

Lab 1 - Blackboard Archive Extractor Product Description

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## 1 Introduction

Blackboard is an online learning management system used by educational institutions throughout the world. Blackboard allows teaching professionals to provide content to students, such as homework assignments, notes, or quizzes. The students can access the provided content through their university's Blackboard website, and can access or download any content provided by the teacher.<sup>1</sup> Blackboard is used at over 17,000 learning institutions throughout the world.<sup>2</sup> Most professors at Old Dominion University use Blackboard extensively. However, Old Dominion University's Blackboard software only stores the course content for a period of two years. After the two year period, the content must be exported to a "Blackboard Course Archive". The requirement to export an archive causes difficulty for some professors, due to record retention requirements for Old Dominion University's annual professor review process.

### 1.1 Blackboard in Learning Institutions

At Old Dominion University, lecturers must undergo a yearly review. For this review, the lecturer must present all course content used since the previous review, including any content stored in Blackboard. Senior lecturers must follow this same processes every three years, and associate professors must follow this process every five years.<sup>3</sup> The major issue relating to this requirement is that if a

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<sup>1</sup> Blackboard | Reimagine Education | Education Technology. (n.d.). Retrieved October 19, 2016, from <http://www.Blackboard.com/>

<sup>2</sup> Corcoran, B. (2014, July 23). Blackboard's Jay Bhatt Strikes Up the Brass Band. Retrieved October 19, 2016, from <https://www.edsurge.com/news/2014-07-23-blackboard-s-jay-bhatt-strikes-up-the-brass-band>

<sup>3</sup> ODU Faculty Handbook. (2005, December 21). Retrieved October 26, 2016, from <http://ww2.odu.edu/ao/facultyhandbook/index.php?page=ch07s01.html>

professor or senior lecturer has provided content to students over Blackboard since the previous review, and not saved that content, the content must be extracted from the Blackboard Course Archive.

### **1.2 Old Dominion University Faculty Review Process**

Extracting content from the Blackboard Course Archive manually is a long and difficult task, the professor must first locate and “empty”<sup>4</sup> Blackboard Course. If there is no empty course, it is not possible to extract content from the archive. The Blackboard Course Archive can be loaded into the “empty” course so that the professor can access the information. The professor must then visit each page and section within the Blackboard course, and manually download any content stored on the page or section. After downloading the content, the professor must then properly format the content for presentation at the annual review. If there is more than one Blackboard Archive to extract, the process must be repeated.

### **1.3 Solution Overview**

Team Crystal’s solution to this problem is the “Blackboard Archive Extractor”. The Blackboard Archive Extractor is a Windows application which allows the user to provide a Blackboard Course Archive, and automatically extracts all content within the archive. The Blackboard Archive Extractor then creates a website which provides all of the course material in a simple, well-formatted manner which the professor can present during his or her annual review process.

## **2 Blackboard Archive Extractor Product Description**

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<sup>4</sup> An “empty” Blackboard course is a course that the University has created in Blackboard for the professor, but that the professor does not use to teach the class. One example is an unused recitation section.

The Blackboard Archive Extractor is an application which allows a user, in this case a teaching professional, to easily extract all content which is stored in a Blackboard Course Archive. The application features a graphical user interface, which allows the end user to select the file location of the Blackboard Course Archive to extract, and the file location in which the generated website will be saved.



Figure 2.1.0.1 -- Blackboard Archive Extractor Interface

## 2.1 Product Features

The Blackboard Course Archive format is an implementation of the IMS (Instructional Management System) Common Cartridge. The Blackboard Course Archive is a .zip file containing multiple folders, resource files, and a metadata manifest file.

The manifest file, named “imsmanifest.xml” of the Blackboard Course Archive is an XML file which contains all metadata regarding the resource files contained within the archive. The metadata contains information regarding an associated resource file, primarily the title of the resource (e.g. “Homework Assignment 1”) and the structure of the resource (e.g. “Homework Assignment 1” is in the “Submissions” section).

