined across the four areas of metadata, Artbase audit, tools, and public presentations, and established a project timeline.

At this time I also began preparing to present about Emulation as a Service at the Association of Moving Image Archivists (AMIA) conference in November 2015. The goal for this presentation was to discuss the architecture of EaaS and its application for CD-ROM artworks, and to provide a workshop/live demonstration leading conference participants through the process of imaging inaccessible media (in this demo, also CD-ROMs), and accessing the software within these materials via EaaS. I began by reviewing recent developments within software emulation documented in existing literature, and examined documentation for the bwFLA project's specific approach with EaaS, and Rhizome's application of the remote framework to a cloud-based implementation for the Theresa Duncan CD-ROM project. For testing the EaaS framework locally, Dragan and I installed EaaS in a Docker container on my laptop computer. To demonstrate for participants the steps involved in accessing a CD-ROM artwork via EaaS I wrote user documentation for creating disk images, choosing an emulation environment, and accessing images within the emulated environment; these user materials are available online at my github NDSR project repository (link included in "Deliverables" section).

CopyrightX

In November of 2015, I conducted an interview with Jessica Meyerson, Zach Vowell, and Euan Cochrane, about the issues posed by intellectual property rights for software emulation, and current work to address these issues. In the course of my research for the interview, I decided to apply for the twelve-week, online CopyrightX course offered yearly by the Berkman Center for Internet & Society at Harvard Law School, which I completed during my Residency. Given the importance of bringing about greater clarity and lessened restrictions for memory institutions in regards to both the use of software

for preservation of and access to digital content, as well as the preservation of software for its own sake, I see progress in this area as one of the most important goals that I can pursue as a digital preservation professional. I will draw on the education provided by the CopyrightX curriculum throughout my career, and I am very grateful to the Berkman Center and to Professor William W. Fisher for the challenging, comprehensive, and entirely free-of-charge educational opportunity provided by CopyrightX.

Artbase Metadata and Audit

Development of access quality metadata for the Artbase began during Dragan's visit to New York in October of 2015. We worked together to assemble a complete inventory of ArtBase artworks that included file locations for all archived and externally-linked works, as well as the complete set of metadata fields represented across a variety of manifestations of the collection. This inventory focused our conversations and next steps to identify, articulate, and categorize sources of damage to the artworks, which we then used to define parameters to include in the auditing process. From this overview of the collection, Dragan and I also worked together to compile the public-facing set of terms representing known categories of damage to artworks. I wrote brief explanatory label texts for these terms, and expanded definitions to be linked as a glossary page.

From the inventory, I worked with Dragan to identify artworks to be audited. We divided the Artbase based on artworks stored on Rhizome's servers, which would be included in the audit, and externally-linked works that are included in the Artbase as a collection but may not be held by Rhizome as stored digital objects. For the externally-linked works, I later prepared a simplified version of Rhizome's current assessment process as a Google Docs form intended for future use within web archiving internships at Rhizome. For the archived works, Michael and Dragan requested that I provide initial training for Rhizome staff members in case staff would participate in the audit. Developing this documentation with the staff perspective in mind shaped the vocabulary of and the approach to the audit materials at the initial phase. As the Residency progressed, however, staffing changes meant that I completed the audit without participation from staff.

One of Dragan's goals for the audit process was to include the subjective element of human judgement in assessing the relative importance of parts within the total experience of an artwork. Based on this objective, we included in the audit process visual examination of artworks rendered within the browser to understand the location and significance of problematic elements within the artwork as a whole, and employed a local controlled vocabulary to assign consistent values for these assessments. This meant

that instead of automatically categorizing as “broken” artworks that incorporated content dependent on unsupported browser plug-ins, for example, during the audit I assigned a value in this category based on my assessment of the relative importance of the plug-in-dependent content to the complete artwork.

