retroTECH Online Project Summary, 2018-2020

Project Team:
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About the Project

Expanding Access Through Emulation: retroTECH Online

From 2018-2020, the Georgia Tech Library was part of an Institute of Museum and Library Services-funded cohort of six organizations--the Guggenheim Museum, Living Computers: Museum + Labs, the University of Arizona, the University of Illinois, and the University of Virginia--exploring the key challenges to providing long-term access to software-dependent cultural heritage. The grant project, [Fostering a Community of Practice (FCoP): Software Preservation and Emulation Experts in Libraries, Archives, and Museums](#) (IMLS grant RE-95-17-0058-17), aimed to broaden participation in software preservation, advance digital preservation practice, and inform field-wide understanding.

Under the umbrella of its [retroTECH](#) initiative, which provides access to vintage technologies and seeks to inspire a culture of long-term thinking, the Georgia Tech Library's project has been to create a proof-of-concept for [retroTECH Online](#), a web presence through which patrons can utilize software from retroTECH's collections for teaching and learning, explore the stories surrounding that software, and foster a virtual retroTECH community. The project team used oral history and emulation to tell the stories of several software innovations created by Georgia Tech community members--from the graphical simulation that helped win Atlanta's 1996 Olympics bid to Game Boy Advance games coded by current students mastering computer science. The project enabled us to grow our oral history program, partner with students to build sustainable library code, and explore how essential human stories and relationships are to preserving and providing access to software and software-dependent collections over time.

The focal point of our project has been what we call the "software story." Through collection development and oral history, we've examined possibilities for using retroTECH Online to spotlight the people at the heart (or too often, the undocumented peripheries) of Georgia Tech's technological pasts and futures. At the outset of the project, the team developed a [documentation strategy](#) and a set of broad criteria to guide the types of stories we would seek to illuminate. Critically, though, it was our two undergraduate Research Assistants, Maura Gerke and Richa Virmani, who mined the archives to select the narratives they found compelling and made the stories discoverable. The telling of software stories, the various activities under the heading of "software preservation" in the context of our project, became, on a very small-scale, an intergenerational effort of Georgia Tech community members--former faculty, active researchers, soon-to-graduate students--remembering and imagining with each other.

By participating in the FCoP cohort, we've benefitted from opportunities to learn from and contribute to a vibrant community of practice, to experiment with emerging emulation technologies, and to learn from project staff and collaborators like [Amelia Acker](#), [Brandon Butler](#), and [Henry Zhu](#). And, perhaps most importantly of all, we've benefitted from regular reassurances that we do not face our challenges alone--that the most powerful asset of the cultural heritage community is its unique capacity for genuine collaboration across institutions and individuals.

The main deliverable of our project is a prototype of [retroTECH Online](#) that explores five Georgia Tech software stories.

This project is just a beginning. There are so many other stories to amplify. (More about that in Reflections and Next Steps.)

About the Georgia Tech Library and retroTECH

A member of the Association of Research Libraries, the Georgia Tech Library includes 100 employees who are working together to define excellence in the creation, preservation, curation, and connection of scholarship. The Library serves over 36,000 students attending the fifth-best public university in the U.S., where 22% of students are international and more women receive engineering degrees than from any other school.

Within the Library, the Georgia Tech Archives, Special Collections, and Digital Curation department's team of eight full-time employees stewards over 1,700 archival collections, 4,300 rare books, and 50,000 Georgia Tech scholarly works. Over the past several years, the team has become actively engaged in the software preservation community, including the Software Preservation Network (SPN), the Emulation as a Service Infrastructure (EaaSI) cohort, and the Society of American Archivists Digital Design Records Task Force.

In 2013, the Library embarked on a user research initiative to better understand the research, teaching, and learning needs of the Georgia Tech community. During that user research effort, faculty members voiced a strong interest in a new Library service and space that would engage students in the histories of technology through hands-on experiences with vintage hardware and software. This idea became retroTECH.

retroTECH is a service and a lab space in the Georgia Tech Library. Our mission is to inspire a culture of long-term thinking, hands-on access to technological heritage, and individual agency to document personal histories, archives, and data. It's also a skunkworks, a research and development arm for the Archives. As of June 2020, retroTECH is a team of five individuals from Archives and Public Services who are dedicated part-time to the initiative, with a combined effort of 1 full-time employee.

We envision retroTECH Online as an extension and expansion of our lab, where community members can utilize emulated software from our collections for teaching and learning and explore the stories surrounding that software. Eventually, we hope to enable users to leave personal traces within the retroTECH Online world, building layers of use and reuse.