The resource files within the archive, which follow the naming format “res01234.dat”, provide information regarding the particular resource. The resource file contains information such as the description, title, creation date, and the content within the file. Figure 2.1.2.2 shows the structure of a

Blackboard Course Archive's resource file. Figure 2.1.2.3 shows the internal structure of a Blackboard Course Archive.

```

<ANNOUNCEMENT id=" 587902_1">
  <TITLE value="Assorted notes in CS350"/>
  -<DESCRIPTION>
    -<TEXT>
      <p><strong>Wrapping up phase 1</strong>: Don't forget to fill out the <a href="https://www.cs.odu.edu/~zeil/evalSurvey.cgi?survey=350s16&amp;asst=phase1" title="peer eval survey" target="_blank">peer evaluation you have done so.</p> <p><strong>Moving on to phase 2</strong>: Phase 2 starts immediately. From here <a href="https://www.cs.odu.edu/~zeil/cs350/latest/Public/phase2/index.html" title="phase 2" target="_blank">Sign up for phase 2/16.</p> <p><strong>Setting up your Development Environment</strong>: A few of you went past the current assignment and installed one of the "developers versions", either Mars 5.2RC2 or the Neon pre-release. This would have caused an assignment. I will give back the points for that test, but I recommend that you re-install the release version of Eclipse. Developer versions are bound to have more bugs, </li> <li>Having different features or behaviors than your teammates.</li> <li>As the semester progresses, you'll be adding plugins to Eclipse for features we want to support. Plugin development on the version releases, so working on the bleeding edge of the Eclipse release can lead to issues with broken plugins.</li>
    </TEXT>
    -<FLAGS>
      <ISHTML value="true"/>
      <ISNEWLINELITERAL value="false"/>
    </FLAGS>
  </DESCRIPTION>
  <ISPERMANENT value="false"/>
  <USERID value="_1622_1"/>
  -<DATES>
    <CREATED value="2016-02-13 10:39:25 EST"/>
    <UPDATED value="2016-02-13 10:39:25 EST"/>
    <RESTRICTSTART value="2016-02-13 10:00:00 EST"/>
    <RESTRICTEND value="2016-02-27 23:59:00 EST"/>
  </DATES>
  <ORDERNUM value="8"/>
  <TITLECOLOR value="#000000"/>
</ANNOUNCEMENT>

```

Figure 2.1.2.2 -- A typical Blackboard Course Archive Resource File

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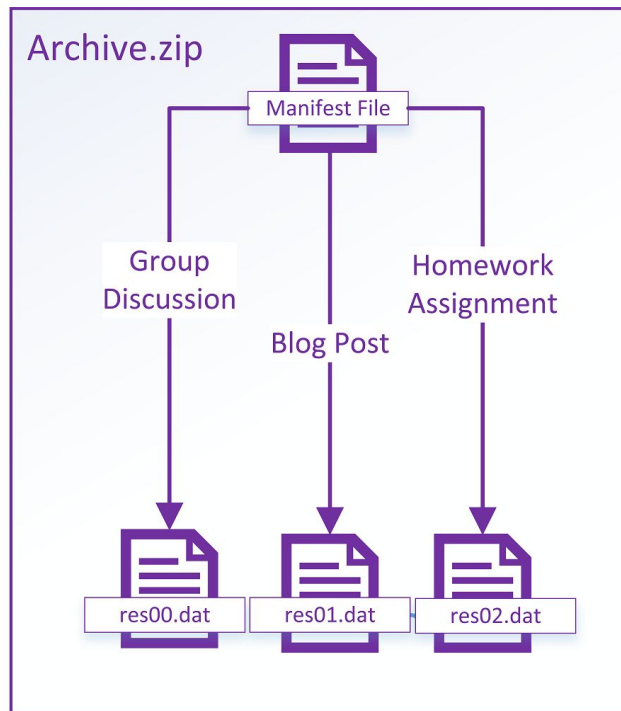


Figure 2.1.2.3 -- The internal structure of a Blackboard Course Archive

The Blackboard Archive Extractor primarily functions through two primary algorithms. These algorithms are the “Linking” Algorithm and the “Formatting” Algorithm. The Linking Algorithm is primarily broken down into two subsections: parsing and linking. The Linking Algorithm interprets the information contained within the Blackboard Course Archive, and creates a data structure which is used by the Formatting Algorithm. The Formatting Algorithm uses the data structure generated by the Linking Algorithm to generate the Blackboard Archive Extractor’s output in the form of a website.