For each work in the audit, I reviewed the artwork’s Artbase metadata and description at Rhizome’s website, evaluated the artwork as a rendered website in Mozilla Firefox running in one of two computers with Macintosh OS X (FF versions 42-47, OS X versions 10.6-10.10), examining source code for many of the works to understand the artwork’s structure and to quickly search for the location of problems such as embedded Flash objects or java applets within a web page, and assigning controlled values for the importance/relevance of properties observed within the audit parameters defined in the Data Dictionary (PDF of Data Dictionary included in “Deliverables” section). In evaluating problems caused by browser plug-ins, we first gathered file format data for all archived works by scanning the collection with [Siegfried](#), a PRONOM-based file format identification tool, then grouped individual PRONOM IDs into broad categories of plug-ins, and included these categories of known problems in the audit sheet to inform first-hand assessment of artwork source code and visual rendering.

The last phase of metadata work in the Residency focused on implementing the audit elements within Rhizome’s Wikibase. I began with research about MediaWiki software and extensions, the Wikibase data model, and Scribunto, a MediaWiki extension that allows for running embedded scripts written in the Lua programming language within Wikitext templates. I translated all metadata elements from the audit process into Wikibase properties and items, and created these within Rhizome’s catalog. I also created a data dictionary for the audit elements, mapped the elements into PREMIS, and created PREMIS XML templates for my suggestions for modeling the audit and the browser plug-ins as a PREMIS Object, Event, and Environment entities.

Webrecorder

At the start of my Residency, Rhizome was awaiting notification about funding for further development of Webrecorder. During this time, my project work with Webrecorder included preliminary discussions with Dragan and Michael about how the tool would fit into Rhizome’s conservation processes, and using the beta version of Webrecorder to capture Shelley Jackson’s *My Body - a Wunderkammer*, which was added to Rhizome’s webenact server and included in a [post about the artwork](#) on Rhizome’s blog. I also researched current practices in web archiving to provide context for understanding Webrecorder

development, experimented with scoping web crawls via wget and wpull, and created initial drafts of documentation of recommended processes for capturing artworks with Webrecorder's beta version.

After official development for Webrecorder began, I participated in planning meetings with Rhizome and Ilya Kreymer, and worked with Dragan during his visit to New York in February 2016 to archive and document the Archive as Artwork collection, which was also added to the Artbase. During the spring I worked on a collaborative development planning document with Masha Lifkin documenting workflow questions, and participated in testing a new Webrecorder version.

Dragan and Michael supported my participation in Rhizome's collaborations with potential Webrecorder users throughout my Residency, which provided views into web archiving practice at a range of institutions. One of these projects, a grant-funded initiative for capturing online art criticism led by Dr. Charlotte Frost at the City University of Hong Kong, offered a particularly exciting opportunity at the conclusion of my residency, when I traveled to Hong Kong at the end of May 2016 to represent Webrecorder in a panel discussion at the 2016 International Symposium on Electronic Art.

B. Outreach and Dissemination Activities

PDFs of the slides for presentations listed below are available in the "Presentations" folder of the NDSR project repository at my Github site:

<https://github.com/anyformation/NDSR/tree/master/Presentations>.

Links to the Signal post and Code4Lib articles are provided in the Deliverables section of this report.

- November 18, 2015. Presentation: "Functional Access for Digital Collections: Emulation as a Service." Part of panel "[Party Like it's 1999: Emulated Access to Complex Media Collections](#)", at 2015 Association of Moving Image Archivists conference, Portland OR
- January 21, 2016. Presentation: "Preservation and Access for Born-Digital Artworks at Rhizome" as part of "National Digital Stewardship Residency Project Updates" panel with NDSR-NY cohort. [2016 METRO conference, New York, NY](#)

