Implementing Controlled Digital Lending with Google Drive and Apps Script: A case study at the NYU Shanghai Library

Qinghua Xu, Leon Lin, and Xiaohua Wu

Abstract:

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Controlled Digital Lending (CDL) is an emerging concept that enables libraries to digitize a physical item from their collections and loan the access-restricted file to one user at a time for a limited time based on the "owned to loaned" ratio in the library's collections. Despite all the discussions and enthusiasm about CDL, there is, however, still a lack of technical infrastructure to support individual libraries to manage their self-hosted collections. With COVID-19 still very much a presence in our lives, many libraries are more than eager to figure out the best approach to circulating materials that only exist in print form to their users in a secure and legitimate way.

NYU Shanghai is a Sino-Foreign university located in Shanghai, Mainland China. This article describes our temporary but creative implementation of CDL amid the COVID-19 pandemic. We managed to work out a technical solution in a very short time, to lend out digital versions of library materials to users when the library is physically inaccessible to them. By collaborating with our campus IT, a Google Spreadsheet with Google Apps Scripts was developed to allow a team of Access Services Staff to do hourly loans, which is a desired function for our reserve collection. Further, when the access to a file expires, staff will be notified via email. We hope our experience can be useful for those libraries that are interested in lending their physical materials using CDL and are in urgent need for an applicable solution without a cost.

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Keywords: CDL, Controlled Digital Lending, Course Reserve, Google Apps Scripts, Access Services, COVID-19

INTRODUCTION

Controlled Digital Lending (CDL) is "an emerging method that allows libraries to loan print books to patrons in a 'lend like print' fashion " (*Main Page | Controlled Digital Lending by Libraries*, n.d.), when there are no alternatives available in the ebook licensing market. The

White Paper on CDL published in 2018 is a foundational document that explains the legal and policy rationales for CDL as well as a variety of risk factors and practical considerations that can guide libraries seeking to implement CDL. (Hansen & Courtney, 2018, p. 1)

Controlled Digital Lending has three core principles:

- "A library must own a legal copy of the physical book, by purchase or gift.

- The library must maintain an 'owned to loaned' ratio, simultaneously lending no more copies than it legally owns.

- The library must use technical measures to ensure that the digital file cannot be copied or redistributed." (*Controlled Digital Lending Fact Sheet | Controlled Digital Lending by Libraries, n.d.*)

In theory, for materials that exist only in print, a library can choose to loan a digitized copy of a book it owns, only to a single user at a time, in place of the physical item. Meanwhile, the corresponding physical copy should be removed from the collection and be placed in storage while the digital version is shared with a patron.

NYU Shanghai is China's first Sino-US research university and the third degree-granting campus of the NYU Global Network, located in Shanghai, China. Our student body currently consists of nearly 2,000 undergraduate and graduate students. We started exploring CDL before the Chinese New Year of 2020 (January 2020) and planned to continue the discussion when the Spring 2020 semester starts. No one had expected that we would not be able to return to campus for almost three months due to the unexpected outbreak of COVID-19.

In response to the global public health crisis triggered by the pandemic, NYU Shanghai followed public health guidance and delayed the opening for the Spring 2020 Semester and moved to online teaching instead. How to make sure our patrons could continue to access the collections remotely became a challenge for our library staff. Our first response was to check whether a book was already available in licensed electronic format; if not, then to further check if there was such a licensed e-version for purchase. However, given the fact that not all of the items in our collections have their corresponding licensed electronic versions, the library access team had to devise a solution to this problem. Controlled Digital Lending seemed to be the only viable option under the special circumstance.

Our previous preliminary work on CDL led us to quickly move the experiment forward into practice. In retrospect, we found we were among the first few small libraries (if not the first) to adopt a CDL-flavored approach to the problems we were facing amid the COVID-19 crisis.

This article is intended to share our technical solution with those who are interested in an easy-to-implement CDL solution. The CDL related legal discussions are not covered in this study.

LITERATURE REVIEW

Despite all the discussions and enthusiasm about CDL, there is, however, still a lack of technical infrastructure or a universal solution to support individual libraries implementing CDL, let alone a tailored one.

One of the major concerns about CDL is that lending libraries must have control over the library-owned, print-turned digital materials. "At its core," as the Courtney & Hansen's

white paper pointed out, "CDL is about replicating with digital lending the legal and economically significant aspects of physical lending. To do so, we libraries must truly exercise control in the process." (Hansen & Courtney, 2018, p. 3). In other words, the materials to be lent should be under such "control" that technically a patron is not able to reproduce the content of the materials by downloading, printing or sharing. The technical control that a library has of its CDL materials is to ensure its legal control of such materials. Therefore, to put CDL into practice, the implementation must be designed so that "technical control" over the materials to be lent will be guaranteed.

Though the term "CDL" got attention quite recently, the idea behind it is barely new. So are the attempts to realize it. Internet Archive (IA) (https://archive.org/) partnered with Boston Public Library to pilot CDL services in 2011 (Bailey, 2019). IA uses Adobe Digital Editions (https://www.adobe.com/solutions/ebook/digital-editions.html) for Digital Rights Management (DRM) behind the scenes to manage its implementation of CDL (*Borrowing From The Lending Library*, n.d.). Besides, Internet Archive assists with many libraries to digitize their collections and make them available via "Controlled Digital Lending," allowing the libraries to lend digital copies of their printed books (Fowler, 2020).

Anabaptist Mennonite Biblical Seminary (AMBS) library (https://www.ambs.edu/library), for example, worked with the Internet Archive to make it possible for students taking their classes remotely to have access to their textbooks. This proved particularly helpful during the pandemic (Board & Stutzman, 2020).

Compared with Internet Archives, the CDL service provided by HathiTrust Temporary Access Service (ETAS) (https://www.hathitrust.org/ETAS-Description) allows its member libraries' users to access digital copies of print materials (when available in HathiTrust) that they own but that are not accessible because the libraries are closed in light of a public health emergency. ETAS is more restricted in terms of controlling the lending. First, a library must meet the Library and Patron Eligibility before it can enable the service. Second, the services must target a smaller group of users: faculty, staff, and students of member libraries. Furthermore, the HathiTrust platform emulates the lending of physical items by allowing users to "check out a [digital] copy for a limited period of time" (HathiTrust Digital Library, n.d.). The owned-to-loaned ratio is strictly maintained at 1-1 at the same time. Thus, controlled lending.

