

Cloud Storage Benchmarking

Data Transfer Options and Available Software

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Part I

Introduction

Chapter 1

Overview

1.1 Testing Structure

The tests detailed in this document were single-file transfers. Various dummy files were generated using the `mkfile <size> <filename>` command and were individually transferred five times. After all transfers were complete, the mean and standard error were found for the estimated transfer speeds of each file size and plotted in R.

The six file sizes used were: 1 MB, 10 MB, 100 MB, 1 GB, 10 GB, 100 GB

An attempt was made to perform four different tests:

1. PC → Google Drive
2. Google Drive → PC
3. HPC filexfer Node → Google Drive
4. Google Drive → HPC filexfer Node

1.2 Profiling Scripts Accessibility

Access to the benchmarking scripts used for these analyses (when applicable), output csv files, and plotting scripts are available from [Github](#).

1.3 Units

It may be worth mentioning that I am using the prefixes kilo, mega, and giga as the standard S.I. prefixes and not binary, so when I say a megabyte, I mean 10^6 bytes and not 1024^3 bytes. This is particularly noted since there are mixing of conventions; the command `mkfile` on Macs creates files with prefixes using the binary convention. The command `truncate` on Linux creates files, when specified with the option `MB` in base 10 metric units. To keep my results uniform, I extracted the exact size of each file in bytes and converted it to metric MB before computing speeds.

1.4 Warnings and Disclaimers

- This file is in flux as I add instructions on installing software and edit. This may mean wordy sentences, repetition, terrible grammar, and other unsightly word messes which I apologize for in advance.
- When downloading files from Google Drive, if you are overwriting an existing file by downloading one with an identical name, the program you are using may not immediately delete the preexisting copy. Instead, it may download the file in chunks which it will concatenate at the end of the download into a single file which will *then* overwrite the existing file. As a result, you may exceed your disk quota which may interrupt file transfers.
- The latest release of Cyberduck (V 7.1.0) has a bug related to the duo authentication and cannot currently connect to the filexfer node using sftp. The previous version (v 7.0.2), however, works. I will update this in the future if this is resolved. This appears to be a known issue.

- The installation of the CLI software is not done using virtualenv. It seems entirely probable that the software could be set up this way. For the time being, I have published notes specifically on how I set up my software and will update with different methodologies if it's decided they are more appropriate.

Chapter 2

Installing Software on HPC

Some of the tests done in this document use CLI programs and so need to be installed on HPC where users don't have root privileges. Some handy blanket instructions are here so they aren't repeated multiple times in the installation guides below.

2.1 Unpacking/Installing .rpm Files

On a Linux machine where you have root privileges, you would typically use the command `rpm` to unpack and install a file with a .rpm extension. On a headless server where you do not have permission to make a system-wide installation, this is not possible. Instead, use the command:

```
rpm2cpio <file-to-install.rpm> | cpio -idv
```

This will unpack the file without making any attempt at installation. Once you have unpacked the file, there should be an executable that you can use to run your program. If you don't want to point to the executable each time you run it, you can permanently add its location to your PATH variable.

2.2 Adding Executables to PATH

To add an executable to your PATH variable so you don't have to specify the path each time you call it:

```
vi ~/.bashrc # Opens a file that lets you permanently change your BASH environment
shift A # To edit
export PATH=$PATH:/path/to/executable # Enter on a blank line to add to PATH
shift : # Turns off editing
wq # Saves and quits
```

Part II

Google Drive

Chapter 1

Google Drive Overview

1.1 Untested Software

There are other options for connecting to Google Drive other than those tested in this section. Other options are listed below:

Subscription-Based Applications

- Globus CLI – These tests have now been started and will be added to the document as results come in.
- Odrive – Some features are freely available while others require a subscription. Without the additional features, working with files can be cumbersome and challenging. I also found the interface a bit more challenging than other options. It is possible in the future I will have some results for this application, but I'm focusing on the programs that I have found to be more user-friendly and are free.
- Netdrive
- Expandrive

Free Applications

The following options are freely available. I may have benchmarking results for these at some point.

- Google Drive File Sync
- Web Interface

1.2 Unzipping Files in Google Drive

I don't know all the options for unzipping files once they're in Google Drive. I will update if I become aware of more.

1.2.1 Google Chrome Extension

1.3 Personal vs. Shared Drives

The below information was taken from [Google Support](#) where more in-depth/comprehensive information can be found.

	My Drive	Shared Drives
Who can add files?	The person who owns My Drive	Any member with Contributor access or higher
What types of files can I add?	All file types	All file types (except Google Maps and Data Studio reports)
Who owns files and folders?	The individual who created the file or folder	The team
Can I move files and folders?	Yes, you can move files and folders around in My Drive	<ul style="list-style-type: none"> If you have Contributor access or higher, you can move files from My Drive to a shared folder If you have Content manager access or higher, you can move files and folders within a shared drive If you want to move folders from My Drive to a shared drive, contact your GSuite administrator
Can I sync files to my computer?	Yes, using Drive File Stream or Backup and Sync	<p>It depends on which sync solution you use:</p> <ul style="list-style-type: none"> Drive File Stream: Yes Backup and Sync: No
How does sharing work?	Different users might see different files in a folder, depending on their access to individual files	All members of the shared drive see all files.
How long do files I delete stay in Trash?	Files or folders in Trash remain there until the user selects Delete Forever .	<p>Each shared drive has its own Trash</p> <ul style="list-style-type: none"> Members with Content manager access and above can move files to trash Files and folders in Trash are deleted forever after 30 days Members with Manager access can permanently delete files before 30 days
Can I restore files?	Yes, if you're an owner of the file	Yes, if you have at least Contributor access

Chapter 2

Results

2.1 Best Performances

Results below were performed with default settings, no additional preferences or flags were specified to boost performance.

Transfer Type	File Size	Software	Average Transfer Speed	Estimated Transfer Time
Fastest Download Speed: Gdrive → Personal Computer	◦ 1G	Gdrive	194 MB/s	5 seconds
	◦ 10G	Gdrive	232 MB/s	43 seconds
	◦ 100G	Gdrive	237 MB/s	7 minutes
Fastest Download Speed: Gdrive → HPC	◦ 1G	Gdrive Rclone	189 MB/s 187 MB/s	5 seconds
	◦ 10G	Gdrive	242 MB/s	41 seconds
	◦ 100G	Cyberduck CLI Gdrive	243 MB/s 238 MB/s	7 minutes
Fastest Upload Speed: Personal Computer → Gdrive	◦ 1G	Cyberduck GUI	77 MB/s	13 seconds
	◦ 10G	Cyberduck GUI	66 MB/s	3 minutes
	◦ 100G	Cyberduck CLI	49 MB/s	34 minutes
Fastest Upload Speed: HPC → Gdrive	◦ 1G	Rclone	50 MB/s	20 seconds
	◦ 10G	Cyberduck CLI Rclone	61 MB/s 55 MB/s	3 minutes
	◦ 100G	Rclone	55 MB/s	30 minutes

