

FolderShare: Building a data sharing cloud on Drupal 8 for researchers

Amit Chourasia, David Nadeau & Michael Norman San Diego Supercomputer Center, UC San Diego

Project code: drupal.org/projects/foldershare drupal.org/projects/smalldata Trial website: sandbox.seedme.org Project website: dibbs.seedme.org

Hiring/contract: Experienced Drupal 8 PHP programmer for custom module development. Please connect via email: amit @ sdsc.edu

About me

Amit Chourasia

San Diego Supercomputer Center @ UC San Diego

- Visualization scholar/evangelist
- Lecturer/Instructor
- Interests
 - Visualization
 - High performance computing
 - Data stewardship

Drupal tinkerer since version 4.7.4 (~2006)

- Personal website (Drupal 4 8: 150 pages)
- Project website (Drupal 5 : 50,000+ pages)
- SeedMe1 cloud service (Drupal 7: 150,000+ pages) In production
- SeedMe2 platform (Drupal 8: Anticipate 1M+ items) In development

•

Hiring/contract: Experienced Drupal 8 PHP programmer for custom module development Please connect via email: amit @sdsc.edu

Presentation Overview

1. SeedMe2 platform

FolderShare: Virtual file system

- » Entity data model & access control
- » File management & security
- » Views integration
- » UI & Command plugins
- » File formatters
- » Web services

Small data module and API

- Visualization
- 2. Demo
 - 1. Usage
 - 2. Administration/setup

SeedMe Projects

SeedMe 1

- a.k.a. Stream encode explore and disseminate My experiments
- Based on Drupal 7
- In production Platform as a Service (PaaS)
- Video encoding was the main focus

SeedMe 2 : Data sharing building blocks

- Evolution of the original SeedMe project (Complete rewrite)
- Based on Drupal 8
- Incorporates user feedback from original SeedMe project
- Built for distribution and extension
- Data sharing and data management is the main focus

What is FolderShare?

A Drupal 8 module that enables a website to

- Present data in a more consumable form e.g. with rich description and visualization via companion small data module
- Store, organize and share data
- Annotate any file/folder with description
- Conduct discussion on any file/folder via comments
- Customize site wide virtual file system with additional fields
 - E.g. Keywords, dates, etc
- Manage data (upload, download, etc.) via
 - Web browser
 - REST API
 - Command line

FolderShare internals

Custom entity that implements a virtual file system that has

- Hierarchical file folder organization
- Access controls for sharing
- Uses custom views to display data
- Plugin API to add operations
- REST API & Client

FolderShare module

Required dependencies (11 - All in Drupal core)

- Datetime
- Field
- File
- Image
- Link
- Media
- Options
- Text

Optional dependencies (3 - All in Drupal core)

- Comment
- Help
- **RESTful web services**
 - HTTP basic authentication •
 - Serialization
- Search
- **Core modules recommended**
 - Text editor
 - Field UI (may be) —
 - Views UI (may be)
- **Contributed modules recommended**
 - Real name _
 - REST UI (may be) —
 - Small Data (for quick visualization of CSV, JSON files)



- System
- User
- Views



FolderShare

FolderShare module

Г			_
	X	X	2
L))	

FolderShare

- Virtual file system (fieldable):
 - Entity type & API
 - Access controls
 - Usage tracking
 - Views, displays, breadcrumbs, forms
 - Plugins for field formatters, search, views, actions, and queue workers
- Configurable by sites
 - e.g. Keywords, comments, flags, DOIs
- Extensible by developers

Files & folders

- Children point to parents
 - Parent IDs enable fast queries for all children of a folder
 - Root IDs enable fast queries for access controls and breadcrumbs

Reprint the point of the parent parent is a parent pare





Abstracted file storage

Folders exist in the database Every uploaded file has a File ID (sequential)

Internal file organization and storage based on 16 bit pattern Bit pattern 0000 0000 0000 0000 Physical hierarchy as 0000/0000/0000/0000/file_id Each underlying folder stores 9,999 files Total file handling: 65,535 * 9,999 = 655,284,465 (~655 million)

Access controls

- Drupal account-based
- Permissions + access control list on top folders
 List of users that can view and author
- Top folder controls entire hierarchy
 - Simpler than desktop OSes
 - Similar to file sharing services
 - Fast to check access

File storage

- Folders only exist in database
- Files described in database & stored on disk
- Disk directory !== folder hierarchy
 - Better for security and load balancing
 - Files have generated names
 - Avoids character set and name length limits
 - Files have no extensions
 - Avoids accidental server execution of ".php", etc.

