Modeling and Viewing Three-Dimensional Artwork

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Mike Gousie
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Wheaton College Permanent Collection

- Compiled in 1974
- 7,000+ objects
- Ancient Mediterranean World to 21st Century Contemporary Art
- 10-12 class visits/semester
- Staffing
  - ½ of tenure-track faculty line
  - 15+ work-study students
- Primarily gifts/bequests with 4 endowed acquisition funds
- Conservation fund

- Cultural objects on campus from founding of seminary
- In mid 1970s, an effort was made to consolidate collections scattered across campus
- Today more than 7,000 objects but never been fully inventoried or catalogued so we are still trying to get a sense of what we have. As part of the ongoing inventory, we regularly discover objects in the Collection Storage Room that have not been catalogued; and we occasionally still find objects around campus. We are also actively acquiring to strengthen collection areas most used for teaching.
- Holdings range from Greco-Roman and Egyptian antiquities to Native North American woven objects and from colonial American candlesticks to 21st century contemporary art. Strongest holdings are in works on paper, American decorative glass, coins, and a growing collection of works created by artists of African descent.
- On average, 10-12 courses using the collection each semester for a variety of projects including visual analysis to provenance research to student-curated exhibitions.
- Our ability to do more with the collection – particularly with regard to cataloguing and dissemination to audiences on- and off-campus – is constrained by staffing resources and by funding.
• Four endowed acquisition funds, only one of which generates more than a few hundred or few thousand dollars/year, and a conservation fund that is not endowed but that is supported by an annual gift from an alumni group.
Why (Digital) Access?

- Attract/retain students
- Enhance aesthetic environment on campus
- Engage campus community
  - Assignments that involve experiential, object-based, and/or service learning
  - Faculty research
  - Alumni & their families
- Recognize/cultivate donors
- Provide off-campus researchers and/or source communities with digital access to objects

Even given our limited resources, we try to provide as much access as possible to collection objects and their related documentation, both hands-on and digitally.

- Tours for prospective students and their parents as part of Visiting Days or Welcome to Wheaton Day for admitted students
  - Work-study employment that, given professional staffing constraints, is about as real-world as it gets.
- 5% displayed around campus (CLICK)
- Engage campus community
  - Class/researcher visits; close collaboration with archives
  - Tours during Commencement/Reunion and Homecoming Weekends and facilitating access for alumni and/or their families to view objects
- Allow donors (and their families) to see how we are using their objects
- Last enables us to learn more about objects - Austria, Italy, Brazil - and their provenance. Allow source communities to learn about the objects and, in rare instances, begin repatriation or restitution claims.
Provide off-campus researchers and/or source communities with digital access to objects...most challenging aspect due to funding/staffing constraints.

At present, the latter is done through the Permanent Collection website, which falls under the Arts on the college’s main webpage. (CLICK)

Permanent Collection database, which is a Filemaker Pro database, is not publicly accessible and on-campus access is restricted to a few users. (CLICK)

However, objects are featured on the PC webpage, particularly those objects on which students have conducted research.

- Raises issue of digital responsibility to students, who own copyright to their work which was produced within context of class assignment.
- Also responsibility to donors, or their family members.

Since I arrived at Wheaton in 2007, collections-based student projects have occurred as part of independent studies, honors thesis research, course-based assignments, and, most recently, as part of Special Interest Groups, or SIGs, through a grant-funded initiative.
IMAGINE Student/Faculty Special Interest Group, Spring 2018

• Grant-funded effort to integrate technology into the arts (2014-2018)
• Develop and outfit makerspaces
  – Lab 213
  – HATCH
  – FiberSpace
  – Mars Sculpture Studio
• Course development
  – Stipends for faculty
  – Budget for equipment
  – Documentation and archiving

