



Lost Art

Exploring the underseen at the Boston MFA

Name	Department	Roles
Shayna Ahteck	MIT Mechanical Engineering	Mobile prototype, museum visit observation
Mulan Mu	Wellesley College	Website design/mockup
Justin Blinder	MIT Media Lab	Data collection/ analysis, machine learning

Concept Overview

Museums often highlight specific works in promotional materials, so much so that their identities end up being shaped (and limited) by their collections' most famous works. However, these collections contain many other pieces that remain less viewed and engaged with by the public; these works languish in relative obscurity even though they are on (permanent) display. Museums report seeking new ways to help the public to engage not only with such works, which almost feel like they are hidden in plain sight, but also less (physically) accessible works in storage or in archival collections.

Our project, Lost Art, seeks to address these challenges by facilitating new modes and pathways of visitor engagement, curated and crafted using real-life user data. First, Lost Art analyzes Instagram posts to examine how visitors pay most attention to specific pieces in a given museum, and helps curators to guide viewers towards less-viewed, but by no means lesser, works. Along the way, Lost Art uses Instagram analytics to provide museum curators with tools to learn more about visitors' interests and higher trafficked areas of the museum in a range of ways. Second, these analytics then help curators to design data-driven tours connecting less viewed works and collections throughout the museum, using newly developed thematic throughlines. These data-driven tours are accessible to visitors via a Lost Art mobile website. Throughout the experience, the Lost Art website encourages users to respond to curators' prompts, and to be the first to post about less-viewed works on Instagram. Finally, Lost Art builds upon these data-driven tours to combine works from the museum's physical spaces to those of its online collection, and it invites visitors to explore less-viewed works both online and in person.

Background Research

Allowing visitors to take photographs of collection holdings may be a relatively new phenomenon in many museums, but it is by no means a rare one. In fact, more and more visitors want to share their experiences of experiencing art-- especially specific works of art-- with their social networks. Visitors want to share their own presence at the museum, personalized and part of the experience, and many museums are starting to take note. For instance, the Metropolitan Museum of Art has worked directly with Instagram influencers in order to help build their online social media presence.¹ With Lost Art, we wanted to explore how this online, social experience of the museum could be used to help museum curators highlight neglected works.

At the outset of our project, we sought to address the following questions:

- Are there patterns between which works are the least and most viewed?
- How can museums learn more about their visitors' interests and preferences?
- How can works neglected by the public be given more relevance, context, and multicultural perspectives?
- How can museums reduce the friction for users to install or interact with custom applications?

We worked specifically with the Boston Museum of Fine Arts (MFA) on this project. Given that the MFA has over 250,000 works in their collection, we focused solely on works in their permanent collection that are currently on-view. It's important to note that all of our work with the museum was done remotely because of the pandemic.

Demographics/ Target audience

Increasing museum visitation was also an important consideration for our project. According to MFA curator Kristen Gresh, the most common visitor demographic group at the MFA consists of white women in their 50s and 60s. One specific challenge lies in attracting and engaging younger visitors, who tend to be more diverse in terms of racial/ethnic backgrounds, and tend to have less discretionary income. How might the MFA better engage and respond to the interests and proclivities of such visitors, who still have decades of potential museum-going ahead of them in their lifetimes? In contrast to the MFA's current, dominant visitor demographic profile, Instagram's largest age group is between 18-29 years old (16%), shortly followed by users between 25-34 years old (15%). Based on this discrepancy, we believe targeting Instagram users' interests could help expand the MFA's visitation demographics.

References/ Influences

A major challenge of our project was trying to understand museum audiences by analyzing large and visual social datasets. In *Cultural Analytics*, Lev Manovich highlights the limitations of quantified analytics and the need to "be sensitive to dimensions and aspects of culture that

¹ Munro, Cait. "The Met Gives Instagram Influencers an All-Access Pass." Artnet News, 18 June 2014, <https://news.artnet.com/art-world/the-met-gives-instagram-influencers-an-all-access-pass-43431>.

existing measurements do not capture” (p.10).² Such blanket quantification can flatten our understanding of individuals and social groups, and create siloed categories and binaries. These ideas greatly informed the ethos of our project and our attempts to combine the aspects of the lived experience at museums with data analysis. Through the course of our project, we discovered that museums struggle to understand their audiences and tend to use methods such as surveys with embedded assumptions regarding how visitors feel about, and interact with, the museum. Using datasets like Instagram photos, in addition to quantitative data, can provide useful insights without removing the lived experiences of those being analyzed.

Another important reference for our project is the Science Museum Group’s “Never Been Seen”³ feature. Each time a user visits or refreshes the website, the online tool displays a photo from its collection that has never been visited online before. This dynamic of revealing the unseen is a key element of our project, and much of our effort was spent towards discovering the degree to which works were viewed at the MFA.

Interviews

During our design process, we interviewed MFA curators Kristen Gresh and Chris Atkins, as well as Olga Khvan, who is one of the MFA’s Content Managers. A key point made by both Kristen and Chris was a desire to gain more multicultural perspectives across exhibitions. Currently, there’s little opportunity for collaboration across different collections. Curators also have little information about who visits their collections and what they’re interested in. The MFA uses exit surveys (which are emailed post-visit), primarily focusing on the overall museum experience (e.g., difficulty purchasing tickets, ability to navigate through the museum). Based on our interviews, being able to ask the visitors questions regarding their opinions on and engagement with specific works in the collection would be very valuable.

The Boston MFA maintains a social media presence across multiple platforms. According to Olga, they primarily use a tool called Sprinklr⁴ to analyze visitors’ posts and find opportunities to engage with their audience. The content management team will occasionally consult with curators about specific posts, e.g., if a visitor has a question about a given work. However, curators generally don’t interact with visitors directly through social media. This information suggests that a feasible way to do so, without being too labor-intensive for either curators or visitors, would substantively help the museum to be and feel more accessible to a diverse range of visitors.

Additionally, one team member (Shayna) visited the MFA and Institute of Contemporary Art museums when they were open to the public in April 2021. While taking notes as a museum-goer with peer companions, they noticed several particular aspects of types of visitor behavior. First was the under-utilization of phones and other mobile devices in the galleries. The MFA app itself was rarely promoted, even when it could have been useful to reduce visitor

² Manovich, L. (2020). *Cultural Analytics*. Cambridge: The MIT Press.