2.2 Software Rankings

Transfer Type	Ranking	1G	10G	100G
Download Speeds Gdrive → Personal Computer	1	Gdrive 194 MB/s	Gdrive 232 MB/s	Gdrive 237 MB/s
	2	Cyberduck GUI 77 MB/s	Cyberduck GUI 77 MB/s	Globus 81 MB/s
	3	Rclone 65 MB/s	Globus 72 MB/s	Cyberduck GUI 72 MB/s
	4	Globus 47 MB/s	Rclone 68 MB/s	Rclone 66 MB/s
	5	Cyberduck CLI 45 MB/s	Cyberduck CLI 52 MB/s	Cyberduck CLI 51 MB/s
Download Speeds: Gdrive → HPC	1	Gdrive 189 MB/s	Gdrive 242 MB/s	Cyberduck CLI 243 MB/s
	2	Rclone 187 MB/s	Rclone 142 MB/s	Gdrive 238 MB/s
	3	Cyberduck GUI 74 MB/s	Cyberduck GUI 126 MB/s	Rclone 138 MB/s
	4	Globus 51 MB/s	Globus 70 MB/s	Cyberduck GUI 88 MB/s
	5	Cyberduck CLI 38 MB/s	Cyberduck CLI 35 MB/s	Globus 72 MB/s
Upload Speeds: Personal Computer → Gdrive	1	Cyberduck GUI 77 MB/s	Cyberduck GUI 66 MB/s	Cyberduck GUI 53 MB/s
	2	Cyberduck CLI 42 MB/s	Cyberduck CLI 52 MB/s	Cyberduck CLI 49 MB/s
	3	Globus 21 MB/s	Globus 26 MB/s	Globus 30 MB/s
	4	Rclone 20 MB/s	Rclone 20 MB/s	Rclone 19 MB/s
	5	Gdrive 19 MB/s	Gdrive 18 MB/s	Gdrive 19 MB/s
Upload Speeds: HPC → Gdrive	1	Rclone 50 MB/s	Cyberduck CLI 61 MB/s	Rclone 55 MB/s
	2	Cyberduck GUI 45 MB/s	Rclone 55 MB/s	Cyberduck GUI 48 MB/s
	3	Cyberduck CLI 37 MB/s	Cyberduck GUI 52 MB/s	Cyberduck CLI 36 MB/s
	4	Globus 22 MB/s	Globus 25 MB/s	Gdrive 18 MB/s
	5	Gdrive 15 MB/s	Gdrive 16 MB/s	Globus 14 MB/s

2.3 Software Pros and Cons

Pros	Cons
Globus	
<ul style="list-style-type: none"> ◦ User-friendly interface ◦ Sends email confirmations when file transfers complete ◦ Versatility with both a CLI and Web version 	<ul style="list-style-type: none"> ◦ Slow upload speeds
Cyberduck CLI	
<ul style="list-style-type: none"> ◦ Excellent download speeds for large files to HPC ◦ Reasonable upload speeds 	<ul style="list-style-type: none"> ◦ Consistently slow download speeds for anything under 100 GB
Cyberduck GUI	
<ul style="list-style-type: none"> ◦ Convenient drag-and-drop interface ◦ Relatively easy setup ◦ Fastest upload speeds 	<ul style="list-style-type: none"> ◦ Some hiccups in user interface which involve navigating errors ◦ As of September 19, 2019, the newest version has a bug that will not allow duo-authentication which means it can't connect to the filexfer node ◦ Not Linux compatible ◦ Does not display progress for files travelling between remote servers
Gdrive	
<ul style="list-style-type: none"> ◦ Easy syntax ◦ Uses a file ID system which allows for storing multiple files with the same filename in Google Drive ◦ Very fast download speeds ◦ Modifiable options to optimize transfer speeds 	<ul style="list-style-type: none"> ◦ Slow for file uploads ◦ Cannot download/delete files from/in Google Drive using filename due to file ID system ◦ Not robust to interrupted connections. Long uploads may get "connection reset by peer" errors which will crash the transfer
Rclone	
<ul style="list-style-type: none"> ◦ Very customizable with a large number of user flags 	

Chapter 3

Software: Tests, Installation, and Results

3.1 Globus Online Interface

There are instructions on how to set up Globus and link it to endpoints in our [Online Documentation](#). Once you've gotten your endpoint(s) set up (either to the HPC filexfer node, your personal computer, or both), you can add your UofA Google Drive as an endpoint via the following steps:

1. Search for the endpoint sdmz-dtn-3 and click the resulting endpoint

The screenshot shows the Globus Online Interface. On the left is a sidebar with options: File Manager, Activity (1 notification), Endpoints (selected), and Groups. The main area is titled 'Endpoints' with a search bar containing 'sdmz-dtn-3'. Below the search bar are filters: Recently Used, In Use, Shareable by You, Shared with You, and Administered by You. A table lists the endpoint 'sdmz-dtn-3' as a 'Managed Public Endpoint' with a 'GCSv5 Connector' role.

2. Under the **Collections** tab, select **Add a Collection**

The screenshot shows the 'Collections' tab for the endpoint 'sdmz-dtn-3'. It includes tabs for Overview, Server, and Collections. Below the tabs is a 'Collections' section with a 'Add a Collection' button.

3. Select Google Drive

Create a Guest Collection

- UA HPC Storage Gateway (POSIX)
- **Google Drive Storage Gateway (Google Drive)**
- UA S3 Gateway (S3)

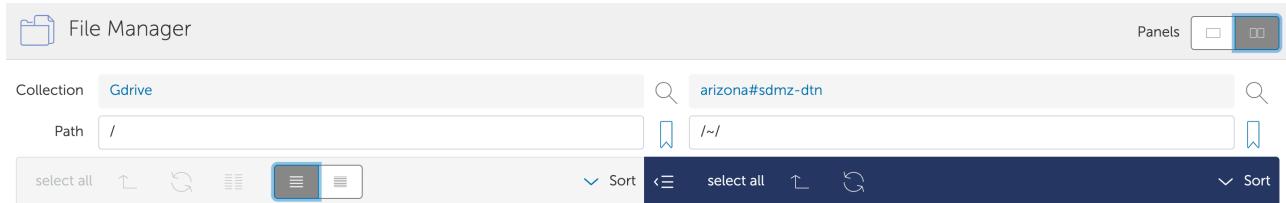
© 2019 University of Chicago [legal](#)

4. Name your **Collection Display Name** something descriptive and identifying for future use

Globus collection information:

Collection Display Name	Gdrive
Description	Shared data Project ABC
Keywords	genomics, Higgs boson, climate change