• In 2014, Wheaton received a grant from the Sherman Fairchild Foundation to integrate technology into the arts by developing makerspaces across campus and by supporting opportunities for student-faculty collaboration. The effort is broadly known as the IMAGINE Network: Inter-Media Arts Group Innovation Network.
• The five-year grant enabled the college to develop 3 new makerspaces and to provide additional equipment for the sculpture studio housed in Mars Arts and Humanities.
  – LAB 213 in Old Science Center has 3D prints, a
  – Humanities, Arts, and Technology Creative Hub, or HATCH, has an Oculus Rift virtual reality headset and eye-tracking technology as well as large LED monitors and a high performance computer desktop.
• SIG awards support team-based collaborative projects undertaken by a team of at least two faculty members from different departments and at least two students who major, minor or have a demonstrated interest or proficiency in the faculty members’ area of specialization,
• or the focus of the proposed project.
  –SIGs may be undertaken during the academic year or the summer.
  –Projects completed during the academic year will receive $5,000
• Students earn academic credit through an independent study sponsored by one of the SIG faculty members.
• Support of this project - materials/objects/students/faculty
• Fundamentally interdisciplinary - and impetus can be entirely student-driven, as was the case with the SIG that is the focus of this presentation.
Last spring, I taught ARTH 334: Exhibiting Africa, a museum studies course in which students explore the ways in which African cultures, objects, animals, and people have been collected, displayed, and interpreted by museums and museum-like institutions in Europe and North America and on the African continent.

As part of the course, students use the Permanent Collection’s holdings of African objects, which includes more than 225 items representing more than 20 different African nations and several dozen cultures.

Types of objects:
- baskets, jewelry, textile fragments, masquerade components, processional and hand crosses, alabaster and glass vessels, prints - both contemporary and colonial era, paintings, etc.

In the last decade, these objects have been used for assignments ranging from formal analysis to student-curated exhibitions.

During the Spring 2018 semester, I asked each student to research five objects of their choosing and to develop a digital map linking each object to its home culture or country.

In planning for the course during the Fall 2017 semester, I was approached by 3 computer science students interested in developing an IMAGINE SIG focused on photogrammetry and using the Permanent Collection as the
• source of 3D objects for the project.
• Their initial intent was to create 3D images of the entire collection, a goal that was quickly scaled down when they saw the number of objects housed in the Collection Storage Room.
• (CLICK) Recognizing the potential for synergy with my planned museum studies course, I agreed to participate as one of two faculty in the SIG if the trio of students focused on African objects in the Permanent Collection. They agreed, as did my colleague, Professor Mike Gousie.
• Although the project faced a number of challenges, it was innovative and, arguably, successful in numerous ways. I’ll turn the floor over to Mike so he can explain technical side of the project.
Three-Dimensional Modeling

Goal is to create a **true** 3D model of an object
- Can view on a web page with movement controls
- Can be viewed in virtual reality (VR)

To do this...
- Requires finding \(xyz\) (width, height, depth) coordinates for thousands of points on the object
- Not only interdisciplinary, but also multimodal
Three-Dimensional Modeling

1. Build hardware
2. Take video of art object
3. Extract frames
4. Use photogrammetry software to generate 3D model
5. Upload to server
Hardware

Makerspace Lab 213:
- 3D Printers
- Laser cutter
- 3- and 5-axis CNC machines
- Programmable loom
- Miscellaneous tools
Step 1: Take Video of Object

24 second video; 250MB
Step 2: Extract Frames

- Python script using OpenCV (Open Source Computer Vision Library)
- Extracts 10 still frames/second

```python
import cv2 as cv
import os
from shutil import rmtree
import glob

imgPerSec = 10
name = input("Enter video name: ")
fileName = os.path.basename(name)
fileName = os.path.splitext(fileName)[0]
print("Processing: ", fileName)

if os.path.exists(fileName):
    rmtree(fileName)
    os.mkdir(fileName)

working = True
vid = cv.VideoCapture(name)
working, image = vid.read()

while working:
    frames = count * (1000 / imgPerSec)
    vid.set(cv.CAP_PROP_POS_MSEC,(frames))
    working, image = vid.read()

    cv.imwrite(fileName + '/frame{}.png'.format(count), image)
    count += 1

    if count > 500:
        working = False

print("Finished: " + fileName)
```
Step 2: Extract Frames