³ *Never been seen*. (2021, January 7). Science Museum Group.
<https://www.sciencemuseumgroup.org.uk/blog/never-been-seen/>

⁴ <https://www.sprinklr.com/>

contact in small indoor spaces in times of social distancing. In conversation with Olga, she noted that the MFA's special exhibitions had descriptions in the app to prevent crowding around plaques and labels. All three interviewed MFA staff also noted visitor hesitancy to download another app, using up precious space on a mobile device for a one time use, and the unreliability of museum WiFi. This informed our decision to create lightweight website experiences optimized for exploring on a desktop distinct from a mobile tour experience.⁵ Second, a sense of self-consciousness about using devices permeated the experience. It seemed to echo the idea of wanting a visitor experience "in the moment" when screen fatigue was taking over many people in the virtual pandemic age, especially college student companions. Another observation was that of visitor fatigue - with so much to see, several companions were lost and burnt out even after an hour. This suggests that visitors might welcome some kind of direction, even when museum tours are not running, and that self-paced tours might constitute an interesting solution. A final observation was the MFA's movement towards diversity and inclusion, such as an empty picture frame inside the colonial portraits gallery asking about who has been left out, as well as inviting youth curators to curate an exhibit on Black history. We see potential for identifying and promoting underseen works, often by minority artists and creators, as an opportunity for supporting diversity and inclusion efforts in the art museum world.

Project Development and Process

Team Roles

Initially we wanted to develop an exploratory analysis website using Instagram data that allows users to discover less viewed art at the MFA, so we divided the work according to our skill sets and interests. Justin, a Research Assistant at the MIT Media Lab and a professional technologist, developed the data collection, analysis, and machine learning aspects of the project. Shayna, who studies Mechanical Engineering at MIT and works closely with the MIT Museum, was in charge of technological exploration (e.g. NFC tags, Snapchat lens) and web development. Mulan, who studies Studio Art at Wellesley College, was interested in and responsible for website design. As the project development progressed, there was the need to deliver design prototypes optimized for demonstrating user flow, with placeholder data, in order to receive several rounds of feedback from class peers. Shayna took on the task of creating a mobile tour website prototype, and Mulan created the exploration website prototype.

Data collection

The MFA makes over 250,000 works accessible online through their website. During the time we developed this project, this data was not available to download. In order to work with the MFA's collection, we scraped this data from their website. We also created a large dataset of Instagram images by scraping posts that have been tagged with the MFA between mid-2019 to mid-2021 over the course of the semester. Both datasets were difficult to acquire because our scrapers were continuously classified as bots and banned, which we circumvented by hopping

⁵ The official MFA app was created by [Cuseum](#), a company specializing in virtual museum tour formats.

through IP addresses. Due to this, the amount of data we could collect over the course of the semester was limited.

Once we acquired both datasets, we classified the works being photographed in each Instagram post. Given the time constraints, we used basic text matching to determine authors or work descriptions that were mentioned in the post captions. This approach has many flaws, one being that it's difficult to detect works that have no known author, such as artifacts. Trying to match parts of the description instead was not as fruitful as we had hoped. Because of this, our analyses were not representative of the entire dataset of Instagram posts but rather a subset. We provide further details on how this process could be improved in the "Enabling Technologies" section.

Analysis

It's important to note that the majority of Instagram data we collected was posted during the COVID-19 pandemic. Since the MFA was closed during part of this time period, it likely impacted some of our findings. We plan to extend our data collection in the future.

While developing our concept, we needed to visualize the Instagram photos we collected in order to validate whether or not visitors were taking photos of artworks. For instance, if the majority of visitors were taking photos of the interior of the museum or their friends, we wouldn't be able to determine whether certain works were viewed more than others. To view this large image dataset in aggregate, we used a method called t-SNE to cluster photos together based on visual similarity and align them on a grid. When analyzing the results, we found that visitors were indeed photographing the art, and that large clusters of photos were of similar artworks, artists, and genres (Fig. 1).

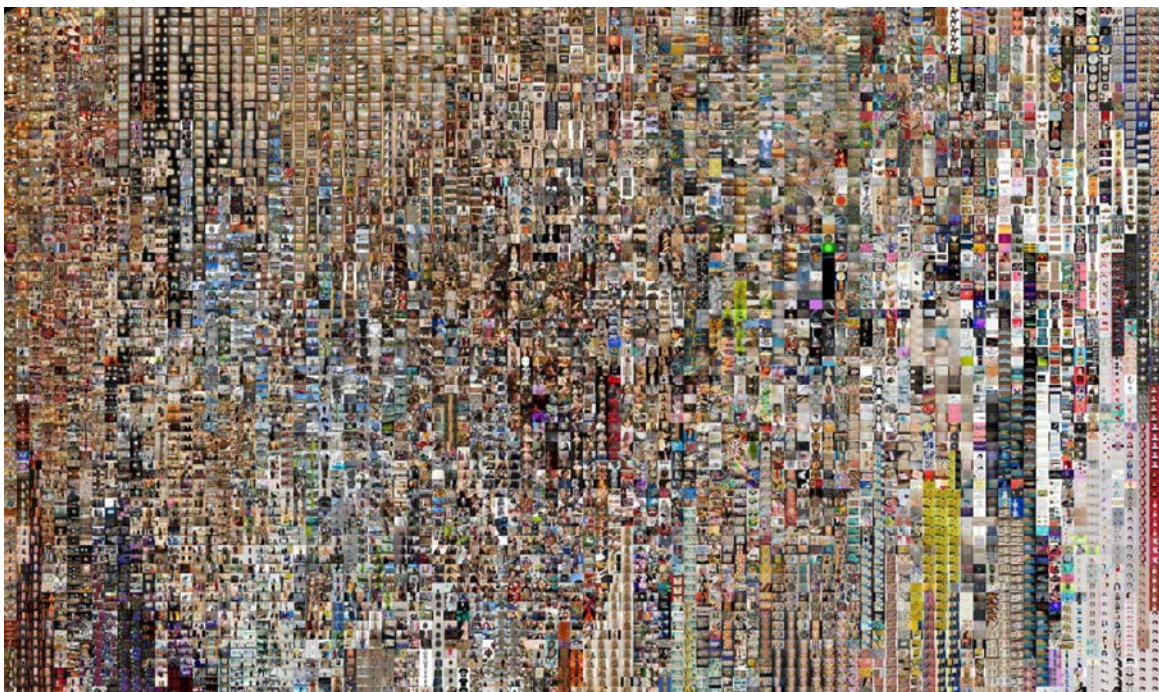


Figure 1: All Instagram photos tagged with the Boston MFA between March - April 2021.