Views

- List personal, public, and shared files & folders
 Pages & embedded views in folder pages
- Integrated desktop-like UI
 - Select files and folders
 - Then choose menu command
- Two UI variants:
 - Scripting but no AJAX
 - Scripting with AJAX

Plugins

- Field formatters
 - Folder names, entity references, MIME-type icons
- Search
 - Index and present results
- Queue worker
 - Update folder hierarchy sizes in background
- Actions & custom commands
 - Menu UI items to add, delete, etc

Foldershare API Documentation

asses, traits, and	Interlaces .		
foldershare-8.x-1.x	Home » API reference » foldershare-8.x-1.x » FolderShare.php		
ame contains N	class FolderShare		
ontains filters are case sensitive	Manages a hierarchy of folders, subfolders, and files.		Search foldershare-8.x- 1.x
AdminSettings	FolderShare objects represent entries in a virtual file system that includes f Every folder or file item has a set of common fields, including:	olders and items in those folders.	Function, file, or topic *
AdminUsagePage	Entity ID. UD.		Partial match search is supported
ArchiveItem	Name. Size. Creation and changed dates.		API Navigation
ChangeOwnerItem	 Owner, Description. Kind. MIME type 	Home » API reference » foldershare-8.x-1.x	
Constants	Language code. Parent folder, if any. Root folder, if any.		
DeleteItem	The 'kind' field has one of these values: folder. 	Name contains Descriptic	Home » API reference » foldershare=8x-1.x » foldershare.api.php function hook_foldershare_access ©
DownloadItem	 rootfolder. file. image. 	Contains filters are case sensitive	hook foldershare access (FolderShareInterface \$entity, string \$op,
DuplicateItem	 media. When 'kind' is 'folder', there are no additionial fields with meaning. 	Name	Controls access to a file or folder.
EditCommand	When 'kind' is 'rootfolder', the root folder (top level folder) has additional f	comment_foldershare_update_index	FolderShare's access control mechanism has these steps:
_	 Access grants for viewing. Access grants for authoring. Access grants for users known, but currently without viewing or authority and the set of the	foldershare_file_download	Check if the user is an admin Check user permissions.
	When 'kind' is 'file', the entity has an additional field containing the entity I	foldershare_foldershare_view	Check emity access grants. Invoke this hook.
	 File entity ID. When 'kind' is 'image', the entity has an additional field containing the entity has a specific the entity	foldershare_get_usage_schema	steps are executed in order and the remaining steps are swipped in there is a definitive answer for a step. For instance, if the user is a doministrator, they are granied access and the remaining steps are not executed. If the user does not have permission or the entity does not predict the network of the remaining steps are not executed. If the user is not an admin and does have permission or adcess granted. This hook, then, can only make a final allow/deny choice.
		foldershare_preuninstall	Parameters
		foldershare_schema	\Drupallfoldershare\FolderShareInterface Sentity: The entity the user wishes to access. If the entity is NULL, the user is requesting access to the root folder list.
		foldershare_theme	string \$op: The operation to be performed. Access operators are one of:
		foldershare_tokens	· 'create'.
		foldershare uninstall	 closed-oct. closed
		foldershare user cancel	• snare. • 'update',
		foldershare_user_predelete	 View. \Drupal\Core\Session\AccountInterface \$account: The user's account.
		foldershare_views_data_alter	Return value
			\Drupal/Core\Access\AccessResultInterface Returns the access result to allow or forbid access, or have a neutral opinion.
			See also

\Drupal\Core\Entity\EntityAccessControlHandler

Fixed route - /foldershare

Tools menu > Folders

Add a menu item anywhere pointing to /foldershare

FOR USERS

Sample project by Alice



Sharing form to restrict access

Share "Project One" Folder Tree

Share all files and folders in this folder tree.

User			Access		
	None	View	Author		
Anonymous (any web site visitor) Anonymous users do not have FolderShare module author permission, so they cannot be granted author access.	0	\bigcirc			
john	\bigcirc	0	\bigcirc		
mary	\bigcirc	\bigcirc	0		
Save					

Quick visualization of CSV & JSON files



Visualizations can be switched interactively to different chart types

SmallData API & Module

		٦	
I			
I			- 1
	_		

- Structured data parsers & writers
 - Tables, trees, and graphs
 - JSON, CSV, TSV, TXT, etc.
- Field formatters
 - Light-weight visualization
 - Line plots, bar charts, pie charts, etc.