5. You can now make transfers to/from Google Drive! Set up transfers in the **File Manager**, accessible from the side menu



3.2 Globus CLI - Permanent Endpoint

On your personal computer, you can download and install globus using pip. You can initiate transfers between HPC and Google Drive/HPC and your PC from your own machine.

```
pip install --upgrade --user globus-cli
globus --help # Check that globus CLI has been installed
globus update # to update your version of the CLI to the latest
pip uninstall globus-cli # to remove CLI
```

```
globus transfer --no-verify-checksum <source_path+filename> <destination_path+filename>
```

To search for UofA's endpoint, use:

```
dhcp-10-132-178-181:~ sarawillis$ globus endpoint search arizona#sdmz-dtn
ID | Owner | Display Name
--- | --- | ---
27cf226c-5402-11e6-824b-22000b97daec | tmerritt@arizona.edu | arizona#sdmz-dtn
8c3f744e-baa8-11e9-9396-02ff96a5aa76 | 0df23eb0-3c61-4dd0-86ed-cec97c0f0aaf@clients.auth.globus.org | sdmz-dtn

dhcp-10-132-178-181:~ sarawillis$UAGlobus=27cf226c-5402-11e6-824b-22000b97daec
(base) dhcp-10-132-178-181:~ sarawillis$ globus endpoint show $UAGlobus
\Display Name: arizona#sdmz-dtn
ID: 27cf226c-5402-11e6-824b-22000b97daec
Owner: tmerritt@arizona.edu
Activated: False
Shareable: True
Department: None
Keywords: None
Endpoint Info Link: None
Contact E-mail: uits-hpc-team@list.arizona.edu
Organization: University of Arizona
Department: None
Other Contact Info: None
Visibility: True
Default Directory: /~/
Force Encryption: False
Managed Endpoint: True
Subscription ID: 50762b6c-44e0-11e9-a618-0a54e005f950
Legacy Name: u_ynojplx3nmi6llt4wmzmpoaqcq#sdmz-dtn
Local User Info Available: True
(base) dhcp-10-132-178-181:~ sarawillis$ globus ls $UAGlobus:\~/CyberduckProfilingTest/
GdriveProfilingTest/
GlobusProfilingTest/
Intro_to_HPC/
ProgrammingSandbox/
PythonTests/
R/
RcloneProfilingTest/
Slurm_Hello_World/
ZippedExecutables/
bin/
include/
lib/
lib64/
miniconda3/
mpi_hello_world/
ondemand/
share/
InstallFSL.sh
Transfer.pbs
TransferToGoogleDocs.py
UploadTests_gdrive_2019-08-19 19:31:03.581258.csv
UploadTests_gdrive_2019-08-29 13:41:10.123468.csv
fslinstaller.py
osacc
restats
testInstall.r
```

There are instructions available that document how to use a virtual environment to install Globus: <https://docs.globus.org/cli/installation/virtualenv/>.

3.3 Cyberduck CLI

These instructions are for users who do not have root privileges and who want to set up their own personal copy of duck.

1. Go to https://repo.cyberduck.io/stable/x86_64/
2. Download the latest version
3. sftp to filexfer node and put file into bin. In my case, I made a directory called Duck in bin where I stored the zipped file. Unzipping duck generates a lot of files and keeping them partitioned isn't a bad idea.
4. Unpack the rpm file and add the executable to your PATH variable. For details, see Installing Software on HPC

3.3.1 Usage

Once the program has been unpacked and the system knows where to find the program, you can set it up to connect with your personal Google Drive account.

You should only need to connect it to your personal Google Drive account the first time you use it. An example is shown below:

1. In the terminal, specify the direction of your file transfer and any additional options

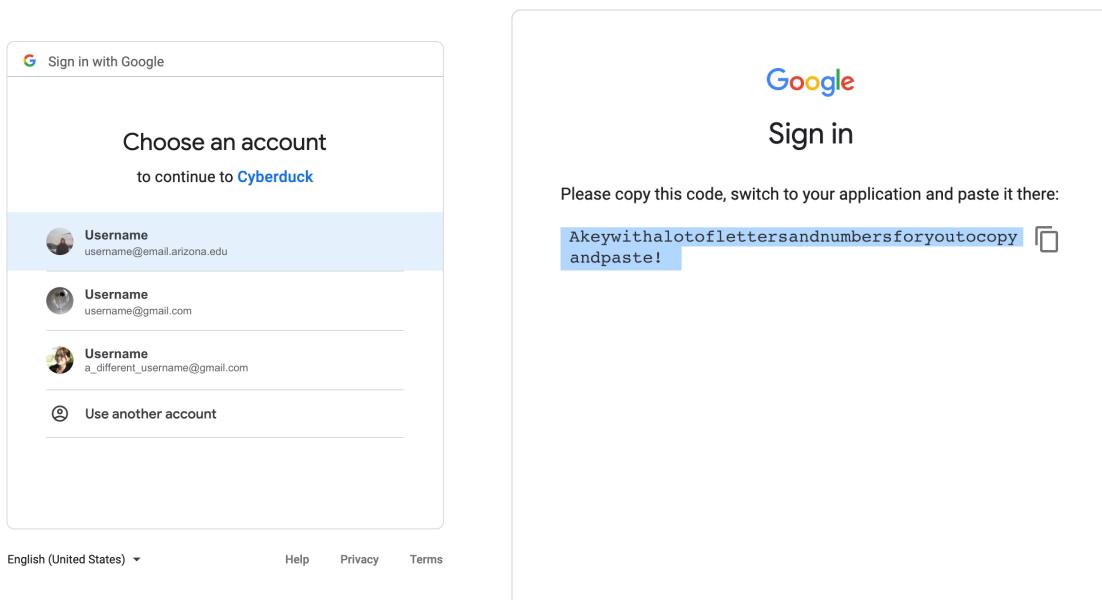
```
duck --username NetID@email.arizona.edu --download "googledrive:My Drive/<remote_filename>" \
<local_filename>
```

2. Copy/paste the url the program gives you into your browser

```
Resolving www.googleapis.com...GLib-GIO-Message: 00:00:00.000: Using the 'memory' GSettings
backend. Your settings will not be saved or shared with other applications.
Google Drive connection opened...

https://accounts.google.com/o/oauth2/auth?client_id=0000000000000000.apps.googleusercontent.com&
redirect_uri=urn:ietf:wg:oauth:2.0:oob&response_type=code&scope=https://www.googleapis.com
/auth/drive&state=00000000
```

3. Select the relevant gdrive account and copy the key that appears in the browser



- Paste the copied key into the terminal. Note: you will not see any characters when you paste the key in. This is normal behavior and everything is working.

```
OAuth2 Authentication. Paste the authentication code from your web browser.
Authentication Code:
```

- If you don't want to authenticate again in the future, save the password with "y" and always use the option --username NetID@email.arizona.edu.

```
WARNING! Passwords are stored in plain text in ~/.duck/credentials.
Save password (y/n): y
```

For more information on Duck usage:

```
duck --help
```

Warning: When downloading files, if you only specify the filename without including a path, it will save to the app folder under opt/duck/ which already has a large number of files in it. Specifying the absolute path with the filename will avoid this problem. You can also specify the relative path, but you will need to remember that the path is relative to the opt/duck directory and not your working directory.