One of our early analyses compared the number of works with the number of Instagram posts for different museum categories (Fig. 2). The museum's two largest collections, the Americas and European Art, predictably correlate with the largest number of Instagram posts. However, even though contemporary art has far fewer works than the European collection, it's not far behind in terms of Instagram posts. We also found that the Asia and Ancient Egypt collections had much fewer Instagram posts compared to their relative numbers of works.

Another notable find was when we categorize works by medium (Fig. 3): Ceramics, Furniture, Paintings, and Sculptures reported the most Instagram posts. Although paintings are the third largest medium, they make up for the majority of posts. Both of these findings highlight the large disparity between collections and mediums that get attention versus those that are less trafficked.

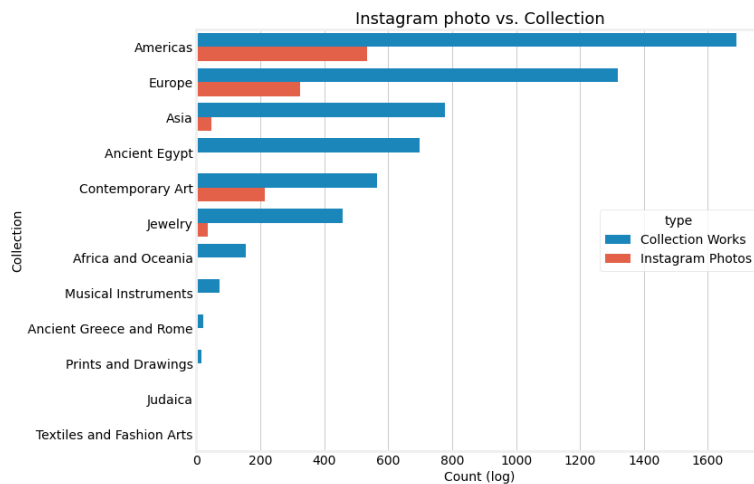


Figure 2: Comparing number of works and Instagram photos by collection.

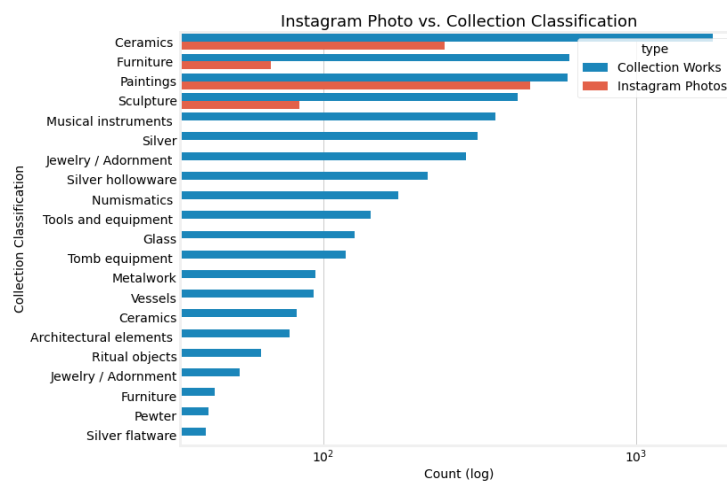


Figure 3: Comparing number of works and Instagram photos by medium.

Since we're working with visual data, we also explored creating more nuanced and custom metrics, such as the objects depicted and dominant color in a work. The four most prominent objects found in paintings were people, boats, ties, and horses (Fig. 4). The majority of paintings at the MFA, based on the dataset we acquired, are from the mid- to late 1800s. When we took a closer look at the photographed works, many of these were portraits, including some where the subject was seated on top of a horse. Additionally, there were various maritime landscapes containing boats. We also analyzed the dominant color of photographed paintings for every decade (Fig. 5). A major challenge here was grouping similar colors together in order to create an averaged tone. We weren't able to discern any information with this analysis; however, visually, it was interesting to see these colors change over time. We think these kinds of image-based metrics are a particularly compelling way for curators and visitors to explore the data. Art historians and curators, of course, could historize and critically examine the meaning of these patterns in ways that we cannot. These approaches might also uncover unforeseen connections between works with varying degrees of visibility.

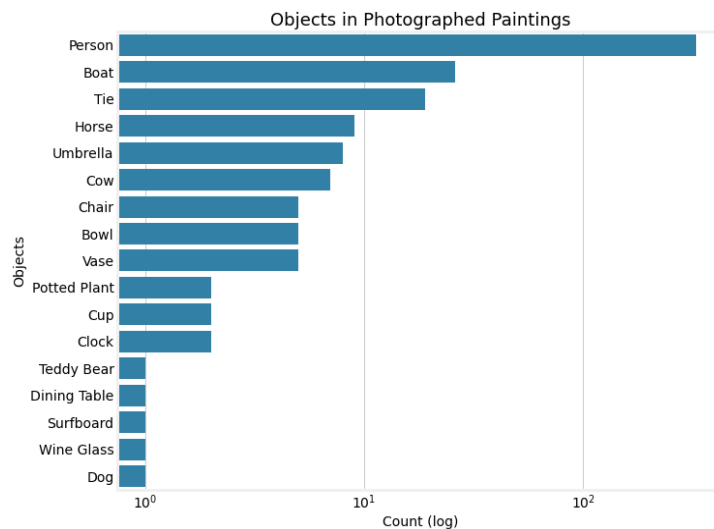


Figure 4: Objects detected in paintings that were shared on Instagram.