- Dec. 20, 2015. Signal blog post: “Intellectual Property Rights Issues for Software Emulation: An Interview with Euan Cochrane, Zach Vowell, and Jessica Meyerson.”
- March 21, 2015. Presentation: “Web Archiving & Webrecorder: Preservation & Access for Born-Digital Artworks at Rhizome.” at [METRO Web Archiving Special Interest Group \(SIG\) and the Archive-It New York Users Group Meeting](#), New York, NY
- April 2016. Collaboratively authored Code4Lib journal article: “How to Party Like it’s 1999: Emulation for Everyone.”
- April 2016. Presentation: “Symmetrical Web Archiving with Webrecorder: High-Fidelity Web Archiving for Born-Digital Artworks and other Complex Web Objects” as part of panel [“The Web Sits for its Portrait: Web Archiving, Process and Product”](#) at ARLIS/NA + VRA Annual Conference, Seattle, WA
- April 28, 2016. Organized panel on web archiving: [“Web Archiving for Everyone”](#) as part of [“Let’s Get Digital” NDSR-NY 2016 Symposium](#), at Brooklyn Historical Society, co-sponsored by the Archivists Round Table of Metropolitan New York (ART) during ART’s [Preservation Week](#), New York, New York
- May 18, 2016. Presentation: “Webrecorder + Rhizome: Open-Source Tools, Preservation & Access for the Dynamic Web” as part of the panel [“Rapid Response Art History: Tools and Techniques for a Fast-Changing Art World”](#) at 2016 International Symposium on Electronic Art, Hong Kong

Project Analysis

A. Results

Objective 1: Preservation & Access Metadata	was this accomplished?	comments
Metadata framework expressing levels of access for artworks in the Artbase, ready for implementation on new Rhizome website. This will also be used for the Artwork audit (objective 2).	yes	created properties and objects in wikibase to allow mapping all audit parameters into Rhizome's catalog, and mapped the combination of risk factors identified to the requested stoplight labels.
documentation of factors affecting access to artworks, to guide the audit process and the creation of public-facing terminology	yes, with reservations	This could be expanded from the glossary documentation.
written descriptions of access categories, corresponding to short labels for use on website, with glossary of labels for public access	yes	
creation of properties in Wikibase corresponding to required technical specifications for artworks	yes	these are the properties and items for the audit parameters.
creation of properties in Wikibase corresponding to access categories	yes	mapped wikibase properties and values to the stoplight labels.
guidelines and workflow for collecting technical metadata necessary for supporting preservation of born-digital artworks in Rhizome's collection	yes	created forms for audit & for future conservation reports
definition of minimum required technical metadata for new artworks	yes	yes, these are contained in the forms above, and my written recommendations for improving the audit process.
documentation outlining process/steps for collecting metadata for works upon acquisition	yes	yes, as above.

Objective 2: Audit Artworks		
Spreadsheet of artworks and metadata properties relating to level of access, with values entered for these properties, which correspond to observed state of born-digital artworks, ready to be imported to Wikibase. # of Artworks to audit <500, exact # TBD.	yes	goal was 500; completed: 837.
Objective 3: Restore Artworks		
Archival files of Webrecorder performances of artworks, stored on Rhizome website (in webenact)	yes, with reservations	fewer than hoped
Complete metadata records for artworks performed via Webrecorder, as defined by Objective 1	yes	these are stored as .ymls in webenact
Documentation of the preservation process for artworks re-performed using EaaS, following workflow and documentation criteria established with DE	yes, with reservations	created Github documentation for EaaS
Objective 4: Presentations & Writing		
AMIA presentation November 18, 2015	yes	led to writing and publication of article on software emulation in Code4Lib Journal
ARLIS/NA presentation March 11, 2016	yes	also invited to participate at ARLIS/NA-NYC
Blog Post in The Signal, week of November 16 3 journal articles on Rhizome website - possible. TBD	Signal: yes; Rhizome: no.	Rhizome has asked me to write a post for their blog about the metadata work, which will be posted to coincide with launching the website interface for the access labels.

B. Analysis of Results

Alterations from Original Project Plan

During the course of the Residency, shifts in the organizational timeline for Webrecorder development led to a greater overall focus on metadata and audit areas of the project; divergence from the original project plan occurred primarily in a greater-than-projected number of artworks audited, and a fewer-than-projected number of artworks conserved with EaaS and Webrecorder. Within the metadata and audit areas of the project, the proposed number of artworks to be audited was “approximately 500”, and the completed number of audited works was 837, which is all of the Artbase artworks stored as archived copies. The original deliverables list in the Project Proposal estimated the goal number of artworks for conservation at "up to 50." In total, I assisted Dragan in adding one collection of artworks comprising six artworks to Rhizome's webenact server, and worked independently on one artwork (Shelley Jackson's *My Body - a Wunderkammer*).