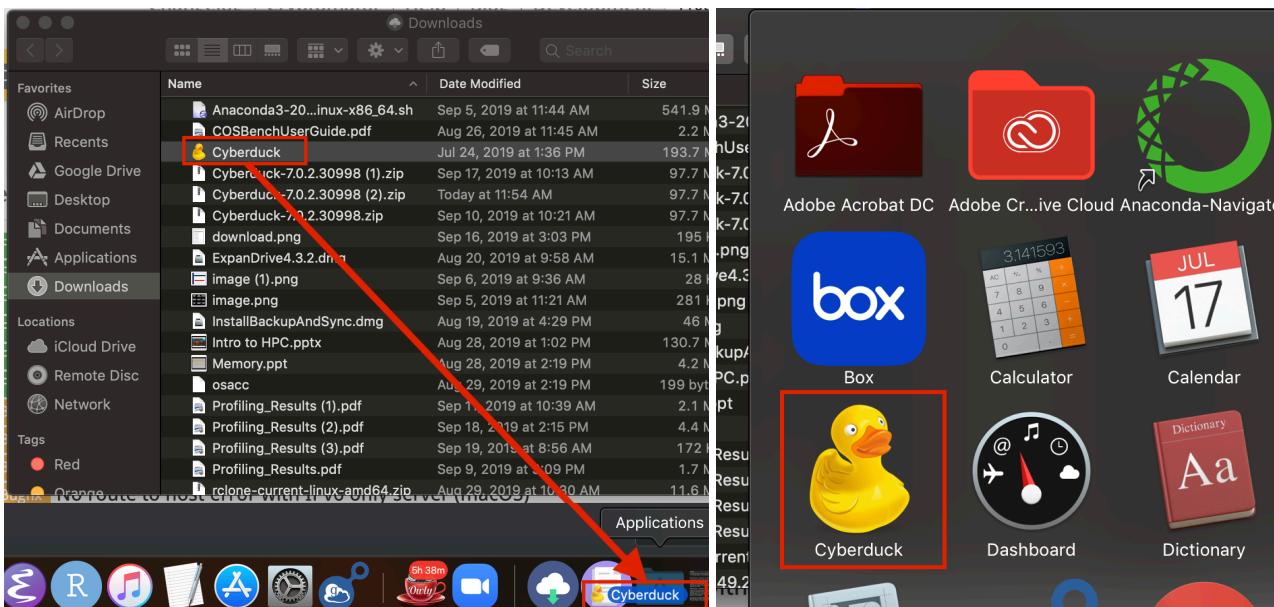
Warning: When downloading, even if you include the --existing overwrite option, the file that you're going to overwrite isn't immediately overwritten. Cyberduck creates a folder where it downloads your file in chunks and once all the chunks have been downloaded, they then get concatenated into the file that will overwrite the previously-existing one. This means that if you're low on space where you're saving your file, you may run exceed your storage quota.

3.4 Cyberduck GUI

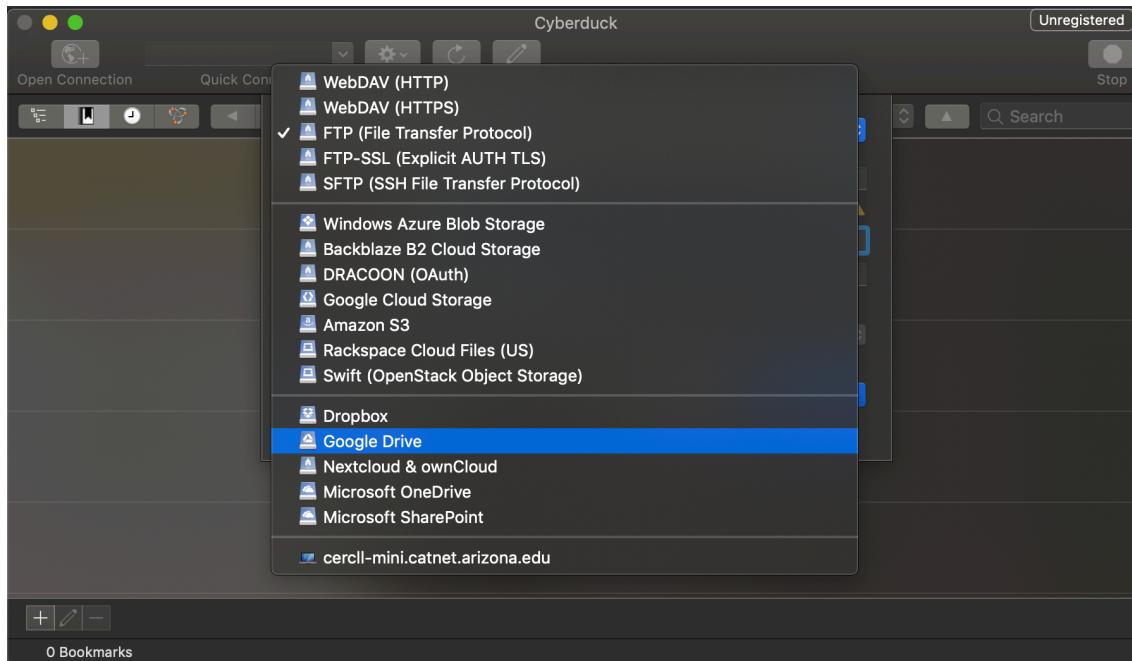
Mac

Installation is fairly simple. Various versions of Cyberduck are [available for download](#). Until the current bug is fixed that successfully allows for Duo Mobile authentication, I recommend using the previous version 7.0.2.