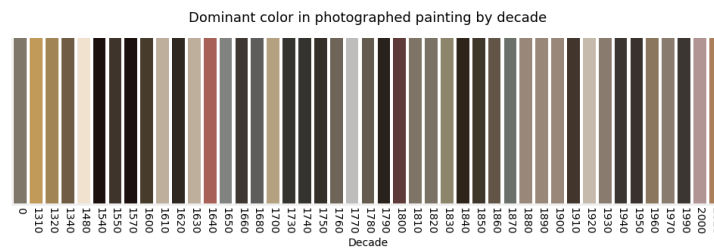


Figure 5: Most common colors in photographed paintings, grouped by decade.

Initial considerations

At the early stage, a talk Chris Atkins gave in our class was inspirational to the formation of our project idea. We were surprised by the low percentage of people downloading new applications

when they go to museums. Therefore, on behalf of accessibility and the cultural analytical nature of our approach, we decided to focus on analysis website development and museum social media interaction. Our main design question was how to increase visitor engagement with less viewed art and areas in the museum, which can be divided into three categories: museum analytics, museum curation, and visitor participation. Thus, we went through brainstorming sessions in order to come up with specific ideas and explore potential mediums and technologies. We selected three ideas that we like the most and explored further. A section of the Miro⁶ board used for planning is depicted below, with an informal “emoji reaction” system of indicating team member interest.

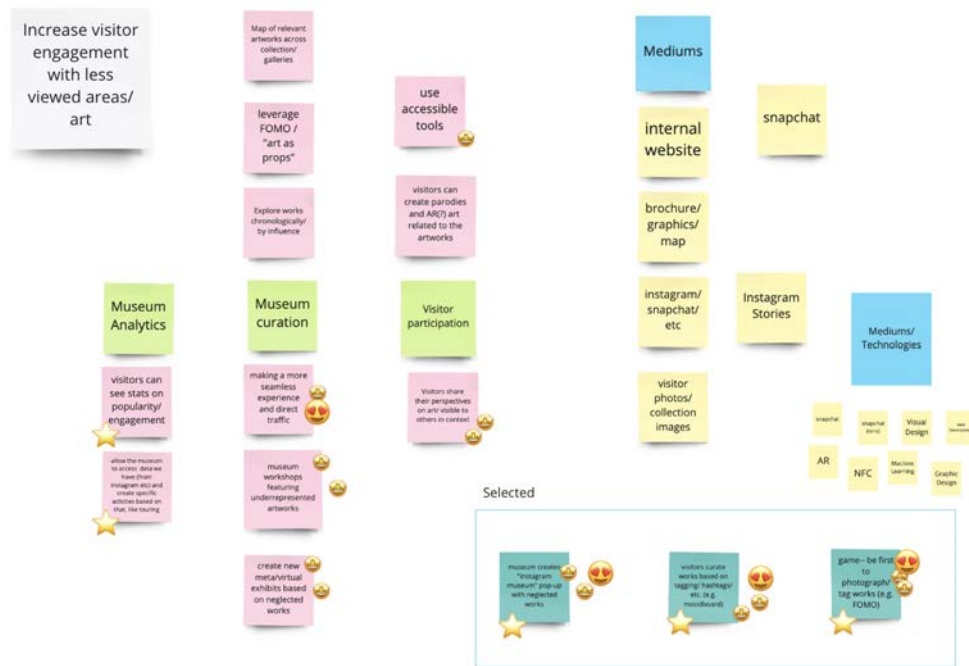


Figure 6: Ideation process using affinity mapping (created with [Miro](https://miro.com/)).

Ideation

As we were developing our user journey, it occurred to us that our initial ideas, namely the exploration website and social media interaction, focus mostly on pre-visit and post-visit experiences. For the in-person museum experience, the be-the-first-to-post game seemed somewhat isolated from other parts. Therefore, we referred back to an early idea of creating a brochure that guides visitors through “cold spots” in the museum and decided to create a separate mobile website. Intending to design a collection of experiences with multiple lenses, this decision of creating multiple platforms that incorporate different voices made a lot more sense in terms of structure and purpose. As a result, we decided to create an exploration website and a mobile tour site. Due to time constraints, the beta version of the two websites are both design prototypes. We divided the work according to each person’s skills and started working on both prototypes simultaneously as well as continued data collection and analysis.

⁶ <https://miro.com/>

Prototype 1 - Exploration Website

We designed the exploration website to be accessible by both museum staff and visitors. The museum can therefore better understand the interests of their audience, and visitors can view artworks from new perspectives. We got several references from websites like Selfiecity⁷, On Broadway⁸, and Google Arts & Culture Map Experiment⁹. The initial single-page interface allows the users to play around with visualizations and metadata and get a broad view of the data. Since we were targeting both the museum and visitors, who have different preferences and interests, we started to expand the functionality and readability of the webpage based on this sketch and initial data scraping results.