Project Team

Name	Job Title	Contribution
Wendy Hagenmaier	Digital Collections Archivist	Wendy managed the project and served as the point of contact for FCoP Project Staff and fellow cohort members.
Maura Gerke	retroTECH Research Assistant	Georgia Tech undergraduate Computational Media student Maura conducted research and built the codebase for retroTECH Online.
Richa Virmani	retroTECH Research Assistant	Georgia Tech undergraduate Computational Media student Richa Virma conducted research and oral history interviews for retroTECH Online.
Amanda Pellerin	Access Archivist	Amanda provided expertise about conducting oral histories with software donors and creators.

Jody Thompson	Head of Archives	Jody provided expertise about the potential of software preservation in the context of the Archives, Special Collections, and Digital Curation department's overall mission.

Project Supporters

Name	Job Title	Contribution
Bruce Henson	Associate Dean for Academic Affairs & Outreach	Bruce advocated for this work and provided crucial administrative sponsorship support for the project.
Bing Wang	Former Assistant Dean, Copyright and Information Policy	Bing provided expertise regarding the intellectual property and policy aspects of the project.
Chris Helms	Application Developer Manager	Chris advised on a framework for the retroTECH Online application and deployed the code on Library servers.
Heather Jeffcoat	Web and Discovery Management Librarian	Heather advised on integrating retroTECH Online with the Library's Drupal website.
Katie Gentilello	Digital Projects Coordinator	Katie advised on oral history video editing, transcription, and publishing.

Project Documentation

- Project Plans
    - Original proposal narrative
    - Kickoff meeting lightning talk
    - Project timeline
- User Stories and Use Cases
    - User stories spreadsheet
    - User stories in ZenHub (snapshot)
    - Scenarios for use and access
    - Software stories inclusion criteria/checklist
    - Review of retroTECH Online use case categories in terms of ARL Code of Best Practices
- Oral History Templates
    - retroTECH Oral History Interview Packet for faculty/staff/alumni
    - retroTECH Oral History Interview Packet for student donors of Game Boy Advance games
- retroTECH Online application code
- Draft User Test Procedures
- Reflections
    - SPN Blog post

- ○ Dr. Amelia Acker's retroTECH [Field Report](#)
- ○ [Presentation at code4lib 2020](#)
- ○ [Capstone meeting lightning talk](#)

Software Stories

Interactive Media Technology Center Olympic System

This software story contains oral histories with Mike Sinclair and Scott Robertson, digitized footage, and documentation related to the Interactive Media Technology Center's development of a multimedia system that played a significant role in making the case for Atlanta to host the 1996 Olympics.

Technology Opportunity Analysis

This software story contains oral histories with Dr. Alan Porter and Nils Newman related to software supporting the Technology Opportunities Analysis approach developed at Georgia Tech. A current iteration of the software, VantagePoint, is produced by Search Technology, Inc., and is available for use by Georgia Tech students and employees.

Office of Jack Pyburn, Architect, Inc.

This software story explores how architect Jack Pyburn has used technology to support his creative process. Pyburn is an Atlanta-based architect and recipient of numerous awards based on his work in the historic preservation community.

Student-Created Game Boy Advance Games

Media Device Architecture, GT CS2261
This software story contains games and stories from Georgia Tech's CS2261 course, Media Device Architecture. CS2261 covers knowledge related to controlling the interface between hardware and software in media devices, as well as machine-level programming (e.g., in C) to create graphics, generate sound, and support user interaction. As part of the course, students create games for the Game Boy Advance. This collection includes selections of the games, as well as oral histories with the student game creators. Several of these games are also playable on a vintage Game Boy Advance device in the retroTECH lab.

Computer Organization and Programming, GT CS2110
This software story contains games and stories from Georgia Tech's CS2110 course, Computer Organization and Programming. CS2110 offers an introduction to basic computer hardware, machine language, assembly language, and C programming. As part of the course, students create games for the Game Boy Advance. This collection includes selections of the games, as well as oral histories with the student game creators. Several of these games are also playable on a vintage Game Boy Advance device in the retroTECH lab.

Ribbit

This software story contains an oral history with Dr. Lance Fortnow, as well as access to a game he created in 1982 called Ribbit. Dr. Fortnow was formerly Chair of the School of Computer Science at Georgia Tech.

Reflections and Next Steps

The overarching goal of Georgia Tech Library's FCoP project has been to create a proof-of-concept for retroTECH Online, a web presence through which patrons can experience software from our collections for teaching and learning, explore the stories surrounding that software, and engage in a virtual retroTECH community. Our project team used oral history, emulation, and documentation to tell the stories of several software innovations created and maintained by Georgia Tech community members.

Based on our main goal, we invested most of our efforts into two phases of the digital curation lifecycle in particular--collection development and access.