Besides the two large-scale CDL solutions mentioned above, a few institutions created hybrid solutions for lending course reserve materials in response to the pandemic. According to the "ASERL's Resource Guide to Controlled Digital Lending for Research Libraries," Oregon State University library utilized ALMA Digital (https://knowledge.exlibrisgroup.com/Alma/Training/Alma_Digital), developed by Exlibris (https://knowledge.exlibrisgroup.com/), to host the content and limit both the number of users accessing the digital items and the time they are allowed to access. The combination of LibCal (https://www.springshare.com/libcal/) email (checkout) with Digify – a digital rights management software (https://digify.com/digital-rights-management.html) allows students to place requests via LibCal and the access is limited by Digify. This solution was in practice at Carnegie Mellon. Similarly, Canvas Learning Management System can limit downloading and copying while the libCal is used for students to place a request (Burger et al., 2021).

By coincidence or not, recent days also have seen a trend toward institutions developing their own versions of CDL applications. In March of 2021, LYRASIS (https://www.lyrasis.org/Pages/Main.aspx) and Columbia University Collaboration announced a new partnership to deploy SimplyE (https://apps.apple.com/us/app/simplye/id1046583900), an open-source e-reader app developed by New York Public Library, to Columbia University

Library users. "The first phase of the partnership includes approximately 20,000 eBooks prepared for discovery through CLIO (Columbia's local Blacklight-based catalog) and delivered through the SimplyE mobile app, hosted by LYRASIS" (Lyrasis, 2021).

As of this writing, NYU libraries (https://library.nyu.edu/) announced they have launched a pilot project aiming at delivering over 150,000 ebooks to NYU users via the SimplyE App, which can be a potential platform to host CDL items. Without losing any amount of the control over the materials to be loaned, SimplyE reduces "number of logins needed," allowing the users to access the ebooks using their campus IDs and passwords (Kannan, 2021).

For all the creative features and benefits of the above technical approaches to the implementation of CDL, they may not be suitable for libraries that are looking for a quick, easy, and affordable way to implement a version of CDL that can be embedded into their current workflows as seamlessly as possible.

Since cloud drive services are now widely available, it is only natural that some libraries have come up with the idea of using one of such drives to manage their digitized items. For example, Google Drive (https://www.google.com/drive/) provides a convenient way to manage and share files with specific trusted users. With regard to implementing CDL files, the file owner can easily limit the sharing so that only a specific authorized user can have access to the shared item for a limited period of time. This "controlled access" can be further narrowed by disabling download and print privileges granted by default when a file is shared. Fordham University has recently deployed a home-grown Digital Reserves Platform using Google Drive as its backend. Their beta version of CDL code was announced in March 2021 through Controlled Digital Lending Implementers (CDLI) (*CDL Implementers*, n.d.) listserv and is hosted on GitHub. An institution must have Google Workspace (Google Docs, Sheets, Slides, etc.) to use the application (*Fordham-University-Libraries/G-CDL*, 2021/2021).

Apart from Google Drive, Google also provides an Apps Script service which enables its users to take advantage of cloud-based scripts to customize the behavior of tools from Google Workspace. This makes it possible for a short-term implementation of CDL to be developed in a rather quick manner and easily ported to similar scenarios with or without modifications of the scripts. Furthermore, Google's Team Drive extends the functionality of Drive to the level that a team, instead of a single owner, can control the stored materials in it with the same and equal privileges.

METHODOLOGY

This study makes use of the interpretive research approach in the sense that no numeric data or quantitative analysis was used or produced. The purpose of this study is to explain in detail why and how NYU Shanghai Library leveraged Google Sheets and Drive to initialize and implement a temporary version of CDL service for the patrons.

In order to implement a temporary CDL platform that meets our expectations, we tested four different options (NYU Box, ARES, Google Drive and Locklizard) available to us within just one week and decided to use Google Sheets as the final solution. The term "available" was defined as the status in which a tool or an application has been purchased or developed by the library or the community to which the library belongs. The tests were performed by the library access team staff using their work laptops and google accounts. Test results were then reviewed and discussed in team meetings organized by the Access Services Librarian.

The testing process was divided into two phases. The first phase was to quickly test if a tool could satisfy two important requirements: it allows for hourly loans and it is available

across the NYU community. Those that passed the first phase were then examined in the second phase where the access team explored the possibility of embedding them into the team's daily workflow.

Due to time constraints, it was not possible for the library to conduct a thorough, data-based analysis of the aforementioned solutions to CDL implementation. Utilities from Google Workspace, such as Google Sheets and Drive, are not designed exclusively for implementing CDL services and have such limitations as lack of a feature-rich ebook viewer and storage restrictions on data scale, but they are adequately effective when being leveraged to quickly implement a working solution that satisfies the library's specific requirements. Although the tools the library has tested have not been statistically compared and analyzed, with the sample of Google Drive, this study presents the technical architecture of this project, indicating that it is possible to implement a makeshift CDL-service platform that is affordable and effective enough, which might be helpful and inspiring to other academic libraries that are looking for similar solutions.

OUR TECHNICAL SOLUTION

We decided to use Google Drive and Sheets as the base of our implementation of CDL for two practical reasons. First, back in February 2020, given the limited time, there were no other existing options available to us that could meet our urgent needs: restricting access and loaning reserves at four hourly intervals.

Before we concluded that Google Drive was the way to go, we investigated three other options at hand. The first was NYU Box (https://www.nyu.edu/life/information-technology/websites-storage-and-sharing/nyu-box.html) but the service is mainly available to the faculty at our university, excluding a major audience branch of the library: the students. Then we looked into Atlas' ARES (https://www.atlas-sys.com/ares), the Course Reserve system used at our university. One of the key features provided by ARES is electronic reserves, such as URLs of journal articles, scanned chapter files, ebooks, etc. These can be posted in ARES and made accessible to all the students enrolled in corresponding courses. Thus, we thought ARES may offer an additional tool of the type. However, we were told that it was not possible for Atlas to provide a solution immediately. We also examined a digital rights management solution called Locklizard (https://www.locklizard.com/). Unfortunately, the tool could not control access by hour, a key requirement for our reserve services, so we did not move forward with it.

Another reason is that Google Drive and Sheets are part of Google Workspace (formerly G Suite), the go-to set of communication applications across the NYU community. Well supported by NYU IT services, Drive and Sheets are the ideal tools for the library to experiment with and customize.

After using Google Drive to share a file for a couple of weeks, some of its limitations came to our attention and proved indeed to be functional shortcomings from our perspective. First of all, only the document owner could uncheck the option to disable downloading, printing, and sharing in the settings, which meant only the owner could "loan" the file to a patron. Secondly, only the owner of a file could set the file expiration date. Thirdly, when it came to setting an expiration time, the minimum unit provided was a *day*. For course reserves, we would like to manage our loans on an hourly basis because materials from our reserve collections are supposed to be lent for 4 hours. Those limitations combined make it inconvenient (if not impossible) for a team of Access Services Staff to manage both the files and access to them as a group.

