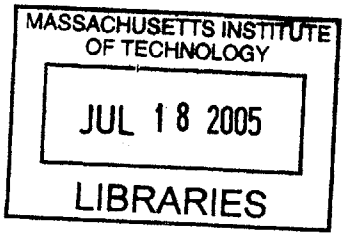
# SloanSpace-DSpace File Transfer Component

by

Genevieve T. Cuevas

Submitted to the Department of Electrical Engineering and Computer Science
in Partial Fulfillment of the Requirements for the Degree of
Master of Engineering in Electrical Engineering and Computer Science
at the Massachusetts Institute of Technology
December 16, 2004 [February 2005]



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## Abstract

This thesis demonstrates how to use Web services to integrate course management systems with digital repositories. We present a component that provides interoperation between SloanSpace, a course management system, and DSpace, a digital repository, both developed at MIT. In particular, a file transfer component was created that enables SloanSpace users to search and retrieve DSpace documents while in SloanSpace, and submit SloanSpace documents into DSpace. DSpace's web services provided the means for interaction between the systems. The architecture of the component was designed to handle not only the metadata mappings between SloanSpace and DSpace metadata, but mappings between file metadata of SloanSpace and other systems as well. Two scenarios were then created to test the effectiveness of the component. The test results demonstrate the ability of the component to decrease the amount of time spent in performing file transfers between the two systems. Most importantly, however, the component demonstrates more generally interoperation with digital repositories. It not only integrates SloanSpace with DSpace, but also allows for a more a general integration with any other system.

# Acknowledgements

I would like to thank Hal Abelson for teaching me how to write a thesis. I could not ask for a better advisor. I would like to thank Al Essa, for helping me construct my thesis. I would like to thank Andrew Grumet for guiding me in the development of my system. I would like to thank MacKenzie Smith and Richard Rodgers for providing the DSpace web services. Lastly, I would like to thank my family. None of this would have been possible without the love and support.

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# 1 Introduction

The number of systems developed to promote the use of technology in learning has risen dramatically as information technology resources have become more readily available. Many higher learning institutions and universities have directed much effort to the creation of course management systems, online courses, and other technologically enhanced learning tools. At the same time, the number of digital repositories being developed has also seen a similar growth rate. Many institutions and communities have created their own digital repositories. Journals, theses, books, software, and other published works now reside in the digital repositories provided by the institution, and members of the institution now have easy access to these digital resources.

It would be expected that the growth and abundance these systems would lead to efforts directed towards the interoperability between the systems. Education and learning tools equipped with direct access to digital repositories would result in more powerful and comprehensive systems. Digital repositories would also see an increase in usage if it can be accessed through other systems. However, a comparatively small amount of time and resources have been spent in making these integrations happen.

The system developed in this thesis provides one such integration. This work provides a component that enables interoperation between two systems developed at MIT – SloanSpace, a course management system, and DSpace, a digital repository. The component allows SloanSpace users to search and retrieve DSpace documents from SloanSpace and submit SloanSpace documents into DSpace. Moreover, because SloanSpace and DSpace follow different file metadata standards, the component contains a mapping interface that transforms file metadata from one system into the file metadata of the other system. Testing the component with two scenarios show that searching and retrieving DSpace documents using the file transfer component cuts the time (i.e. the time it takes using current system without the file transfer component) by 57%. Similarly,

submitting SloanSpace files into DSpace using the file transfer component cuts the time by 44%.

# 2 Background

## 2.1 SloanSpace

SloanSpace [1] is an online management system for courses and learning communities that enables information to be shared within each class or community. Each community or course in SloanSpace has a community area web page that stores and displays community content. Access to this community area is given only to community members. Furthermore, different types of access can be given to the members. These access types determine what types of actions members can perform in the respective community area.

Currently, all MIT Sloan School classes use SloanSpace to store and display class content. A typical class area in SloanSpace contains such content as class documents, a class calendar and syllabus, class news, and a class forum. Professors, teaching assistants, and administrators for that class are given a professor-type access to the class community area, which allows them to add and modify the displayed content. Students are typically given a student-type access, which restricts them from viewing or modifying certain content in the class area.

SloanSpace is also being used by various online communities at MIT. Examples of such communities are student groups and research groups. Through SloanSpace, members of the groups can communicate with each other online via the community forums. SloanSpace also enables them to share their files securely.

Each community area has an associated file storage area page, which displays files and related to that class or community as well as operations to the file. A link is also available for each file, which, when clicked, will take the user to the respective file area.

The file area contains links to perform operations on the file, such as editing the file or deleting the file. Operations on files and the file storage area can be restricted so as only to prohibit certain members from performing certain actions. For instance, only members of type professor or teaching assistant may modify or add files to the area. Either files or URLs can be added to the file storage area. Directories may also be added to organize the files.

SloanSpace is organized into packages. A package represents a single component or service. For example, the file storage package is the package associated with the file storage area in the community area in where users can add and manage community files. The calendar package is the package associated with the calendar for the community. Each package comprises of the user interface files for that component, the library files containing processes, or operations, related to the component, and database files containing database table definitions and functions for the component. Below is a screenshot of main SloanSpace class page for the "Intro to CS" class.

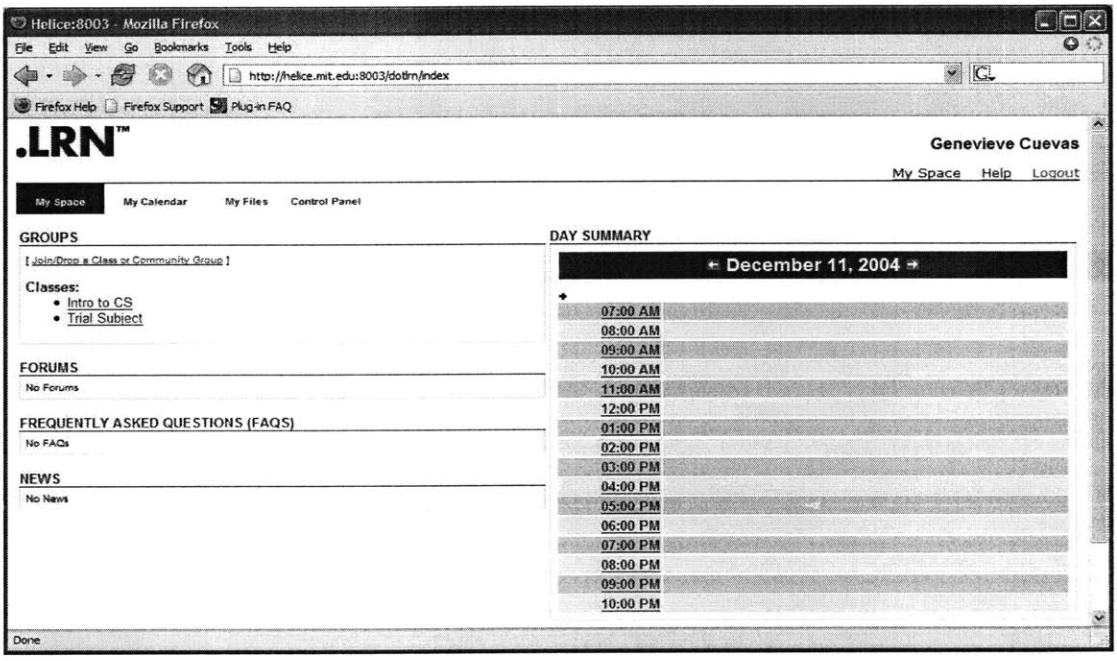



**Figure 2-1: SloanSpace screenshot**

The calendar package is responsible for the calendar component shown in the screenshot. Similarly, the forums package contains all the code files and user interface files that handle the forums component. The file storage area is reachable by clicking the "File Storage" tab in the top of the page. Again, this file storage area is handled by the file storage package.

SloanSpace is an implementation of .LRN [3], an open-source course application suite for online course management systems and learning communities. .LRN is based on the OpenACS framework [4], a toolkit used for building online community-oriented web applications. OpenACS, and SloanSpace, in turn, are implemented in Tcl.

## 2.2 DSpace

DSpace [2] is a digital repository that provides long-term storage for all types of digital content developed at MIT. Examples of content stored currently in DSpace are papers, theses, books, preprints, images, simulations, computer programs, and multimedia publications.

Content in DSpace is organized by communities and collections. All items belong to a specific collection, and all collections belong to a community. In addition, each item contains two types of data – the metadata, which describes the item, and the item content, stored as bitstreams. The item metadata is based on the Dublin Core metadata standard [5].

Access to the content stored in DSpace can be done via the DSpace web interface. Through this web user interface, users can browse or search for DSpace content. Users can also submit content into DSpace via this interface. The submission process consists of two tasks: the user must first enter the content description (or metadata) and then upload the file into DSpace. Users must also specify which collection to store the item in. Access to some of the collections and to the submission interface is restricted to authorized users.

DSpace also provides a web service to enable communication with other systems. Methods implemented in the web service include a search and browse function, an ingest function, and a deposit function. The search/browse function, which allows users to search and browse DSpace content, is based on SRW (Search/Retrieve Web Service). Through SRW, a user may enter a search or browse query via a URL, and will be returned an XML document containing results. For example, the URL query for a search for "math" returning the 1st result is:

http://dspace-demo.mit.edu:8080/SRW/search/DSpace?query=math&maximumRecords=1 &startRecord=1

When this URL is entered, the DSpace SRW service returns the XML document containing the search result. Below is part of that XML document:

```
<?xml version="1.0" ?>
<?xml-stylesheet type="text/xsl"
href="/SRW/searchRetrieveResponse.xsl"?>
<searchRetrieveResponse xmlns="http://www.loc.gov/zing/srw/">
   <version>1.1</version>
   <numberOfRecords>1</numberOfRecords>
   <resultSetId>fov7co</resultSetId>
   <resultSetIdleTime>300</resultSetIdleTime>
   <records>
    <record>
     <recordSchema>default</recordSchema>
     <recordPacking/>
     <recordData><srw_dc:dc xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:srw_dc="info:srw/schema/1/dc-v1.1">
    <dc:contributor.author>Carroll, Lewis</dc:contributor.author>
    <dc:date.accessioned>2003-12-03T22:04:10Z</dc:date.accessioned>
    <dc:date.available>2003-12-03T22:04:10Z</dc:date.available>
    <dc:date.issued>2002-12-03T21:26:17Z</dc:date.issued> . . .
```

DSpace also provides a two SOAP based web service that allows users to submit and retrieve DSpace content. The ItemAccessService contains methods that allow users to retrieve DSpace files. Similarly, the ItemIngestService contains methods that allow users to deposit files into DSpace. For example, in order to retrieve a file from DSpace, the user calls the retrieveItem and retrieveBitstream SOAP methods of the ItemAccessService. The file id is given as an input to index the file. The retrieveItem request retrieves the file metadata associated with the file, while the retrieveBitstream request retrieves the file content encoded in a base64 string from DSpace.

## 2.3 Scenario 1: Populating a SloanSpace File Storage Area via DSpace

Say, for example, that Professor Smith, the professor for Physics 101, wants to populate the course's SloanSpace file storage area. He feels that DSpace would be a good repository to search for such files. Prof. Smith can accomplish this task with the current system, but it would require him to interact explicitly with both SloanSpace and DSpace. In the following chapter, we'll see how this need to explicitly deal with both systems can be avoided.

Here is the current process Prof. Smith would go through in order to accomplish this task:

He first would first through DSpace via the DSpace web interface. The following screenshot shows the DSpace web user interface:

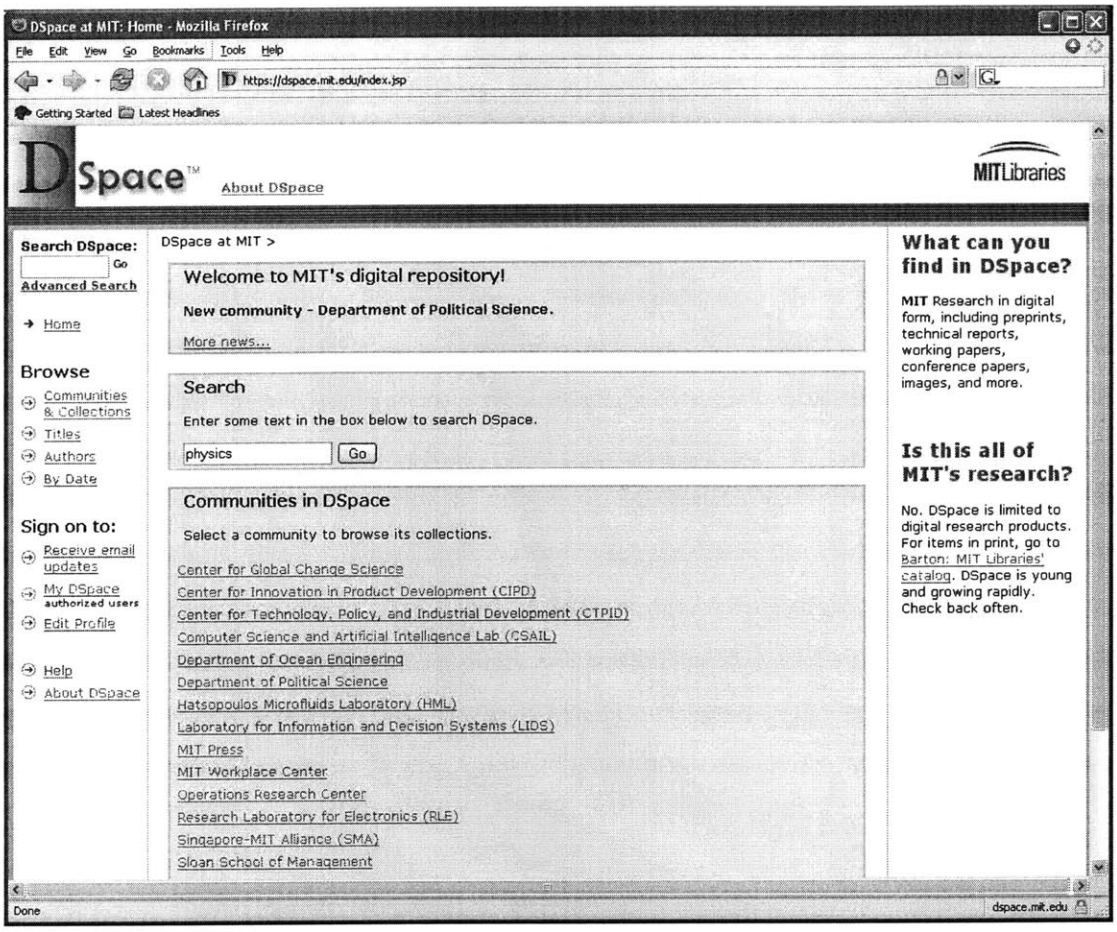



**Figure 2-2: DSpace home page**

Once the search query "physics" is entered into the search textbox, as shown above, Prof. Smith clicks on the "Go" button to fetch the search results. The following figure is the screenshot of the page returned by DSpace, containing the search results for the query:

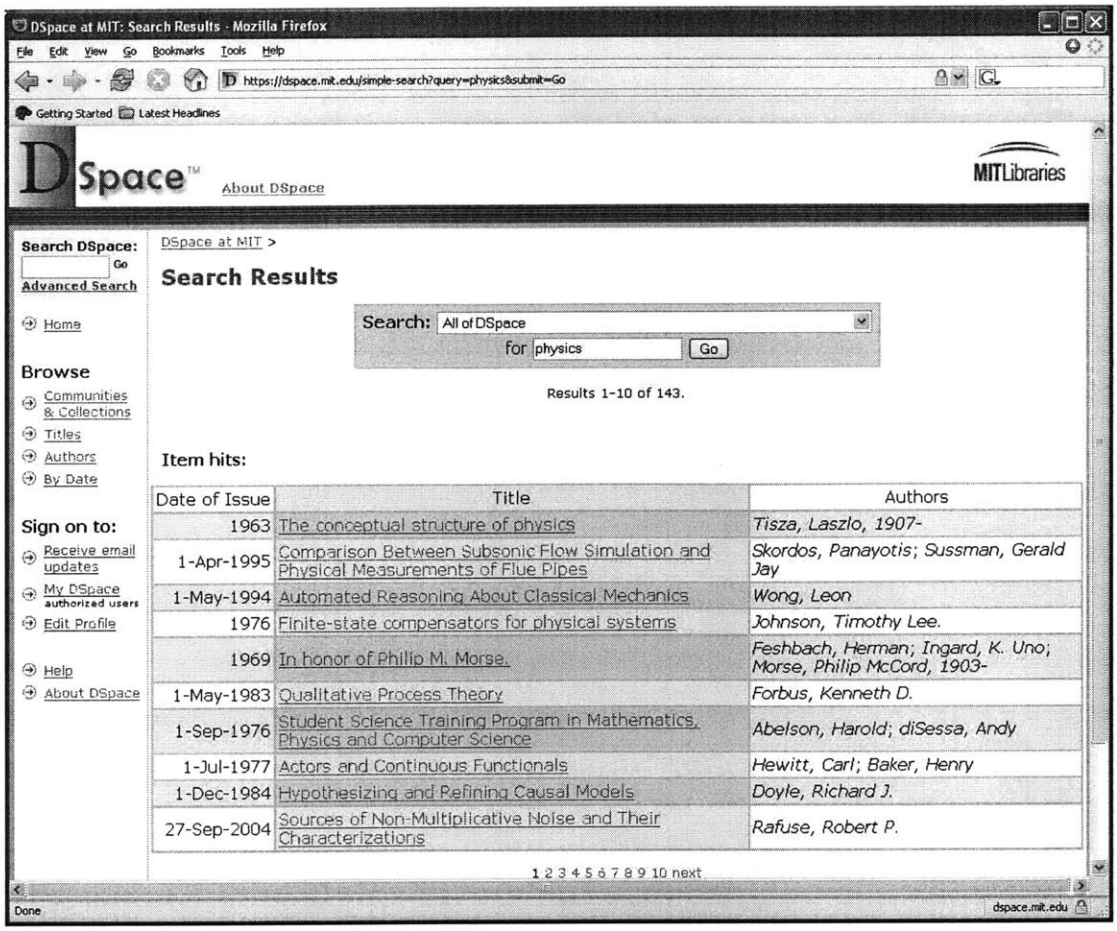



**Figure 2-3: DSpace search results**

Prof. Smith then would browse through these results and choose whichever ones he feels is appropriate for the class. Once he has decided which files to add into the file storage area, he would then click on the link for that result. For example, suppose Prof. Smith decides that the first file listed above, "The conceptual structure of physics", is a good candidate, he would then click on the file link to go to the page displaying the file information. The following is a page that displays the file information:

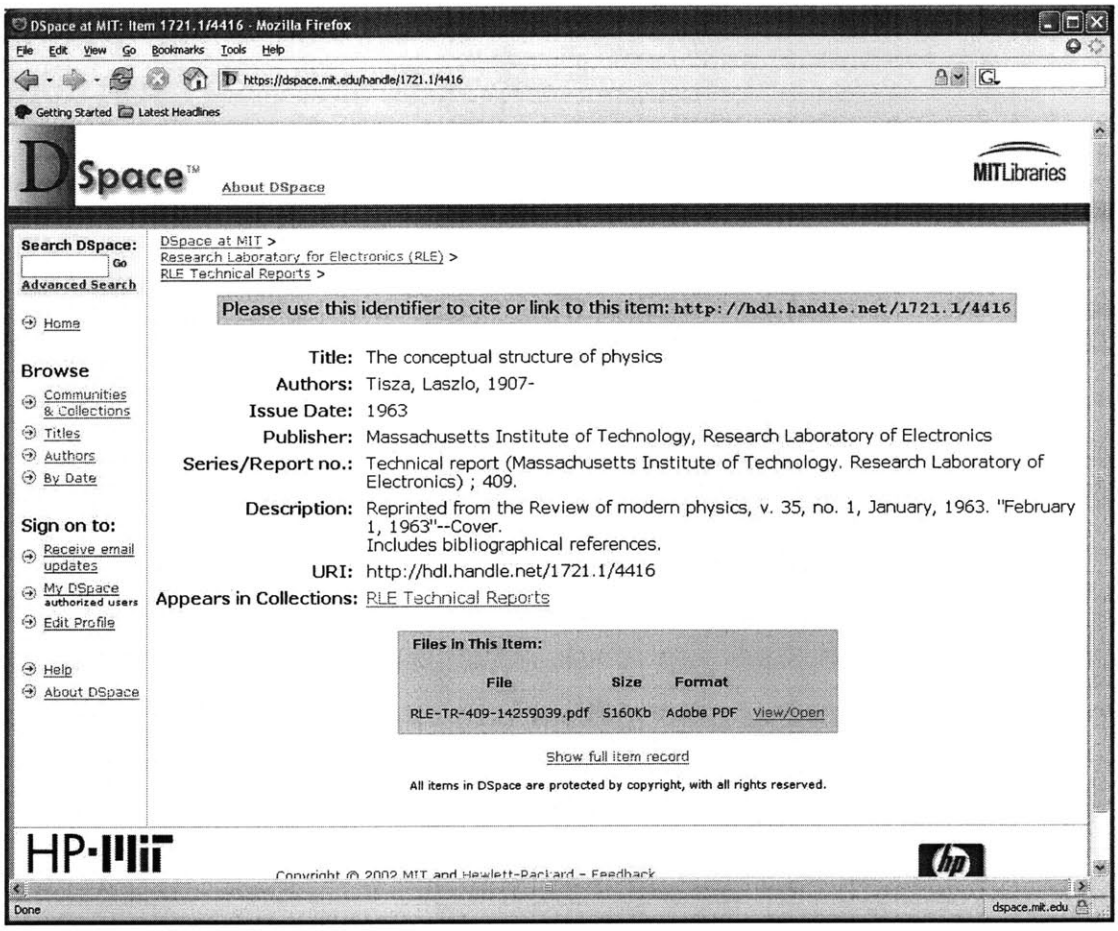



**Figure 2-4: DSpace search result**

Suppose Prof. Smith simply wanted to add the URL of the file. He would then simply have to save the value for URI listed above, and then add this URL to the file storage area. Suppose however that he wanted to add the actual file into the file storage area. He would then need to save the file into his local computer, by either right clicking on the "View/Open" link above and choosing the "Save" option, or click on the link and then saving it into his computer from the menu bar. Once he saves it into his computer, he then logs on to SloanSpace and goes to the file storage area for the class. Here is the file storage area for Physics 101:

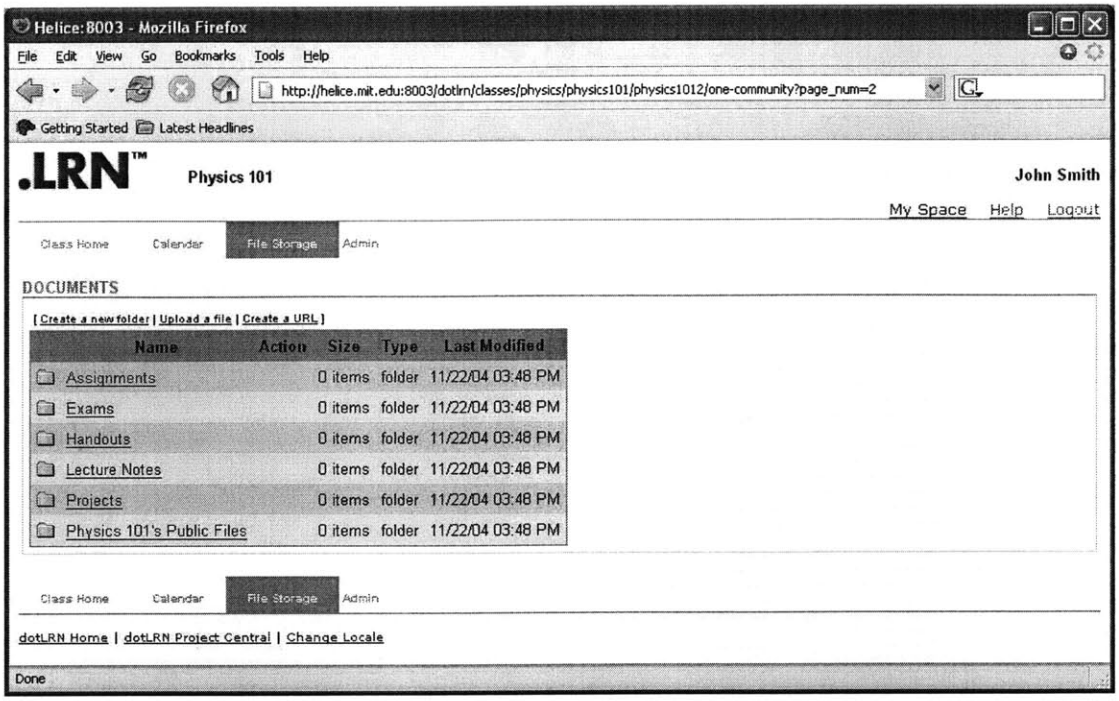



**Figure 2-5: SloanSpace file storage area**

Finally, in order to upload the file into the file storage area, shown above, Prof. Smith would then click on the "Upload a file" link, and from there, proceed with uploading the file he saved in his computer from DSpace, into the file storage area. The "upload a file" screen is shown below:

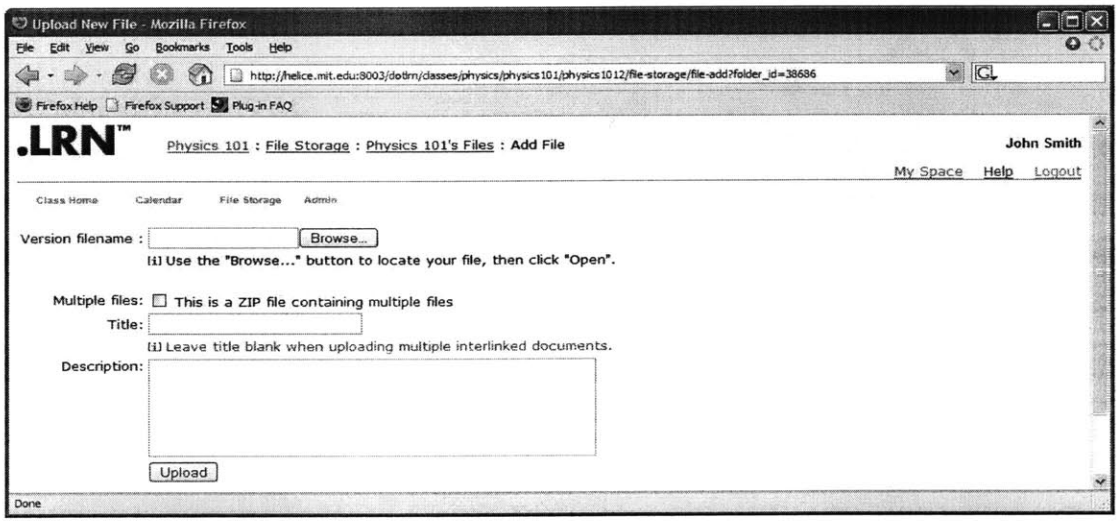



**Figure 2-6: SloanSpace file upload**

Once Prof. Smith enters all the information and clicks on the Upload button, the file is then added into the file storage area.