The first stage of the parsing stage of the linking algorithm parses the metadata defined within the manifest file. Initially, the parsing phase will be looking at the first element within the manifest file. Before any processing begins, the root node of the data structure is created. This node will contain references to the primary sections within the Blackboard Course, as seen in Figure 2.1.2.4.



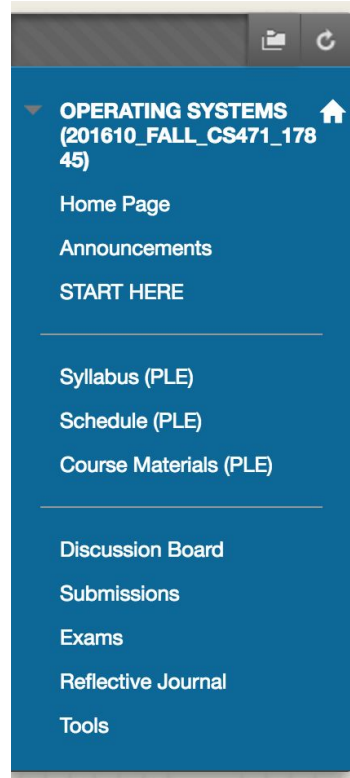


Figure 2.1.2.4 -- Primary Sections in a Blackboard Course

The parser then begins to parse the manifest. Each time a new element is parsed, the Linking algorithm then moves into the linking phase. In the linking phase, the algorithm finds the resource file associated with the previously parsed manifest element. Any information within the resource file is processed and turned into a node. The newly created node is connected to the appropriate parent node, and the algorithm returns to the parsing phase, to parse the next manifest element. This process repeats until no elements remain in the manifest file. An overview of this process is available in Figure 2.1.2.5.

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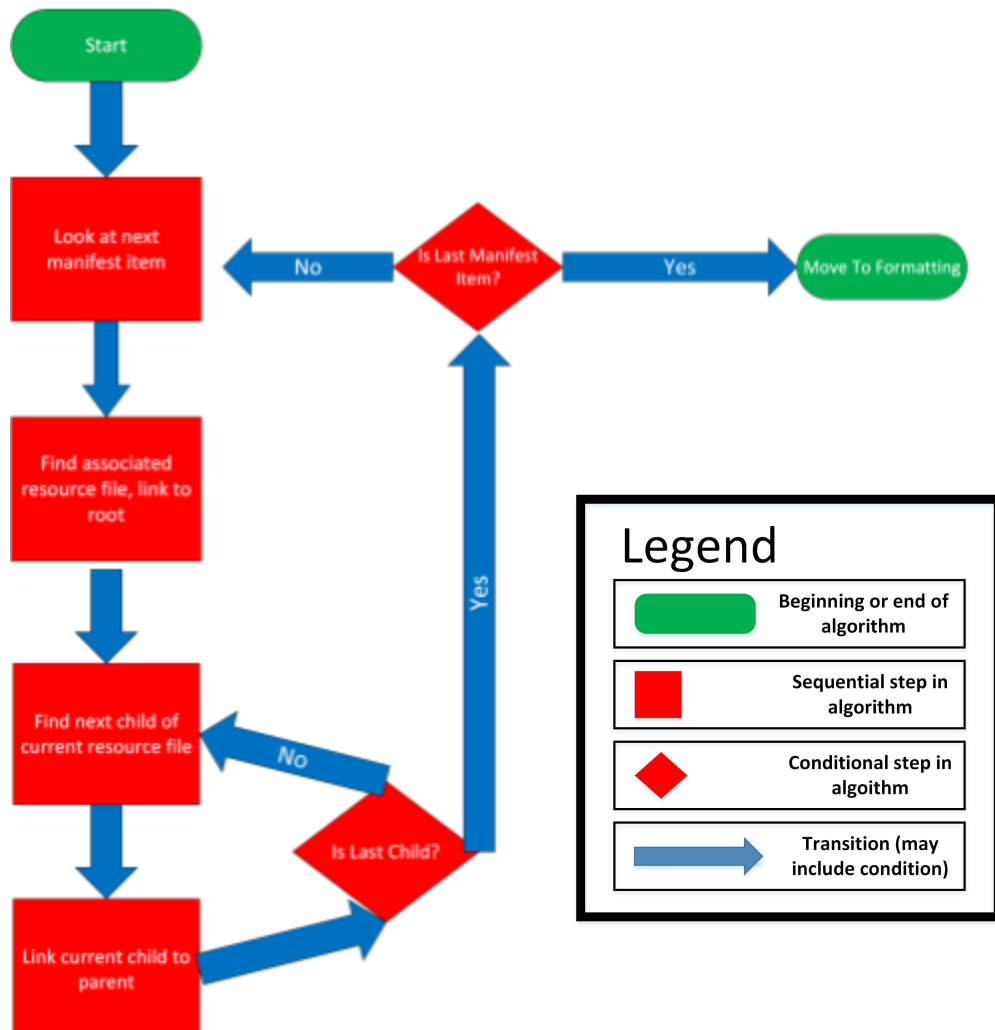