- Python script using OpenCV (Open Source Computer Vision Library)
- Extracts 10 still frames/second

```python
import cv2 as cv
import os
from shutil import rmtree
import glob

imgPerSec = 10
name = raw_input("Enter video name: ")
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    rmtree(fileName)
    os.mkdir(fileName)

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working, image = vid.read()

while working:
    frames = count * (1000 / imgPerSec)
    vid.set(cv.CAP_PROP_POS_MSEC, frames)
    working, image = vid.read()
    cv.imwrite(fileName + "/frame{}.png".format(count), image)
    count += 1

print("Finished: "+fileName)
```

AUTOMATIC
Step 2: Extract Frames
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240 Images; 2.6GB
Step 3: Photogrammetry

Calculating 3D (xyz) coordinates
  • RealityCapture software
  • Triangulation
Step 3: Photogrammetry

Calculating 3D (xyz) coordinates
- RealityCapture software
- Triangulation
- Correspondence problem
Step 3: Photogrammetry

Generating 3D object
• Triangulation yields 3D point cloud
Step 3: Photogrammetry

Generating 3D object
- Triangulation yields 3D point cloud
- Triangulation (Def. 2) yields triangles
- Generate 3D object, material, and color files
- Takes 30 minutes to create files (23MB)
Step 4: Upload to Server

- Use RealityCapture to reduce number of triangles
- Upload 3D object file (triangles)
- Upload material (texture) and color files
- HTML document includes jsmodeler JavaScript framework to render 3D models

http://cs.wheatoncollege.edu/~whedomain/
Collaboration with Archives and Digital Initiatives
What the Library (and A/DI) “does”

- How Archives and Digital Initiatives came to be:
  - The Archives has been traditionally charged with maintaining access to institutional history, pedagogical history, faculty files, anything as it officially and unofficially relates to the college... so, this new incarnation of Digital Initiatives sitting within the Library (along with campus partners and stakeholders like faculty, IT/TechSupport, Media Services, the Archives, Systems folks) is charged with both building process and infrastructure to do so, pushing/encouraging/and changing campus culture, and... start to collect all the stuff... which you can tell is super easy and straightforward from this “map.”
This year, Wheaton received funding from the Council of Independent College’s Consortium on Digital Resources for Teaching and Learning to utilize Artstor/JSTOR Forum (formerly Shared Shelf) in more robust ways. The ultimate goal: to increase discoverability and provide access to scholarship with limited resources. (Does this situation sound familiar to anyone?)

From here on out, for the sake of clarity, I am going to refer to what-was-formerly-known-as Artstor/Shared Shelf as JSTOR Forum.

The CIC’s Consortium was looking for partners to “push JSTOR Forum’s system” to open the doors to discovering and sharing out different types of digital cultural heritage beyond images: JSTOR Forum’s original mission.

Our Institutionally-based JSTOR Forum collections are the birthplace of our Digital Commonwealth collection, as Digital Commonwealth (with the collective expertise of my colleague Thomas San Filippo and Eben) harvests our Archives Image Collection from JSTOR Forum. In time, our goal is that DC will harvest this new collection of digital scholarship, too!

But, we quickly learned that this wasn’t going to be easy, and that to do this
right, we would have to work backwards, not forwards as pictured here.
• Our main goal was to start collecting this digital scholarship (mainly Professor Gousie and Niederstadt and student’s work) for archival purposes so that in 20 years, our students and faculty and researchers could evaluate Wheaton’s curricular efforts as they do now with primary institutional sources.

• However, we quickly realized two things:
  
  ○ 1. That in addition to providing access to the scholarship, we needed to provide instructions on how to make and create this work, as the technology that was utilized to do so will evolve and change by the second

  ○ 2. That we needed to employ our digital repository beyond its traditional means as a text-based digital archive to cache holistic digital scholarship, as JSTOR Forum only accepts (and displays and emulates) certain file types... of which our digital scholarship is well beyond

Nothing like a few speed bumps and roadblocks to get you started on a journey.
But, what this really meant is that we needed to get this outstanding student work which was first holistic in this format...
… looking like this for both tree structure purposes, and College branding purposes. (Always good to make friends with the Marketing and Communications department.)
• … And, then we needed to force it all into this kind of (not sexy, not stimulating, or engaging) storage “bucket.”