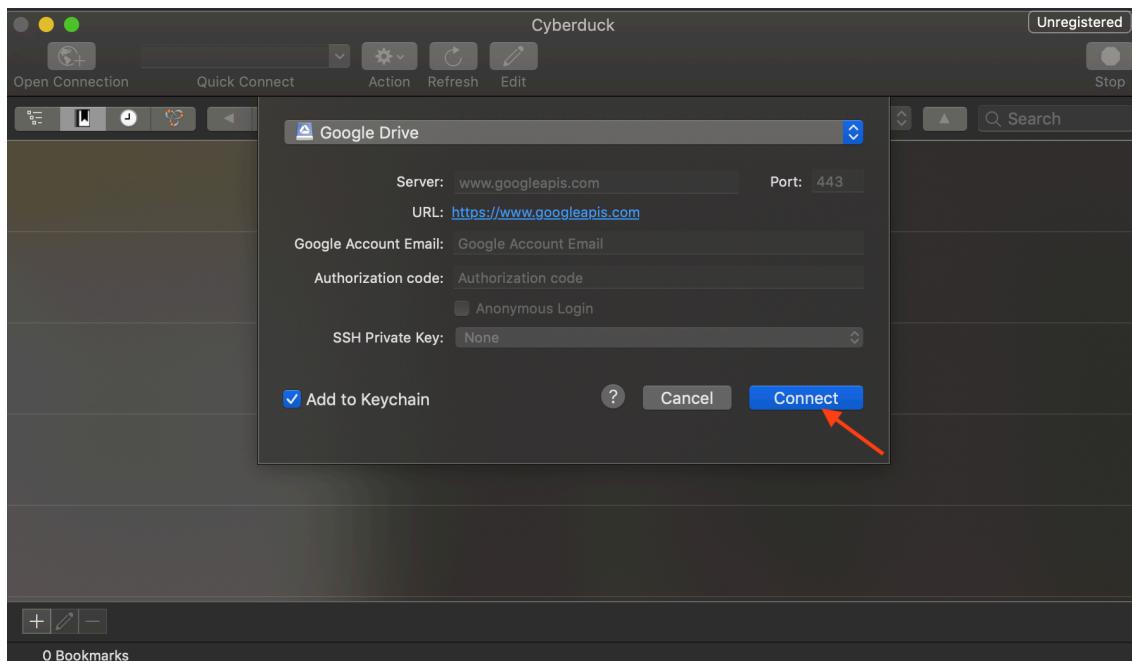
- Download the zipped file, unpack, drag/drop the program into your applications folder, and double-click the icon to start Cyberduck.



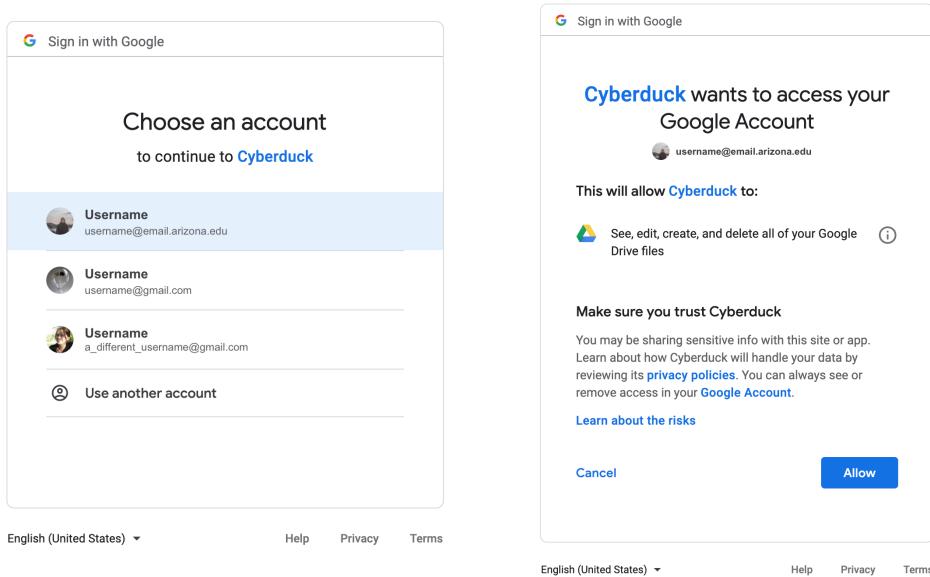
2. To establish a connection with Google Drive, use the drop-down menu by clicking “Open Connection”.



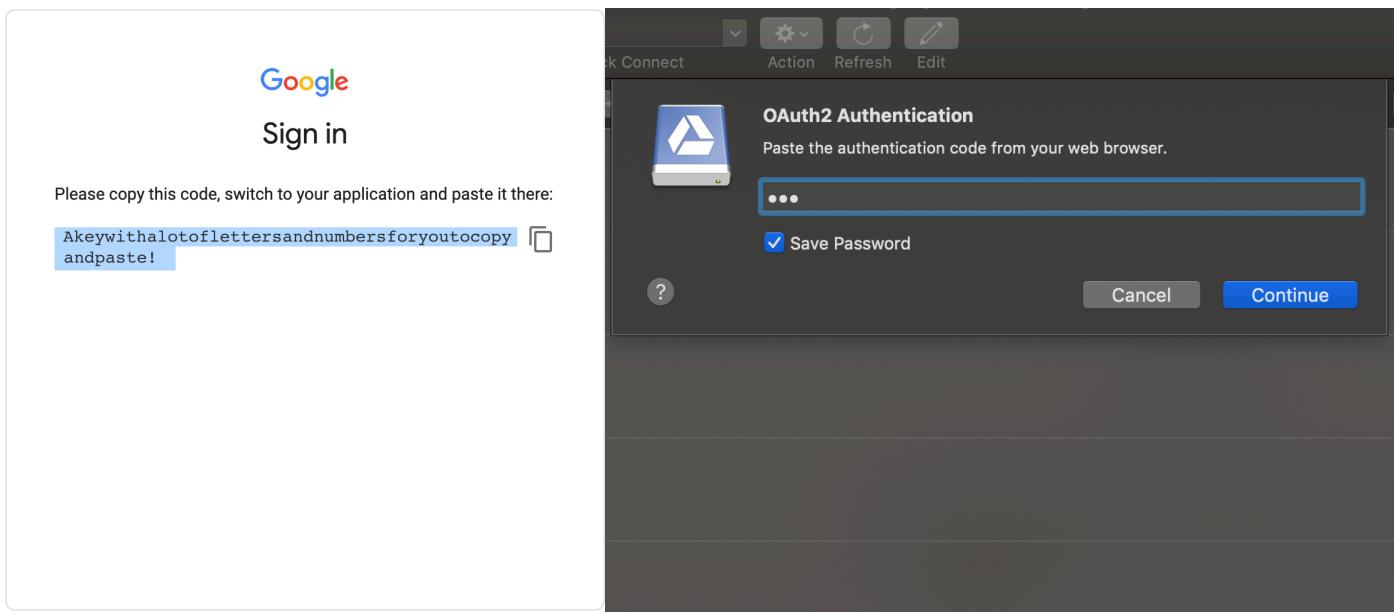
3. The default settings do not need to be edited; click Connect to proceed.