Figure 2.1.2.5 -- Overview of the Linking Algorithm Process

The Linking Algorithm creates a data structure pre formatted to match the structure of the website which will be created by the formatting algorithm. The new data structure is a tree. The root node of the tree is the “root index” of our website. This root index contains links to the different types of content which are available in the Blackboard course, such as homework assignments, notes, or quizzes. Each node below the root index acts as an index for all content within that classification. For example, all children of the “assignments” node will be content which is available within the assignments section of the course. Figure 2.1.2.6 shows the layout of data structure created by the Linking Algorithm.

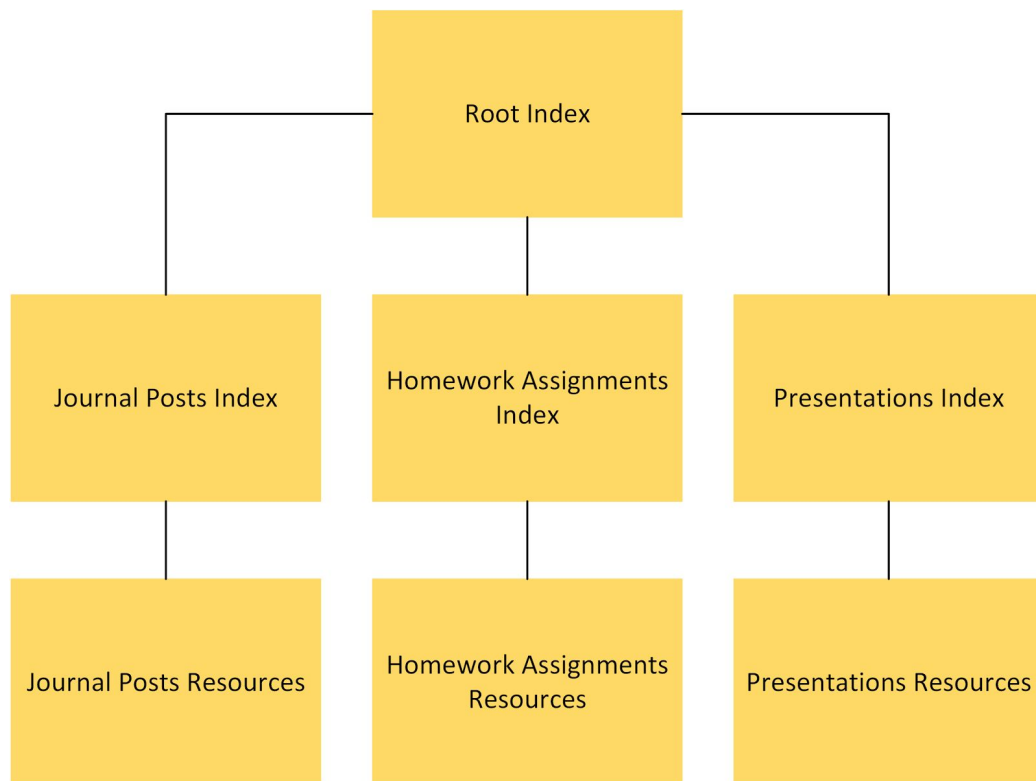


Figure 2.1.2.6 -- The format of the data structure generated by the Linking Algorithm

The Formatting Algorithm uses the data structure generated by the Linking Algorithm, and uses the data structure to build the Blackboard Archive Extractor’s output in the form of a website.