We reached out to our campus Google Workspace expert for advice. After reviewing our case, the expert advised us to use team drive (or shared drives) in place of Google Drive (or My Drive). A team drive differs from an individual user drive in that staff members can be added to a shared drive in such a way that each of them can perform the same operations using their own account regardless of whoever is the document owner.

In that case, the last challenge facing us was how to customize Google scripts. Although it allows us to prohibit downloading, sharing and copying, Google team drive does not come with a feature which allows for user-defined expirations on an hourly basis. It turned out what we needed then was to develop a Google script which sets an hour-level time limit on a file and removes the users from the shared file automatically based on the expiration time. The script had gone through four versions, from March 2020 to early June 2020.

1st version and problems

In the first place, we found a Google script that could set an auto expiration date for a shared link (Agarwal, 2017). The workings of this script consist of two parts: a time-driven trigger (https://developers.google.com/apps-script/guides/triggers/installable#time-driven_triggers) which launches the script at the set time (a date or a point of time); and the functions defined in the script which will automatically disable the shared link and remove the shared user from the viewer list. We decided to try out this script and add more functions based on our needs.

However, we still faced two problems by then. One was that we needed an email notification feature to inform the library staff when a shared link expires. By doing so, the library staff can check in the item(s) in our ILS and put the book(s) back on the shelf. The other problem was that sometimes the script would finish without removing the added viewers at all.

2nd version and bugfixes

In regard to the first problem in the first version, we added an email notification function to the script so that each time a shared link expires, the library staff group will be notified via email. A drawback of this method, however, is that the email address to whom the notification will go can be set and modified only in the script.

For the second problem, after several days of intensive searching and troubleshooting, we found that the root cause was that *getEditors()* methed from DriveApp API acts in a different way than does *getViewers()*. These two methods return different values in Google team drive, as shown in Figure 1.

```
+------------------------+-------------+-------------------+
| Team Drive Permission  | getAccess() | Folder API Method |
+------------------------+-------------+-------------------+
| Manager                | ORGANIZER   | (None)            |
| Content Manager        | NONE        | (None)            |
| Contributor            | EDIT        | getEditors()      |
| Commenter              | COMMENT     | getViewers()      |
| Viewer                 | VIEW        | getViewers()      |
| (None)                 | NONE        | (None)            |
+------------------------+-------------+-------------------+
```

Figure 1. Note: Adapted from Stack Overflow (https://stackoverflow.com/questions/54189752/how-do-i-get-the-managers-contributors-etc-of-a-google-team-drive).

When the script runs *getEditers()*, it will return all members with edit permissions (e.g. manager, content, and contributors) of this team drive folder. Such users are treated as special members of a shared drive by design and therefore should not be removed. Our previous attempts to remove them created a logic conflict in the script's runtime, which in turn triggered an error and stopped the script. As a result, the viewer-removing function did not run as expected. To prevent this from happening again, we agreed to not assign any contributors in this specific team drive folder.

3rd version and improvements

In spite of the verbal agreement, to err is human. Therefore, in order to improve the error tolerance, we added a try block (https://en.wikipedia.org/wiki/Exception_handling_syntax) to catch and skip errors of this type. Besides, the error logs caught by the try block will also be helpful when it comes to debugging the script.

4th version (currently in use and the final version)

With all the above-mentioned problems and bugs resolved, we made one additional improvement: adding a function to allow the receiver address to be edited in the 2nd tab of the spreadsheet. For more details, refer to Appendix A.

Whole project structure

To make the project concise and easy to extend, we split the project into the following three script files:

Menu.gs

This script file is to add and modify the menu UI of the spreadsheet. Any users would take any interactions through these menus. For the sake of simplicity, we have only two options -- authorize and start tracing. This script includes an important function called *onOpen()*, which initializes the customized menus upon opening the spreadsheet.

Utility.gs

This script file includes the function that makes the process more efficient and straightforward. Here we only have an authorizing function for the spreadsheet to gain necessary permissions from a user. For future use, we may add more functions to improve processes or services.

Code.gs

This script includes the main function to achieve the auto expiration feature. It includes the functions of automatically removing shared links, setting triggers at 15-minute intervals and sending email notifications for every trigger.

For public use

These script files are ready for public use (see appendix A). One important notice for any library that would like to adopt the scripts is that the user MUST replace the receiver email address in the 2nd tab of the spreadsheet with their own. One thing to point out is that during our test, we found out that it is not required that your institution must have a Google Workplace license. A free Google account would also work. However, we would recommend using a shared account if more than one staff member will manage the service.

For a detailed, step-by-step adoption of our workflow using Google Workspace (https://workspace.google.com/) with the scripts, see Appendix A.

CONCLUSION

NYU Shanghai Library has a small reserve collection ranging from 200-300 physical titles each semester. For example, 542 books circulated around 3,000 times during Fiscal year 2019. The total number of physical books on reserve for Spring and Summer 2020 was around 180; the circulation, however, decreased significantly in Fiscal year 2020, to nearly one-third of the average in the past years. Not to mention that this circulation number included the transactions prior to the pandemic. As to the circulation of our CDL items, from early March of 2020 (when the project was initiated) to the middle April of 2021, we have fulfilled 64 requests in total. Therefore, our workflow may be more applicable to small libraries. We feel the script can be useful for libraries seeking a simple solution to implementing CDL in a short time.

It is worth mentioning that file sizes larger than 100MB will not be displayed by Google Drive's built-in PDF viewer. Users may get a "file is too large to view" error message and be asked to download the file. Since the CDL file is not downloadable, it is suggested to reduce the file size down to 50-60MB before sharing with a patron. Adobe Acrobat DC Pro offers such a feature called "Reduce File Size" to allow users to compress a PDF file size. (https://helpx.adobe.com/acrobat/how-to/compress-pdf.html)

The experience of reading a book using Google Drive is not very ideal (but acceptable for the short term). That is why we all need a long-term technical solution to automate the process., i.e., something similar to the various commercial eBook platforms. Some disadvantages of using the **PDF viewer** for CDL purposes are: users cannot jump to a section from a table of content; they cannot search or browse; they cannot download it and read it offline. From the library staff's point of view, it is troublesome having to manually set the due time and share the link with a patron. In addition, staff need to operate multiple systems such as ILS, ILLiad, and spreadsheets to keep track of the checked-out materials and the stats. Furthermore, because we disable downloading, we have to reduce the size of the original scans to make the file viewable for users, which is also time-consuming. Another potential risk is that the user can see the file in their browser unless they refresh or close the browser window after the shared link expires. But that problem also occurs when you use Google's own expiration feature.

The other questions to consider include a mechanism by which a patron can discover a CDL item and initiate a request on it. Last but not least, libraries that adopt CDL need to consider putting it together with a list of criteria as to what to scan. The white paper suggests focusing efforts on low-risk book candidates such as books in public domain, out of print, etc. (Hansen & Courtney, 2018, p. 38).