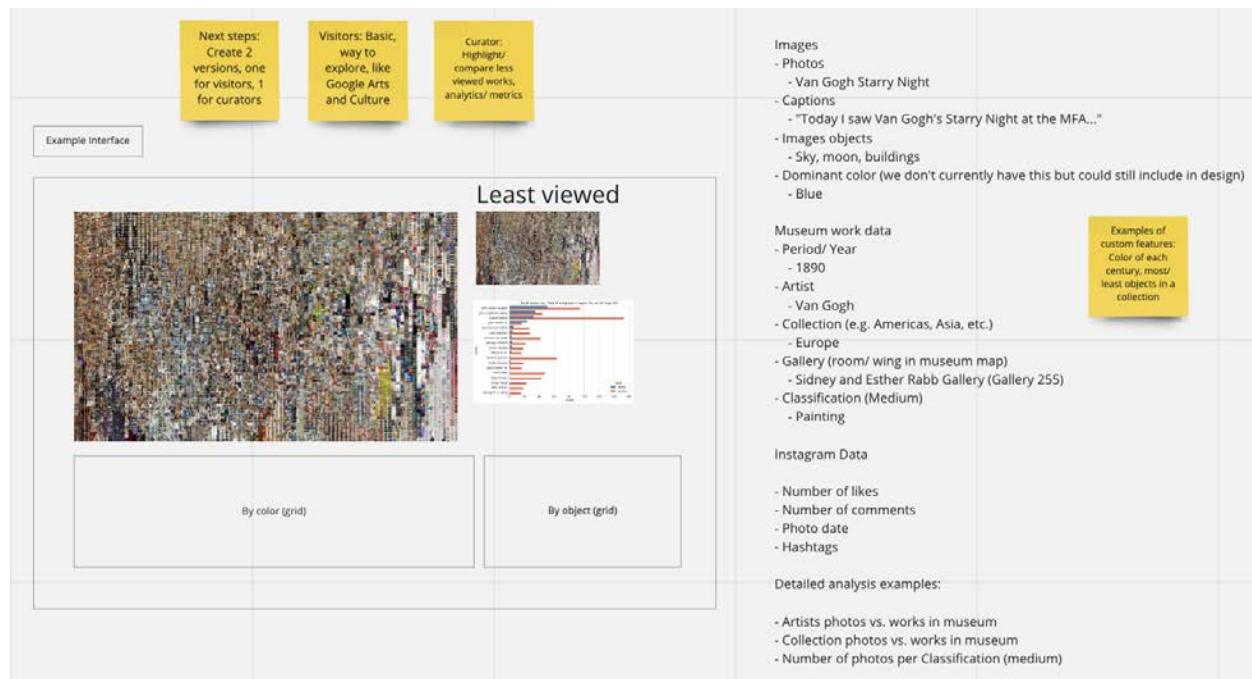


Figure 7: Exploration website design process (created with [Miro](#)).

The exploration website has three components: (i) the main/insights page; (ii) the exploratory experiment page; and (iii) the visitor exploration page. The main page includes a brief introduction of this project and a collection of Instagram photos we put together in our data analysis. When users scroll down, they can view some findings we got from the data. For example, the relationship between Instagram photo and collection classification, popularity of Instagram post hashtags, and objects present in Instagram photos. When users click on the photo collection, they will be directed to the exploratory experiment page, which evolved from our initial sketch. We put an emphasis on grids of least viewed objects at the museum. The users can change the parameters like color, medium, object in artworks, culture, and time periods. The experiment page is mostly static in our current iteration. The third component is the

⁷ <http://selfiecity.net/>

⁸ <http://www.on-broadway.nyc/>

⁹ <https://artsandculture.google.com/>

user exploration page. We came up with this page because we wanted visitors to have a casual “surprise me” exploration of individual artworks instead of merely looking at analytics and a collection of artworks. We divided artworks into three main categories: collection classification, art style, and medium. Visitors can change the subcategories and get another random artwork. At first, the interface shows only part of the artwork, and you can get some basic information when hovering on it. Users can then click into the artwork to view more specific information. Later we also added a component that allows users to explore Instagram photos of this work. At this point, we received constructive feedback about creating a connection/narrative between the exploration site and the mobile site. Consequently, we had an idea of adding a “my collection” feature to both sites, so that users can easily discover artworks they are interested in and be able to explore them further in the museum.

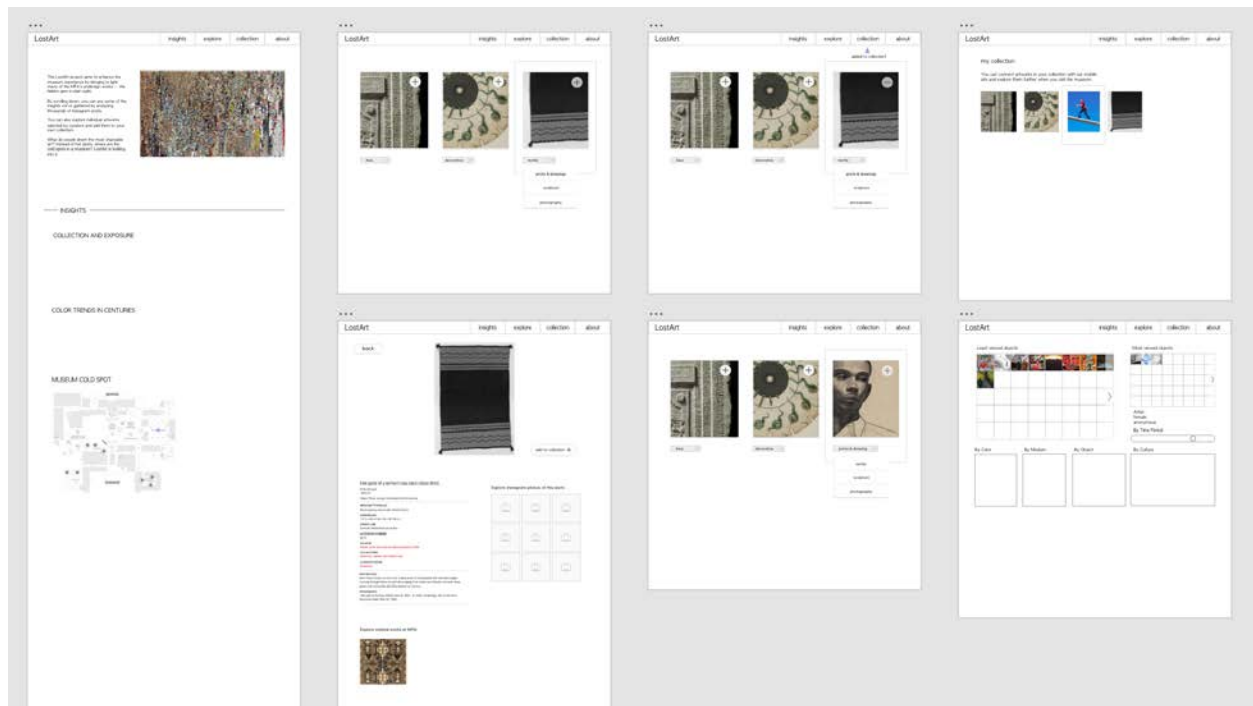


Figure 8: Exploration website wireframes (created with [Adobe XD](#)).