The Formatting algorithm begins by starting with the “Root Index” node. The algorithm builds a webpage from the information in this node. The webpage contains links to all of subpages that will be created. For

the example structure in Figure 2.1.2.6, the generated webpage would contain links to the Journal Posts index page, the Homework Assignments index page, and the Presentations index page.

After creating the webpage for the root index, the algorithm then creates the webpages for the child nodes in the data structure. For the example structure in figure 2.1.2.6, the “Presentations” index page would contain every presentation resource available within the Blackboard Course Archive. This process would repeat for every second-level node in the structure. Figure 2.1.2.7 shows the process flow of the Formatting algorithm.

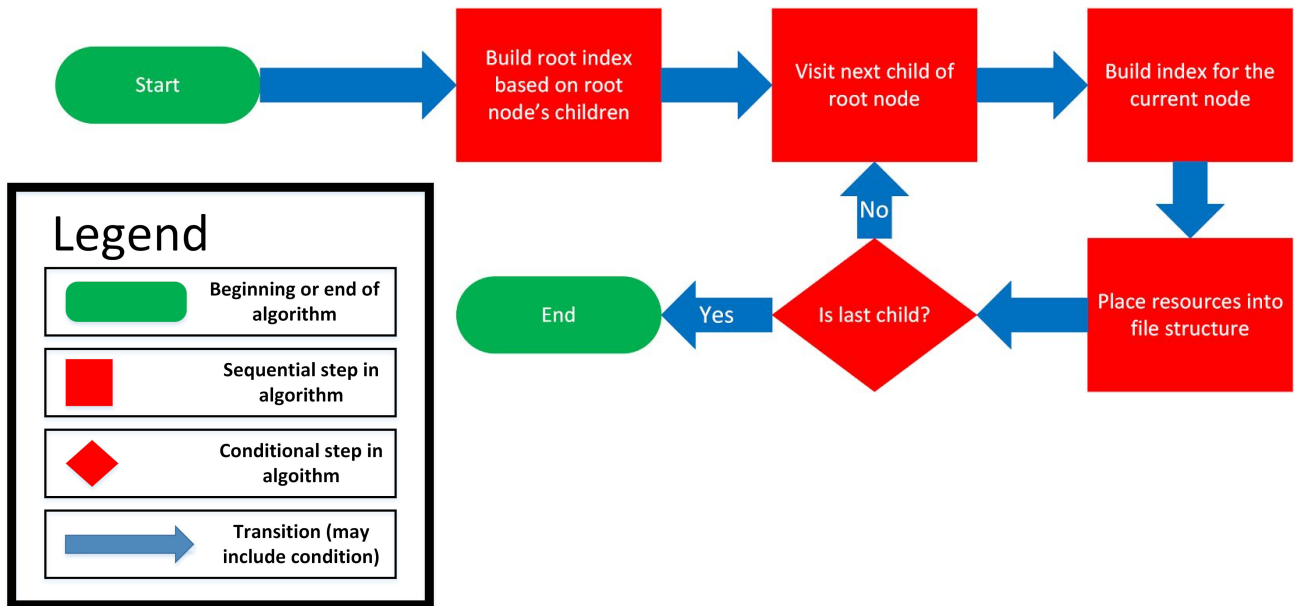


Figure 2.1.2.7 -- The Formatting Algorithm

Once the two algorithms have completed, the Blackboard Course Archive will now be completely available to the professor in the form of a website. All content and course material contained within the archive will be readily available to the professor without the need for any reformatting or structuring before being presented to the professor’s review board for his or her annual evaluation. The newly created

website will be designed using a responsive design framework, such as Bootstrap<sup>5</sup>. Figure 2.1.3.1 shows a sample of the Blackboard Archive Extractor's output.