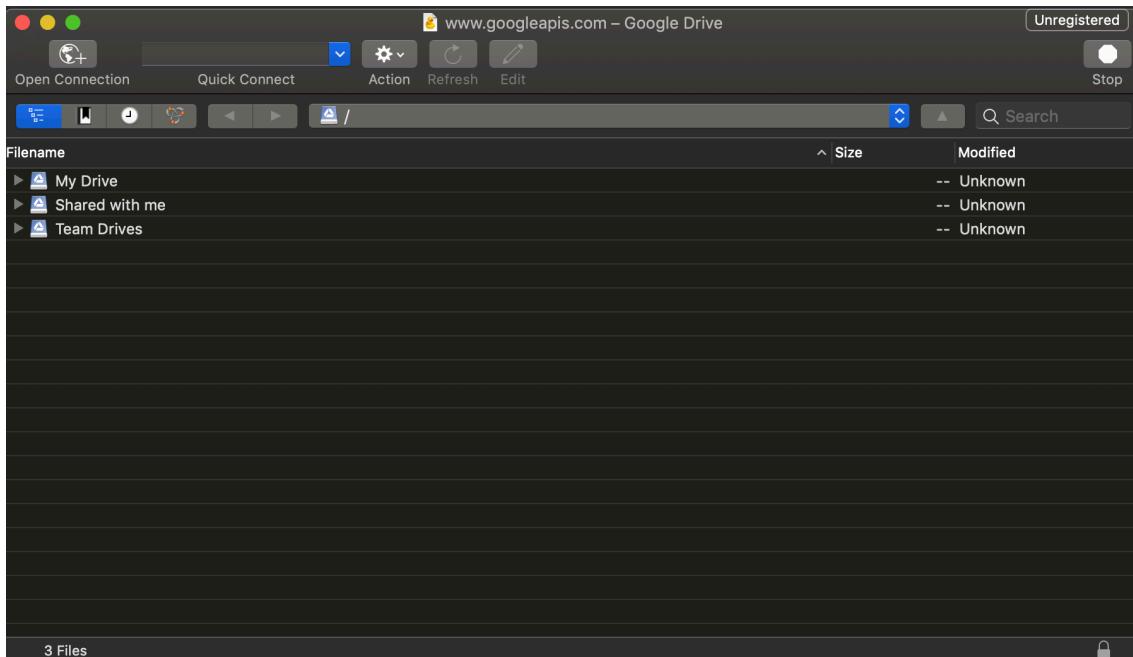
4. Select the account you'd like to connect with and grant Cyberduck access



5. Copy and paste the code that appears in your browser

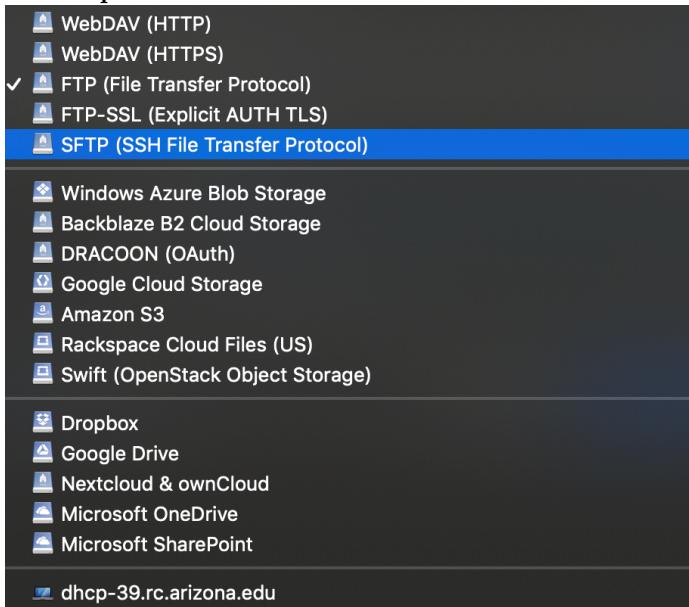


6. You are now connected to Google Drive!



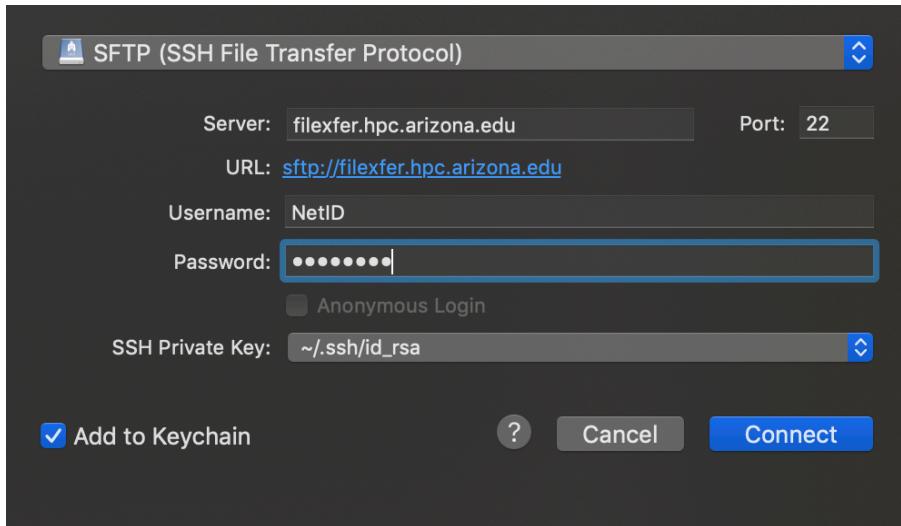
To make transfers between your personal computer and your Google Drive account, you can simply drag-and-drop files. To transfer files between Google Drive and HPC, you will need to open a second window to connect to HPC's filexfer node:

1. Go to file and select **New Browser**
2. Under **Open Connection** select **SFTP**

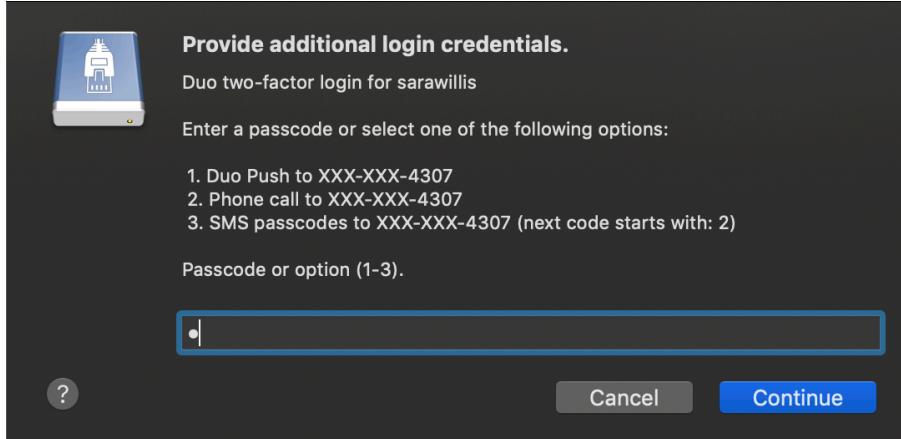


3. Enter your credentials to connect with the filexfer node:

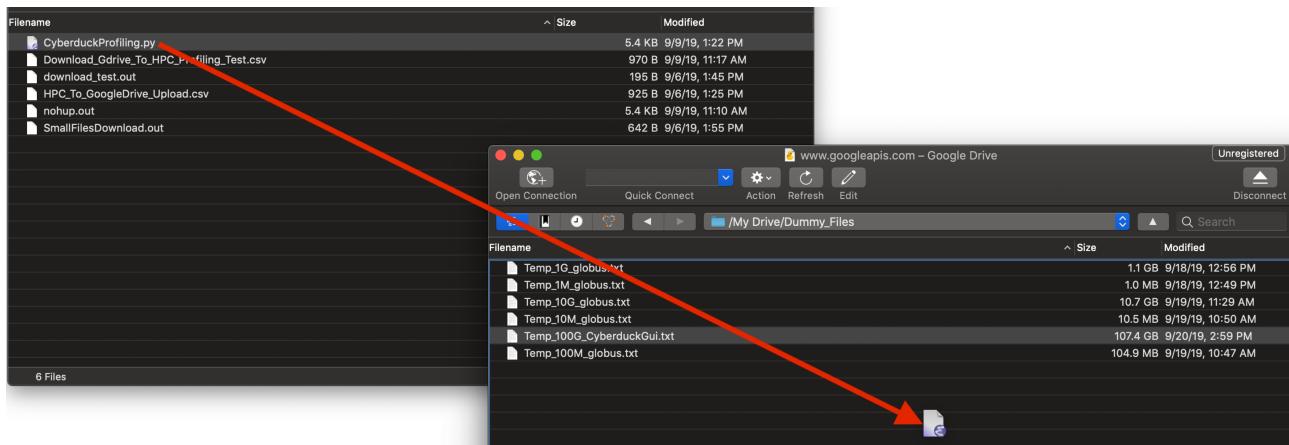
- Server: filexfer.hpc.arizona.edu
- Port: 22 (default)
- Username: <NetID>
- Password: <Your password>



4. You will be prompted to enter an option for two-factor authentication



5. You are now connected! To initiate a transfer, drag-and-drop files between the Google Drive and filexfer windows



3.5 Gdrive

Gdrive's Github gives a good overview of the installation process for various operating systems here: <https://github.com/gdrive-org/gdrive>

To run Gdrive on HPC, download the Linux 64-bit file, transfer it to HPC, and add executable permissions:

```
chmod +x gdrive
```

You may also want to change the filename to something like `Gdrive`.

3.5.1 Usage

The command

```
gdrive help
```

gives a list of relevant commands. When used in conjunction with a command, gdrive prints specific instructions for a command, e.g.:

```
(base) cc-ea-lafrese:Desktop sarawillis$ gdrive help download
Download file or directory
gdrive [global] download [options] <fileId>

global:
  -c, --config <configDir>           Application path, default: /Users/sarawillis/.gdrive
  ...
```

3.6 RClone

Rclone setup requires some additional steps if you want to use your own key. I'll include instructions on that below. Fortunately, Rclone has good documentation.

1. Download the .rpm file from <https://rclone.org/downloads/>
2. Use sftp to transfer rpm file to filexfer node
3. Rpm2cpio <filename>.rpm | cpio -idv # To unpack the rpm file without installation which requires root privileges
4. cd usr/bin # usr is located in the unpacked file
5. ./rclone config # and follow prompts:

```
No remotes found - make a new one
n) New remote
s) Set configuration password
q) Quit config
n/s/q> n

name> <something descriptive>

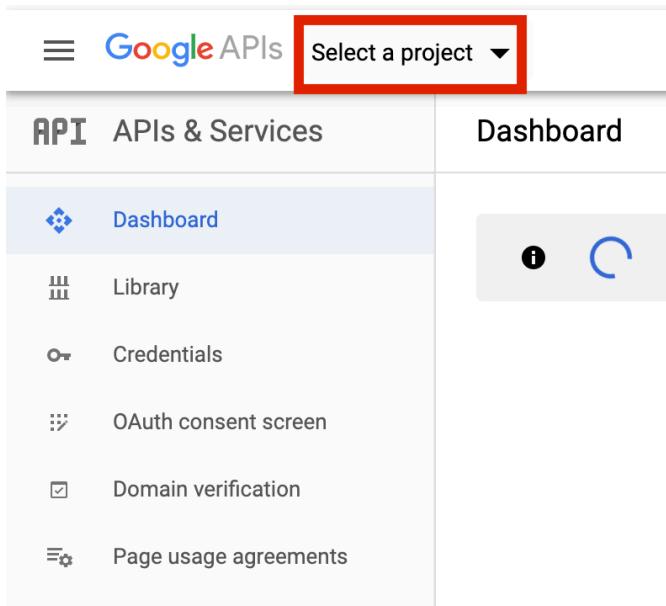
Type of storage to configure.
Enter a string value. Press Enter for the default ("").
Choose a number from below, or type in your own value
1 / 1Fichier
  \ "fichier"
2 / Alias for an existing remote
  \ "alias"
...
Storage> 12

** See help for drive backend at: https://rclone.org/drive/ **

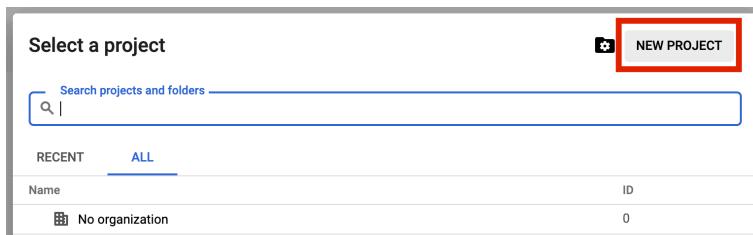
Google Application Client Id
Setting your own is recommended.
See https://rclone.org/drive/#making-your-own-client-id for how to create your own.
If you leave this blank, it will use an internal key which is low performance.
Enter a string value. Press Enter for the default ("").
```

As rclone states, you can either create your own client ID or you can use the default. I haven't done any testing to determine the speeds using the public key vs. creating your own. Note: Thus far, I have not been successful in creating a client ID with my UofA profile and have only been successful when using a personal account. To create your own key, follow the [instructions on the rclone site](#) which I'll replicate below:

1. Go to [Google's API console](#)
2. click **Select a project**



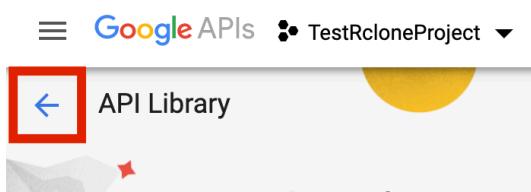
3. Select "New Project"



4. Give your project a descriptive name and then click **Create**

The screenshot shows the "New Project" creation form. At the top, it says "New Project". Below that is a message: "⚠ You have 12 projects remaining in your quota. Request an increase or delete projects. [Learn more](#)". Underneath is a "MANAGE QUOTAS" link. The main form has a "Project name *" field containing "TestCloneProject" with a question mark icon to its right. Below it is a "Project ID" field showing "testrcloneproject. It cannot be changed later." with an "EDIT" link. There's also a "Location *" field with "No organization" selected and a "BROWSE" button. At the bottom are two buttons: a blue "CREATE" button and a white "CANCEL" button.