• This is DSpace, our digital repository platform. Just to reiterate, we needed to employ our digital repository beyond its traditional means as a text-based digital archive to cache holistic digital scholarship, as JSTOR Forum only accepts (and displays and emulates) certain file types… Not that DSpace can emulate those file types either, but they can at least ingest and store them (the .obj, .mtel files, etc.)
● This bucket (DSpace) is not the type of structure or environment that interactive web content and digital scholarship is used to, to say the least.
● In this second revision of our workflow, DSpace, our digital repository, is actually in the center part of pipeline…. we are hoping that JSTORF harvests DSpace using the OAI-ORE mechanism (= Open Archives Initiative-Object Reuse and Exchange), in the same way that Digital Commonwealth harvests JSTORF using the OAI-PMH mechanism (=Open Archives Initiative-Protocol for Metadata Harvesting)
  ○ We sent that enhancement idea out to JSTORForum listserv… to which we got little to no response from users, but interest from the JSTORF team. If anyone is interested in this, please let me know!
While we wait in the meantime, we started to use a script written by another one of our brilliant students to crawl web pages, then save as PDFs with live links intact, and bulk upload to JSTORF using a “headless browser.” With links intact IS IMPORTANT as the goal is to both collect and broadcast digital scholarship, but also to broadcast instructions on how best to create and share new material in real time. Not only could the actual creations change given technology, but links could in time, too, so capturing everything holistically at once is a priority.

The steps here are:

1. put in project ID number (on JSTORF) along with put in your user/pwd for JSTORF
2. put in URL you are archiving
3. press enter, and it does two things at the same time:
   a. Sends to chromium/prints PDF
   b. sends to WGET, which essentially creates list of links and dedupes them
4. Checks if PDFs already exists in working folder, if not: sends back to loop, if there, sends to print to PDF
5. Saves those in working folder
6. Goes into First IN First OUT (FIFO) upload queue
1. Then curl keeps running the job against JSTORF until links are finished

Lived with the script for about four days now
So, where are we now?

- Just determined metadata schema on JSTORF
- We are beginning to write a narrative of how we’ve gone about this… this is going to be the hardest part, as well as:
  - soliciting more/different students and their work (inclusivity)
  - rollout to campus (faculty in particular… “selling” this process and support to them might be… tough)
- Again: goal is to develop more
resources for teaching and learning (defined as learning objects, etc.) Here’s hoping for good things to come and lots more to share at Digital Commonwealth next year!
Image references

Slide 2-6: All images Leah Niederstadt or Wheaton College
Slide 23: Point Cloud To Mesh Project Proposal For Cs184, Brett Rapponotti, Michael Snowden, and Allen Zeng
   https://cs184team.github.io/cs184-final/
Slide 25: Dick Fish Company, Inc., Woman using card catalog in Goodell addition, photograph, ca. 1961
   https://www.digitalcommonwealth.org/search/commonwealth-oai:ff369946h
Slide 27: Kate Boylan and Mark LeBlanc, CIC Consortium on Digital Resources for Teaching and Learning grant application Figure 1, 2018.
Slide 28: JSTOR Forum supported file types, ITHAKA, 2019
   http://support.forum.jstor.org/article/supported-file-types-and-sizes
Slide 29: 3D Modeling to Virtual Viewing, Mathew LeBlanc, Eammon Littler, and Jacob Loberti, 2018
   http://cs.wheatoncollege.edu/~mleblanc/3Dart.html
Slide 30: Wheaton College 3D Art Collection, Yun Zhang, 2019
   http://cs.wheatoncollege.edu/~whedomain/
Slide 31: Collaborative Scholarship, Wheaton College Digital Repository, 2019
   https://digitalrepository.wheatoncollege.edu/handle/11040/24525
Slide 34: JSTOR Forum admin Project Settings, ITHAKA, 2019
   https://forum.jstor.org/admin/1/projects