Prototype 2 - Mobile Website

The idea of the mobile site came from the concepts of multi-lensed curation and additional ways to interact with a collection of artworks. We had many different ideas about what this interface would be like. Originally we envisioned a Spotify playlist-like function, with which visitors or curators can make their own small collections of artworks and share with others using pictures and audios, but later we found that this mode is very similar to the Cuseum template that they made for many museums including the MFA. This template is efficient but also seems to be universal, primarily focusing on assisting a virtual tour experience with descriptions. We also considered adding location-specific functionality that will allow relevant works to appear when users approach them, but the methods of getting locations are difficult in terms of user privacy and actual implementation. After an actual museum visit, we also discussed the possibility of

making an interactive conversational experience (messenger chatbot) with the museum through Instagram.

In the design process for the mobile site, we discussed a lot about how to seek a balance between interactivity and accessibility when engaging the users. We came up with several examples of the site (Fig. 9). The first three examples have issues such as having too many constraints and steps that may hinder the onboarding process, and having a lot of words and information to read through that may be overwhelming. So we ended up incorporating the last idea that presented multiple perspectives with a tab function. Selecting different profiles allows the visitor to explore these different curatorial commentaries without being overwhelmed by information.

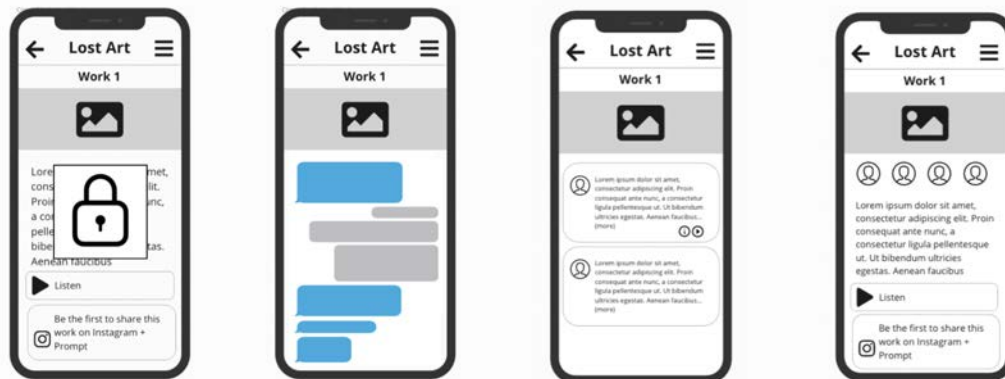


Figure 9: Mobile website interface idea examples.

Final Design

In the final design for the exploration website, we included charts in the insights section that were generated with real data, and added short descriptions for each chart (see Fig. 10). In addition, we finalized the static version of the exploratory experiment (see Fig. 11). The artworks in the grids were manually found on the MFA website according to the data collected. To better link the exploration and mobile experiences, we proposed a “My Collection” section on the mobile experience to collect works selected by the user in the exploration website. While the final design of the mobile website still contains some elements similar to a traditional museum tour app, we hope to differentiate by focusing on curatorial perspectives, less popular and underseen pieces as discovered by our data, and incorporating varied combinations of features on listing pages (narratives, multiple perspectives, audio, the occasional first-to-share prompts) to appeal to a sense of discovery.

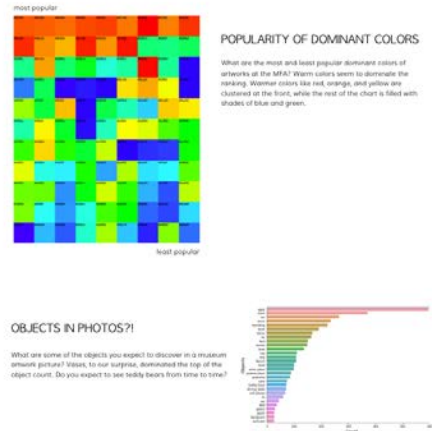
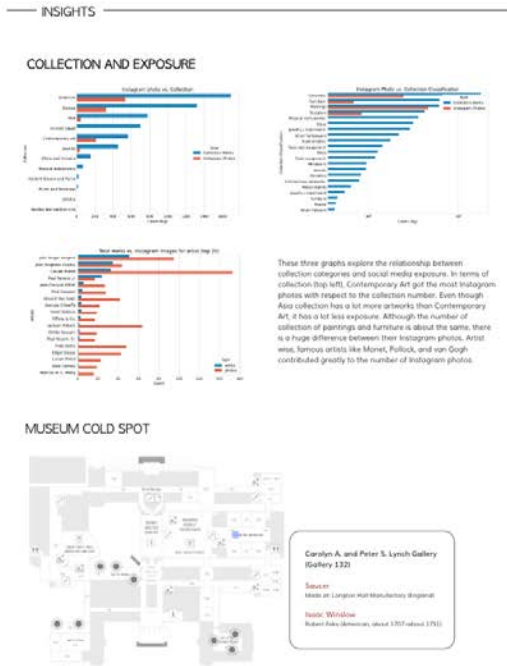


Figure 10: Exploration website insights section (created with [Adobe XD](#)).

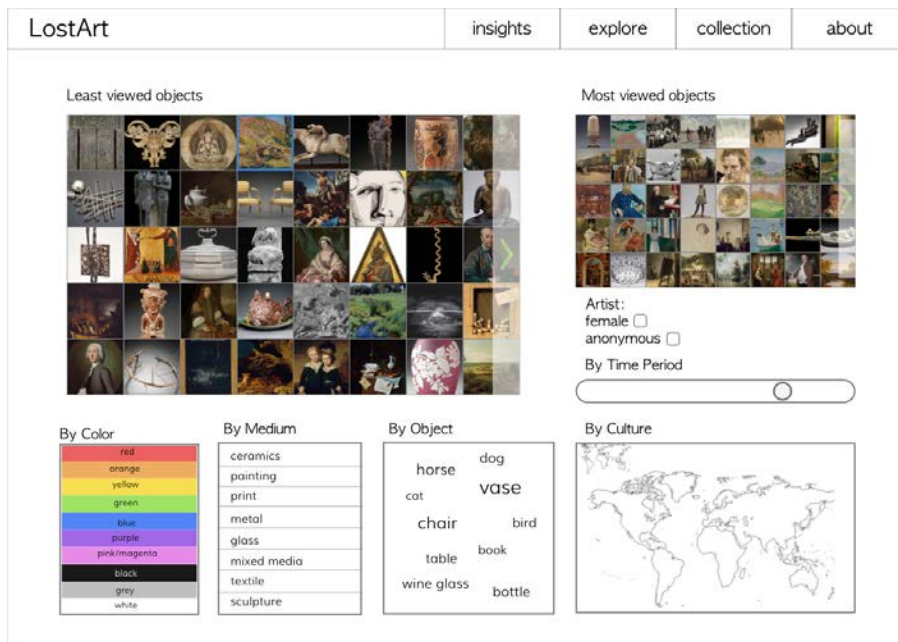


Figure 11: Exploration website exploratory experiment section (created with [Adobe XD](#)).