NYU Shanghai campus reopened on April 27, 2020, ending a nearly three-month closure due to the COVID-19 pandemic. As we still have users who are outside China and are not able to return to campus for in-person classes, we may still lend CDL copies at the request of patrons using the workflow we developed. The service has not been actively promoted at the current stage. As New York University favors SimplyE more, we may investigate the possibility of utilizing SimplyE as our CDL platform.

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APPENDIX A

CDL Using Google Drive and Apps Script

Step 1. Disable downloading, Sharing and Printing

If you use **Team Drive,** go to "Shared Drive Setting" (one-time setup)
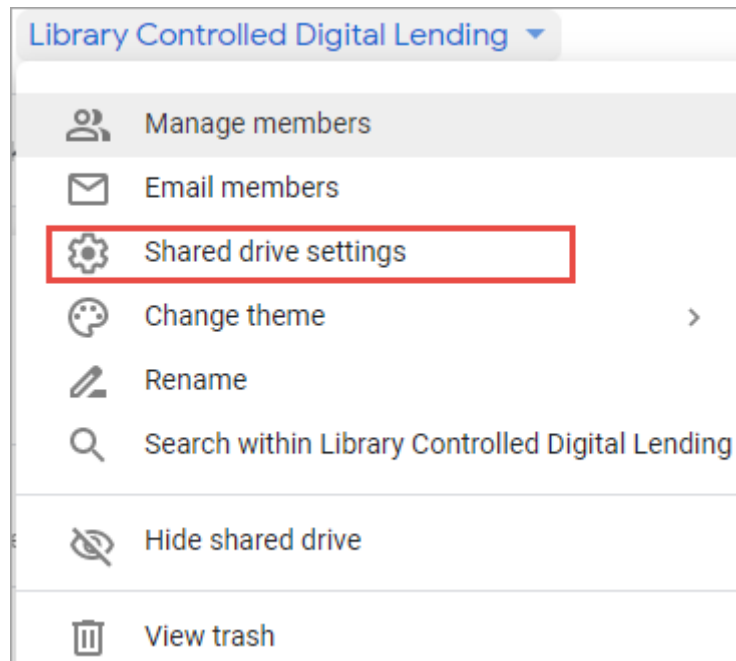

Figure 2

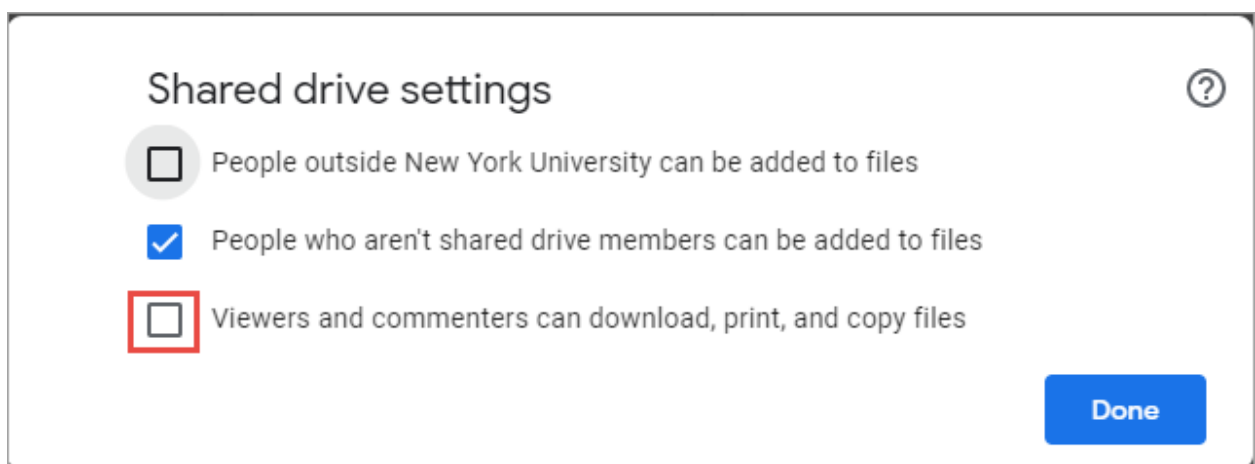Uncheck "Viewers and commenters can download, print and copy files".

Figure 3

If you use **Google Drive,** select the file and go to share with people settings (you will have to do this for **every** file).
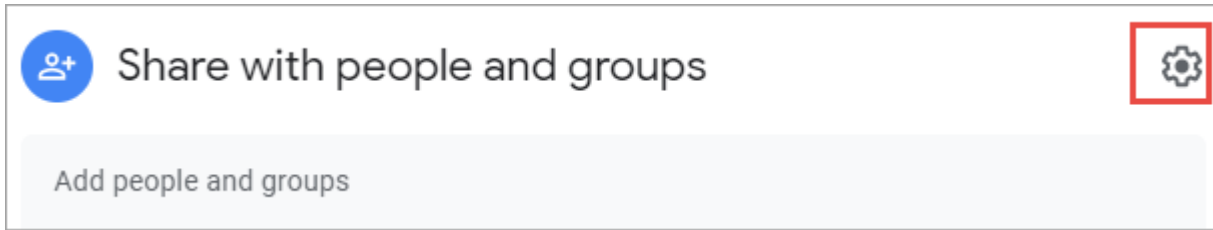
Figure 4

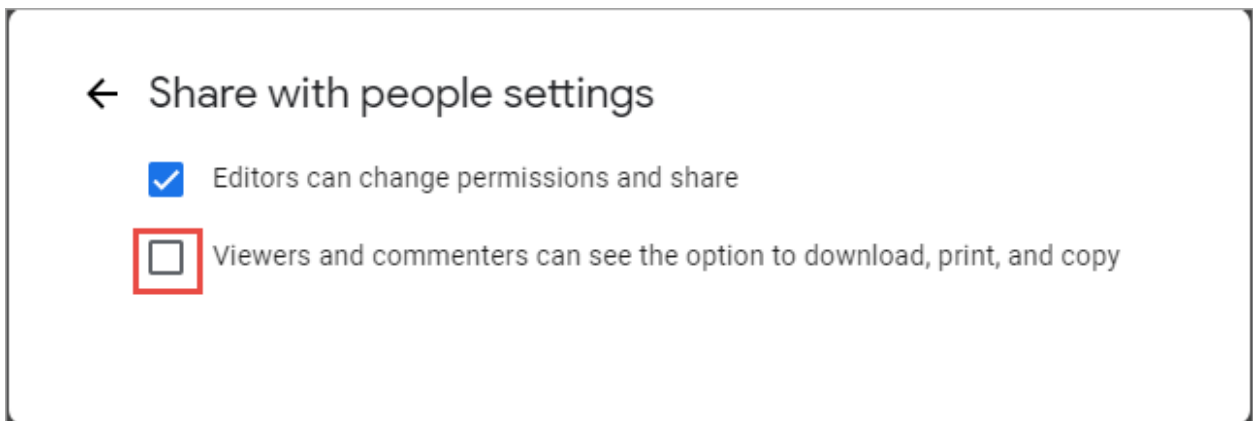Uncheck "Viewers and commenters can see the option to download, print and copy."