## 2.4 Scenario 2: Submitting a SloanSpace file to DSpace

Suppose that Jane, a member of the Dolphins Research Group, wanted to submit a group research paper into DSpace. In order for all the members to be able to contribute to the paper, the file was uploaded in the Dolphins Research Group SloanSpace file storage area. Once the file was ready for submission, Jane and her group were ready to submit the paper into DSpace. Here is the submission process Jane would currently go through in order to accomplish this task:

First, Jane would download the file from the file storage area into her computer. She would then go to the DSpace web submission interface, and enter all the metadata information for the file. A screenshot of one of several pages for the DSpace web submission interface is shown in the following figure:

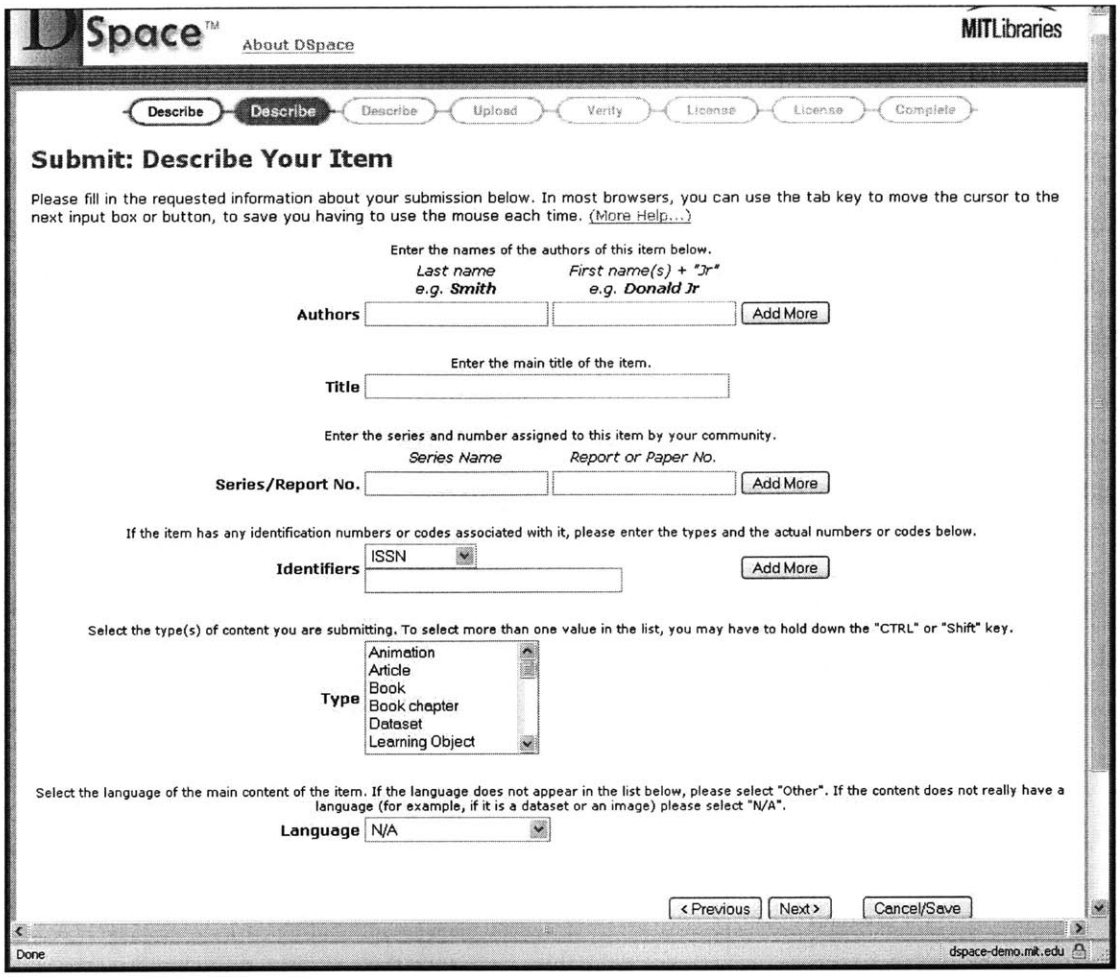



**Figure 2-7: DSpace submission page**

There are 8 screens Jane would need to go through in order to complete the submission. The "Describe" tab, highlighted in red in the screen above, shows where she is in the submission process. The screens query Jane for the file metadata. Examples of metadata are the title, the author, the type, and the language, as shown above.

## 2.5 What is the motivation behind this system?

The two scenarios described above shows content transfer between SloanSpace and DSpace. However, imagine if there was some component that would simply enable users to perform these content transfers without having to switch between both environments. Even more so, the component would make use of the file information already stored in the system, and use that information when performing the content transfer, instead of

having the user supply this information once again. This component is the system developed in this thesis.

SloanSpace and DSpace are merely two of several systems at MIT developed to incorporate technology into the learning environment. OpenCourseWare, which places MIT course materials on the web for free, is another one of these systems. Efforts to integrate OpenCourseWare with DSpace are also being made. The vision for the future is that all of these different learning environments can interoperate with each other, thus building a very comprehensive environment for the users. This system in this thesis is the first of such integrations.

Most importantly, however, the system developed in this system demonstrates more generally interoperation with digital repositories. Although more and more digital repositories are being developed, a relatively small effort has been made to integrate other systems with these repositories. The system developed in this thesis not only integrates SloanSpace with DSpace, but also allows for a more a general integration with any other system.

## 2.6 Challenges

The main problem to be solved in this thesis deals with the metadata handling. The files from DSpace and SloanSpace have metadata associated with them, but the specific metadata stored in the SloanSpace files and DSpace files is different. The metadata for DSpace files is based on the Dublin Core metadata standard. The metadata standard specifies elements for the metadata, such as the title, the author, the publication date, the type, and the publisher, among others. The SloanSpace files also have data associated with it, such as the title, the user who uploaded the file into SloanSpace, the date the file was uploaded, the file size, and the file type. Since the metadata specifications for both systems are different, the file metadata for files transferred from one system to the other must be adjusted to map to the file metadata specifications for the other system. For instance, a file coming in from DSpace contains Dublin Core metadata. In order to add the file to SloanSpace, the file must contain SloanSpace specific metadata. Thus the

system must contain a mapping module that maps the DSpace metadata to the SloanSpace data.

Another challenge in this thesis is developing a user interface that will make it easier for users to transfer files between the two systems. Files being transferred already contain metadata from the system they are coming from. Thus the file submission process to the new system must be simpler than the current submission process for that system. For instance, as shown in Scenario 2, in order to submit files into DSpace (via the DSpace web interface), users enter file metadata through a series of screens. Since the Dublin Core metadata standard contains a significant number of elements, the process can be lengthy. In the file transfer interface developed in this thesis, submitting a file into DSpace from SloanSpace should be a faster and simpler process since the file being submitted already contains metadata from SloanSpace. In other words, a user should not have to enter the DSpace metadata that maps directly to the SloanSpace metadata. Thus the user interface must pre-populate DSpace metadata from the SloanSpace metadata using information from the metadata mapping module.

Finally, the design of the system should be more general to include integration with other repositories, and not specific solely for integration with DSpace. For example, the metadata mapping module must also be able to map SloanSpace metadata with metadata of any other system or repository.

## 2.7 Related Work

Awareness of the need for integration between systems and digital repositories has been growing over the past few years. For example, an effort has been made by IMS and OKI to develop standards of integration among education systems and repositories. The work done by these two organizations focus mainly on developing the specifications for interoperability between systems and repositories, whereas the system developed in this thesis is an actual implementation of a system that provides this interoperability.

The IMS Digital Repositories Interoperability (DRI) Specification provides specifications for digital repository interoperation of common repository functions. It specifies five core interactions between systems and repositories. These five interactions include search/expose, gather/expose, request/deliver, submit/store, and alert/expose [9]. The search/expose interaction defines the process in which systems search metadata exposed by content repositories. The gather/expose interaction defines the process in which systems request metadata that is exposed by the repository. The request/deliver interaction involves the process in which a system requests access to the learning object exposed through the search operation. The submit/store interaction defines the process in which a system submits content to the repository. This interaction refers to the IMS Content Packaging Specification as a standard on how to package and export the content. Lastly, the alert/expose specification defines the process in which repositories alert systems on new or updated metadata or resources.

The Open Service Interface Definitions (OSIDs) developed by the Open Knowledge Initiative (OKI) provides specifications for integration in an education technology environment. These specifications describe how components of education technology systems interact with one another. OSIDs provide a layer of abstraction between the client application and the service application [10]. Implementation details of the service application need not be known by the client application in order for the client to interoperate with the service application. Similarly, details of the client application are hidden from the service application. OSIDs simply specify what is needed from the service and what is expected out of the client. Repository OSIDs are OSIDs developed for interoperability between digital repositories and other components. With repository OSIDs, clients don't need to know the implementation details of each particular repository, and instead simply provide data the OSID specifies is expected out of the client [11]. The repositories on the other hand would provide data that the OSIDs have specified for them to provide to the client.

# 3 System Overview

The file transfer component described in this thesis integrates SloanSpace with DSpace, as illustrated in the figure below.

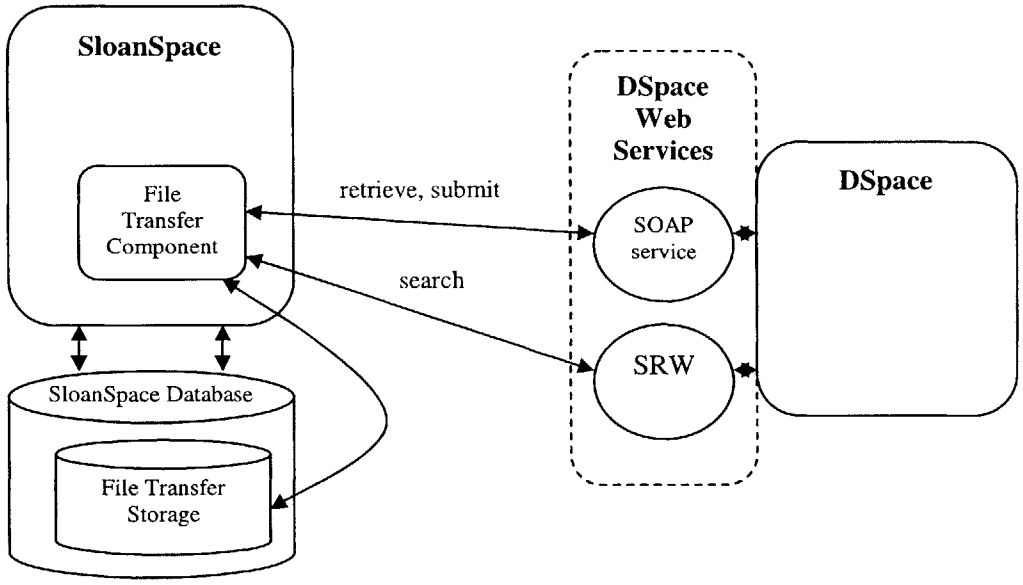



**Figure 3-1: System overview**

The component sits in SloanSpace, and interacts with DSpace, directly through two of DSpace's web services – the SOAP web service and SRW (Search/Retrieve Web Service). Three types of operations can be performed by this component. The search operation searches DSpace content through SRW. The retrieve operation gets files from DSpace and places them in the proper SloanSpace area. The submit operation submits files from SloanSpace to DSpace. Both the retrieve and submit operations are performed via the DSpace SOAP web service.

The file transfer component contains a storage element, which consists of database tables used to store both the metadata mappings and the specific file metadata. These database

tables are created in the SloanSpace database, and can therefore reference other tables in the database.

This chapter first shows how the system functions. In particular, it shows the how the system behaves in the two scenarios described in the previous chapter. Then it describes the data model of the system, on which the database tables are based. Finally, it describes the implementation details of the system.

## 3.1 System Functions

### 3.1.1 Search/Retrieve

The search and retrieve interface allows SloanSpace users to search and retrieve files from DSpace, without leaving the SloanSpace environment.

Recall the first scenario described in the previous chapter, where Prof. Smith wants to populate his Physics 101 SloanSpace file storage area. Although he was able to accomplish his task, he had to leave the SloanSpace environment and go to DSpace to search the files. Then he had to save the file in his own computer, after which he could then finally upload the file to the SloanSpace file storage area.

The search and retrieve interface developed in the system in this thesis makes Prof. Smith's job much easier and speeds up the process, by enabling Prof. Smith to search and retrieve DSpace files, while never leaving the SloanSpace environment. Here now is the process Prof. Smith would go through in the same scenario, but using the system in this thesis:

He would first go to the file storage area. Here is the screenshot of the file storage area in this system:

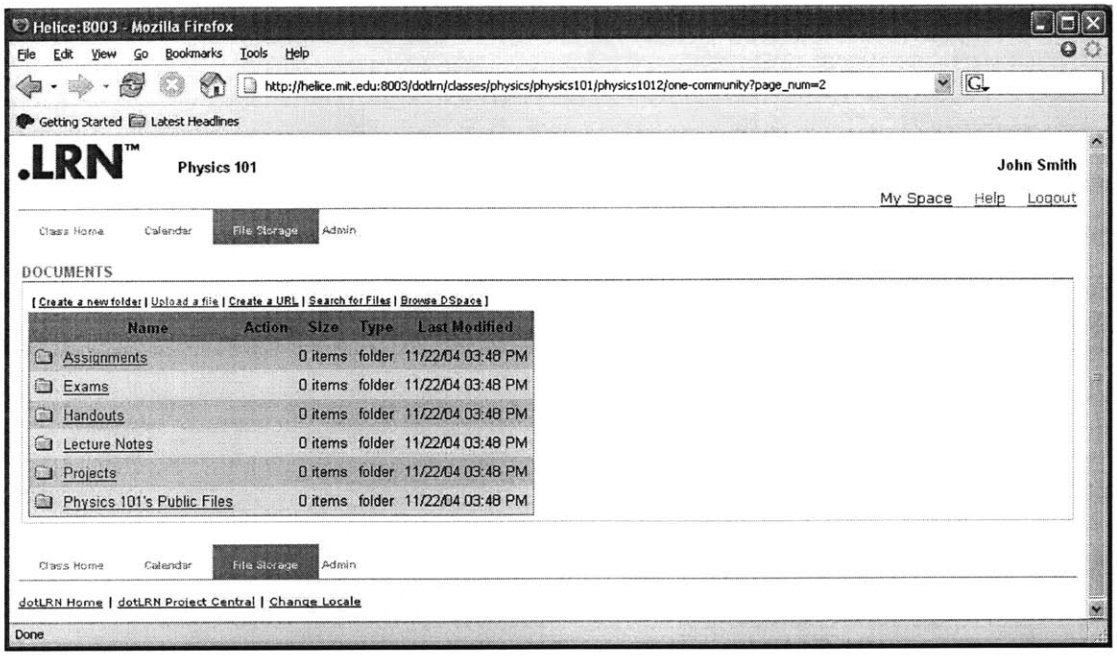



**Figure 3-2: Prof. Smith's File Storage**

In this system, the file storage area now contains a "Search for Files" link, shown above. To proceed with the DSpace file search, Prof. Smith would now click on this link. When he clicks on the link, he is directed to the first page of the search interface, which is the page in which Prof. Smith can enter the search query. As described in the previous chapter, Prof. Smith then enters "physics" as the search query. Below is the search interface page, with the query "physics" typed in the text box for the query:

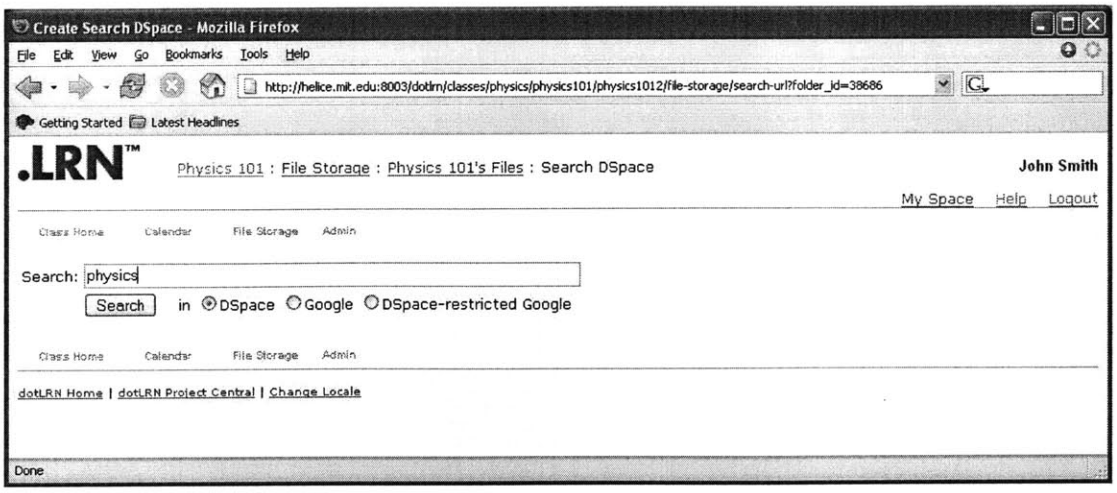



**Figure 3-3: Search query page**

As shown in the page above, Prof. Smith also has an option of searching Google and a restricted version of Google where it would only search through DSpace URLs, indicated above by the "Google" and "DSpace-restricted Google" radio buttons respectively. An example of search using these different domains will be shown later in this section.

Once Prof. Smith has entered the query into the text box, as shown above, he would now click on the "Search" button to get the search results. Below is the search results page returned for the query "physics":

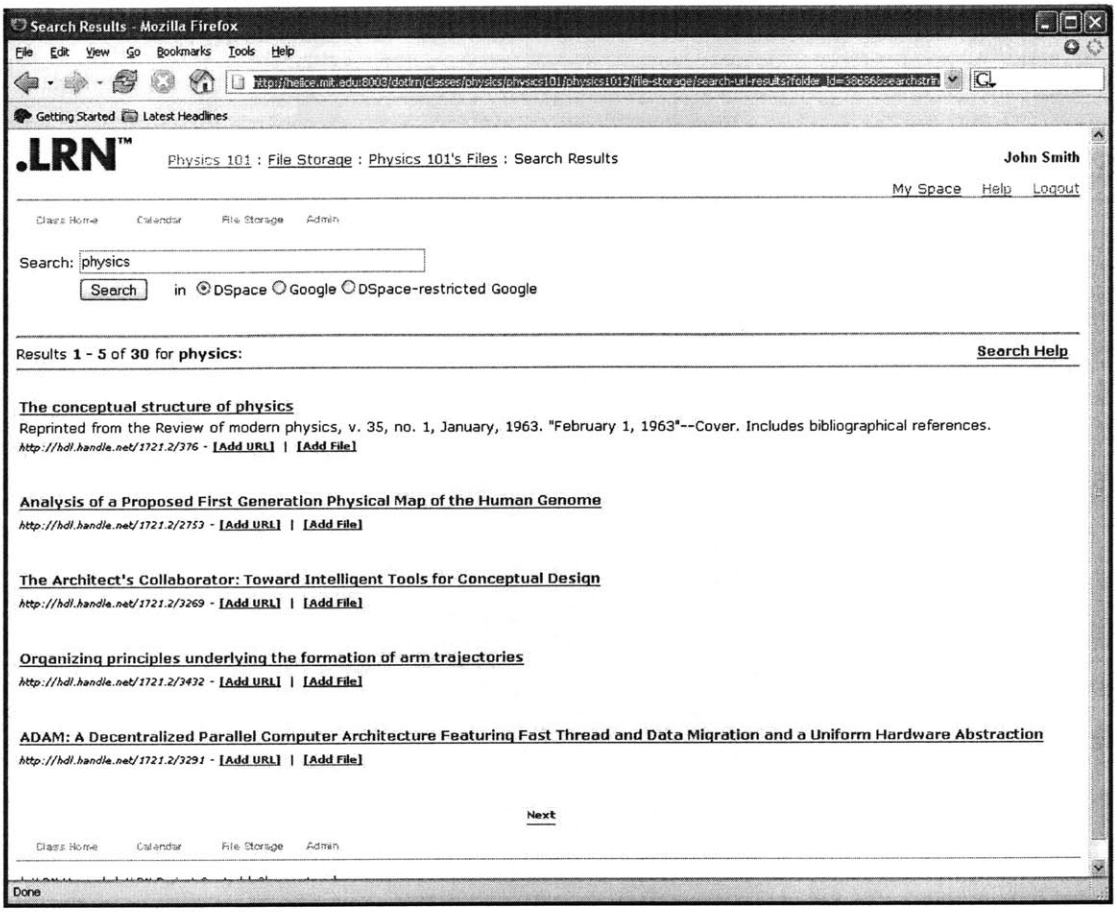
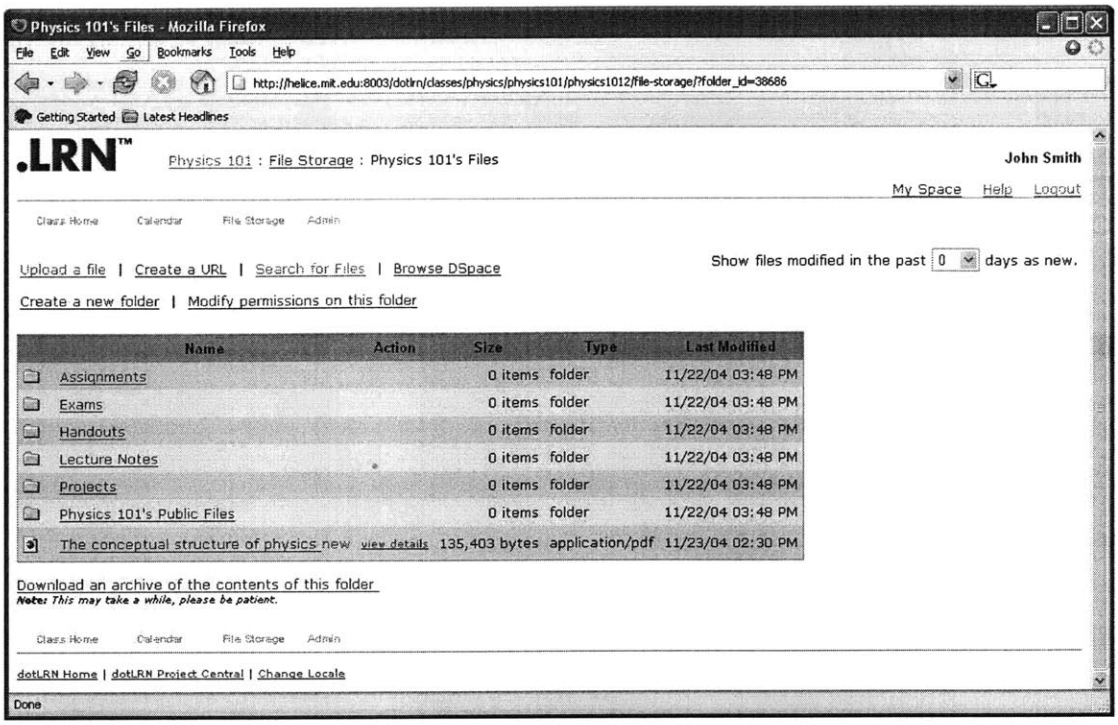



**Figure 3-4: Search results page**

Each result in the search results page for a DSpace search displays the result title, the result description, and the URL of the document, as shown above. In addition, the result contains two links displayed to the right of the URL – the "Add URL" and the "Add File" link. If Prof. Smith wanted to add the URL of the file to the file storage area, he would click on the "Add URL" link. If he instead wanted to add the file itself in the file storage area, then he would click on the "Add File" link. Suppose Prof. Smith wanted to add the first document, "The conceptual structure of physics" to the file storage area, he then clicks on the "Add File" link for this result. After he clicks on this, he is then redirected back to the file storage area, which now contains the added file. Here is a screenshot of the newly updated file storage area:




A design issue arose of whether or not to throw away the extra metadata. That is, the file coming from DSpace contained other metadata values that SloanSpace does not need. Although throwing away the extra metadata allows for simplicity and does not require the addition of extra storage space, the metadata would be useful when the system is extended to allow for integrations with other systems, since these other systems may use the extra metadata. Thus for this system, extensibility was chosen over simplicity.

Using the system in this thesis, Prof. Smith then did not have to leave SloanSpace to search DSpace. Furthermore, he did not have to first save the file into his local computer. Most importantly, however, Prof. Smith did not need to enter all the file information, as he did when using the current system. Recall that when using the current system, Prof. Smith had to upload the file manually to SloanSpace, which required him to fill out the SloanSpace file information. In particular, he had to fill out the title, description, and file location. Using the file transfer component in this thesis, Prof. Smith did not need to fill this out. Instead, the retrieve interface mapped the DSpace metadata values of the file to

the SloanSpace metadata values, and automatically filled out this information, thus speeding up the file transfer process.