\$ foldershare --help
Usage is: foldershare [HOST_OPTIONS] [COMMAND] [OPTIONS]

Create, delete, change, and manage files and folders on a remote web site that uses the FolderShare module.

Sample comma^{Commands}

foldershare --help
foldershare --host http://demo.seedme.

help

config cp get ls mkdir mv put rm rmdir stat update usage version	Show the host administrator configuration. Copy files and folders. Download files and folders. List files and folders. Make new folders. Move files and folders. Upload files and folders. Remove files or folders. Remove empty folders. Show the status of files and folders. Update fields on files and folders. Show the user's storage use. Show version numbers.
Add "help" after Host and account	any command to show its description and flags.
 All commands requir	e a remote host and account:
host HOSTNAME username NAME password PASS	Select the host (and optional port) for the site. Specify the user login name on the site. Specify the user password on the site.
Example: foldersharehos	st myhost —username me ——password pw ls /
If the username and	/or password are omitted, the command will prompt for th
Additional options	
help verbose version format type	Show this help information. Be verbose while performing the operation. Show application version numbers. Select how information is displayed: auto (default) Use an operation-specific default full Show full-detail nested-array output keyvalue Show a table of key-value pairs linux Show a Linux-style output text Show key-value pairs as text
For Linux/macOS/BSD and output is forma	estyle commands, the format type defaults to 'linux' atted similar to those OS commands.

em.

Example:

foldershare ---host myhost ---format full stat /myfolder

Sample command line interaction

foldershare --help
foldershare --host http://demo.seedme.org --user dave --password 'cliRocks!'

help

```
mkdir --help
mkdir "/test"
mkdir "/test/data"
ls --help
ls /
upload --help
upload "plots/villi.png" "/test"
upload "plots/composite.png" "/test"
Upload "sample-small-data/OpenGL mesh memory use.csv"
```

```
Upload "sample-small-data/Image classification breakdown schedule.json" "/test/data"
```

"/test/data"

```
download --help
download <u>"/test" "/Users/amit/downloads"</u>
```

```
rm --help
rm -rf "/test"
```

Admin menu Structure > FolderShare

FOR ADMINISTRATORS

Manage fields, forms & display

Configuration located in admin menu Structure > FolderShare

FolderShare

Fields

Files

Lists

Search

Security

Web services

Interface

Settings Manage fields Manage form display Manage display

FolderShare manages a virtual file system with files, folders, and subfolders. Module settings control how content is stored, presented, searched, and secured. See also <u>Module help</u> and the module's <u>Usage report</u>.

Manage fields for files and folders.

Files and folders contain fields for names, dates, sizes, descriptions, and more. You may add your own fields and adjust how fields are displayed when viewed and edited.

Fields, forms, and displays

Built-in fields for files and folders include a name, description, size, and creation and modification dates. Fields may be adjusted with the optional <u>Field UI module</u> to add new fields and manage how fields are viewed and edited.

Manage fields

Create, delete, and modify additional fields for files and folders.

Manage form display

Manage forms to edit fields for files and folders.

Restore original settings

Manage display

Manage how fields are presented on file and folder pages.

Restore original settings

See also

Content Language (Not enabled)

Enable users to select a default language for appropriate text fields. (Core module)

Comment types

Configure how comments are created and shown on files and folders. See the Comments of documentation. (Core module)

Dates and times

Configure date and time formats available when creation and modification dates are displayed. See the <u>Date-</u> Time @ documentation. (Core module)

Languages (Not enabled)

Enable users to provide authored translations of appropriate text fields. (Core module)

Regional

Configure regional formats for the display of dates and times, and select how times are mapped to the current or user time zone. (Core module)

Text Editors

Configure WYSIWYG text editors available on entity edit forms to assist in editing formatted text. See the Text editor @ documentation. (Core module)

Text Formats

Configure text formats available on entity edit forms to filter and process formatted text. See the Filter & documentation. (Core module)

Tokens

Manage tokens created by this module and others. (Third-party module)