Figure 5

Step 2. Make a copy of this Google spreadsheet. A Google spreadsheet is simply an instance of Google Sheets (https://www.google.com/sheets/about/). The script is bound with the newly-copied sheet which can be placed in the same folder as the PDF files.

Step 2. 1. Authorize the script (one-time)
After copying the above spreadsheet, you will need to first authorize the script. *This should be done by the **owner** of the file (for Google Drive) or Team Drive **manager***.
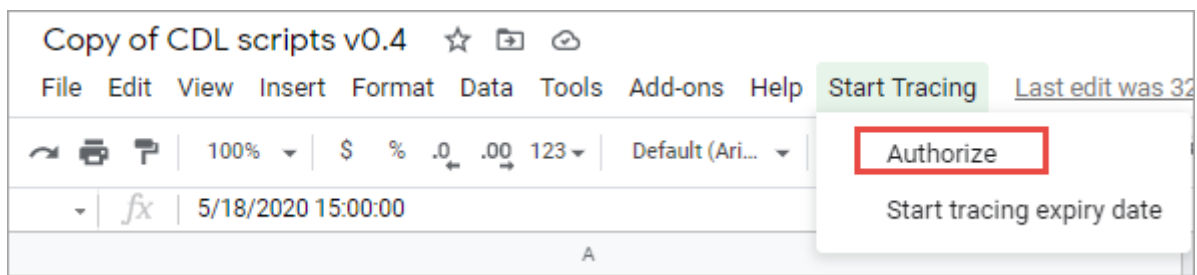
Figure 6

Step 2.2. Click on **start tracking expiry date** below "**Authorize**" (one-time). A dialog box will pop up asking for your permission to continue. Click on **Continue**.
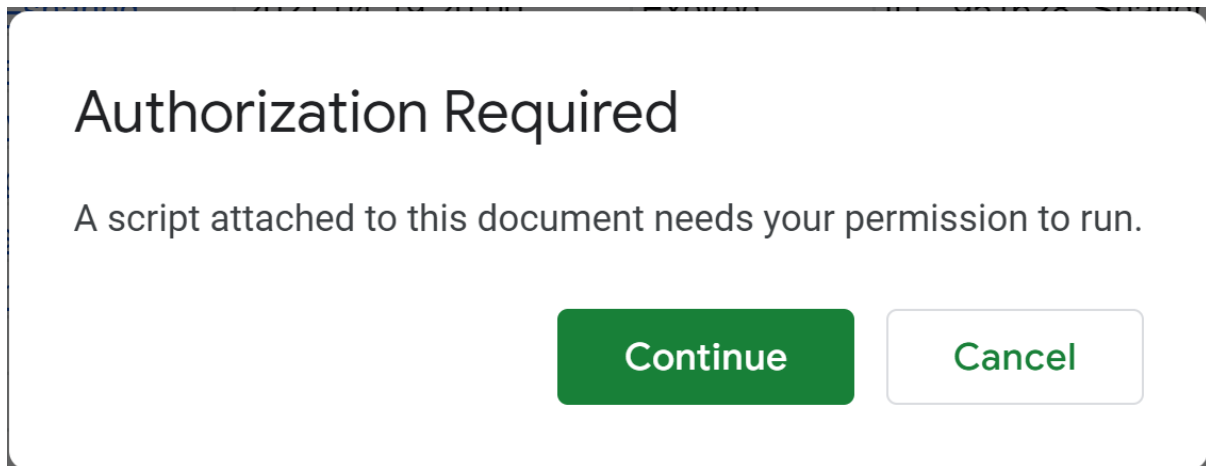
Figure 7

Then a separate browser window will be populated (see below), asking you to choose the proper account to run the scripts.
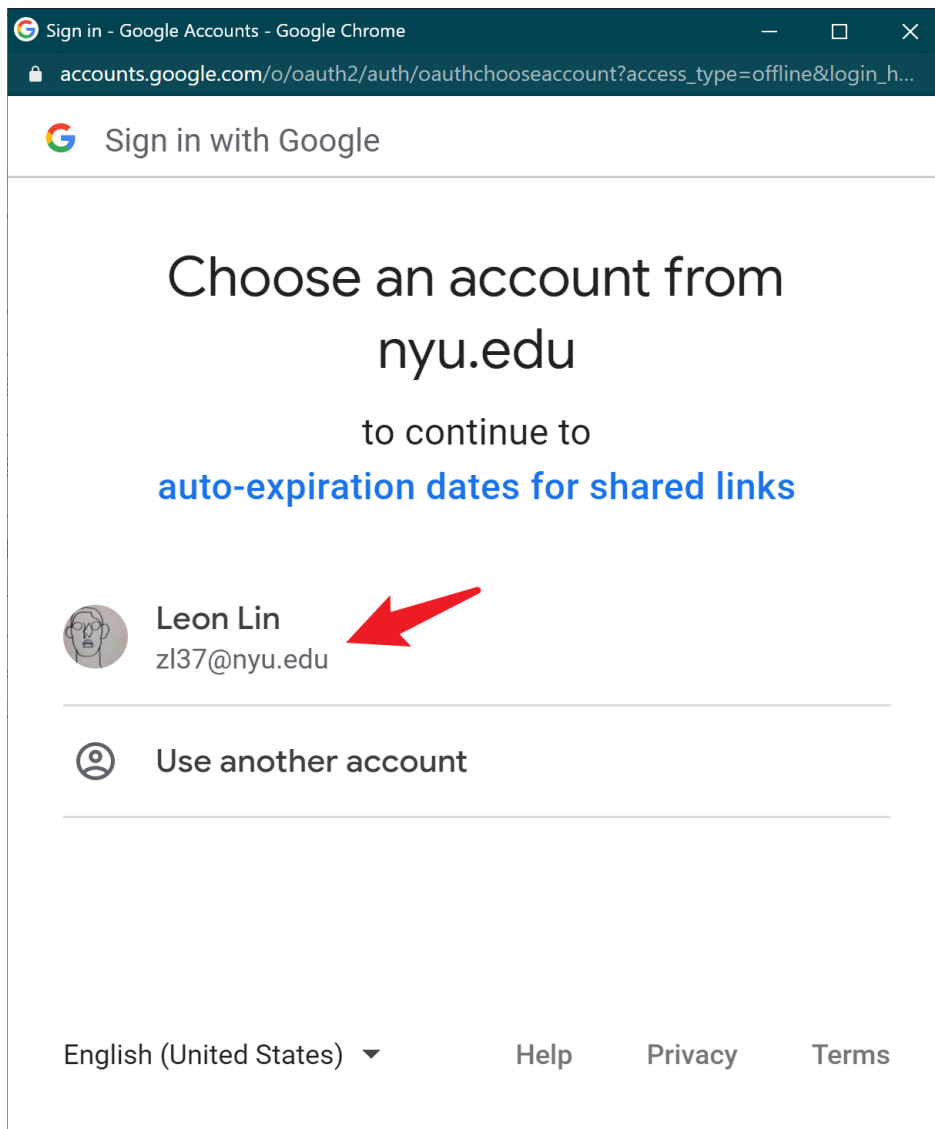
Figure 8