In addition to searching through the DSpace domain, users can also search through Google. For instance, suppose Prof. Smith was not satisfied with the search results returned by DSpace. He can then search through Google by the following process: He first goes to the file storage area, as he did before, and clicks on the "Search for Files" link. Now, instead of selecting the "DSpace" button in the search query page as he did in the previous scenario, he now selects the "Google" button. This is shown below:

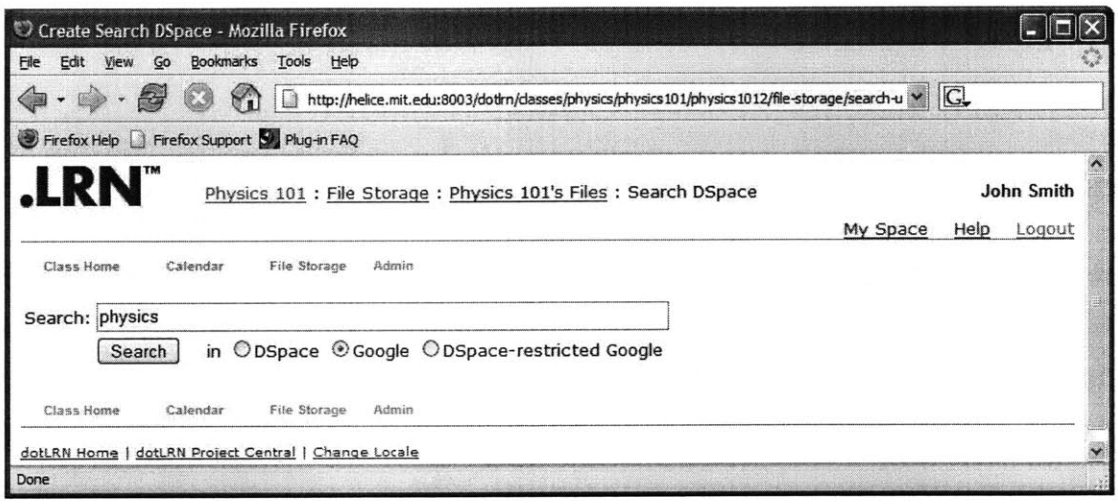



**Figure 3-5: Google search**

He then clicks on the "Search" button as he did before to get the search results. Here in the following figure is the search results page for the "Google" search for "physics":

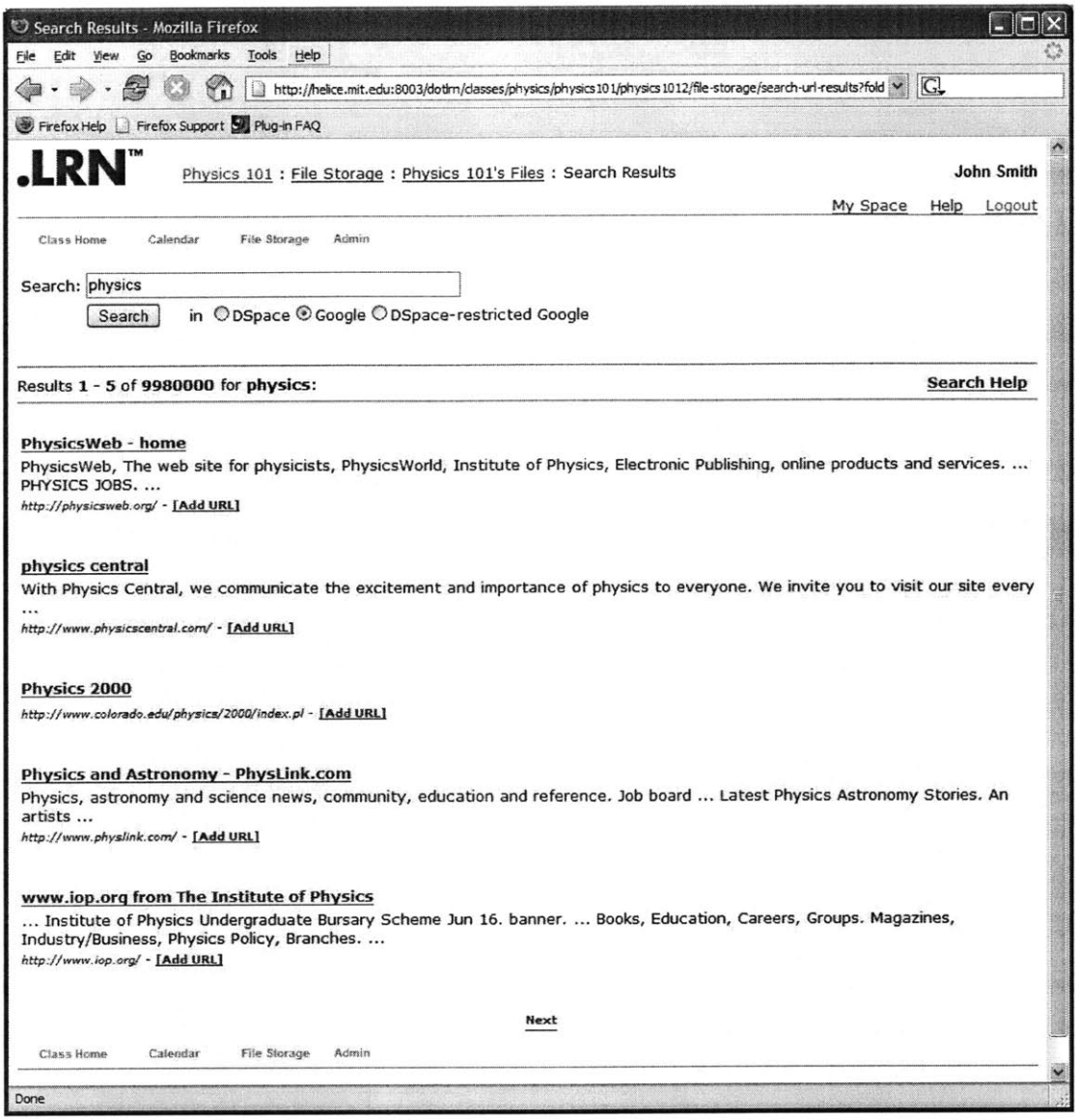



**Figure 3-6: Google search results**

Note that the "Add File" link is not available for the Google page, since the results returned are web sites instead of web documents returned in the DSpace search. Thus, only the URL's of the results can be added to the file storage area.

### 3.1.2 Submit

Through the file transfer component, SloanSpace users would be able to submit files in their file storage area to DSpace, while never leaving the SloanSpace environment.

Recall the second scenario described in the previous chapter, where Jane wanted to submit a group research paper into DSpace. In order to do this using the current system, Jane had to go to the DSpace submission web user interface, which, through a series of screens, queried her for the file metadata.

The submit interface in the file transfer component developed in this thesis makes the process in this scenario easier and faster by accomplishing two things. First, using the file transfer component, Jane no longer has to leave the SloanSpace environment to submit files into DSpace. And second, the submit interface pre-populates the entries for the DSpace file metadata values by mapping the SloanSpace metadata values to the corresponding DSpace metadata values. Thus Jane will no longer have to fill out values for file metadata entries that SloanSpace already maintains. Here now is the process Jane would go through for the second scenario described in the previous chapter, but this time using the submit interface developed in this thesis:

First, Jane would go to the file area for the file that she wants to submit to DSpace. Here is the file area for the file:

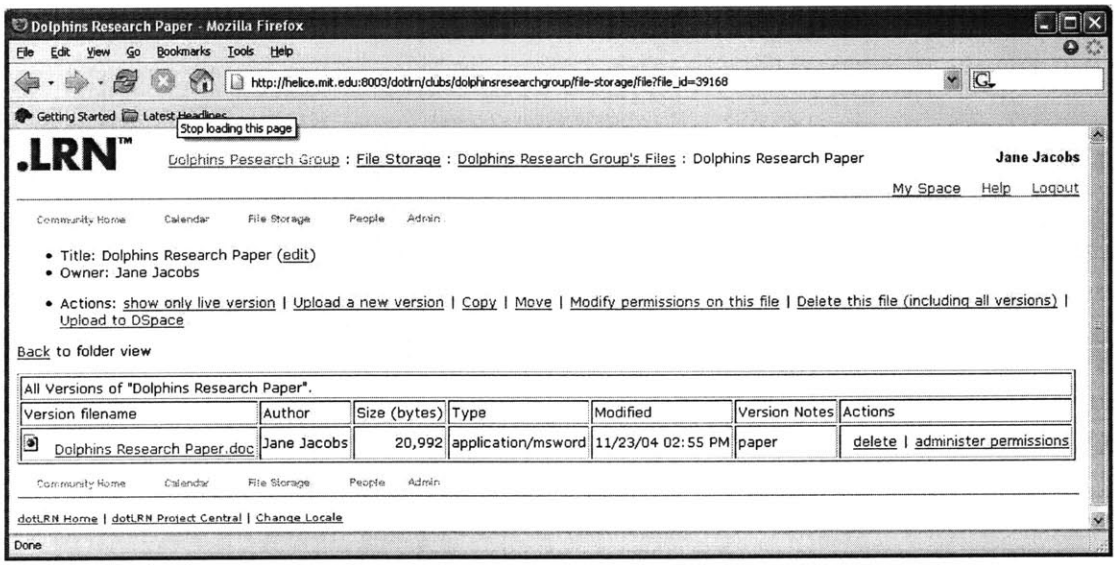



**Figure 3-7: File area**

To proceed with the DSpace submission, Jane would click on the "Upload to DSpace" link, shown above as one of the actions for the file. Clicking on this directs Jane to the page that contains the form that queries for the file DSpace metadata values. Some of the metadata values are filled out, depending if there exists a mapping from a SloanSpace file metadata field to the respective DSpace field. Here are two screenshots of this page. The first screenshot shows the top of the page. The second screenshot shows the page when scrolled to the bottom.

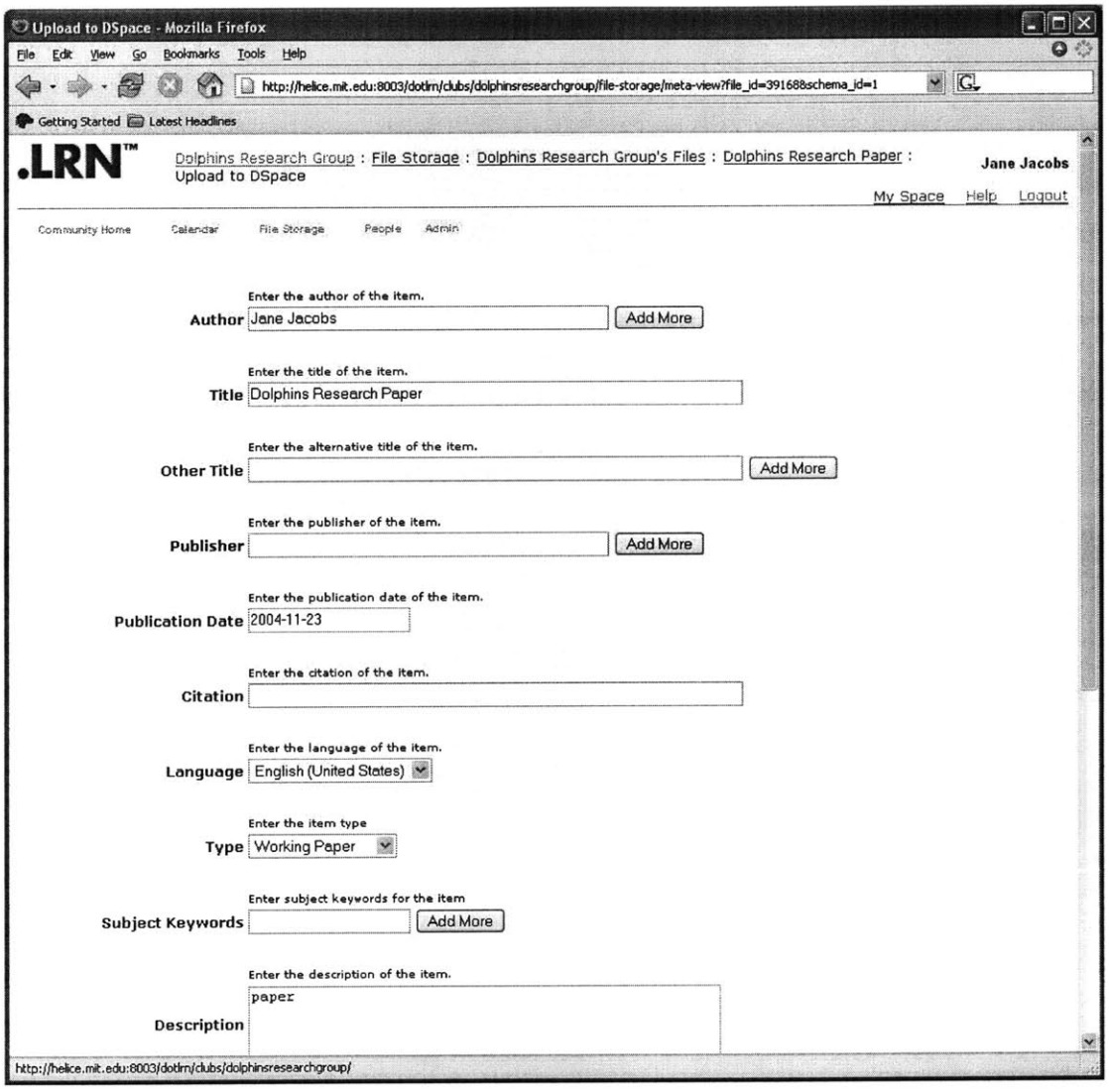



**Figure 3-8: Metadata entry**

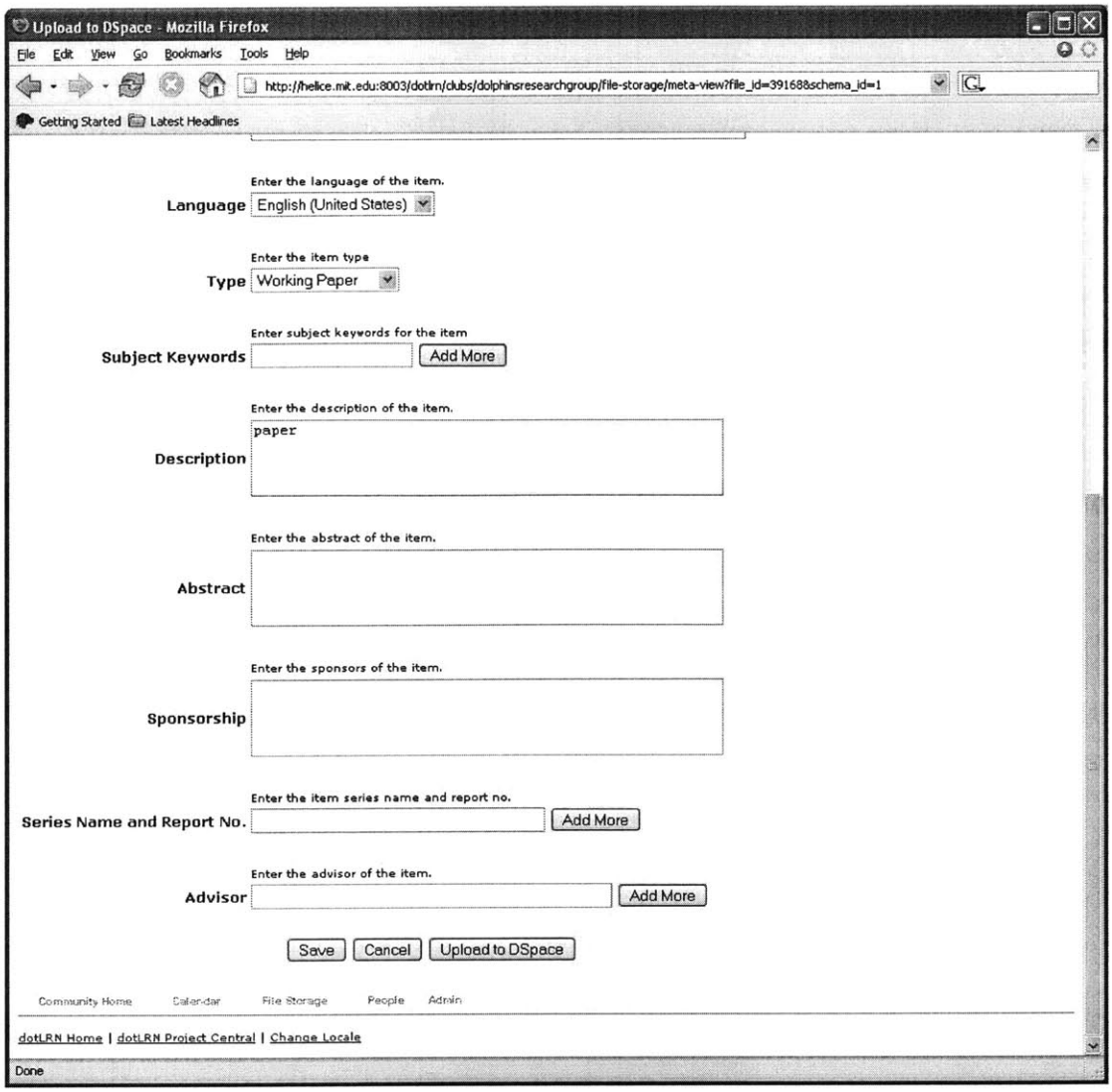



**Figure 3-9: Bottom of metadata entry**

In the page above, all the fields and all their display information, including the field label, the display text above the field input element, the input element (i.e. the text box, select list, or text area associated with the field), and the "Add More" button (for fields that can have multiple values) are all dynamically generated. Moreover, the author, title, publication date, and description values were pre-populated. After Jane finishes filling out the rest of the values, she then clicks on the "Upload to DSpace" button at the bottom of page, which would finally submit the file to DSpace. Note that Jane also has an option

of saving the current metadata entries, and come back to the submission process later, on canceling the process, by clicking the "Save" or "Cancel" buttons respectively.

After the submission is made, the submit interface returns a page the status of the submission. That is, it shows whether or not the submission was successful. The success of the submission depends on the values Jane submitted. For example, if the value for the field is required for submission, but Jane has failed to fill it out, then she will be directed back to the pre-populated entry page with a message for field that was unsuccessfully fill out. Here is an example of that returned page, when Jane did not fill out the required title field. Note the red error text, "Please enter a title", next to the title field:

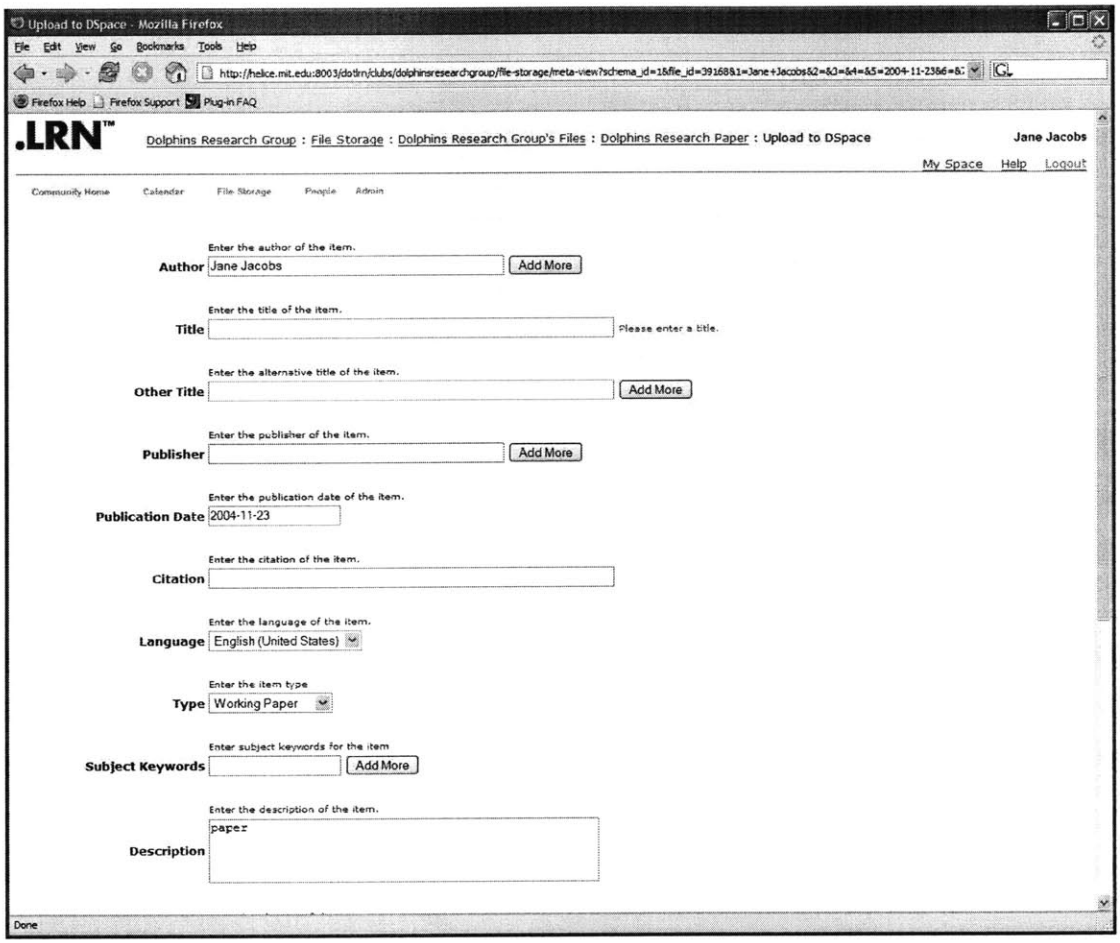



**Figure 3-10: Metadata entry error text**

Finally, once all the field values are successfully entered, the interface submits the file to DSpace. Here is the page returned to Jane indicating that the submission was successful:

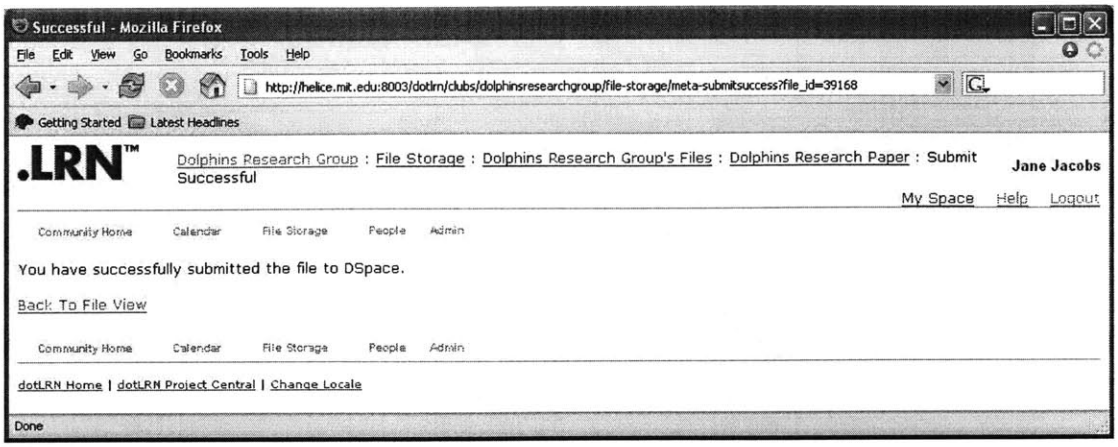



**Figure 3-11: Successful submission**

In order to indicate that the file has already been submitted to DSpace, a new icon is associated with the file. The new icon is similar to the old file icon, except that it shows a "D" beside it. Here is a screenshot of the updated file storage area:

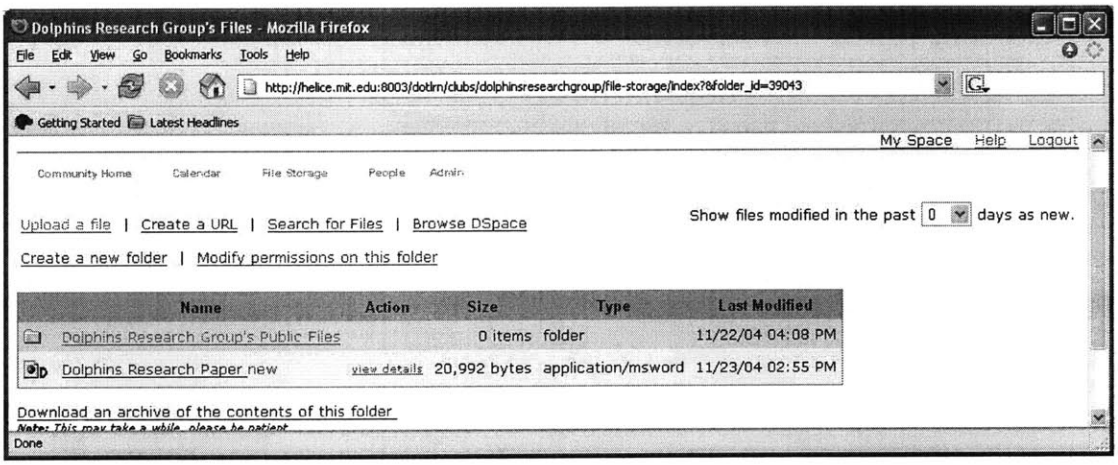



**Figure 3-12: Updated file storage area**

The icon for the "Dolphins Research Paper" shows a "D" next to the file icon. In addition, the submit interface won't allow the file to be submitted to DSpace. The

interface simply returns a page telling the user that the file has already been submitted to DSpace.