Save configuration

Files

Storage location & upload restrictions

FolderSh	nare
The file extension	ons list has been restored to its original values.
Settings	Manage fields Manage form display Manage display
FolderShare ma searched, and se	nages a virtual file system with files, folders, and subfolders. Module settings control how content is stored, presented, cured. See also <u>Module help</u> and the module's <u>Usage report</u> .
Fields	Select how files are uploaded and stored.
Files	Files are stored on the site's server and tracked in the site\'s database. Administrators may restrict uploaded files based upon their size and name extension, and limit the number of files uploaded at once.
Interface	
Lists	File system
Search	Select whether the module should use the site's <i>Public</i> or <i>Private</i> file system to store files. A <i>Private</i> file system provides better security.
Security	This setting is disabled because there are already files under management by this module. To change this setting,
Web service	File system: * (Private +)
	Default: Public
	Storage location
	Select the server subfolder in the <i>Public</i> or <i>Private</i> file system into which the module will save files. This is typically named after the module. The subfolder will be created automatically if necessary.
	This setting is disabled because there are already files under management by this module. To change this setting,

you must Delete all files first.

Location: * foldershare

File name extensions

Select whether uploaded files should be restricted to a specific set of allowed file name extensions.

Enable restrictions

Allowed file name extensions:

Ist 3ds a aac accda accdb accde accdr accdt ade adn adp aiff asc ascii asp aspx au avi bash bat blend bmp bz2 c++ cab cdb cgi cgm cmake config op opio cpp cs csh css csx csx dae daq dat data dmg doc docb docm docx dot dotm dotx dtd dxf esp fig fits fits flac gif gz h h5 hdf hdf5 hpp htm html ico icn icnulude info ini install iso j2k jar java jp2 jpeg jpf jpg jpm jpx js json jsp laccdb ldb less ltx m m3u m4a m4p m4v maf make mam man maq mar mat mat md mda mdb mde mdf mdn mdt mdw mj2 mkv miv mn module mogg mov mp3 mp4 mpeg mpg mpv nc oga ogg p pbm pdf peri pgm phar php pi pm png pnm pot potm potx ppam ppm pps ppsm ppsx ppt pptm pptx pri proj ps py pyc python qt r rar ras rdf readme rss rtf sass scss sh shar sit sit sldm sldx stt Separate extensions with spaces and do not include dots. Changing this list does not affect files that are already on the site.

Restore original settings

Maximum file upload size

Set the maximum size allowed for each uploaded file. This size is also limited by PHP settings in your server's "php.ini" file and your site's top-level ".htaccess" file. These are currently limiting file sizes to 524288000 bytes.

Size: * 524288000

Default: 524288000 bytes

Maximum number of files per upload

Set the maximum number of files that may be uploaded in a single pload. This number is also limited by PHP settings in your server's "php.ini" file and your site's top-level ".htaccess" file. These are currently limiting file uploads to 20 files.

Interface

Command plugins

FolderShare

Settings Manage fields Manage form display Manage display

FolderShare manages a virtual file system with files, folders, and subfolders. Module settings control how content is stored, presented, searched, and secured. See also Module help and the module's Usage report.

	File and folder lists include a menu and toolbar for commands to create, upload, edit, and delete items. You
Files	configure select the commands to include.
Interface	
Lists	Mends
Search	Commands are plugins provided by this module and others. By default, all available commands are included menus. You may restrict menus to a specific set of commands.
Security	Enable command menu restrictions
Web services	Select the commands to allow:
	Upload Files Upload files into a folder. (foldershare module)
	Move Move files and folders to another folder. (foldershare module)
	Duplicate Duplicate files and folders, and all of their contents. (foldershare module)
	Uncompress Uncompress an archive file and add its contents to this folder. (foldershare module)
	Change Owner Change the owner of files and folders, including the content of subfolders. (foldershare module)
	Rename Rename an item. (foldershare module)
	Delete Delete files and folders, and all of their content. (foldershare module)
	Download Download files and folders, and all of their content. (foldershare module)
	Copy Copy files and folders to another folder. (foldershare module)
	New Folder Create a new empty folder with a default name. (foldershare module)
	Share Folder Tree Share a folder tree and all of its contents with other users. (foldershare module)
	Compress files and folders, and all of their contents. (foldershare module)
	Edit

Save configuration

Lists

Manage listing of file and folders

FolderShare

Settings Manage fields Manage form display Manage display

FolderShare manages a virtual file system with files, folders, and subfolders. Module settings control how content is stored, presented, searched, and secured. See also Module help and the module's Usage report.