We also had several secondary, symbiotic goals:
- Invest, bottom-up and outside-in, in Georgia Tech Library digital curation efforts
- Grow an oral history program
- Explore how emulation might be useful in achieving the Georgia Tech Library's mission
- Partner with talented students to build and execute software for the Library
- Pursue what makes retroTECH unique and relevant: Georgia Tech-specific stories, collections, and learning

Timeline of Milestones and Capacity-Building Moments for Our Team

- Spring 2018:
  - Onboarding student research assistants (Wendy and Amanda)
  - Conversations with peer libraries about oral history workflows (Amanda and Wendy)
- Summer 2018:
  - Identifying target software stories (Maura and Richa)
  - Training students in oral history techniques and developing oral history interview template (Amanda)
- Fall 2018:
  - Creating user story backlog (Wendy, Maura, Richa)
  - Setting up Oral History Metadata Synchronizer instance (Chris, Wendy, Amanda)
  - Conducting first oral history interviews (Richa and Wendy)
- Winter 2019:
  - Joining the Software Preservation Network (Jody and Wendy)
  - Drafting user testing procedures (Maura and Richa)
  - Pivoting through library moves (building and website) (everyone)
- Spring 2019:
  - Reviewing IP status of software stories (Wendy and Bing)
  - Conducting remaining oral history interviews (Richa)
  - Getting Game Boy Advance code to work on original hardware (Wendy)
  - Digitizing Olympic System tapes (Wendy, Maura, Richa)
- Summer: 2019:
  - Illuminating silos and inefficiencies in digital curation and oral history workflows (everyone)
  - Receiving born-digital architectural collection (Jody and Wendy)
  - Learning from Dr. Amelia Acker's visit to Georgia Tech (everyone)
  - Participating in software preservation workshop at Society of American Archivists Annual Meeting (Wendy)
- Fall 2019:
  - Bringing the pieces together (Maura and Wendy, with cohort and Klaus)
  - Integrating additional library team members into software preservation work (Tyler, Susan,

Chris)
- Winter 2020:
  - Reflecting for code4lib (Amanda, Maura, and Wendy)
  - Setting up local EaaSI node (Chris)
- Spring 2020:
  - Launching extensible, student-created software application on library server (Maura and Chris)
- Summer 2020:
  - Sharing project with software story participants (Wendy)
  - Expanding Georgia Tech software preservation use cases (cross-functional Library Digital Curation Group)

This timeline reveals how our project served each team member with growth opportunities specific to their professional goals (for example, Amanda's goal to build an oral history program or Maura's goal to design and develop software). It also underscores how broad the umbrella of "software preservation" has been for us and how diverse the activities under it have been--creating a documentation strategy, facilitating intergenerational conversations, outsourcing digitization of u-matic tapes, disk imaging, emulation sandbox testing, etc.

Challenges and Lessons Learned

Over the course of this project, our physical context totally shifted: we boxed up the retroTECH Lab and moved from one Library building to another. The Library website went through a complete redesign, inspiring us to alter our technical course. Meanwhile, we assembled Georgia Tech software stories by recording interviews, creating personas and user stories, setting up emulations, and digitizing documentation.

Because the components of our software stories live in different systems (ArchivesSpace, DSpace, MediaSpace, the Oral History Metadata Synchronizer, and the Library's Drupal website), our project's key technical challenge entailed building bridges among our various data and metadata siloes to create a streamlined online discovery point. We knew we wanted ArchivesSpace to be our metadata system of record, but we wouldn't be able to display oral histories and emulations side-by-side in the ArchivesSpace public user interface without writing a plugin. It didn't seem efficient to build a plugin to modify the whole ArchivesSpace public user interface for a small handful of collections. At the same time, we wanted to create a streamlined pathway for users to navigate from the retroTECH web page to retroTECH Online, but we weren't able to present data retrieved via the ArchivesSpace API on the retroTECH Drupal page.

Ultimately, we decided to use a web framework independent of, but integrated into, the main Georgia Tech Library website that allows for the dynamic generation of software story pages using data and metadata from multiple online sources. When the user opens a software story page in their browser, associated data is sourced from the library's systems and presented as one cohesive page. The application, built by undergraduate Computational Media student Maura Gerke using the Laravel framework, is woven into the main Georgia Tech Library website to give the user a continuous experience and allow retroTECH Online to be discoverable through the Library's general search.

The journey to build retroTECH Online underscores the fact that our digital curation future will be one of flexible pipelines and microservices, requiring metadata crosswalking and API expertise. As systems and tools evolve over time, we will need to build data flows among our multiple systems to meet users where they are. We wish we could have constructed something more revolutionary and interactive than relatively basic pages that bring these storytelling pieces together (for example, could the oral history link to specific moments in the

emulation?), but just building and launching a prototype was a serious feat of flexibility and endurance during a time of such significant change. There is plenty we can explore and improve in the future, to be sure.