Journey Map

Before visiting the museum, visitors can use the exploration website to see less viewed artworks and different analytics derived from Instagram data. They can click into more information about one particular work or add artworks directly into their own collection, which they can have access to when they go to the museum later. This initial exploration can help visitors learn about the artworks for further discovery at the museum. In this process, they can create their own narratives and learn from curators. When they arrive at the museum, they can open the mobile site with curated prompts that allows the users to, for example, explore the Blue Collection. The locations of selected artworks will be shown on the screen, and the users can freely explore any of them. The users can simply click on “more info” to read and listen to curatorial notes from different curators shown in an Instagram story-like appearance. There will also be prompts to “be the first to share the work on Instagram” below, which creates possibilities for interactions between museums and visitors on social media. After the visit, the users can connect with and provide feedback for the museum on social media. The museum will then refine and update their curations and featured artworks for future visitors.

Enabling Technologies

Data collection, analysis, and machine learning

We used the Python programming language for all of the data collection, analysis, and machine learning components of the project. To scrape data from the MFA website, we used the Beautiful Soup and Selenium libraries. Our attempts to scrape the site were occasionally blocked by bot detection software. To overcome this, we changed our IP addresses every time we requested data from the site by hopping between a list of different free proxy servers (using the Proxy List Scraper library). We scraped Instagram images using the Instaloader library, and we needed to use proxies to prevent bot detection software. We also needed to create a series of burner Instagram accounts that we swapped through during the collection process.

The MFA collection pages aren’t completely standardized, so our dataset required extensive cleaning. We used the Pandas library to perform data cleaning, feature engineering, and exploratory data analysis. To create features based on image contents like detecting the objects in an image, finding the dominant color, and clustering images based on visual similarity, we used a combination of OpenCV¹⁰, ColorTheif¹¹, Keras¹², and Scikit-Learn¹³.

For the prototype, we matched images to artworks by checking if the name, author, or parts of the description of an artwork were found in the caption of an Instagram post. This prevented us from being able to use a large portion of the Instagram images we collected. A more robust

¹⁰ <https://opencv.org/>

¹¹ <https://lokeshdhakar.com/projects/color-thief/>

¹² <https://keras.io/>

¹³ <https://scikit-learn.org/>

solution, that we didn't have the time or resources to implement, would be to train a machine learning model to detect artworks in an image. This would require multiple images of each work in the museum, each labeled with metadata about that work. These images would then be used to train a neural network to detect those artworks. Normally these training datasets require large numbers of images in order to work successfully. However, Amazon provides an image classification service called Rekognition to train and use image classification models with a small subset of training data. Using a service like Amazon Rekognition¹⁴ would greatly simplify the artwork detection aspect of this project and provide additional benefits including: better documentation, scalability, and seamlessly integrating with other AWS services.

Exploration website

The prototype of the exploration website is created by Adobe XD. It is intuitive to use and doesn't require a long time to learn in order to create the design. It also allows the design process to be easily connected with prototyping and walkthrough.

Tour website

The current iteration of the mobile experience website (often referred to as the "tour website") is mocked-up as a Figma prototype. This was a great tool to help understand the design, layout, and general flow of the experience without getting bogged down in the coding. Rapid prototypes in response to feedback during class sessions helped to evolve and improve each demonstration with more features.

On the backend, it allows for the curation of meta-exhibitions, cross-museum exhibitions with a story to tell between the pieces. The easiest way to conceptualize this is as a tour in physical space, but part of our vision was also pulling in elements that can't be on display. Items in the MFA's vast collection and catalog likewise can contribute to the curatorial narrative, unable to be put on display for a wide variety of reasons (archival decay, time/money, relevancy, etc). In this way, tour themes can transcend physical gallery space and bring curator's perspectives into a museum experience. The visitor can not just see the objects and artifacts, but the amount of intention behind being on display (or not!)

On the visitor's frontend, these meta-collections are realized as tours across the museum, with a map of various points, and gentle guiding towards various pieces alongside curator commentary. Currently the prototype realizes text-based curator commentary, audio commentary, as well as sharing multiple perspectives.

¹⁴ <https://aws.amazon.com/rekognition/>

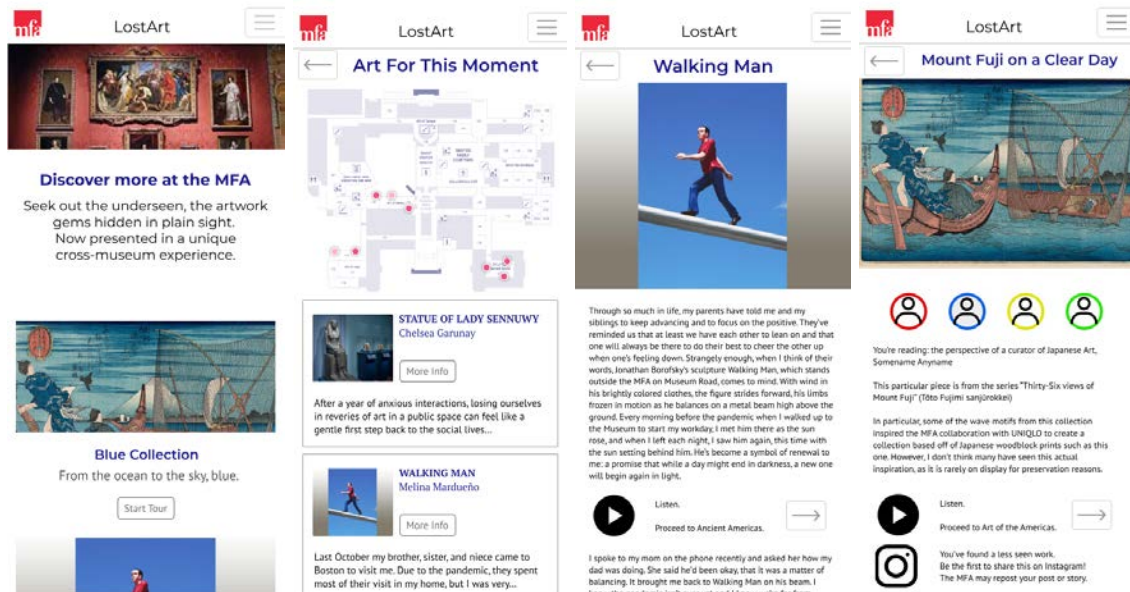


Figure 12: The main menu page, a collection page, and individual listings with commentary.