Fields	Manage lists of files and folders.
Files	You may configure file and folder lists to adjust which fields are displayed and how their values are presented.
Interface	Views
Lists	The layout and presentation of lists may be controlled using the optional Views UI module.
Search	FolderShare Lists
	List files, folders, and subfolders.
Security	Restore original settings
Web services	
	See also
	Dates and times
	Configure date and time formats available when creation and modification dates are displayed. See the <u>Date-</u> Time & documentation. (Core module)
	Regional
	Configure regional formats for the display of dates and times, and select how times are mapped to the current
	or user time zone. (Core module)
ave configuratio	

FolderShare configuration Search (optional)

FolderShare

Settings Manage fields Manage form display Manage display

FolderShare manages a virtual file system with files, folders, and subfolders. Module settings control how content is stored, presented, searched, and secured. See also Module help and the module's Usage report.

Fields	Manage search indexing and results.
Files	File and folder names, descriptions, and file content is indexed and shown in search results. You may configure when indexing is done, what is included, and how search results are presented.
Interface	
Lists	Core search
Search	The optional <u>Search module</u> provides basic support for searching content. FolderShare provides an optional search plugin to index and present search results for files and folders.
Security	Search pages
Web services	Configure how search creates indexes of site content and presents search results. Restore original settings
	See also
	Cron
	Configure and run automatic administrative tasks, such as when search indexing is done. See the <u>System</u> <i>P</i> and <u>Automated Cron</u> <i>P</i> documentation. (Core module)
Save configuration	

Security

Manage sharing capabilities

FolderShare

Settings Manage fields Manage form display Manage display

FolderShare manages a virtual file system with files, folders, and subfolders. Module settings control how content is stored, presented, searched, and secured. See also <u>Module help</u> and the module's <u>Usage report</u>.

Fields	Manage how content is secured and shared.
Files	Files and folders may be shared among users and with the public. Content may be accessed using a web browser and using optional services that work with software that runs on personal computers and mobile devices.
Interface	
Lists	Sharing
Search	Select whether to enable sharing, and whether users may may publish their content for public access by anonymous site visitors. When sharing is disabled, users may only view and edit their own files and folders.
Security	Enable shared access
Web services	Enable shared access with anonymous users
	See also
	User permissions
	Grant view, author, share, and administer permissions to user roles. See the <u>User</u> documentation. (Core module)
0 11 11	7
Save configuration	

Web services (optional)

Manage REST capabilities

FolderShare Settings Manage fields Manage form display Manage display

FolderShare manages a virtual file system with files, folders, and subfolders. Module settings control how content is stored, presented, searched, and secured. See also Module help and the module's Usage report.

Manage REST web services.

Files and folders are always accessible via a web browser, but additional web services may be enabled to allow client applications to access content without a browser. You may configure these services to enable or disable specific types of access.

REST web services

The <u>REST module</u> manages REST (Representational State Transfer) web services, such as those provided by FolderShare. While you can edit YML files to customize a configuration, the optional <u>REST UI module</u> provides a better user interface. Using the <u>REST UI module</u> you may enable and disable specific services and adjust their features.

REST module

Provide REST web services for entities and other features at the site.

Restore original settings

See also

REST administration permissions

Grant administrative permissions for REST services. See the REST documentation. (Core module)

REST UI

Manage the REST configuration for the site. (Third-party module)

Save configuration

Fields

Files

Interface Lists

Search

Security

Web services

FolderShare REST settings

Requires REST UI contributed module

Manage REST operations

Settings for resource FolderShare files and folders

Here you can restrict which HTTP methods should this resource support. And within each method, the available serialization formats and authentication providers.