Although the interface and basic steps involved in using Webrecorder are simple, the challenges of incorporating these steps into scalable processes to both define and ensure the complete capture of various kinds of web content involve complications at a number of levels. I found the ability to participate in development discussions, to ask questions and receive immediate feedback, and most of all to directly observe processes, to be essential elements for understanding my host site's development and implementation of the software. In this regard, I found that periods when collaborative work could take place in-person instead of remotely offered greater opportunities for learning about my host site's approach to developing artwork conservation processes.

My work with EaaS focused on learning and testing the platform, and creating documentation and workshop materials as described above, rather than preparing a body of artworks for exhibition. In the course of learning and testing EaaS, I worked with Laurie Anderson's *Puppet Motel* (1995), as well as *The Doors of Perception* (1994) created by the Netherlands Design Institute and Mediamatic, *IdeaON! the Database of Experience* (1996) by Troy Innocent, the three Theresa Duncan CD-ROM games stored on the bwFLA demo server: *Chop Suey* (1995, co-created with Monica Gesue), *Smarty* (1996), and *Zero Zero* (1997), and Shelley Jackson's *Patchwork Girl*. Presentation of CD-ROM artworks is a primary use-case for EaaS, and although there are future exhibition possibilities in this area that Rhizome is investigating, there were none under active development during my Residency. In retrospect, I think that if I had made

the development and execution of an exhibition of artworks via EaaS a personal priority during my Residency, Rhizome would have supported this initiative.

Significant Accomplishments

In my assessment, the Artbase metadata and audit work completed during this Residency fulfills the host site's goal of addressing the gap in knowledge about a collection that developed anarchically, alongside the growth of the Web itself, by establishing a clearer picture of the extent of damages, and providing a means for communicating this information to an important contingency within the organization's designated community: visitors to Rhizome's website/exhibition space.

As described above, the audit process implemented in this project evolved in response to including visual evaluation of rendered works as essential to accurately assessing damage by analyzing the relationships between form and content in the artworks. The approach we developed combines methodical examination of likely points of fragility weighed against subjective evaluation of the importance of these properties for the overall work. By adopting a controlled vocabulary for qualitative evaluation of a range of variables, and translating the output of this assessment into a consistent framework describing causes and manifestations of damage, the audit seeks to provide a workable foundation for communicating to users the access quality of internet-based artworks within this collection. The user-facing and internal vocabulary implemented in the audit was matched to the host site's request for conducting the process and communicating the results in simple, non-technical language, to allow participation from part-time staff members and short-term interns who might have limited familiarity with Rhizome's digital conservation processes. This data set also organizes artworks into categories of risk, from which Dragan will determine future conservation actions, including the creation of derivative versions of artworks as WARC files from the archival copies of complete artworks, to stabilize each artwork within an archival container format and simplify Rhizome's infrastructure requirements. As integration between oldweb.today and Webrecorder continues, future access via emulated browsers to artworks stored as WARC files may provide a performance environment for many artworks currently inaccessible within the collection.

Rhizome's use of the audit data in a number of contexts, to prioritize and inform future conservation initiatives and to provide greater clarity about artworks for the public, will provide additional information about the strengths and drawbacks of the audit process and the structured representations for the data it collected. The properties and elements created in Rhizome's catalog using the Wikibase

data model will serve Rhizome's ongoing development of their catalog as linked data and implementation of a SPARQL endpoint for their MediaWiki. Mapping these elements to the simple spotlight and text-based label choices will allow Rhizome to implement either presentation on their website. Representing our locally-generated parameters as an event within a suggested XML template for PREMIS records offers a possible method for a standardized "condition report" for internet-based artworks. The precision of PREMIS's data model and entity relationships provides a significant advantage for articulating the interdependency of description and preservation metadata for these digital objects. Although it is sometimes regarded as an unapproachable standard requiring automated implementation, the natural language of our first-hand evaluations mapped easily within the XML templates, providing accessible human-readable values. I hope that this very basic implementation may contribute a useful example to ongoing development of a wide range of practical implementations for representing software dependencies using the Environment entity within PREMIS 3.0.