Using the file transfer component, Jane no longer has to leave the SloanSpace environment. More importantly, Jane doesn't need to fill in some of the metadata fields, whose values can be mapped to SloanSpace file values, making the submission process faster and easier.

## 3.2 Data Model

In order to explain the design choices for the data model, this section first takes a closer look at the two scenarios and explores the types of data needed to be managed and stored in order to perform the specific functionalities. Then, the section explains how this data was modified to allow for generality. That is, the section describes how the data was structured to not only contain information specific to DSpace, but also to contain information for other remote systems that wish to integrate with SloanSpace as well.

### 3.2.1 Exploring the Data Model Requirements

Recall the second scenario where Jane wants to submit a paper into DSpace. In particular, recall what happens once Jane clicks on the "Upload to DSpace" link in the file area. Illustrated below is a summary of this process:

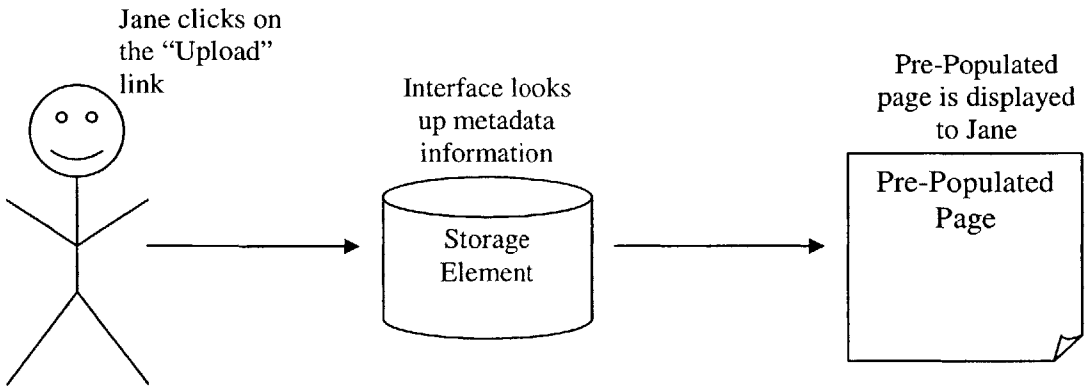



**Figure 3-13: Submit process summary**

As seen in the illustration, the storage element contains the information needed to generate the data in the pre-populated page. In particular, recall the two types of data dynamically generated in the pre-populated page. The first is the metadata fields, and the information associated with those fields. This information includes the display label and text for the field, the input type, and flags indicating whether the field value is required upon submission and whether or not the field can have multiple values. The second type of data dynamically generated is the pre-populated values for the field, where the values are the SloanSpace field values that map to the respective DSpace value. Thus the storage element needed to store data containing the DSpace metadata fields and their information, including the display information, the multiple and required flags, and the SloanSpace – DSpace mapping information. In addition, once the file was submitted to DSpace, the submit interface tagged the file so as to indicate that the file was already submitted. In order to do this, the storage element then needed to store a record of the files that were submitted to DSpace.

Now, recall the first scenario where Prof. Smith wants to search and retrieve files from DSpace into the file storage area for his class. In particular, recall what happens once Prof. Smith has clicked on the "Add File" link associated with a particular search result. Illustrated below is a summary of this process:

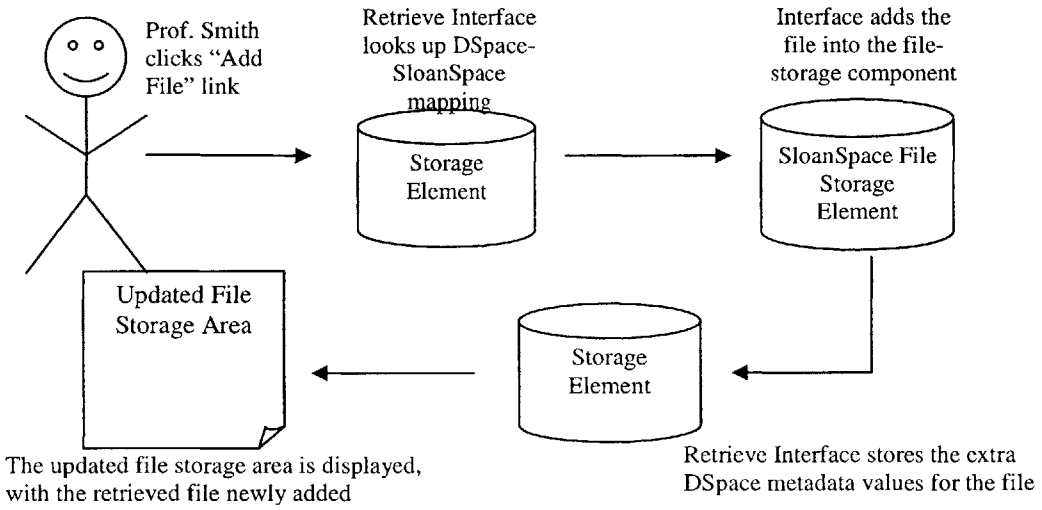



**Figure 3-14: Retrieve process summary**

The illustration above shows the need for the file transfer component's storage element to additionally store two types of information. The first is the DSpace-SloanSpace mapping, shown in the second step of the process. The second is the DSpace metadata for the file being retrieved from DSpace, shown in the fourth step of the process.

In summary, the scenarios described above require the storage element to store the following information. First, it needs to store the DSpace metadata fields and the information associated with them. This information includes the display information, the multiple and required flags, and the mapping information. Mapping information in both directions, that is, SloanSpace field to DSpace field and DSpace field to SloanSpace field needs to be stored since the submit interface uses the first type of mapping mentioned, and the retrieve interface uses the second. Second, it needs to store a record of the files being submitted to DSpace. And third, it needs to store the DSpace metadata information for files retrieved from DSpace.

### 3.2.2 Generalizing the Data Model

The most important design decision for the data model was to structure the data in a way that would easily allow other remote systems to integrate with SloanSpace. In order to accomplish this task, the data stored needed to be generalized for any remote system, not just DSpace, but still meet the data model requirements outlined in the previous section. Thus, the data model requirements were modified as follows. First, instead of simply storing the DSpace metadata fields and the information associated with them, the data model was modified to now store any type of metadata field, from any system. This data type is called **metadata_fields.** However, since each field in **metadata_fields** can now belong to any system, the fields then needed to contain an extra property indicating which metadata schema (or system) it belongs to. Second, instead of simply storing a record of the files submitted to DSpace, the data model now stores records of files submitted to any remote system. This data type is called **metadata_submissions**. Like the **metadata_fields** data type, each record needed to contain an extra property indicating which metadata schema (or system) the file was submitted to. Finally, instead of simply

storing the DSpace metadata information for files retrieved from DSpace, the modified data model stores any remote system's metadata information for files retrieved from that system. This data is called **metadata_field_values**.

In addition, three other data types needed to be created to complete the generalized data model. First, as described above, both the **metadata_fields** and **metadata_submissions** contain an extra property that indicates which remote system the data belongs to. In order to do this, an extra data type was created that stores all the remote systems integrating with SloanSpace. This of course includes DSpace as one of its records. Let us call this new data type, the **metadata_schemas**. Second, the SloanSpace metadata exists in several tables. For instance, the file title exists in one SloanSpace table, while the file creator exists in another. Thus, the field mapping in the **metadata_fields** can't simply list the SloanSpace metadata field name. Instead, a new data type was created to solve this problem, where each record contains the SloanSpace metadata field name and the SloanSpace table and column that contains the value for that field. Let us call this new data type, the **ss_metadata_fields**. Lastly, when other systems, along with DSpace, are integrated with SloanSpace in the future, the metadata values of the retrieved files coming from a remote system can be used in the pre-population step of the submission process into another system. In order to be able to do this, a new data type was created that stored mapping information between the fields of remote systems. This data type is called **metadata_mappings.**

Thus, in summary, six data types (database tables) were created:

1. **metadata_schemas** – stores information about the different metadata systems integrated with SloanSpace.
2. **metadata_fields** – stores the information about the metadata fields.
3. **ss_metadata_fields** – stores information about the SloanSpace file metadata. More specifically, it gives the table and column locations of the metadata values.
4. **metadata_field_values** – stores the remote system metadata information for the retrieved files

5. **metadata_submissions** – stores the records of the file submissions to remote systems.
6. **metadata_mappings** – stores mapping information between the metadata of remote systems.

SloanSpace, and in turn, the file transfer component, uses Oracle for its relational database.

## 3.3 System Implementation Details

### 3.3.1 Search Interface

The main design decision made in developing the search user interface was to allow for generality. That is, not only should the search interface enable users to search through DSpace, but the design of the interface should also allow the search interfaces of other remote systems to be easily built and integrated with the current search interface.

In the first scenario described in section 3.1, Prof. Smith has an option of searching through both the DSpace and the Google domain. The search query page in which Prof. Smith entered the query contained radio buttons indicating which domain to search through. When Prof. Smith clicked on the search button, the interface then searched through the proper domain, and returned the respective results. The only difference between processes of searching DSpace and Google was in the step that fetches the search results from the given domain, and the parsing of those results. The use of ACS service contracts allowed for this task of developing a more generalized search interface.

ACS service contracts is a package available in OpenACS, and, in turn, is available in SloanSpace. Service contracts provide a way to develop interfaces or contracts, which can then be implemented by other packages. The contracts specify operations that implementers are required to fill.

The search service contract contained a paged search operation, paged_search. This operation takes as input a query string, a page number, and the number of results per page. The output of this operation is the search results, indexed on the page number. The

number of search results returned is the number of results per page indicated in the input. For instance, if the page number is 2 and the number of results per page is 5, then the operation will return the 6th through the 10th search results. Each search result is an array of three strings. The first value in the array is the string value for the title of the search result document. The second value it the URL of the document. The third value is the string containing the search result document description.

The DSpace search interface implements the search service contract, and therefore contains a method that fulfills the contract requirements of the paged_search operation. As the paged_search operation specifies, the DSpace paged_search operation takes as input a query string, a page number, and the number of results per page. This method then searches DSpace content via the DSpace SRW web service. The SRW web service allows remote systems to search through DSpace, through its SRU (Search and Retrieve URL service) service. Through SRU, remote systems can formulate search requests to DSpace via a URL. The query URL consists of two parts, separated by a "?" symbol. The first part specifies the SRW server location, and the second part specifies the query string and other query options or elements, where each query option is separated by a "&" symbol. Each search option contains the option tag followed by an "=" sign which is followed by the option value. For example, using the first scenario in section 3.1, Prof. Smith's query to search for content in DSpace containing the word "physics", starting with the 3rd search result, and returning a maximum of 5 results would be:

http://dspace-demo.mit.edu:8080/SRW/search/DSpace?query=phsyics&maximum Records= 5&startRecord=3

The DSpace paged_search method makes the search request to DSpace by calling this URL. The response returned by the SRW service is an XML document which contains the search results and the Dublin Core metadata for the result. The method then parses the XML document, using the XML parsing processes of the TCL Tdom package, in order to obtain the Dublin Core metadata values for the result document's title, description, and URL.

In order to further demonstrate the usability of the search service contract, a Google search interface was also developed. The Google paged_search method implements the paged_search operation of the service contract. This method searches Google content through Google's SOAP-based web service. In particular, it calls the doGoogleSearch SOAP request, and is returned a SOAP response, which is then parsed using the SOAP methods of the TclSOAP package. The SOAP response returned by the Google web service contains the title, the description, and the URL of the search results.

Thus, once Prof. Smith has clicked the "Search" button in the search query page, the search interface calls the search service contract paged_search operation for specific implementer, depending on which domain radio button was selected in the search query page. Finally, the search results page displays the results of the paged_search operation.

### 3.3.2 Retrieve Interface

The "Create URL" method in SloanSpace simply takes in a title, description, and URL, and adds that to the file storage area. Thus, once the "Add URL" is clicked, the retrieve interface simply needs to call the "Create URL" method using the title, description, and URL values returned in the search result.

The "Add File" interface on the other hand, can't simply take the values returned in the search result, since it actually needs to fetch the contents of the file and the extra file metadata. In order to this, the interface makes the SOAP requests to the DSpace ItemAccessService SOAP-based web service. The ItemAccessService contains the SOAP requests "retrieveItem" and "retrieveBitstream". The "retrieveItem" request asks the service to return the Dublin Core metadata for the file, encoded in XML. The "retrieveBitstream" request, on the other hand, asks the service to return the bitstream content of the file. In order to know which file contents to return, both methods require the SOAP service client to supply the file id, which is the file URL returned by the SRW service.

Using the "retrieveItem" and "retrieveBitstream" SOAP requests, the "Add File" component then works as follows:

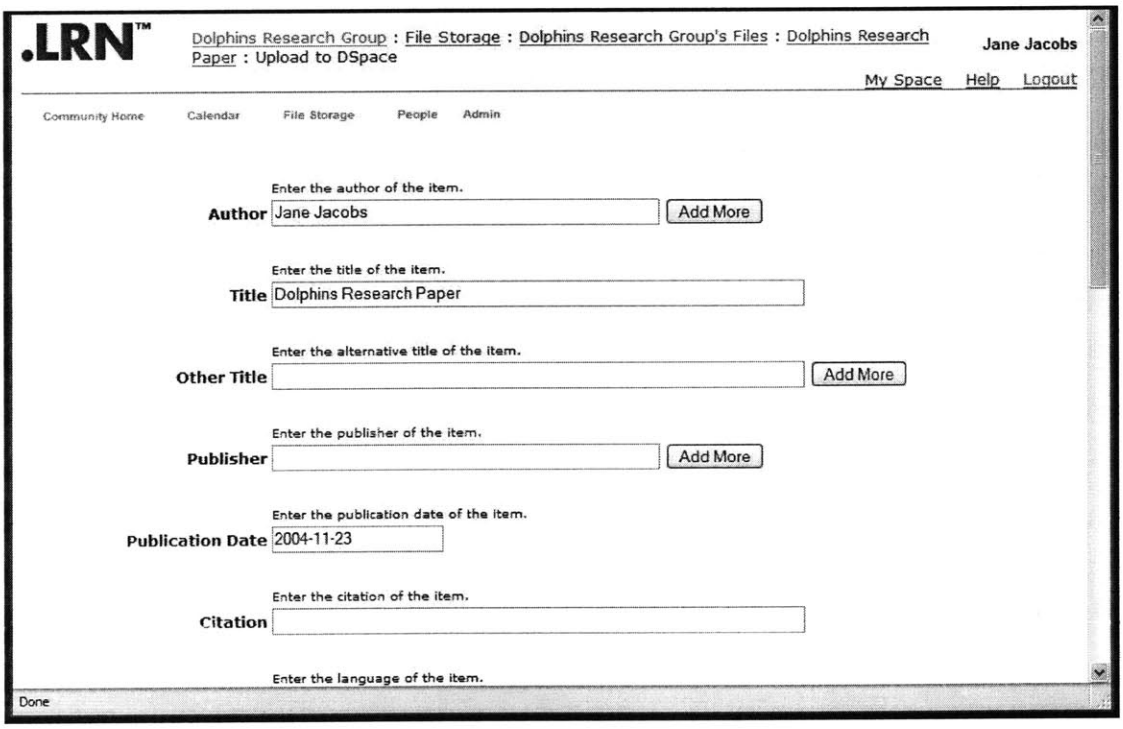
```
process add_file (file_id) {
      1. title_fields = lookup metadata fields in metadata fields table
         that SloanSpace title field maps to
      2. desc_fields = lookup metadata fields in metadata fields table
         that SloanSpace description field maps to
      3. Initialize title_fields_value, desc_fields_value
      4. xml_doc = retrieveItem(file_id)
      5. name_value_array = xml_parse(xml_doc)
            a. xml_parse also sets title_fields_value and
               desc_fields_value
      6. bitstream = retrieveBitstream(file_id)
      7. temp = create_file(bitstream)
      8. upload_file(title_fields_value,desc_fields_value,temp.loc)
      9. add values in name_value_array to metadata_field_values table
}
```

The first step of the process looks in the "metadata fields" table for the Dublin Core metadata elements to which the SloanSpace title field maps to, and stores this list of elements in an array. The second step does the same for the SloanSpace description field. The third step initializes the variables title_fields_value and desc_fields_value, which will contain the values that map to the SloanSpace title field and the SloanSpace description field, respectively. Once these arrays are set and the variables are initialized, step 4 then calls the "retrieveItem" SOAP request, which returns an XML file. Step 5 parses this XML file to get all of the file's Dublin Core metadata element name and value pairs. During the XML parsing, if the metadata element being read is in the title_fields or desc_fields arrays, then the value of this element is concatenated to the current title_fields_value or desc_fields_value, respectively. Thus, after step 5, the name_value_array contains all the file's Dublin Core metadata name-value pairs, while title_fields_value contains the value for the file's SloanSpace title and desc_fields_value contains the value for the file's SloanSpace description. Step 6 then calls the "retrieveBitstream" request, which fetches the bitstream content of the file. Step 7 saves

this bitstream content into a temporary file. Step 8 then calls the same file upload process used when a SloanSpace user manually uploads a file into the file storage area, which takes in the SloanSpace file title, the SloanSpace file description, and the file location. Step 8 calls this process using title_fields_value, desc_fields_value, and the temporary file location as the input. Finally, step 9 adds the file metadata values from the name_value_array into the "metadata field values" table.

### 3.3.3 Submit Interface

The most important process of the submit interface is dynamic generation of the pre-population page, reached when a user clicks on the "Upload to DSpace" link the file area, as shown in the second scenario in section 3.1. Recall from the second scenario, the generated pre-populated page when Jane clicked on the "Upload to DSpace" link. A portion of the screenshot for this page can be seen below:




The dynamic generation for this page works as follows: First, the submit interface looks up the **metadata_fields** table for all the fields and their corresponding field information. For each field, the submit interface then generates an entry for the field, containing the

field label, the display text, an input element, and an optional "Add More" button, depending if the field's multiple flag is true. Finally, the submit interface looks up the SloanSpace – DSpace mapping of the field. If a mapping exists, then the interface looks up the **ss_metadata_fields** table for the SloanSpace table and column name containing the SloanSpace mapped value for this field. It then calls the appropriate database query to fetch this value, and pre-populates the field input element with this value. As shown above, the author, title, and publication date are already pre-populated by the submit interface.

Once the metadata values have been filled and the user has clicked on the "Upload to DSpace" button, the submit interface generates the SOAP request to the DSpace ItemIngestService SOAP-based web service. Three ItemIngestService SOAP requests must be called in a particular order to submit the file into DSpace. The first SOAP request is "depositItem", which deposits the file metadata, encoded in XML. Thus before this SOAP request is made, the interface first encodes the metadata into XML. After "depositItem" is called, the interface must then make the "depositBitstream" SOAP request. This submits the file contents to DSpace, encoded as a base64 string. Finally, the interface calls "depositComplete" which finalizes the file submission process.

If the "depositComplete" request returns true, indicating the success of the DSpace file submission, the interface adds the file to the "metadata submissions" table, and then redirects the user to a page displaying a message indicating the success of the file submission.

# 4 Integrating the File Transfer Component with Other Systems

The process for integrating another system with the file transfer component consists of several steps. First, the file transfer component's database tables need to be filled with the metadata information of the system being integrated. Then, the code that communicates with the web service, both to submit and retrieve files from the system

remotely, must be provided. Lastly, a search service contract implementation that searches through the system's domain must be implemented.

To demonstrate the process of integrating a system with the file transfer component, this chapter will show the steps taken to integrate a sample repository called "JJ Digital Repository".

## 4.1 Filling in the Tables Using the Add Schema Interface

The first step in making the integrating involves filling in the file transfer component's database tables with the metadata information and metadata mappings of the system being integrated. In order to simplify this process, an "Add Schema" user interface was developed. This interface queries the user for the metadata information of the system being integrated then adds the information to the database.

For instance, suppose Jane Jacobs now wanted integrate the "JJ Digital Repository" with SloanSpace. Say that the metadata for the files in her system contain three fields each – author, description, and language, where the language can only be either English or Spanish. Furthermore, say that author was a required field, and that it could contain multiple values. In other words, the file can have multiple authors. The process would then proceed as follows:

First, Jane goes to the main "Add Schema" page, and enters the schema name and the number of metadata fields of the schema. This page is shown in the following screenshot:

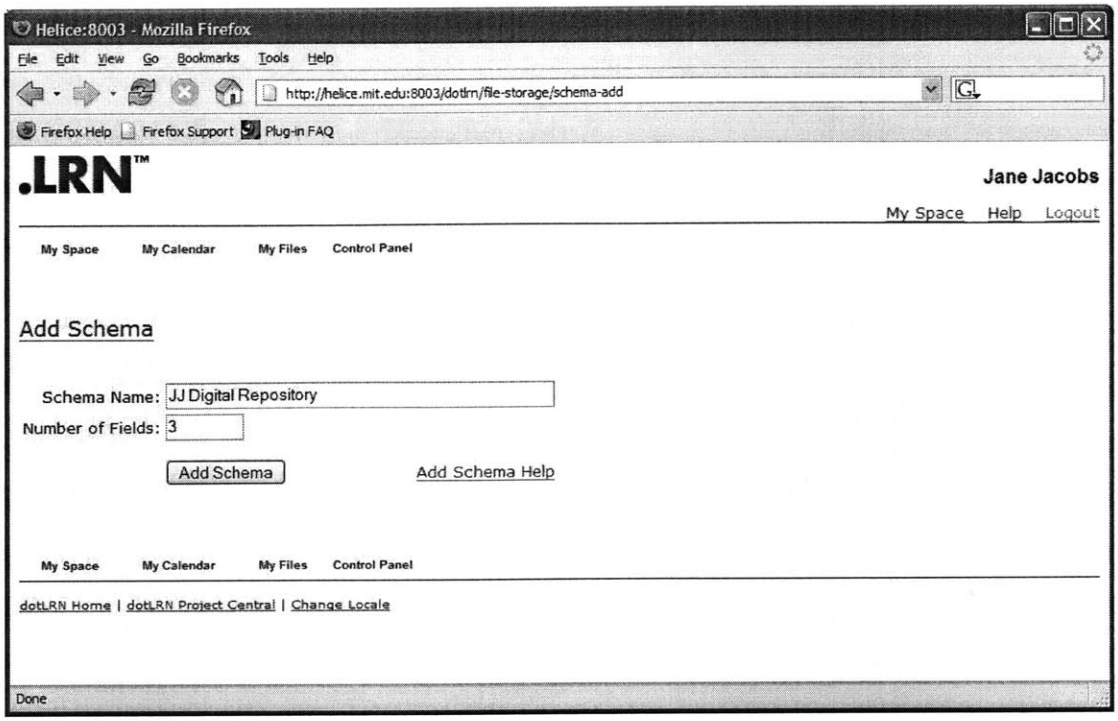



**Figure 4-1: Adding a schema**

Then, Jane clicks on the "Add Schema" button to proceed to the field addition page. Here, Jane fills out the appropriate field information. The field information consists of the field name, the SloanSpace mapping, the mapping type, the required field flag, the multiple values flag, the display name, and the display type, as shown in the following screenshot:

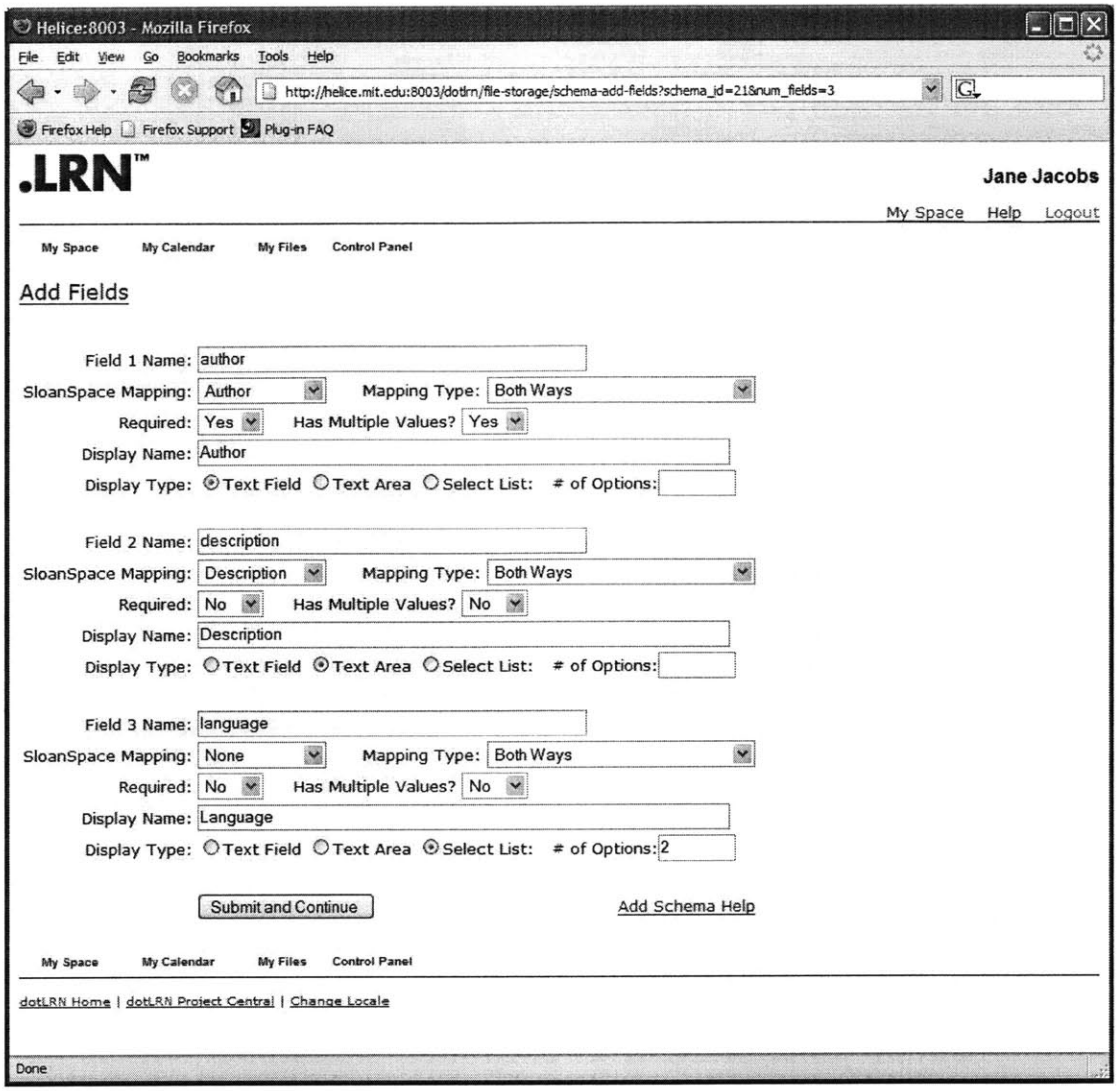



**Figure 4-2: Adding field information**

Once Jane, has filled out the field information, she then clicks on the "Submit and Continue" button. Clicking on this button will then direct Jane to the next page, which queries her for the field display information which is used in the submit interface's pre-populated metadata field query page. Here in the following screenshot is this field display information query page, with the appropriate information filled out:

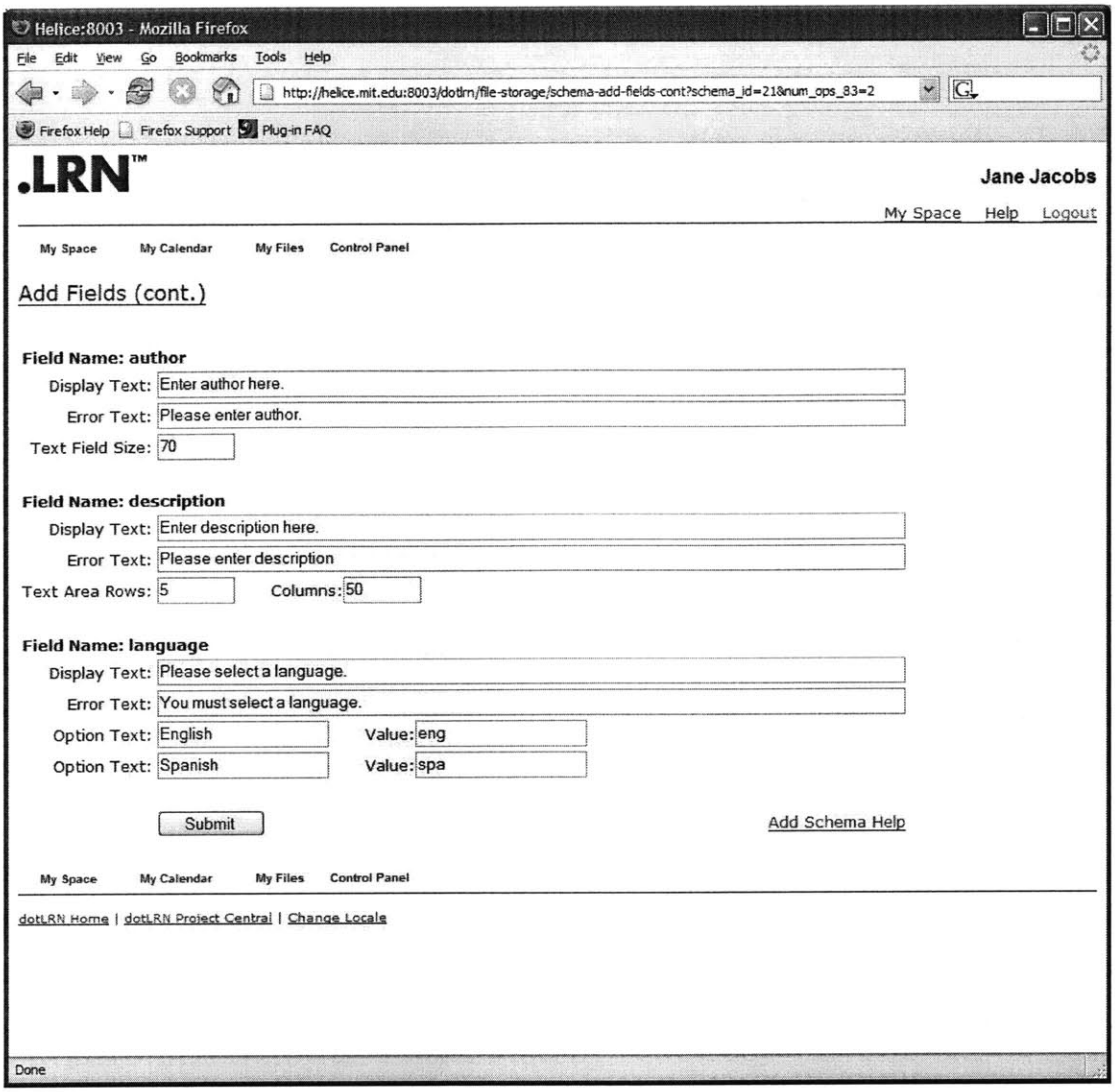



**Figure 4-3: Adding field display information**

Finally, Jane clicks on the "Submit" button to finish the process. The following screenshot shows the page that indicates the success of the submission:

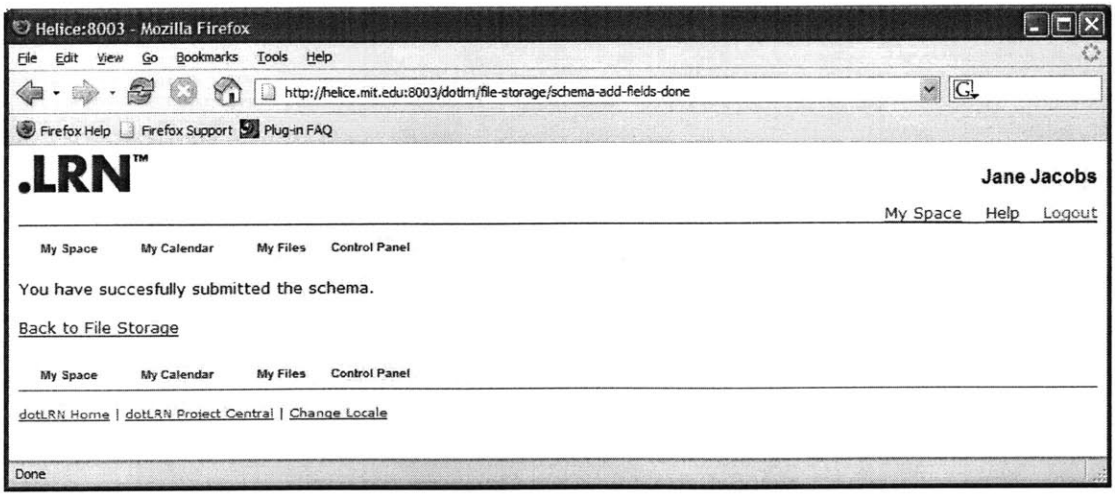



**Figure 4-4: Add schema success**

This process creates the data necessary for the integration. Through this process, the submit interface can now dynamically generate the metadata entry page, using the fields in this schema. To demonstrate this, here is a demo page that will generate the metadata entry page for a file.

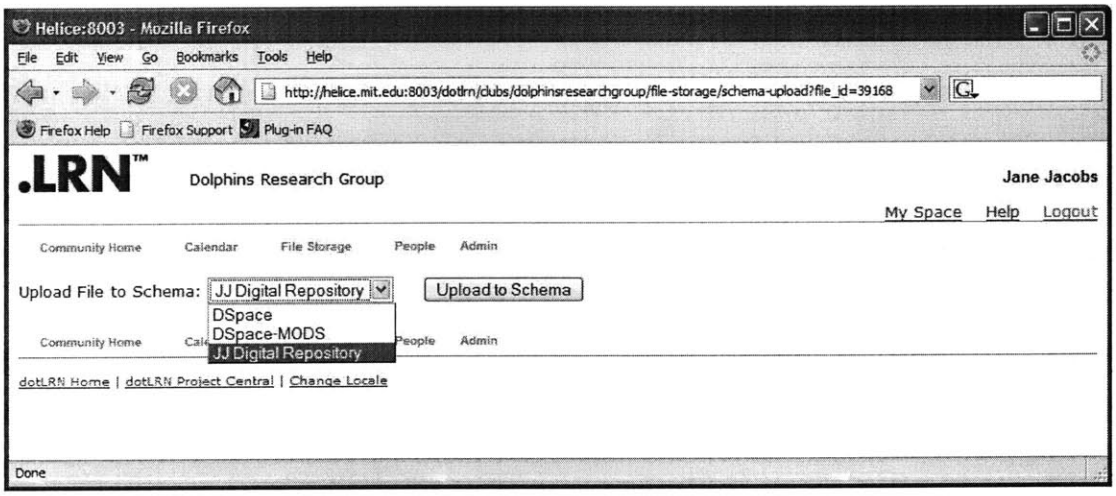



**Figure 4-5: View new schema metadata**

This page, created simply for the purpose of demonstrating the "Add Schema" functionality, allows a user to choose which system to upload the file to. To show that

the "Add Schema" worked for the JJ Digital Repository Jane created, the JJ Digital Repository option is selected. Once the "Upload to Schema" button it now clicked, the dynamically generated metadata entry page for a JJ Digital Repository file submission is displayed. Here below is a screenshot of that page:

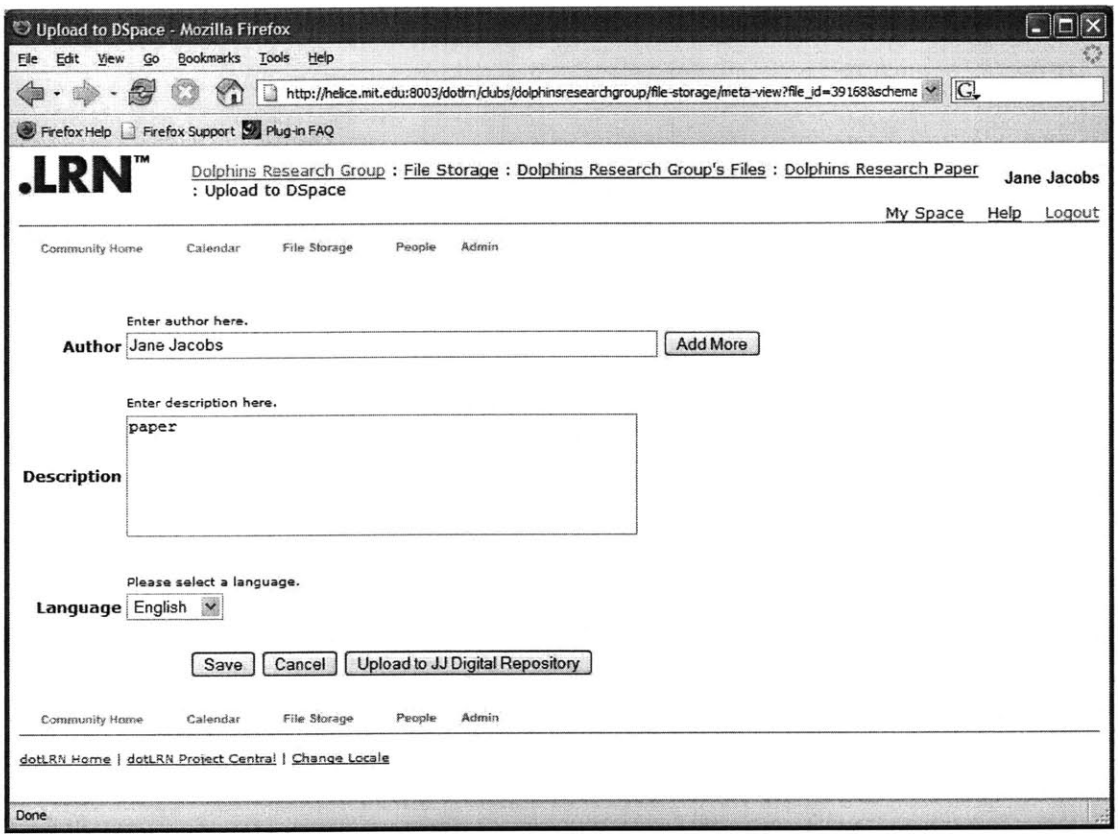



**Figure 4-6: New schema metadata page**

Note that the author field was pre-populated with the SloanSpace author field, which Jane indicated during the "Add Schema" process. In addition, note that the author entry input is a text box, while the description input is a text area, and the language entry input is a select list. Furthermore, the author entry contains an "Add More" button since this field was specified to allow multiple values.

## 4.2 Providing the Code for the Submit and Retrieve Interfaces

Once Jane has added the metadata schema and fields to the database, she must now provide the code that communicates with the "JJ Digital Repository" web service. This code makes the necessary calls to the web service in order to submit the file into the repository. For example, say that the web service contains the SOAP method "submitToJJ" that takes in the base64 encoded content and the values for the metadata field. Jane would then need to create a file with the code that does the following:

- create SOAP request for "submitToJJ"
- encode the file content into base64
- call the SOAP request with the base 64 content and the metadata values

Then, Jane would need to specify, in meta-submit.tcl (which can be found in the appendix), to redirect to this file when the "Upload" button is clicked and the schema id equals the schema id for the "JJ Digital Repository" schema.

Similarly, Jane would need to add the code that retrieves a file from the repository, via the web service. For instance, say that the web service contains two SOAP methods "retrieveMetadataFromJJ" and "retrieveContentFromJJ", that both take in a file id. The "retrieveMetadataFromJJ" method returns the file metadata and the "retrieveContentFromJJ" returns the base 64 encoded file content. Jane would then need to create a file with the code that does the following:

- create SOAP request for "retrieveContentFromJJ"
- call the SOAP request for "retrieveContentFromJJ" with the file id
- save the content into a temporary file
- create SOAP request for "retrieveMetadataFromJJ"
- call the SOAP request for "retrieveMetadataFromJJ" with the file id
- add the temporary file into the file storage area, and use the title and description fields returned by the "retrieveMetadataFromJJ" method

- add the metadata values returned by the "retrieveMetadataFromJJ" method into the metadata_field_values table

### 4.3 Implementing the Search Service Contract

The last component needed to complete the integration is the implementation of the search service contract. Like both the DSpace and Google implementations, Jane needs to create a "JJ Digital Repository" implementation that contains a paged_search operation that takes in a query string, a page number, and the number of results per page. The operation then searches "JJ Digital Repository" content via the repository's web service. Finally, it returns the parses then returns the search results, returned by the web service.

## 5 System Testing and Analysis

This section describes the tests run to measure the effectiveness of the file transfer component, and discusses the results of the tests.

### 5.1 Testing the File Transfer Component

To show the effectiveness of the search and retrieve interface, a test was conducted using the first scenario. The test comprised of running the task in the first scenario, first without using the file transfer component, and then using the file transfer component. Recall that the task consisted of searching for the word "physics" in DSpace, and then adding the search result entitled "The Conceptual Structure of Physics" into the file storage area. The times it took to accomplish the task both without the file transfer component with the file transfer component were recorded and compared.

To show the effectiveness of the submit interface, a similar test was conducted, this time using the second scenario. Recall that the task of the second scenario consisted of submitting a file that was already in SloanSpace into DSpace. Like the first test for the search and retrieve interface, this test comprised of running the task in the second scenario first without using the file transfer component, and then using the file transfer

component. The times it took to accomplish the task without the file transfer component and with the file transfer component were recorded and compared.

Note that the file transfer component tests were done on a development version of SloanSpace, and not the actual deployed version of SloanSpace. Furthermore, the tests were run against a development DSpace web service.

## 5.2 Results of the Tests

Below are summary of results obtained from three users: (Note that the time is recorded in minutes).

Here first are the results from the search and retrieve test:

| Search and Retrieve Test | | |
|---|---|---|
| Time w/o component | Time w/ component | (Time w/ component) / (Time w/o component) |
| 3:16 | 1:25 | .434 |
| 4:07 | 1:34 | .381 |
| 2:15 | 1:03 | .467 |

**Table 5-1: Results for the search and retrieve test**

Here now are the results from the submit test.

| Submit Test | | |
|---|---|---|
| Time w/o component | Time w/ component | (Time w/ component) / (Time w/o component) |
| 4:50 | 2:43 | .562 |
| 3:58 | 2:25 | .609 |
| 4:40 | 2:26 | .521 |

**Table 5-2: Results of the submit test**

The results for the search and retrieve test, shown in Table 1, show that using the file transfer component speeds up the task in the first scenario significantly. On average, ratio of the time to accomplish the task with the component to the time to accomplish the task without the component is .427:1. Thus, using the file transfer component cuts the time to accomplish the task without the component by 57%, which is a little more than half.

The results for the submit test, shown in Table 2, also show a significant decrease in time spent performing the task in the second scenario when using the current system without the file transfer component vs. using the file transfer component. On average, the ratio of the time to accomplish the task with the component to the time to accomplish the task without the component is .564:1. Thus, using the file transfer component cuts the time to accomplish the task without the component by 44%, which is a little less than half.

## 5.3 Discussion of the Test Results

The test results show that the search and retrieve interface significantly cuts down the time to search DSpace, and to place the search results into the respective file storage area. Several factors contribute to this improvement. First, the user performing the search need not leave the SloanSpace environment. So time is no longer spent switching between the two environments. Second, with the file transfer component, the user no longer has to save the file into the local computer. And third, the user no longer has to fill in the information for the uploaded file. Recall that when uploading a file into SloanSpace, the user has to fill out the title, description, and file location (in the local computer). When using the file transfer component, this information is filled in automatically. Thus a significant amount of time is saved.

The results also show that the submit interface significantly cuts down the time to submit a file into DSpace, if the file was already uploaded into SloanSpace. This is again due to several factors. First, as in the search and retrieve interface, the user performing the

submission need not leave the SloanSpace environment. And second, the file transfer component pre-populates the metadata so that users no longer have to fill in data that SloanSpace already keeps track of.

More importantly however, the results show the usefulness of interoperability between SloanSpace and DSpace, and more generally, the interoperability between systems and repositories. This project shows integrating SloanSpace with DSpace allows for faster file transfers between the two systems by using the data already stored by the systems, cutting down time to accomplish the tasks approximately by half.

# 6 Future Work

## 6.1 System Deployment

The file transfer component currently runs on a development version of SloanSpace, and communicates with a development version of the DSpace web services. The hope for the future is for this component to actually be deployed and used in the deployed version of SloanSpace.

However, in order for the file transfer component to be deployed, two major issues need to first be addressed. The first issue deals with authentication. Currently, users who wish to submit files into DSpace must be registered DSpace users. With the file transfer component however, any SloanSpace user can submit files into DSpace. DSpace has no way to authenticate the users who are submitting files to their system if the users submit files through the SloanSpace file transfer component. In order then for the system to be deployed and used, a component must be developed that allows DSpace to authenticate and authorize the user before performing any file transfer operations.

The second issue deals with which DSpace collection the files go to when submitted via the file transfer component. Currently, in DSpace, when a user wishes to submit a file, he first specifies which DSpace collection he wants to add the file in. The file transfer

component currently submits all files into a demo collection. An example solution to this problem would be for DSpace to create a collection specifically for files coming in from SloanSpace. Using this, the file transfer component would then only need the identification for this collection. Although this simplifies the process, it is not very flexible and not very organized, since papers from SloanSpace can be very varied, as they can come from different SloanSpace communities. Another potential solution to this problem would be for the file transfer component to provide the users with a list of DSpace collections, and have the user choose the collection he wishes to add the file to. The problem with this is that certain collections can be restricted, and so there must also be a way to know which collections can be accessed.

## 6.2 Integration with Other Systems

Future work can also be directed towards integrating more systems with SloanSpace. The architecture of the file transfer component allows this to be done easily, as shown in chapter 4. For example, a useful integration would be to integrate OpenCourseWare with DSpace. OpenCourseWare is a system that places MIT course materials on the web for free. The course materials are not the materials of the current semester, but the material of a past semester. Thus, in order to construct an OpenCourseWare page, it would simplify the process if material from SloanSpace could be transferred easily into OpenCourseWare. Integration could also be made with other digital repositories. This would enable users to search through more domains.

# References


[1] SloanSpace. http://sloanspace.mit.edu

[2] DSpace. http://dspace.mit.edu

[3] .LRN. http://www.dotlrn.org

[4] OpenACS. http://www.openacs.org

[5] DublinCore. http://www.dublincore.org

[6] OpenCourseWare. http://ocw.mit.edu

[7] IMS Global Learning Consortium. http://imsglobal.org

[8] OKI – Open Knowledge Initiative. http://www.okiproject.org

[9] K. Riley and M. McKell. "IMS Digital Repositories Interoperability - Core Functions Information Model." 13 January 2003. 8 December 2004. http://www.imsglobal.org/digitalrepositories/driv1p0/imsdri_infov1p0.html#1263439

[10] "About the Open Knowledge Initiative." 26 July 2004. 8 December 2004. http://www.okiproject.org/documents/About%20OKI.pdf

[11] "Managing Complexity and Surviving Technology Change". Massachusetts Institute of Technology. 2004. 8 December 2004. http://www.okiproject.org/documents/OKIManagingComplexity_rel_1_0.pdf

[12] TclSOAP. http://tclsoap.sourceforge.net

[13] TDom. http://www.tdom.org

# A Database Tables

```
-- The table contains the metadata schemas used by the system.
-- Each row in the table contains the schema name and the table
-- name of the schema table.  (The schema table is the table containing
-- information for that specific schema.  For every schema added, a
-- new schema table is created.)

create table metadata_schemas (
       schema_id             integer
                             constraint metadata_schemas_table_name_pk
                             primary key,
       schema_name           varchar(100)
                             constraint metadata_schemas_name_nn
                             not null
);

create sequence seq_schema_id start with 1 increment by 1;

create or replace trigger trg_schema_insert
       before insert on metadata_schemas
       for each row
begin
       if :new.schema_id is null then
       select seq_schema_id.nextval into :new.schema_id from dual;
       end if;
end;
/


-- This table will contain the SloanSpace metadata.  Each row contains
-- the SS metadata name, the original SloanSpace table or view,
-- and the column that the field is mapped to.

create table sloanspace_file_metadata (
       field_name            varchar(50)
                             constraint ss_file_name_pk
                             primary key,
       mapping_table_or_view varchar(50),
                             --table or view name of column to which this field is
mapped to
       mapping_col_name      varchar(50)
                             --column name
);

-- This table contains the fields and the field information for the Dublin
-- Core metadata schema.  It is specific to the Dublic Core schema.  Each
-- row contains the field id, the field name, the SloanSpace metadata field
-- that the Dublin Core field is mapped to, and the mapping certainty value,
-- which specifies how certain the mapping is between the two fields.

create table metadata_fields (
       field_id                      integer
                             constraint metadata_fields_field_id_pk
                             primary key,
       field_name            varchar(50)
                             constraint metadata_fields_name_nn
                             not null,
       pretty_name           varchar(100)
                             constraint metadata_fields_pretty_name_nn
                             not null,
       schema_id             integer
                             constraint metadata_fields_schema_fk
                             references metadata_schemas
                             constraint metadata_fields_schema_nn
                             not null,
       mapping_ss_field      varchar(50)
                             constraint metadata_fields_mapping_fk
                             references sloanspace_file_metadata,
                             --table or view name of column to which this field is
```

```
                                --mapped to
        map_type                integer
                                constraint metadata_field_map_type_ck
                                check (map_type in (1,0,-1)),
                                --map type = 1 if from field to ss, 0
                                --if both to and from, and -1 if from ss to field
        display_text            varchar(200),
        display_type            varchar(30),
                                -- type of input display, e.g. text, textarea, select,
                                -- radio, etc.
                                -- display_type will be inside <display_type> and
                                -- </display_type>
        display_attributes      varchar(200),
                                -- attributes of the display, ex. for textarea rows=3
                                -- cols=50, etc.
                                -- ex. <display_type display_attributes></display_type>
        display_elements        varchar2(4000),
                                -- elements of display (for select lists)
                                -- ex. <display_type
                                -- display_attributes>display_elements</display_type>
        error_text              varchar(500),
                                -- text displayed field is required, but left empty
        required                char(1)
                                default 'f'
                                constraint metadata_fields_required_nn
                                not null
                                constraint metadata_fields_required_ck
                                check (required in ('t','f')),
                                -- indicates whether or not the field is required upon
                                -- submission
        multiple                char(1)
                                default 'f'
                                constraint metadata_fields_multiple_nn
                                not null
                                constraint metadata_fields_multiple_ck
                                check (multiple in ('t','f'))
);

create sequence seq_field_id start with 1 increment by 1;

create or replace trigger trg_field_insert
        before insert on metadata_fields
        for each row
begin
        if :new.field_id is null then
        select seq_field_id.nextval into :new.field_id from dual;
        end if;
end;
/

create table metadata_field_values (
        file_id                 integer
                                constraint metadata_values_file_id_nn
                                not null,
        field_id                integer
                                constraint metadata_values_field_id_nn
                                not null,
        field_value             varchar2(4000),
        schema_id               integer
                                constraint metadata_values_schema_nn
                                not null
);

--map type = 1 if from field_1 to field_2, 0 if both to and from, and -1 if from field 2
to field 1
create table metadata_schema_mappings (
        field_id_1              integer
                                constraint metadata_mappings_f1_nn
                                not null,
        schema_id_1             integer
                                constraint metadata_mappings_s1_nn
```

```
                                not null,
        field_id_2              integer
                                constraint metadata_mappings_f2_nn
                                not null,
        schema_id_2             integer
                                constraint metadata_mapings_s2_nn
                                not null,
        map_type                integer
                                constraint metadata_mappings_ck
                                check (map_type in (1,0,-1))
);


create table metadata_submissions (
        file_id                 integer
                                constraint metadata_subm_file_id_fk
                                references cr_items
                                constraint metadata_subm_file_id_nn
                                not null,
        schema_id               integer
                                constraint metadata_subm_schema_fk
                                references metadata_schemas
                                constraint metadata_subm_schema_nn
                                not null
);


-- VIEWS --

create or replace view metadata_file_view
as
select  i.item_id as file_id,
        i.name,
        r.title as file_name,
        r.publish_date,
        r.description,
        r.content,
        r.content_length,
        r.mime_type
from    cr_items i, cr_revisions r
where   i.live_revision = r.revision_id;


create or replace view metadata_user_view
as
select  o.object_id as file_id,
        p.first_names || ' ' || p.last_name as full_name
from    acs_objects o, persons p
where   o.creation_user = p.person_id;

-- DATA --

--
--insert the sloanspace file metadata
--

insert into sloanspace_file_metadata values ('author','metadata_user_view','full_name');
insert into sloanspace_file_metadata values ('title','metadata_file_view','name');
insert into sloanspace_file_metadata values
('publish_date','metadata_file_view','publish_date');
insert into sloanspace_file_metadata values
('description','metadata_file_view','description');
```