The project as a whole required more time than expected, and as a result, there were activities we had to table for future work (user testing, curricular integration, richer and more consistent metadata, features for commenting or uploading files into the software story worlds). We navigated challenging logistics (scheduling interviews with busy researchers, beta testing emulation environments, pivoting through a library website overhaul, staying focused during a building move, juggling local versus cohort priorities, plus, no joke, rare diseases and a pandemic). Upon reflection, doing new things competes with getting existing things in order. At the same time, R&D illuminates dysfunction in current workflows--and ultimately helps prioritize areas for improvement.

Looking Ahead

So we made a prototype. And we are moving forward. Over the next few years, we will continue to collect and share software stories on a small scale, expanding our scope of use cases to include research software and software-dependent projects created in the Library. We will also incorporate the invaluable deliverables of the other FCoP projects and streamline workflows for digital curation, oral history production, and student-driven application development. And we will continue as active participants in allied communities of practice--the Software Preservation Network, the Emulation as a Service Infrastructure nodes, museums preserving vintage hardware and software, and archives stewarding digital architectural collections.

The Software Preservation Network, in which Georgia Tech is a sustaining member, has crucial roles to play in building capacity for software preservation: serving as a coordinator, convener, aligner, and balancer among these communities of practice as, together, we divide-and-conquer progress on the various facets of software preservation work. These communities are each delving into specific segments of the software preservation landscape; an organization like SPN, with its holistic meta-view of the field, is critical to our local on-the-ground progress. We're just getting started with software preservation at Georgia Tech, and there are so many directions we could investigate--preserving research software for reproducibility, using emulation to facilitate appraisal, figuring out which institutions are preserving which software and why so we all don't have to reinvent the wheel.

But as the field moves forward, we are really interested, in particular, to see more work focused on the *who* of software preservation--the stakeholders, creators, and reusers. Delving into the who empowers us to expand our understanding of the why--why we do this work and whom it serves.

retroTECH's core values are about the *who*:
- long-term thinking
- peer-to-peer discovery, empathy, and collaborative expertise
- individual agency to document over personal histories, archives, and data
- hands-on experimentation, research, and discovery
- voices of Georgia Tech's technological pasts, presents, and futures

Towards our documentation strategy goal of proactively giving voice and archival real estate to underrepresented computing cultures at Georgia Tech, we want to talk with alumni and entrepreneurs of color about how we can support their voices. We want to document the experiences of female computer scientists in the Georgia Tech Research Institute and embed in a Georgia Tech Female Founders software startup to study

what interests they might have in making their software stories preservable. We want to work on requirements-gathering for intergenerational user experiences, to explore how preserved software environments can function as generative pedagogical tools. To ask: how can software preservation efforts foster dialogue between software creators of the past and the future?

Action agenda items for software preservation and emulation at Georgia Tech
- Continue to collect and share software stories on a small scale
  - Explore a few use cases related to research software and software-dependent projects (e.g. data visualizations created in the Library, campus research data use cases)
  - Grow and diversify our team, including more people in the work (especially during the pandemic era, in which virtual work and online access are essential)
- Streamline workflows for digital curation, oral history production, and student-driven application development
  - Prioritize effort based on forthcoming digital curation roadmap
  - Scope activities in accordance with capacity, expertise, and curiosity of digital curation team members; most of all, scope activities to be sustainable, and innovate in small ways where our users need us and where we can offer unique contributions to the field
  - Incorporate deliverables from the other FCoP projects into our local practice (e.g. metadata workflows)
  - Formalize oral history program
  - Identify needs for consolidating and building data flows among digital curation system silos
  - Formalize models of students coding projects for/with the Library
  - Conduct user testing
- Emphasize the who (the stakeholders, creators, and reusers) of digital curation in general and software preservation in particular
  - Hold ourselves accountable to our documentation strategy, to giving voice where archival silence has been present and supporting documentation of un(der)documented histories
  - Build intergenerational user experiences: explore integration of retroTECH Online in courses and explore how preserved software environments can function as generative pedagogical tools
  - Investigate how software preservation efforts can build empathy and foster dialogue between software creators of the past and the future
- Continue as active participants in allied communities
  - Nurture formal organizations and communities of practice such as the Software Preservation Network and Emulation as a Service Infrastructure nodes
  - Participate in affinity groups such as museums preserving vintage hardware and software, and archives stewarding digital architectural collections

Action agenda items for software preservation and emulation fields as a whole
- Identify which institutions are preserving which software and how we can share it so we can avoid redundant effort
- Research approaches to preservation of browser-based software as a service (convergence with web archiving?)
- Explore preserving research software and software-dependent data for reproducibility
- Investigate using emulation to facilitate appraisal
- Study personal archives use cases for software preservation and emulation
- Prioritize work that explores the *who* of software preservation