[--TOP--](#)  
[General Information](#)  
[1 Introduction \(01/10/2016 - 01/16/2016\)](#)  
[Overview](#)  
[watch Welcome to CS350](#)  
[Read Syllabus](#)  
[Slides: Read the communications policy.](#)  
[Attend the orientation session. \(01/11/2016 19:30PM EST. 7:30-8:30PM\)](#)  
[Do: Account Setup](#)  
[Do lab: Opening discussion](#)  
[Read lecture notes: What Makes Software Development Difficult?](#)  
[In your recitation section](#)  
Recitations will not meet this week.  
[At the end of the week](#)  
[Review: Feedback](#)  
[2 The Software Development Process \(01/17/2016 - 01/23/2016\)](#)  
[Overview](#)  
[Process Models](#)  
[Read Agarwal. Ch.2](#)  
[Read van Vliet. Sect. 3.2, 3.3](#)  
[Read lecture notes: Software Development Process Models](#)  
[watch The Problem of Local Optimization](#)  
[Do lab: Lab: Secure Shell Keys](#)  
[Staffing](#)  
[Read lecture notes: Team Organization](#)  
[Read van Vliet. Sect. 5.2](#)  
[Assignment: ssh Keys \(Due: 01/31/2016\)](#)  
[In Your Recitation Section](#)  
In your recitation section: Important: most recitations require some preparation in advance of your schedu  
[In your recitation section: Network Conferencing 1: Google Hangouts 1 \(01/20/2016 - 01/22/2016\)](#)

Figure 2.1.3.1 -- Output from the Blackboard Archive Extractor

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<sup>5</sup> "Bootstrap · The World's Most Popular Mobile-first and Responsive Front-end Framework." Bootstrap · The World's Most Popular Mobile-first and Responsive Front-end Framework. Twitter Inc., n.d. Web. 04 Feb. 2017.

## 2.2 Major Components

The major functional components of the Blackboard Archive Extractor are all software components. The application consists of the interface, the parser, the linker, and the formatter. Figure 2.2.1 shows the major functional components of the Blackboard Archive Extractor.

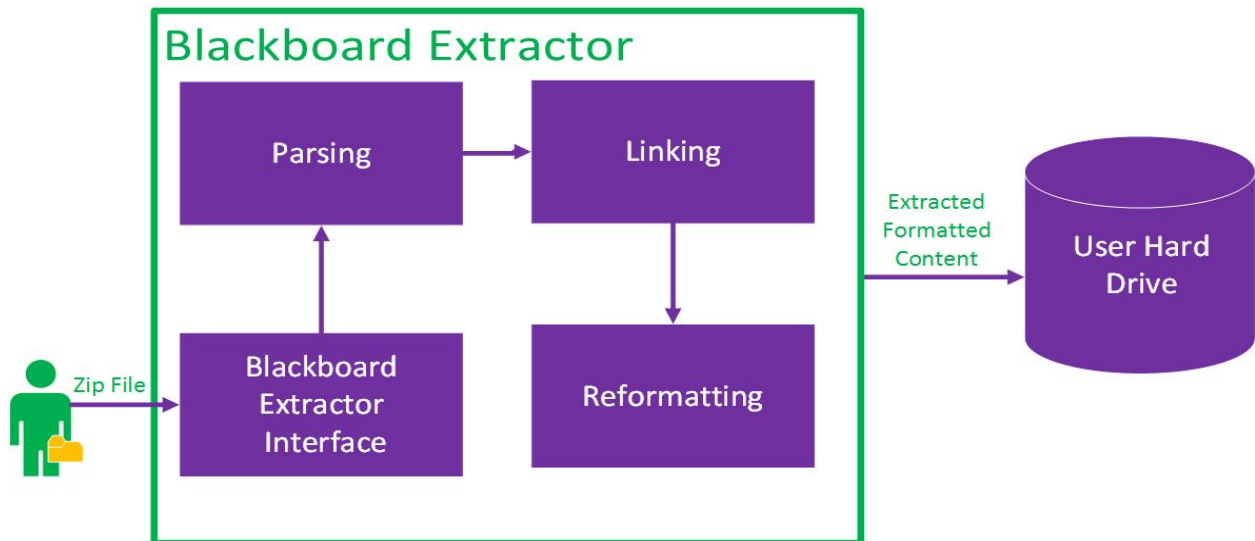


Figure 2.2.1 -- Major Functional Component Diagram of the Blackboard Archive Extractor