# B Critical Source Code

## B.1 dspace-get.tcl

```
ad_page_contract {
    Add File From DSpace

    @author Genevieve Cuevas (gtcuevas@mit.edu)
    @creation-date 1 Apr 2004
} {
    folder_id:integer,notnull
    schema_id:integer,notnull
    {itemID:trim none}
    {title:trim ""}
    {description:trim ""}
} -validate {
    valid_folder -requires {folder_id:integer} {
        if ![fs_folder_p $folder_id] {
            ad_complain "[_ file-storage.lt_The_specified_parent_]"
        }
    }

}

set old_title $title
set old_desc $description
set title ""
set description ""

set context [fs_context_bar_list -final "Add File From DSpace" $folder_id]

#get the dspace-export file
#base this on file title or filename (however dspace web service is formatted)
#set content [util_httpget http://web.mit.edu/gtcuevas/Public/export.txt]


##### DSPACE WEB SERVICE CALL ####
::SOAP::create GetFile \
    -uri "http://dspace-14.mit.edu:8080/axis/services/ItemAccessService" \
    -proxy "http://dspace-14.mit.edu:8080/axis/services/ItemAccessService "\
    -name "retrieveItem" \
    -action "" \
    -params { epersonID string itemID string }

set personid rrodgers@mit.edu
set itemid http://hdl.handle.net/123456789/23
if [catch {set content_encoded [GetFile $personid $itemid]} errmsg] {
    ad_return_complaint 1 "Error getting the file from DSpace"
    ad_script_abort
}
set content [::base64::decode $content_encoded]


#get the field name of the fields that map to ss title and description
set titles \
    [db_list get_titles \
        "select field_name from metadata_fields where mapping_ss_field='title' and
schema_id=$schema_id and (map_type=1 or map_type=0)"]
set descriptions \
    [db_list get_desc \
        "select field_name from metadata_fields where mapping_ss_field='description' and
schema_id=$schema_id and (map_type=1 or map_type=0)"]

#parse export file
if { [catch {dom parse $content doc} errMsg] } {
    return
```

```
}
set root [$doc documentElement]

set mods_field ""
set mods_value ""
set file_loc ""
set file_md [list]

foreach child [$root childNodes] {
    set childName [$child nodeName]
    lappend file_content $childName
    if [string equal $childName fileSec] {
        foreach fileSecChild [$child childNodes] {
            if [string equal [$fileSecChild nodeName] fileGrp] {
                foreach fileGrpChild [$fileSecChild childNodes] {
                    if [string equal [$fileGrpChild nodeName] file] {
                        set parsed_file_loc [$fileGrpChild getAttribute OWNERID noval]
                        if { ![string equal $parsed_file_loc noval] } {
                            if { ![string equal $parsed_file_loc ""] } {
                                set file_loc "$parsed_file_loc"
                            }
                        }
                    }
                }
            }
        }
    } elseif [string equal $childName dmdSec] {
        foreach dmdChild [$child childNodes] {
            set dmdChildName [$dmdChild nodeName]
            if [string equal $dmdChildName mdWrap] {
                foreach mdChild [$dmdChild childNodes] {
                    set mdChildName [$mdChild nodeName]
                    if [string equal $mdChildName xmlData] {
                        foreach field [$mdChild childNodes] {
                            set mods_field ""
                            set mods_value ""
                            set fieldName [$field nodeName]
                            lappend md_content $fieldName
                            if { [llength [$field childNodes]] == 1} {
                                set field_child [$field firstChild]
                                ### parse the mods fields
                                if [string equal $fieldName mods:abstract] {
                                    if [string equal [$field_child nodeType] TEXT_NODE] {
                                        set mods_field description_abstract
                                        set mods_value [$field text]
                                    }
                                } elseif [string equal $fieldName mods:accessCondition] {
                                    if { [$field hasAttribute xlink:simpleLink] == 1} {
                                        if [string equal [$field_child nodeType] TEXT_NODE]
{
                                            set mods_field rights_uri
                                            set mods_value [$field text]
                                        }
                                    } elseif { [string equal [$field getAttribute type
noval] "useAndReproducation"] } {
                                        if [string equal [$field_child nodeType] TEXT_NODE]
{
                                            set mods_field rights
                                            set mods_value [$field text]
                                        }
                                    }
                                } elseif [string equal $fieldName mods:classification] {
                                    set attr_val [$field getAttribute authority noval]
                                    if [string equal [$field_child nodeType] TEXT_NODE] {
                                        if [string equal $attr_val ddc] {
                                            set mods_field subject_ddc
                                            set mods_value [$field text]
                                        } elseif [string equal $attr_val lcc] {
                                            set mods_field subject_lcc
                                            set mods_value [$field text]
                                        } elseif [string equal $attr_val lcsh] {
```

```
                                    set mods_field subject_lcsh
                                    set mods_value [$field text]
                                } elseif [string equal $attr_val mesh] {
                                    set mods_field subject_mesh
                                    set mods_value [$field text]
                                } elseif [string equal $attr_val local] {
                                    set mods_field subject_other
                                    set mods_value [$field text]
                                } elseif [string equal $attr_val noval] {
                                    set mods_field subject_classification
                                    set mods_value [$field text]
                                }
                            }
                        } elseif [string equal $fieldName mods:extension] {
                            if [string equal [$field_child nodeType] ELEMENT_NODE]
{
                                if [string equal [$field_child getAttribute encoding
noval] iso8601] {
                                    if { [llength [$field_child childNodes]] == 1} {
                                        set element_child [$field_child firstChild]
                                        if [string equal [$element_child nodeType]
TEXT_NODE] {
                                            set element_name [$field_child nodeName]
                                            if [string equal $element_name
mods:dateAccessioned] {
                                                set mods_field date_accessioned
                                                set mods_value [$field_child text]
                                            } elseif [string equal $element_name
mods:dateAvailable] {
                                                set mods_field date_available
                                                set mods_value [$field_child text]
                                            } elseif [string equal $element_name
mods:dateSubmitted] {
                                                set mods_field date_submitted
                                                set mods_value [$field_child text]
                                            }
                                        }
                                    }
                                }
                            }
                        } elseif [string equal $fieldName mods:genre] {
                            if [string equal [$field_child nodeType] TEXT_NODE] {
                                set mods_field type
                                set mods_value [$field text]
                            }
                        } elseif [string equal $fieldName mods:identifier] {
                            set attr_val [$field getAttribute type noval]
                            if [string equal [$field_child nodeType] TEXT_NODE] {
                                if [string equal $attr_val govdoc] {
                                    set mods_field identifier_govdoc
                                    set mods_value [$field text]
                                } elseif [string equal $attr_val isbn] {
                                    set mods_field identifier_isbn
                                    set mods_value [$field text]
                                } elseif [string equal $attr_val ismn] {
                                    set mods_field identifier_ismn
                                    set mods_value [$field text]
                                } elseif [string equal $attr_val issn] {
                                    set mods_field identifier_issn
                                    set mods_value [$field text]
                                } elseif [string equal $attr_val local] {
                                    set mods_field identifier_local
                                    set mods_value [$field text]
                                } elseif [string equal $attr_val sici] {
                                    set mods_field identifier_sici
                                    set mods_value [$field text]
                                } elseif [string equal $attr_val uri] {
                                    set mods_field identifier_uri
                                    set mods_value [$field text]
                                } elseif [string equal $attr_val noval] {
                                    set mods_field identifier
```

```
                                    set mods_value [$field text]
                                }
                            }
                        } elseif [string equal $fieldName mods:language] {
                            if [string equal [$field_child nodeType] ELEMENT_NODE]
{
                                if [string equal [$field_child nodeName]
mods:languageTerm] {
                                    set element_attr [$field_child getAttribute
authority noval]
                                    if { [llength [$field_child childNodes]] == 1} {
                                        if [string equal [[$field_child firstChild]
nodeType] TEXT_NODE] {
                                            if [string equal $element_attr rfc3066]
{
                                                set mods_field language_iso
                                                set mods_value [$field_child text]
                                            } elseif [string equal $element_attr
noval] {
                                                set mods_field language
                                                set mods_value [$field_child text]
                                            }
                                        }
                                    }
                                }
                            }
                        } elseif [string equal $fieldName mods:name] {
                            if [string equal [$field_child nodeType] ELEMENT_NODE]
{
                                if [string equal [$field_child nodeName]
mods:namePart] {
                                    if { [llength [$field_child childNodes]] == 1} {
                                        if [string equal [[$field_child firstChild]
nodeType] TEXT_NODE] {
                                            set mods_field contributor
                                            set mods_value [$field_child text]
                                        }
                                    }
                                }
                            }
                        } elseif [string equal $fieldName mods:note] {
                            if [string equal [$field_child nodeType] TEXT_NODE] {
                                if { [$field hasAttribute xlink:simpleLink] == 1} {
                                    set mods_field description_uri
                                    set mods_value [$field text]
                                } else {
                                    set attr_val [$field getAttribute type noval]
                                    if [string equal $attr_val provenance] {
                                        set mods_field description_provenance
                                        set mods_value [$field text]
                                    } elseif [string equal $attr_val sponsorship] {
                                        set mods_field description_sponsorship
                                        set mods_value [$field text]
                                    } elseif [string equal $attr_val "statement of
responsibility"] {
                                        set mods_field
description_statementofresponsibility
                                        set mods_value [$field text]
                                    } elseif [string equal $attr_val noval] {
                                        set mods_field description
                                        set mods_value [$field text]
                                    }
                                }
                            }
                        } elseif [string equal $fieldName mods:originInfo] {
                            if [string equal [$field_child nodeType] ELEMENT_NODE]
{
                                if { [llength [$field_child childNodes]] == 1} {
                                    if [string equal [[$field_child firstChild]
nodeType] TEXT_NODE] {
```

```
                                        set attr_val [$field_child getAttribute
encoding noval]
                                        set element_name [$field_child nodeName]
                                        if {string equal $attr_val iso8601] {
                                            if [string equal $element_name
mods:copyrightDate] {
                                                set mods_field date_copyright
                                                set mods_value [$field_child text]
                                            } elseif [string equal $element_name
mods:dateCreated] {
                                                set mods_field date_created
                                                set mods_value [$field_child text]
                                            } elseif [string equal $element_name
mods:dateIssued] {
                                                set mods_field date_issued
                                                set mods_value [$field_child text]
                                            } elseif [string equal $element_name
mods:dateOther] {
                                                set mods_field date
                                                set mods_value [$field_child text]
                                            }
                                        } elseif [string equal $attr_val noval] {
                                            if [string equal $element_name
mods:publisher] {
                                                set mods_field publisher
                                                set mods_value [$field_child text]
                                            }
                                        }
                                    }
                                }
                            } elseif [string equal $fieldName mods:physicalDescription]
{
                                if [string equal [$field_child nodeType] ELEMENT_NODE]
{
                                    if { [llength [$field_child childNodes]] == 1 } {
                                        if [string equal [[$field_child firstChild]
nodeType] TEXT_NODE] {
                                            set element_name [$field_child nodeName]
                                            if [string equal $element_name mods:extent]
{
                                                set mods_field format_extent
                                                set mods_value [$field_child text]
                                            } elseif [string equal $element_name
mods:form] {
                                                set mods_field format
                                                set mods_value [$field_child text]
                                            } elseif [string equal $element_name
mods:internetMediaType] {
                                                set mods_field format_mimetype
                                                set mods_value [$field_child text]
                                            }
                                        }
                                    }
                                }
                            } elseif [string equal $fieldName mods:relatedItem] {
                                if [string equal [$field_child nodeType] ELEMENT_NODE]
{
                                    if [string equal [$field getAttribute type noval]
host] {
                                        if [string equal [$field_child nodeName]
mods:part] {
                                            if { [llength [$field_child childNodes]] ==
1 } {
                                                set text_node [$field_child firstChild]
                                                if [string equal [$text_node nodeType]
ELEMENT_NODE] {
                                                    if [string equal [$text_node
nodeName] mods:text] {
                                                        set mods_field
identifier_citation
```

```
                                        set mods_value [$text_node text]
                                    }
                                }
                            }
                        }
                    } elseif [string equal [$field getAttribute type
noval] noval] {
                        if [string equal [$field_child nodeName]
mods:title] {
                            set mods_field relation
                            set mods_value [$field_child text]
                        } elseif [string equal [$field_child nodeName]
mods:location] {
                            if { [llength [$field_child childNodes]] ==
1} {
                                set url_ele [$field_child firstChild]
                                if [string equal [$url_ele nodeName]
mods:url] {
                                    set mods_field relation_uri
                                    set mods_value [$url_ele text]
                                }
                            }
                        }
                    }
                } elseif [string equal [$field_child nodeType]
TEXT_NODE] {
                    set attr_val [$field getAttribute type noval]
                    if [string equal $attr_val constituent] {
                        set mods_field relation_haspart
                        set mods_value [$field text]
                    } elseif [string equal $attr_val otherVersion] {
                        set mods_field relation_version
                        set mods_value [$field text]
                    } elseif [string equal $attr_val original] {
                        set mods_field relation_isbasedon
                        set mods_value [$field text]
                    } elseif [string equal $attr_val otherFormat] {
                        set mods_field relation_isformatof
                        set mods_value [$field text]
                    } elseif [string equal $attr_val host] {
                        set mods_field relation_ispartof
                        set mods_value [$field text]
                    } elseif [string equal $attr_val series] {
                        set mods_field relation_ispartofseries
                        set mods_value [$field text]
                    } elseif [string equal $attr_val isReferencedBy] {
                        set mods_field relation_isreferencedby
                        set mods_value [$field text]
                    } elseif [string equal $attr_val succeeding] {
                        set mods_field relation_isreplacedby
                        set mods_value [$field text]
                    } elseif [string equal $attr_val replaces] {
                        set mods_field relation_replaces
                        set mods_value [$field text]
                    } elseif [string equal $attr_val requires] {
                        set mods_field relation_requires
                        set mods_value [$field text]
                    } elseif [string equal $attr_val original] {
                        if { [$field hasAttribute xlink:simpleLink] ==
1} {
                            set mods_field source_uri
                            set mods_value [$field text]
                        } else {
                            set mods_field source
                            set mods_value [$field text]
                        }
                    }
                }
            } elseif [string equal $fieldName mods:subject] {
                if [string equal [$field_child nodeType] ELEMENT_NODE]
{
```

```
                                    if { [llength [$field_child childNodes]] == 1 } {
                                        if [string equal [[$field_child firstChild]
nodeType] TEXT_NODE] {
                                            set element_name [$field_child nodeName]
                                            if [string equal $element_name
mods:geographic] {
                                                set mods_field coverage_spatial
                                                set mods_value [$field_child text]
                                            } elseif [string equal $element_name
mods:temporal] {
                                                set mods_field coverage_temporal
                                                set mods_value [$field_child text]
                                            } elseif [string equal $element_name
mods:topic] {
                                                set mods_field subject
                                                set mods_value [$field_child text]
                                            }
                                        }
                                    }
                                } elseif [string equal $fieldName mods:tableOfContents] {
                                    if [string equal [$field_child nodeType] TEXT_NODE] {
                                        set mods_field type
                                        set mods_value [$field text]
                                    }
                                } elseif [string equal $fieldName mods:titleInfo] {
                                    if [string equal [$field_child nodeType] TEXT_NODE] {
                                        set attr_val [$field getAttribute type noval]
                                        if [string equal $attr_val alternative] {
                                            set mods_field title_alternative
                                            set mods_value [$field text]
                                        } elseif [string equal $attr_val noval] {
                                            set mods_field title
                                            set mods_value [$field text]
                                        }
                                    }
                                }
                            } elseif { [llength [$field childNodes]] == 2} {
                                if [string equal $fieldName mods:name] {
                                    set role_ele [$field firstChild]
                                    set namePart_ele [$field lastChild]
                                    if [string equal [$role_ele nodeName] mods:role] {
                                        if [string equal [$namePart_ele nodeName]
mods:namePart] {
                                            if { [llength [$role_ele childNodes]] == 1} {
                                                set roleTerm_ele [$role_ele firstChild]
                                                if [string equal [$roleTerm_ele nodeName]
mods:roleTerm] {
                                                    if [string equal [$roleTerm_ele
getAttribute type noval] text] {
                                                        set role_term [$roleTerm_ele text]
                                                        if [string equal $role_term advisor]
{
                                                            set mods_field
contributor_advisor
                                                            set mods_value [$namePart_ele
text]
                                                        } elseif [string equal $role_term
author] {
                                                            set mods_field contributor_author
                                                            set mods_value [$namePart_ele
text]
                                                        } elseif [string equal $role_term
editor] {
                                                            set mods_field contributor_editor
                                                            set mods_value [$namePart_ele
text]
                                                        } elseif [string equal $role_term
illustrator] {
                                                            set mods_field
contributor_illustrator
```

```
                                                    set mods_value [$namePart_ele
text]
                                                } elseif [string equal $role_term
other] {
                                                    set mods_field contributor_other
                                                    set mods_value [$namePart_ele
text]
                                                }
                                            }
                                        }
                                    }
                                }
                            }
                            if { ![string equal $mods_value ""] } {
                                lappend file_md [list $mods_field $mods_value]
                                if { [lsearch -exact $titles $mods_field] != -1} {
                                    append title "$mods_value "
                                }
                                if { [lsearch -exact $descriptions $mods_field] != -1} {
                                    append description "$mods_value "
                                }
                            }
                        }
                    }
                }
            }
        }
    }
}

#### DSPACE WEB SERVICE CALL ###

::SOAP::create GetContent \
    -uri "http://dspace-14.mit.edu:8080/axis/services/ItemAccessService" \
    -proxy "http://dspace-14.mit.edu:8080/axis/services/ItemAccessService "\
    -name "retrieveBitstream" \
    -action "" \
    -params { epersonID string bitstreamID string }

set bitstream_content [GetContent $personid $file_loc]
set tempfile_loc [acs_root_dir]/packages/file-storage/www/dspace-temp/tempfile
set out [open $tempfile_loc w]
fconfigure $out -translation binary
puts -nonewline $out [::base64::decode $bitstream_content]
close $out

### add the file into sloanspace ###

# Check for write permission on this folder
ad_require_permission $folder_id write

# Get the user
set user_id [ad_conn user_id]

# Get the ip
set creation_ip [ad_conn peeraddr]

# Get file mime_type
set mime_type [cr_filename_to_mime_type -create $file_loc]

# Get the filename part of the upload file
if { ![regexp {[^//\\]+$} $file_loc filename] } {
    # no match
    set filename $file_loc
}

# Get the title
if { [empty_string_p $title] } {
    set title $filename
```

```
}

#db calls
db_transaction {
    set file_id [db_exec_plsql new_lob_file {}]
    set version_id [db_exec_plsql new_version {}]
    db_dml lob_content {} -blob_files [list $tempfile_loc]
    # Unfortunately, we can only calculate the file size after the lob is uploaded
    db_dml lob_size {}

    if { [string is false [permission::permission_p -party_id $user_id -object_id
$folder_id -privilege admin]] } {
        permission::grant -party_id $user_id -object_id $file_id -privilege admin
    }

    ### add metadata to metadata_field_values ###
    ### delete any old records for files (so this new record will replace them)
    db_dml delete_old_values \
        "delete from metadata_field_values where file_id = $file_id and schema_id =
$schema_id"

    #set insert_record ""

    #add record
    foreach data_record $file_md {
        set data_field [lindex $data_record 0]
        set data_value [lindex $data_record 1]
        query get_fieldid data_field_id onevalue \
            "select field_id from metadata_fields where schema_id=$schema_id and
field_name='$data_field'"
        ### substitute single quotes ' for two single quotes (so i can insert in oracle)
''
        regsub -all "'" $data_value "''" data_value_for_oracle
        db_dml insert_record \
            "insert into metadata_field_values values
($file_id,$data_field_id,'$data_value_for_oracle',$schema_id)"
    }

    db_dml insert_md_submission \
        "insert into metadata_submissions values ($file_id,1)"
} on_error {
    ad_return_complaint 1 "We got an error here.  The file probably already exists."
    ad_script_abort
}

ad_returnredirect "dspace-getsuccess?file_id=$file_id"
```

## B.2 dspace-submit.tcl

```
ad_page_contract {
    Try meta
} {
    schema_id:integer
    file_id:integer
}

set url_query [ad_conn query]

###
### check if submit type = addmore
###

set addmore_start [string first addmore $url_query]
if { $addmore_start > -1 } {
    set query_length [string length $url_query]
    set substring [string range $url_query $addmore_start [expr $query_length - 1]]
    set addmore_end [string first = $substring]
    set addmore_string [string range $substring 8 [expr $addmore_end - 1]]
    append url_query "&multiple-$addmore_string"
    ad_returnredirect "meta-view?$url_query"
    ad_script_abort
}


###
### check if submit type = cancel
###

set submit_type [ns_queryget submit_type]

if [string equal $submit_type Cancel] {
    ad_returnredirect "file?file_id=$file_id"
    ad_script_abort
}

###
### check to see if file was already submitted
###

if { [db_0orlrow get_val "select * from metadata_submissions where file_id=$file_id and
schema_id=$schema_id"] == 1} {
    ad_returnredirect "dspace-submitted?schema_id=$schema_id&file_id=$file_id"
    ad_script_abort
}

set has_required 0

###
###check for empty fields
###
db_foreach get_required "select * from metadata_fields where schema_id=$schema_id" {
    #get empty fields
    if [string equal $required t] {
        if [empty_string_p [ns_queryget $field_id]] {
            append url_query "&empty_req_field=$field_id"
            set has_required 1
        }
    }
}

###
### upload to dspace
###

set mylist [list]
```

```
set xml_file "<dublin_core>\n"

#process fields
if { $has_required == 1 } {
    ad_returnredirect "meta-view?$url_query"
    ad_script_abort
} else {
    db_dml delete_old_values {
        delete from metadata_field_values where file_id = :file_id and schema_id =
:schema_id
    }
    db_foreach get_fields "select * from metadata_fields where schema_id=$schema_id" {

        #set field name tag for xml file
        regsub -all "_" $field_name " " split_fname
        set elt [lindex $split_fname 0]
        set qual "none"
        if { [llength $split_fname] > 1 } {
            set qual [lindex $split_fname 1]
        }

        #get value
        if [ns_queryexists $field_id] {
            if { ![empty_string_p [ns_queryget $field_id]]} {
                set value [ns_queryget $field_id]
                lappend mylist "$field_id = $value"

                #add value to database
                db_dml insert_value {
                    insert into metadata_field_values values (:file_id, :field_id, :value,
:schema_id)
                }

                #insert value into xml file
                append xml_file "<dcvalue element=\"$elt\"
qualifier=\"$qual\">$value</dcvalue>\n"

            }
        }
        # get multiple values
        if [ns_queryexists multiple-$field_id] {
            set mult_list [ns_querygetall multiple-$field_id]
            foreach mult $mult_list {
                if { ![string equal $mult ""] } {
                    db_dml insert_mult_val {
                        insert into metadata_field_values values (:file_id, :field_id,
:mult, :schema_id)
                    }

                    append xml_file "<dcvalue element=\"$elt\"
qualifier=\"$qual\">$mult</dcvalue>\n"
                }
            }
        }
    }
}

#append end tag to xml file
append xml_file "</dublin_core>"

#either save or submit
if [string equal $submit_type Save] {
    ad_returnredirect "dspace-submitsaved?file_id=$file_id"
    ad_script_abort
} else {

    ### ADD OTHER SUBMIT CALLS HERE ###

    if { $schema_id != 1} {
        ad_returnredirect "file?file_id=$file_id"
    }
```

```
    #turn xml file into base64binary string
    set xml_file_base64 [::base64::encode $xml_file]

    set file_name [db_string get_fn "select file_name from metadata_file_view where
file_id = $file_id"]

    #get the file content and save as an base64 encoded string
    set tempfile "/web/gen/www/temp"
    set blob_file [db_blob_get_file "get_content" \
                      "select content from metadata_file_view where file_id = $file_id" \
                      -file $tempfile]
    set open_file [open $tempfile r]
    fconfigure $open_file -encoding binary
    set pure_file [read $open_file]
    close $open_file
    set encoded_string [::base64::encode $pure_file]

    ### DSPACE WEB SERVICE CALL ###

    ## Create SOAP Requests
    ::SOAP::create DepositItem \
        -uri "http://18.42.6.79:8080/axis/services/ItemIngestService" \
        -proxy "http://18.42.6.79:8080/axis/services/ItemIngestService" \
        -name "depositItem" \
        -action "" \
        -params { epersonID string collectionID string docBytes base64Binary }

    ::SOAP::create DepositBitstream \
        -uri "http://18.42.6.79:8080/axis/services/ItemIngestService" \
        -proxy "http://18.42.6.79:8080/axis/services/ItemIngestService" \
        -name "depositBitstream" \
        -action "" \
        -params { ticket string fileName string bitstream base64Binary }

    ::SOAP::create DepositComplete \
        -uri "http://18.42.6.79:8080/axis/services/ItemIngestService" \
        -proxy "http://18.42.6.79:8080/axis/services/ItemIngestService" \
        -name "depositComplete" \
        -action "" \
        -params { ticket string }


    ## Call SOAP Methods
    set personid rrodgers@mit.edu
    set collectionid http://hdl.handle.net/123456789/2
    if [catch {set ticket [DepositItem $personid $collectionid $xml_file_base64]} errmsg]
{
        ad_return_complaint 1 "Error depositing metadata into DSpace"
        ad_script_abort
    }
    if [catch {set depositBitstream [DepositBitstream $ticket $file_name
$encoded_string]} errmsg] {
        ad_return_complaint 1 "Error depositing file bitstrean into DSpace"
        ad_script_abort
    }
    if [catch { set depositComplete [DepositComplete $ticket]  } errmsg] {
        ad_return_complaint 1 "Error depositing file bitstrean into DSpace"
        ad_script_abort
    }

    db_dml insert_submission {
        insert into metadata_submissions values (:file_id, :schema_id)
    }

    ad_returnredirect "dspace-submitsuccess?file_id=$file_id"
    ad_script_abort
}
```