Granularity Resource S Methods GET POST DELETE PATCH Accepted request formats ison xml Authentication providers basic_auth cookie Save configuration

FolderShare Usage

Admin menu Reports > FolderShare usage

FolderShare usage

Current usage by user

<u>Users</u> ▼	<u>Top-level</u> <u>folders</u>	Folders	<u>Files</u>	<u>Bytes</u>
Anonymous	0	0	0	0 bytes
<u>Dr. Aarush</u> <u>Ahuja</u>	1	2	16	0 bytes
<u>Dr. Buena</u> <u>Bonita</u>	0	1	5	1.27 KB
<u>Dr. Chandler</u> <u>Charles</u>	1	2	20	1.54 KB
<u>Site</u> Administrator	0	0	0	120.68 MB
<u>demo (Data</u> <u>manager)</u>	0	0	0	0 bytes
Total				

FolderShare permissions

Permission	Anonymous user	Authenticated user	Data manager	Administrator
FolderShare				
Administer files and folders <i>Warning: Give to trusted roles only; this permission has security implications.</i> Administer public, private, and shared files and folders. Create, delete, view, download, edit, and change the ownership of content owned by any user.			V	\checkmark
Author files and folders Create, delete, view, upload, download, and edit files and folders owned by the user, and by other users that grant author access using folder sharing.			\checkmark	\checkmark
Create and share top-level folders Create and adjust settings for sharable top-level folders that group content that may be made public, kept private, or shared with specific users.			\checkmark	\checkmark
View files and folders View and download files and folders owned by the user, and by other users that grant view access using folder sharing.			\checkmark	\checkmark

SeedMe2 – Target users/Use cases

Researchers

- Collaboration hub or personal dashboard

Project repositories

Include project specific customization (e.g. taxonomy, keywords)

Developers

Integrate your scientific application

• Science gateways

- Data sharing
- Data publishing
- Data escrow service

CyberInfrastructure providers

Offer SeedMe platform to your user base/communities

Coulomb Implosion

Devel

Real usage by physicists

Name 🔺	Modified	Status	Owner	Size	
EPOCH input deck	03/13/2018 - 18:05	Shared		4.25 KB	
Snapshots of the electron density. The color-coding is n_e in $1/m^3$.	03/13/2018 - 18:07	Shared		6.58 MB	
In <u>n</u> <u>i</u> Snapshots of the ion density. The color-coding is n_i in $1/m^3$.	03/13/2018 - 18:07	Shared		6.33 MB	
Total electric field Snapshots of the total electric field $E = \sqrt{E_x^2 + E_y^2}$. The color-coding is E in volt/m.	03/13/2018 - 18:08	Shared		5.65 MB	
Total electric field [zoom] Snapshots of the total electric field $E = \sqrt{E_x^2 + E_y^2}$ in the central part of the target. The color-coding is E in vol	03/13/2018 - 18:10	Shared		1.2 MB	
5 items Image slideshow					

Owner:

View

=

Modified: 03/13/2018 - 17:52 PIC simulations of a rectangular plasma with a cavity irradiated by 4 laser pulses.

 $\lambda = 1 \ \mu m$ - laser wavelength;

 $I = 5 \times 10^{18}$ watt/cm² - peak intensity of each laser pulse;

 $n_e = n_i = 30n_{crit}$ - initial electron and ion densities;

R = 60 nm - radius of the cavity;

cell size is 2 nm by 2 nm; 20 electron macro-particles and 20 ion macro-particles per cell;

Laser electric field is in the plane of the simulation;

Each pulse is $\Delta t = 20$ fs long, with the field envelope given by $(1 - \cos(2\pi t/\Delta t))/2$.

FolderShare design restrictions

Unsupported features (alphabetic listing)	Reason
 Access control Arbitrary file/folder Group based Role based 	Performance& complexity concerns
File/folder versioning	Complexity, usability & performance concerns
1:1 mapping of virtual file system with disk file system	Security, file system balancing, and performance
Multiple FolderShare bundles (aka content types equivalent)	Routing complexity & usability concerns

Try it yourself!

Explorers welcome (web browser needed)

Trial website: sandbox.seedme.org

Developers invited

Download code: https://dibbs.seedme.org/downloads



Amit Chourasia, David Nadeau, Dmitry Mishin & Michael Norman San Diego Supercomputer Center | University of California San Diego

Acknowledgements

All users and application integrators for their valuable feedback

National Science Foundation

This material is based upon work supported by the National Science Foundation under Grant No. ACI-1235505 and ACI-1443083

"Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation."

Talk to us amit @ sdsc.edu

- Hiring/Contract: Experienced Drupal 8 PHP programmer for custom module development
- Keen to learn about potential FolderShare uses cases in your work
- Single sign-on: Checkout <u>http://www.cilogon.org/drupal</u>

Project code: drupal.org/projects/foldershare drupal.org/projects/smalldata Trial website: sandbox.seedme.org Project website: dibbs.seedme.org