Next, Google will ask you to confirm that you allow the scripts to modify the files stored in the shared drive. Click on **Allow** at the bottom.
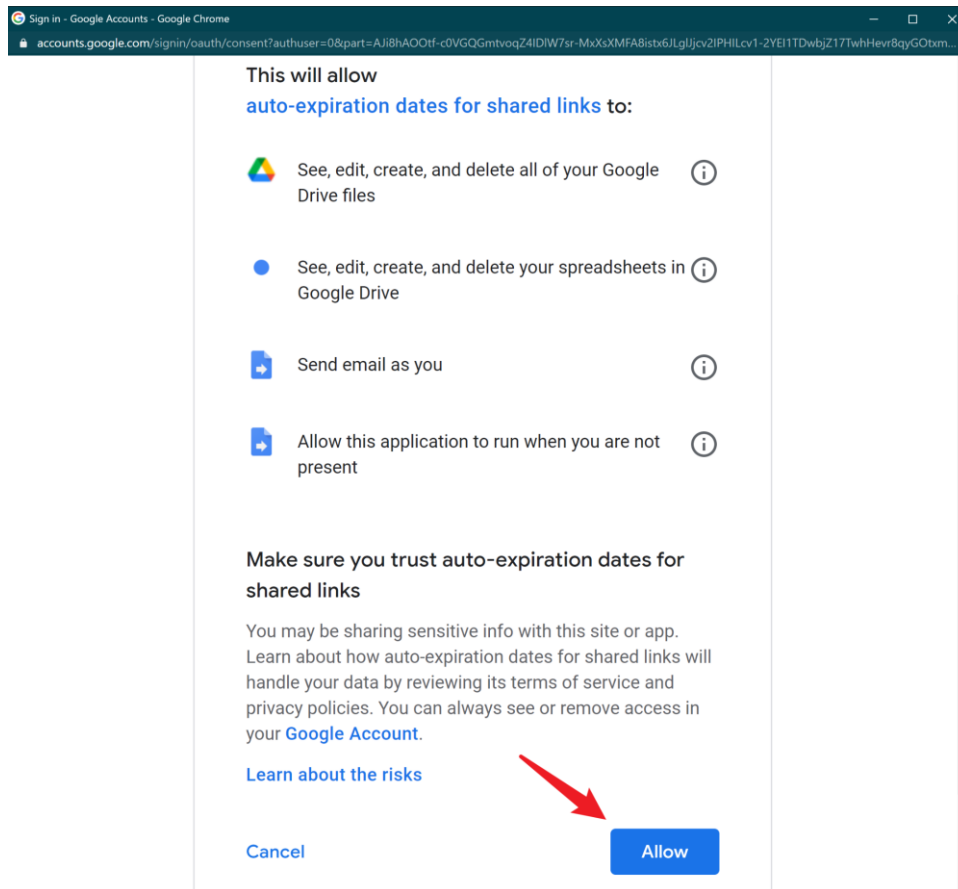
Figure 9

Step 2.3. Replace the email address with your group's.

Click on the second tab "SetupEmailAdd" in the spreadsheet and replace the original email with your preferred email address (**group email address is recommended, for example, the email of your service account**). The current version of the script only supports adding one email address.
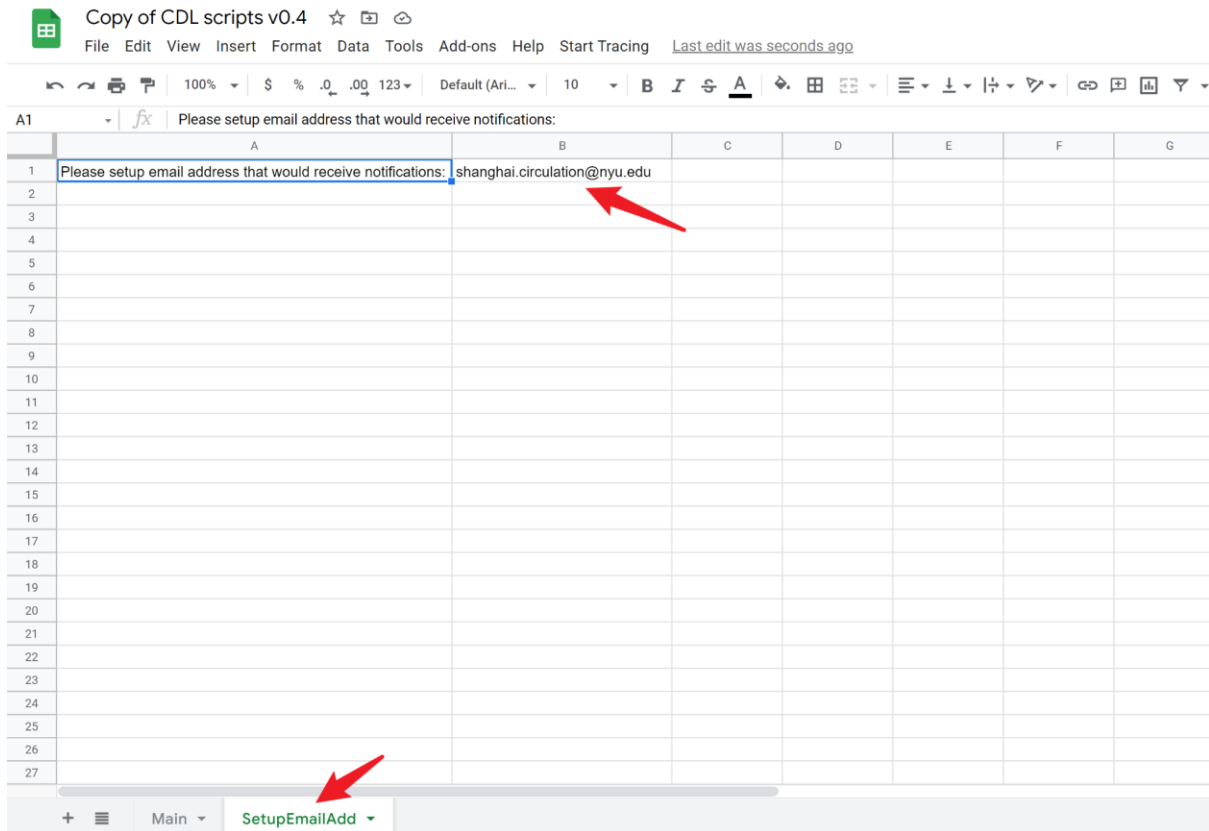
Figure 10