## B.3 meta-view.adp

```
<master>
<property name="title">Upload to DSpace</property>
<property name="context">@context;noquote@</property>
<form method=get action="@submit_file_name@">
<input type=hidden name=schema_id value=@schema_id@>
<input type=hidden name=file_id value=@file_id@>
<table>
<multiple name=ds>
<tr height=40 valign=bottom><td></td><td>
        <if @ds.display_text@ not nil>
                <small>@ds.display_text@</small>
        </if>
</td>
</tr>
<tr><td align="right"><b>@ds.pretty_name@</b></td>
<td>
        <if @ds.display_type@ eq "text" and @ds.value@ eq "">
                <input type=text @ds.display_attributes@ name=@ds.field_id@>
        </if>
        <if @ds.display_type@ eq "text" and @ds.value@ not eq "">
                <input type=text @ds.display_attributes@ name=@ds.field_id@
value="@ds.value@">
        </if>
        <if @ds.display_type@ eq "textarea" and @ds.value@ eq "">
                <textarea @ds.display_attributes@ name=@ds.field_id@></textarea>
        </if>
        <if @ds.display_type@ eq "textarea" and @ds.value@ not eq "">
                <textarea @ds.display_attributes@ name=@ds.field_id@>@ds.value@</textarea>
        </if>
        <if @ds.display_type@ eq "select">
                <select @ds.display_attributes@
name=@ds.field_id@>@ds.display_elements;noquote@</select>
        </if>
        <if @ds.multiple@ eq "t">
                <input type=submit name=addmore-@ds.field_id@ value="Add More">
        </if>
        <if @ds.empty@ gt -1>
                <small><font color=red>@ds.error_text@</font></small>
        </if>
</td></tr>

<multiple name=multiple_fields>
<if @multiple_fields.fid@ eq @ds.field_id@>
<tr>
<td></td>
<td>
<if @ds.display_type@ eq "text">
<input type=text name=multiple-@ds.field_id@ @ds.display_attributes@
value="@multiple_fields.fval@"></if>
<if @ds.display_type@ eq "textarea">
<textarea @ds.display_attributes@ name=multiple-
@ds.field_id@>@multiple_fields.fval@</textarea></if>
</td>
</tr>
</if>
</multiple>
</multiple>
<tr><td colspan=2 height=20></tr>
<tr><td colspan=2 align=center>
<input type=submit name=submit_type value="Save">
<input type=submit name=submit_type value="Cancel">
<input type=submit name=submit_type value="Upload to @schema_name@">
</td></tr>
</table>
</form>
```

## B.4 meta-view.tcl

```
ad_page_contract {
    Try meta
} {
    schema_id:integer
    file_id:integer
}

set schema_name [db_string get_sn "select schema_name from metadata_schemas where
schema_id=$schema_id"]

set context [fs_context_bar_list -final "Upload to $schema_name" $file_id]

### set the submit file
if [string equal $schema_name DSpace] {
    set submit_file_name dspace-submit
}

set empty_fields [list]

#check for empty required fields
if [ns_queryexists empty_req_field] {
    set empty_fields [ns_querygetall empty_req_field]
}

set startrow 1
set numrows 0
multirow create multiple_fields fid fval

db_multirow -extend { value empty } ds get_dsmetadata {
    select * from metadata_fields where schema_id = :schema_id
} {
    #check for empty field
    set empty [lsearch -exact $empty_fields $field_id]

    #check for and set existing field values
    if [ns_queryexists $field_id] {
        set value [ns_queryget $field_id]
    } else {
        set db_values [db_list get_val "select field_value from metadata_field_values
where file_id=$file_id and field_id=$field_id"]
        if { [llength $db_values] == 1 } {
            set value [lindex $db_values 0]
        } elseif { [llength $db_values] > 1 } {
            set i 0
            foreach db_value $db_values {
                if { ![string equal $db_value ""] } {
                    if { $i == 0 } {
                        set value $db_value
                    } else {
                        if [string equal $multiple t] {
                            multirow append multiple_fields $field_id $db_value
                        } elseif [string equal $multiple f] {
                            append value " $db_value"
                        }
                    }
                    set i [expr $i + 1]
                }
            }
        } else {
            #get from other schemas
            set value ""
            set db_mapped_fields_1 \
                [db_list \
                     get_mf1 \
                     "select field_id_1 from metadata_schema_mappings where
field_id_2=$field_id and (map_type=0 or map_type=1)"]
            set db_mapped_fields_2 \
                [db_list \
```

```
                    get_mf2 \
                    "select field_id_2 from metadata_schema_mappings where
field_id_1=$field_id and (map_type=0 or map_type=-1)"]
            set db_mapped_fields [concat $db_mapped_fields_1 $db_mapped_fields_2]
            if { [llength $db_mapped_fields] >= 1 } {
                foreach mfield $db_mapped_fields {
                    set db_vals [db_list get_vals "select field_value from
metadata_field_values where file_id=$file_id and field_id=$mfield"]
                    if { [llength $db_vals] == 1} {
                        set value [lindex $db_vals 0]
                    } elseif { [llength $db_vals] > 1} {
                        set j 0
                        foreach db_val $db_vals {
                            if { ![string equal $db_val ""] } {
                                if {$j == 0} {
                                    set value $db_val
                                } else {
                                    if [string equal $multiple t] {
                                        multirow append multiple_fields $field_id $db_val
                                    } elseif [string equal $multiple f] {
                                        append value " $db_val"
                                    }
                                }
                                set j [expr $j + 1]
                            }
                        }
                    }
                }
            }

            #get from ss table
            if [string equal $value ""] {
                if { [exists_and_not_null mapping_ss_field] && ($map_type == 0 ||
$map_type==-1) } {
                    set value ""
                    set has_mapping \
                        [db_0or1row \
                             get_mapping \
                             "select mapping_table_or_view,mapping_col_name from
sloanspace_file_metadata where field_name='$mapping_ss_field'"]
                    if {$has_mapping == 1} {
                        query get_value value onevalue \
                            "select $mapping_col_name from $mapping_table_or_view where
file_id=$file_id"
                    }
                } else {
                    set value ""
                }
            }
        }
    }

    #check for multiple values in querystring and append to multiple_fields multirow
    set mult_list [ns_querygetall multiple-$field_id]
    set list_length [llength $mult_list]
    foreach mult $mult_list {
        multirow append multiple_fields $field_id $mult
    }

    #replace selected in select lists with new value
    if [string equal $display_type select] {
        if { ![empty_string_p value] } {
            if { ![string equal $value ""] } {
                set string_length [string length $display_elements]
                set val_index [string first value=\"$value\" $display_elements]
                if { $val_index > -1 } {
                    set start_index [expr [string length value=$value] + $val_index + 2]

                    set start_string [string range $display_elements 0 [expr $start_index
- 1]]
```

```
                    set end_string [string range $display_elements $start_index [expr
$string_length - 1]]

                    set display_elements $start_string
                    append display_elements " selected"
                    append display_elements $end_string
                }
            }
        }
    }
}
```

## B.5 schema-add.adp

```
<master>
<br>
<table width=100% cellspacing=0 cellpadding=0>
<tr><td><font size="+1" color=#003366><u>Add Schema</u><br></td></tr></table>
<br><br>
<form action="schema-add-2" method=get>
<table>
<tr>
<td align="right">Schema Name:</td>
<td colspan=2><input type=text name="name" value="" size=50></td>
<td></td>
</tr>
<tr><td align="right">Number of Fields:</td>
<td align="left" colspan=2><input type=text name="num_fields" value="" size=7></td>
</tr>
<tr>
<td colspan=3 height=10></td></tr>
<tr>
<td></td>
<td align="left"><input type="submit" value="Add Schema"></td>
<td align="right"><a href="schema-add-help">Add Schema Help</a></td>
</tr>
</table>
</form>
<br>
<br>
```

## B.6 schema-add-2.tcl

```
ad_page_contract {
    page to add a new nonversioned object to the system

    @author Genevieve Cuevas (gtcuevas@mit.edu)
    @creation-date 01 April 2004
} {
    name:trim
    num_fields:integer
}

set schema_id [db_string get_id "select seq_schema_id.nextval from dual"]

db_dml add_schema {
    insert into metadata_schemas values (:schema_id,:name)
}

ad_returnredirect "schema-add-fields?schema_id=$schema_id&num_fields=$num_fields"
```

## B.7 schema-add-fields.adp

```
<master>
<table width=100% cellspacing=0 cellpadding=0>
<tr><td><font size="+1" color=#003366><u>Add Fields</u><br></td></tr></table>
<br><br>

<form method=get action="schema-add-fields-2">
<input type=hidden name="schema_id" value=@schema_id@>
<input type=hidden name="num_fields" value=@num_fields@>
<table>

<multiple name=fields>

<tr>
<td align="right">Field @fields.rownum@ Name:</td>
<td colspan=2><input type=text name="field_@fields.rownum@" value="" size=50></td>
</tr>

<tr>
<td align="right">SloanSpace Mapping:</td>
<td colspan=2><select name="ssm_@fields.rownum@">
<option value="none">None</option>
<option value="author">Author</option>
<option value="title">Title</option>
<option value="publish_date">Publish Date</option>
<option value="description">Description</option>
</select>
    
Mapping Type:
<select name="ssmt_@fields.rownum@">
<option value="0">Both Ways</option>
<option value="1">Remote Schema to SloanSpace</option>
<option value="-1">SloanSpace to Remote Schema</option>
</select></td>
</tr>

<tr>
<td align="right">Required:</td>
<td colspan=2><select name="req_@fields.rownum@">
<option value="t">Yes</option>
<option value="f">No</option>
</select>   
Has Multiple Values?
<select name="mult_@fields.rownum@">
<option value="t">Yes</option>
<option value="f">No</option>
</select></td>
</tr>

<tr>
<td align="right">Display Name:</td>
<td colspan=2><input type=text name="pn_@fields.rownum@" value="" size=70></td>
</tr>

<tr>
<td align="right">Display Type:</td>
<td colspan=2><input type=radio name="dt_@fields.rownum@" value="text" checked>Text Field
<input type=radio name="dt_@fields.rownum@" value="textarea">Text Area
<input type=radio name="dt_@fields.rownum@" value="select">Select List:
 
# of Options:<input type=text name="num_ops_@fields.rownum@" value="" size=7>
</td>
</tr>

<tr>
<td colspan=2 height=20></td>
</tr>

</multiple>
```

```
<tr>
<td></td>
<td align="left">
<input type=submit value=" Submit and Continue  ">
</td>
<td align="right"><a href="schema-add-help">Add Schema Help</a></td>
</tr>

</table>
</form>
```

## B.8 schema-add-fields.tcl

```
ad_page_contract {
    page to add a new nonversioned object to the system

    @author Genevieve Cuevas (gtcuevas@mit.edu)
    @creation-date 01 April 2004
} {
    schema_id:integer
    num_fields:integer
}

multirow create fields fname

for {set i 1} {$i <= $num_fields} {incr i} {
    multirow append fields "field_$i"
}
```

## B.9 schema-add-fields-2.tcl

```
ad_page_contract {
    page to add a new nonversioned object to the system

    @author Genevieve Cuevas (gtcuevas@mit.edu)
    @creation-date 01 April 2004
} {
    schema_id:integer
    num_fields:integer
}

set mylist [list 1]

set options_query ""

#process fields from schema-add-fields
for {set i 1} {$i <= $num_fields} {incr i} {
    set field_name [ns_queryget field_$i]
    set ss_mapping [ns_queryget ssm_$i]
    set map_type [ns_queryget ssmt_$i]
    set required [ns_queryget req_$i]
    set is_mult [ns_queryget mult_$i]
    set pretty_name [ns_queryget pn_$i]
    set display_type [ns_queryget dt_$i]

    lappend mylist $field_name
    lappend mylist $pretty_name

    if { ![string equal $field_name ""] && ![string equal $pretty_name ""] } {
        set field_id [db_string get_id "select seq_field_id.nextval from dual"]
        if [string equal $ss_mapping "none"] {
            db_dml add_field \
                "insert into metadata_fields
values($field_id,'$field_name','$pretty_name',$schema_id,null,$map_type, \

null,'$display_type',null,null,null,'$required','$is_mult')"

        } else {
            db_dml add_field \
                "insert into metadata_fields
values($field_id,'$field_name','$pretty_name',$schema_id,'$ss_mapping', \

$map_type,null,'$display_type',null,null,null, \
                                                    '$required','$is_mult')"
        }
    }

    if [string equal $display_type "select"] {
        set num_options [ns_queryget num_ops_$i]
        append options_query "&num_ops_$field_id=$num_options"
    }
}

#redirect to continue page
ad_returnredirect "schema-add-fields-cont?schema_id=$schema_id$options_query"
```

## B.10 schema-add-fields-cont.adp

```
<master>
<table width=100% cellspacing=0 cellpadding=0>
<tr><td><font size="+1" color=#003366><u>Add Fields (cont.)</u><br></td></tr></table>
<br><br>
<form action="schema-add-fields-cont-2" method=get>
<table>
<input type=hidden name=schema_id value=@schema_id@>
<multiple name=fields>

<tr><td colspan=3><b>Field Name: @fields.field_name@</b></td></tr>

<tr>
<td align="right">Display Text:</td>
<td colspan=2><input type=text name=dt_@fields.field_id@ size=100></td>
</tr>
<tr>
<td align="right">Error Text:</td>
<td colspan=2><input type=text name=et_@fields.field_id@ size=100></td>
</tr>

<if @fields.display_type@ eq "text">
        <tr>
        <td align="right">Text Field Size:</td>
        <td colspan=2><input type=text name=tfs_@fields.field_id@ size=7></td>
        </tr>
</if>
<if @fields.display_type@ eq "textarea">
        <tr>
        <td align="right">Text Area Rows:</td>
        <td colspan=2><input type=text name=tar_@fields.field_id@ size=7>
                    
                Columns:<input type=text name=tac_@fields.field_id@ size=7>
        </td>
        </tr>
</if>
<if @fields.display_type@ eq "select">
        <multiple name="options">
        <if @options.field_id@ eq @fields.field_id@>
        <tr>
        <td align="right">Option Text:</td>
        <td colspan=2><input type=text name=opt_@fields.field_id@_@options.index@ size=20>
                    
                Value:<input type=text name=opv_@fields.field_id@_@options.index@ size=20>
        </td>
        </tr>
        </if>
        </multiple>
</if>

<tr><td colspan=3 height=20></td></tr>
</multiple>

<multiple name="num_ops_list">
<input type=hidden name=@num_ops_list.num_ops_string@ value=@num_ops_list.num_ops_value@>
</multiple>

<tr>
<td></td>
<td align="left">
<input type=submit value="     Submit      ">
</td>
<td align="right"><a href="schema-add-help">Add Schema Help</a></td>
</tr>
</table>

</form>
```

## B.11 schema-add-fields-cont.tcl

```
ad_page_contract {
    page to add a new nonversioned object to the system

    @author Genevieve Cuevas (gtcuevas@mit.edu)
    @creation-date 01 April 2004
} {
    schema_id:integer
}

multirow create options field_id index

#this is the multirow for the num_ops key in the query
multirow create num_ops_list num_ops_string num_ops_value

db_multirow fields get_fields {
    select * from metadata_fields where schema_id = :schema_id
} {
    if [string equal $display_type "select"] {
        if [ns_queryexists num_ops_$field_id] {
            set num_ops [ns_queryget num_ops_$field_id]
            for {set i 1} {$i <= $num_ops} {incr i} {
                multirow append options $field_id $i
            }
            multirow append num_ops_list num_ops_$field_id $num_ops
        }
    }
}
```

## B.12 schema-add-fields-cont-2.tcl

```
ad_page_contract {
    page to add a new nonversioned object to the system

    @author Genevieve Cuevas (gtcuevas@mit.edu)
    @creation-date 01 April 2004
} {
    schema_id:integer
}

#process fields for schema-add-fields-cont
db_foreach set_fields "select * from metadata_fields where schema_id=$schema_id" {
    set display_text null
    set error_text null
    set display_attributes null
    set display_elements null

    ### set field values ###
    if [ns_queryexists dt_$field_id] {
        set display_text [ns_queryget dt_$field_id]
    }

    if [ns_queryexists et_$field_id] {
        set error_text [ns_queryget et_$field_id]
    }
    if [string equal $display_type "text"] {
        if [ns_queryexists tfs_$field_id] {
            set size [ns_queryget tfs_$field_id]
            set display_attributes "size=$size"
        }
    } elseif [string equal $display_type "textarea"] {
        set rows ""
        set cols ""
        if [ns_queryexists tar_$field_id] {
            set rows "rows=[ns_queryget tar_$field_id]"
        }
        if [ns_queryexists tac_$field_id] {
            set cols "cols=[ns_queryget tac_$field_id]"
        }
        set display_attributes "$rows $cols"
    } elseif [string equal $display_type "select"] {
        set display_attributes ""
        set display_elements ""
        if [ns_queryexists num_ops_$field_id] {
            set num_ops [ns_queryget num_ops_$field_id]
            for {set i 1} {$i <= $num_ops} {incr i} {
                set option_text ""
                set option_value ""
                set opt_str opt_$field_id
                append opt_str "_$i"
                set opv_str opv_$field_id
                append opv_str "_$i"
                if {[ns_queryexists $opt_str] && [ns_queryexists $opv_str]} {
                    set option_text [ns_queryget $opt_str]
                    set option_value [ns_queryget $opv_str]
                    append display_elements "<option
value=\"$option_value\">$option_text</option>"
                }
            }
        }
    }
    #add avlues to database
    db_dml set_values "update metadata_fields set display_text='$display_text',
error_text='$error_text', \
display_attributes='$display_attributes', display_elements='$display_elements' where
field_id=$field_id"
}
ad_returnredirect "schema-add-fields-done"
```

## B.13 search-url.adp

```
<master>
<property name="title">@page_title;noquote@</property>
<property name="context">@context;noquote@</property>

<form method=GET action="search-url-results">
<input type=hidden name="folder_id" value="@folder_id@">

<table border=0>

<tr>
<td align=right>Search:</td>
<td colspan=2><input size=70 name=searchstring value=""></td>
</tr>

<tr>
<td></td>
<td><input type=submit value="Search">   
in <input type=radio name="searchtype" value="dspace" checked>DSpace
<input type=radio name="searchtype" value="google">Google
<input type=radio name="searchtype" value="googledspace">DSpace-restricted Google</td>

</tr>

</table>
</form>
```

## B.14 search-url.tcl

```
ad_page_contract {
    page to add a new nonversioned object to the system

    @author Genevieve Cuevas (gtcuevas@mit.edu)
    @creation-date 01 April 2004
} {
    folder_id:integer,notnull
    {type "fs_url"}
    {title ""}
    {lock_title_p 0}
} -validate {
    valid_folder -requires {folder_id:integer} {
        if ![fs_folder_p $folder_id] {
            ad_complain "[_ file-storage.lt_The_specified_parent_]"
        }
    }
} -properties {
    folder_id:onevalue
    context:onevalue
}

# check for write permission on the folder

ad_require_permission $folder_id write

# set templating datasources

set pretty_name "Search DSpace"
if {[empty_string_p $pretty_name]} {
    return -code error "[_ file-storage.No_such_type]"
}

#set context [fs_context_bar_list -final [_ file-storage.Search [list pretty_name
$pretty_name]] $folder_id]
set context [fs_context_bar_list -final "Search DSpace" $folder_id]

# Should probably generate the item_id and version_id now for
# double-click protection

# if title isn't passed in ignore lock_title_p
if {[empty_string_p $title]} {
    set lock_title_p 0
}

# Message lookup uses variable pretty_name
set page_title [_ file-storage.simple_add_page_title]
```

## B.15 search-url-results.adp

```
<master>
<property name="title">Search Results</property>
<property name="context">@context;noquote@</property>

<form method=GET action="search-url-results">
<table>
<input type=hidden name="folder_id" value="@folder_id@">
<tr><td align="right">Search:</td>
<td><input size=50 name=searchstring value="@searchstring@"></td>
</tr>
<tr>
<td></td>
<td><input type=submit value="Search">
   
in
<if @searchtype@ eq "dspace"><input type=radio name="searchtype" value="dspace"
checked>DSpace</if>
<else><input type=radio name="searchtype" value="dspace">DSpace</else>
<if @searchtype@ eq "google"><input type=radio name="searchtype" value="google"
checked>Google</if>
<else><input type=radio name="searchtype" value="google">Google</else>
<if @searchtype@ eq "googledspace"><input type=radio name="searchtype"
value="googledspace" checked>DSpace-restricted Google</if>
<else><input type=radio name="searchtype" value="googledspace">DSpace-restricted
Google</else>
</td>
</tr>
</table></p><br>
</form>

<hr>
<table cellspacing=0 cellpadding=0 width=100%>
<tr>
<if @numrecords@ eq 0><tr><td>No Matches</td></if>
<else>
<td>Results <b>@pageminval@ - <if @numrecords@ lt @pagemaxval@>@numrecords@</if>
<else>@pagemaxval@</else> </b>of <b>@numrecords@</b> for <b>@searchstring@</b>:</td>
</else>
<td align="right"><a href="search-url-help"><b>Search Help</b></a></td>
<td width=1%></td>
</tr>
</table><hr><br>

<table>

<multiple name="urls">
<tr><td><a href="@urls.url@"><b>@urls.title;noquote@</b></a></td></tr>
<tr><td>@urls.description;noquote@</td></tr>
<tr><td><small><i>@urls.url@</i> -
<a href="simple-add-
2?folder_id=@folder_id@&title=@urls.title@&url=@urls.url@&description=@urls.description@"
><b>[Add URL]</b></a>
<if @searchtype@ eq "dspace">
 | 
<a href="dspace-
get?folder_id=@folder_id@&schema_id=2&itemID=@urls.url@&title=@urls.title@&description=@u
rls.description@">
<b>[Add File]</b></a></if>
</small>
</td>
</tr>
<tr height=30><td> </td><tr>
</multiple>

<tr><td align=center>
<if @pagenum@ gt 1>
```

```
<a href="search-url-
results?folder_id=@folder_id@&searchstring=@searchstring@&pagenum=@prevpage@&searchtype=@
searchtype@">
<small><b>Previous</b></small></a>
</if>
   
<if @numrecords@ gt @pagemaxval@>
<a href="search-url-
results?folder_id=@folder_id@&searchstring=@searchstring@&pagenum=@nextpage@&searchtype=@
searchtype@">
<small><b>Next</b></small></a>
</if>
</td></tr>
</table>
```

## B.16 search-url-results.tcl

```
ad_page_contract {
    Search results in DSpace

    @author Genevieve Cuevas (gtcuevas@mit.edu)
    @creation-date 1 Apr 2004
} {
    folder_id:integer,notnull
    searchstring:trim
    {searchtype dspace}
    {pagenum:integer 1}
} -validate {
    valid_folder -requires {folder_id:integer} {
        if ![fs_folder_p $folder_id] {
            ad_complain "[_ file-storage.lt_The_specified_parent_]"
        }
    }

}

# check for write permission on the folder

ad_require_permission $folder_id write

set context [fs_context_bar_list -final "Search Results" $folder_id]

#set pagination variables
set recordsperpage 5
set pagemaxval [expr $pagenum * $recordsperpage]
set pageminval [expr $pagemaxval - $recordsperpage + 1]
set nextpage [expr $pagenum + 1]
set prevpage [expr $pagenum - 1]

multirow create urls title url description

if [string equal $searchtype google] {
    set results [acs_sc::invoke \
                    -operation paged_search \
                    -contract URLSearcher \
                    -impl GoogleSearcher \
                    -call_args [list $searchstring $recordsperpage $pagenum]]
} elseif [string equal $searchtype googledspace] {
    set results [acs_sc::invoke \
                    -operation restricted_paged_search \
                    -contract URLSearcher \
                    -impl GoogleSearcher \
                    -call_args [list $searchstring $recordsperpage $pagenum "dspace"]]
} else {
    set results [acs_sc::invoke \
                    -operation paged_search \
                    -contract URLSearcher \
                    -impl DSpaceSearcher \
                    -call_args [list $searchstring $recordsperpage $pagenum]]
}

set resultslist [lindex $results 1]
foreach result $resultslist {
    multirow append urls [lindex $result 0] [lindex $result 1] [lindex $result 2]
}

set numrecords [lindex $results 0]
```