5. This will take you to an API Library page. To continue with this process, click the back button



6. Select **Credentials** from the side menu and select OAuth client ID

The screenshot shows the "APIs & Services" dashboard. On the left, there is a sidebar with the following items: Dashboard, Library, **Credentials** (which is highlighted with a red box), OAuth consent screen, Domain verification, and Page usage agreements. To the right, under the "Credentials" section, there are four options: "Create credentials" (dropdown), "API key" (disabled), "OAuth client ID" (selected, highlighted with a red box), and "Service account key". A tooltip for "OAuth client ID" states: "Requests user consent so your app can access the user's data". Below these options is a "Help me choose" link.

7. Click **Configure consent screen** and name your application something descriptive. The Application name is what will pop up when Google Drive asks for your consent when you try to connect to it using Rclone.

The screenshot shows the "Configure consent screen" page. It has a warning message: "⚠️ To create an OAuth client ID, you must first set a product name on the consent screen". Below that is a "Configure consent screen" button. The main area has a "Application name" field with a question mark icon, containing the text "The name of the app asking for consent". A text input field contains the value "Rclone".

8. Give your OAuth client ID a name and click **Create**. Your Client ID and Secret will appear. You'll need to hold onto these for the next step in the Rclone setup

[←](#) Create OAuth client ID

For applications that use the OAuth 2.0 protocol to call Google APIs, you can use an OAuth 2.0 client ID to generate an access token. The token contains a unique identifier. See [Setting up OAuth 2.0](#) for more information.

- Application type**
- Web application
 - Android [Learn more](#)
 - Chrome App [Learn more](#)
 - iOS [Learn more](#)
 - Other

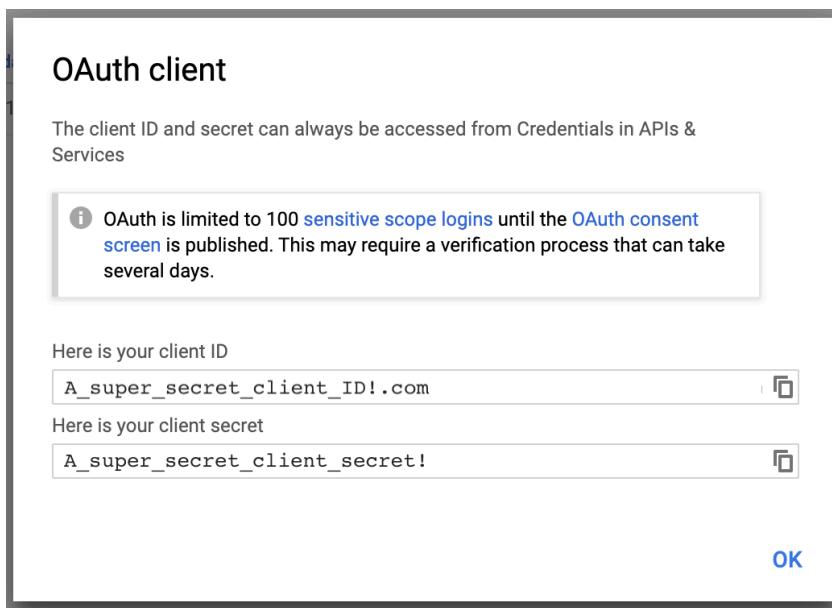
Name [?](#)

SarasTest

[Create](#)

[Cancel](#)

9. Your Client ID and Secret will appear. You'll need to hold onto these for the next step in the Rclone setup



If you decided to get your own Client ID, once you have it and your Client Secret, enter them to continue. If you've decided to use the public key, leave the entry blank and hit enter.

```
client_id> <Your Client ID>

Google Application Client Secret
Setting your own is recommended.
Enter a string value. Press Enter for the default ("").
client_secret> <Your Client Secret>

Scope that rclone should use when requesting access from drive.
Enter a string value. Press Enter for the default ("").
Choose a number from below, or type in your own value
  1 / Full access all files, excluding Application Data Folder.
  \ "drive"
```

```

2 / Read-only access to file metadata and file contents.
  \ "drive.readonly"
  / Access to files created by rclone only.
3 | These are visible in the drive website.
| File authorization is revoked when the user deauthorizes the app.
  \ "drive.file"
  / Allows read and write access to the Application Data folder.
4 | This is not visible in the drive website.
  \ "drive.appfolder"
  / Allows read-only access to file metadata but
5 | does not allow any access to read or download file content.
  \ "drive.metadata.readonly"
scope> <1-5>

```

ID of the root folder
Leave blank normally.
Fill in to access "Computers" folders. (see docs).
Enter a string value. Press Enter for the default ("").
root_folder_id>

Service Account Credentials JSON file path
Leave blank normally.
Needed only if you want use SA instead of interactive login.
Enter a string value. Press Enter for the default ("").
service_account_file>

Edit advanced config? (y/n)
y) Yes
n) No
y/n> n

Use auto config?
* Say Y if not sure
* Say N if you are working on a remote or headless machine
y) Yes
n) No
y/n> N # Use N if working on HPC, Y is fine for your PC
If your browser doesn't open automatically go to the following link: <longurl>
Log in and authorize rclone for access
Enter verification code> <verification code>

Configure this as a team drive?
y) Yes
n) No
y/n> n

[GoogleDriveTest]
type = drive
client_id = <Your Client ID>
client_secret = <Your Client Secret>
scope = drive
token = {Info}

y) Yes this is OK
e) Edit this remote
d) Delete this remote
y/e/d> y

```
Current remotes:
```

Name	Type
=====	=====
GoogleDriveTest	drive
MyGoogleDrive	drive

```
e) Edit existing remote
n) New remote
d) Delete remote
r) Rename remote
c) Copy remote
s) Set configuration password
q) Quit config
e/n/d/r/c/s/q>
```

Multiple Google Drive connections can be established so you can connect to as many drives as you wish. You just need to go through the installation process for each new connection you create, though it isn't necessary to create multiple client IDs.

3.7 iRODS

iRODS is configured on HPC. To transfer files to CyVerse, you will need an account: www.cyverse.org

Information on setting up iRODS can be found here: <https://public.confluence.arizona.edu/display/UAHPC/Transferring+Files#TransferringFiles-iRODS>

Information on using i commands can be found here: <https://wiki.cyverse.org/wiki/display/DS/Using+iCommands>