After launching the program, the user provides the zip file which contains the Blackboard Course Archive using the Blackboard Extractor Interface. The Blackboard Course Archive is extracted from the .zip format and the files within the archive are loaded into the program. The application then sends the information contained within these files to the “Linking Algorithm” which contains the parsing and linking components of the application. The linking algorithm builds the primary data structure which will later be used by the reformatting component to build the output in the form of a website. As the reformatter builds the website, the website is saved to the user’s disk drive where he or she can easily access the material which was previously stored within the Blackboard Course Archive.

## 2.3 Customer Base

The primary customer for this application is Old Dominion University. The application is

designed to fit the needs of professors from all fields at Old Dominion University. The primary end user would be any Blackboard User at Old Dominion University who uses Blackboard from the teaching role, such as professors, lecturers, and teaching assistants. Although Old Dominion University is the primary target customer, the application is designed so that may be used by a professor at any university currently using Blackboard.

### **3 Blackboard Extractor Prototype**

#### **3.1 Prototype Goals**

The primary goal of the prototype for the Blackboard Archive Extractor is to be fully functional without support for all possible Blackboard course configurations. Blackboard courses are modular, and can support many types of content. Some types of content, such as Blog posts, may not be fully supported in the prototype implementation of the Blackboard Archive Extractor.

#### **3.2 Prototype Challenges**

The main challenge that will be faced during the production of the Blackboard Archive Extractor is developing the architecture of the application to be flexible enough to support future changes made to the Blackboard Course Archive format. Small changes, such as the addition or removal of content types, could pose varying difficulty. Addition of support for embedded videos would be an example of a change with relatively low difficulty to maintain. A proprietary format for powerpoint presentations would be an example of a change which would pose more challenge to maintain, as there would not be any predefined support for such a format.

Another major difficulty that may be faced during the development of the Blackboard Archive Extractor prototype is building a website that produces output that is simple to use and aesthetically pleasing. The website must be useful to teaching professionals from all disciplines and to their review

boards. This issue can be mitigated by interviewing professors and providing demo websites, to determine the best format for the website. With the use of a responsive design libraries, the website can be developed so that the appearance of the website can be easily modified by switching between different stylesheets.



### Glossary

**Blackboard:** An online learning management system which allows professors to provide course material to students online.

**Blackboard Archive:** A zip file containing all material relating to a single Blackboard course, including material such as homework assignments and presentations.

**GUI - Graphical User Interface:** An interface for an application which provides graphical elements, such as buttons and menus for the end user.

**IMS Course Cartridge:** A standardized archival format for learning management systems to use for course archives. The Blackboard Course Archive follows this format.

**Learning Management System:** An application or tool which allows professors to organize and manage course material for a class. This is typically an online, cloud-based application.

**ODU:** Old Dominion University

**Root Index:** A webpage which acts as a directory for all material and subpages within the website.

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### References

1. Corcoran, B. (2014, July 23). Blackboard's Jay Bhatt Strikes Up the Brass Band. Retrieved October 19, 2016, from <https://www.edsurge.com/news/2014-07-23-blackboard-s-jay-bhatt-strikes-up-the-brass-band>
2. ODU Faculty Handbook. (2005, December 21). Retrieved October 26, 2016, from <http://ww2.odu.edu/ao/facultyhandbook/index.php?page=ch07s01.html>  
BFree: Extract Blackboard content. (n.d.). Retrieved October 19, 2016, from <https://its2.unc.edu/tl/tli/bFree/index.html>
3. Blackboard | Reimagine Education | Education Technology. (n.d.). Retrieved October 19, 2016, from <http://www.Blackboard.com/>
4. "Bootstrap · The World's Most Popular Mobile-first and Responsive Front-end Framework."  
Bootstrap · The World's Most Popular Mobile-first and Responsive Front-end Framework.  
Twitter Inc., n.d. Web. 04 Feb. 2017.