## B.17 dspace-search-procs.tcl

```
ad_library {

    The "dspace searcher" searches and retrieves dspace urls.

    @author gtcuevas@mit.edu
    @version $Id: dspace-search-procs.tcl,v 1.0 04/14/04 09:51:04 peterm Exp $
}

namespace eval dspace_search {

    ad_proc -private search_url {
        query
    } {
        Implements the search operation for URLSearcher.
    } {
        set res1 [list "Google" "www.google.com" "google website"]
        set res2 [list "Yahoo" "www.yahoo.com" "yahoo website"]
        set res3 [list "MIT" "web.mit.edu" "mit website"]
        return [list $res1 $res2 $res3 $query]
    }

    ad_proc -private paged_search_url {
        query
        results_per_page
        page_num
    } {
        Implements the paged search operation for URLSearcher.
    } {
        #initialize results list
        set results [list]

        #set pagination vars
        set pagemaxval [expr $page_num * $results_per_page]
        set pageminval [expr $pagemaxval - $results_per_page + 1]

        regsub -all " " $query "+" url_query
        if { [catch {set content [ns_httpget http://dspace-
demo.mit.edu:8080/SRW/search/DSpace?query=%22$url_query%22&maximumRecords=$results_per_pa
ge&startRecord=$pageminval]} errMsg] } {
            return
        }

        #set doc [dom parse $content]
        if { [catch {dom parse $content doc} errMsg] } {
            return
        }
        set root [$doc documentElement]

        set recordTitle ""
        set recordUrl ""
        set recordDesc ""
        set numrecords 0

        foreach child [$root childNodes] {
            set childName [$child nodeName]
            if [string equal $childName numberOfRecords] {
                set numrecords [$child text]
            } elseif [string equal $childName records] {
                foreach recordsChild [$child childNodes] {
                    set recordsChildName [$recordsChild nodeName]
                    if [string equal $recordsChildName record] {
                        set recordDesc ""
                        foreach recordChild [$recordsChild childNodes] {
                            set recordChildName [$recordChild nodeName]
                            if [string equal $recordChildName recordData] {
                                foreach dataChild [$recordChild childNodes] {
                                    set dataChildName [$dataChild nodeName]
                                    if [string equal $dataChildName srw_dc:dc] {
```

```
                                    foreach dcChild [$dataChild childNodes] {
                                        set dcChildName [$dcChild nodeName]
                                        if [string equal $dcChildName dc:identifier.uri]
{
                                            set recordUrl [$dcChild text]
                                        } elseif [string equal $dcChildName dc:title] {
                                            set recordTitle [$dcChild text]
                                        } elseif [string equal $dcChildName
dc:description] {
                                            append recordDesc " "
                                            append recordDesc [$dcChild text]
                                        }
                                    }
                                    set result [list $recordTitle $recordUrl
$recordDesc]
                                    lappend results $result
                                }
                            }
                        }
                    }
                }
            }
        }

        return [list $numrecords $results]
    }
}
```

## B.18 google-search-procs.tcl

```
ad_library {

    The "google searcher" searches and retrieves google urls.

    @author gtcuevas@mit.edu
    @version $Id: dspace-search-procs.tcl,v 1.0 04/14/04 09:51:04 peterm Exp $
}

namespace eval google_search {

    ad_proc -private search_url {
        query
    } {
        Implements the search operation for URLSearcher.
    } {
        set res1 [list "Google" "www.google.com" "google website"]
        set res2 [list "Yahoo" "www.yahoo.com" "yahoo website"]
        set res3 [list "MIT" "web.mit.edu" "mit website"]
         return [list $res1 $res2 $res3 $query]
    }

    ad_proc -private paged_search_url {
        query
        results_per_page
        page_num
    } {
        Implements the paged search operation for URLSearcher.
    } {
        #initialize results list
        set results [list]

        #set pagination vars
        set google_page_num [expr $page_num - 1]
        set start_index [expr $google_page_num * $results_per_page]

        #set google soap variables
        set endpoint http://api.google.com/search/beta2
        set schema http://www.w3.org/2001/XMLSchema
        set Key {orDfgkBQFHKCjA1mJ3TqqHksuu+SUmZm}

        #google soap method call
        ::SOAP::create doGoogleSearch \
            -proxy $endpoint \
            -params {key string q string start int maxResults int \
                        filter boolean restrict string safeSearch boolean \
                        lr string ie string oe string} \
            -action urn:GoogleSearchAction \
            -encoding http://schemas.xmlsoap.org/soap/encoding/ \
            -schema [list xsd $schema] \
            -uri urn:GoogleSearch

        set unparsedresult [doGoogleSearch \
                                $Key \
                                $query \
                                $start_index \
                                $results_per_page \
                                false \
                                "" \
                                false \
                                "" \
                                utf-8 \
                                utf-8]

        #-----parse the results

        set resultTagIndex [lsearch -exact $unparsedresult resultElements]
        set resultsIndex [expr $resultTagIndex + 1]
        set resultList [lindex $unparsedresult $resultsIndex]
```

```
        set totalNumResultsTagIndex [lsearch -exact $unparsedresult
estimatedTotalResultsCount]
        set totalNumResultsIndex [expr $totalNumResultsTagIndex + 1]
        set totalNumResults [lindex $unparsedresult $totalNumResultsIndex]

        foreach record $resultList {
            set urlTagIndex [lsearch -exact $record URL]
            set urlIndex [expr $urlTagIndex + 1]
            set titleTagIndex [lsearch -exact $record title]
            set titleIndex [expr $titleTagIndex + 1]
            set snippetTagIndex [lsearch -exact $record snippet]
            set snippetIndex [expr $snippetTagIndex + 1]
            set title [ns_striphtml [lindex $record $titleIndex]]
            set url [ns_striphtml [lindex $record $urlIndex]]
            set snippet [ns_striphtml [lindex $record $snippetIndex]]
            set result [list $title $url $snippet]
            #set result [list [lindex $record $titleIndex] [lindex $record $urlIndex]
[lindex $record $snippetIndex]]
            lappend results $result
        }

        return [list $totalNumResults $results]
    }

    ad_proc -private restricted_paged_search_url {
        query
        results_per_page
        page_num
        restriction
    } {
        Implements the paged search operation for URLSearcher.
    } {
        #initialize results list
        set results [list]

        #set pagination vars
        set google_page_num [expr $page_num - 1]
        set start_index [expr $google_page_num * $results_per_page]

        #set google soap variables
        set endpoint http://api.google.com/search/beta2
        set schema http://www.w3.org/2001/XMLSchema
        set Key {orDfgkBQFHKCjAlmJ3TqqHksuu+SUmZm}

        #google soap method call
        ::SOAP::create doGoogleSearch \
            -proxy $endpoint \
            -params {key string q string start int maxResults int \
                        filter boolean restrict string safeSearch boolean \
                        lr string ie string oe string} \
            -action urn:GoogleSearchAction \
            -encoding http://schemas.xmlsoap.org/soap/encoding/ \
            -schema [list xsd $schema] \
            -uri urn:GoogleSearch

        set unparsedresult [doGoogleSearch \
                                $Key \
                                $query \
                                $start_index \
                                $results_per_page \
                                false \
                                $restriction \
                                false \
                                "" \
                                utf-8 \
                                utf-8]

        #-----parse the results

        set resultTagIndex [lsearch -exact $unparsedresult resultElements]
```

```
        set resultsIndex [expr $resultTagIndex + 1]
        set resultList [lindex $unparsedresult $resultsIndex]

        set totalNumResultsTagIndex [lsearch -exact $unparsedresult
estimatedTotalResultsCount]
        set totalNumResultsIndex [expr $totalNumResultsTagIndex + 1]
        set totalNumResults [lindex $unparsedresult $totalNumResultsIndex]

        foreach record $resultList {
            set urlTagIndex [lsearch -exact $record URL]
            set urlIndex [expr $urlTagIndex + 1]
            set titleTagIndex [lsearch -exact $record title]
            set titleIndex [expr $titleTagIndex + 1]
            set snippetTagIndex [lsearch -exact $record snippet]
            set snippetIndex [expr $snippetTagIndex + 1]
            set title [ns_striphtml [lindex $record $titleIndex]]
            set url [ns_striphtml [lindex $record $urlIndex]]
            set snippet [ns_striphtml [lindex $record $snippetIndex]]
            set result [list $title $url $snippet]
            lappend results $result
        }

        return [list $totalNumResults $results]
    }
}
```

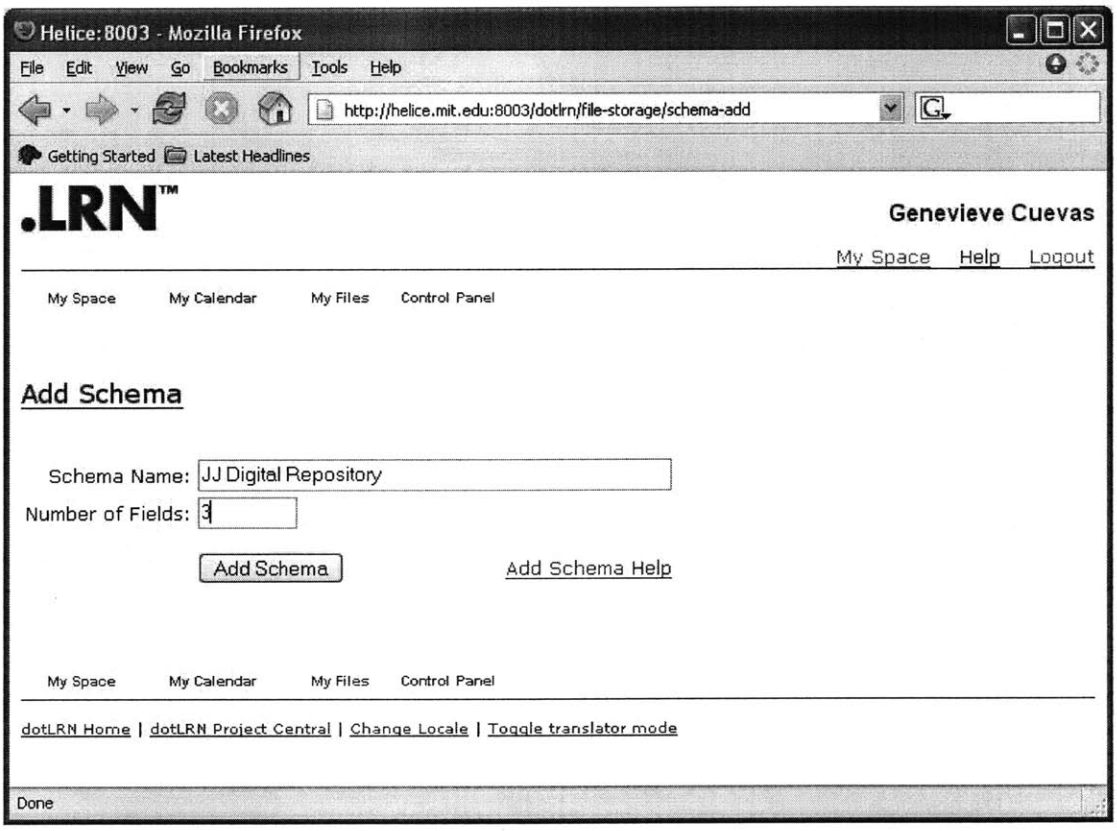
# C Instructions for Integration With Other Systems

Here are instructions for how to integrate other systems with the file transfer component. Three major steps need to be completed in order to make the integration:

1. Fill in the database tables via the Add Schema interface.
2. Add the code files for the submit interface.
3. Add the implementation for the search service contract.
4. Add the code files for the retrieve interface.

## C.1 Filling in the database tables via the Add Schema Interface

1. Go to the add schema interface at: http://your_url/dotlrn/file-storage/schema-add
2. Enter the schema name and the number of fields. For example, enter "JJ Digital Repository" for schema name and "3" for number of fields as shown below:

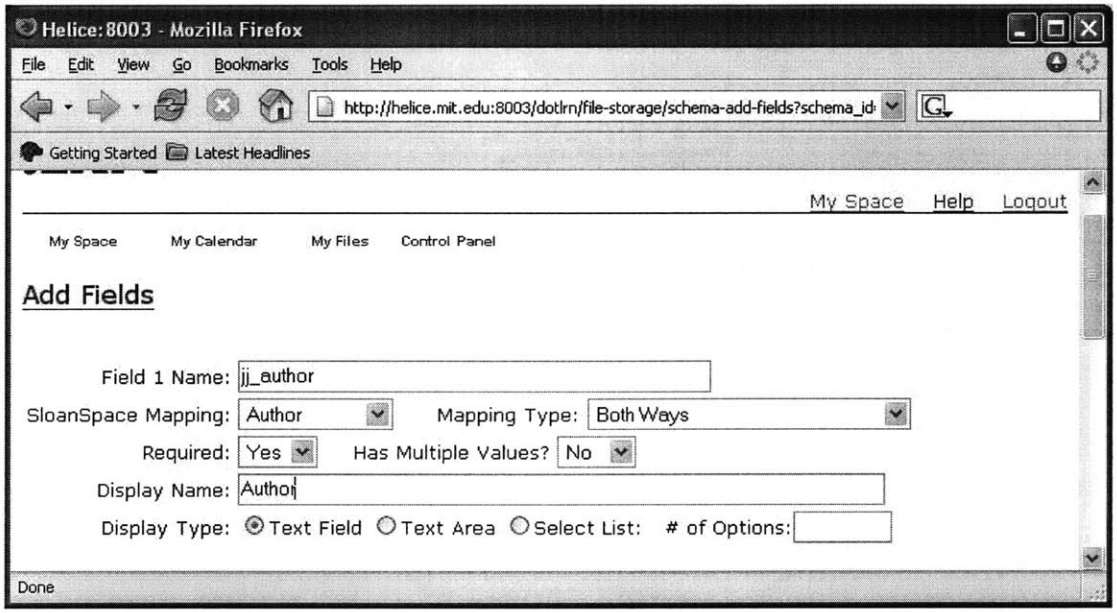



Click on the "Add Schema" button when finished.

3. Fill in the field information with the metadata field information of your metadata schema. The information queried is as follows:

a. Name: specifies the name of the field.
b. SloanSpace Mapping: specifies which SloanSpace field it maps to.
c. Mapping Type: which direction the mapping goes.
d. Required: specifies whether or not a value for this field must be supplied when submitting into your system being integrated.
e. Has Multiple Values: specifies whether or not the field can contain multiple values.
f. Display Name: specifies the name of the field displayed in the submit user interface.
g. Display Type: specifies the input type of the field value.
h. # of Options: this is only relevant if the display type selected is "Select List". This specifies how many options the select list will have.

Below are sample values:




4. Click on the "Submit and Continue" button when finished.
5. Fill out the rest of the field information. The information queried is as follows:
    a. Display Text: specifies the text appearing on top of the input form, containing instructions for filling out that field.
    b. Error Text: specifies the text that appears when this field is filled out incorrectly.

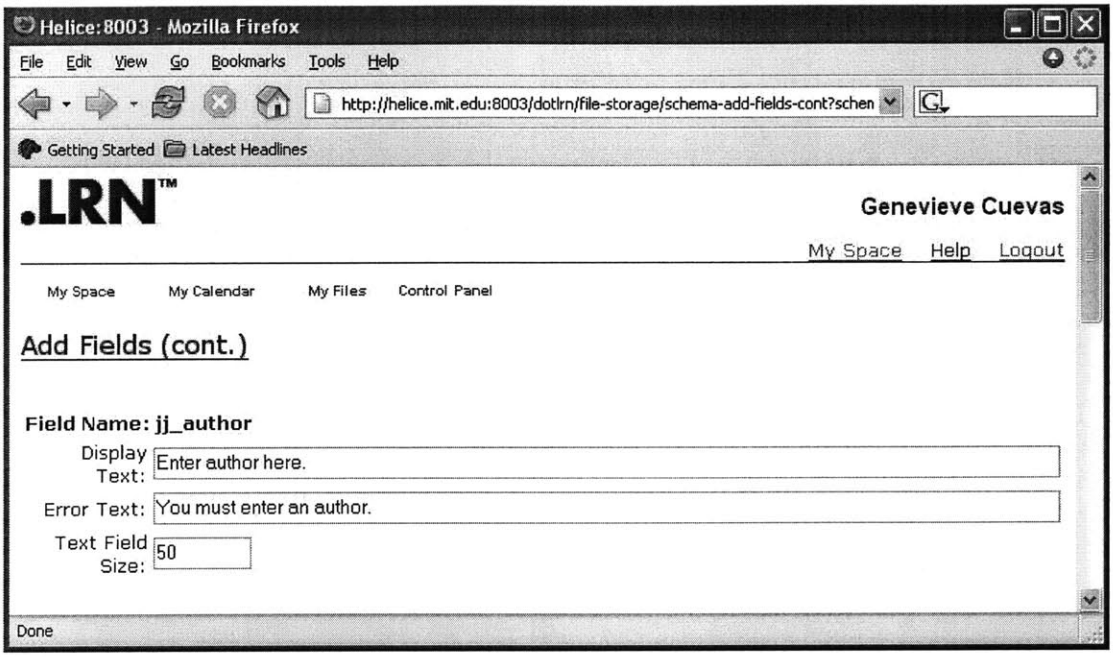
c. Text Field Size: specifies the size of the text field, if the display type is "text field".

d. Text Area Rows: specifies the number of rows of the text area, if the display type is "text area".

e. Columns: specifies the number of columns of the text area, if the display type is "text area".

f. Option Text and Option Value: specifies the option text and option values of the select list, if the display type is "select list".

Below is an example of the field information for jj_author, created above:




6. Click "Submit" when done. This concludes filling out the database tables.

## C.2 Adding the code for the submit interface

In order to complete the submit portion of the integration, you would first need to provide the code that communicates with your web service method that submits files into your system. For example, say the "JJ Digital Repository" created above has a web service with a method called "SubmitIntoJJ(content, jj_author, jj_title, jj_description)". "SubmitIntoJJ" has as input the content, encoded in base64, and the values for the

metadata fields jj_author, jj_title, and jj_description. Thus, the code must contain a call to this method. Here is a sample of what the tcl code file for the "JJ Digital Repository" submit component will look like. Let's name this file "jj-submit.tcl".

**jj-submit.tcl**

```
ad_page_contract {
  Try meta
} {
  schema_id: integer
  file_id: integer
}

## get the jj_author, title, and description fields
set author [ns_queryget $author_field_id]
set title [ns_queryget $title_field_id]
set description [ns_queryget $description_field_id]

## get the file contents and encode it to a base 64 string
set content [::base64::encode $file]

## call the web service "SubmitIntoJJ" web service method
::SOAP::create SubmitIntoJJ
 -uri "http://www.jjdigitalrepository.com/webservice
 -name "SubmitIntoJJ"
 -params {content string, jj_author string, jj_title string, jj description string}
SubmitIntoJJ $content, $author, $title, $description

## redirect to the file area
ad_returnredirect "file?file_id=$file_id"
```

Once this file is created, you would now need to call this code when the "Upload" button is clicked in the submit user interface, if the schema_id specified is the schema_id of your schema. To do this, you would need to modify the meta-view.tcl file as follows. Look for the line in meta-view.tcl that says "### set the submit file . . . ". This looks like:

```
### set the submit file
if [string equal $schema_name DSpace] {
    set submit_file_name dspace-submit
}
```

Add to this the following:

```
if [string equal $schema_name <your_schema_name>] {
    set submit_file_name <your_code_file_name>
}
```

For example, for the jj_submit.tcl file above, the new piece of code will look like:

```
### set the submit file
if [string equal $schema_name DSpace] {
    set submit_file_name dspace-submit
}
if [string equal $schema_name "JJ Digital Repository] {
    set submit_file_name jj_submit
}
```

## C.3 Adding the search service contract implementation

In order to complete the search component of the integration, you must add an implementation of the search service contract that searches your system, through your web service.

To do this, first create the service contract operations to the database. Do this by creating a file called <system>-search-create.sql. For example, for "JJ Digital Repository", create a file called "jj-repository-search-create.sql. The contents of the file are as follows:

```
declare
    foo integer;
begin
    --create implementation
    foo := acs_sc_impl.new (
        impl_contract_name => 'URLSearcher',
        impl_name => 'JJRepositorySearcher',
        impl_pretty_name => 'JJ Digital Repository URL Search',
        impl_owner_name => 'jjrepository_search'
    );

    --create paged search operation
    foo := acs_sc_impl.new_alias (
        impl_contract_name => 'URLSearcher',
        impl_name => 'JJRepositorySearcher',
        impl_operation_name => 'paged_search',
        impl_alias => 'jjrepository_search::paged_search_url',
        impl_pl => 'TCL'
    );

    --add binding
    acs_sc_binding.new (
        contract_name => 'URLSearcher',
        impl_name => 'JJRepositorySearcher'
    );

end;
/
show errors
```

Copy the file contents above and replace all instances of "JJRepository" with your system name.

Also create the drop file. For example, here are the contents of "jj-repository-search-drop.sql" file:

```
declare
    foo integer;
begin

    acs_sc_binding.del(
        contract_name => 'URLSearcher',
        impl_name => 'JJRepositorySearcher'
    );

    foo := acs_sc_impl.delete_alias(
        impl_contract_name => 'URLSearcher',
        impl_name => 'JJRepositorySearcher',
        impl_operation_name => 'search'
    );

    foo := acs_sc_impl.delete_alias(
        impl_contract_name => 'URLSearcher',
        impl_name => 'JJRepositorySearcher',
        impl_operation_name => 'paged_search'
    );

    acs_sc_impl.del(
        impl_contract_name => 'URLSearcher',
        impl_name => 'JJRepositorySearcher'
    );

end;
/
show errors
```

Copy the file contents above, and replace all instances of "JJRepository" with your system name. Add both these files to your /packages/file-storage/sql/oracle directory.

Now, you are ready to supply the code of the implemented operation. First, create the file <system>-search-procs.tcl, and add this file to your /packages/file-storage/tcl directory. Now copy the contents below:

```
ad_library {

    The "<system> searcher" searches and retrieves <system> urls.

    @author gtcuevas@mit.edu
    @version $Id: dspace-search-procs.tcl,v 1.0 04/14/04 09:51:04 peterm Exp $
}

namespace eval dspace_search {

    ad_proc -private search_url {
        query
    } {
        Implements the search operation for URLSearcher.
    } {
        //fill in search code here
    }
}
```

Fill in the code starting at the line "//fill in search code here", with the code that searches your system.

After this is done, you must now add the radio button for this search implementation. To do this, open "search-url.adp", and add the following after the line "<input type=radio name="searchtype" value="googledspace" . . . ":

```
<input type=radio name="searchtype" value="your_system_name">
```

Now, add the following to "search-url-results.tcl", after the line "-call_args [list $searchstring $recordsperpage $pagenum "dspace"]]", with the following:

```
} elseif [string equal $searchtype jjrepository] {
    set results [acs_sc::invoke \
                    -operation restricted_paged_search \
                    -contract URLSearcher \
                    -impl JJRepositorySearcher \
                    -call_args [list $searchstring $recordsperpage $pagenum "dspace"]]
```

Change all instances of "JJRepository" above with your system name.

Once all these pieces have been implemented, you are now ready to integrate the retrieve component.

## C.4 Adding the code for the retrieve interface

The steps for adding the retrieve interface are as follows. First, create the code file that communicates with your web service method that fetches files from your system's web service. For instance, say "JJ Digital Repository" has 2 web service methods: GetJJFileContent and GetJJFileMetadata. Both these methods have as input, file_id, which is the id of file you want to fetch. The GetJJFileContent method returns a base64 encoded string containing the file contents, and the GetJJFileMetadata method returns the metadata in XML format. The code file, "jj-get.tcl", will be as follows:

**jj-get.tcl**

```
ad_page_contract {Add File} {
  folder_id:integer
  schema_id:integer
}

#call the web service methods
::SOAP::create GetContent
  -uri "http://www.jjdigitalrepository.com/webservice
  -name "GetJJFileContent"
  -params {file_id string}
::SOAP::create GetMetadata
  -uri "http://www.jjdigitalrepository.com/webservice
  -name "GetJJFileMetadata"
  -params {file_id string}
set content GetContent $file_id
set metadata GetMetadata $file_id

#parse the metadata file to get the parameters

#add the file into the folder with folder_id = $folder_id
```

Once this file has been created, modify the "search-url-results.adp" file, adding the following line after the line "[Add File]</a></if>":

```
<if @searchtype@ eq "your_system_name">
 | 
<a
href="your_get_file?folder_id=@folder_id@&schema_id=2&itemID=@urls.url@&title=@urls.title
@&description=@urls.description@\
">
<b>[Add File]</b></a></if>
```

Replace "your_system_name" with your system name, and "your_get_file" with the get code file you created in the previous step.

Once this is all done, restart your .LRN server. Enjoy!!!

# D Installing the system into .LRN

1. Go to "http://web.mit.edu/gtcuevas/www/Thesis" and get the "Thesis.tar" file.
2. Unxip Thesis.tar
3. Go to the main directory, "Thesis"
4. "Thesis"contains 3 directories:
    a. file-storage
    b. fs-portlet
    c. sql
5. Go to file-storage, and do the following:
    a. Copy all the files in file-storage/sql/oracle/ and place them in your .LRN packages/file-storage/sql/oracle/ directory
    b. Copy all the files in file-storage/sql/oracle/ and place them in your .LRN packages/file-storage/sql/oracle/ directory
    c. Copy all the files in file-storage/sql/oracle/ and place them in your .LRN packages/file-storage/sql/oracle/ directory
    d. For all the files in file-storage/www/Modified, copy them and paste them into your .LRN packages/file-storage/www/ directory, replacing all the original files in .LRN with these modified files.
    e. Make a directory called dspace-temp into the .LRN packages/file-storage/www/ directory, and set permissions so that the directory is writable by all users.
    f. Copy all the files in file-storage/www/Modified/resources/ and place them in your .LRN packages/file-storage/www/resources/ directory.
6. Now, go back up to the fs-portlet directory in "Thesis", and do the following:
    a. Copy the file in fs-portlet/www/Modified/ into your .LRN packages/fs-portlet/www/ directory (replacing the original .LRN file with this modified file).
7. Restart the server.