C. Next Steps and Recommendations

To make the audit data gathered during this project available to visitors viewing artworks at Rhizome's website, Rhizome will need to choose which approach to access quality labels to implement (stoplight system or text-based labels). As Rhizome revises the presentation interface for artworks in the Artbase, these discussions could include whether to incorporate within artworks' metadata pages either system, a combination of the two, or an alternate approach entirely. In case Rhizome decides to use the stoplight labels proposed for this project, I mapped combinations of audit data values to stoplight labels according to the access-quality outcomes for all combinations of audit parameters, and from these mappings created a suggestion for a python script to assign stoplight values to audit data. Within the audit parameters, the "documentation/not web" category has not yet settled on a final selection for public-facing terms. If Rhizome includes this audit parameter in the artwork presentation interface, this category needs a decision about wording to clarify the distinction between an online artwork and a representation. Dragan and I also discussed the potential for expansion within this category, to include new varieties of representations (such as "webrecording"), as they appear in Rhizome's catalog.

The PREMIS templates created in this project suggest a starting point for representing software environments in relation to the artworks they support. As Rhizome's software curation work continues, I hope that the templates provide a useful reference for future development and improvement. One such improvement would be greater specificity about versions, instead of the broad categorization of browser plug-ins used in this project, which grouped together a range of versions within each plug-in evaluated. Categories could be refined by subdividing plug-ins by versions according to PRONOM puids. The relevance values assigned to plug-in content during this audit would still be valid, and Rhizome could use the more specific version information to inform decision-making about creating emulated browser environments within oldweb.today as customized performance environments closest to the software suggested based on artworks' file format information.

As this NDSR project concludes, Rhizome's exploration of next steps for further developing Wikibase continues. Ideally, Rhizome's next steps in this area will be integrated with development of the Wikibase software at a high level, as Dragan's ongoing communications with Wikimedia developers in Germany inform the organization's understanding of how development will shape Rhizome's use of Wikibase. Since it's not clear at what pace Wikibase development will take place, Rhizome may consider

implementing an existing content management system to provide a more immediate route to actively working with collection data. This could be an asset in supporting infrastructure improvements aimed at bit-level preservation that Dragan has accomplished during his tenure as digital conservator, such as significantly improving redundancy and geographic distribution for Rhizome's storage infrastructure by migrating the collections from local storage at the New Museum and on external drives, to cloud-based remote storage through a mix of services provided by Amazon Web Services.

If Rhizome decides to continue the audit process in the future as new acquisitions are added to the Artbase, audit parameters will need to be updated as the context of born-digital artworks changes. For example, the location of artworks in third-party services, such as Tumblr or Instagram blogs, currently represents one of the largest problems among new acquisitions, and should be added to the condition reports or other data collection method that Rhizome uses. This parameter could offer the auditor a controlled list of relevant platforms to select from, and add new platforms as they appear.

Deliverables

Listed below are links to some of the deliverables produced in the course of this project.

1. I created a repository for some of my NDSR-NY project materials at my github site: <https://github.com/anyformation/NDSR>. This repository includes presentation slides as PDFs, my data dictionary for Artbase audit elements, and example XML templates for representing artworks, the Artbase audit, and browser plug-in software as PREMIS Object, Event, and Environment entities.
2. The documentation I created for EaaS is available at: <https://github.com/anyformation/eaas-docs>.
The bwFLA project forked this repository and included it within their own expanded documentation for EaaS, at: <https://github.com/eaas-framework/eaas-docs>
3. “How to Party Like It’s 1999: Emulation for Everyone.” By Dianne Dietrich, Julia Kim, Morgan McKeegan, and Alison Rhonemus. Code4Lib Journal, Issue 32, 2016-04-25.
<http://journal.code4lib.org/articles/11386>
4. Data Dictionary for Rhizome Artbase audit Elements (PDF attached)
5. Signal Blog Post:
<http://blogs.loc.gov/digitalpreservation/2016/01/intellectual-property-rights-issues-for-software-emulation-an-interview-with-euan-cochrane-zach-vowell-and-jessica-meyerson/>
6. Archive as Artwork collection, accessible via Rhizome’s webenact server:
<https://rhizome.org/art/artbase/collections/collection-artist-made-web-archives/>