Step 2.4. Adjust your time zone settings to make the script work properly

- Go to **Files**, click **Spreadsheet Settings**
  - Choose the correct "**Time Zone**"
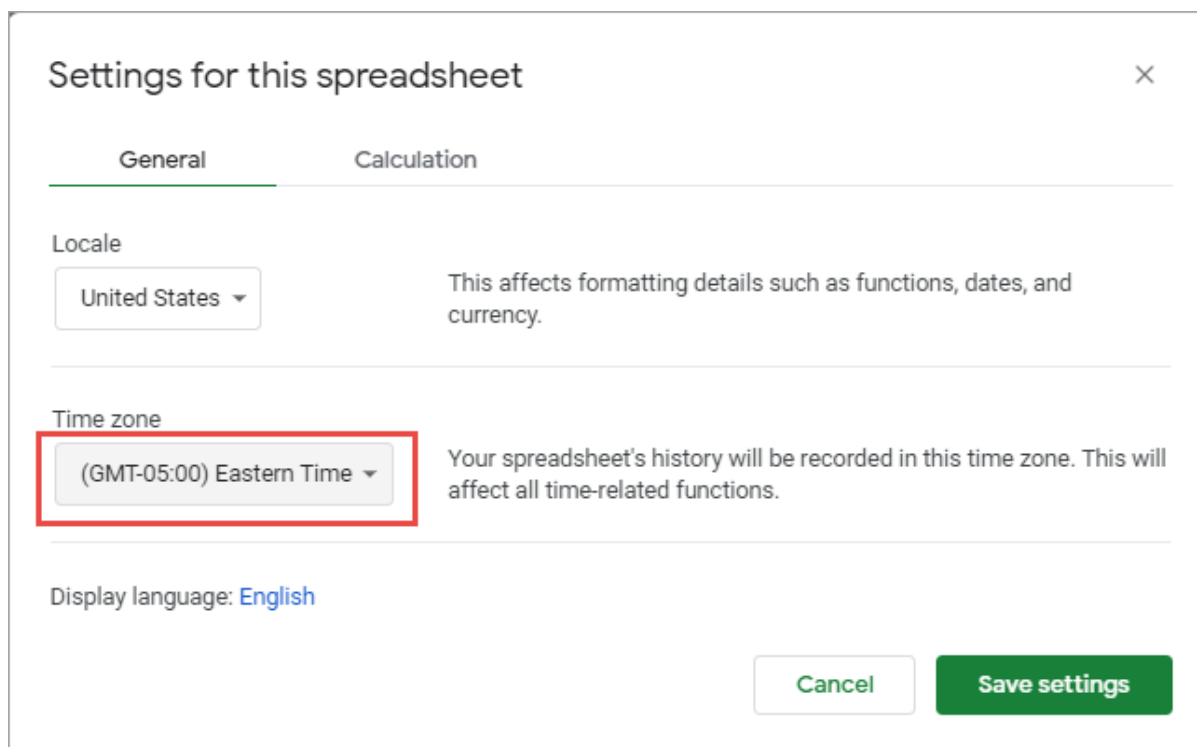
Figure 11

- Go to **Tools**, click **Script Editor**
  - Switch to **Legacy Editor** if you are on the **New Editor**
  - Under **Files,** click **Project Properties**
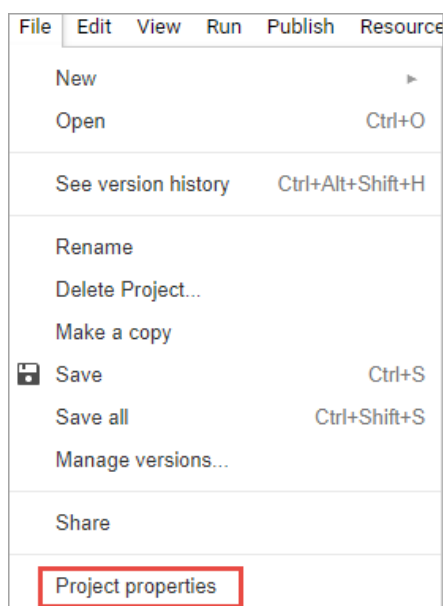 - Choose the correct "**Time Zone**" under the "**Info**" tab

Figure 12

Figure 13

Step 3. Check out the physical item in ILS (optional)

Before we share the digital file with a patron, we check out the physical book to a dummy patron in our ILS and move the book from the shelf to our storage. This way, the book will show in our catalog as checked-out with its due date/time, meanwhile only one copy is being circulated at a time. That might work for a regular circulating item; however, it may be troublesome having to check in/out a physical course reserve item frequently. At present, we were able to handle the reserve request as the number of requests is relatively low.

Step 4. Select the file

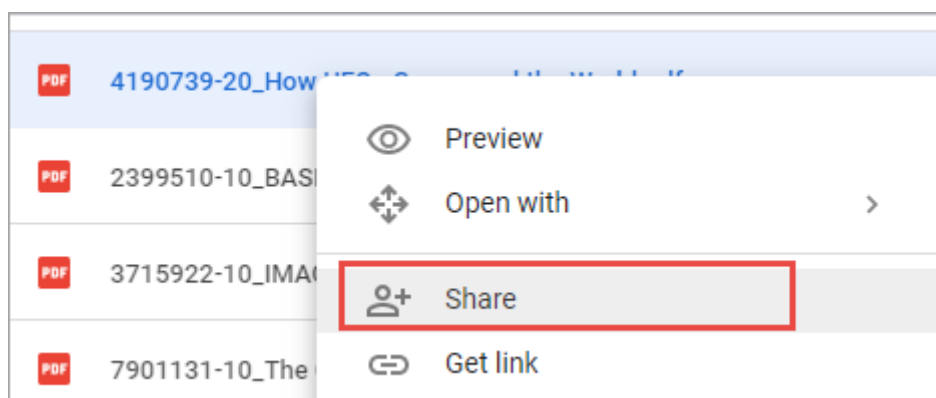Find the target file to be checked out in the Google Drive folder. Click on +**Share** to add a viewer