Likewise, as a game-like feature, easter-egg-like share banners will often randomly appear, prompting the visitor to snap a photo and being the first to post about it. This sense of novelty and discovery aims to appeal to visitors who come to museums to explore and engage with works with calls to action. This loops right back into the Instagram data analysis by encouraging posts and personal social media interaction, giving feedback to the museum about what's being seen and the method's efficacy.

We tried to design the mobile experience to be as least intrusive as possible with easy onboarding. Visitors don't want to stare at their phones for a whole visit, nor jump through hoops where technology should be enhancing their visit rather than be another burden.

Future Directions

Taking note of our relative inaccessibility to museums at the moment of the pandemic and during the ideation cycle, a lot of more experimental technology was ruled out due to not being able to examine the physical space of the museum. Shayna experimented with NFC tags and augmented reality Snapchat lenses before quickly realizing that many of these would be dependent on acknowledging the museum's physical structure, which was hard to access during the time of development. Therefore, our project as it currently exists is more of a proposal with lots of room to grow. One particular example is looking into "cold spots" and places in the museum less traveled, that would require being in the galleries and observing.

Similarly, the structure of the technologies on the visitor-facing side have room to grow beyond the menu-based template of the mobile experience. A curator could perhaps invite visitors to submit comments and annotations in a way to enhance the experience. Much like a choose-your-own adventure book, visitors could possibly discover unique branching paths of

tours in a less linear way. The Instagram game concept evolved to be a easter-egg-like share prompt on some tour pages, which could possibly extend to using hidden NFC tags as an actual physical museum hidden interaction.

In one instance of brainstorming new features for the mobile experience, we played around with potentially having a chatbot guide you through one of these meta-collection tours. This was inspired by prior instances of using chatbots and other similarly conversation-based guides. One such example was the ASK Brooklyn Museum app that connected visitors to experts for insights.¹⁵ This theme influenced our thinking of bringing in multiple pre-set curatorial experiences as a more passive interaction, but we would still be interested in exploring a chatbot in the future.

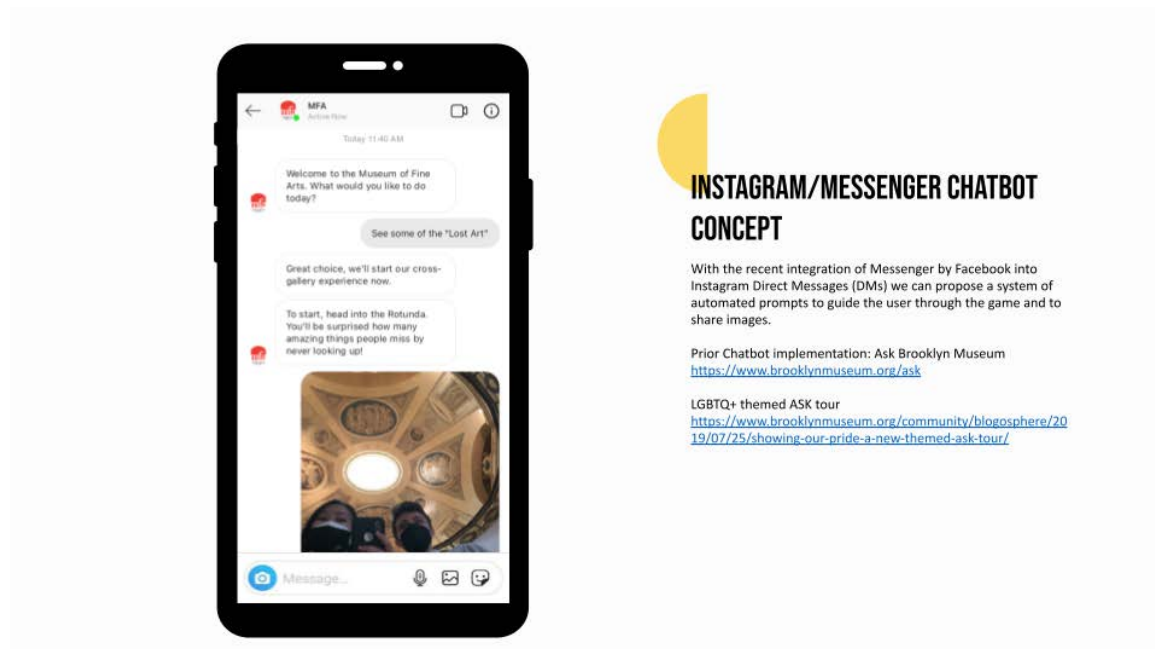


Figure 13: An early mock-up of what a chatbot feature in Instagram DMs could look like

While these works may not be truly “Lost Art” in the sense of lost paintings due to theft, archival decay, or other loss, we still seek to highlight the hidden gems in museum collections and uplift often less-seen diverse perspectives. With data-informed decisions, we can see rather what’s not being represented and seek to capitalize on explorative nature to bring great works to the museumgoer’s attention.

¹⁵ Brooklyn Museum: ASK <https://www.brooklynmuseum.org/ask>

Acknowledgements

We would like to thank Kristen Gresh, Chris Atkins, and Olga Khvan from the Boston Museum of Fine Arts for their valuable insight on curatorial roles and virtual museum engagement.

Thank you to Kurt Fendt and Nim Shapira, as well as the rest of the CMS.636 class for continued support and feedback in development over the Spring 2021 semester.