Figure 14

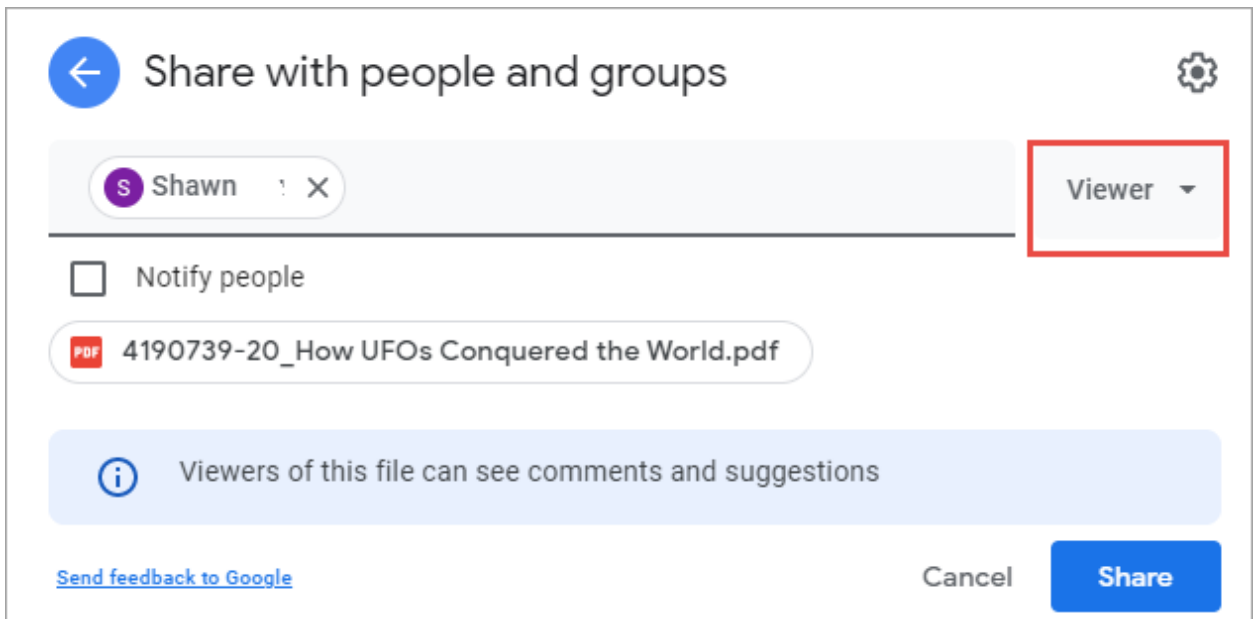**Step 5** Add a patron to be a **Viewer** of a file

Figure 15

Optional: We also uncheck "*Notify people*" because we'd like to use an email template to notify patrons via our regular circulation email address instead of this team drive group.

The name convention of the pdf file we came up with consists of a barcode and the title of the physical item: *barcode_title*. We also have an inventory list of all PDF files for staff to keep track of.

Step 6. Copy the link

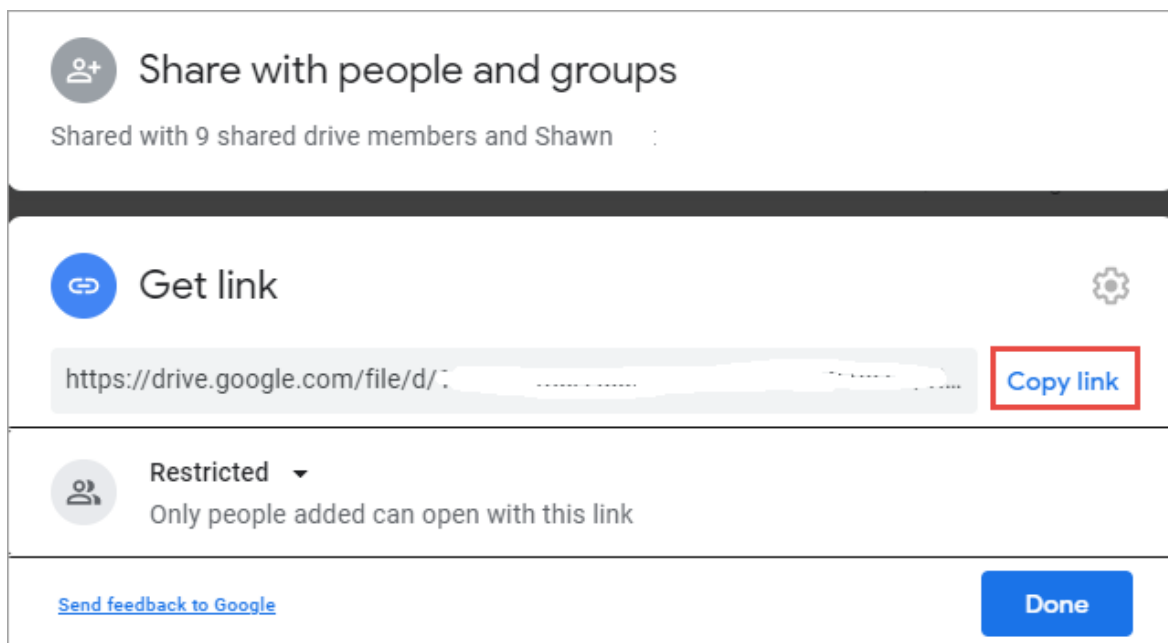Copy the shared link of the file to be entered into the spreadsheet (see Step 7)

Figure 16

Step 7. Enter the information in the script spreadsheet

You are only required to enter information for "File URL", "Expiration Time" and "File Name". Please leave column "**Status**" empty. The rest columns are optional and can be modified as needed.

Step 7.1. You may start filling out the information from row 2 and leave the first row as your example. Paste the URL copied from the previous step in "**File URL**" column

Step 7.2. Enter the **Expiration Time** in the exact format as shown in the example

Step 7.3. Leave the **Status** column *blank* since the script will automatically fill in that column around the expiration time.

Step 7.4. Enter something in the "**File Name**" field

Step 7.5. Enter information for the rest of columns as needed

If you use Google Team drive, all members of the team drive should be able to manage this process. But if you use Google Drive, it has to be the owner of the file who can manage the lending, which is why we highly recommend using a shared account or a service account.

Step 8. Email the patron (optional)

If you check "Notify people", you may skip this step. Currently, we use a simple email template to notify the patron. The template basically contains the below information:

- Item title

- Shared link

- Expiration time

- Our contact information

In the email, we also make sure to let patrons know the file cannot be downloaded, printed or shared.

Step 9. You will receive an email upon file expiration

Step 10. Check in the physical item (optional)

About the authors

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